

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Residuals Management Program
Residuals Land Application Approvals
BRP WP 93 Type I Renewal Approval of Suitability (AOS)
Instructions and Supporting Materials

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Introduction

MassDEP *Permit Applications*, as well as *Instructions & Support Materials*, are available for download from the MassDEP Web site at mass.gov/dep in two file formats: Microsoft Word™ and Adobe Acrobat PDF™.

Instructions & Support Materials provide guidance on how to prepare a permit application.

These *Permit Applications*, supporting documents, and the fee payment (if applicable) must now be submitted through the ePLACE Portal. See ePLACE step-by-step instructions on the mass.gov page for this application.



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Permit Fact Sheet

1. What is the purpose of this approval?

BRP 93 allows for the renewal of a Type I Approval of Suitability necessary for land application of residuals for beneficial purposes. In accordance with the provisions in 310 CMR 32.13(11) these approvals are presumptively approved within 45 days.

These permits and approvals are intended to protect public health, safety and the environment by comprehensively regulating the land application of sludge, sludge products (such as compost and pellets), and septage. Land application of these materials must be conducted in a proper manner to prevent pollution of ground and surface waters, drinking water supplies, and protect public health from potential contamination and transport of heavy metals and pathogens.

Statutory authority is provided in MGL Chapter 21, s. 27(9), 27(12), and 43; Chapter 21A s. 2(28); and Chapter 111, s. 160. Regulatory authority is stated in 310 CMR 32.00.

2. Who must apply?

Any individual, business, organization or commercial establishment that wish to utilize sludge, sludge derived products, or septage as a fertilizer or soil conditioner by providing nutrients for growing vegetation or improving the quality of the soil for the purpose of growing vegetation. The applicant should carefully read all relevant guidance documents and MassDEP Guidelines for Sludge Analysis before filling out any application forms.

3. What other requirements should be considered when applying for these approvals?

A copy of all completed applications must be submitted to the Local Board of Health for their concurrence. For Type I classification requests, applications should be submitted to the local Board of Health in the city or town where the treatment facility resides. A copy of the written concurrence from the local Board of Health must be submitted with the application.

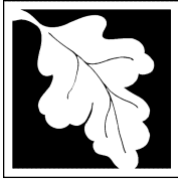
Each container in which Type I, II and III sludge is sold, distributed, or transported or offered for use, sale, or distribution shall itself prominently display or, if such display is not practicable, shall be accompanied by a shipping paper which shall prominently display the items listed in 310 CMR 32.51 for Type I sludge and the items listed in 310 CMR 32.52 (5) for Type II or Type III sludge.

Sludge containing molybdenum shall be accompanied by a written label or bill of lading according to the requirements of 310 CMR 32.40 (4). This requirement is for Type I sludge per 310 CMR 32.51 (d) and for Type II and III sludge per 310 CMR 32.52 (8). Additional information regarding biosolids containing molybdenum can be found at [Labeling Requirement and Additional Information Regarding Biosolids Containing Molybdenum](#).

Note: These additional requirements are intended to serve as a guide to the applicant. They do not necessarily include all requirements.

4. What is the application fee for this permit?

BRP WP 93 \$1,700



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5. Where should the application be sent?

The application must be submitted through ePLACE, located here: <https://eplace.eea.mass.gov/citizenaccess>

Additional visual ePLACE step-by-step instructions to assist in submitting your application are available at: <https://www.mass.gov/how-to/wp-93-renewal-of-type-i-approval-of-suitability-aos>

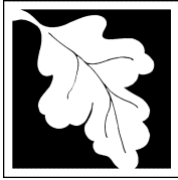
The first step in the application process is to "Claim Your Authorization" (you do this only once and assuming you did not apply for your existing Permit through ePLACE). This process will link an existing Permit to your application and will verify your identity.

Complete the following:

- Log into the ePLACE Portal at: <https://ePLACE.eea.mass.gov/citizenaccess> or create an account if you do not already have one.
- Once logged in, click on the large blue button on the right, "File an Online Application".
- Read and agree to the disclaimer. Click "Continue".
- Click on "Apply for an EEA General Request". Note that in ePLACE all Permits are referred to as "Legacy Records".
- Select "Claim Authorization Form". Click "Continue".
- Select Whether you are claiming this for yourself or someone else. Click "Continue Application".
- Choose the following in order to "Claim Your Authorization":
 - a. Under, "Which agency is the Legacy Record from?" select "DEP".
 - b. Under, "Which program is the Legacy Record from?" select "Water Pollution (WP)".
 - c. Under, "General Information" complete your Groundwater permit number and expiration date.
 - d. You will **not** be required to attach anything in the Documents section. Click "Continue Application".
 - e. Check the certification box at the bottom of the next screen and click "Continue Application". Your authorization claim has now been submitted.
 - f. Note that you will not be able to submit the application until your authorization claim has been submitted to **and** approved by MassDEP.
 - g. It may take MassDEP a day or two to respond and approve your authorization claim. At that point, you can log into ePLACE and proceed with submitting your application.
- Upon receiving approval of your authorization claim from MassDEP, log in to ePLACE and perform the steps below to submit the application. Note that the above steps only need to be performed the first time you submit information about a facility in ePLACE.
- Click on "My Records" where you will see the Permit for which you have an approved authorization claim. Your "Renewal" will show up under Action depending on the type of application you are applying for. Select this, and then follow prompts to proceed with submittal of the application and supporting information. In the Documents section you will need to attach your WP 93 application form completed in either the MS Word™ or Adobe Acrobat PDF™ formats available on the website.
- Note that you can save an application and return to it later provided you select "Save and Return Later". Once you submit your application you can no longer upload documents without approval from MassDEP personnel.
- Once the application has been submitted, you will receive an email that will provide you the record number.
- From the "My Records" button, you will be able to view the status of your application through the review and approval processes.

Important Contacts

- For technical assistance regarding online filing, contact the ePLACE Help Desk Team at (844) 733-7522 or ePLACE_helpdesk@mass.gov.



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- To see a copy of your application after submittal, also see:
<https://eeaonline.eea.state.ma.us/EEA/PublicApp>.

6. Where can I get a copy of the timelines?

The timelines are available on the MassDEP Website: <https://www.mass.gov/lists/massdep-fees-timelines>

7. How long are these approvals in effect?

BRP WP 93 This approval is in effect for up to 5 years.

8. How can I avoid the most common mistakes made in applying for these approvals?

- a. Fill in all information requested on the application forms.
- b. Make sure all required project descriptions, maps, and site plans are included with both copies of the registration form.
- c. Include all required reports and applications with sufficient detail and description.
- d. Make sure copies of all documents are submitted to the local Board of Health, if applicable.
- e. Make sure the application is signed by a legally responsible official.
- f. Submit the application & documents listed above and pay fee through ePLACE,
<https://eplace.eea.mass.gov/citizenaccess>.

9. What are the regulations and policies that apply to these approvals? Where can I get copies?

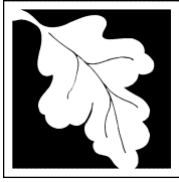
These regulations and policies include, but are not limited to:

- a. Regulations for the Land Application of Sludge and Septage, 310 CMR 32.00.
- b. Timely Action Schedule and Fee Provisions, 310 CMR 4.00.
- c. Administrative Penalty Regulations, 310 CMR 5.00.
- d. WPC, Wastewater Residuals Guidance Document No. 87-1, "Blending Policy".
- e. WPC, Wastewater Residuals Guidance Document No. 87-2, "Horticultural Use".
- f. WPC, Wastewater Residuals Guidance Document No. 87-3, "Multi-site/Single-ownership".

These may be purchased at:

State House Bookstore
Room 116
Boston, MA 02133
617-727-2834

State House West Bookstore
436 Dwight Street
Springfield, MA 01103
413-784-1376



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Application Completeness Checklist

For BRP WP 93:

- ☐ Application for Approval of Suitability (AOS), including Signature and Date, is completed.
- ☐ Copy of concurrence from the local Board of Health.

To submit the application package:

- ☐ Submit the application and documents listed above through ePLACE,
<https://eplace.eea.mass.gov/citizenaccess>
- ☐ Pay fee: \$1700 (if applicable)

You can pay online in ePLACE or pay by mail in the form of a check or money order made payable to *Commonwealth of Massachusetts* (please follow email instructions provided to you once your application is submitted).

MassDEP/DWPC, Wastewater Residuals
Guidance Document No. 87-1

Blending Policy

The Department needs to develop a position on the issue of how the existing land application regulations apply to the utilization of blended sludge compost products (compost mixed with sand, peat, or other materials).

The underlying assumption which forms the foundation for this clarification document is that the regulated materials for which a suitability classification is made, are those materials which are actually applied to the land and distributed. For example, if sludge compost is proposed to be mixed with some other materials (sand, peat etc.) after compost operations and then land applied, our land application regulations would apply to the final mixed material and not the original compost.

Simply, this means that the material that should be regulated, and for which the suitability classification is made, is that which is actually applied to the land.

Having made such a determination, there are various procedural and regulatory measures that should be included in a Blending Policy. It is important to stress that to blend for the sake of blending is not to be allowed. The POTW and/or the Distributor proposing the blending program must clearly show that the application of the Blending Policy is necessary for the particular market(s) attempting to be utilized, and further, that there are no reasonably viable alternative markets available which could be expected to be utilized for the non-blended sludge compost product. The underlying basis for these minimum requirements is to ensure that the application of the Blending Policy is not utilized to replace implementation of industrial pretreatment requirements. Application of the Blending Policy is to be limited to those POTW's which can prove, to the satisfaction of the Department, that they have taken "all reasonable measures" to control priority pollutants from entering their wastewater stream, and hence their sludge.

The determination of what the Department considers "all reasonable measures" should be assessed on a case-by-case basis, but that at a minimum the POTW must comply with the following:

If the POTW is required by EPA or MassDEP to implement a pretreatment program, the POTW must provide documentation that the program has been approved by EPA/MassDEP and also that it has been deemed by EPA/MassDEP to be fully implemented, or on an agreed-upon implementation schedule. In addition, the POTW should be required to substantiate that it has adequately attempted to find and eliminate, or mitigate, those pollutant(s) of concern which are responsible for the blending request.

Again the intent is to ensure that the Blending Policy is not being utilized as an alternative to industrial pretreatment.

The Blending Policy will also be restricted to those situations where the ultimate utilization of the blended material is for a beneficial use. The intent is not to allow application of the Blending Policy just to provide the POTW with an easier method of sludge disposal.

The Department can consider, but is not required to approve, blending procedures for all possible upgrading scenarios (i.e., Type III to II, Type III to I or Type II to I).

The term blending, in the context of this policy, only applies after the last point in the treatment process (i.e., sludge has been composted), and does not apply to the normal treatment operations of the POTW. The following sludge treatment processes are not considered blending: the addition of ferric chloride and lime to aid in dewatering, the addition of compost amendment (woodchips, sawdust, etc.) to the sludge prior to composting; and the addition of chemicals utilized in a chemical fixation process for sludge management. It would apply to the addition of materials to the final sludge material after it leaves the last treatment process, an example of this situation would be the adding of additional compost amendment to cured compost solely to reduce the concentrations of pollutants in the final material.

The policy also would not apply to the situation where a number of POTW's have an agreement to jointly process/treat/manage their respective sludges (either prior to, or after dewatering). An example is the situation where three POTW's, two of which produce a Type II sludge while the third produces a Type III sludge, prior to the final residuals management phase mix their sludges together producing a mix which is a Type II sludge. Under this scenario the mixing of the three sludges would not be considered blending. The blending policy would apply only if a proposal were presented to upgrade the sludge type of the final mixed matrix i.e., transforming the Type II combined sludge matrix to Type I.

Any sludge deemed to be a hazardous waste, even if proposed to be incorporated into a larger volume of non-hazardous sludge, is categorically eliminated from eligibility for blending.

There are also non-POTW sludges which emanate from certain food processing or agricultural processing wastewater treatment plants which have been shown to be appropriate for land application, and therefore will also be eligible for consideration by the Department for the Blending Policy. These determinations shall be made on a case-by-case basis, but only with the written concurrence of the Department's Residuals Program Manager.

SGL/sf (405)

MassDEP/DWPC, Wastewater Residuals
Guidance Document No. 87-2

Horticultural Use

Background

It has been determined that utilization of sludge materials for horticultural purposes is significantly different than "typical" land application projects and therefore the regulatory procedures to be followed require clarification. This document attempts to perform that function.

The utilization of wastewater treatment plant sludge (or sludge products) in horticultural products (turf, trees, shrubs, potted plants) is regulated, in general, by 310 CMR 32.00, and is controlled by the chemical classification, and approval of suitability requirements.

After an Approval of Suitability has been granted, Type I material may be used without further approval of the Department. Type II material may be used only with the prior approval of the Department. The Approval of Suitability and Land Application Certificate are needed to regulate the use of the material.

Because of the strict regulatory controls for Type III material, such as requirements for recording the application site in the registry of deeds, and the fact that the horticultural products will get wide distribution, it is the Task Force's opinion that such sludges should not be allowed for these purposes, unless the Department is convinced that for a specific project proposal, it can adequately control all eventual uses.

Therefore, Type I and Type II sludge materials are most suitable for horticultural utilization. In addition, commercial users will prefer the high quality sludge and less burdensome regulations, and buyers will have more confidence in the final product.

Where a POTW provides (either through sale or give-away) sludge to a commercial agent, there will be a jointly regulated party (POTW and commercial agent) with all process and product usage defined in the Land Application Certificate (LAC). The intent is that the product trail, from the POTW, to the commercial agent, to final use, is clearly articulated and agreed to by all parties. For example, the LAC would indicate that the POTW is authorized to transfer (blank) cubic yards of screened compost to Ajax gardening center where the compost will be utilized as an ingredient in a potting soil mix which will be used on-site by the agent for potted flowering plants, and the plants would then be sold on the retail market.

Once the Department approves this process, the regulatory trail ends and does not pass down to the individual purchaser of the potted plant. In other words the Department's regulatory control applies to both producer and commercial user but not the retail consumer.

While it may be difficult to monitor long-term impacts at "application sites" (either where a product is developed, grown or transplanted) due to the wide distribution of the final product, it is very unlikely that there will be any adverse impacts because these are basically one-time applications. Essentially, sludge is beneficially used once for growing a specific product (potted plant, tree root ball, or sod), as opposed to being used to fertilize a plot of land. Once the product is produced and sold, it is unlikely that there will be continued application of sludge to the product.

SGL/sf
(405)

MassDEP/DWPC, Wastewater Residuals
Guidance Document, No. 87-3

Multi-site/Single-ownership

This paper is intended to address the concern that the requirements of Regulations 310 CMR 32.00 are too cumbersome when a multi-site/single ownership land application project is contemplated. Therefore, this document is intended to provide an approach which is realistic yet conforms to the requirements of the regulations.

Sections 32.11 through 32.14 inclusive, of the land application regulations deal with the "Approval of Suitability" of sludge or septage generated by a specific treatment facility for beneficial use. Sections 32.20 through 32.26 inclusive, deal with "Approval of Sites for Land Application of Type II or Type III Sludge or Septage" generated by a facility that has obtained an "Approval of Suitability". Section 32.25 specifically requires a "Land Application Certificate" be obtained from the Department for each location prior to land application occurring and also outlines the minimum information to be provided for each site being contemplated for such use.

Therefore, taking the regulations at face value, if for example, a Town DPW wished to apply a type II sludge on 20 different Town-owned locations, 20 separate applications with supporting information for "Land Application Certificates" would be filed with the Department.

In order to avoid filing redundant materials for each application site the Task Force is of the opinion that the following approach is appropriate.

A single consolidated application can be submitted to MassDEP which contains a request for approval of a number of different sites. Certain types of information in the application would be generic to all sites while site specific information, for all sites proposed for use, would still need to be submitted. This information would need to be clearly delineated in the application. The applicant should also be instructed to indicate whether he/she wishes to request that MassDEP review and process the application as one non-segmentable plan or as an overall program proposal which can be considered as being comprised of a number of segmentable application proposals (sites). As long as the applicant is willing to allow a phased-approval, such a review and approval process can be accomplished by MassDEP.

Specifically, an application for such a segmentable process would include the following elements:

1. The multi-site application should be broken into three distinct parts - cover letter, information generic to every location, and site specific information.
2. The cover letter should list each location being sought, prioritize the review and processing order of the locations, and request or otherwise allow the Department to act on a portion of the locations in the event that a site specific problem prevents action on the entire request. (For the purpose of 32.25(5), the Department shall consider that it has received a fully completed application for each of the proposed sites and will proceed with action pursuant to 32.25(5).)
3. The generic information section would apply to each location and negate the need for filing redundant information. This generic section could address Application Management Requirements, Section 32.23 (application rate, public access, grazing animals, crops and seasonal restrictions), Soil Sampling Requirements, Section 32.24 (frequency, parameters, etc.), and any other information applicable to all sites.
4. The site specific section would provide information to address all the requirements of Section 32.25(3) which were not fulfilled by the generic section as well as any other site specific information required by the Department.

MassDEP/DWPC, Wastewater Residuals
Guidance Document No. 87-4

Pilot and Demonstration Program

Each application must be considered on a case-by-case basis and should be reviewed on its own particular merits. In the project request, the applicant should clearly indicate the elements of the regulations which it believes do not, or should not, apply to the proposal, and the reasons for such a statement or request. It would be up to the Regional Office, in consultation with the Central Office, to determine the acceptability of the proposal.

It appears that such approvals have been granted in the past, are an important method of obtaining system operations data, and that this procedure should continue to be utilized in future activities.

Reference Section

(To be retained by applicant)

List of Approved Test Procedures for Sludge Parameters (1)

| Parameter | Standard Methods (17th Edition) | EPA SW-846 | EPA 1979 | ASTM | USGS | Other |
|---------------------------------------|---------------------------------|------------|----------------------------|----------------------------|------------------------|-------------------------------------|
| pH | 4500-H+ | | 150.1 | D1293-84(A) or D1293-84(B) | 1-1586-94 | (7) |
| Total Solids | 2540 | | 160.3 | | 1-3750-84 | |
| Total Nitrogen (N) | 4500-N | | 351.1, 351.2, 351.3, 351.4 | D3590-84 | 1-4551-78 | (8) - 33.051 |
| Ammonia Nitrogen (NH ₃ -N) | 4500-NH ₃ | | 350.1, 350.2, 350.3 | D1426-79(A), (C), (D) | 1-3520-84 1-4523-84 | (8) - 33.057 (17) |
| Nitrate Nitrogen (NO ₃ -N) | 4500-NO ₃ | | 352.1 | D992-71 | | (8) - 33.063 (9) - p. 28 |
| Nitrite Nitrogen (NO ₂ -N) | 4500-NO ₂ | | 354.1 | D1254-67 | 1-4540-84 | (10) |
| Total Phosphorus (P) | 4500-P | | 365.1, 365.2, 365.3, 365.4 | D515-82(A) | 1-4600-84 | (8) - 33.III |
| Metals:⁽¹⁸⁾ | | | | | | |
| Potassium (K) | 3500-K | 7610 | 258.1 | D1428-82(A) | 1-3630-84 | (8) - 33.103 (11) - Method 200.7 |
| Arsenic (As) | 3500-As | 7060 | | | | |

| | | | | | | |
|--------------|---------|--------------|----------------|-------------------|------------------------|--|
| | | 7061 | | | | |
| Cadmium (Cd) | 3500-Cd | 7130 7131 | 213.1 213.2 | D3557-84 (A), (C) | 1-3135-84 1-3136-84 | (8) - 33.089 (9) - p. 37 (11) - Met. 200.7 |

List of Approved Test Procedures for Sludge Parameters (1) - continued

| Parameter | Standard Methods (17th Edition) | EPA SW-846 | EPA 1979 | ASTM | USGS | Other |
|---------------------|---------------------------------|--------------|---------------------|---------------------------|------------------------|--|
| Total Chromium (Cr) | 3500-Cr | 7190 7191 | 218.1, 218.2, 218.3 | D1687-84 (A), (D) | 1-3236-84 | (8) - 33.089 (11) - Met. 200.7 |
| Copper (Cu) | 3500-Cu | 7210 | 220.1, 220.2 | D1688-84 (A), (D), (E) | 1-3270-84 1-3271-84 | (8) - 33.089 (9) - p. 37 (11) - Met. 200.7 (12) |
| Lead (Pb) | 3500-Pb | 7420 7421 | 239.1, 239.2 | D3559-85 (A, B, & C) | 1-3399-84 | (8) - 33.089 (11) - Met. 200.7 |
| Mercury (Hg) | 3500-Hg | 7470 7471 | 245.1, 245.2 | D3223-80 | 1-3462-84 | (8) - 33.095 |
| Molybdenum (Mo) | 3500-Mo | 7480 7481 | 246.1, 246.2 | | 1-3490-84 | (11) - Met. 200.7 |
| Nickel (Ni) | 3500-Ni | 7520 | 249.1, 249.2 | D1886-84 (C), (D) | 1-3499-84 | (11) - Met. 200.7 |
| Selenium (Se) | 3500-Se | 7740 7741 | | | | |

| | | | | | | |
|-------------------------------------|---------|------|--------------|-------------------|-----------|--|
| Zinc (Zn) | 3500-Zn | 7950 | 289.1, 289.2 | D1691-84 (C), (D) | 1-3900-84 | (8) - 33.089 (9) - p. 37 (11) - Met. 200.7 (13) |
| Boron (B) | 4500-B | | 212.3 | | 1-3112-84 | (11) - Met. 200.7 |
| Polychlorinated Biphenyls (PCBs) | 6431 | 8080 | 608, 625 | | | (14) (15) - p. 43 |
| TCLP | | 1311 | | | | (16) Met.1310 |

Analytical References:

- (1) Abstracted from the Code of Federal Regulations, 40 CFR Part 136, Revised as of July 1, 1986.
- (2) "Standard Methods for the Examination of Water and Wastewater", 17th edition (1989), American Public Health Association, 1015 Fifteenth St., N.W. Washington, D.C. 20036.
- (3) "Test Methods for Evaluating Solid Waste", U.S. Environmental Protection Agency, (EPA SW-846, November 1986), Office of Solid Waste and Emergency Response, Washington, D.C. 20460
- (4) "Methods for the Chemical Analysis of Water and Wastes", U.S. Environmental Protection Agency (EPA - 600/4-79-020 Revised March 1983) ORD Publications, CERL, U.S. EPA, Cincinnati, Ohio 45268.
- (5) "American Society for Testing and Materials (ASTM) Annual Book of Standards, Section 11, Water" ASTM, 1916 Race St., Philadelphia, PA 19103.
- (6) "Methods for Analysis of Inorganic Substances in Water and Fluvial Sediments", U.S. Department of the Interior, U.S. Geological Survey, Open - File Report 85-495 (1986), U.S.G.S., Branch of Distribution, 1200 South East Street, Arlington, VA 22202.
- (7) "Hydrogen Ion (pH) Automated Electrode Method, Industrial Method Number 378-75WA", October 1976, Technicon Auto - Analyzer II, Technicon Industrial Systems, Tarrytown, New York 10591.
- (8) "Official Methods of Analysis of the Association of Official Analytical Chemists", AOAC Methods Manual, 14th edition (1985); AOAC, 1111 North 19th Street, Suite 210, Arlington, VA 22209.
- (9) "American National Standard on Photographic Processing Effluents", April 2, 1975 - Available from American National Standards Institute, 1430 Broadway, New York, New York 10018.
- (10) "Nitrogen, Nitrite, Method 8507", Hach Chemical Company, P.O. Box 389; Loveland, Colorado 80537.
- (11) See Appendix C, 40 CFR Part 136, July 1, 1986 Federal Register: "Inductively Coupled Plasma Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes."
- (12) "Cooper, Bicinchoniate Method, Method 8506", Hach Handbook of Water Analysis, 1979, Hach Chemical Company, P.O. Box 389, Loveland, Colorado 80537.
- (13) "Zinc, Zincon Method, Method 8009", Hach Handbook of Water Analysis, 1979, pp. 2-231 and 2-333, Hach Chemical Company, Loveland, Colorado 80537.
- (14) The full texts of EPA Methods 608 and 625 are given at Appendix A, "Test Procedures for Analysis of Organic Pollutants", Federal Register, 40 CFR Part 136, July 1, 1986. The standardized test procedure to be used to determine the method detection limit (MDL) for these test procedures is given at Appendix B, "Definition and Procedure for the Determination of the Method Detection Limit", of this Part 136.
- (15) "Methods for Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater", U.S. EPA, September, 1978- available from: ORD Publications, CERL, U.S. EPA, Cincinnati, Ohio 45268.
- (16) "Test Methods for Evaluating Solid Waste - Volume 10: Laboratory Manual - Physical/Chemical Methods", SW-846, Third Edition, U.S. EPA (1986).
- (17) "Ammonia, Automated Electrode Method", Industrial Method Number 379-75WE February 19, 1976, Technicon Auto Analyzer II, Technicon Industrial Systems, Tarrytown, New York 10591.

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- (18) For the determination of total metals the sample is not filtered before processing. A digestion procedure is required to solubilize suspended material and to destroy organic - metal complexes. Two digestion procedures are given in Reference (2), No. 4.1.3. and 4.1.4. In all cases the method write-up should be consulted for specific instructions and/or cautions.

Required Containers, Preservation Techniques, and Holding Times for Sludge Parameters ⁽¹⁾

| Parameter | Container ⁽²⁾ | Preservation ⁽³⁾ | Holding Time ⁽⁴⁾ |
|-----------------------------|--------------------------|-----------------------------------|-----------------------------|
| pH | P, G | None Required | Analyze immediately |
| Total Solids | P, G | Cool, 4 C | 7 days |
| Total Nitrogen | P, G | Cool, 4 C, sulfuric acid to pH <2 | 28 days |
| Ammonium Nitrogen | P, G | Cool, 4 C, sulfuric acid to pH <2 | 28 days |
| Nitrate Nitrogen | P, G | Cool, 4 C | 48 hours |
| Nitrite Nitrogen | P, G | Cool, 4 C | 48 hours |
| Total Phosphorus | P, G | Cool, 4 C, sulfuric acid to pH <2 | 28 days |
| Metals⁽⁵⁾ | | | |
| Arsenic | P, G | Nitric acid to pH < 2 | 6 months |
| Boron | P, G | Nitric acid to pH < 2 | 6 months |
| Cadmium | P, G | Nitric acid to pH < 2 | 6 months |
| Chromium (Total) | P, G | Nitric acid to pH < 2 | 6 months |
| Copper | P, G | Nitric acid to pH < 2 | 6 months |
| Lead | P, G | Nitric acid to pH < 2 | 6 months |
| Mercury | P, G | Nitric acid to pH < 2 | 28 days |
| Molybdenum | P, G | Nitric acid to pH < 2 | 6 months |
| Nickel | P, G | Nitric acid to pH < 2 | 6 months |

Required Containers, Preservation Techniques, and Holding Times for Sludge Parameters ⁽¹⁾

| Parameter | Container ⁽²⁾ | Preservation ⁽³⁾ | Holding Time ⁽⁴⁾ |
|---------------------------------|--------------------------------------|---|---|
| Potassium | P, G | Nitric acid to pH < 2 | 6 months |
| Selenium | P, G | Nitric acid to pH < 2 | 6 months |
| Polychlorinated Biphenyls | G, Teflon-lined cap or aluminum foil | Cool, 4 C | extract within 7 days, analyze within 40 days after extraction. |
| Purgeable Halocarbons | G, Teflon-lined septum | Cool, 4 C, 0.008% Na ₂ S ₂ O ₃ (8) | 14 days |
| Purgeable Aromatic Hydrocarbons | G, Teflon-lined septum | Cool, 4 C, 0.008% Na ₂ S ₂ O ₃ HCL to pH 2 (8) (9) | 14 days |
| Pesticides | G, Teflon-lined cap | Cool, 4 C, pH 5-9 (10) | 7 days until extraction, 40 days after extraction |

Sample Collection References:

- (1) Abstracted from the Code of Federal Regulations, 40 CFR Part 136, revised as of July 1986.
- (2) Polyethylene (P) or Glass (G).
- (3) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4 C until composting and sample splitting is completed.
- (4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Some samples may not be stable for the maximum time period given in the table. A permittee or monitoring laboratory is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability.
- (5) Analyze sludge samples for the total metals listed.
- (6) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for the optimum safeguard of sample integrity.
- (7) The following optional preservation may be used when the referenced categories are to be analyzed in a single sample: Cool to 4 C, add 0.008% $\text{Na}_2\text{S}_2\text{O}_3$ to reduce residual chlorine, only if present; store in dark; adjust pH 6.0-9.0. Samples preserved in this manner may be held for seven days before extraction and for forty days after extraction.
- (8) 0.008% $\text{Na}_2\text{S}_2\text{O}_3$ should only be used in the presence of residual chlorine.
- (9) Sampling receiving no pH adjustment must be analyzed within 7 days of sampling.
- (10) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are within 72 hours of collection.

Table 1
Required Data for Substances Specified in 310 CMR 32.12(2)(a) & (b)
and new EPA Part 503 Regulations
(A minimum of 3 separate analyses are required for initial approval)

| (1) Parameter | (2) Reporting Units | (3) Concentration (dry weight) | (4) Preservation Technique | (5) Date Sampled | (6) Date Extracted | (7) Date Analyzed | (8) Method Reference No. | (9) Detection Limits |
|-------------------------|---------------------------|--------------------------------------|----------------------------------|------------------------|--------------------------|-------------------------|-----------------------------------|----------------------------|
| 1. pH | X | X | | | | | | X |
| 2. % Solids | % | | | | | | | X |
| 3. % Total Nitrogen | % | | | | | | | |
| 4. % NH ₄ -N | % | | | | | | | |
| 5. % NO ₃ -N | % | | | | | | | |
| 6. % Total Phosphorus | % | | | | | | | |
| 7. % Potassium | % | | | | | | | |
| 8. ppm Cadmium | | | | | | | | |
| 9. ppm Total Chromium | | | | | | | | |
| 10.ppm Copper | | | | | | | | |
| 11.ppm Lead | | | | | | | | |

Table 1 - Continued
Required Data for Substances Specified in 310 CMR 32.12(2)(a) & (b)
and new EPA Part 503 Regulations
 (A minimum of 3 separate analyses are required for initial approval)

| (1) Parameter | (2) Reporting Units | (3) Concentration (dry weight) | (4) Preservation Technique | (5) Date Sampled | (6) Date Extracted | (7) Date Analyzed | (8) Method Reference No. | (9) Detection Limits |
|-----------------------|---------------------------|--------------------------------------|----------------------------------|------------------------|--------------------------|-------------------------|-----------------------------------|----------------------------|
| 12. ppm Mercury | | | | | | | | |
| 13. ppm Nickel | | | | | | | | |
| 14. ppm Zinc | | | | | | | | |
| 15. ppm Molybdenum | | | | | | | | |
| 16. ppm Boron | | | | | | | | |
| 17. ppm PCBs | | | | | | | | |
| 18. ppm Arsenic | | | | | | | | |
| 19. ppm Selenium | | | | | | | | |

Table 2
Required Data for TCLP (Toxicity Characteristic Leaching Procedure)
 (A minimum of 1 analysis is required for initial approval)

| (1) Parameter | (2) Reporting Units | (3) Concentration (wet weight) | (4) Preservation Technique | (5) Date Sampled | (6) Date Extracted | (7) Date Analyzed | (8) Method Reference No. | (9) Detection Limits |
|------------------|---------------------------|--------------------------------------|----------------------------------|------------------------|--------------------------|-------------------------|-----------------------------------|----------------------------|
| 1. Arsenic | mg/l | | | | | | | |
| 2. Barium | mg/l | | | | | | | |
| 3. Cadmium | mg/l | | | | | | | |
| 4. Chromium | mg/l | | | | | | | |
| 5. Lead | mg/l | | | | | | | |
| 6. Mercury | mg/l | | | | | | | |
| 7. Selenium | mg/l | | | | | | | |
| 8. Silver | mg/l | | | | | | | |
| 9. Endrin | mg/l | | | | | | | |
| 10. Lindane | mg/l | | | | | | | |
| 11. Methoxychlor | mg/l | | | | | | | |
| 12. Toxaphene | mg/l | | | | | | | |
| 13. 2,4,-D | mg/l | | | | | | | |
| 14. 2,4,5-TP | mg/l | | | | | | | |
| 15. Benzene | mg/l | | | | | | | |

Table 2 - continued
Required Data for TCLP (Toxicity Characteristic Leaching Procedure)
 (A minimum of 1 analysis is required for initial approval)

| (1) Parameter | (2) Reporting Units | (3) Concentration (wet weight) | (4) Preservation Technique | (5) Date Sampled | (6) Date Extracted | (7) Date Analyzed | (8) Method Reference No. | (9) Detection Limits |
|--------------------------|---------------------------|--------------------------------------|----------------------------------|------------------------|--------------------------|-------------------------|-----------------------------------|----------------------------|
| 16. Carbon Tetrachloride | mg/l | | | | | | | |
| 17. Chlordane | mg/l | | | | | | | |
| 18. Chlorobenzene | mg/l | | | | | | | |
| 19. Chloroform | mg/l | | | | | | | |
| 20. O-Creosol | mg/l | | | | | | | |
| 21. M-Creosol | mg/l | | | | | | | |
| 22. p-Creosol | mg/l | | | | | | | |
| 23. Creosol | mg/l | | | | | | | |
| 24. 1,4 Dichlorobenzene | mg/l | | | | | | | |
| 25. 1,2 Dichloroethane | mg/l | | | | | | | |
| 26. 1,1 Dichloroethylene | mg/l | | | | | | | |
| 27. 2,4 Dinitrotoluene | mg/l | | | | | | | |

Table 2 - continued
Required Data for TCLP (Toxicity Characteristic Leaching Procedure)
 (A minimum of 1 analysis is required for initial approval)

| (1) Parameter | (2) Reporting Units | (3) Concentration (wet weight) | (4) Preservation Technique | (5) Date Sampled | (6) Date Extracted | (7) Date Analyzed | (8) Method Reference No. | (9) Detection Limits |
|---------------------------|---------------------------|--------------------------------------|----------------------------------|------------------------|--------------------------|-------------------------|-----------------------------------|----------------------------|
| 28. Heptachlor | mg/l | | | | | | | |
| 29. Hexachlorobenzene | mg/l | | | | | | | |
| 30. Hexachlorobutadiene | mg/l | | | | | | | |
| 31. Hexachloroethane | mg/l | | | | | | | |
| 32. Methyl ethyl ketone | mg/l | | | | | | | |
| 33. Nitrobenzene | mg/l | | | | | | | |
| 34. Pentachlorophenol | mg/l | | | | | | | |
| 35. Pyridine | mg/l | | | | | | | |
| 36. Tetrachloroethylene | mg/l | | | | | | | |
| 37. Trichloroethylene | mg/l | | | | | | | |
| 38. 2,4,6 Trichlorophenol | mg/l | | | | | | | |
| 39. 2,4,5 Trichlorophenol | mg/l | | | | | | | |
| 40. Vinyl Chloride | mg/l | | | | | | | |

Reference Section

(To be retained by applicant)

List of Approved Test Procedures for Sludge Parameters (1)

| Parameter | Standard Methods (17th Edition) | EPA SW-846 | EPA 1979 | ASTM | USGS | Other |
|---------------------------------------|---------------------------------|--------------|----------------------------|----------------------------|------------------------|-------------------------------------|
| pH | 4500-H+ | | 150.1 | D1293-84(A) or D1293-84(B) | 1-1586-94 | (7) |
| Total Solids | 2540 | | 160.3 | | 1-3750-84 | |
| Total Nitrogen (N) | 4500-N | | 351.1, 351.2, 351.3, 351.4 | D3590-84 | 1-4551-78 | (8) - 33.051 |
| Ammonia Nitrogen (NH ₃ -N) | 4500-NH ₃ | | 350.1, 350.2, 350.3 | D1426-79(A), (C), (D) | 1-3520-84 1-4523-84 | (8) - 33.057 (17) |
| Nitrate Nitrogen (NO ₃ -N) | 4500-NO ₃ | | 352.1 | D992-71 | | (8) - 33.063 (9) - p. 28 |
| Nitrite Nitrogen (NO ₂ -N) | 4500-NO ₂ | | 354.1 | D1254-67 | 1-4540-84 | (10) |
| Total Phosphorus (P) | 4500-P | | 365.1, 365.2, 365.3, 365.4 | D515-82(A) | 1-4600-84 | (8) - 33.III |
| Metals:⁽¹⁸⁾ | | | | | | |
| Potassium (K) | 3500-K | 7610 | 258.1 | D1428-82(A) | 1-3630-84 | (8) - 33.103 (11) - Method 200.7 |
| Arsenic (As) | 3500-As | 7060 7061 | | | | |

List of Approved Test Procedures for Sludge Parameters (1) - continued

| Parameter | Standard Methods (17th Edition) | EPA SW-846 | EPA 1979 | ASTM | USGS | Other |
|-------------------------------------|---------------------------------|--------------|---------------------|---------------------------|------------------------|--|
| Total Chromium (Cr) | 3500-Cr | 7190 7191 | 218.1, 218.2, 218.3 | D1687-84 (A), (D) | 1-3236-84 | (8) - 33.089 (11) - Met. 200.7 |
| Copper (Cu) | 3500-Cu | 7210 | 220.1, 220.2 | D1688-84 (A), (D), (E) | 1-3270-84 1-3271-84 | (8) - 33.089 (9) - p. 37 (11) - Met. 200.7 (12) |
| Lead (Pb) | 3500-Pb | 7420 7421 | 239.1, 239.2 | D3559-85 (A, B, & C) | 1-3399-84 | (8) - 33.089 (11) - Met. 200.7 |
| Mercury (Hg) | 3500-Hg | 7470 7471 | 245.1, 245.2 | D3223-80 | 1-3462-84 | (8) - 33.095 |
| Molybdenum (Mo) | 3500-Mo | 7480 7481 | 246.1, 246.2 | | 1-3490-84 | (11) - Met. 200.7 |
| Nickel (Ni) | 3500-Ni | 7520 | 249.1, 249.2 | D1886-84 (C), (D) | 1-3499-84 | (11) - Met. 200.7 |
| Selenium (Se) | 3500-Se | 7740 7741 | | | | |
| Zinc (Zn) | 3500-Zn | 7950 | 289.1, 289.2 | D1691-84 (C), (D) | 1-3900-84 | (8) - 33.089 (9) - p. 37 (11) - Met. 200.7 (13) |
| Boron (B) | 4500-B | | 212.3 | | 1-3112-84 | (11) - Met. 200.7 |
| Polychlorinated Biphenyls (PCBs) | 6431 | 8080 | 608, 625 | | | (14) (15) - p. 43 |
| TCLP | | 1311 | | | | (16) Met.1310 |

Analytical References:

- (1) Abstracted from the Code of Federal Regulations, 40 CFR Part 136, Revised as of July 1, 1986.
- (2) "Standard Methods for the Examination of Water and Wastewater", 17th edition (1989), American Public Health Association, 1015 Fifteenth St., N.W. Washington, D.C. 20036.
- (3) "Test Methods for Evaluating Solid Waste", U.S. Environmental Protection Agency, (EPA SW-846, November 1986), Office of Solid Waste and Emergency Response, Washington, D.C. 20460
- (4) "Methods for the Chemical Analysis of Water and Wastes", U.S. Environmental Protection Agency (EPA - 600/4-79-020 Revised March 1983) ORD Publications, CERL, U.S. EPA, Cincinnati, Ohio 45268.
- (5) "American Society for Testing and Materials (ASTM) Annual Book of Standards, Section 11, Water" ASTM, 1916 Race St., Philadelphia, PA 19103.
- (6) "Methods for Analysis of Inorganic Substances in Water and Fluvial Sediments", U.S. Department of the Interior, U.S. Geological Survey, Open - File Report 85-495 (1986), U.S.G.S., Branch of Distribution, 1200 South East Street, Arlington, VA 22202.
- (7) "Hydrogen Ion (pH) Automated Electrode Method, Industrial Method Number 378-75WA", October 1976, Technicon Auto - Analyzer II, Technicon Industrial Systems, Tarrytown, New York 10591.
- (8) "Official Methods of Analysis of the Association of Official Analytical Chemists", AOAC Methods Manual, 14th edition (1985); AOAC, 1111 North 19th Street, Suite 210, Arlington, VA 22209.
- (9) "American National Standard on Photographic Processing Effluents", April 2, 1975 - Available from American National Standards Institute, 1430 Broadway, New York, New York 10018.
- (10) "Nitrogen, Nitrite, Method 8507", Hach Chemical Company, P.O. Box 389; Loveland, Colorado 80537.
- (11) See Appendix C, 40 CFR Part 136, July 1, 1986 Federal Register: "Inductively Coupled Plasma Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes."
- (12) "Cooper, Bicinchoniate Method, Method 8506", Hach Handbook of Water Analysis, 1979, Hach Chemical Company, P.O. Box 389, Loveland, Colorado 80537.
- (13) "Zinc, Zincon Method, Method 8009", Hach Handbook of Water Analysis, 1979, pages 2-231 and 2-333, Hach Chemical Company, Loveland, Colorado 80537.
- (14) The full texts of EPA Methods 608 and 625 are given at Appendix A, "Test Procedures for Analysis of Organic Pollutants", Federal Register, 40 CFR Part 136, July 1, 1986. The standardized test procedure to be used to determine the method detection limit (MDL) for these test procedures is given at Appendix B, "Definition and Procedure for the Determination of the Method Detection Limit", of this Part 136.

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- (15) "Methods for Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater", U.S. EPA, September, 1978- available from: ORD Publications, CERL, U.S. EPA, Cincinnati, Ohio 45268.
- (16) "Test Methods for Evaluating Solid Waste - Volume 10: Laboratory Manual - Physical/Chemical Methods", SW-846, Third Edition, U.S. EPA (1986).
- (17) "Ammonia, Automated Electrode Method", Industrial Method Number 379-75WE February 19, 1976, Technicon Auto Analyzer II, Technicon Industrial Systems, Tarrytown, New York 10591.
- (18) For the determination of total metals the sample is not filtered before processing. A digestion procedure is required to solubilize suspended material and to destroy organic - metal complexes. Two digestion procedures are given in Reference (2), No. 4.1.3. and 4.1.4. In all cases the method write-up should be consulted for specific instructions and/or cautions.

Required Containers, Preservation Techniques, and Holding Times for Sludge Parameters ⁽¹⁾

| Parameter | Container ⁽²⁾ | Preservation ⁽³⁾ | Holding Time ⁽⁴⁾ |
|-----------------------------|--------------------------|-----------------------------------|-----------------------------|
| pH | P, G | None Required | Analyze immediately |
| Total Solids | P, G | Cool, 4 C | 7 days |
| Total Nitrogen | P, G | Cool, 4 C, sulfuric acid to pH <2 | 28 days |
| Ammonium Nitrogen | P, G | Cool, 4 C, sulfuric acid to pH <2 | 28 days |
| Nitrate Nitrogen | P, G | Cool, 4 C | 48 hours |
| Nitrite Nitrogen | P, G | Cool, 4 C | 48 hours |
| Total Phosphorus | P, G | Cool, 4 C, sulfuric acid to pH <2 | 28 days |
| Metals⁽⁵⁾ | | | |
| Arsenic | P, G | Nitric acid to pH < 2 | 6 months |
| Boron | P, G | Nitric acid to pH < 2 | 6 months |
| Cadmium | P, G | Nitric acid to pH < 2 | 6 months |
| Chromium (Total) | P, G | Nitric acid to pH < 2 | 6 months |
| Copper | P, G | Nitric acid to pH < 2 | 6 months |
| Lead | P, G | Nitric acid to pH < 2 | 6 months |
| Mercury | P, G | Nitric acid to pH < 2 | 28 days |
| Molybdenum | P, G | Nitric acid to pH < 2 | 6 months |
| Nickel | P, G | Nitric acid to pH < 2 | 6 months |

Required Containers, Preservation Techniques, and Holding Times for Sludge Parameters ⁽¹⁾

| Parameter | Container ⁽²⁾ | Preservation ⁽³⁾ | Holding Time ⁽⁴⁾ |
|---------------------------------|--------------------------------------|--|---|
| Potassium | P, G | Nitric acid to pH < 2 | 6 months |
| Selenium | P, G | Nitric acid to pH < 2 | 6 months |
| Polychlorinated Biphenyls | G, Teflon-lined cap or aluminum foil | Cool, 4 C | extract within 7 days, analyze within 40 days after extraction. |
| Purgeable Halocarbons | G, Teflon-lined septum | Cool, 4 C, 0.008% Na ₂ S ₂ O ₃ (8) | 14 days |
| Purgeable Aromatic Hydrocarbons | G, Teflon-lined septum | Cool, 4 C, 0.008% Na ₂ S ₂ O ₃ HCL to pH 2 (8) (9) | 14 days |
| Pesticides | G, Teflon-lined cap | Cool, 4 C, pH 5-9 (10) | 7 days until extraction, 40 days after extraction |

Sample Collection References:

- (1) Abstracted from the Code of Federal Regulations, 40 CFR Part 136, revised as of July 1986.
- (2) Polyethylene (P) or Glass (G).
- (3) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4 C until composting and sample splitting is completed.
- (4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Some samples may not be stable for the maximum time period given in the table. A permittee or monitoring laboratory is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability.
- (5) Analyze sludge samples for the total metals listed.
- (6) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for the optimum safeguard of sample integrity.
- (7) The following optional preservation may be used when the referenced categories are to be analyzed in a single sample: Cool to 4 C, add 0.008% $\text{Na}_2\text{S}_2\text{O}_3$ to reduce residual chlorine, only if present; store in dark; adjust pH 6.0-9.0. Samples preserved in this manner may be held for seven days before extraction and for forty days after extraction.
- (8) 0.008% $\text{Na}_2\text{S}_2\text{O}_3$ should only be used in the presence of residual chlorine.
- (9) Sampling receiving no pH adjustment must be analyzed within 7 days of sampling.
- (10) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are within 72 hours of collection.

Table 1. Soil Test Levels for Phosphorus and Potassium

| Soil Test Level | Phosphorus Test (lbs./acre) | Potassium Test |
|-----------------|--------------------------------|----------------|
| Very low | 0 - 10 | 0 - 80 |
| Low | 11 - 20 | 81 - 150 |
| Medium | 21 - 30 | 151 - 120 |
| High | 31 - 70 | 211 - 300 |
| Very high | 71+ | 300+ |

Table 2. Fertilizer Recommendations for Corn and Soybeans

| Expected Yield (bu/A) | Nitrogen Needed (lbs/A) | K or P | P ₂ O ₅ and K ₂ O needed if soil test level* is | | | | |
|-----------------------------|-------------------------------|-------------------------------|--|-----|--------|------|---------|
| | | | V. Low | Low | Medium | High | V. High |
| Corn | | | lbs/acre | | | | |
| 100-110 | 120 | P ₂ O ₅ | 100 | 70 | 50 | 30 | 0 |
| | | K ₂ O | 100 | 70 | 50 | 30 | 0 |
| 111-125 | 140 | P ₂ O ₅ | 110 | 80 | 60 | 30 | 0 |
| | | K ₂ O | 120 | 90 | 60 | 30 | 0 |
| 126-150 | 170 | P ₂ O ₅ | 120 | 90 | 60 | 40 | 10 |
| | | K ₂ O | 150 | 120 | 70 | 40 | 0 |
| 151-175 | 200 | P ₂ O ₅ | 130 | 100 | 70 | 50 | 10 |
| | | K ₂ O | 180 | 140 | 90 | 60 | 0 |
| 176-200 | 230 | P ₂ O ₅ | 150 | 120 | 80 | 50 | 10 |
| | | K ₂ O | 200 | 160 | 120 | 80 | 0 |
| Soybeans | | | | | | | |
| 30-40 | 140** | P ₂ O ₅ | 60 | 50 | 40 | 30 | 0 |
| | | K ₂ O | 100 | 80 | 50 | 40 | 0 |
| 41-50 | 175 | P ₂ O ₅ | 80 | 70 | 50 | 30 | 0 |
| | | K ₂ O | 120 | 90 | 60 | 60 | 0 |
| 51-60 | 210 | P ₂ O ₅ | 100 | 90 | 70 | 40 | 0 |
| | | K ₂ O | 150 | 120 | 90 | 60 | 0 |
| 61-70 | 245 | P ₂ O ₅ | 120 | 100 | 80 | 50 | 20 |
| | | K ₂ O | 180 | 150 | 120 | 80 | 0 |
| 71+ | 300 | P ₂ O ₅ | 120 | 100 | 80 | 50 | 20 |
| | | K ₂ O | 200 | 170 | 130 | 80 | 20 |

* See Table 1 definition of soil test levels.

** Not recommended with conventional fertilization practices because of nitrogen fixation by soybeans.

Table 3. Fertilizer Recommendations for Small Grains and Forages

| Expected Yield (bu/A) | Nitrogen Needed (lbs/A) | K or P | P ₂ O ₅ and K ₂ O needed if soil test level* is | | | | |
|--|-------------------------------|-------------------------------|--|-----|--------|------|---------|
| | | | V. Low | Low | Medium | High | V. High |
| Wheat and Rye (WR) Oats & Barley (OB) | | | lbs/acre | | | | |
| WR, 30-44 bu. | 55 | P ₂ O ₅ | 90 | 60 | 30 | 20 | 20 |
| OB, 70-85 bu. | 55 | K ₂ O | 90 | 60 | 30 | 0 | 0 |
| | | | | | | | |
| WR,45-54 bu. | 65 | P ₂ O ₅ | 120 | 90 | 60 | 30 | 20 |
| OB, 86-100 bu. | 65 | K ₂ O | 120 | 90 | 60 | 30 | 0 |
| | | | | | | | |
| WR, 55-64 bu. | 75 | P ₂ O ₅ | 120 | 90 | 60 | 30 | 20 |
| OB, 101-115 bu. | 75 | K ₂ O | 120 | 90 | 60 | 30 | 0 |
| | | | | | | | |
| WR, 65-74 bu. | 85 | P ₂ O ₅ | 140 | 110 | 90 | 60 | 20 |
| OB, 116-130 bu. | 85 | K ₂ O | 120 | 90 | 60 | 30 | 0 |
| | | | | | | | |
| WR, 75+ bu. | 95 | P ₂ O ₅ | 140 | 110 | 90 | 60 | 20 |
| OB, 131+ bu. | 95 | K ₂ O | 120 | 90 | 60 | 30 | 0 |
| Forage Crops (FC) | | | | | | | |
| FC, 4 tons | 100 | P ₂ O ₅ | 100 | 80 | 50 | 30 | 20 |
| | | K ₂ O | 240 | 200 | 150 | 80 | 0 |
| FC, 6 tons | 200 | P ₂ O ₅ | 120 | 100 | 70 | 50 | 40 |
| | | K ₂ O | 360 | 300 | 240 | 180 | 120 |
| FC, 8 tons | 350 | P ₂ O ₅ | 140 | 120 | 90 | 70 | 50 |
| | | K ₂ O | 480 | 420 | 360 | 300 | 240 |

* See Table 1 definition of soil test levels.

Table 4. Maximum Annual Application

| Substance | CEC less than 5 | CEC 5 or more |
|-----------|-----------------|---------------|
| Cadmium | all soils | 0.45 lbs/acre |

Table 5. Maximum Cumulative Additions Limit

| Substance | CEC less than 5 | CEC 5 or more |
|-----------|-----------------|----------------|
| Cadmium | 4.5 lbs/acre | 4.5 lbs/acre |
| Zinc | 250.0 lbs/acre | 500.0 lbs/acre |
| Copper | 125.0 lbs/acre | 250.0 lbs/acre |
| Nickel | 50.0 lbs/acre | 100.0 lbs/acre |

Table 6. Maximum Cumulative Limit - Includes Background Level

| Substance | CEC less than 5 | CEC 5 or more |
|-----------|-----------------|---------------|
| Lead | 445 lbs/acre | 600/lbs/acre |
| PCB's | 2 lbs/acre | 2 lbs/acre |