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Biosolids Analytical Methods

General Permit for Biosolids Management

## Analytical Methods

The methods outlined below are approved for use under the general permit for biosolids management per WAC 173-308-140. Ecology maintains this list separate from the general permit to enable regular updates as necessary. If you have any questions about the methods listed below, please reach out to your biosolids coordinator.

### Enteric viruses

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| “Standard Practice for Recovery of Viruses From Wastewater Sludges”, 1992 Annual Book of ASTM Standards: Section 11 - Water and Environmental Technology, ASTM, 1916 Race Street, Philadelphia, PA 19103-1187. | ASTM D 4994-89 | [Method](https://www.astm.org/DATABASE.CART/HISTORICAL/D4994-89R02.htm) |
| “Control of Pathogens and Vector Attraction in Sewage Sludge”, Revised July 2003, National Risk Management Research Laboratory Cincinnati, OH 45268 | Appendix H, EPA/625/R-92/013 | [Method](https://www.epa.gov/sites/default/files/2015-07/documents/epa-625-r-92-013.pdf) |

### Fecal coliform

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| “Standard Methods for the Examination of Water and Wastewater”, 18th Edition, 1992, American Public Health Association, 1015 15th Street, NW, Washington, DC 20005. | Part 9221 E | 9221 E (1992) is no longer available. [9221 E (2017)](https://www.standardmethods.org/doi/10.2105/SMWW.2882.192)  |
| “Standard Methods for the Examination of Water and Wastewater”, 18th Edition, 1992, American Public Health Association, 1015 15th Street, NW, Washington, DC 20005. | Part 9222 D | 9222 D (1992) is no longer available. [9222 D (2017)](https://www.standardmethods.org/doi/10.2105/SMWW.2882.193)  |
| 40 CFR Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants | EPA Method 1680 | [Method](https://www.epa.gov/sites/production/files/2019-08/documents/method_1680_2014.pdf) |
| 40 CFR Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants | EPA Method 1681 | [Method](https://www.epa.gov/sites/production/files/2015-08/documents/method_1681_2006.pdf) |
| “Control of Pathogens and Vector Attraction in Sewage Sludge”, Revised July 2003, National Risk Management Research Laboratory Cincinnati, OH 45268 | Appendix F, EPA/625/R-92/013 | [Method](https://www.epa.gov/sites/default/files/2015-07/documents/epa-625-r-92-013.pdf) |

### Helminth ova

Fecal coliform (continued)

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| Yanko, W.A., “Occurrence of Pathogens in Distribution and Marketing Municipal Sludges”, EPA 600/1-87-014, 1987. National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161 (PB 88-154273/AS). | Yanko, 1987 | [Method](https://www.epa.gov/node/250675) |
| “Control of Pathogens and Vector Attraction in Sewage Sludge”, Revised July 2003, National Risk Management Research Laboratory Cincinnati, OH 45268 | Appendix I, EPA/625/R-92/013 | [Method](https://www.epa.gov/sites/default/files/2015-07/documents/epa-625-r-92-013.pdf) |

### Salmonella sp. bacteria

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| “Standard Methods for the Examination of Water and Wastewater”, 18th Edition, 1992, American Public Health Association, 1015 15th Street, NW, Washington, DC 20005 | Part 9260 D | 9260 D (1992) is no longer available.[9260 D (2017)](https://www.standardmethods.org/doi/10.2105/SMWW.2882.201)  |
| Kenner, B.A. and H.P. Clark, “Detection and enumeration of Salmonella and Pseudomonas aeruginosa”, Journal of the Water Pollution Control Federation, Vol. 46, No. 9, September 1974, pp. 2163-2171. Water Environment Federation, 601 Wythe Street, Alexandria, Virginia 22314. | Kenner and Clark, 1974 | [Method](https://www.epa.gov/sites/production/files/2015-04/documents/control_of_pathogens_and_vector_attraction_in_sewage_sludge_july_2003.pdf#page=149) |
| 40 CFR Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants | EPA Method 1682 | [Method](https://www.epa.gov/sites/production/files/2015-08/documents/method_1682_2006.pdf) |

### Specific oxygen uptake rate (SOUR)

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| “Standard Methods for the Examination of Water and Wastewater”, 18th Edition, 1992, American Public Health Association, 1015 15th Street, NW, Washington, DC 20005. | Part 2710 B | 2710 B (1992) is no longer available. [2710 B (2017)](https://www.standardmethods.org/doi/10.2105/SMWW.2882.035)  |
| “Control of Pathogens and Vector Attraction in Sewage Sludge”, Revised July 2003, National Risk Management Research Laboratory Cincinnati, OH 45268 | Appendix D (2), EPA/625/R-92/013 | [Method](https://www.epa.gov/sites/default/files/2015-07/documents/epa-625-r-92-013.pdf) |

### Total, fixed, and volatile solids

SOUR (continued)

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| “Standard Methods for the Examination of Water and Wastewater”, 18th Edition, 1992, American Public Health Association, 1015 15th Street, NW, Washington, DC 20005. | Part 2540 G | 2540 G (1992) is no longer available.[2540 G (2017)](https://www.standardmethods.org/doi/10.2105/SMWW.2882.030)  |

### Inorganic pollutants

**Methods Source:** Test Methods for Evaluating Solid Waste, Physical/Chemical Methods”, EPA Publication SW-846, Second Edition (1982) with Updates I (April 1984) and II (April 1985) and Third Edition (November 1986) with Revision I (December 1987). Second Edition and Updates I and II are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 (PB-87-120-291). Third Edition and Revision I are available from Superintendent of Documents, Government Printing Office, 941 North Capitol Street, NE, Washington, DC 20002 (Document Number 955-001-00000-1).

| ****Methods Number**** | ****Reference**** |
| --- | --- |
| SW-846 6010 | SW-846 6010 is no longer available. [SW-846 6010D](https://www.epa.gov/hw-sw846/sw-846-test-method-6010d-inductively-coupled-plasma-optical-emission-spectrometry-icp-oes) |
| SW-846 7061 | SW-846 7061 is no longer available. [SW-846 7061A](https://www.epa.gov/hw-sw846/sw-846-test-method-7061a-arsenic-atomic-absorption-gaseous-hydride) |
| SW-846 7000A | SW-846 7000A is no longer available. [SW-846 7000B](https://www.epa.gov/hw-sw846/sw-846-test-method-7000b-flame-atomic-absorption-spectrophotometry) |
| SW-846 7470 | SW-846 7470 is no longer available. [SW-846 7470A](https://www.epa.gov/hw-sw846/sw-846-test-method-7470a-mercury-liquid-waste-manual-cold-vapor-technique) |
| SW-846 7471 | SW-846 7471 is no longer available. [SW-846 7471B](https://www.epa.gov/hw-sw846/sw-846-test-method-7471b-mercury-solid-or-semisolid-waste-manual-cold-vapor-technique) |
| SW-846 6020B | SW-846 6020 is no longer available. [SW-846 6020B](https://www.epa.gov/esam/epa-method-6020b-sw-846-inductively-coupled-plasma-mass-spectrometry) |
| SW-846 7010 | [SW-846 7010](https://www.epa.gov/hw-sw846/sw-846-test-method-7010-graphite-furnace-atomic-absorption-spectrophotometry#:~:text=Related%20Topics%3A-,SW%2D846%20Test%20Method%207010%3A%20Graphite%20Furnace%20Atomic%20Absorption%20Spectrophotometry,%2C%20sediments%2C%20and%20similar%20wastes.) |
| SW-846 7741A | SW-846 7741 is no longer available. [SW-846 7741A](https://www.epa.gov/hw-sw846/sw-846-test-method-7741a-selenium-atomic-absorption-gaseous-hydride) |

### Total Kjeldahl Nitrogen (TKN)

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| “Standard Methods for the Examination of Water and Wastewater”, 18th Edition, 1992, American Public Health Association, 1015 15th Street, NW, Washington, DC 20005. | SM 4500, Norg B | [Method](https://www.standardmethods.org/doi/full/10.2105/SMWW.2882.090) |
| “Standard Methods for the Examination of Water and Wastewater”, 18th Edition, 1992, American Public Health Association, 1015 15th Street, NW, Washington, DC 20005. | SM 4500, Norg C | [Method](https://www.standardmethods.org/doi/full/10.2105/SMWW.2882.090) |
| ASTM International, Book of Standards Volume 11.01, Standard Test Methods for Total Kjeldahl Nitrogen in Water, 1994, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA | ASTM D3590-89R94E01 | [Method](https://www.astm.org/d3590-89r94e01.html) |
| ASTM International, Book of Standards Volume 11.02, Standard Test Methods for Total Kjeldahl Nitrogen in Water, 1994, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA | ASTM D3590-02 | [Method](https://www.astm.org/d3590-02.html) |

### Nitrate-nitrogen

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| 40 CFR Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants | EPA 353.2 | [Method](https://www.epa.gov/sites/default/files/2015-08/documents/method_353-2_1993.pdf) |
| “Standard Methods for the Examination of Water and Wastewater”, 18th Edition, 1992, American Public Health Association, 1015 15th Street, NW, Washington, DC 20005. | SM 4500-NO3 E, F, or H | [Method](https://www.standardmethods.org/doi/full/10.2105/SMWW.2882.089) |

### Ammonia-nitrogen

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| “Standard Methods for the Examination of Water and Wastewater”, 18th Edition, 1992, American Public Health Association, 1015 15th Street, NW, Washington, DC 20005. | SM 4500-NH3 B + C, D, E, or G | [Method](https://www.standardmethods.org/doi/full/10.2105/SMWW.2882.087) |

### Organic nitrogen

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| See TKN and Ammonia-Nitrogen | Calculated: TKN minus NH3-N | See TKN and Ammonia-Nitrogen |

### Total phosphorus

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| 40 CFR Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants | EPA 365.1 | [Method](https://www.epa.gov/sites/default/files/2015-08/documents/method_365-1_1993.pdf) |
| 40 CFR Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants | EPA 365.3 | <Method> |
| “Standard Methods for the Examination of Water and Wastewater”, 18th Edition, 1992, American Public Health Association, 1015 15th Street, NW, Washington, DC 20005. | SM 4500-P B + E or F | [Method](https://www.standardmethods.org/doi/10.2105/SMWW.2882.093) |
| Bray, Roger H.; Kurtz, L. T.2 Determination of total, organic, and available forms of phosphorus in soils, Soil Science: January 1945 - Volume 59 - Issue 1 - p 39-46 | Bray | [Method](https://journals.lww.com/soilsci/Citation/1945/01000/DETERMINATION_OF_TOTAL%2C_ORGANIC%2C_AND_AVAILABLE.6.aspx) |
| Olsen, S. and Sommers, L. (1983). Phosphorus. In Methods of Soil Analysis, A. Page (Ed.). https://doi.org/10.2134/agronmonogr9.2.2ed.c24 | Olsen | [Method](https://acsess.onlinelibrary.wiley.com/doi/abs/10.2134/agronmonogr9.2.2ed.c24) |
| A. Mehlich (1984) Mehlich 3 soil test extractant: A modification of Mehlich 2 extractant, Communications in Soil Science and Plant Analysis, 15:12, 1409-1416, DOI: 10.1080/00103628409367568 | Mehlich-3 | [Method](https://www.tandfonline.com/doi/abs/10.1080/00103628409367568?journalCode=lcss20) |

### Semi-volatile organic compounds

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| Test Methods for Evaluating Solid Waste, Physical/Chemical Methods”, EPA Publication SW-846, Second Edition (1982) with Updates I (April 1984) and II (April 1985) and Third Edition (November 1986) with Revision I (December 1987). Second Edition and Updates I and II are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 (PB-87-120-291). Third Edition and Revision I are available from Superintendent of Documents, Government Printing Office, 941 North Capitol Street, NE, Washington, DC 20002 (Document Number 955-001-00000-1). | SW-846 8270E | [Method](https://www.epa.gov/hw-sw846/sw-846-test-method-8270e-semivolatile-organic-compounds-gas-chromatographymass) |

### Volatile organic compounds

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| Test Methods for Evaluating Solid Waste, Physical/Chemical Methods”, EPA Publication SW-846, Second Edition (1982) with Updates I (April 1984) and II (April 1985) and Third Edition (November 1986) with Revision I (December 1987). Second Edition and Updates I and II are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 (PB-87-120-291). Third Edition and Revision I are available from Superintendent of Documents, Government Printing Office, 941 North Capitol Street, NE, Washington, DC 20002 (Document Number 955-001-00000-1). | SW-846 8260D | [Method](https://www.epa.gov/hw-sw846/sw-846-test-method-8260d-volatile-organic-compounds-gas-chromatographymass-spectrometry) |

### Additional volatile solids reductions for *anaerobically* digested solids

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| “Control of Pathogens and Vector Attraction in Sewage Sludge”, Revised July 2003, National Risk Management Research Laboratory Cincinnati, OH 45268 | Appendix D.1, EPA/625/R-92/013 | [Method](https://www.epa.gov/sites/default/files/2015-07/documents/epa-625-r-92-013.pdf) |

### Additional volatile solids reductions for *aerobically* digested solids

| ****Methods Source**** | ****Methods Number**** | ****Reference**** |
| --- | --- | --- |
| “Control of Pathogens and Vector Attraction in Sewage Sludge”, Revised July 2003, National Risk Management Research Laboratory Cincinnati, OH 45268 | Appendix D.3, EPA/625/R-92/013 | [Method](https://www.epa.gov/sites/default/files/2015-07/documents/epa-625-r-92-013.pdf) |

### **pH**

**Methods Source:** Test Methods for Evaluating Solid Waste, Physical/Chemical Methods”, EPA Publication SW-846, Second Edition (1982) with Updates I (April 1984) and II (April 1985) and Third Edition (November 1986) with Revision I (December 1987). Second Edition and Updates I and II are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 (PB-87-120-291). Third Edition and Revision I are available from Superintendent of Documents, Government Printing Office, 941 North Capitol Street, NE, Washington, DC 20002 (Document Number 955-001-00000-1).

| ****Methods Number**** | ****Reference**** |
| --- | --- |
| SW-846 9040C (if <80% solids) | [Method](https://www.epa.gov/hw-sw846/sw-846-test-method-9040c-ph-electrometric-measurement) |
| SW-846 9045D (if >80% solids) | [Method](https://www.epa.gov/hw-sw846/sw-846-test-method-9045d-soil-and-waste-ph) |

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