North Carolina Department of Environment and Natural Resources
Division of Water Quality

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Residuals Management Program Summary

Division of Water Quality

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Program Overview

North Carolina's Residuals Management Program combines quality assurances, operational requirements, and regulatory oversight to provide protection of both human health and the environment. The program meets or exceeds Federal requirements for the land application or disposal of domestic and non-domestic residuals. State regulators work with residuals generators, land owners, local health departments, interested citizens, and other stakeholders to maintain a program that meets the requirements of applicable statutes and rules. The program is designed to protect water resources as well as balance the interests of various stakeholders.

Land application of residuals is the most common method of residuals management used in North Carolina and in the United States. Land application is designed to be the beneficial reuse of residuals as a soil amendment. Residuals have many characteristics that are beneficial to soil and plants. Land application takes advantage of these beneficial qualities, whereas disposal in landfills or by incineration does not. For these reasons, North Carolina and the EPA consider controlled land application a "beneficial use" of residuals.

Under North Carolina General Statute (NCGS) residuals are defined as waste (NCGS 143-213), and any system that collects, treats, or disposes of waste cannot be constructed or operated without a permit (NCGS 143-215.1(a) (2)). The statute authorizes the Environmental Management Commission (EMC) and the Department of Environment and Natural Resources (DENR) to develop and implement state regulations and issue permits for the generation and disposal of residuals. These functions are carried out by DENR's Division of Water Quality (DWQ).

The Division of Water Quality's (DWQ) Residuals Management Program regulates the treatment, storage, transportation, use, and disposal of residuals as specified in 15A NCAC 02T: Waste Not Discharged to Surface Waters. Under these rules, residuals have been defined as any solid, semi solid, or liquid waste, other than effluent or residues from agricultural products and processing, generated from a wastewater treatment facility, water supply treatment facility or air pollution control facility permitted under the authority of the EMC. Rules specific to Residuals Management are located in Section .1100 of Subchapter 02T. Depending on the quality of the residuals, the generator may land apply the residuals for beneficial use or dispose of the residuals in a surface disposal unit. Residuals not meeting minimum requirements could be further processed until requirements are met, or sent to a permitted landfill or incinerator for disposal. Table 1 shows the number of permitted residuals management facilities land applying or disposing of residuals, and shows that the majority of residuals generated in North Carolina are land applied for beneficial use.

Table 1
Number of Residuals Permits by Permit Type (as of December 21, 2009)

Permit Type	Number of Permitted Facilities
Land Application for Beneficial Use	260 [a]
For Surface Disposal Only	15
Total Residuals Management Permits	275

[a] Includes Class A and B residuals as described below.

The 02T Rules for residuals management meet or exceed the Federal 40 CFR 503 standards for the use or disposal of sewage sludge. Examples of where North Carolina's program is more protective than the 40 CFR 503 requirements are 1) the establishment of additional setbacks from land application fields for increased protection of the State's water resources and of human health, and 2) establishment of site specific agronomic loading rates based on crop realistic yield expectations for improved nutrient management. For residuals generated during the treatment of wastes other than domestic sewage and therefore not covered under 40 CFR 503, the State requirements meet or exceed the Federal requirements for land application of wastes established in 40 CFR 257.

Permitting Strategy

DWQ implements a permitting strategy designed to assure that relevant information is available to concerned parties before, during, and after application of residuals to assure that the residuals are managed safely. For a typical residuals management program the following permitting strategies are used:

- The permit is most often issued to the residuals generator (usually the wastewater treatment facility owner). For situations where the wastes are managed by a residuals management service provider (e.g. Synagro), the permit may be issued to the service provider based upon the terms of a service contract between the residuals generator and the service provider.
- The permit holder maintains a signed Land Owner Agreement Form with each land owner of the permitted fields. The agreement specifies the responsibility of each party.
- The permit holder provides the land owner with information on the residuals quantity, quality, and use restrictions.
- The land owners agree to provide the permit holder with information on intended crops, and any additional nutrient sources applied or intended to be applied.
- Each permit indicates specifically which source(s) and site(s) are authorized for application. If additional sources or sites are desired, a permit modification is necessary to assure the proper handling of all residuals products.
    - For approval of new residuals sources, the modification process is meant to provide documentation that the residuals meet all quality requirements, and that there are sufficient land application fields and disposal methods available for managing the new residuals source(s).
    - For approval of new land application fields, the modification process is meant to provide documentation of field location, size, predominant soil type, applicable setbacks, watershed classification, signed land owner agreements, and notification to the County Manager of the proposed new field(s).

- DWQ conducts regional and central office reviews of all permit applications and conducts site visits to proposed fields to verify field conditions.
- DWQ works with the County Manager and County Health Departments to address local concerns with proposed land application activities.
- Permit holders are responsible to meet the requirements of their permit and to self report any violation.
- Permit holders are required to submit an annual report summarizing the past years activities and documenting that effluent quality, nutrient management, and operation and management practice requirements were met.

Permit Types

DWQ's Residuals Management Program provides requirements for the treatment, storage, transportation, use, and disposal of residuals. Typically permits are issued to facilities that treat and store residuals. The facilities use one or more methods for disposal or use of the residuals, depending on the quality of residuals they are able to produce, and the resources they have available for managing a residuals program. The following use and disposal options exist for facilities:

1. Distribution of Class A Residuals
2. Land Application of Class B Residuals to non-dedicated fields
3. Land Application of Class B Residuals to dedicated fields
4. Surface Disposal of Residuals

The quality requirements for the residuals decrease as an alternative further down the list is selected (i.e. quality requirements of Class A residuals is greater than the quality requirements for a Class B residual), and therefore the requirements to assure protection of human health and the environment increase as an alternative further down the list is selected (e.g. more site investigation and predictive modeling is required for a surface disposal unit as compared to a Class B residuals field).

The Distribution of Class A Residuals program refers to high quality residuals that are sold or given away in a bag or other small container, or may be distributed in bulk quantities to be applied over larger areas. Class A residuals are of higher quality and meet Federal and State standards which require more stringent metal limits, lower pathogen concentrations, as well as vector attraction reduction requirements. The land onto which Class A residuals are applied is deemed permitted under 15A NCAC 02T.1103. In addition to meeting the quality requirements, the permit holder has specific requirements for operation, monitoring, and reporting. Acceptors of the residuals receive information on the quality and guidelines for proper use of the residuals (e.g. nutrient content, recommended application rates). Users of bulk Class A residuals sign an agreement form that specifies requirements for proper use of the bulk residuals. The permitted residuals generator is responsible for tracking volume of residuals distributed.

The Land Application of Class B Residuals to non-dedicated fields refers to Class B residuals that are applied on agricultural crop land at agronomic rates (i.e. in the amount that will meet the nitrogen needs of the crop). The land application sites must be approved and listed on the permit prior to the utilization of the fields for residuals land application. Residuals must meet the Class B requirements for metals, pathogens, and vector attraction reduction. In addition to meeting the quality requirements, the permit holder has specific requirements for operation, monitoring, and reporting. Acceptors of the residuals sign an agreement form specifying the requirements of the generator and receiver of the residuals. The agreement includes requirements for the generator to provide the acceptor with information on the quality and proper use of the residuals, and for the acceptor to provide information on intended crop type, and additional nutrients applied to each field. The residuals generator is responsible for tracking volume of residuals applied to each field, and tracks both the nutrient loading and cumulative metals loading to each field.

Land Application of residuals to dedicated fields refers to Class A or B residuals that are applied to fields meeting specified criteria that have a greater risk of over application. To be considered a dedicated field, at least one of the following criteria must be met; 1) bulk residuals are applied to the land at greater than agronomic rates, 2) bulk residuals are applied through fixed irrigation facilities or irrigation facilities fed through a fixed supply system or 3) where the primary use of the land to which the residuals are applied, is for the disposal of bulk residuals, and agricultural crop production is of secondary importance. Since the residuals application under a dedicated program is likely more intensive and frequent than the non-dedicated program, additional requirements exist. For example, the permit application submittal for a dedicated land application site requires additional documentation (including a hydrogeologic report), and on-site monitoring wells are typically required to monitor groundwater quality.

Surface Disposal of Residuals describes a permitted site on which residuals are placed for final disposal. This does not include land on which residuals are either treated or stored. Examples of surface disposal units are monofills, lagoons or trenches. Although residuals placed in surface disposal units are exempt from meeting the Class A or Class B pathogen requirements provided that vector attraction reduction requirements are met, surface disposal units are required to meet ceiling requirements for Arsenic, Chromium and Nickel and to conduct routine monitoring and reporting at a frequency based on the metric tons of residuals applied per year. Requirements for the management of decant water, leachate, and methane gas are in place. These facilities are required to submit closure plans for the unit when use is discontinued, and maintain the permit for a minimum of three years following successful closure. On-site monitoring wells are typically required to monitor groundwater quality while they are permitted for active use and for three calendar years after their closure.

Table 2 shows the number of permitted residuals management facilities by land application or disposal method, and shows that the majority of residuals generated in North Carolina are land applied to non-dedicated fields for the beneficial use. The table also show estimates on the total dry tons permitted for use or disposal.

Table 2
Number of Residuals Permits and Dry Tons by Permit Type (as of December 21, 2009)

Permit Type	Number of Permitted Facilities
Land Application Permits	
Distribution of Class A	70
Land Application of Class B Residuals to non-dedicated fields	169
Land Application of Class B residuals to dedicated fields	21[a]
Surface Disposal permits	15
Total Residuals Management Permits	275

[a] Permit for Land Application of Class B residuals to Dedicated fields includes permits with a combination of dedicated and non-dedicated fields. Of the 21 dedicated field permits, the majority of the fields within the permits are non-dedicated.

Land Application of Class B residuals comprise the majority of the residuals generated and utilized in North Carolina. Table 3 shows the approximate number of fields permitted, acres of land permitted, acres of land utilized in 2008, and dry tons applied in 2008 to non-dedicated and dedicated fields. Figure 1 is a map showing permitted fields with known location information included in the DWQ's database. The figure includes a table with the total number of permitted fields mapped and not mapped, as well as the total acreage of permitted fields. DWQ continues to update its database with current location data for all of the permitted fields as permit applications are submitted for modification or renewal.

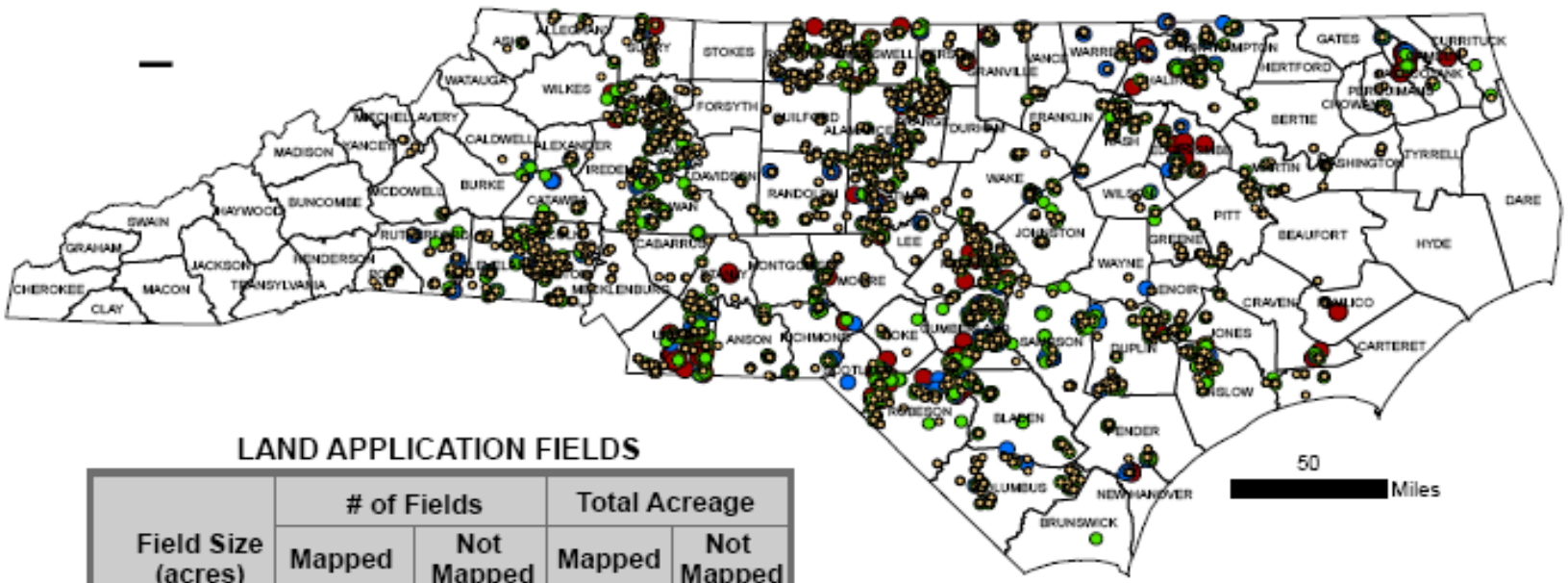
Table 3
Summary of Class B Residuals Activity

Criteria	Number
Approximate Number of permitted fields (September 2009):	5,000
Approx. acres of permitted fields (Sept. 2009):	107,000
Approx acres applied on in 2008:	27,500
Approx. dry tons applied in NC in 2008:	88,500

Figure 1

Land Application of Residuals in North Carolina

Permitted Fields



LAND APPLICATION FIELDS

Field Size (acres)	# of Fields		Total Acreage	
	Mapped	Not Mapped	Mapped	Not Mapped
0 - 20	3084	444	29260	4209
20 - 40	890	204	24373	5655
40 - 60	194	61	9212	2948
60 - 500	200	68	24523	7034
TOTAL	4368	777	87368	19846

NC DENR Division of Water Quality, Aquifer Protection Section

September 2009

Quality Requirements

The quality of the residuals is critical to assure that proper management practices are matched with the residuals to assure that they are land applied, or disposed of, in a safe manner. The quality of the residuals is dependent on the characteristics of the wastewater being treated, and the type of wastewater treatment and sludge stabilization process used. Residuals quality requirements include demonstration that the residuals are non-hazardous, metals and pathogen concentrations do not exceed a ceiling limit, micro nutrient values for nutrient management are met, and prescribed methods for pathogen and vector attraction reduction are met.

Non-hazardous Waste Determination

Residuals generated by each facility are analyzed to demonstrate that they are non-hazardous under the Resource Conservation and Recovery Act (RCRA). A corrosivity, ignitability, and reactivity analysis as well as a Toxicity Characteristics Leaching Procedure (TCLP) analysis is conducted on each residuals source. Monitoring frequencies vary according to the type and volume of residuals generated.

Metals Limits

Both ceiling concentration and cumulative pollutant loading rates have been established for metals identified by the EPA as being of significant concern in residuals. Table 4 shows the different metals limits for Class A and Class B residuals. It should be noted that since the implementation of the State's pretreatment program, the amount of metals and other pollutants associated with industrial discharges in wastewater have decreased significantly. It is rare that residuals generated at municipal wastewater treatment facilities approach the ceiling limits. Monitoring frequencies very according to the type and volume of residuals generated.

Table 4
State and Federal Residuals Metals Limits

Parameter	**Class A Monthly Average Concentration** *(mg/kg)*	**Class A and B Ceiling Concentration** *(mg/kg)*	**Class B Cumulative Pollutant Loading Rates** *(pounds per acre)*
Arsenic	41	75	36
Cadmium	39	85	34
Copper	1,500	4,300	1,338
Lead	300	840	267
Mercury	17	57	15
Molybdenum	n/a	75	n/a
Nickel	420	420	374
Selenium	100	100	89
Zinc	2,800	7,500	2,498

Pathogen Reduction Requirements
Biological Class B Residuals

Residuals that are generated as part of a biological process are more likely to contain a greater concentration of potentially harmful pathogens. Therefore pathogen reduction requirements have been established as part of the minimum quality assurance for residuals. Due to the greater likelihood of human contact with Class A residuals, the pathogen reduction requirements for Class A residuals are more stringent than for Class B residuals. For both Class A and Class B residuals, either one or a combination of maximum pathogen concentration limits and approved methods for the reduction of pathogens, are available to meet the pathogen reduction requirements. The pathogen reduction requirements are routinely met after proper digestion of the sludge. However, the ability to meet monthly average metals concentration for Class A residuals is generally the limiting factor for facilities determining if they can consistently meet Class A requirements.

The pathogen reduction requirements for Class B biological residuals are to either demonstrate that adequate pathogen concentrations are obtained or that an approved method for the reduction of pathogens is in place. State pathogen reduction requirements match Federal Requirements of 40 CFR 503. Permitted facilities must demonstrate that they can meet one of the listed pathogen requirements shown below:

- Demonstrate a concentration of Fecal Coliforms < 2,000,000 Most Probable Number per gram of total solids;
- Demonstrate a concentration of Fecal Coliforms < 2,000,000 Colony Forming Units per gram of total solids;
- Aerobic digestion of the residuals;
- Air drying of the residuals;
- Anaerobic digestion of the residuals;
- Composting of the residuals; or
- Lime Stabilization of the residuals.

Pathogen Reduction Requirements
Biological Class A Residuals

The pathogen reduction for Class A biological residuals is to both demonstrate that adequate pathogen concentrations are obtained, and demonstrate that an approved method for the reduction of pathogens is in place. The alternatives allowed by North Carolina Administrative Code match alternatives allowed under 40 CFR 503 for pathogen reduction.

Permitted facilities generating Class A biological residuals must demonstrate that they can meet one of the pathogen concentration requirements listed below:

- Fecal Coliform < 1,000 Most Probable Number per gram of total solids; or
- Salmonella < 3 Most Probable Number per four grams of total solids.

In addition, permitted facilities generating Class A biological residuals must demonstrate that they have a process capable of reducing pathogens. North Carolina Administrative Code and Federal Requirements provide the available alternatives for demonstrating that an adequate process is in place. The available alternatives include specific unit processes and treatment conditions capable of meeting pathogen reduction requirements, as well as providing residuals sampling alternatives for other pathogen indicator organisms that demonstrate that adequate processes are in place. The available alternative processes and requirements to demonstrate the process is adequate to reduce pathogens are specified by 15A NCAC 02T .1106(b). Permitted facilities generating Class A biological residuals must demonstrate that there is a process in place that meets one of the following:

- Maintain the residuals at a minimum temperature for a specified period of time;
- Maintain the residuals at a pH of 12 and at a minimum temperature for a specified amount of time;
- Demonstrate concentration of enteric viruses < 1 plaque forming unit per 4 grams residuals;
- Demonstrate concentration of Helminth ova < 1 per 4 grams total solids;
- Composting of the residuals;
- Heat Drying of the residuals;
- Heat treatment of the residuals;
- Thermophilic Aerobic Digestion of the residuals;
- Beta Ray Irradiation of the residuals;
- Gamma Ray Irradiation of the residuals; or
- Pasteurization of the residuals.

Vector Attraction Reduction Requirements

Residuals that are generated as part of a biological process are more likely to contain a greater concentration of potentially harmful pathogens, as well have characteristics that attract rodents, flies, mosquitoes or other organisms capable of transporting pathogens. Vector Attraction Reduction requirements establish necessary steps to stabilize the residuals to avoid characteristics in the residuals that attract pests. The alternatives allowed by North Carolina Administrative Code match alternatives allowed under 40 CFR 503 for vector attraction reduction. Permitted facilities generating either Class A or Class B biological residuals must demonstrate that they can meet one of the vector attraction reduction alternatives listed below:

- Demonstrate the residual have been stabilized by determining volatile solids reduction of the residuals between the time that the biological residuals enter the digestion process and the time it is land applied;
- Demonstrate the residuals have been stabilized by determining potential volatile solids reduction through complete digestion in a laboratory;
- Demonstrate the residuals have been stabilized by determining the specific oxygen uptake rate during further digestion;
- Maintain the residuals at a specified temperature and in aerobic conditions for a minimum amount of time;
- Maintain the residuals at a minimum pH for a specified amount of time;
- Dry the residuals to a specified value;
- Inject residuals below the surface of the land; or
- Incorporate the residuals into the soil.

Nutrient Management

Nutrient management is another factor in proper disposal and use of residuals. Requirements are in place to assure that disposal or use of residuals does not result in the contravention of groundwater standards or in the limitation of crop growth due to over application of nutrients.

When residuals are disposed of or applied to dedicated fields at greater than agronomic rates a hydro-geologic investigation including predictive modeling to demonstrate that groundwater standards will be protected is required. In addition, monitoring wells are often required to track groundwater quality.

When residuals are applied to non-dedicated fields, residuals must be applied at agronomic rates. In North Carolina, agronomic rates are based on realistic yield expectations (RYE) for crops matched to local soil classification. Recommended application rates for nitrogen and phosphorus based on RYE are available through a joint effort of the NC State University, the Natural Resource Conservation Service, the North Carolina Department of Agriculture and Consumer Services, and the North Carolina Division of Soil and Water Conservation. NC State manages a website for convenient access to recommended loading rates. A printout of the website is included as Attachment A (see pages 17 and 18).

In addition to not exceeding recommended rates based on RYE, an annual soils analysis (i.e., Standard Soil Fertility Analysis) is conducted on each land application site to receive residuals that year. The soils analysis allows the residuals generator, the land owner, and DWQ, to track soil pH and certain metal indices to further assure that soil conditions allow for crop growth. Table 5 shows the parameters sampled in as part of The Standard Soil Fertility Analysis.

Table 5
The Standard Soil Fertility Analysis

Acidity	Exchangeable Sodium Percentage	
Calcium	Magnesium	Phosphorus
Cation Exchange Capacity	Manganese	Potassium
Copper	Percent Humic Matter	Sodium
Base Saturation	pH	Zinc

Operational and Management Practices

Operational and management practice requirements are in place to specify under what conditions residuals can be land applied, and establish time frames for restricted use of fields after residuals are land applied. Specifically, these practices outline what information is required to be shared between the residuals generator and the person accepting the residuals for use, under what field conditions residuals may be applied, what types of public access control need to be maintained, what type of use restriction exists after the residuals are applied, and what steps must be taken for proper closure of surface disposal units.

Class A residuals that are distributed in bags or other small containers are highly treated and pose little threat for over-application, and therefore have minimal use restrictions. The characteristics of Class A residuals are often similar to other fertilizers and soil amendments available for retail, and the residuals are often marketed as such. A label or information sheet is required to be affixed to each bag or container specifying 1) the name and address of the preparer of the residuals, 2) a statement that the residuals shall be applied according to the instruction on the label; 3) the residuals shall be applied at agronomic rates, and 4) nutrient information including recommended application rates.

Land receiving either Class A or Class B bulk residuals have a greater likelihood of over application, run-off, or causing environmental concern or a human nuisance condition than Class A residuals distributed in bags or small containers. Required operation and management practices to address concerns with potential environmental impact and nuisance concerns include the following.

- Application cannot cause prolonged nuisance conditions.
- The land must assimilate the bulk residuals and the application must not cause the contravention of surface water or groundwater standards.
- Application cannot occur if the land is flooded, frozen, or snow-covered or is otherwise in a condition such that runoff of the residuals would occur.
- Application cannot occur within the 100-year flood elevation unless the bulk residuals are injected or incorporated within a 24-hour period following the residuals land application event.
- Application cannot occur during precipitation events or within 24 hours following a rainfall event of 0.5 inches or greater in a 24-hour period.
- Application cannot occur if the slope of the land is greater than 10 percent when bulk liquid residuals are surface applied, and if the slope of the land is greater than 18 percent when bulk liquid residuals are injected or incorporated.
- Application cannot occur if the land does not have an established vegetative cover crop unless the bulk residuals are injected or incorporated within a 24-hour period following the residuals land application event.
- Application cannot occur on fields where the vertical separation of the seasonal high water table and the depth of residuals application is less than one foot.
- Application cannot occur on fields where the vertical separation of the depth to bedrock and the depth of residuals application is less than one foot.
- Application cannot exceed agronomic rates except for permitted dedicated sites where the applicant has specifically requested higher rates as allowed by Rule.

Land receiving Class B bulk residuals have a greater likelihood of having pathogen concentrations greater than those found on fields receiving Class A residuals. Required operation and management practices to address concerns with potential human contact to fields with higher concentration of pathogen are listed below. Public contact sites are defined by 40 CFR 503 and refer to land with a high potential for public contact (e.g. public parks, ball fields, plant nurseries, turf farms, golf courses).

- Public access to public contact sites shall be restricted for one calendar year after any residuals land application event.
- Public access to land that is not a public contact site shall be restricted for 30 days after any residuals land application event.
- Public access to land associated with a dedicated land application site shall be restricted continuously while the land is permitted.

Land receiving Class B residuals also have a greater likelihood of having impacts to grazing animals, and humans consuming crops grown on the land. Operation and management practices addressing concerns with animal grazing and food chain crops are as follows:

- Animals are not allowed to graze on land for 30 days after any residuals land application event.
- Food crops, feed crops, and fiber crops shall not be harvested for 30 calendar days after any residuals land application event.
- Food crops with harvested parts that touch the residuals/soil mixture and are totally above the land surface shall not be harvested for 14 months after any residuals land application event.
- Food crops with harvested parts below the surface of the land shall not be harvested for 20 months after any residuals land application event when the residuals remain on the land surface for four months or longer prior to incorporation into the soil.
- Food crops with harvested parts below the surface of the land shall not be harvested for 38 months after any residuals land application event when the residuals remain on the land surface for less than four months prior to incorporation into the soil.
- Turf grown on land where residuals are applied shall not be harvested for one calendar year after any residuals land application event.

Proper residuals application to the land also includes maintaining adequate setbacks to protect water resources, and human health. The Federal 40 CFR 503 establishes a single setback for Class B residuals fields of 10 meters (i.e. approximately 32.8 feet) to waters of the United States. The North Carolina requirements for setbacks to surface waters are more stringent than the Federal setback. State Administrative Code has established additional setback requirements that vary according to type of residuals, the method of application used, and the form of the residuals. Land application area boundaries are required to be clearly marked on each land application site prior to and during a bulk residuals land application event.

Table 6 shows the setback requirements for Class B residuals fields. Setbacks for Class B residuals vary by application type. Application types with lower risk of the residuals not applied to or staying within the intended area have increased setback requirements.

Table 6
Setback Requirements for Fields Receiving Class B Residuals

Description of Setback	Setback by Type of Application (feet)		
	Surface Application by Vehicle	Surface Application by Irrigation	Injection / Incorporation
Habitable residence or place of public assembly under separate ownership or not to be maintained as part of the project site	400	400	200
Habitable residence or places of public assembly owned by the permit holder, the owner of the land, or the lessee/operator of the land to be maintained as part of the project site	0	200	0
Property lines	50	150	50
Public right of way	50	50	50
Private or public water supply	100	100	100
Surface Waters (streams – intermittent and perennial, perennial water bodies, and wetlands)	100	100	50
Surface water diversions (ephemeral streams, waterways, ditches)	25	100	25
Groundwater lowering ditches (where the bottom of the ditch intersects the SHWT)	25	100	25
Subsurface groundwater lowering system	0	100	0
Wells with exception to monitoring wells	100	100	100
Bedrock outcrops	25	25	25
Top of slope of embankments or cuts of two feet or more in vertical height	15	15	15
Building foundations or basements	0	15	0
Waterlines	0	10	0
Swimming pools	100	100	100
Nitrification fields	0	20	0

Table 7 shows the setback requirements for Class A residuals fields. Setbacks for Class A residuals vary with the form the residuals are in. Class A residuals applied in cake form have a lower chance of runoff and therefore have reduced setbacks in comparison to liquid residuals.

Table 7
Setback Requirements for Fields Receiving Class A Residuals

Description of Setback	Setback by type of residual (feet)	
	Liquid	Cake
Any private or public water supply source:	100	100
Surface waters:	100	25
Surface water diversions:	25	0
Groundwater lowering ditches:	25	0
Any well with exception of monitoring wells:	100	100
Bedrock outcrops:	25	0

Operation Certification

Facilities permitted for the land application of residuals are classified by the Certification Commission as land application systems and is required to designate one Operator in Responsible Charge (ORC) and one or more Backup ORCs who possesses valid land application of residuals operator certifications.

Certification for Land Application of Residuals System Operators requires the completion of an approved training school, passing a certification examination, and maintaining continuing education credits. The responsibilities of an ORC include visiting the facility regularly to insure proper operation, operating and maintaining the facility to remain in compliance with the permit, certifying, by signature, all of the monitoring and reporting information performed on the system as required by the permit, maintaining a daily log including maintenance, visitations and operation, notifying the owner of violations to the permit conditions, and being available to the permittee or regulatory officials for questions and handling emergency situations.

Reporting

The residuals program is a self reporting program that requires Permit holders to contact DWQ when permit violations occur. In addition, the permittee is required to submit to the Division an annual report summarizing the past years activities. The report must be submitted to the Division by March 1st of the following year and include the following information:

- A summary of all land application events for previous year.
- Quantity of residuals distributed or applied to each permitted field.
- Quality of residuals distributed or applied (e.g. metals and nutrient concentrations).
- Track metal loadings applied to permitted fields to demonstrate that ceiling and cumulative loading rates are not exceeded.
- Demonstration that agronomic rates were not exceeded for each permitted field.
- An annual soils analysis for each site receiving residuals.
- Demonstration of compliance with Pathogen and Vector Attraction Reduction requirements.
- Documentation of any permit condition violation.

Inspection and Enforcement

DWQ Regional office leads in the compliance and enforcement oversight of local residual programs. The regional office conducts regular site inspections, and evaluates each new site or field that has been requested to be permitted. Enforcement actions are initiated in the regional offices while the enforcement cases are compiled in the central office and brought before the division director for a final decision.

Interaction with the Public and other Environmental Agencies

Residuals are the unavoidable by-products of the disinfection process of water and wastewater. Managing these by-products in a manner that is protective of human health and the environment is one of the biggest challenges associated with the ongoing operation and maintenance of wastewater and water treatment facilities.

One of the most important steps in making an effective residuals program is the interaction with the public and other environmental agencies. DWQ Regional offices respond to public complaints or incidents that are linked to the residuals programs and are prepared to require corrective action. On many occasions this action involves the education of the public about the residuals program. DWQ also recognizes that County interaction with the program is a key component. County Health Departments are among the first authorities to be contacted when someone is seeking answers regarding residuals land application activities. In order to keep the County Health Departments informed and updated on current residuals programs in their counties, the Division requires the permittee to notify each County Manager in the county where the land application will take place of the permittee's intent to have fields permitted. This process is completed through a DWQ standardized form. This form invites the county manager to comment on the permit application that is expected to be submitted to the Division. If the sites are permitted by DWQ, the County Health department is sent a copy of the signed permit along with attachments indicating approved sources and locations of permitted fields that are located in their counties.

Realistic Yield Expectations for North Carolina Soils

The following tables are the result of extensive data gathering and review process conducted by NC State University, the Natural Resource Conservation Service, the North Carolina Department of Agriculture and Consumer Services, and the North Carolina Division of Soil and Water Conservation. In 1999, county-based representatives of each of the above-named organizations were asked to collect yield data and make a reasoned judgment of the yields for various crops on each of the soils occurring in their county. These data were collected from 87 responses, representing 93 counties. The data were then compared with available research data and intensively reviewed by a panel of field agronomists, soil scientists and researchers familiar with the soils, crops and climatic conditions in each region. In reviewing the data, the following assumptions were made:

1. Realistic Yield Expectations should be based on the average of the best 3 years in a 5 year period which could be achieved with a high level of management (top 20% of growers)
2. For soils that may be mapped in multiple regions or in slightly different landscapes (for example, flood plains or stream terraces), the Realistic Yields are based on the most common prevailing conditions for that soil rather than the most ideal site for agricultural production.
3. For soils that are Somewhat Poorly, Poorly, or Very Poorly Drained, effective artificial drainage MUST be in place to achieve the yields shown in the RYE tables.
4. For tobacco production in the Piedmont physiographic, irrigation was assumed to be available, whereas no irrigation was assumed in the Coastal Plain physiographic region. This is in accordance with numerous surveys which show less than 15%-20% of tobacco in the Coastal Plain is irrigated, while 70 to 80% of tobacco in the Piedmont receives some irrigation

Citation: North Carolina Nutrient Management Workgroup. 2003. Realistic yields and nitrogen application factors for North Carolina crops. http://nutrients.soil.ncsu.edu/yields/ North Carolina State University, North Carolina Department of Agriculture and Consumer Services, North Carolina Department of Environment and Natural Resources, Natural Resources Conservation Service. Raleigh NC.

To access the database, select a county and at least one crop. Multiple crops may be selected by holding the Ctrl key when selecting crops. A report will be generated showing a summary of currently available data for the county you selected.

Select Your County

Select Your Soil

AaB: Alamance silt loam, 2 to 6 percent slopes (Callison)
AbB: Appling coarse sandy loam, 2 to 6 percent slopes
AbB2: Appling coarse sandy loam, 2 to 6 percent slopes, eroded

Correct for Slope

Use Representative Slope Typical of the Soil Map unit

Use my slope 0

Submit Reset

Realistic Yields for AbB: Appling coarse sandy loam, 2 to 6 percent slopes *in Alamance County*

Crop	Yield	Nitrogen Factor	Realistic Nitrogen Rate (lbs/acre)	Estimated Phosphorus Removal (lbs P_2O_5/acre)
Barley (Grain)	86 Bushels	1.49	128	33
Corn (Grain)	132 Bushels	1.11	147	58
Corn (Silage)	24.5 Tons	10.9	267	83
Cotton	760 Pounds	0.081	62	22
Sorghum (Silage)	20.8 Tons	7.6	158	62
Oats (Grain)	108 Bushels	1.13	122	27
Rye (Grain)	64 Bushels	2.01	128	21
Small Grain (Silage)	11.3 Tons	11.1	125	61
Sorghum (Grain)	64 CWT	1.72	110	48
Soybeans (Double Cropped)	45 Bushels	0	0	36
Soybeans (Full Season)	54 Bushels	0	0	43
Soybeans (Double Cropped - Manured)	45 Bushels	3.89	175	36
Soybeans (Full Season - Manured)	54 Bushels	3.89	210	43
Tobacco (Burley)	0 Pounds	0.074	0	0
Tobacco (Flue Cured)	3234 Pounds	0.029	94	16
Triticale (Grain)	89 Bushels	1.52	136	30
Tropical Corn (Silage)	24.5 Tons	6.5	159	83
Wheat (Grain)	64 Bushels	2.01	128	32
Bahiagrass (Hay)	3.9 Tons	44	172	45
Caucasion/Old World Bluestem (Hay)	4.4 Tons	44	194	52
Common Bermudagrass (Hay)	3.9 Tons	44	172	47
Dallisgrass (Hay)	3.9 Tons	44	172	51
Fescue (Hay)	5.4 Tons	44	237	85
Hybrid Bermudagrass (Hay)	5.4 Tons	44	237	66
Hybrid Bermudagrass overseeded with Rescuegrass (Hay)	0 Tons	44	0	0
Mixed Cool Season Grass (Hay)	3.9 Tons	44	172	56
Orchardgrass (Hay)	4.4 Tons	44	194	64
Pearl Millet (Hay)	4.7 Tons	49	228	62
Rescuegrass (Hay)	0 Tons	44	0	0
Sorghum Sudan (Hay)	5.1 Tons	49	252	72
Timothy Grass (Hay)	0 Tons	44	0	0