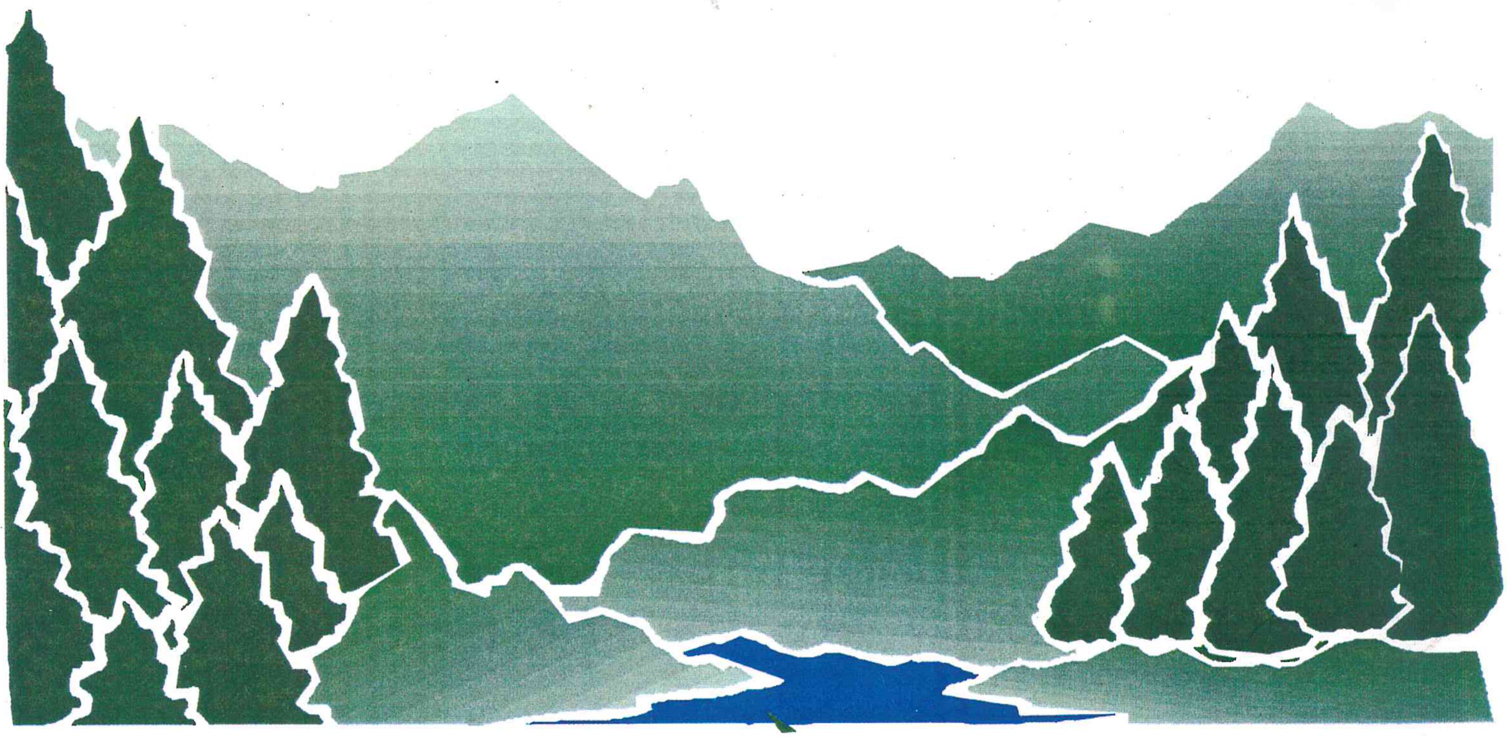
NEW JERSEY
ENVIRONMENTAL INDICATORS TECHNICAL REPORT
2ND EDITION

National Environmental Performance Partnership System (NEPPS)



NJ Department of Environmental Protection

2001

POLLUTION AND RELEASE PREVENTION

Introduction

Pollution can be generated from virtually any sector of society including agriculture, consumers, energy production, government, industry, and transportation. In order to prevent pollution, it is first necessary to identify the sources of pollution. Once the sources have been identified, steps may be taken to reduce or eliminate the pollution. Chemical pollution can result from direct use and subsequent release of the substance to the environment or can occur when two or more substances react to form a new substance (e.g., when NOx reacts with VOCs to form ozone (O_3)).

Chemical releases are often multi-media in nature and may result as a direct discharge to air and water or as an off-site transfer to a landfill. For example, ammonia can be released to air through evaporation when it is used to clean the floor. Water releases occur when the solution is poured down the drain or on the ground. Off-site transfers occur when the ammonia bottle, containing residual material, is tossed in the garbage for landfill disposal. If the consumer adds chlorine bleach to the ammonia the resulting chemical reaction releases an extremely hazardous substance known as chloramine gas.

At the industrial level, pollution (and subsequent releases) may result from direct use of a hazardous substance in a manufacturing process or as a product or byproduct of the process. When hazardous substances are used in a production process they will either end up in the product (e.g., as a bottle of ammonia), be chemically consumed in a reaction, or become production-related waste. Although the product may contain the hazardous substance, it is not considered pollution, at least not at this point, since it is the desired end result of the production process. The hazardous substances which are consumed in the production no longer exist and, therefore, are no longer a hazard. Pollution then stems from production-related waste. Some of the production related waste may be released directly, or may be recycled either on-site, as a raw material, or sent off-site for recycling/use by another facility (e.g. scrap metal re-smelted to form a new alloy). Much of the waste is treated in some fashion so the total amount released to the environment is considerably less than what is produced. Some material may be sent to an on-site treatment device, as in the case of VOCs sent to a wet scrubber, before being released to the air or water. Other material may be disposed of in a landfill, either on- or off-site.

Numerous federal and state regulations require facilities to install treatment and control devices in order to reduce the amount of waste released to the environment. In general, the strategy of waste minimization and waste prevention has received less attention in the past. Often control devices are designed to reduce direct emissions; however cross-media shifts can occur when contaminants are transferred to other environmental media. For example, when a wet scrubber is used as a control device to reduce direct VOC air emissions, the VOCs are transferred from air to water. The resulting wastewater may be discharged directly to ground or surface water or sent off site for treatment by a publicly owned treatment works (POTW). In spite of the control device, the contaminants may ultimately wind up as an air emission if they evaporate from the wastewater stream. To be most effective, pollution prevention efforts must be founded on sound information about the use and end result of the substances that become, or lead to the generation of pollution. Multi-media materials accounting data, which quantitatively track the flow of material through a facility, provide the facility with the necessary information to identify and quantify sources of pollution, and also provides release information required by regulatory agencies.

The federal Pollution Prevention Act of 1990 sets a national policy and hierarchy for controlling pollution stating that pollution prevention (source reduction) will be at the top of the hierarchy, followed by recycling, treatment and then disposal. The Act also directed EPA to collect source reduction data. In 1987 EPA began tracking, nationally, multi-media releases of approximately 320 chemicals and 20 chemical categories through the federal Toxic Chemical Release Inventory (TRI) program. TRI originally collected information on facility level releases, however it did not account for all sources of waste, including recycling and energy recovery nor did it account for source reduction or total facility use of these substances. In 1991, EPA began to collect quantitative information on energy recovery and recycling. In 1998, EPA expanded the scope of TRI, however, it does not yet require full materials accounting for covered TRI facilities. Since facilities do not report data on total use of hazardous substances, TRI data are not an adequate measure of source reduction/pollution prevention. Pollution Prevention Planning is also not required on the national level.

The New Jersey Worker and Community Right-to-Know Act established a regulatory process for collecting materials accounting data on the flow of toxic materials though individual manufacturing facilities. Any New Jersey facility that is required to complete one or more federal “Form Rs” is also required to submit to NJDEP an annual Release and Pollution Prevention Report (RPPR) containing facility level information on throughput (i.e. chemical use), non-product output (total production-related waste), releases to the environment, and transfers to off-site waste management facilities for all TRI substances exceeding the reporting threshold. This information provides useful insight into toxic pollution produced by industrial facilities and provides a basis for measuring progress in pollution prevention by these facilities. This unique data can be used for a variety of environmental performance measures including pollution prevention trends, identification of unpermitted releases, and identification of cross-media transfers.

Pursuant to the New Jersey Pollution Prevention Act of 1991, any manufacturing facility in a regulated SIC code that is required to submit an RPPR is also required to perform Pollution Prevention Planning if the facility manufactures, processes or otherwise uses 10,000 pounds or more of a hazardous substance listed on the federal TRI list. Facilities in SIC codes 26, 28, 30, 33, and 34 (the "Big Five") were required to prepare five year Pollution Prevention Plans, based on 1993 data, and submit summaries of those plans to NJDEP by July 1, 1994. The “Big 5” account for approximately 85% of all nonproduct output (NPO) generated in New Jersey. The indicators on the following pages represent various pollution or release prevention measures that New Jersey considers important for use in its results-based management system.

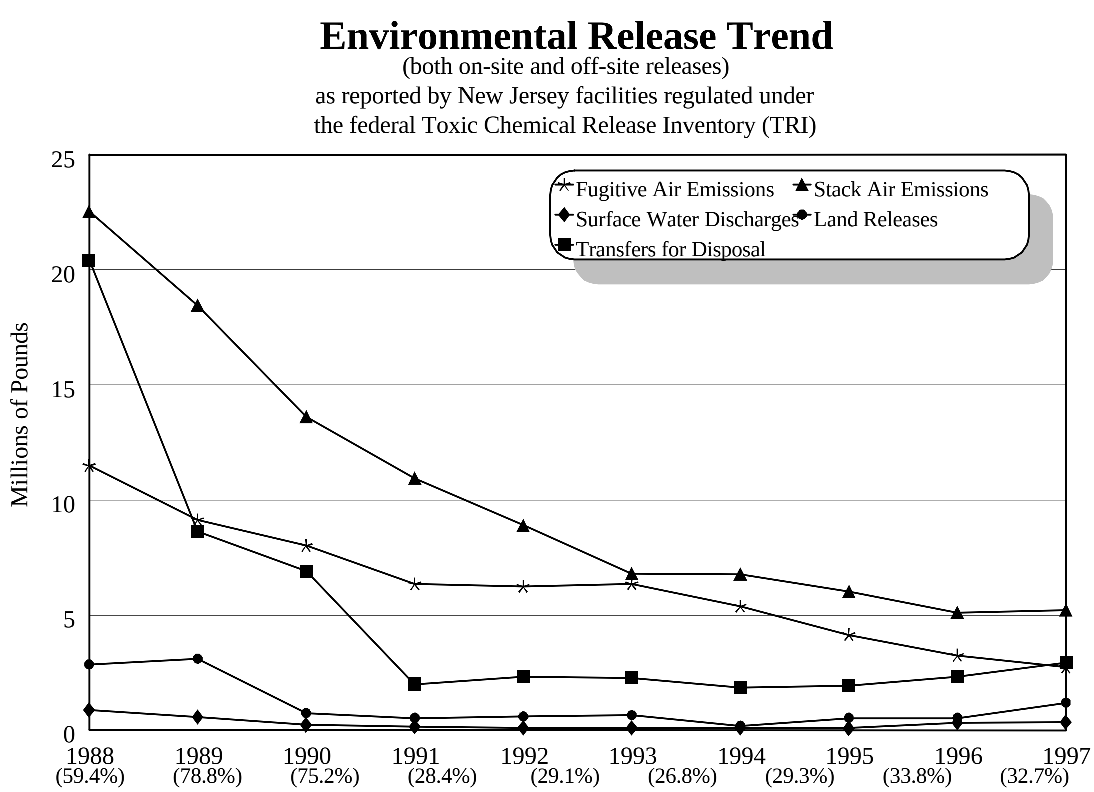
Milestone: By 2005, through pollution prevention techniques, industrial facilities will reduce the quantity of toxic chemicals generated as nonproduct output (production-related waste) by 50% from 1993 levels.

Indicator: Changes in Releases and Transfers of Hazardous Substances on A Statewide Basis. (CPM)

Type of Indicator: Cause

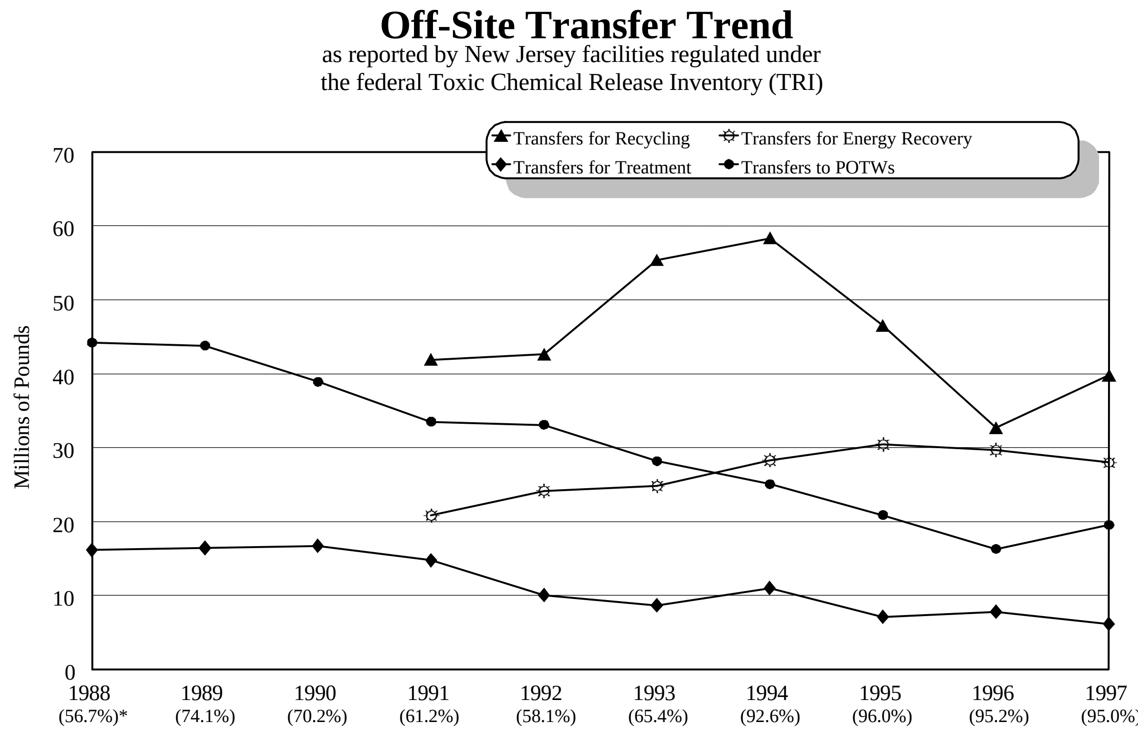
Nonproduct output (NPO) is a measure, in pounds, of hazardous (or toxic) substances that are generated as waste prior to any sort of treatment or control at industrial facilities. By measuring NPO quantities before treatment, it is possible to determine whether reductions are due to pollution prevention (i.e., making production processes more efficient) or to the installation of more effective or stringent treatment or control devices. Several measures are available to assess progress toward this milestone, including environmental release data and on-site and off-site waste management data provided on both the federal Form R and state Release and Pollution Prevention Report.

Figure 1



TRI Trend Data are for "Core" Chemicals as reported by NJ facilities on the USEPA Form R; Core Chemicals are the chemicals and categories that were reportable in all years - there are 310 substances listed as "core" chemicals (all quantities in millions of
*The percent value below each year indicates the amount that the core chemicals represent relative to the total reported quantity for the

Figure 2



TRI Trend Data are for "Core" Chemicals as reported by NJ facilities on the USEPA Form R; Core Chemicals are the chemicals and chemical categories that were reportable in all years - there are 310 substances listed as "core" chemicals (all quantities in millions of pounds).
*The percent value below each year indicates the amount that the core chemicals represent relative to the total reported quantity for the year.

Data Description

New Jersey facilities that are required to complete one or more Toxic Chemical Release Inventory (TRI) Reporting Forms (Form R) pursuant to Section 313 of the federal Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) are also subject to the New Jersey Release and Pollution Prevention Report (RPPR or DEQ-114) requirements. These facilities are required to submit additional information on the RPPR for every TRI toxic chemical reported on the Form R. Through reporting year 1997, owners and operators of facilities that met all three of the following criteria had to file the federal Form R and the NJ RPPR:

- the facility's business activity was included in the manufacturing Standard Industrial Classification codes major groups 20 through 39; <u>and</u>

- the facility had 10 or more full-time employees (or the equivalent; that is, the facility's payroll included 20,000 or more work-hours for the reporting year); <u>and</u>

- the facility manufactured (defined to include imported) or processed any listed toxic chemical in quantities equal to or greater than 25,000 pounds or otherwise used any listed chemical in quantities equal to or greater than 10,000 pounds.

Data are collected for approximately 500-550 facilities (1997 data) subject to EPCRA Section 313 in New Jersey. Facilities that are subject to submitting Form R are required to report on the New Jersey Release and Pollution Prevention Report all EPCRA Section 313 toxic chemicals that are manufactured, processed or otherwise used in excess of 10,000 pounds pursuant to the New Jersey Pollution Prevention Act. This means that a regulated employer must report all Form R chemicals reported at the federal thresholds stated previously plus any listed chemical manufactured or processed in excess of 10,000 pounds but less than the federal 25,000 pounds threshold. The data are annual, aggregated, facility-wide quantities that are to be reported by July 1 of the year following the reporting year.

Data Characteristics

Regulated employers are required to report annual chemical throughput information to the DEP. Chemical throughput includes data on chemical use, environmental releases at the reporting facility, on-site waste management activities, and off-site transfers of non-product output. The throughput data are evaluated as chemical inputs and outputs. The input component includes: the starting inventory of the toxic chemical for the year; the quantity produced on site; and the quantity brought on site. The output component includes: the quantity consumed (chemically reacted in process) on site; the quantity shipped off site as (or in) product; the quantity destroyed through on-site treatment; the quantity destroyed through on-site energy recovery; the ending inventory; and all on-site environmental releases and off-site transfers for further management. Facility owners and operators are not required to monitor or measure any data element to an extent greater than is required by federal or state regulations, permits, conditions, etc. of approved operations. The data used for analysis were restricted to those toxic substances that were reportable in all years, so that the data set represents a consistent, "core" set of chemicals.

Much of the NPO generated at industrial facilities is managed or processed in some way to remove these toxic substances, so the actual quantity of toxic substances released into the environment is considerably smaller (see Figures 1 and 2). The overall quantity of total releases and transfers of the core chemicals has shown a downward decline. A closer look at the categories of releases and transfers shows that some types of releases, including fugitive air, stack air and transfers to Publicly Owned Treatment Works (POTWs) have declined (see Figures 1 and 2). Other categories of releases, including transfers for disposal, land releases, transfers for energy recovery, and transfers for recycling, have shown upward trends in recent years. There are a variety of possible reasons for changes in particular categories including, but not limited to:

- reductions in the use of toxic substances and the subsequent generation of toxic NPO; when a facility does not exceed a threshold for a chemical in a reporting year, it does not have to report any activities relevant to that chemical;

- the elimination of a process or the closure of a facility that used a reportable chemical;
- reporting by newly regulated facilities or of newly reportable chemicals at facilities that have been reporting in previous years;
- more stringent regulations in a particular media program, cross-media shifts (where pollutants are moved from one media to another by treatment or control activities);
- a change or clarification in the federal reporting requirements relevant to the reporting of releases or transfers to any media or waste management activity; and,
- changes in economic and /or production activities. It is likely that pollution prevention has played a significant role in this decline, especially considering that total statewide use (or throughput) has continued to increase in recent years. It is also likely that increases in economic production in New Jersey since 1995 have resulted in increases in the amount of NPO generated and in similar increases in quantities of environmental releases and off-site transfers.

Data Strengths and Limitations

These data are limited to covered chemicals as reported by covered industrial facilities, and thus do not include many parameters and sources important to the overall environmental quality in New Jersey. Additionally, the data are limited to the core chemicals only, i.e. those that were reportable in every year since 1998. Also, TRI and RPPR data are self-reported by the regulated facilities. New Jersey RPPR data are based on materials accounting, a method of comparing the inputs and outputs of a toxic substance to determine how much of the substance ended up in the product, was chemically consumed or became nonproduct output ("waste"). NJDEP staff annually review the data submitted for consistency, and, in the case of RPPR throughput data, perform mass balance calculations to assess the extent to which reported outputs correspond to reported inputs. However, unlike some regulatory programs, NJDEP does not routinely check actual facility measurements to verify their accuracy. Because inputs and outputs should balance (given some margin of error), materials accounting data provide a more comprehensive view of the chemical life cycle at a facility than the federal "release" data that are collected at the national level as part of TRI.

Discussion

The direct releases to the environment and the quantities of NPO reported as transferred off site under the TRI and RPPR reporting requirements have shown marked declines since 1988. Year-to-year comparisons of the on-site releases and off-site transfers are based on a consistent set of chemicals that have been reported for all years. The "core" chemicals are those that were reportable in every year of the federal TRI program. This normalization process produces quantities that will differ from those generated by analyses of any one year's full data set. As a point of reference, Figures 1 and 2 present the percent value that the core chemicals represent of the total quantity reported in each year (see the value in parentheses below each year on the X axis). Remember that the reporting requirements have changed over the years including increasing stringent manufacture and process thresholds from 1987 to 1989, additions and deletions of chemicals to the list of reportable substances, and clarifications to the reporting requirements. Yet, the observations indicate that the trends are in the right direction.

In addition to measuring trends in chemical use, releases, off-site transfers and total NPO, it is necessary to determine whether these trends are impacted by changes in economic activity. Several indicators presented in the remainder of this section will describe the potential impacts of such factors.

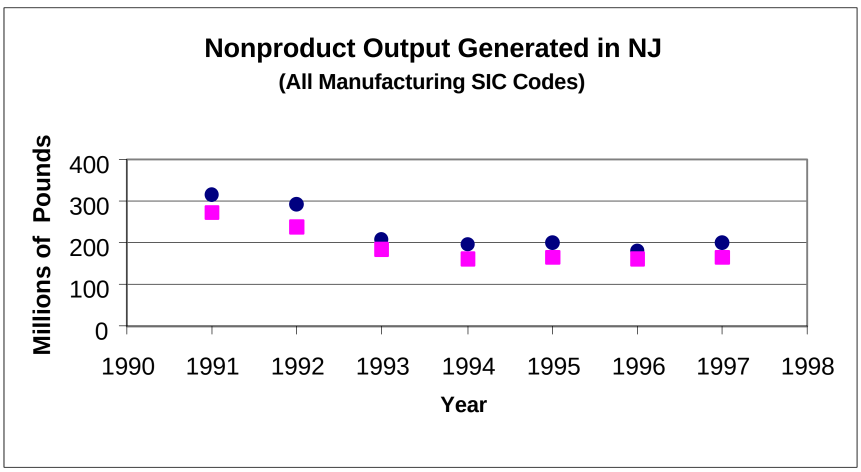
Milestone: By 2005, through pollution prevention techniques, industrial facilities will reduce the quantity of toxic chemicals generated as nonproduct output (production-related) waste by 50% from 1993 levels.

Indicator: Changes in Throughput/Chemical Use and Nonproduct Output on A Statewide Basis (CPM)

Type of Indicator: Cause

The quantity of nonproduct output (NPO) generated by New Jersey manufacturing facilities has shown a downward trend from 1991 to 1993, although the rate of decline has flattened since 1994 (see Figure 3). This trend is consistent with data reported for the overall quantity of total releases and transfers, reported in the previous indicator, which shows a similar decline over the same time period. It is likely that pollution prevention has played a significant role in this decline, especially considering that total statewide use (or throughput) has shown a slight increase in recent years (see Figures 4 and 5).

Figure 3



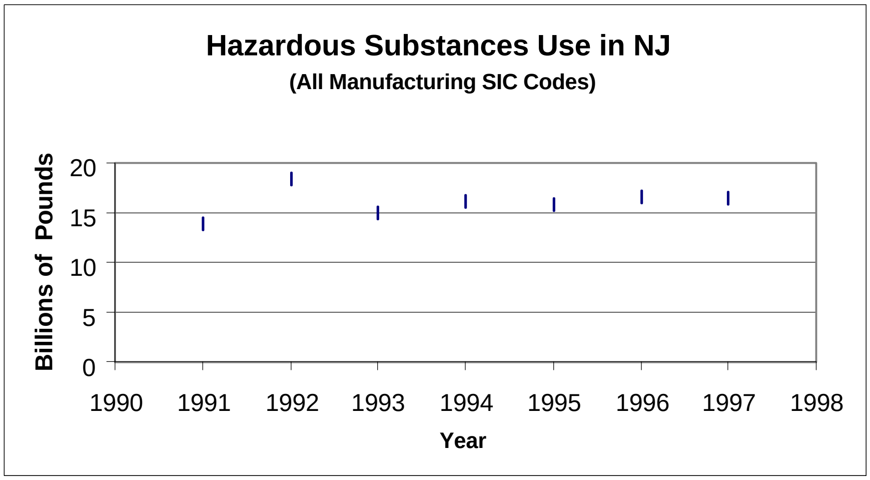
○ **All SIC codes / manufacturers in NJ**

□ **Big 5 SIC codes**

Data are for manufacturing facilities subject to Release and Pollution Prevention Reporting in NJ and represent the "core chemicals" (those hazardous substances that were reported every year over the time period analyzed).

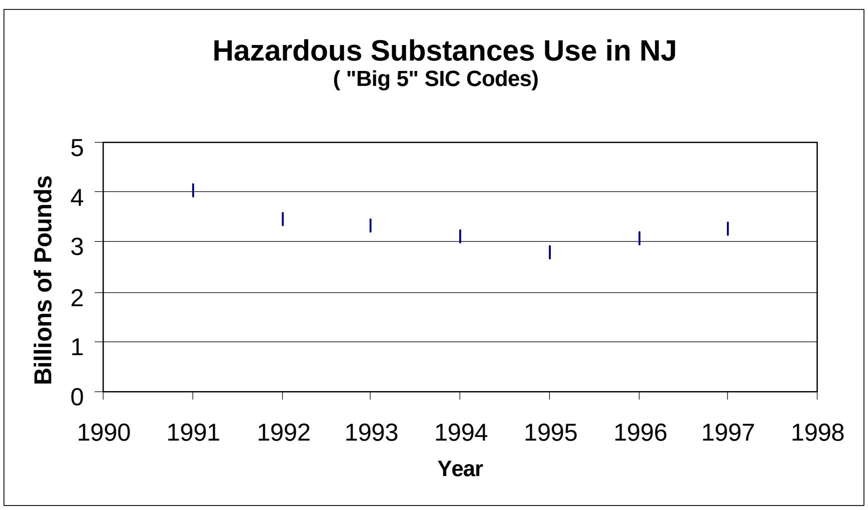
The "Big 5" refers to SIC codes 26, 28, 30, 33 & 34. This portion of the manufacturing sector generates 85% of statewide NPO in NJ.

Figure 4



Data are for all manufacturing facilities subject to Release and Pollution Prevention Reporting in NJ and represent the "core chemicals" (those hazardous substances that were reported every year over the time period analyzed).

Figure 5



Data are for the "Big 5" manufacturing facilities subject to Release and Pollution Prevention Reporting in NJ and represent the "core chemicals" (those hazardous substances that were reported every year over the time period analyzed).

The "Big 5" refers to SIC codes 26, 28, 30, 33 & 34. This portion of the manufacturing sector generates 85% of statewide NPO in NJ.

Data Description

These data are collected for approximately 600 facilities subject to Pollution Prevention Planning in New Jersey, which includes manufacturing facilities in Standard Industrial Classification codes 20-39 who use 10,000 pounds or more of any hazardous substance on the federal Toxic Chemical Release Inventory. The "Big 5" category of facilities refers to those covered facilities in SIC codes 26 (paper products), 28 (chemical and allied products), 30 (rubber and miscellaneous plastics), 33 (primary metals) and 34 (fabricated metals) who began Pollution Prevention Planning in 1993 and who account for approximately 85% of all NPO generated in New Jersey.

Data Characteristics

The data used for analysis were modified to remove hazardous substances that were added or deleted from TRI, during the period analyzed, so that the data set represents a consistent set of “core” chemicals. One data element (called "Energy Recovery") was also deleted from the NPO and use analyses because large errors in reporting are known to have occurred over the time period analyzed.

Data Strengths and Limitations

Facility level materials accounting data are collected in New Jersey through the submission of the Release and Pollution Prevention Report. Materials accounting data is a method of comparing the inputs and outputs of a hazardous substance to determine how much of the substance ended up in the product, was chemically consumed or became nonproduct output ("waste"). Because inputs and outputs need to balance, materials accounting data are more complete than "release" data that are collected at the national level, as part of TRI.

Discussion

From 1991 to 1993 there has been a downward trend in the quantities of NPO generated by the manufacturing sector (SIC codes 20-39) in New Jersey. The rate of decline has flattened since 1994. This trend has been mirrored by the “Big 5” facilities which account for approximately 85% of all NPO generated in New Jersey (see Figure 3). As expected, this trend is consistent with the decline in total releases and transfers discussed in the previous indicator. It is likely that pollution prevention has played a significant role in the decline of NPO, especially considering that total statewide use (or throughput) of hazardous substances for all New Jersey manufacturing facilities, as well as the “Big 5,” has shown a slight increase in recent years (see Figures 4 and 5).

As mentioned in the Throughput/Chemical Use & Economic Activity indicator, New Jersey is working to achieve a new milestone since the previous milestone was achieved around 1994. The new milestone sets an aggressive goal of 50% reduction in nonproduct output from New Jersey’s manufacturing sector compared to 1993 levels. Although minimal progress has been made toward this milestone, additional environmental strategies may be required to achieve this goal. Many of the 600 manufacturing facilities covered under pollution prevention planning began a second five-year Pollution Prevention Planning cycle in 1998 and it is hoped that there will be statewide reductions associated with those efforts.

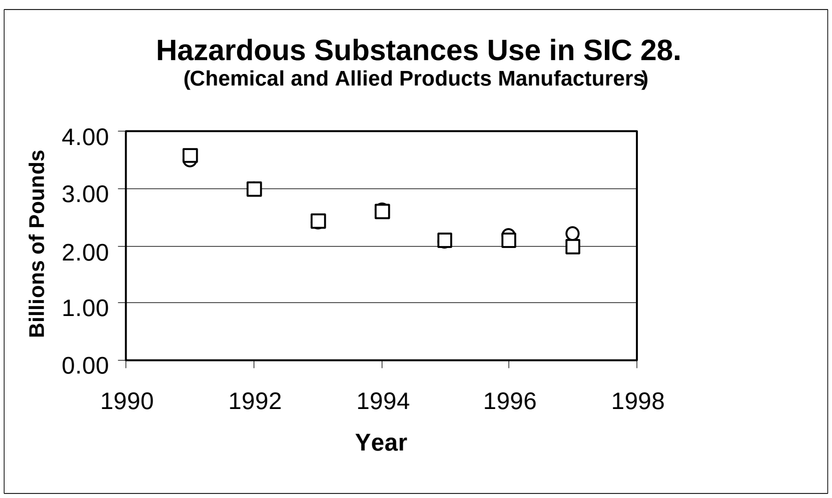
Milestone: By 2005, through pollution prevention techniques, industrial facilities will reduce the quantity of toxic chemicals generated as nonproduct output (production-related waste) by 50% from 1993 levels.

Indicator: Measures of Changes in Throughput/Chemical Use, Nonproduct Output & Releases of Hazardous Substances Resulting From Economic Activity Changes (CPM)

Type of Indicator: Cause

Between 1991 and 1997, the annual use of hazardous substances by the Chemical and Allied Products (SIC code 28) sector in New Jersey decreased by approximately 1.2 billion pounds (see Figure 6). Nonproduct output (NPO) for SIC code 28 decreased approximately 120 million pounds over the same time period (see Figure 7). After adjusting the figures for economic growth, using the Mid-Atlantic Manufacturing Index (MMI), the trend in the use of hazardous substances for SIC code 28 continues to show a slight decline, even in recent years when economic activity increased.

Figure 6



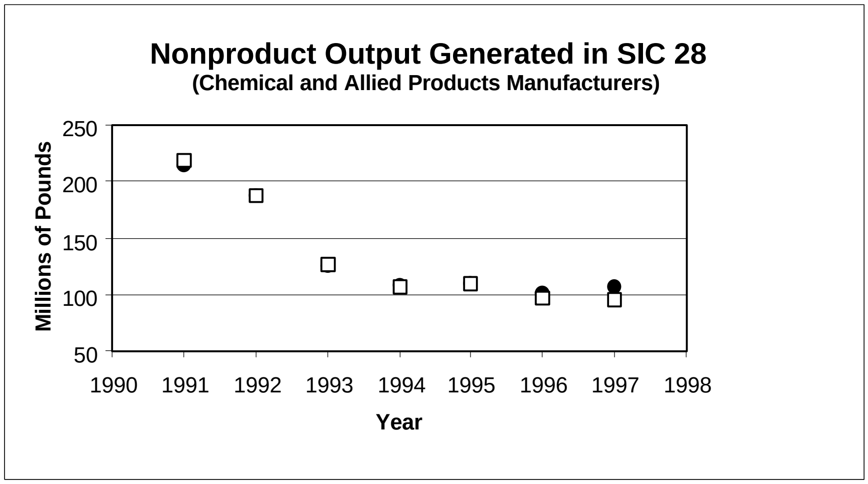
○ **Total Use**

□ **Total Use Corrected Using MMI**

Data are for SIC 28 facilities subject to Release and Pollution Prevention Reporting in NJ and represent the "core chemicals" (those hazardous substances that were reported every year over the time period analyzed).

The Mid-Atlantic Manufacturing Index (MMI) was used to correct for economic activity. The figures reported are the quantities of hazardous substance use that would be expected without any change in economic activity.

Figure 7



○ **Total NPO**
□ **Total NPO Corrected Using MMI**

Data are for SIC 28 facilities subject to Release and Pollution Prevention Reporting in NJ and represent the "core chemicals" (those hazardous substances that were reported every year over the time period analyzed).

The Mid-Atlantic Manufacturing Index (MMI) was used to correct for economic activity. The figures reported are the quantities of Nonproduct Output (NPO) that would be expected without any change in economic activity.

Data Description

The reasons for measuring NPO, use and releases are described above in the discussion sections of the previous two indicators. The "Big 5" SIC codes account for approximately 85% of all statewide NPO. Standard Industrial Classification code 28 was chosen for this indicator because a very large percent of the Big 5's NPO (approximately 90%) is generated in the chemical manufacturing sector and because the economic growth in this sector is similar to overall growth for all manufacturing sectors in New Jersey over this time period.

Nonproduct output quantities come from data submitted annually to NJDEP as part of Release and Pollution Prevention Reporting. Production factors, developed by the Federal Reserve Bank of Philadelphia as part of the Mid-Atlantic Manufacturing Index (MMI), were used to adjust these NPO quantities in order to account for economic activity.

Data Characteristics

The data used for this indicator are the same as the data used in the previous two indicators. The Mid-Atlantic Manufacturing Index measures economic productivity in the manufacturing sector in the Mid-Atlantic Region (defined here as Delaware, New

Jersey, New York and Pennsylvania). Production Indices are available for each manufacturing SIC Code 20-39.

Data Strengths and Limitations

It is important to use an economic indicator that measures economic effects in the manufacturing sector, since manufacturing is more sensitive to economic change than other parts of the economy. Other measurements, such as Gross State Product or Gross National Product, would not be as accurate in measuring production changes in the manufacturing sector. Although one does not exist at this time, a Manufacturing Index specific for New Jersey would provide for a more accurate picture of economic activity in the state.

Discussion

Increases in economic growth are expected to result in increases in the amount of hazardous substances used on a statewide basis, with concurrent increases in the amount of NPO generated and released to the environment, unless industrial facilities implement pollution prevention. To determine whether economic activity has had any measurable effect on pollution prevention progress in New Jersey, the quantities of hazardous substances used and generated as NPO in a single industrial sector, Chemicals and Allied Products (SIC Code 28), were examined with and without adjustment for production increases. Figures 6 & 7 indicate the quantities of hazardous substances used and generated as NPO (respectively) as well as the quantities that would be expected without any change in economic activity.

With the exception of the last few years, production changes do not appear to have had much of an effect on hazardous substance use and NPO generation. During 1996 and 1997, however, production has increased and this increase has had an impact on the quantity of hazardous substances used and NPO generated in New Jersey. It appears that the rate of economic growth for 1996 and 1997 has exceeded the rate of pollution prevention improvement, and may explain the increases in NPO, use and releases on a statewide basis (see Figures 1- 5). Without new environmental strategies, it is likely that these indicators will continue to increase as economic growth continues.

After reaching the previous milestone in approximately 1994, New Jersey has set a new milestone of 50% reduction in nonproduct output compared to 1993 levels. Many of the 600 manufacturing facilities covered under pollution prevention planning began a second five-year Pollution Prevention Planning cycle in 1998 and it is hoped that there will be statewide reductions associated with those efforts. Although progress has been made toward this milestone, additional environmental strategies may be required to achieve this goal.

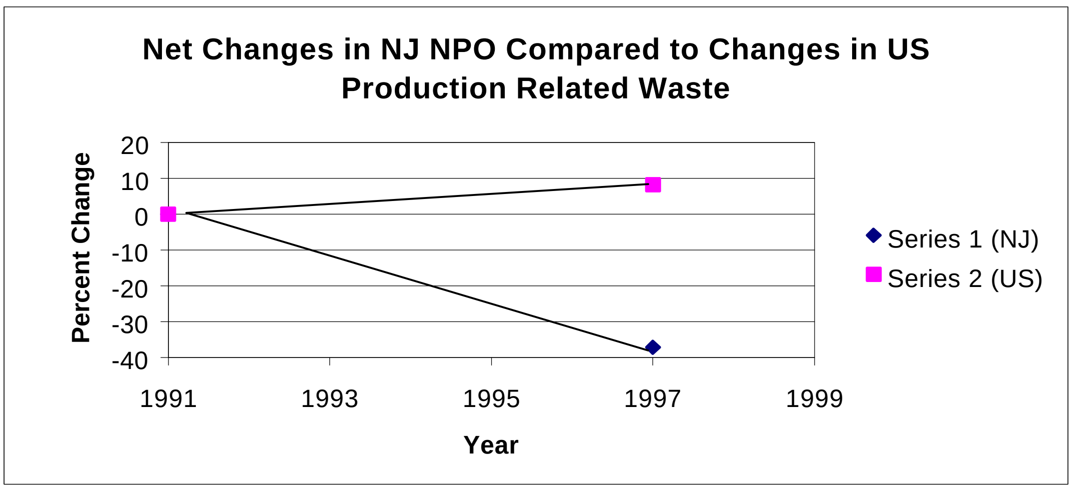
Milestone: By 2005, through pollution prevention techniques, industrial facilities will reduce the quantity of toxic chemicals generated as production-related waste by 50% from 1993 levels.

Indicator: Comparison of New Jersey Pollution Prevention Trends Compared to U.S. Pollution Prevention Trends.

Type of Indicator: Condition

In 1997, the amount of nonproduct output (NPO) generated in New Jersey decreased by 37.1% compared to 1991 figures. In contrast, "Production Related Waste", measured on the national level as part of the Toxic Chemical Release Inventory (TRI), increased by 8.3% over the same time period.

Figure 8



Data Description

As described in the discussion section of the previous three indicators, New Jersey uses NPO as a measure of pollution prevention progress. At the national level, EPA measures "production related waste" as part of the Toxic Chemical Release Inventory. These two measurements are very similar, so this indicator compares the changes in rates of NPO/production related waste over time. Series 1 represents the percent change in NPO in New Jersey from 1991 to 1997. Series 2 represents the percent change in Production Related Waste for the entire United States from 1991 to 1997.

Data Characteristics

For most facilities, the quantities of production related waste and NPO will be the same and these quantities are directly comparable. Because EPA uses slightly different definitions of what constitutes recycling, there could be slight differences in these quantities.

Data Strengths and Limitations

Data collected at both the state and federal level will include errors in reporting, especially since all of the data are self-reported by facilities. EPA has been improving its ability to identify major errors in reporting, and the data used in this indicator reflects some of these corrections.

Discussion

While the rates of change differ from year to year, this indicator clearly shows that the trend in United States NPO is increasing at the same time that NPO has shown a significant decrease in New Jersey. The decline in NPO in New Jersey represents major progress in pollution prevention compared to the United States and may be the result of materials accounting and pollution prevention rules that have been in place in New Jersey for the past ten years. Although the decline in New Jersey includes some decreases in NPO due to facility or process shutdowns as well as true pollution prevention activities, facilities in New Jersey have made significant accomplishments in pollution prevention, particularly in the chemical and allied products sector.

GLOBAL CLIMATE CHANGE

Introduction

Emissions of greenhouse gases (GHGs) by anthropogenic sources are now considered to be a significant contributor to a changing worldwide climate. New Jersey is a heavily industrialized state, with high population density and with major urban areas. It is also a coastal state, surrounded on water by three sides, making the state not only a contributor to increasing atmospheric levels of GHGs but subject to vulnerability from climate-related impacts such as rising sea level, urban heat island effects, changes in agricultural patterns, and reduced water supply. The New Jersey GHG Emissions Inventory established a 1990 baseline of emissions by source and type of GHG as well as catalogues the sources of GHG emissions in New Jersey by their major sectors of production: transportation, residential and commercial buildings, industrial operations, landfills and changes to natural resources (e.g., clearing of trees). More than 80% of GHGs in New Jersey result from the combustion of fossil fuel to produce energy. Projections indicate emissions in New Jersey by 2005 will be approximately 15 million tons of carbon dioxide (CO_2) equivalents[1] higher than they were in 1990. On March 17, 1998, the NJDEP issued an Administrative Order establishing a goal of a 3.5% reduction in New Jersey's GHG emissions below 1990 levels by 2005. The New Jersey Sustainability GHG Action Plan (available at www.state.nj.us/dep/dsr/gcc), developed through an extensive stakeholder process and published in January 2000, describes specific strategies to achieve the more than 20 million ton reduction in CO_2 equivalents below current levels to meet the 3.5% reduction goal. The Action Plan identifies the proposed strategies for GHG reduction under the following categories:

- energy conservation
- innovative technologies
- pollution prevention
- waste management - recycling
- open space/natural resources

Implementation of specific GHG reduction strategies will require a number of actions. The implementation effort will be aided if public officials lead the effort to heighten awareness of climate change among citizens and solicit their assistance in developing and implementing solutions. Also important will be carrying out New Jersey-specific research to obtain more detailed and accurate data on fuel use, develop tools to evaluate policy options, and support projects evaluating innovative technologies that produce energy while emitting less GHGs. All of these activities can serve as the basis for environmental indicators related to GHGs.

Indicators have been developed to quantify annual statewide GHG levels, key contributing sources such as annual total vehicle miles traveled and impacts such as sea

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1 Carbon dioxide equivalents represent the emissions of a greenhouse gas converted to what those emissions would be if they were carbon dioxide. The conversion is based on the global warming potential (GWP) of a gas, which, for many gases, is higher than the global warming potential of carbon dioxide. For example, methane has a GWP of 21, so 1 ton of methane emissions is equal to 21 tons of carbon dioxide equivalent emissions.

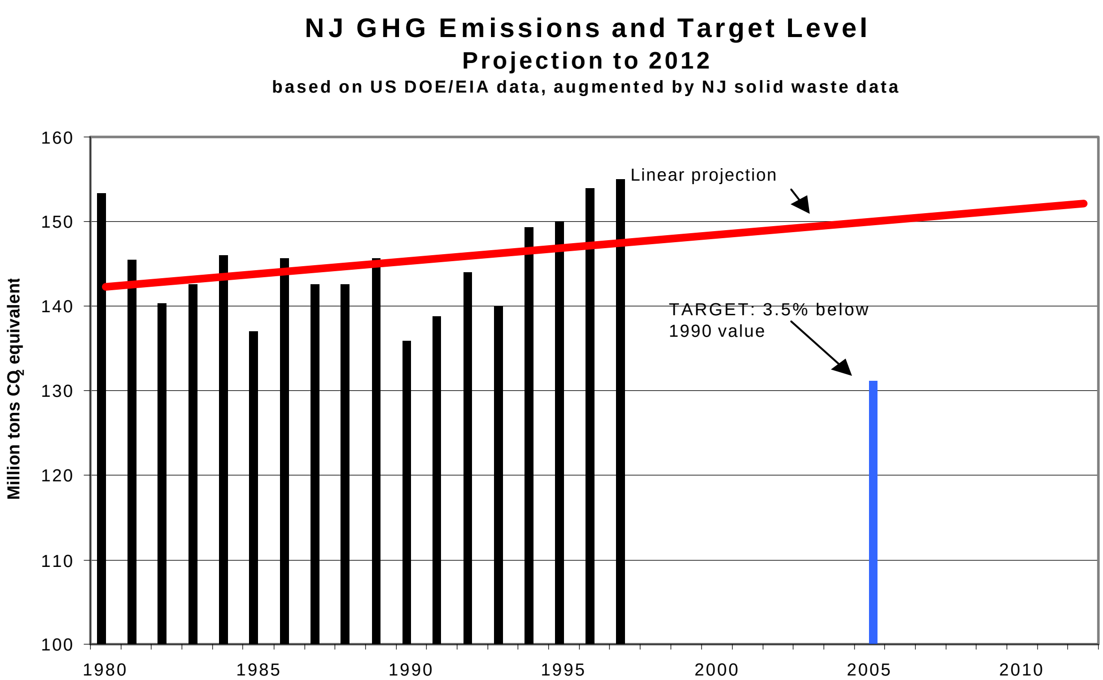
level and temperature. Additional, more detailed data must be acquired and additional indicators developed if progress towards the 3.5% reduction goal is to be accurately assessed.

Milestone: Total amounts of NJ's GHG emissions will be reduced to 1990 levels by 2000. Levels in 2005 will be 3.5% below 1990 levels (Baseline: NJ's GHG emissions were 135 million tons of CO_2 equivalents).

Indicator: Total Amount of NJ GHG Emissions Using USDOE EIA Data

Type of Indicator: Condition

Two approaches for calculating New Jersey's annual GHG emissions presently exist. The first uses statewide NJ fuel use survey data which are available from the US Department of Energy (USDOE) , Energy Information Agency (EIA). The second approach utilizes data supplied by the US Environmental Protection Agency (USEPA). In each case, NJDEP solid waste and open space and natural resource data supplement these data. Both approaches show New Jersey's GHG emissions increasing since the early 1990s. Projections on future levels of annual statewide GHG emissions have been made to determine the amount of reduction needed to achieve the DEP goal of a 3.5% cut below 1990 levels by 2005.



Data Discussion

This indicator presents total New Jersey GHG emissions based on USDOE/EIA data. These data show statewide emissions increasing since the early 1990s. The trend line projects future emissions and enables calculations of what reductions will be needed to achieve specific goals. Since different gases have different global warming potential (GWP) (one molecule of methane has 21 times the GWP of one molecule of carbon dioxide), all gases are converted to units of CO_2 equivalents. The DEP goal, established by Commissioner Robert C. Shinn, Jr., through Administrative Order 1998-09, is a 3.5% reduction in New Jersey's GHG emissions below our 1990 baseline by 2005. This translates to a reduction from an anticipated 2005 level of 151 million tons of CO_2 equivalents to (0.965)* (135 million tons of CO_2 equivalents), or 151-130 = 21 million tons of CO_2 equivalents.

Data Characteristics

Methods to calculate statewide GHG emissions are available from the USEPA and USDOE. The USDOE/EIA data are only currently available through 1997; it generally takes 1-2 years for this information to be accessible. There is a strong correlation between the amount of energy consumed and the amount of GHGs emitted since approximately 82% of New Jersey's GHG emissions result from the combustion of fossil fuel.

Strengths and Limitations

There is no direct measure of annual total statewide GHG emissions, so indirect measures such as the amount of fuel used to power cars and heat homes must be used and then converted to units of tons of CO_2 equivalents. The linear projection for future GHG emissions assumes that current economic trends will continue, an assumption that is uncertain. Lack of precision in the data does not obviate the necessity of making reasonable projections on future trends, which is required for policy development.

Discussion

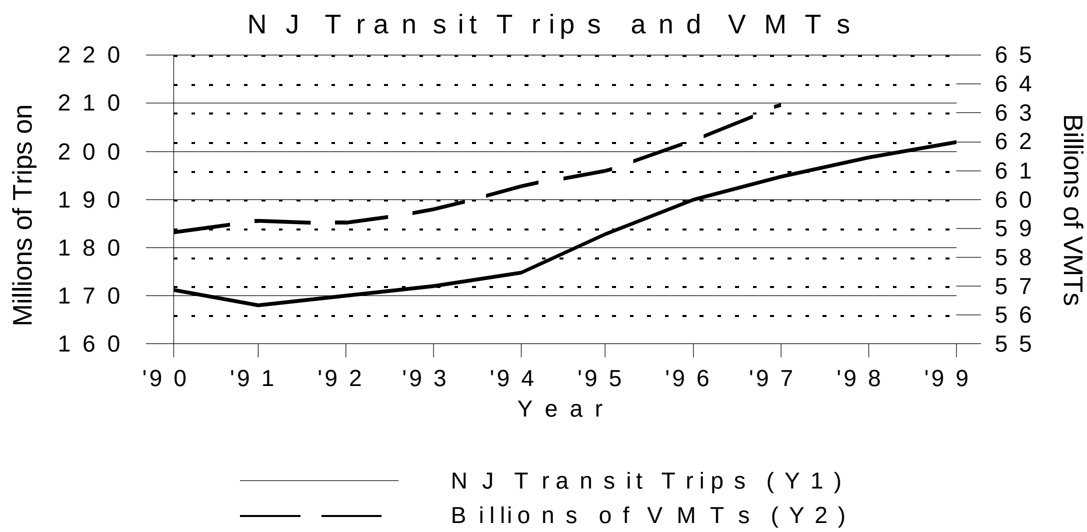
Most climate scientists believe in a correlation between the amount of GHGs emitted and the change in climate. New Jersey contributes only about 2% of the total GHG emissions of the US, which is approximately 20% of the worldwide total, so changes in New Jersey practices will have little overall effect on global emissions. However, lowering GHGs emissions in New Jersey can have other immediate collateral benefits such as reducing oxides of nitrogen (NO_x), volatile organic compounds (VOCs) and toxics such as mercury. Reducing GHG emissions can also save energy and money for both individuals and companies.

Milestone: Total amounts of NJ's GHG emissions will be reduced to 1990 levels by 2000. Levels in 2005 will be 3.5% below 1990 levels (Baseline: NJ's GHG emissions were 135 million tons of CO_2 equivalents).

Indicator: Commutation by Public Transportation

Type of Indicator: Response

From 1990-1999, the number of annual trips taken on NJ Transit has increased 20%. However, information on total state vehicle miles traveled (VMTs) shows that most people are still driving as much as or more than, previously. In the future, the VMT data could be modified with data on gasoline sold in New Jersey and overall energy efficiency of the vehicle fleet.



Data Discussion

This indicator shows the total number of annual trips taken on NJ Transit as well as total state vehicle miles traveled (VMTs). The more people that drive cars to work, the more CO_2 is emitted. Mobile sources represent more than 1/3 of New Jersey's total inventory of GHG emissions. If a greater percentage of people take the train rather than drive, this would lower GHG emissions. The data suggest that the same RATIO of people drive and take the train; the increase in NJ Transit ridership does not reflect a movement from private automobiles to public transportation.

Data Characteristics

Total trips taken information includes both buses and trains operated by NJ Transit and is provided by the NJ Department of Transportation (website: www.state.nj.us/transportation).

Data Strengths and Limitations

The data are highly accurate. 80% of all trips taken on NJ Transit are for work commutation. Not included are trips using public transportation taken on other systems (private buses and vans).

Discussion

The data show that total public transit ridership is up. Stable rail and bus fares since 1990 contribute to increased use. However, there is a strong correlation with amount of vehicle miles traveled. There has NOT been any apparent increase in the last 10 years in the percentage of people in NJ who take public transportation to work. This means that the amount of GHGs from mobile sources will likely continue to increase.

Milestone: Total amounts of NJ's GHG emissions will be reduced to 1990 levels by 2000. Levels in 2005 will be 3.5% below 1990 levels (Baseline: NJ's GHG emissions were 135 million tons of CO_2 equivalents).

Indicator: Annual Measurement of Sea Level Rise

Type of Indicator: Cause

Annual tidal gauge measurements at Atlantic City show that the rate of sea-level rise is 3.8 mm/year (0.15 in/year), or twice the worldwide average. There is a strong correlation between increases in global mean temperature and rising sea levels.

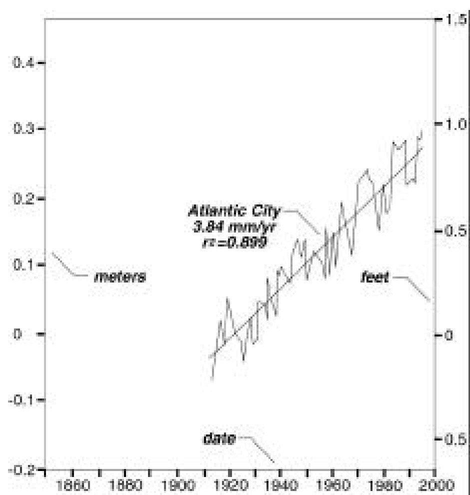


Figure 2. Tide gauge records for Atlantic City and Sandy Hook, New Jersey (modified from Psuty and Collins, 1996).

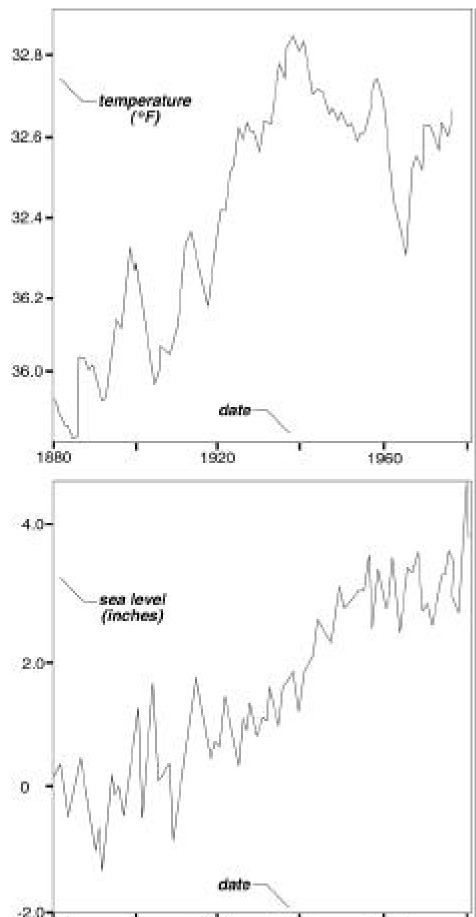


Figure 3. Correlation between global temperature and sea-level rise during the last century (from Intergovernmental Panel on Climate Change, 1990).

Data Discussion

This indicator reflects trends in sea levels at Atlantic City and worldwide trends in both sea level and temperature. The implication is that global warming, caused by increases in atmospheric CO_2, is causing the seas to rise because of thermal expansion.

Data Characteristics

Historical records for both temperature and sea-level rise, both nationally and in New Jersey, are highly accurate.

Strengths and Limitations

The amount of sea level rise at Atlantic City is also due to land subsidence along the coast because of sediment compaction. This does not change the conclusion that sea levels are rising in part because the air and water temperatures are getting warmer due to increases in atmospheric concentrations of greenhouse gases.

Discussion

The question that cannot be answered with certainty is how much of the observed global warming is attributable to natural climate fluctuations and how much to the heat-trapping of GHGs. The preponderance of scientific opinion is that continued and increased emissions of GHGs will warm the earth's climate.[2] It is very likely that this warming will lead to increased sea level rise. This sea level rise will cause coastal storms to penetrate father inland, increasing the vulnerability of wetlands to storm disruption. A rising sea level also increases the potential for salt-water intrusion in major aquifers.

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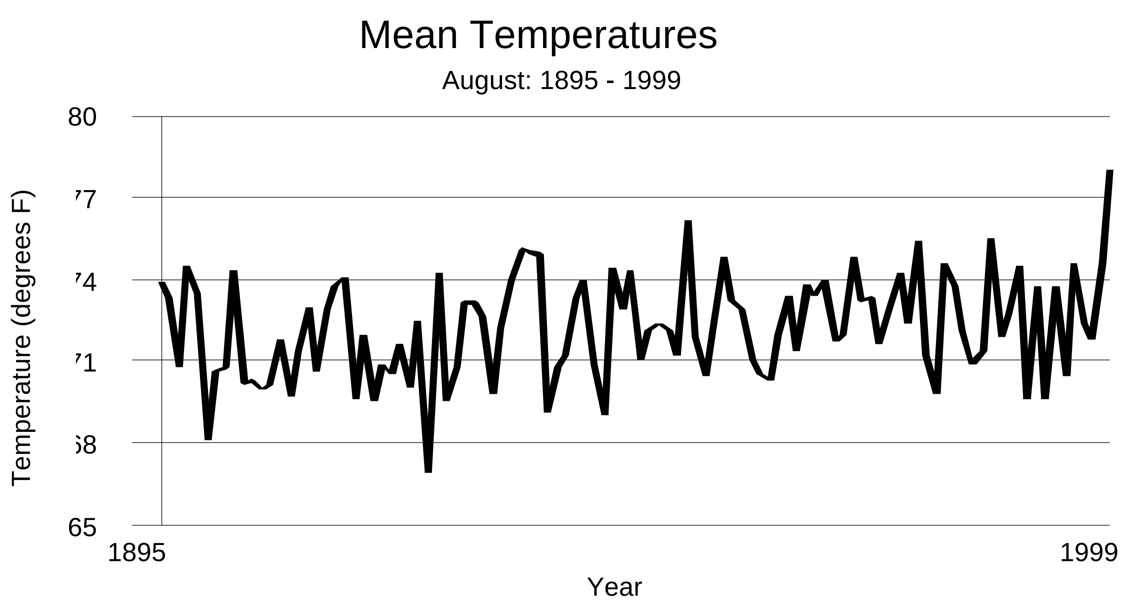
2 Mahlman, J.D., 1997, Uncertainties in projections of human-caused climate warming, Science, 278, 1416-1417.

Milestone: Total amounts of NJ's GHG emissions will be reduced to 1990 levels by 2000. Levels in 2005 will be 3.5% below 1990 levels (Baseline: NJ's GHG emissions were 135 million tons of CO_2 equivalents).

Indicator: Annual Mean Surface Air Temperature

Type of Indicator: Condition

The statewide annual average surface temperature has increased over the past 100 years. At New Brunswick, the annual average was 50.4EF for the period 1895-1918; for the period 1966-1998, the annual mean increased to 52.2EF. The data shown for the hottest month of the year (August) show higher mean temperatures throughout the state in the past 20-30 years.



Data Description

This indicator reflects the annual mean August temperature in New Jersey for the last 105 years. Increases in GHG emissions, particularly CO2, have been shown to be closely correlated with increases in surface air temperatures, and have also increased over this period (see sea level rise indicator). Therefore, surface air temperature is viewed as one important condition indicator for climate change.

Data Characteristics

Values are calculated from a spatially weighted average of more than 2 dozen stations throughout the state. Data are similar at other locations.

Strengths and Limitations

The data are highly accurate. Surface air temperature varies by site; the display of an averaged value for the state eliminates local impacts. Changes in temperature should be most noticeable by the public in the hottest month of the year, August.

Discussion

Most climate scientists conclude that anthropogenic activities, such as the burning of fossil fuels, contribute to global warming. The issue of mean surface air temperature and its relationship to climate change in New Jersey has been summarized in the referenced EPA report[3.] There is no direct measure that positively links increases in GHG emissions to climate changes; models are used to predict future climate-related environmental changes assuming projected trends in emissions.

[3] Climate Change and New Jersey, EPA:230-F-97-008dd, September 1997

AIR QUALITY/RADIATION

Introduction – Air Quality

The air in New Jersey is affected by many naturally occurring and manmade pollutants, and air quality in the state varies significantly depending on location, time and weather conditions. It is affected both by local emissions and by pollution which is transported into the area by the prevailing winds.

There are a wide variety of air pollution sources. These can generally be categorized as mobile sources (cars and trucks), stationary sources (chemical factories, sewage treatment plants, and utility power plants), and miscellaneous sources (use of consumer products, and home oil or wood combustion for heating). The pollutants emitted by these sources may also impact water quality and ecosystem health in this state if they are deposited on New Jersey's aquatic and terrestrial ecosystems.

There are six specific air pollutants ("criteria pollutants") which are used as indicators of air quality and for which National Ambient Air Quality Standards (NAAQS) have been established. The NAAQS are based both on human health effects (for the primary standards) and welfare effects (for the secondary standards). Based on these indicators, air quality in New Jersey has improved significantly since the passage of the original Clean Air Act in 1970. But still more needs to be done.

The human health standard for ground level ozone was revised in July 1997. It was changed from a maximum 1-hour concentration of 0.12 parts per million (ppm) to a maximum 8-hour concentration of 0.08 ppm. The old standard would have been exceeded on 4 days in New Jersey in 2000 while the new standard was exceeded on 19 days. This shows how much more stringent the new standard is. While efforts to reduce ozone concentrations have been successful, the new standard will require significant additional effort if it is to be met.

Carbon monoxide, which was responsible for unhealthy air quality on 44 days in 1984, has declined significantly in recent years and has not reached unhealthy levels since January 1995. There were no exceedances of the air quality standards for inhalable particulates, sulfur dioxide, nitrogen dioxide, or lead in 1999. It is important to note, however, that in addition to changing the standards for ozone, EPA also added a new standard for fine particulates in 1997. As there was no routine monitoring for fine particulates, this required that a whole new network be established. This network was completed in 1999 and preliminary data indicate that the new standards may not be met in the more urbanized parts of the state.

Pollutants other than the six criteria pollutants, and parameters such as meteorology and acid precipitation, are also routinely monitored by NJDEP. Acid precipitation remains a persistent environmental problem in New Jersey. Measured pH levels ten times more acidic than the naturally occurring pH of rainwater (5.0 to 5.6) are recorded regularly and total sulfate deposition hovers around the accepted aquatic effects level every year.

In addition to the criteria air pollutants, other toxic air pollutants are also of concern. This year NJDEP undertook a new initiative to establish 4 comprehensive air toxic monitoring sites. These sites will be supplemented by shorter term monitoring studies that will focus on local areas of special concern. The four permanent sites are scheduled to begin operation in early 2001 and the first special studies to start the following summer.

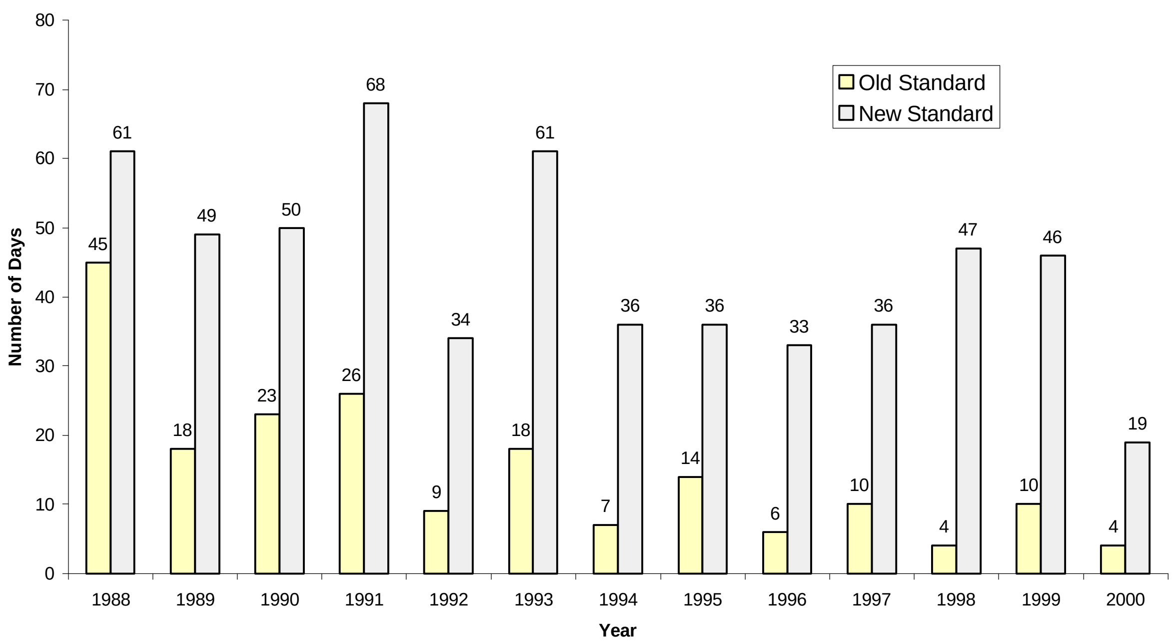
Milestone: Attain the air quality standards for ozone (O_3) by 2007.

Indicator: Number of Exceedances of the Ozone Standard

Type of Indicator: Condition

In 1997, the U.S. Environmental Protection Agency (EPA) changed the health standard for ground level ozone. The old standard was based on a maximum one hour concentration of 0.12 parts per million. The new standard was set at 0.08 ppm averaged over eight hours. The new standard is much more difficult to meet and the change makes depicting long term trends in ozone difficult. In 1999, there were 10 days rated unhealthy based on the old standard but there were 46 days considered to be unhealthy based on the new standard.[1] In 2000, there were 4 days considered unhealthy based on the old standard, and 19 days considered unhealthy based on the new standard.

Days on Which the Old and New Ozone Standard Have Been Exceeded 1988 - 2000



[1] Due to a pending case before the U.S. Supreme Court, NJDEP is tracking compliance with the old ozone standard (set at a one hour peak concentration of 0.12 ppm) and with the new contested standard (set at 0.08 ppm for an 8-hour average).

Data Description

In 2000, there were 4 days on which the old EPA one-hour average standard for ozone was exceeded, and in 1999, there were 10 such days. EPA's new eight-hour average standard was exceeded on 19 days in 2000, 46 days in 1999, and 47 days in 1998. While levels based on the eight-hour standard over the past five years appear generally lower than the previous 5-year period, a preliminary analysis indicates that there is not a statistically significant continuing downward trend since the early 1990s.

Ozone is not emitted directly into the atmosphere but results from a series of reactions between nitrogen oxides and volatile organic compounds in the presence of sunlight. As a result, ozone is a problem on hot sunny summer days and the vast majority of exceedances of the standard occur between May 15 and August 31. Ozone is only one of a class of compounds, known collectively as photochemical oxidants, that result from such reactions. The mixture of pollutants that forms on high ozone days is commonly referred to as "smog".

Ozone directly affects the respiratory system, where it reacts with and irritates the mucous membranes of the nose, throat and airways; ninety percent of the ozone inhaled into the lungs is never exhaled. Generally the first symptoms to appear relate to restriction of airways and include reductions in respiratory volume and velocity (which can compromise respiratory function in those with existing respiratory diseases) as well as facilitating asthmatic reactions in sensitive individuals. Other symptoms at somewhat higher levels of exposure include coughing, chest pain, and throat irritation. Exposure to ozone can also increase susceptibility to respiratory infections. Repeated exposures to high ozone levels may lead to permanent scarring of lung tissue, loss of lung function, and reduced lung elasticity. Welfare effects include crop loss, damage to vegetation, and material degradation - especially to rubber.

Data Characteristics

Ozone concentrations in ambient air are measured by the NJDEP on a continuous (around-the-clock) basis and summaries of this and other air pollution data are published annually. Ozone monitors were operated at 15 sites in 2000. NJDEP's Geographic Information System receives hourly updates of ozone data. These data are available on the NJDEP web page (http://www.state.nj.us/dep/airmon/). Data can be obtained by writing or calling the Bureau of Air Monitoring at 401 East State Street, P.O. Box 418, Trenton, New Jersey 08625; (609) 292-0138. Ozone forecast levels can also be seen on New Jersey Network's nightly news during the summer months. Health advisories are issued to the media when ozone levels exceed the standard.

Data Strengths and Limitations

The ambient monitoring database for ozone is long term and high in quality, but using the number of exceedances of the standard as an indicator does have some limitations. Ozone is monitored at 15 locations statewide (the fifteenth site was added in 1999). While this provides reasonable coverage, there are large areas of the state without monitors. In addition, using just the number of exceedances does not take into account the duration of the events, the extent of the area affected or the severity of the exceedances. For example, a day on which one site has one hour just marginally above the standard is counted the same as a day on which all sites exceed the standard by a significant amount for several hours. Also, levels that are marginally below the standard and may be affecting sensitive individuals are not distinguished from those that are well below it.

Discussion

In calendar year 2000, there were a total of 4 days on which the old ozone standard was exceeded. This compares to 10 days in 1999 and 4 days in 1998. Overall the trend in ozone levels in the past decade has been downward and significant progress has been made towards attaining the standard, although much still needs to be done. The chart above shows the number of days that the old and new ozone standards have been exceeded since 1988. Year-to-year fluctuations in the number of days on which the standards are exceeded are due in part to variations in weather. Cool summers, as experienced in 2000, can lead to relatively fewer high-ozone days.

The overall decrease in the number of exceedances is the result of several factors. Automobiles, a major source of ozone-forming VOCs and oxides of nitrogen, emit far less of these pollutants than they did in 1988 and they tend to be better maintained because of the State's Inspection and Maintenance program. There have also been significant emission limitations placed on industrial sources. Between the 1988 and 1989 ozone seasons, restrictions were placed on the volatility of gasoline sold in New Jersey in the summer, and vapor recovery systems were mandated at gasoline stations. These efforts significantly reduced evaporative emissions of volatile organic compounds.

But the comparisons to the new 8-hour standard show that there is still much to do. Additional emissions reductions, including reductions in other states, will be needed if this new ozone standard is to be met.

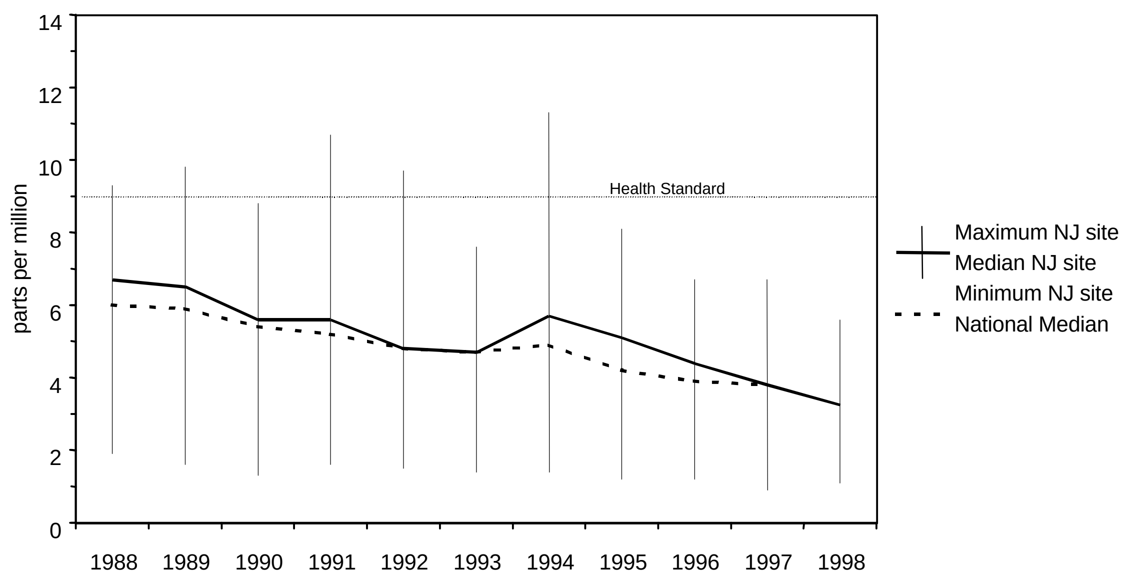
Objective: Attain and maintain the air quality standards for carbon monoxide.

Indicator: Number of Exceedances of the Carbon Monoxide Standard

Type of Indicator: Condition

The carbon monoxide standard allows one exceedance per year at each monitoring site. It is the second exceedance of the standard that results in a violation. In 1998, there were no exceedances of the carbon monoxide standard measured anywhere in the state.[2]

Trend in Carbon Monoxide Concentrations in New Jersey, 1988 - 1998: Second Highest 8-Hour Averages



Data Description

Carbon monoxide is an odorless, colorless gas that is a by-product of the incomplete burning of fuels. Industrial processes contribute to carbon monoxide pollutant levels, but the principle source of carbon monoxide pollution in most large urban areas is motor vehicles. Cigarettes and other sources of incomplete combustion also produce carbon monoxide.

[2] The National Ambient Air Quality Standards for carbon monoxide are set at a peak 1-hour level of 35 ppm and an 8-hour average of 9 ppm.

Carbon monoxide is inhaled and enters the blood stream; there it binds chemically with hemoglobin, the substance that carries oxygen to the cells, thereby reducing the amount of oxygen delivered to all tissues of the body. Carbon monoxide also weakens the contractions of the heart, thus reducing the amount of blood pumped to various parts of the body. In a healthy person, this effect significantly reduces the ability to perform physical exercises. In persons with chronic heart disease, these effects can threaten the overall quality of life, since their systems are unable to compensate for the decrease in oxygen reaching body tissues.

The carbon monoxide National Ambient Air Quality Standard (NAAQS) allows one exceedance of the standard at each monitoring site. It is the second exceedance of the standard that results in a violation at the site. Because the standard is written this way, it is the second-highest recorded concentration that is of interest at each site.

Data Characteristics

Carbon monoxide concentrations in ambient air are measured by the NJDEP on a continuous (around-the-clock) basis and summaries of these and other air pollution data are published annually. NJDEP's Geographic Information System receives hourly updates of carbon monoxide data and hourly data are available on the NJDEP web page (http://www.state.nj.us/dep/airmon). Data can also be obtained by writing or calling the Bureau of Air Monitoring at 401 East State Street, P.O. Box 418, Trenton, New Jersey 08625; (609) 292-0138. Health advisories are issued to the media when carbon monoxide levels exceed the standard.

Data Strengths and Limitations

The ambient air monitoring database for carbon monoxide is long term and high in quality, but using the number of exceedances of the standard as an indicator does have some limitations. Carbon monoxide is monitored at 15 locations statewide. While this provides reasonable coverage, there are large areas of the state without monitors. In addition, since most monitors are placed to determine population exposure, there may be local areas of higher concentrations that are missed.

Discussion

The figure above shows the range of carbon monoxide concentrations observed at all monitoring sites based on the second highest 8-hour average for comparison to the standard. Peak one-hour concentrations are not shown since New Jersey has been meeting this standard for many years. No exceedances of the carbon monoxide NAAQS were recorded in 1998. The highest 1-hour average of 12.0 parts per million was recorded in Morristown. The highest 8-hour average of 6.0 parts per million was recorded in North Bergen. The chart above shows trends in carbon monoxide levels from 1988-1998.

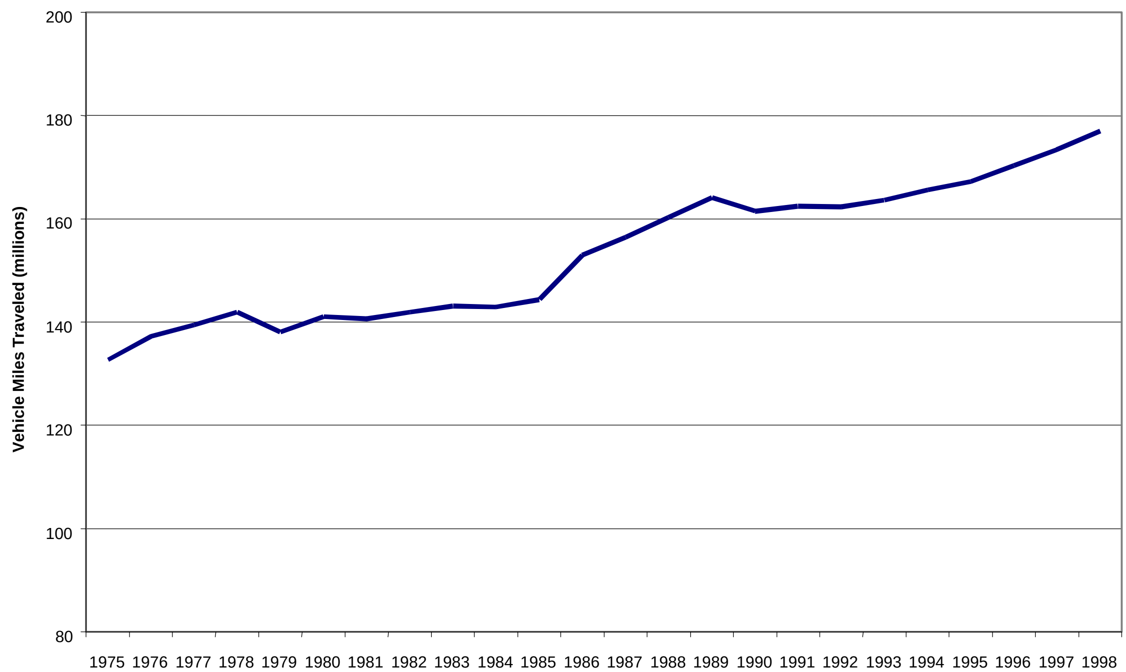
Milestones: **Attain the air quality standards for ozone (O_3) by 2007. Attain and maintain the air quality standards for carbon monoxide (CO).**

Indicator: **Vehicle Miles Traveled**

Type of Indicator: Cause

Vehicle use in New Jersey is an indirect indicator of vehicle emissions and is also tracked to determine whether increases in miles driven may interfere with attaining the ozone and carbon monoxide standards. From 1991 to 1998, the average daily vehicle miles traveled in the state grew by about 1 percent per year.

Estimate of Daily Vehicle Use in New Jersey



Data Description

Ozone is not emitted directly into the atmosphere but results from a series of reactions between nitrogen oxides and volatile organic compounds in the presence of sunlight. Carbon monoxide results from incomplete combustion and is emitted directly from sources. Highway motor vehicles are the single largest source category of ozone precursor and carbon monoxide emissions in New Jersey. One indicator of vehicle use is measured in terms of vehicle miles traveled. Currently, vehicles travel approximately 180 million miles per day on New Jersey roadways. Thus it is important to understand and track vehicle use.

Data Characteristics

The estimates of miles of travel are computed by the New Jersey Department of Transportation. These estimates are computed using data from the Highway Performance Monitoring System. The Highway Performance Monitoring System methodology utilizes actual traffic counts in accordance with the Federal Highway Administration's Traffic Monitoring Guide. For further information on these vehicle use estimates contact the Bureau of Air Quality Planning at (609) 292-6722 or via fax at (609) 633-6198 or the New Jersey Department of Transportation Bureau of Statewide Planning at (609) 530-2884.

Data Strengths and Limitations

The intent of the Highway Performance Monitoring System estimates of vehicle miles traveled is to monitor highway use and aid Federal Highway Administration in allocating Federal transportation funding to individual states. By extension, the data are a reasonable approximation of vehicle travel on New Jersey’s roadways in the aggregate. These data do not provide estimates of other important indicators such as number of vehicle trips and information regarding the origin and destination of a trip or the speed the vehicle is traveling during the trip. The number of trips may be more indicative of vehicle emissions than vehicle miles traveled, but trip data are not readily available. Vehicle miles traveled data also do not consider the impacts of improved vehicle technology which is expected to reduce emissions.

Discussion

From 1991 to 1998, the vehicle miles traveled grew by approximately 15 million miles on an average day. This corresponds to yearly growth rate of more than 1%. In contrast, based on U.S. Census data, New Jersey’s population grew during this period by approximately 0.5% per year.

Objective: Maintain current attainment status for particulate matter (PM10)

Indicator: Number of Exceedances of the Particulate Matter Standard

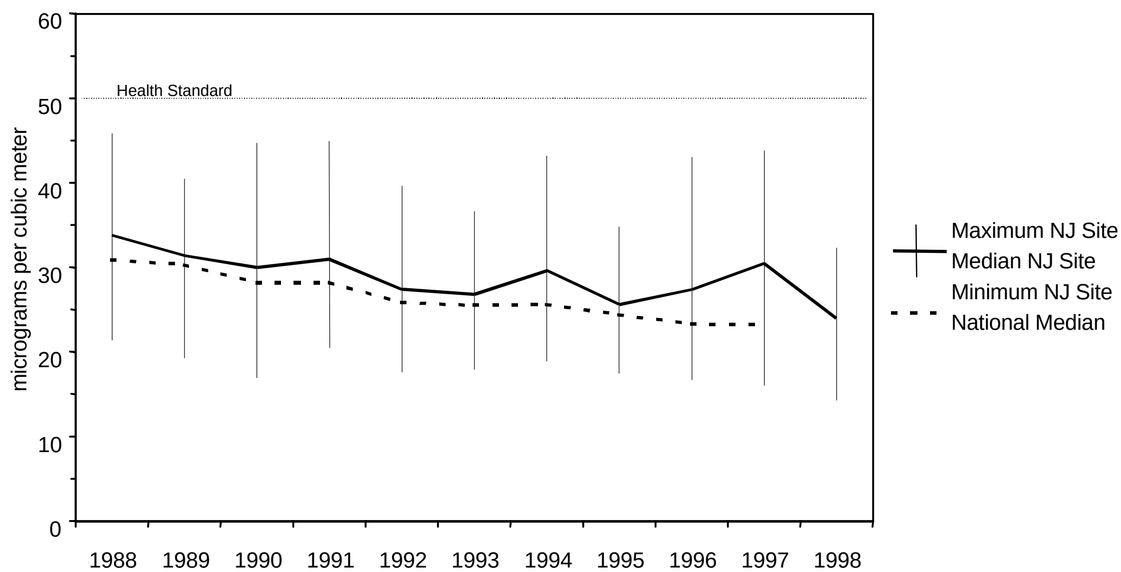
Type of Indicator: Condition

Concentrations of particulate matter with aerodynamic diameter of 10 microns or more are collected and compared to the national air quality standard. The entire state is currently attaining the standard for particulates even though one exceedance of the standard was recorded in 1998. The new air quality standard promulgated by EPA for particulate matter with a smaller diameter may be more difficult to achieve[3].

Trend in Inhalable Particulate Concentrations

in New Jersey, 1988 - 1998:

Annual Averages



Data Description

Particulate matter is solid matter or liquid droplets from smoke, dust, fly ash or condensing vapors that can be suspended in the air for long periods of time. It represents a broad class of

[3] The National Ambient Air Quality Standard (NAAQS) for inhalable particulate (known as PM10) is set at a peak 24-hour average of 150 $\mu g/m^3$ and an annual average of 50 $\mu g/m^3$. The NAAQS for fine particulate (known as PM2.5) has been set at a peak 24-hour average of 65 $\mu g/m^3$ and an annual average of 15 $\mu g/m^3$; however, the fine particulate standard is on hold pending a review by the U.S. Supreme Court.

chemically diverse particles that range in size from molecular clusters at about 0.005 microns to coarse particles 50-100 microns in diameter. Particulate matter results from all types of combustion, materials abrasion, and re-entrained dust.

The observed human health effects of particulate matter include breathing and respiratory symptoms, aggravation of existing respiratory and cardiovascular disease, alterations in the body's defense system against inhaled materials and organisms, and damage to lung tissue. Groups that appear to be most sensitive to the effects of particulate matter include individuals with chronic lung or cardiovascular disease, asthmatics, and elderly people and young children. Unlike larger particles, which are cleared fairly rapidly from the nose and upper airways through sneezing and coughing, tiny particles are inhaled deep into the lungs, where they become lodged and interfere with lung function. For this reason, recent sampling emphasis has been placed on particles measuring 10 microns and less in diameter and a new standard has been established for particles less then 2.5 microns in diameter.

Data Characteristics

Particulate matter concentrations in ambient air are generally determined by weighing 24-hour samples taken on a once every six-day sampling schedule. This schedule ensures that data are collected on different days of the week throughout the year. Results are processed quarterly and data are published annually. An equivalent monitoring technology that makes available real-time data on a continuous basis is being used at five locations. Data can be obtained by writing or calling the Bureau of Air Monitoring at 401 East State Street, P.O. Box 418, Trenton, New Jersey 08625; (609) 292-0138. The following is a website that provides air quality information: www.state.nj.us/dep/airmon.

Data Strengths and Limitations

The ambient air sampling database for particulate matter is long term, and high in quality, but since sampling is conducted on a pre-determined schedule, some high concentrations may be missed. Although PM10 is being sampled at about 11 locations, the highest ambient concentrations are difficult to determine since the monitoring methodology and siting criteria make it difficult to place samplers. New health effects studies have shown that particles less than 2.5 microns may be critical at even lower concentrations. Measuring these particles will require a new sampling methodology; a new PM network is in the process of being implemented.

Discussion

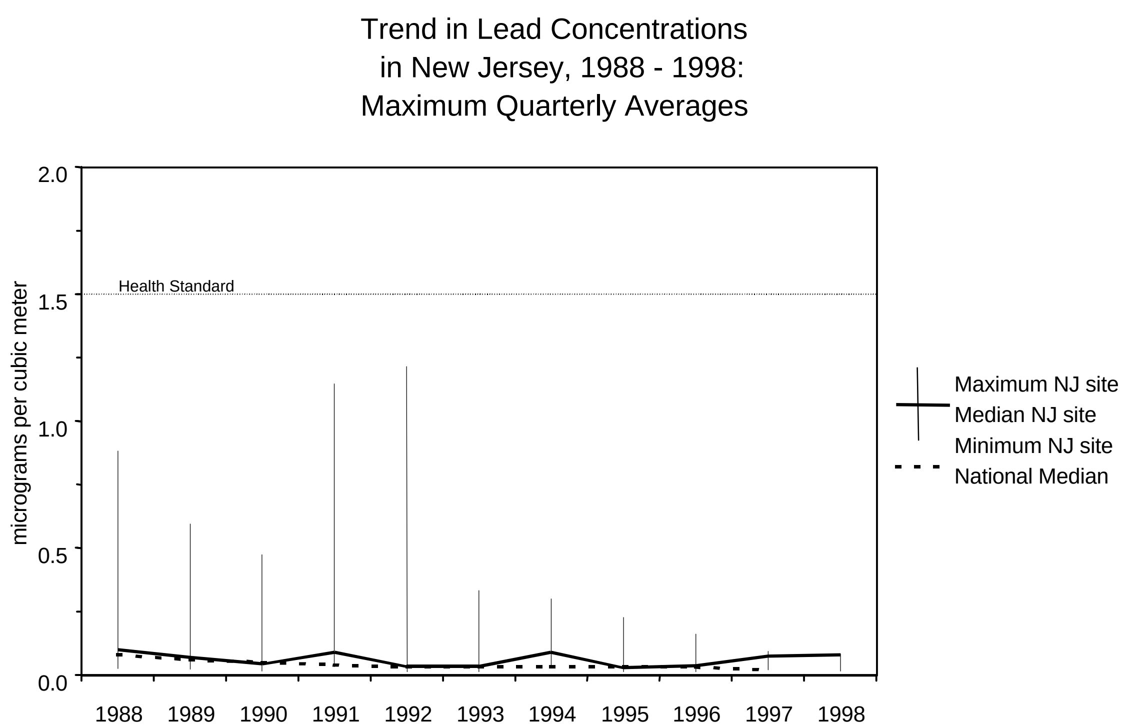
In calendar year 1998, there were no exceedances of the NAAQS for particulate matter. A maximum 24-hour average of 237 ug/m^3 was recorded by a sampler located in Fort Lee. However, since the standard is based on an annual average, the latter reading does not represent an exceedance. The chart above shows trends in PM10 levels from 1988-1998. The trend in New Jersey values is consistent with the national trend, as shown in the chart.

Objective: Maintain the current attainment status for lead (Pb).

Indicator: Number of Exceedances of the Lead Standard

Type of Indicator: Condition

Concentrations of lead in outdoor air are collected and compared to the national air quality standard. There have been no exceedances of the national standard in the past decade. However, in 1992 there was an exceedance of the New Jersey ambient air quality standard, which has the same value as the national standard but is calculated on a rolling average basis.[4]



Data Description

Lead may be found in ambient air as particulate matter. Motor vehicles were the largest source of lead in the air prior to the phase-out of leaded gasoline in the late 1970s. Lead is now primarily emitted from industrial sources including petroleum refining, municipal solid waste incineration, and smelting operations. Many old paints also contained lead which can enter the air during paint removal operations.

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4 The National Ambient Air Quality Standard for lead is set at 1.5 $\mu g/m^3$ over a calendar quarter.

In young children, exposure to airborne lead has been associated with behavioral changes and decrease in cognitive ability. About 40 percent of airborne lead is absorbed by the lungs and accumulates in the bones and may be released into the bloodstream under certain conditions such as a feverish illness or old age. There were no exceedances of the lead standard in 1998.

Data Characteristics

Lead concentrations in ambient air are determined by laboratory analysis of total suspended particulate 24-hour samples generally taken on a once every six-day sampling schedule. This schedule ensures that data are collected on different days of the week throughout the year. Results are processed quarterly for comparison to the NAAQS and data are published annually. Data can be obtained by writing or calling the Bureau of Air Monitoring at 401 East State Street, P.O. Box 418, Trenton, New Jersey 08625; (609) 292-0138. The following is a website that provides air quality information: www.state.nj.us/dep/airmon.

Data Strengths and Limitations

The ambient air sampling database for lead is long term and high in quality, but using the calendar quarterly average as an indicator does have some limitations. Since sampling is conducted on a predetermined schedule, some high concentrations may be missed. Since the phase-out of leaded gasoline, only sampling locations near lead emissions point sources will be needed and population oriented sampling is being discontinued. Lead data are also not available on a real-time basis because of the required laboratory analyses which are also conducted quarterly.

Discussion

In calendar year 1998 there were no exceedances of the NAAQS for lead. The New Jersey standard for lead, which has the same value as the national standard but is calculated on a rolling average basis, has not been exceeded in New Jersey since 1992. The maximum quarterly average recorded in 1998 was 0.082 ug/m^3 in the vicinity of an industrial source in New Brunswick. The chart above shows long term trends in lead concentration in ambient air. The trend in New Jersey values is consistent with the national trend, as shown in the chart.

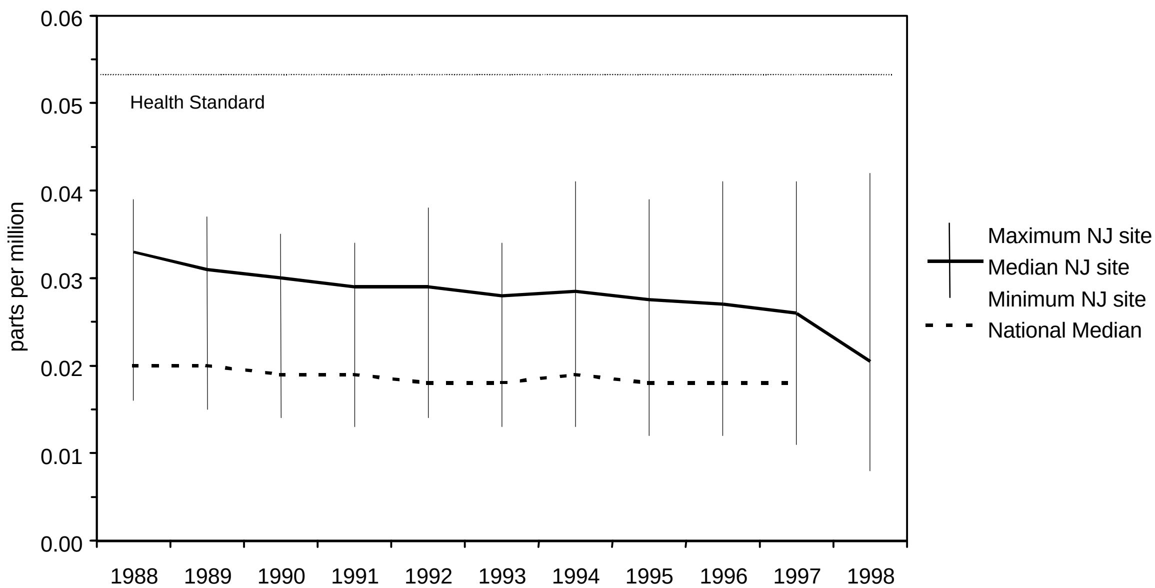
Objective: Maintain current attainment status for nitrogen dioxide.

Indicator: Number of Exceedances of the Nitrogen Dioxide Standard

Type of Indicator: Condition

Concentrations of nitrogen dioxide are monitored at 10 sites and compared to the national air quality standard. The standard for nitrogen dioxide has not been exceeded in New Jersey since 1973. On a statewide basis, there has been very little change in nitrogen dioxide concentrations during the past decade.[5]

Trend in Nitrogen Dioxide Concentrations
in New Jersey, 1988 - 1998:
Annual Averages



Data Description

Nitrogen dioxide is a light brown gas that can become an important component of urban haze. Nitrogen oxides usually enter the air as the result of high temperature combustion processes, such as those occurring in motor vehicles and power plants. Home heaters and gas stoves also produce substantial emissions of nitrogen dioxide. Nitrogen oxides play an important role in the atmospheric reactions that generate ozone, in the formation of the nitric acid constituent of acid rain, and in the formation of fine particulate nitrates which can travel long distances before deposition.

[5] The National Ambient Air Quality Standard for nitrogen dioxide is set at an annual average of 0.05 ppm.

Healthy individuals experience respiratory problems when exposed to high levels of nitrogen dioxide. Asthmatics are especially sensitive and changes in airway responsiveness have been observed in some studies of exercising asthmatics exposed to relatively low levels of nitrogen dioxide. Many animal studies suggest that nitrogen dioxide impairs the respiratory defense mechanisms and increases the susceptibility to infections. There were no exceedances of the nitrogen dioxide standards in 1998.

Data Characteristics

Nitrogen dioxide concentrations in ambient air are measured by the NJDEP on a continuous basis and summaries of this and other air pollution data are published annually. NJDEP's Geographic Information System receives hourly updates of nitrogen dioxide data and these are also available on the NJDEP webpage (http://www.state.nj.us/dep/airmon). Data can also be obtained by writing or calling the Bureau of Air Monitoring at 401 East State Street, P.O. Box 418, Trenton, New Jersey 08625; (609) 292-0138. Health advisories would be issued to the media if nitrogen dioxide levels exceeded the primary standard.

Data Strengths and Limitations

The ambient monitoring database for nitrogen dioxide is long term and high in quality. Nitrogen dioxide is monitored at 10 locations statewide. While this provides reasonable coverage there are large areas of the state without monitors. In addition, since most monitors are placed to determine general population exposure, there may be local areas of higher concentrations that are missed.

Discussion

In calendar year 1998, all 10 of the monitoring locations for nitrogen dioxide were in compliance with the NAAQS. The standard for nitrogen dioxide has not been exceeded in New Jersey since 1973. In 1998, the highest annual average of 0.042 parts per million was calculated for the Elizabeth Lab monitoring location. The chart above shows nitrogen dioxide levels from 1988 - 1998. On a statewide basis, there has been very little change in nitrogen dioxide concentrations during the past decade.

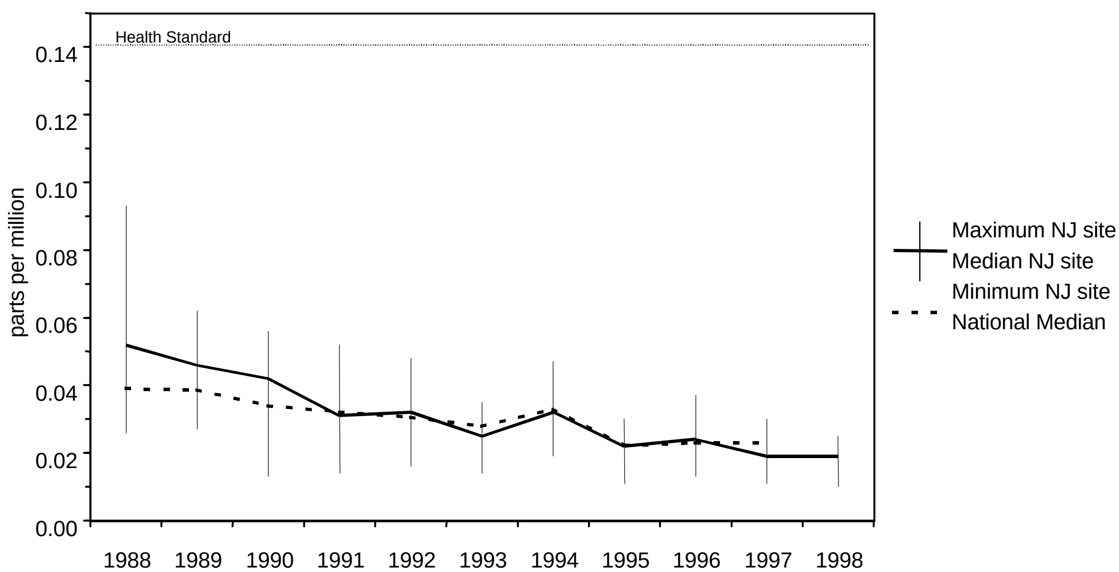
Milestone: Attain sulfur dioxide (SO_2) standard statewide by 2000.

Indicator: Number of Exceedances of the Sulfur Dioxide Standard

Type of Indicator: Condition

Concentrations of sulfur dioxide are measured in ambient air and compared to the national air quality standards. In recent years there have been no monitored violations of the standard. However, dispersion modeling indicates that there is a nonattainment area in Warren County.[6]

Trend in Sulfur Dioxide Concentrations
in New Jersey, 1988 - 1998:
Second Highest Daily Averages



Data Description

Sulfur dioxide is a colorless reactive gas that is odorless at low concentrations, but pungent at higher concentrations. It is emitted primarily when fossil fuels and ores that contain sulfur are burned or processed. Major sources of sulfur dioxide are fossil fuel-burning power plants and industrial boilers.

Exposure to sulfur dioxide can cause impairment of respiratory function, aggravation of existing respiratory disease (especially bronchitis), and a decrease in the ability of the lungs to clear

[6] The National Ambient Air Quality Standards for sulfur dioxide are set for three different averaging times. The 3-hour standard is 0.5 ppm; the 24-hour standard is 0.14 ppm; and the annual average is 0.03 ppm.

foreign particles. It can also lead to increased mortality, especially if elevated levels of particulate matter are also present. Effects of short-term peak exposures show that sulfur dioxide generally increases airway resistance in the lungs and can cause significant constriction of the air passages in sensitive asthmatics. These changes in lung functions are accompanied by perceptible symptoms such as wheezing, shortness of breath, and coughing. There were no exceedances of the sulfur dioxide standard in 1998.

Data Characteristics

Sulfur dioxide concentrations in ambient air are measured by the NJDEP on a continuous basis and summaries of this and other air pollution data are published annually. NJDEP's Geographic Information System receives hourly updates of sulfur dioxide data and these are also available on the NJDEP web page (http://www.state.nj.us/dep/airmon). Data can be obtained by writing or calling the Bureau of Air Monitoring at 401 East State Street, P.O. Box 418, Trenton, New Jersey 08625; (609) 292-0138. Health advisories would be issued to the media if sulfur dioxide levels exceeded the primary standard.

Data Strengths and Limitations

The ambient monitoring database for sulfur dioxide is long term and high in quality, but using the number of exceedances of the standard as an indicator does have some limitations. Sulfur dioxide is monitored at 15 locations statewide. While this provides reasonable coverage, there are large areas of the state without monitors. In addition, since most monitors are placed to determine general population exposure, there may be local areas of higher concentrations that are missed. As recent evidence indicates that short-term (five minutes or less) exposure to higher concentrations of sulfur dioxide may also produce adverse health effects, these gaps in the network may be especially significant near large individual sources.

In the case of sulfur dioxide, the ambient air monitoring has proven to be insufficient to demonstrate statewide compliance with the air quality standard. For this pollutant, a portion of Warren County has been designated to be in nonattainment on the basis of dispersion modeling results; and dispersion modeling will be used in the future to show attainment, since there is not presently a monitoring site in the vicinity. Because of the modeled nonattainment status of this region, the current milestone for this pollutant is to attain the standard statewide, even though there have been no actual measured violations for many years.

Discussion

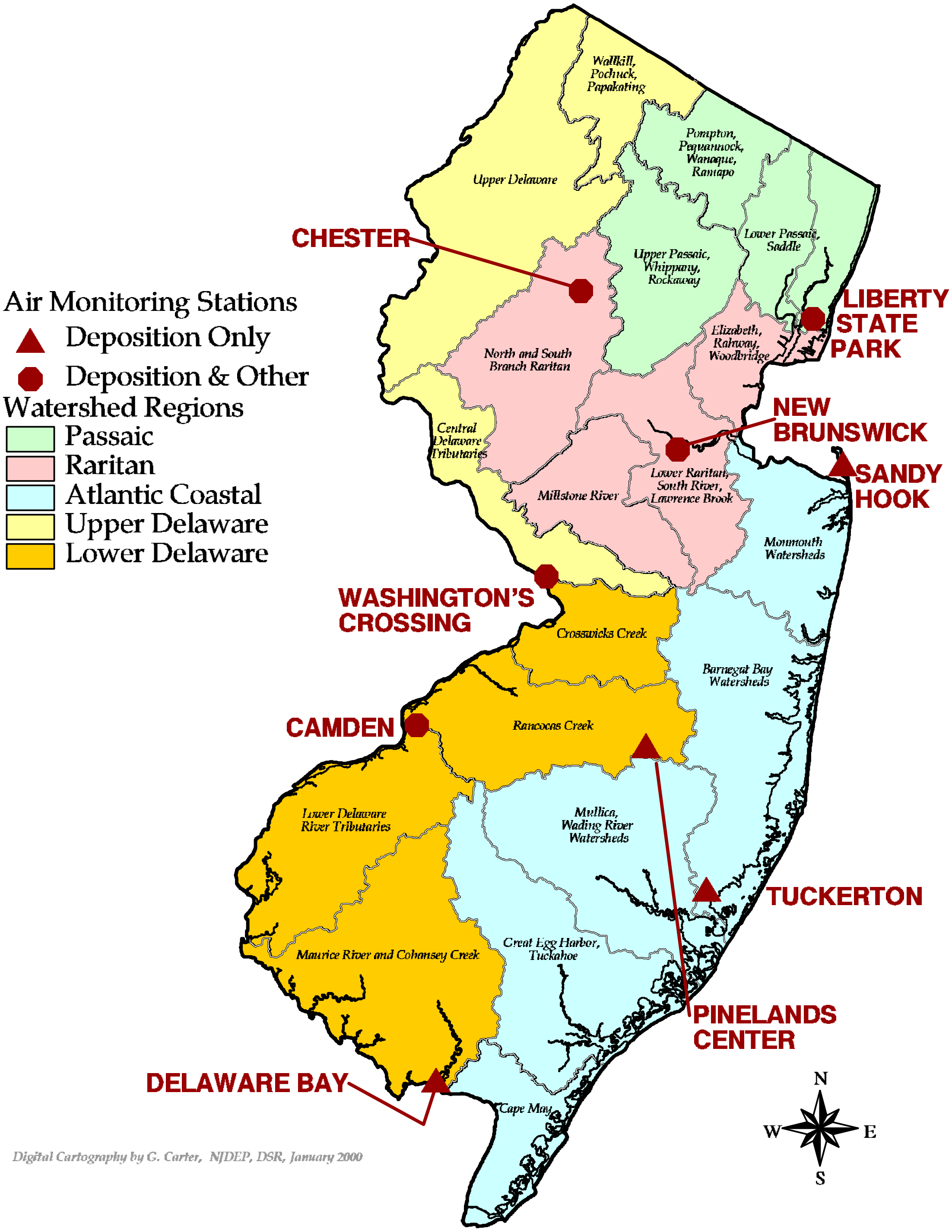
In calendar year 1998, there were no exceedances of the NAAQS for sulfur dioxide. The standard for sulfur dioxide has not been exceeded in New Jersey since 1974. The maximum 24-hour average recorded in 1998 was 0.031 parts per million. This value was reached at the following sites; Elizabeth Lab; Jersey City; and Newark. The maximum three-hour average of 0.076 parts per million was recorded at Clarksboro. The highest annual average of 0.090 parts per million was calculated for the Jersey City site. The chart above shows trends in sulfur dioxide levels from 1988 - 1998. There has been little change statewide in sulfur dioxide concentrations over this time period. Dramatic reductions in sulfur dioxide concentrations were seen, however, between 1967 and 1971, a period in which several sulfur regulations went into effect in New Jersey.

Introduction - Air Deposition

Atmospheric deposition is known to be an important non-point source input to aquatic and terrestrial ecosystems. The amount of non-point source input to New Jersey from atmospheric deposition, and the location of contributing point and/or area sources, has not been sufficiently evaluated. To determine how much non-point loading to land and water bodies is due to atmospheric deposition and to determine the sources of these pollutants, the NJDEP has contracted with Rutgers University to develop the New Jersey Atmospheric Deposition Network (NJADN). The NJADN has two major objectives: (1) gain an understanding of the magnitude of toxic and other chemical deposition throughout State and (2) assess the relative contributions of in-state versus out-of-state sources of air toxics and other air pollutants.

The NJADN consists of 9 sites throughout the state where atmospheric deposition data will be collected for 3 years. Parameters to be measured include a suite of toxic organics including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and chlorinated pesticides, mercury, metals and the nutrients nitrogen and phosphorous. The NJADN design is based on the well-developed atmospheric deposition programs in the Great Lakes and the Chesapeake Bay. The sites were selected to evaluate several issues: influences of nearby urban areas such New York City and Philadelphia, PA on New Jersey (New Brunswick, Liberty Science Center and Sandy Hook for New York, and Camden for Philadelphia), mechanisms of pollutant transport over either short or long distances (Salem when the wind direction is from the south, Washington's Crossing when the wind direction is from the west) and impacts to sensitive watershed management areas (Tuckerton and Pinelands). Rainfall is collected on an event basis, while air samples (both particulate and gaseous forms) are being collected for 24 hours every 12 days. The sum of the wet (rainfall) and air (dry) concentrations will be adjusted for the amount of rain collected and the amount of air collected, respectively, and then summed to derive total deposition values. The network sites are shown on the map below.

Air Deposition Monitoring Stations and Watershed Management Areas



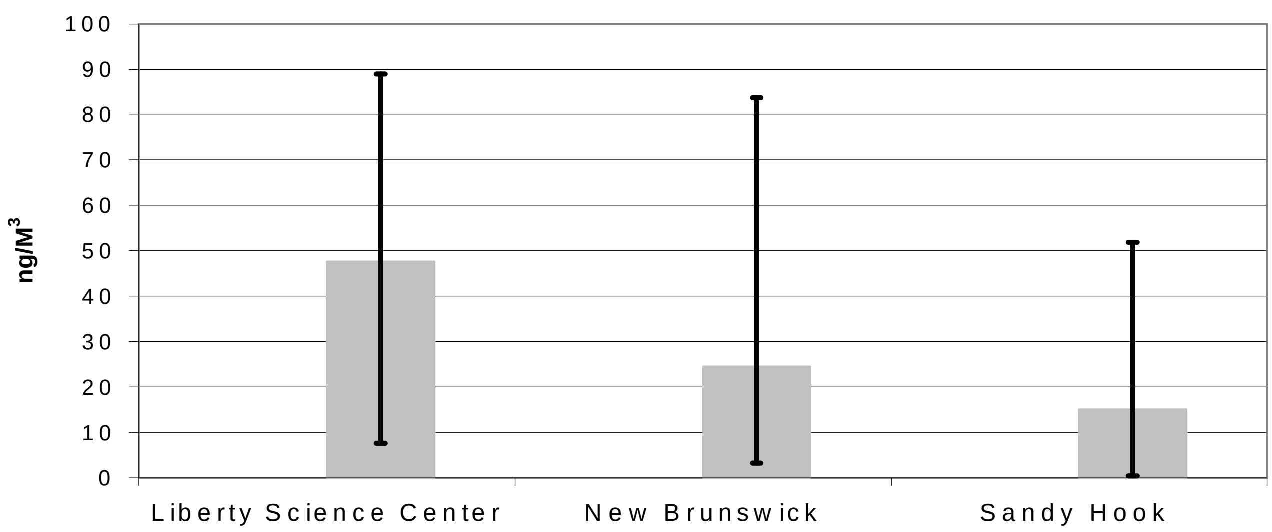
Milestone: By 2010, total air deposition loading to land and water in NJ will be reduced compared to 1998 baseline levels.

Indicator: Air Concentrations for Polycyclic Aromatic Hydrocarbons (PAHs) at New Brunswick, Liberty Science Center and Sandy Hook

Type of Indicator: Condition

The data shown are preliminary data on atmospheric concentrations of total PAHs. This indicator shows gaseous air concentrations) for total PAHs at New Brunswick from October 1997 to July 1999, at Liberty Science Center from July 1998 to July 1999, and at Sandy Hook from February 1998 to July 1999. Also shown are gas- and particle-phase atmospheric concentrations at the New Brunswick site for one calendar year of the period. Concentrations of gas phase PAHs are typically much higher particle phase concentrations. The levels of PAHs at the Liberty Science Center and at New Brunswick are 2-4 times higher than at the coastal site at Sandy Hook, suggesting significant local urban sources impacting the Liberty Science Center and New Brunswick.

Figure 1
Total PAH Gas Phase Air Concentrations and Range



Data Description

The New Jersey Atmospheric Deposition Network (NJADN) was established in late 1997 to measure the amounts of nutrients, organics and metals in air and rain to determine the deposition of these pollutants and their potential impacts, particularly on water resources. Data have been reported for three sites (New Brunswick, Sandy Hook and Liberty State Park) for periods of from 2 to 22 months; the remaining six monitoring sites are now collecting data. PAHs are semi-volatile organic compounds that are by-products of fossil fuel combustion and have been shown to have deleterious effects on human health. Figure 1 compares air concentrations at 3 sites for total PAHs. Figure 2 shows trends for monthly summations of 38 individual PAH species from air samples collected for 24 hours every 9 days at New Brunswick.

Data Characteristics

Sample collection and analyses are being performed by a research group at Rutgers University, Cook College. All data are at least ten times the minimum detection level. Data are maintained at Rutgers University; for more information contact the Division of Science, Research and Technology (609-984-6070). Individual PAHs have been measured separately in the gas, particle, and precipitation phases; the data here show total aggregated air concentrations for both particle- and gas-phase species at one site and total aggregated air gas-phase concentrations at three sites.

Data Strengths and Limitations

The data obtained to date are the first comprehensive look at air concentrations of PAHs in New Jersey. More data at each of the nine sites need to be collected and analyzed to develop information representative of the entire state. There is no estimate of the collection efficiency of precipitation and/or aerosol by the sampling equipment.

Discussion

Concentrations of gas-phase PAHs are much higher than those from particle-phase, indicating the potential for long-range transport of these species. The levels at New Brunswick are 2-4 times higher than at the coastal site at Sandy Hook, suggesting the possibility of significant local urban sources at New Brunswick. Data from the Liberty Science Center are in the same concentration range as New Brunswick. These values appear relatively high compared to other urban regions in the U.S., except for Chicago, Illinois, although the concentrations are perhaps 10x lower than observed in the Newark, NJ area in the early 1980s.[7] When more data from these and other NJADN sites are obtained, use of specific PAH ratios and back trajectory analyses utilizing meteorological information on the movement of air masses will be utilized to attribute PAHs to specific source areas.

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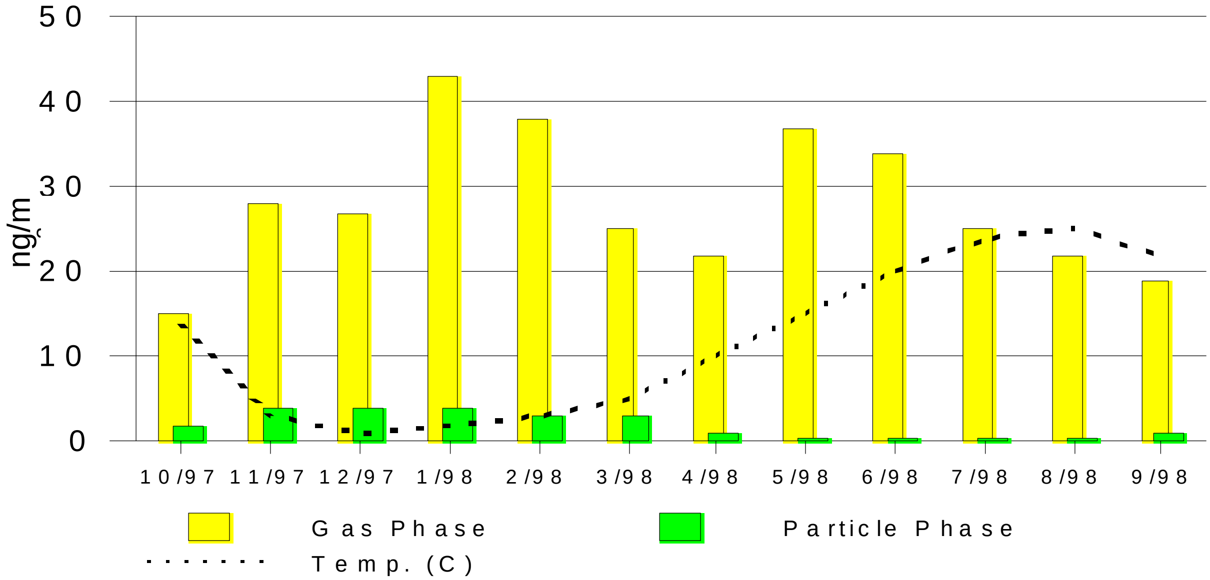
7 Eisenreich, S.J., C. L. Gigliotti, P.A. Brunciak, J. Dachs, T.R. Glenn IV, E.D. Nelson, L. A. Totten, D A. Van Ry, Persistent Organic Pollutants in the Coastal Atmosphere of the Mid-Atlantic States – USA, ACS Symposium Book Series, In Press, 2000.

Figure 2

Total PAHs in Air at New Brunswick

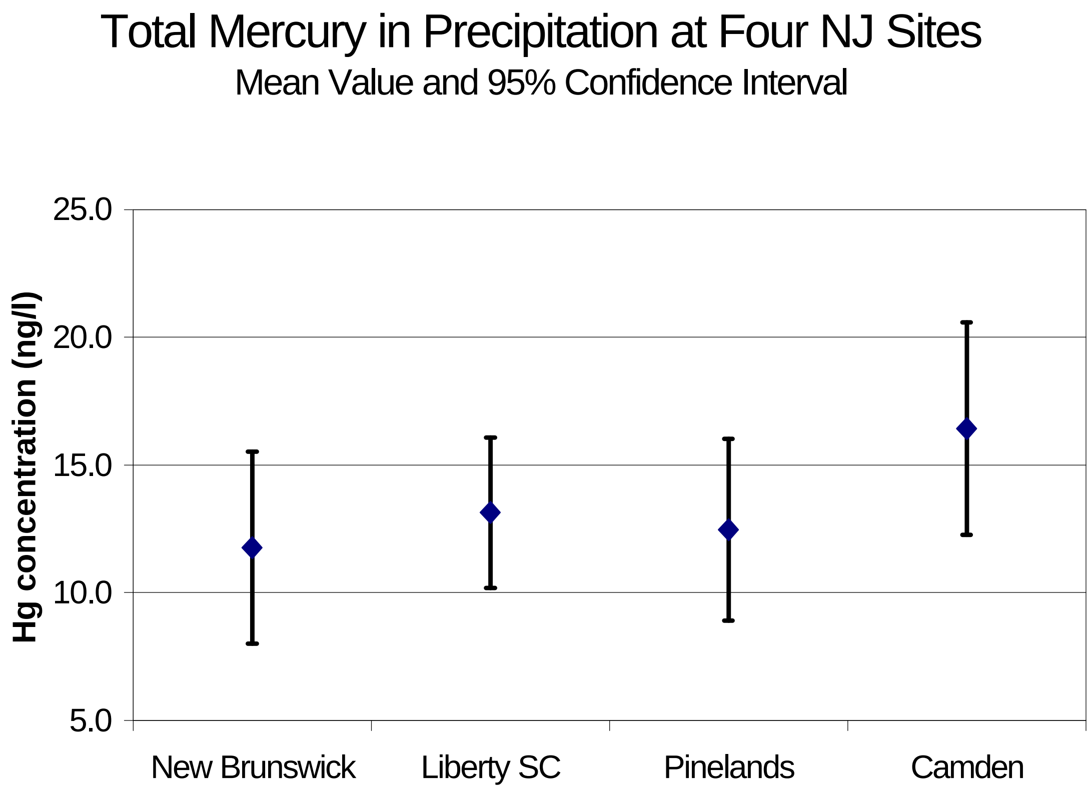


Milestone: By 2010, total air deposition loading to land and water in NJ will be reduced compared to 1998 baseline levels.

Indicator: Air and Rainfall Concentrations for Mercury at Sandy Hook

Type of Indicator: Condition

The data shown are baseline data to determine atmospheric deposition for mercury (Hg) in New Jersey, reported for New Brunswick and Liberty Science Center from November 1999 to August 2000 and for the other two sites from February or March 2000 to August 2000. Concentrations of Hg in precipitation at these sites appear to be somewhat higher than, but in the same general range as precipitation Hg concentrations in the eastern U.S.



Data Description

The NJADN was established in late 1997 to measure the amounts of nutrients, organics and metals in air and rain to determine the deposition of these pollutants and their potential impacts, particularly on water resources. Mercury is of concern because of its impacts on biota and fish and the detrimental effects on human health of eating mercury-contaminated fish. There is also significant interest in identifying and reducing specific mercury emission sources. All nine

NJADN sites are currently operational. Particulate air samples are collected every 12 days, as well as event collections of wet deposition.

Data Characteristics

All data are ten times the minimum detection level. This is sufficient for measurement by cold-vapor atomic emission spectroscopy. Sample collection and analyses are being performed by a research group at Rutgers University, Cook College. All data are maintained at Rutgers. For more information contact the Division of Science, Research & Technology (609-984-6071).

Data Strengths and Limitations

Samples have been collected for which data have not yet been reported. More data at each of the nine sites need to be and analyzed to develop information representative of the entire state. There is no current information on the collection efficiency of precipitation and/or aerosol by the sampling equipment for Hg. Additional research is planned to address this issue.

Discussion

Preliminary analyses of the data suggest that concentrations in precipitation are higher in the summer months than in the winter. It also appears from the data that concentrations are higher in the Camden area than elsewhere, suggesting the influence of local or regional sources.

A weighted average of the mean concentration in precipitation suggests a statewide level in the range of 13 ng/l, which translates to an annual wet deposition in New Jersey in the range of 15µg/m^2/yr . Average wet deposition in the eastern U.S. & eastern Canada is in the range of 10µg/m^2/yr.8 Dry deposition can be expected to add perhaps another 40% to the total, based on preliminary estimates.

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8 Sweet, C., E. Prestbo, and B. Brunette, Wet deposition of mercury in the U.S. and Canada, presented at "Mercury in the Environment Specialty Conference," September 15-17, 1999, Minneapolis, MN, Proceedings published by Air and Waste Mgmt. Assoc., Pittsburgh, PA

Milestone: By 2010, total air deposition loading to land and water in NJ will be reduced compared to 1998 baseline levels.

Indicator: Air Concentrations and Deposition for Metals at Sandy Hook

Type of Indicator: Condition

Data for metals, Cl^-, NO_3^-, and SO_4^{--} have been reported for one year at New Brunswick and Liberty Science Center and for approximately 6 months at Pinelands and Camden. Mean deposition values for these elements have been calculated based on data made available through the NJADN project.

Mean Concentration of Trace Metals in Rain (mg/L)

	New Brunswick	Liberty Sci. Center	Pinelands	Camden
Mg	55.13	80.83	59.05	91.28
Pd	0.01	0.01	0.00	0.01
Ag	0.01	0.02	0.00	0.00
Cd	0.05	0.07	0.03	0.10
Sb	0.07	0.14	0.24	0.15
Pb	1.36	2.35	0.61	3.20
Al	17.88	23.31	18.33	37.23
V	0.42	0.73	0.36	0.97
Cr	0.17	0.16	0.05	0.21
Mn	2.32	1.98	2.31	3.69
Fe	23.35	38.15	14.96	49.78
Co	0.04	0.11	0.02	0.14
Ni	0.59	1.10	0.36	0.62
Cu	1.17	2.02	0.41	2.08
Zn	7.48	8.97	7.39	15.17
As	0.09	0.11	0.15	0.17
Hg(pM)	58.82	65.66	62.36	82.14
Cl-(uM)	11.41	23.00	10.75	22.64
NO3-(uM)	32.59	31.76	32.81	42.14
SO4--(uM)	24.03	26.45	23.88	29.66

Data Description

The New Jersey Atmospheric Deposition Network (NJADN) was established in late 1997 to measure the amounts of nutrients, organics and metals in air and rain to determine the deposition of these pollutants and their potential impacts, particularly on water resources. These data are combinations of measurements of air (gas and particle) and rainfall. Rainfall samples are event collections of wet-only deposition. All 9 NJADN sites are currently in operation .

Data Characteristics

All data are at least 10 times the minimum detection level, which means that we have collected sufficient amounts of particulate and rainfall and that the concentrations of metals in both media are of high enough concentration to be quantified by analysis using inductively-coupled plasma mass spectroscopy. Sample collection and analyses are being performed by a research group at Rutgers University, Cook College. For more information contact the Division of Science, Research & Technology (609-984-6071).

Data Strengths and Limitations and Discussion

More data at each of the nine sites need to be collected and analyzed to develop information representative of the entire state. There is no information on the collection efficiency of precipitation and/or aerosol obtained by the sampling equipment. Research is being planned to address this issue.

Introduction - Radiation Protection

A. Indoor Radon

NJDEP is also concerned with the quality of indoor air for New Jersey residents. Indoor air may be affected by a variety of sources, from indoor application of pesticides and use of various consumer products to infiltration of outdoor pollution. The primary responsibilities for NJDEP related to indoor air pollutants are indoor application of pesticides and infiltration of radon (pesticides applications are addressed in the Pesticides section of this document).

Radon is a colorless, odorless, and tasteless radioactive gas that is a naturally occurring decay product of uranium-238. While outdoor radon concentrations are relatively low, radon can become concentrated to unhealthy levels in confined homes and buildings. Radon is the second-leading cause of lung cancer after smoking. In 1991, a certification program was established to regulate mitigation and testing in New Jersey. Today there are over 700 certified businesses and individuals in the state.

Since 1985, NJDEP has been working to educate the public about the risks associated with radon. An extensive outreach program exists that targets homeowners, builders, real estate professionals, schools, local code officials, health officials, and numerous others. In the last several years, radon testing has become a routine, although not mandatory, part of real estate transactions thus increasing the level of radon awareness in New Jersey.

From the radon test data, a Tier Assignment Report and corresponding Tier Map have been developed which define municipalities as having low (Tier 3), moderate (Tier 2), or high radon potential (Tier 1). NJDEP recommends that mitigation be considered if the radon concentration is 4 pico-Curies per liter (pCi/l) or greater. Test data indicate that a majority of the counties in New Jersey have some homes with radon concentrations over 100 pCi/l. In addition, at least six counties have more than 40 schools in Tier 1 (high radon potential) areas.

B. Radiation Exposure

There are four commercial nuclear power plants operating in New Jersey (Salem I, Salem II, Hope Creek and Oyster Creek). NJDEP has continuously monitored the radiation levels in the environment around each nuclear power generating station from the beginning of each reactor's operation. In 1997, nuclear energy supplied approximately 60% (13.9 million megawatt-hours) of the electricity generated in the State. Currently, New Jersey receives approximately 35% of its electricity from nuclear power. Approximately 55% of the electricity produced from New Jersey in-state sources is from nuclear power plants.[9] Coal is the dominant power source for electricity consumed in New Jersey, much of which is produced elsewhere. Coal would likely play an even larger role should nuclear capacity decline.

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[9] USEPA, 1999, Emissions Generation Resource Integrated Database (E-GRID), Version 1.2, USEPA Acid Rain Division, February, 1999. (http:/www.epa.gov/acidrain/egrid/egrid.html)

Despite the positive aspects of nuclear energy technology, its use can increase the public's exposure to radiation. Radiation is a proven cause of human cancer; the prevailing scientific belief is that any exposure to radiation increases the risk of cancer. One of the primary objectives for radiation control is to reduce or control the ambient radiological emissions from nuclear power plants. To ensure the safe operation of New Jersey's nuclear power plants, NJDEP evaluates the licensing criteria, operational safety, environmental impact, and emergency preparedness of the plants.

Specific to reducing or controlling air pollutants, the New Jersey Radiation Accident Response Act directed the development and implementation of a comprehensive monitoring strategy, which includes the daily monitoring of levels of radioactivity in the environment. To do this, the Department operates and maintains an Environmental Surveillance and Monitoring Program (ESMP) - data for which are collected at and beyond the site boundaries of the nuclear generating stations. Through the ESMP, potential hazards that may impact on the public's health and safety can be analyzed and mitigated. Information is provided to the public through annual environmental surveillance and monitoring reports.

The indicators in this section will be used to monitor the risks associated with specific nuclear energy technology practices.

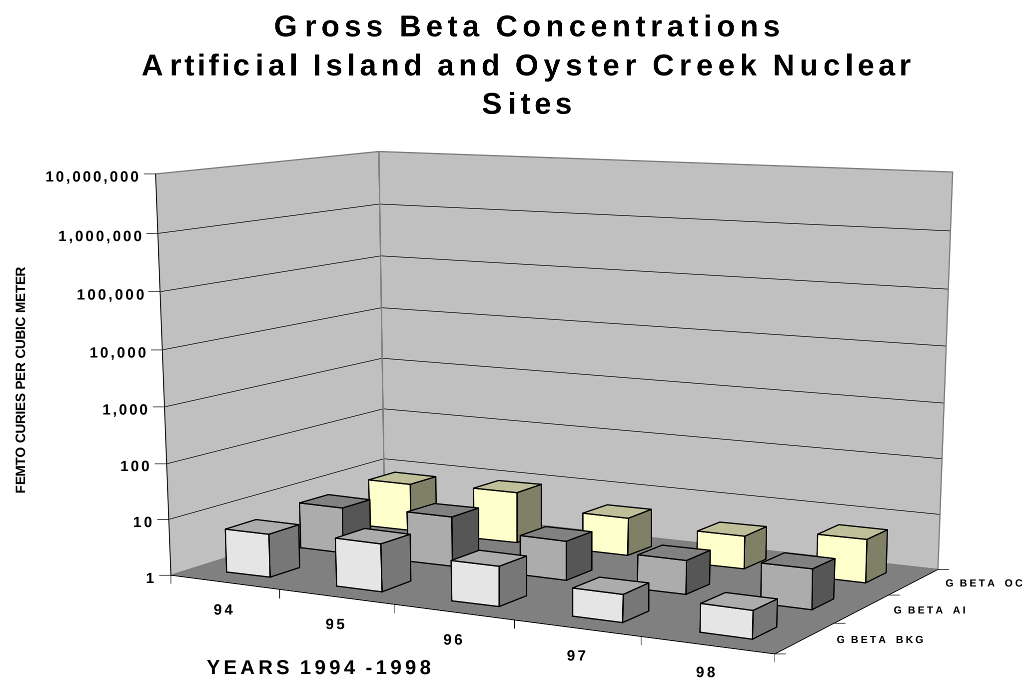
Milestone: **Reduce or control the airborne radiological emissions from nuclear power plants to below 10 millirem/year. Reduce or control the number of unmonitored pathways for airborne radiological emissions to under 10% of the annual reportable airborne discharge**

Indicator: **Weekly Analysis of Air Charcoals and Particulate Filters for Gross Beta and Specific Gamma**

Type of Indicator: Condition

The NJDEP operates and maintains an Environmental Surveillance and Monitoring Program (ESMP) that independently monitors and assesses radiation in the environment outside the site boundaries of the four nuclear power generating stations in New Jersey. The information obtained from the ESMP is used to determine the effect of the operation of the nuclear power plants, if any, on the environment and the public. From the results obtained, it can be concluded that the concentrations of radionuclides measured in air were not significantly different than the ambient background radiation levels. In fact, to monitor any concentrations of significance, radiological emissions would have to be almost 10,000 times higher than those detected by the ESMP.

Iodine – 131 Concentrations
Artificial Island and Oyster Creek Nuclear Sites



Data Description

The NJDEP operates and maintains an ESMP that independently monitors and assesses radiation in the environment outside the site boundaries of the four nuclear power generating stations in New Jersey. The information obtained from the ESMP is used to determine the effect of the operation of the nuclear power plants, if any, on the environment and the public.

Artificial Island is the site of Salem I, Salem II, and Hope Creek nuclear generating stations. A fourth nuclear generating station is located at Oyster Creek. Part of the ESMP includes air monitoring and analysis of specific gamma and gross beta radionuclides at ten sites in the immediate vicinity of the power generating stations. Of the specific gamma radionuclides, iodine-131 is of particular interest because it is the most abundant radionuclide measured at a nuclear power plant. Continuous air samplers containing chemically treated cartridges and filters allow weekly collection of iodine-131 (specific gamma) and air particulates (gross beta) to evaluate the inhalation pathway. Selection of air sampling sites takes into account population density, atmospheric stability data, prevailing wind direction, and height of the gaseous release point. Air radiation pathways are monitored up to 10 miles from the release point. Background concentrations of specific gamma and gross beta in air are monitored at Lebanon State Forest.

In assessing the impact of radioactivity on the public or environment, it is important to understand the quantity of radioactivity being measured as it relates to allowable release limits and to ambient background levels. The common unit of radioactivity is the Curie (Ci). It represents the radioactivity in one gram of natural radium that is equal to a decay rate of 37 billion radiation emissions every second. Because the level of radioactive material in the environment is very small, it's more convenient to work with fractions of a Curie, such as the femtoCurie (fCi) which is one one-millionth of a billionth of a Curie.

In accordance with the Nuclear Regulatory Commission's 10CFR20 (Appendix B), nuclear generating facilities are allowed to release a maximum average concentration of $2x10^{-10}$ uCi/ml of I-131, which is equivalent to $2x10^{5}$ femtocuries per cubic meter. This indicator shows average radionuclide in air measurements many orders of magnitude below these maximum permissible average concentrations in air. Specific gamma measurements, in the form of iodine-131, were not significantly above background in any of the air charcoal samples collected weekly from the continuous air monitoring stations. Gross beta and isotopic analysis of air particulate samples did not detect any nuclides of interest. All sites measured were not significantly different than the ambient background concentrations found at Lebanon State Forest. In summary, airborne radiological emissions from New Jersey's four nuclear generating plants were about 0.001 millirem per year (converting an average concentration of 10 femtocuries per cubic meter millirem per year), far below our indicator's milestone which is set at 10 millirem per year.

Data Characteristics

The source of this indicator’s data is the NJDEP's Environmental Surveillance and Monitoring Program or ESMP. The purpose of the ESMP is to monitor the various pathways by which people and the environment could be exposed to radiation. Specific gamma and gross beta measurements are taken weekly. Background measurements are conducted as a comparison to natural radiation sources. Summaries of the data and other radiological environmental monitoring data from the ESMP are published annually in environmental surveillance and monitoring reports. These reports are available through public libraries or through contacting the Bureau of Nuclear Engineering at PO Box 415, Trenton, New Jersey 08625-0415.

Data Strengths and Limitations

The New Jersey Radiation Accident Response Act (N.J.S.A. 26:2D-43.g.) authorizes and directs the NJDEP to "develop and implement a comprehensive monitoring strategy which shall include, but not necessarily be limited to, the daily monitoring of levels of radioactivity in the environment". The ESMP is the result of this legislative authority. Funding is provided through an annual assessment against each utility which has an ownership or operating interest in a nuclear facility located in New Jersey. This regulatory authority provides the mechanism for continuous monitoring and collection of data. Sample collection and analysis rates for FY99 were 92% collected and 95% analyzed. These rates are more than sufficient to provide oversight of the effects, if any, of gross beta and specific gamma measurements on the public and the environment.

Another strength of the air monitoring data is that it's consistent with both the Continuous Radiological Environmental Surveillance Telemetry (CREST) data collected by the NJDEP every minute at 26 sites and with Thermoluminescent Dosimeter (TLD) data collected and analyzed by the NJDEP at 33 sites quarterly. The CREST system is a direct gamma radiation surveillance and monitoring system which has the capability of detecting radiation from background levels up to radiation levels encountered during an emergency. TLD's are the primary detectors used by the NJDEP to monitor gamma radiation in the environment. They are passive and are designed to have the same sensitivity to radiation as human tissue. TLD's provide an integrated exposure dose.

Limitations of the air sampling data may be the result of inoperable air sampling motors or lack of power at a site, although both instances are infrequent. Additionally, predominant wind directions used for siting air box locations change seasonally and don't always flow in the patterns expected which may result in abnormal fluctuations in the data.

Discussion

Fiscal year 1999 air monitoring of the environs of the nuclear generating stations in New Jersey was conducted in accordance with the legislative authority of the New Jersey Radiation Accident Response Act. The measurement of radionuclide concentrations in air was not significantly different than the ambient background radiation levels. The data indicate that none of the four operating nuclear facilities in New Jersey are exceeding the Nuclear Regulatory Commission limitations on air discharges to the environment.

Milestone: By 2005, 25% of the homes in New Jersey will have tested for radon.

Indicators: Average Indoor Radon Concentration per County in NJ
Number of Homes ^{3}4pCi/l, ^{3}50pCi/l, and ^{3}100pCi/l in NJ

Type of Indicator: Condition

Number of Tests vs. Number of Occupied Homes

Type of Indicator: Response

Between 1992 and 1996, approximately 36,000 homes in New Jersey were found to have radon concentrations greater than or equal to 4 pico Curies per liter (pCi/l), which is the concentration at and above which the Department recommends mitigation. The indicator showing the number of homes with radon concentrations ^{3}4pCi/l, ^{3}50pCi/l, ^{3}100pCi/l (Figures 3-5) clearly demonstrates the significant levels of radon and the fact that a majority of the counties have some homes with radon concentrations over 100pCi/l. The response indicator (Figure 6) shows the percentage of the available housing units tested for the presence of either radon or radon decay products since the start of calendar year 1992 to the end of calendar year 1998. This indicator shows that approximately 5.5% of the available housing units in New Jersey were tested for the presence of either radon or radon decay products, during this seven year period.

Figure 1 - Average Radon Concentration from Residential & Non-Residential Structures with Basements

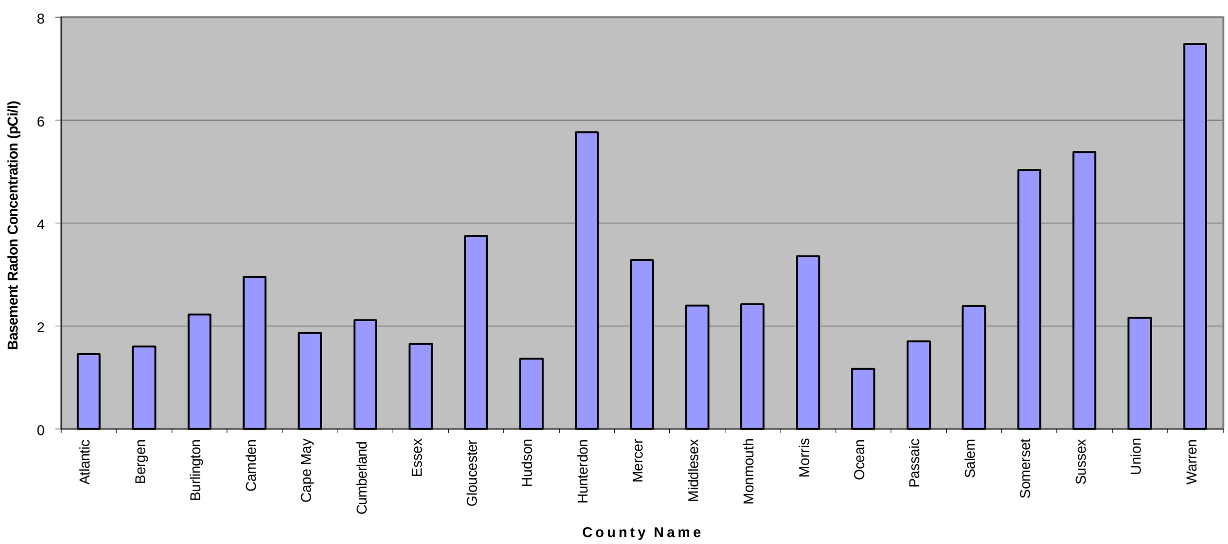


Figure 2 -Average Radon Concentration from Residential & Non-Residential Structures Without a Basement

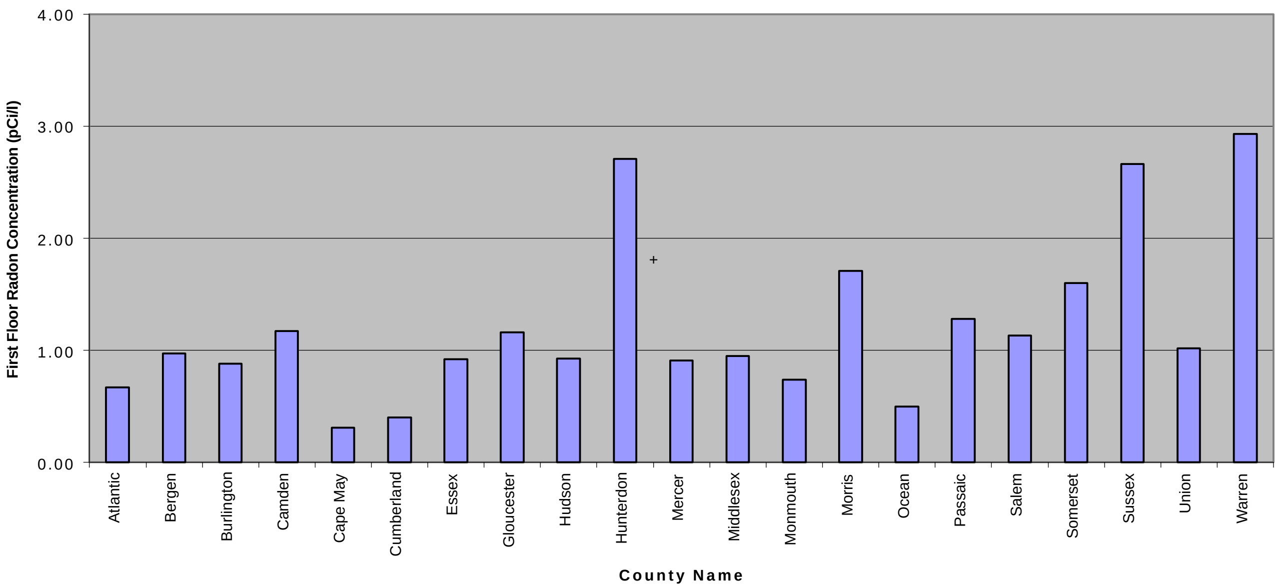


Figure 3 - Distribution of Homes Found to Have Radon Concentrations >= 4 pCi/l

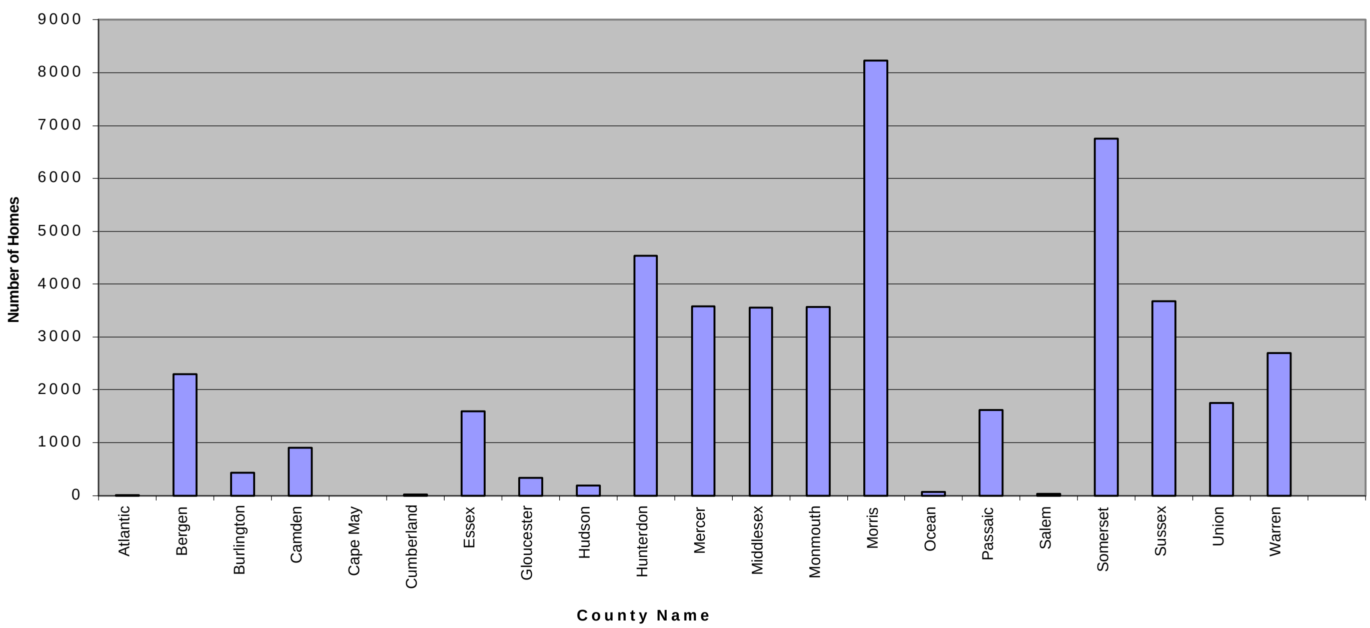


Figure 4 - Distribution of Homes with Radon Concentrations >= 50 pCi/l

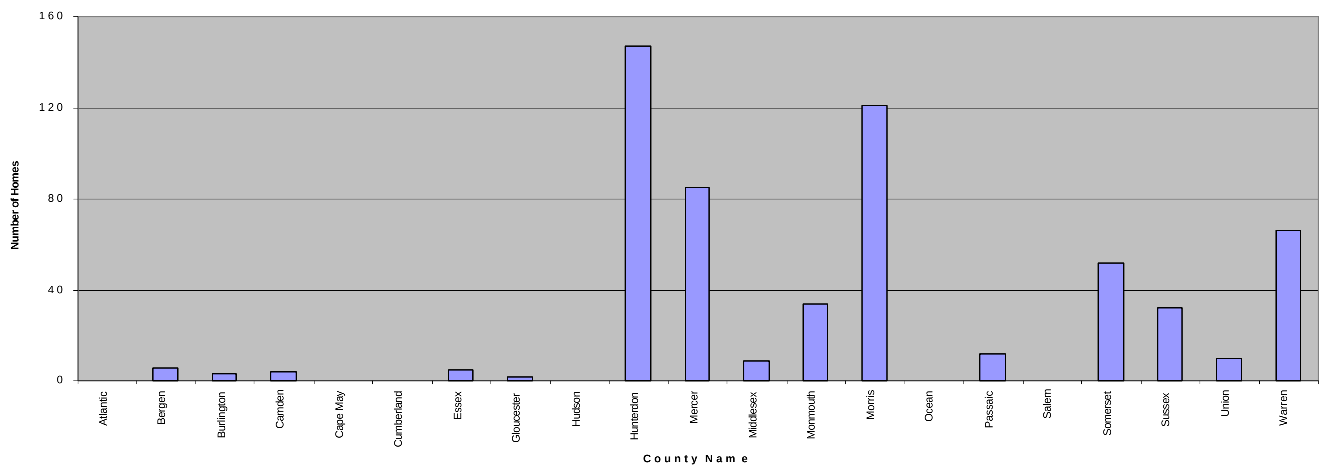


Figure 5 - Distribution of Homes with Radon Concentrations >= 100 pCi/l

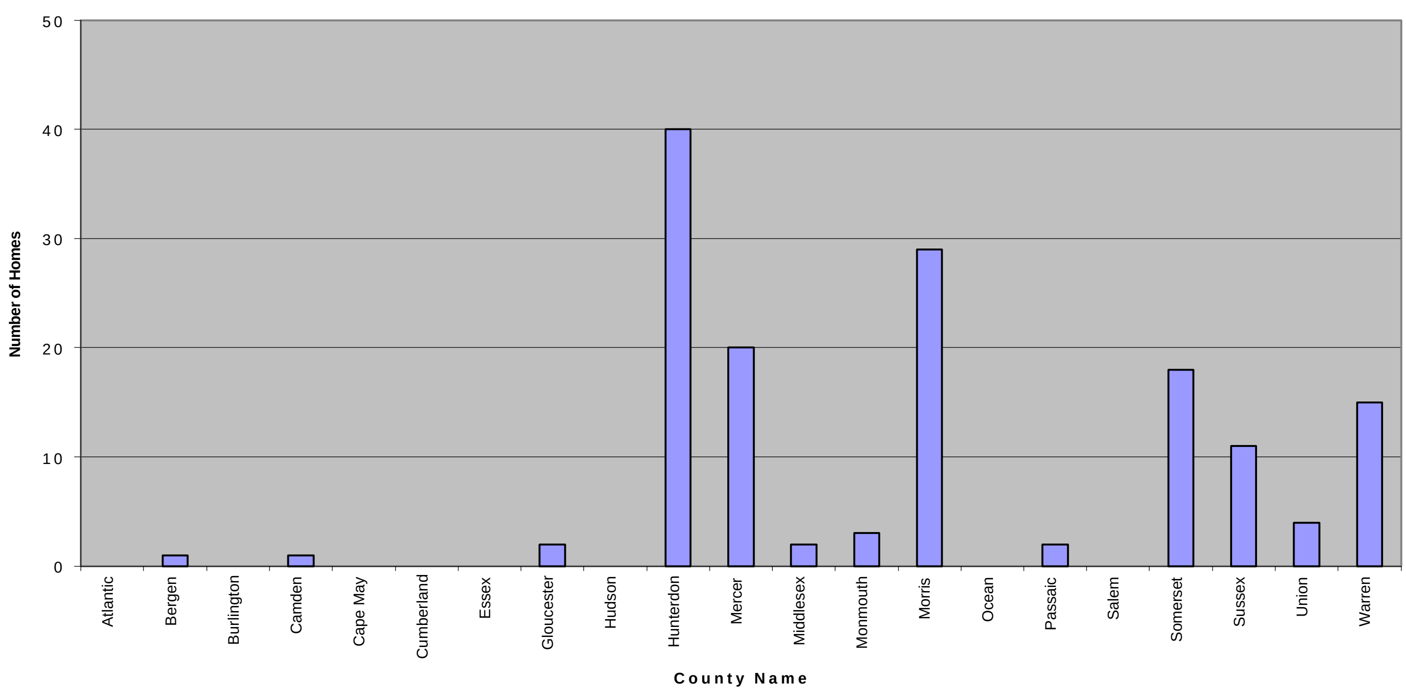


Figure 6 - The Cumulative Percentage of All New Jersey Housing Units Tested for Radon or Radon Decay Products

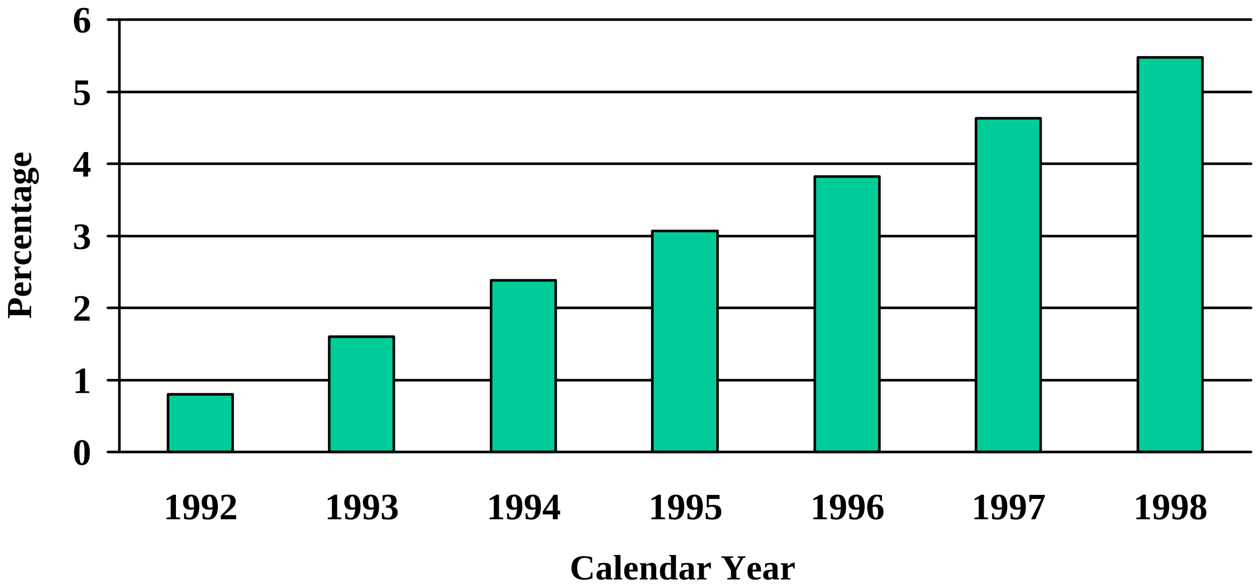
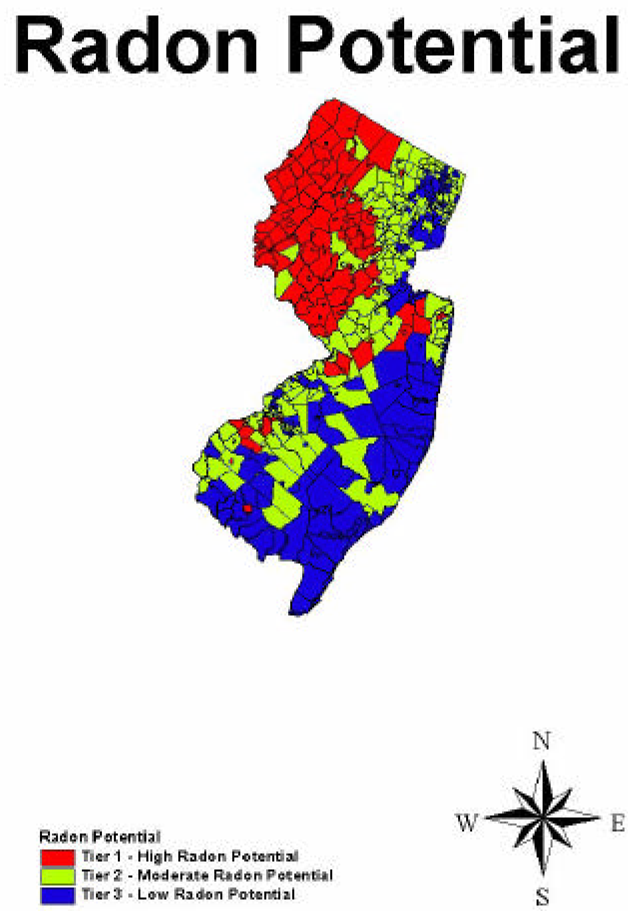


Figure 7.



Data Description

Radon is a naturally occurring radioactive gas that is a decay product of uranium and is found in soil everywhere in varying concentrations. Radon gas can enter buildings through cracks and other openings and may build up to high concentrations. The decay products of radon can damage lung tissue and increase the risk of lung cancer. The New Jersey Department of Environmental Protection recommends testing all homes in New Jersey for radon.

The National Research Council's report of the sixth Committee on Biological Effects of Ionizing Radiation (BEIR VI), released on February 19, 1998, brought radon to the public's attention nationally once again. The BEIR VI report represents the most definitive accumulation of scientific data gathered on radon since the BEIR IV report of 1988. The Committee estimates that 15,400 or 21,800 (estimates vary depending on which of the Committee's preferred two risk models are used) lung cancer deaths may be due to residential radon exposure annually. Of these deaths, the BEIR VI report states, perhaps one-third could be avoided by reducing radon in homes where it is above the action guideline level of 4pCi/l to below the action levels recommended by the Environmental Protection Agency. Although there is some uncertainty in these risk estimates, the report concludes that indoor radon is the second leading cause of lung cancer after cigarette smoking.

Because of New Jersey's diverse geology, average radon levels vary throughout the state. The first indicator provides data on the average radon concentration measured in residential and non-residential basement and slab-on-grade type structures in each county (Figure 1 and 2). Although a county has a low average radon concentration, many counties have some homes with radon concentrations ≥4pCi/l. The second indicator provides a breakdown of the number of homes per county with indoor radon concentrations ≥4pCi/l, ≥50pCi/l, ≥100pCi/l (Figures 3–5). The third indicator (shown in Figure 6) provides the number of homes in New Jersey that have been tested over the past several years for radon.

Data Characteristics

Certified radon measurement businesses are required to report the results of all radon measurement tests conducted in New Jersey to the Radon Program. The data have been collected in accordance with the regulations for Certification of Radon Testers and Mitigators, N.J.A.C. 7:28-27, and are available from May 1991 to the present. The radon measurement data, which are entered into the Mandatory Radon Certification Database, were used to prepare the indicator graphics.

The average indoor radon concentrations shown in Figures 1 and 2 above include data from homes, schools and other commercial buildings. The vast majority of the data comes from homes, with only a small percentage, approximately 3%, from schools and commercial buildings.

Data Strengths and Limitations

The radon testing database contains the results of well over 415,000 tests and the mitigation database contains reports on over 16,000 mitigation systems installed since the start of mandatory radon certification in New Jersey on May 13, 1991. The radon testing database is used to:

- Track the radon testing and mitigation history of homes in New Jersey;
- Identify homes with radon concentrations over 4pCi/l that have not been mitigated;
- Determine the radon potential for every incorporated municipality in New Jersey and update the New Jersey Radon Tier Map (Figure 7);
- Prepare printouts of radon tests conducted or mitigation systems installed over a defined time frame;
- Evaluate the average, median, maximum and minimum radon concentrations for a given municipality.

Radon test results are indexed according to the municipal-county code (a five digit number assigned to all 566 incorporated municipalities in New Jersey) and a sequence code (an eleven character string based on the first three digits of the street number, the first three characters of the street name and the name of the building owner). The results of radon tests conducted on a number of adjacent buildings may be recorded as coming from the same building. For example, if you test a number of buildings on the same street with four digit street numbers – e.g., 1401, 1403, 1405, 1407 and 1409 Smith Street - the results would appear to come from the same building, because the first three digits of the street number (140) are used to index the radon test results. This problem is a minor one since the majority of homes in New Jersey have street numbers with three digits or less.

Radon test results contain information associated with the reason that the radon test was conducted. Tests are characterized as being the first radon test (known as a screening test), real estate related, follow-up (any test conducted after the initial screening test), pre-mitigation, post-mitigation, diagnostic, or a quality control related test (such as a duplicate or a blank). The radon measurement community may not correctly characterize the purpose of each test. For example, the individual requesting the radon test may not be aware of the building's past testing history and may indicate that a follow-up test was conducted for screening purposes. Statistical analysis of radon data typically uses the results of screening tests. If the test purpose is listed incorrectly, radon test results with purposes other than screening may be evaluated in the statistical analysis.

According to the New Jersey Statutory Authority (N.J.S.A.) 26:2D-78, the Radon Program is prohibited from keeping data more than five years after it was collected. This legislative mandate has been kept by breaking the index between the radon test results and the location of the building in which the test was conducted. Therefore, testing information requiring knowledge of the building in which a test was conducted is not available for data collected over five years ago.

Discussion

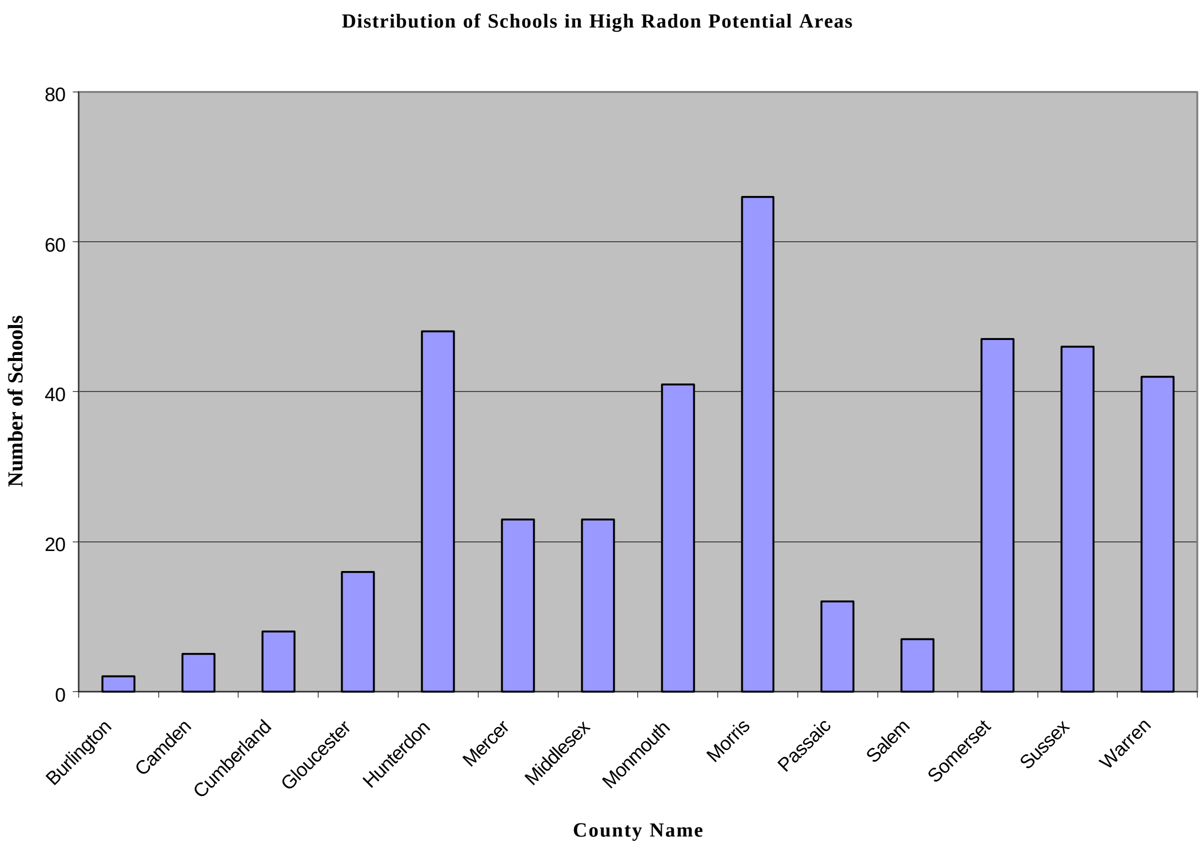
The indicator for average indoor radon concentration per county (Figures 1 and 2) alone does not give a clear picture of the radon problem in New Jersey. Because the average concentration is given, it is not immediately apparent from the graphic that many radon readings in New Jersey are above 4pCi/l, and in some cases significantly above. For example, between 1992 and 1996 approximately 36,000 homes in New Jersey were found to have concentrations greater than or equal to 4pCi/l (the concentration at and above which the Department recommends mitigation). The indicator showing the number of homes with radon concentrations ≥4pCi/l, ≥50pCi/l, ≥100pCi/l (Figures 3-5) clearly demonstrates the significant levels of radon and the fact that a majority of the counties have some homes with radon concentrations over 100pCi/l. The response indicator (Figure 6) shows that approximately 5.5% of the housing units in New Jersey were tested for the presence of either radon or radon decay products between 1992 and 1998.

Milestone: By 2005, all New Jersey schools in Tier 1 will have tested for Radon.

Indicator: Number of Schools in Tier 1 Areas

Type of Indicator: Condition

The graph below shows the distribution of schools in high radon potential (Tier 1) areas. Six counties have over 40 schools with radon concentrations greater than or equal to 4pCi/l.



Data Description

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Municipalities have been designated Tier 1, 2, or 3 based on reports of test results that have been reported to the Radon Program by the certified testing companies. Tier 3 communities have at least 25 homes tested with less than 5% having radon concentrations ≥4pCi/l; Tier 2 communities have at least 25 homes tested with between 5% and 24% having radon concentrations ≥4pCi/l; and Tier 1 communities have at least 25 homes tested with 25% or more having radon concentrations ≥4pCi/l. While the Radon Section recommends that everyone test for radon, outreach strategies often begin with those groups that are at highest risk in Tier 1 areas.

High radon concentrations in schools pose a risk to children since, at school, they are exposed on a constant basis for long periods of time. The Radon Section has several outreach initiatives involving schools, both to encourage the school officials to test and to inform students of the risk associated with radon and the importance of testing. This indicator shows the number of schools in Tier 1.

Data Characteristics

The source of the schools data is the New Jersey Department of Education web-site listing of all public school principals in New Jersey. The number of schools in Tier 1 was obtained by using only schools in municipalities with a Tier 1 listing.

Discussion

The number of schools in Tier 1 areas is the foundation on which the other radon indicators for schools are based. Six counties have over 40 schools with radon concentrations greater than or equal to 4pCi/l. In the future, the Radon Section plans to report on the number of schools in Tier 1 that have tested, the number that had radon concentrations ≥4pCi/l, and the percentage of those schools that mitigated.

CLEAN & PLENTIFUL WATER

Introduction   Surface, Ground & Marine Water

New Jersey has approximately 6,450 river miles, 1,200 freshwater lakes and ponds and 1,033 square miles of freshwater wetlands. These water resources provide a variety of aquatic and terrestrial habitats ranging from cool trout waters in the north to acidic streams in the Pinelands. For the most part, streams and rivers originate in undeveloped, rural or agricultural areas, and flow through suburban, urban and industrial areas, before discharging to the ocean. Human uses of these waters include drinking water, industrial process and cooling water, irrigation, recreation, and effluent disposal. Surface water supplies provide approximately 72% of all water used annually in New Jersey for human consumption, industrial and agricultural uses.

New Jersey's watersheds encompass a variety of land uses. Unfortunately, the widespread industrial base and dense population in New Jersey have created significant stresses on water quality including contributions to eutrophication of lakes, toxic contamination in fish, and loss of wetlands. Over the last 20 years, however, the NJDEP and the regulated community have made tremendous strides towards correcting these problems. As a result of the implementation of comprehensive standards, permitting, enforcement and finance programs, major improvements to water quality have occurred. Several of the indicators provided in this report highlight these improvements:

- *BOD/CBOD loads have remained relatively stable between 1990 and 1997.*
- *The number of facilities in compliance with acute whole effluent toxicity (WET) limits for all testing increased 10% from 1995-1997*

Although significant water quality improvements have been achieved, further effort is needed to reduce the impacts of combined sewer overflows, and in some cases, municipal and industrial point sources. More importantly, as point source pollution has decreased, the impacts of nonpoint source pollution have become more apparent. Therefore, considerable effort must be directed toward the management of nonpoint sources such as stormwater runoff from construction, urban, suburban and agricultural lands; waste disposal and contaminated sites; air deposition to lakes and land; infiltration of contaminated ground water; hydrologic and habitat modification; and marina and boating activities in lakes and coastal waters. The NJDEP is proposing to address these problems primarily through a watershed management process that will coordinate state, county and local efforts. This process will allow us to systematically investigate, characterize, monitor, and correct point and nonpoint sources of pollution for a watershed on a comprehensive basis.

The subgoals for freshwater watersheds reflect designated uses (aquatic life, swimming, fish consumption). Indicators to evaluate progress toward these subgoals were selected. There is significant overlap between the freshwater key issues (and therefore the indicators) that impair designated uses.

This report also includes indicators for marine waters and ground water for the first time. The subgoals for marine waters are to provide recreational beach water that is safe for swimming and shellfish that is safe to harvest from designated waters. Significant progress has been made in both areas.

- X *New Jersey experienced the lowest number of ocean beach closings in 1997 and 1998 since 1988*
- X *In 1998, 127 miles (100%) of ocean beaches and 3.9 miles (99.3%) bay beaches fully supported recreational swimming*
- X *In 2000, 87.9% of the shellfish beds were safe for harvest*
- X *6,848 areas of shellfish waters were upgraded in 2000*

As with freshwater watersheds, nonpoint source pollution poses a significant threat to our marine waters. To ensure that New Jersey beaches remain open for recreational uses, the NJDEP is implementing a more comprehensive approach, working with both public and private sectors to promote watershed management and reduce nonpoint sources of bacteria. NJDEP is also developing a Coastal Nonpoint Source Monitoring Strategy to identify pollution sources and relate the sources of pollution to impairments. This type of evaluation has resulted in the establishment of a "no discharge zone" for the Manasquan River.

The goal for New Jersey's ground water is protect and enhance its quality so that an adequate quantity is available for domestic and industrial uses, while also providing high quality base flow to our freshwater streams. This report includes an indicator on the status of nitrate loadings to our groundwaters. Onsite sewage disposal systems (septic systems) are a primary source of nitrate loadings to groundwater. The overall number of septic systems has decreased statewide as a result of expanding sewer service areas to publicly owned treatment works (POTWs). Counties classified as rural in 1970, including Sussex, Hunterdon, Burlington, Cape May, Cumberland, Warren, Salem, Camden and Gloucester Counties are experiencing development pressures. In these counties, the number of septic systems has been increasing which will create additional burdens on ground water and surface waters. The NJDEP proposed new watershed management planning rules in July 2000 that provide for a more integrated and comprehensive approach to water resource planning and protection.

The indicators presented in this report are, in many cases, a first attempt to quantify years of water resource information. It is important to note that many of these data sources were designed to evaluate specific pollution control efforts and to provide required reporting to EPA. The NJDEP continues to refine these indicators through additional data analysis or developing new indicators based on improved data collection. It is anticipated that these future indicators will provide an even more accurate measure of environmental progress. For this report, only a subset of the water indicators included in the 1999-2001 Performance Partnership Agreement are presented. In particular, we have included those indicators for which data and data assessments were available. For instance, while both point and nonpoint source pollution loadings contribute to water quality, due to significant data and data analysis gaps, only point source pollution loadings indicators can be reported here. Clearly, indicators of nonpoint source pollution loadings are needed to provide a more comprehensive picture. As the watershed management process is implemented, additional data on the loads of pollutants from nonpoint source pollution loadings will become available. Further, watershed-based monitoring and modeling will provide data regarding the relative contributions of point and nonpoint sources to ambient water quality. Feedback from and evaluation of this report will help in the refinement of the existing indicators.

Overall, the environmental indicators presented in this report show that significant progress has been made over time toward the goal of clean and plentiful water and that many waterways are progressing toward meeting the objectives of the Performance Partnership Agreement.

Introduction - Drinking Water

In New Jersey, public drinking water systems test for approximately 90 contaminants. There are two main types of public water systems: community water systems and noncommunity water systems. A community water system serves at least 15 service connections used by year-round residents or serves at least 25 year-round residents (e.g., town, a mobile home park). In New Jersey, there were 616 community water systems active during 1998. Noncommunity water systems do not serve permanent residents and are further categorized into transient noncommunity and nontransient noncommunity. A nontransient noncommunity water system serves at least 25 of the same persons over six months per year (e.g., schools, office buildings). A transient noncommunity water system serves at least 25 people per day but the people are different each day (e.g., highway rest stop, motel). In New Jersey, there were 4005 noncommunity water systems active during 1998: 1015 nontransient noncommunity water systems and 2990 transient noncommunity water systems.

The major contaminant groups monitored in public water systems are microbiological, turbidity, disinfectant residual, inorganic chemicals including lead and copper, volatile organic chemicals, synthetic organic contaminants including pesticides, radiological contaminants, and disinfection byproducts. However, not all public water systems test for these contaminants. Major factors used to determine the type of contaminants that need to be monitored in a public water system are the type of water system (as described above), the source of the drinking water (ground water or surface water), the number of people served by the water system, the vulnerability of the water source(s) to contamination, and previous test results.

The only contaminants that are monitored in all public water systems in New Jersey are microbiological contaminants and nitrate, an inorganic chemical. Only community water systems are required to monitor for radiological contaminants and disinfection byproducts. Both community and nontransient noncommunity water systems monitor for the remaining contaminants. New Jersey adopts all federal drinking water standards and regulations by reference (40 CFR 141). However, New Jersey regulations contain additions and clarifications that are specific to this state. According to New Jersey statute (N.J.S.A. 58:12A-13(b)), when standards are developed by both federal and state drinking water agencies, the more stringent standard applies. This is important in New Jersey because 13 drinking water standards developed by NJDEP are lower than EPA standards. Five additional drinking water contaminants regulated in New Jersey do not have federal drinking water standards.

A drinking water standard, or “maximum contaminant level,” is the highest concentration of a contaminant that is allowed in drinking water. An “action level,” which is different than a maximum contaminant level, applies only to the concentration of lead or copper in water, and determines the corrosion control treatment that a water system is required to install.

Until the late 1980's, nearly all drinking water sampling took place at the consumer’s tap in order to measure directly what the consumer was drinking. Today, only microbiological contaminants, disinfection byproducts, lead, copper, asbestos (sometimes) and radiological contaminants are sampled at the consumer's tap. Except for radiological contaminants, these contaminants are associated with water quality problems that may develop in the water distribution system. The distribution system sampling location for radiological contaminants is expected to be revised in future EPA regulations. When required by regulation to be sampled, inorganic chemicals, volatile organic chemicals, synthetic organic contaminants, turbidity and disinfectant residuals are monitored by each community and nontransient noncommunity water system at points-of-entry to the water distribution system after treatment. These contaminants are closely related to source water quality, as are the radiological contaminants. In general, community water systems have multiple points-of-entry and nontransient noncommunity water systems and transient noncommunity water systems usually have one point-of-entry. Water systems with multiple points-of-entry must submit test results for each point-of-entry to represent all the water sources used.

State or federal laws and regulations do not directly regulate testing of wells that serve individual homes or small businesses, referred to as private wells or domestic wells. Testing of these sources of drinking water is the responsibility of the owner. The maximum contaminant levels developed for public water systems are used to assess the drinking water quality of private wells.

A selection of the most significant environmental indicators for the drinking water program is presented on the following pages. The indicators describe the status of drinking water quality in 1998. Trends in the environment were noted whenever the data were available and assessed. The full suite of drinking water environmental indicators may be found in the FY1999-2001 Performance Partnership Agreement (June 1999). The following are highlights of the public drinking water system indicators in New Jersey.

- *Over 97% of public water systems that sampled for total coliform bacteria in 1998 (and over 95% of the population served) met the microbiological drinking water standard for total coliform bacteria.*

- *Over 92% of community and nontransient noncommunity water systems that sampled for chemical parameters in 1998 met the chemical drinking water standards.*

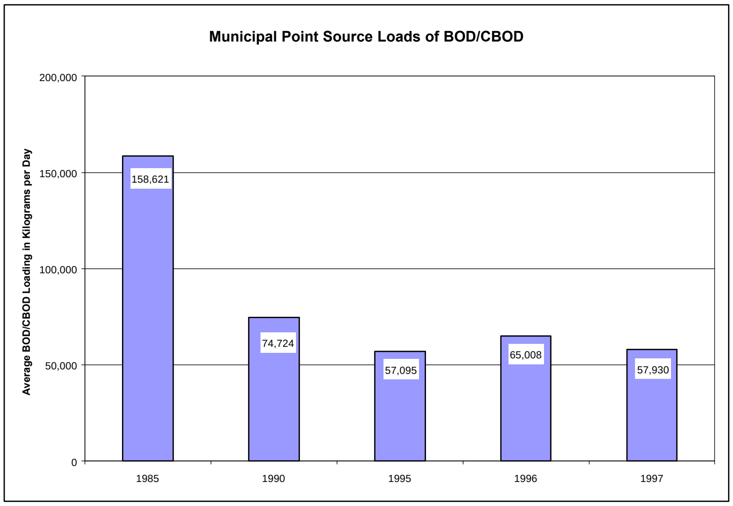
- *There have been no outbreaks of waterborne disease due to disease-causing microorganisms in drinking water in New Jersey since 1989. The July 1989 outbreak was in a transient noncommunity water system at a campsite. Eight persons were infected with an unidentified pathogen.*

Milestone: By 2005, 50% of assessed river miles will support healthy sustainable biological communities.

Indicator: Status and Trends in Municipal Point Source BOD/CBOD

Type of Indicator: Cause

Municipal point source BOD/CBOD (i.e., BOD or CBOD, or a combination of the two) levels decreased as a result of the federal mandate for secondary treatment in 1988. Changes to the overall BOD/CBOD loadings did not appear to have occurred since 1990, although the number of residents in sewered areas has increased.



Data Description

Biological Oxygen Demand (BOD) and Carbonaceous Biological Oxygen Demand (CBOD) have been selected to indicate the overall effect of municipal wastewater treatment plants on the waters of the state. These tests indicate the amount of oxygen needed for biochemical degradation of organic materials in wastewater. Excessive BOD/CBOD loadings may reduce the ambient dissolved oxygen levels and stress the aquatic community.

Municipal point source BOD/CBOD loads decreased from 160,000 kilograms per day (kg/d) to 75,000 kg/d between 1985 and 1990 as a result of the federal mandate for secondary treatment in

1988. No significant changes to the overall BOD/CBOD loadings occurred between 1990 and 1997, although the number of residents in sewered areas increased.

Data Characteristics

All municipal wastewater treatment plants in New Jersey are required to sample, analyze and report BOD/CBOD concentrations and loadings on a monthly basis on Discharge Monitoring Reports (DMRs). The facilities are required to sample BOD/CBOD in the influent and effluent in accordance with their discharge permit. The samples are required to be analyzed by a certified laboratory. Loadings in kilograms per day are calculated based on BOD/CBOD concentration and effluent flow data. Concentration and loadings data were available beginning in 1990 from computerized data systems at NJDEP and EPA. Paper copies of DMRs are retained by the NJDEP for five years in the NJDEP Central File Room at 401 East State Street, Trenton, New Jersey. BOD data for 1985 were derived from NJPDES fee assessment records. Additional information can be obtained from the Division of Water Quality, Bureau of Permit Management, PO Box 029, Trenton, New Jersey 08625 or by calling (609) 984-4428.

Data Strengths and Limitations

Data reported by the regulated dischargers pursuant to the NJPDES permit requirements were used for this indicator. BOD is a national performance indicator for wastewater treatment. These data were reported by all municipal dischargers to ensure compliance with their NJPDES permit requirements. The sample collection frequency is established based upon the design flow of the treatment plant. The samples were analyzed by a NJDEP certified laboratory using an EPA approved analytical method.

The NJDEP is converting permit requirements from BOD to CBOD as permits are renewed or modified. The BOD test includes both the Carbonaceous BOD and Nitrogenous BOD. Permit compliance with Nitrogenous BOD is measured by another effluent test. Since CBOD is a subset of BOD, this conversion will result in lower overall BOD/CBOD loadings amounts without any improvement to the level of wastewater treatment. The data presented for the 1985 and 1990 were all BOD values. In 1994, only a few facilities were reporting CBOD so this conversion had a relatively minor effect on the calculation through 1995. The number of facilities reporting CBOD is expected to increase in the next few years and will be addressed in future indicator reports. Although in most cases, CBOD limits are based upon water quality studies, the standard conversion for secondary treatment level is that 30 milligrams BOD is approximately equivalent to 25 milligrams CBOD per liter.

Combined Sewer Overflows (CSOs) and by-passes continue to represent a significant unquantified BOD/CBOD load to the surface waters of the state. CSOs occur primarily in the urban New Jersey-New York Harbor area and the lower Delaware River around Camden.

The BOD loadings used to determine the statewide environmental indicator do not include schools. The BOD load contribution from these facilities is relatively insignificant on a statewide basis but will be more significant as indicators are developed on a watershed management area basis.

Industrial facilities are usually not required to monitor the discharge of BOD because industrial wastewater does not usually contain significant amounts of organic materials that exert a biological oxygen demand. However, it is possible that some additional unquantified BOD/CBOD load is contributed by these industrial facilities.

Discussion

The largest BOD reductions in recent years were due to the establishment of secondary wastewater treatment. Plant upgrades and tie-ins to larger regional facilities occurred primarily from 1985 through 1990. As many old primary plants were tied-in to larger regional facilities, wastewater was transferred from one watershed to another. A large portion of wastewater was transferred from small tributaries into major rivers and from back bays to the ocean, which can assimilate significantly more pollutants. These transfers will become more evident when the data are presented by watershed management area. Most of the tie-ins that are now occurring involve moving previously unsewered areas of the state into sewage treatment systems. These tie-ins increase the BOD/CBOD load into the sewage treatment plant. So far, the effluent levels of BOD from the secondary plants have remained fairly constant.

Combined Sewer Overflows (CSOs) and bypasses still represent a significant unquantified BOD/CBOD load. CSOs occur primarily in the urban New Jersey-New York Harbor area and the lower Delaware River around Camden. Nonpoint sources of pollution, which are also unquantified, may also contribute to the statewide BOD load.

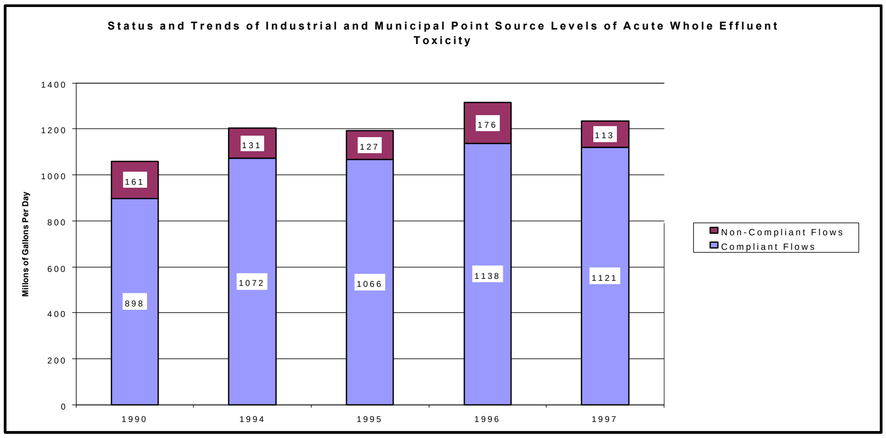
NJDEP is planning to present this indicator by watershed management area in the future. This presentation would add utility to the statewide analysis presented here.

Milestone: By 2005, 50% of assessed river miles will support healthy sustainable biological communities.

Indicator: Status and Trends of Industrial and Municipal Point Source Levels of Acute Whole Effluent Toxicity

Type of Indicator: Cause

Whole Effluent Toxicity (WET) is a measure of the potential toxic effect of an effluent on the aquatic community. The health of the biological community may improve as dischargers attain compliance with WET limits. The number of facilities in compliance with acute WET limits for all testing increased 10% from 197 in 1995 to 215 in 1997. Currently, the average flow regulated for acute WET represents 21% of the 5.6 billion gallons per day regulated by NJPDES permits.



Data Description

Whole Effluent Toxicity (WET) is a measure of the potential toxic effect of an effluent on the in-stream aquatic community. WET is measured by exposing aquatic organisms to dilutions of the effluent under specific test conditions. In acute toxicity tests, lethal effects of an effluent on aquatic organisms are measured. In chronic toxicity tests, sub-lethal effects on aquatic organisms, such as growth and reproduction, are measured. Toxicity tests are an important component of water pollution evaluations because chemical and physical tests alone are not sufficient to assess potential effects on aquatic biota. The health of the biological community may be improved as additional dischargers are regulated and compliance is attained with applicable WET limits.

The WET permit limits and monitoring requirements for a discharger depend on the effluent volume and assimilative capacity of the receiving water.

Data Characteristics

WET results are reported to the NJDEP by municipal and industrial dischargers on Discharge Monitoring Reports (DMRs). For each WET result, a discharger is also required to submit a test report form which details the raw data and specific test procedures used in the toxicity test. Dischargers are required to monitor for WET as specified in their NJPDES permit. The frequency for monitoring for WET is, in most instances, quarterly. Acute WET results are available since 1985. The precision of WET test methods is within the range of chemical testing and in fact is sometimes better. WET testing is performed by New Jersey certified biomonitoring laboratories. Copies of DMRs and test report forms are available in the NJDEP Central File Room at 401 East State Street.

Additional information on WET results may be obtained from the Division of Water Quality, Bureau of Point Source Permitting-Region 1 or 2, P.O. Box 029, Trenton, New Jersey, or by calling (609) 292-4860 or (609) 633-3869.

Data Strengths and Limitations

The NJDEP reviews each biomonitoring test report form as part of an extensive Quality Assurance/Quality Control (QA/QC) program. This QA/QC review ensures that reliable WET data, which complies with applicable test procedures for toxicity testing, is used for compliance purposes. Test methods and applicable QA/QC methods are consistent with federal guidelines and methods and are similar to those used in other states.

The evaluation of compliance with acute WET limits may be limited by the use of only one acute test result for a discharger. This is due to a prior demonstration of compliance with the applicable acute toxicity limit which resulted in a testing frequency reduction to annually. Percent compliance for a facility was determined by a ratio of acute WET results in non-compliance to the total number of acute WET results for that facility for each year evaluated.

The average effluent flow was calculated from the reported effluent flows for the year. The average daily flow was multiplied by the percent of tests in compliance with the effluent limit.

Discussion

The evaluation of compliance with acute WET limits for 1990, 1994, 1995, 1996 and 1997 is based on a comparison with the water quality based acute WET limit. In many cases, the water quality based effluent limit is less stringent than the minimum state standard of LC 50 ≤ 50% effluent. (LC 50 ≤ 50% effluent means that the concentration that is lethal to 50% or more of the organisms tested, LC, cannot be exceeded by a mixture of 50% or less of effluent and receiving water.) In these cases, the permit required compliance with the minimum state standard. The minimum state standard requires that a discharge not be lethal to 50% of the organisms tested in a solution of 50% effluent and 50% receiving water. This limitation was developed to prevent significant mortality in the area immediately surrounding the discharge point. The minimum acute toxicity effluent standard was routinely incorporated into NJPDES permits in the 1980s. Since acute WET limits have been included in NJPDES permits, compliance with this minimum state standard increased significantly as dischargers upgraded wastewater treatment systems to secondary treatment or effected improvements to influent quality and/or wastewater treatment to meet the acute limit.

The overall flow regulated with acute WET limits has increased from 1 BGD to about 1.2 BGD. At the same time, the overall percent of flow in compliance with acute WET limits has increased from 85% in 1990 to 91% in 1997. More importantly, the number of facilities demonstrating consistent compliance with acute WET limits has increased by 10% from 1995 to 1997.

In 1989, the NJDEP expanded the WET program to include chronic toxicity testing and chronic WET limits. These limitations are more reflective of actual discharge conditions and receiving stream assimilative capacity than the minimum state standard. As NJPDES permits are renewed for industrial and municipal dischargers, those permits will be evaluated for the need for water quality based acute or chronic WET limits and testing requirements. A number of dischargers' WET limits have been changed from the minimum state standard acute toxicity limit to a more stringent acute or chronic toxicity water quality based limit since 1989. This trend is expected to continue, and future rates of compliance are expected to reflect lower compliance rates for a period of time as dischargers receive the new limitations and begin to implement measures to meet new water quality based WET limits. Most dischargers with chronic WET limits are in a "monitor only" period with chronic WET limits becoming effective in 1997 or later. Chronic WET limits became effective for six facilities in 1997. All but one demonstrated consistent compliance and resulted in an additional 14.5 MGD of compliant flows for 1997. The inclusion of water quality based effluent limits for WET should improve the health of biological communities.

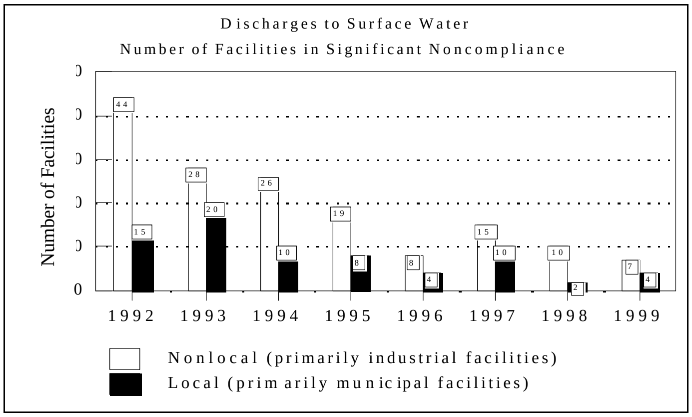
In the coming years, the focus of this indicator will change from evaluating facilities based only on acute WET to evaluating facilities based on water quality based acute and chronic WET limitations.

Milestone: By 2005, 50% of assessed river miles will support healthy, sustainable biological communities.

Indicator: Status and Trends of Industrial and Municipal Facilities in Significant Non-Compliance (SNC)

Type of Indicator: Response

Between 1992 and 1999, the number of facilities in Significant Non-Compliance decreased from 44 to 7 nonlocal (typically industrial) facilities and from 15 to 4 local (typically municipal) facilities. In 1999, the Significant Non-Compliance rate for non-local facilities was 0.9% and 1.5% for local facilities.



Data Description

The Water Compliance and Enforcement Element within NJDEP uses the terms "nonlocal" and "local" facilities, which are defined by state statute, rather than common "industrial" and "municipal" classifications. Local facilities are a political subdivision of the state, or agency thereof, and are typically municipal wastewater treatment facilities. Nonlocal agencies are typically industrial wastewater treatment facilities.

The status and trends of local and nonlocal facilities in "significant non-compliance" (SNC) is a measure of the facilities with permits to discharge to surface water which had repeated, serious permit violations. This measure indicates progress toward maintaining and improving compliance. A greater level of compliance with permit discharge limitations is an indirect measure of water quality protection.

Significant noncompliance is defined in terms of violating permit limits for the same pollutant at the same discharge point over time. [1] Formal enforcement actions are taken by the Water Compliance and Enforcement Element if a facility is found to be in significant noncompliance with their permit as defined by the New Jersey Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq. The 1990 amendments concerning determination of significant noncompliance became effective on July 1, 1991. The analysis for this indicator commenced with calendar year 1992 since it was the first full year for which data were generated on SNC's.

There has been a consistent and strong downward trend in the number of local and nonlocal facilities in significant noncompliance with effluent limitations. In 1992, the SNC rate was 4.0% (44 of 1100) for nonlocal facilities and 4.3% (15 of 350) for local facilities. By 1995, the SNC rate declined to 2.7% (19 of 900) for nonlocal facilities and 2.1% (8 of 300) local facilities. In 1999, the most recent year data are available, the SNC rate was 0.9% (7 of 750) for nonlocal facilities and 1.5% (4 of 260) for local facilities. Facilities in SNC as a result of monitoring/reporting violations were not included in these calculations.

Data Characteristics

Facilities with permits to discharge to surface water are required to collect samples of the discharge(s), analyze samples using approved methods by a state certified laboratory and report the results to NJDEP on Discharge Monitoring Reports (DMRs). The discharge data are evaluated for compliance. Upon verifying that a violation causes the facility to be in, or continue to be in SNC, NJDEP will issue a formal enforcement action, including a penalty assessment. Compliance information is stored by NJDEP in a Q&A database as well as in the NJPDES mainframe computer system. Data are available from July 1, 1991 to present. Information on SNC's is provided in the Annual Report of the Clean Water Enforcement Act which is published in March of each year for the preceding calendar year. This report is widely distributed and portions of it can also be found on the Division of Water Quality's web site located at: www.state.nj.us/dep/dwq. Any questions concerning this indicator or requests for copies of the Clean Water Enforcement Act Report should be directed to the Office of the Administrator, Water Compliance and Enforcement Element at (609) 984-5855.

Data Strengths and Limitations

The significant noncompliance data are highly accurate and precise. The indicator was limited to facilities that were in SNC as a result of effluent violations. The total number of local and nonlocal facilities in SNC is actually slightly higher because some facilities were in SNC because of reporting violations (i.e., failure to submit the monthly discharge monitoring report or omitting parameters from that report). Reporting violations were not included since the SNC status was caused by administrative permit violations. While it is important to evaluate administrative violations for

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1 **Significant noncompliance** is defined in the 1990 amendments to the New Jersey Water Pollution Control Act as follows: (a) violating an effluent limitation for a hazardous pollutant by 20% or more in any two months of any six month period; (b) violating an effluent limitation for a nonhazardous pollutant by 40% or more in any two months of any six month period; (c) exceeding the permitted monthly average concentration by any amount in any four months of any six month period; (d) if a permitted monthly average concentration was not established, the monthly average of daily maximum concentrations is calculated; (e) failure to submit a completed discharge monitoring report in any two months of any six month period.

compliance purposes, these violations are not typically reflective of negative impacts on environmental conditions.

Discussion

This indicator shows a significant overall decrease over the past eight years in the number of facilities in significant noncompliance with permit limitations. Thus, serious and chronic exceedances of permit limits have declined. This higher level of compliance means improved discharge quality from more permitted facilities. This is expected to result in some degree of overall water quality improvement, however localized.

Although in most years there are approximately twice as many nonlocal facilities in SNC than local facilities, the SNC noncompliance rates are similar (0.9% versus 1.5% in 1999) because there are approximately three times as many nonlocal dischargers as local (750 to 260 respectively as of 1999). Since most facilities are now in compliance with permit limitations, a continuation of the steep decrease of SNCs seen earlier in the 1990's was not expected. In fact, as predicted, the number of facilities in SNC has essentially leveled off over the past few years as indicated in the graph above.

Milestone: By 2005, 100% of New Jersey s coastal recreational beach waters will be safe for swimming.

Indicator: Ocean and Bay Beach Closings; Number of Miles of Ocean and Bay Bathing Beaches Attaining Recreational Designated Uses

Type of Indicator: Condition

In 1997 and 1998, New Jersey experienced the lowest number of ocean beach closings since the beginning of the Cooperative Coastal Monitoring Program. One hundred percent of ocean and bay beaches fully supported recreational uses in 1997. In 1998, 127 miles (100%) and 3.9 of 4 miles (99.3%) of bay beaches fully supported recreational use.

Figure 1.

Ocean Beach Closings (1989 1998)

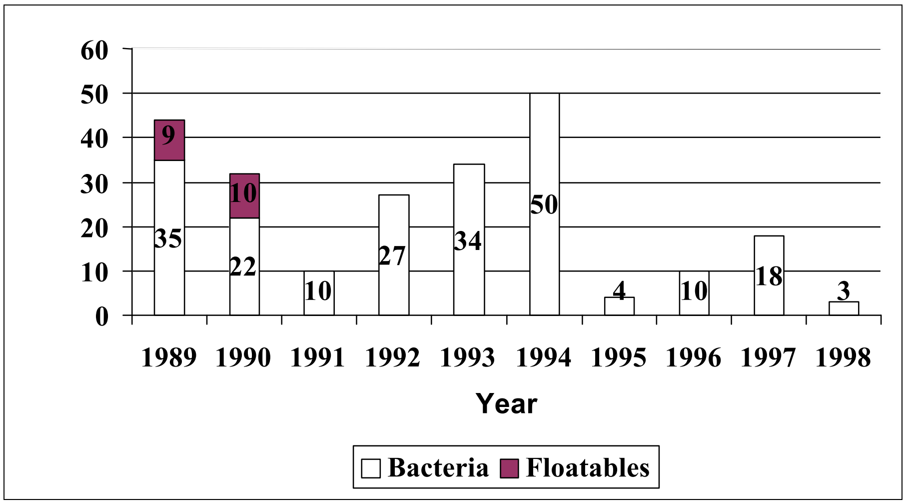
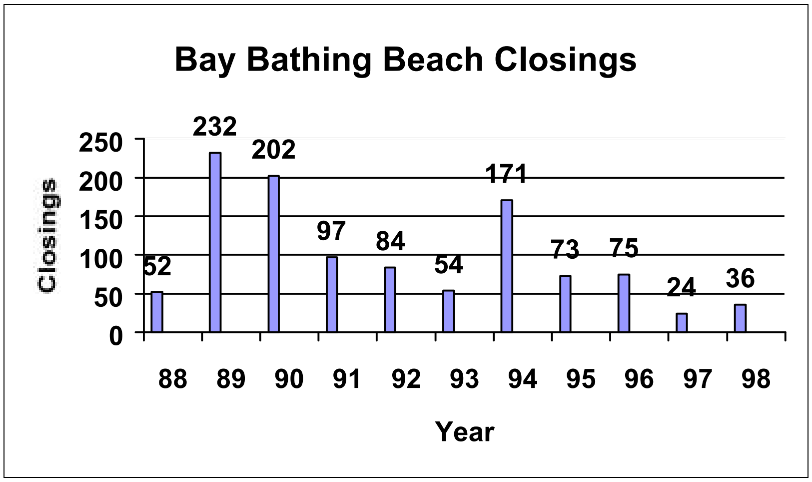


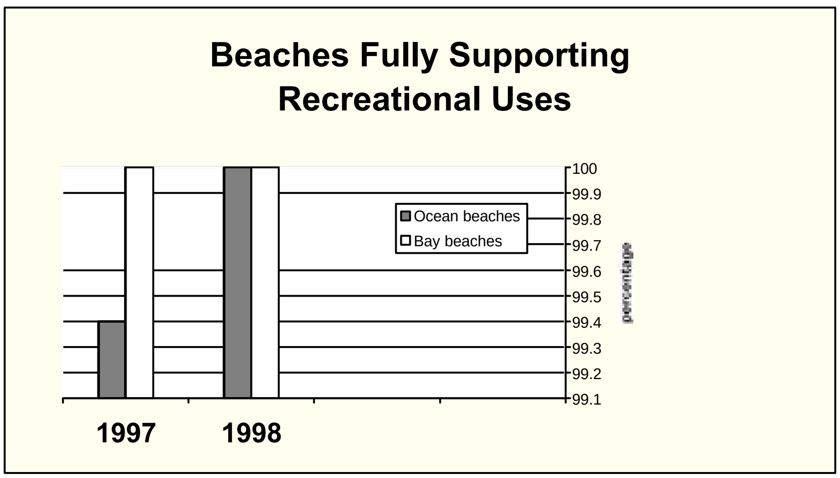
Figure 2.

Bay Beach Closings



Note: All closures due to bacteria, none due to floatable material.

Figure 3.



Data Description

DEP uses fecal coliform concentrations to detect the presence of sewage and/or nonpoint source pollution at recreational beaches. The New Jersey Department of Health and Senior Services adopted a primary contact standard of 200 fecal organisms in 100 milliliters of water. When fecal coliform concentrations exceed this standard, the waters are considered unsafe for swimming and are closed. Trends in fecal coliform concentrations are used to identify locations where water quality is improving, declining or remaining stable and the effectiveness of remediation actions. Recreational designated use attainment provides a measure of miles supporting recreational uses of the beaches, based on the frequency of closings during the 100-day beach season. The Cooperative Coastal Monitoring Program (CCMP) evaluates water quality for swimming using data collected during the summer.

Status Information

Data collected in 1997 and 1998 were compared to the fecal coliform criteria. During this period, all 179 (100%) ocean stations met the standard. In 1997, all 138 bay beaches also met the standard. In 1998, 137 of the 138 bay beaches (99.3%) met the standard. This information is based on weekly sampling at each station during each season, at least 5,000 to 6,000 sampling events.

In order to link indicators, core performance measures and Water Quality Inventory Reporting, these results are also provided in terms of recreational designated use attainment. Recreational designated use for New Jersey beaches has been defined by adapting EPA's Water Quality Inventory Report Guidance as follows: for 100 beach days between Memorial Day and Labor Day, 0-10% beach days closed – full support; 11-25% beach days closed – partial support; greater than 25% beach days closed – no support.

In 1998, 100% of New Jersey's 179 ocean beaches (127 miles) fully supported recreational designated uses. There are an estimated 3.92 miles of bay beaches: each of 138 bay beaches was estimated to be 150 feet of beachfront. In 1998, 3.9 of 4 estimated bay beach miles (99.3%) fully supported recreational use.

Trends Information

Between 1988 and 1998, the CCMP has recorded a significant decrease in the number and duration of ocean and bay beach closing days. In 1988, a record high 784 ocean beach closing days occurred due to exceedances of the primary contact standard for bacteria at bathing beaches. In addition, 19 closings were required due to wash-ups of floatable debris. By 1998, ocean beach closings had dropped significantly with only three closings due to high bacteria. No beaches have been closed due to floatable debris in coastal waters since 1990.

A similar trend has been evident at bay beaches. In 1989, 232 bay beaches were closed due to exceedances in the primary contact standard for bacteria at bathing beaches. From 1990 to 1998, the number of bay beach closings ranged from 171 in 1994 to 36 in 1998.

Data Characteristics

Local and State environmental health agencies that participate in the CCMP perform sanitary surveys of beach areas and monitor concentrations of bacteria in nearshore coastal and estuarine waters to assess the acceptability of these waters for recreational bathing. These activities and the resulting data are used to respond to immediate public health concerns associated with recreational water quality and to eliminate the sources of fecal contamination that impact coastal waters. As part of this program, NJDEP routinely inspects the 17 wastewater treatment facilities that discharge to the ocean. NJDEP also performs daily aerial surveillance of New Jersey nearshore coastal waters and the Hudson-Raritan estuaries to observe changing coastal water quality conditions and potential pollution sources.

The State Sanitary Code N.J.A.C. 8:26 and the DEP *Field Sampling Procedures Manual* prescribe the sampling techniques and beach opening and closing procedures the agencies use for the CCMP. The agencies perform routine sampling from mid-May through mid-September on Mondays. Samples are analyzed for fecal coliform concentrations using DEP-certified laboratories including those of the utilities authorities. MPN or membrane filter methods provide results within 24 hours of sampling. In 1998, as in a number of previous years, samples were collected and analyzed for enterococci from a subset of ocean and bay stations in all of the coastal counties as the state prepares for further federal direction in beach management.

The recreational bathing standard for all waters in New Jersey is 200 fecal coliforms per 100 ml of sample and closings are based on two consecutive single samples. If the results from the first sampling of the week are within the standard, sampling is complete until the following week. If a sample from a station exceeds the standard, the water at that station is immediately resampled and adjacent beaches are sampled to determine the extent of the pollution. A sanitary survey of the area is also conducted. A second consecutive fecal coliform concentration exceeding the standard or the identification of a pollution source requires closing of the beach. Health officials retain the discretion to close beaches for any public health reason, with or without water quality data.

In 1997 and 1998, the program included 179 ocean water quality monitoring stations, covering 127 miles of ocean beach and 138 bay monitoring stations, covering about 4 miles of bay beaches. Most ocean stations are sampled to evaluate the water quality at several lifeguarded beaches in an “area” rather than just one lifeguarded beach. These areas consist of contiguous, similar beaches with no permanent pollution sources. Individual beaches with permanent sources are assigned monitoring stations. A monitoring station is assigned to each recreational bay beach because of their locations on noncontiguous shorelines. To estimate bay beach miles, each of 138 bay beaches was estimated to be 50 yards long, for a total of about 4 miles. These estimates will be improved in the future.

Data Strengths and Limitations

Fecal coliform data have been collected consistently since 1986, providing a rich source of information. Trained personnel collect all samples using standard procedures. Samples are analyzed at certified laboratories. Analysis methods and detection limits for this parameter have remained consistent since the beginning of the CCMP.

The fecal coliform data do not provide direct measure of the threat to human health from pathogenic contamination. These data indicate the presence of fecal material in water. Fecal coliform bacteria are generally not a threat to human health, but other pathogens contained in human and animal fecal material do threaten human health. These pathogens may or may not be present with the fecal coliform bacteria. However, it is time consuming, expensive and not possible to test for all pathogenic organisms in water. EPA is conducting research to evaluate other indicator organisms that would provide a better assessment of the threat to human health from exposure to pathogens while swimming.

Discussion

The ubiquitous nature of fecal coliform bacteria highlights the importance of swimming only in designated bathing areas, which are tested regularly by local or county health agencies.

Water quality at locations monitored by county health departments is excellent, as shown by low beach closing rates and almost full designated use attainment. The geometric means of fecal coliform concentrations at ocean monitoring points is on Figure 4 below. These values have remained relatively consistent. Slight differences may be due to increased rainfall in certain years.

Closures due to floatables have not occurred in recent years due to removal of floating and shoreline debris. The Army Corp of Engineers removed 21,046,000 pounds of floatable debris from the New York Harbor in 1997 and 1998. The Clean Shores program removed 10,700,000 pounds of debris from New Jersey shorelines.

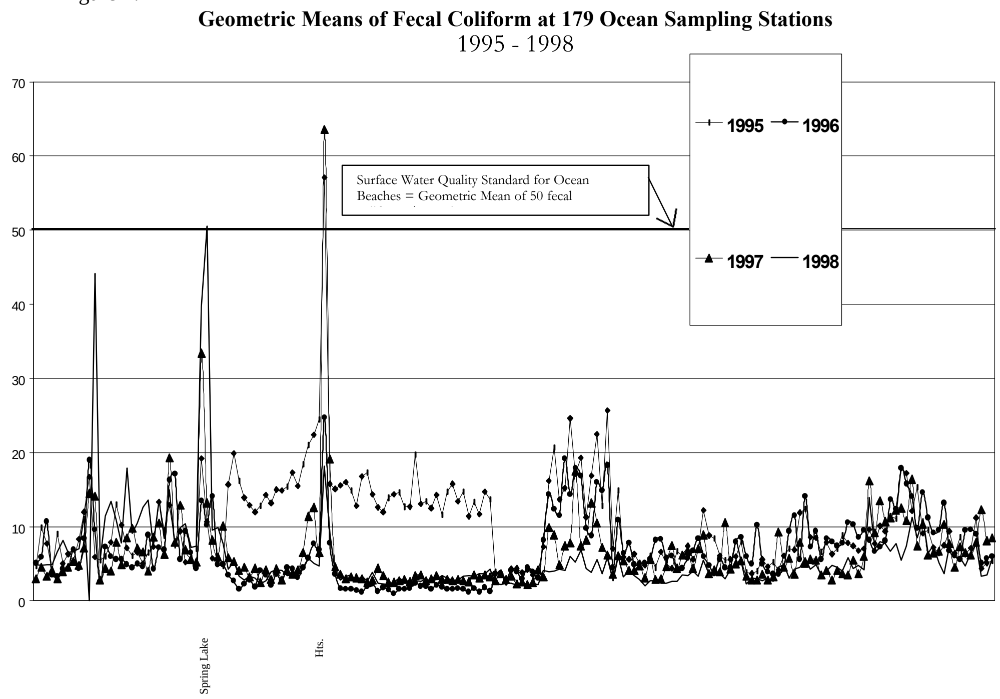
At locations where periodic episodes of fecal coliform contamination are evident, the sources of contamination are generally known or can be identified by conducting a sanitary survey. Both point and nonpoint sources of pollution may contribute to fecal contamination and through implementation of watershed management, possible specific nonpoint source problems may be identified.

Nonpoint sources are considered to be the major source of fecal coliform pollution. Nonpoint sources include municipal stormwater, which is released to the ocean and bays from over 7,000 outfalls, combined sewer overflows, and domestic and wild animal populations.

Sewage effluent is disinfected so that effluent concentrations are 200 organisms per 100 milliliters or less. The municipal utilities authorities, which manage the sewage treatment facilities and their ocean discharges, are an integral part of the overall monitoring program in New Jersey and they are key to the current good quality of the state s coastal waters and further improvement. However, occasional failures of collection systems and even rarer instances of treatment system failures occur, resulting in beach closings.

To implement the more comprehensive approach to the improvement of New Jersey’s coastal water quality which requires the reduction of nonpoint sources of bacteria, NJDEP is working with private and public sectors to promote watershed management. The water quality data and beach closing numbers, therefore, will be used as indicators of the success of the strategies implemented to resolve remaining water quality problems of various origins.

Figure 4.

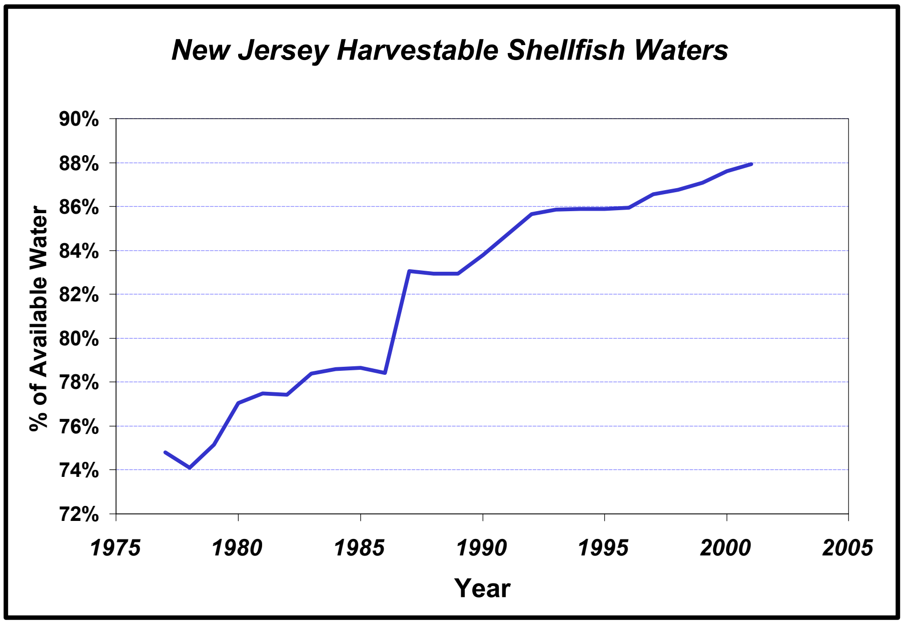

Geometric Means of Fecal Coliform at 179 Ocean Sampling Stations
1995 - 1998
70
60
50
40
30
20
10
0
Surface Water Quality Standard for Ocean Beaches = Geometric Mean of 50 fecal
1995
1996
1997
1998
Spring Lake
Hts.

Milestone: By 2005, 90% of New Jersey s designated waters will provide shellfish safe to harvest.

Indicator: Status and Trends of Shellfish Harvest Classifications in Acres and % of Total Resource Available as a. Unrestricted, b. Special Restricted, c. Prohibited

Type of Indicator: Response

In 2000, 87.92% of shellfish beds supported harvesting. The majority of these waters (811 square miles or 77%) fully support shellfish consumption and 113 square miles (10.8%) are available under seasonal or special restricted conditions, and thus partially support shellfish consumption. In 2000, 10.69 square miles (6,848 acres) were upgraded and 280 acres were downgraded. (Classification changes effective March 2001.)



Data Description

This indicator tells us the amount of water from which shellfish can be safely harvested in New Jersey. It is a good indicator of New Jersey's progress in improving coastal water quality because it incorporates water quality testing and pollution source surveys to establish the shellfish water classifications. Classification of New Jersey's shellfish waters is performed in accordance with the National Shellfish Sanitation Program (NSSP). In order to maintain compliance with the NSSP, New Jersey collects and analyzes about 15,000 samples of it's coastal waters each year. Results of this monitoring are compared to national standards for safe shellfish harvest. The NSSP also requires that the state shellfish control agencies perform routine surveys of pollution sources within the watersheds of coastal waters. Studies are also performed to assess hydrographic and meteorological factors impacting water quality.

Data Characteristics

The Bureau of Marine Water Monitoring collects and analyzes samples throughout the year. The Bureau then evaluates these results relative to national standards and produces an annual evaluation of the state's coastal water quality. Results of this evaluation are used to upgrade the state's regulations regarding shellfish harvesting and are published each year in the New Jersey Shellfish Growing Water Classification charts. Detailed surveys of each coastal area are performed once every three years under the National Shellfish Sanitation Program. Intensive sanitary surveys are performed at least once every 12 years under the same program. These reports and other information on shellfish water classifications can be obtained by calling the Bureau of Marine Water Monitoring at (609) 748-2000 or at our web site (*www.state.nj.us/dep/watershedmgt/bmw*).

Data Strengths and Limitations

Shellfish waters classifications are a valuable indicator for New Jersey because they represent the most long-term, consistent measure of New Jersey's coastal water quality. The Bureau of Marine Water Monitoring has been performing water quality testing since before 1912 in New Jersey's coastal environment. The limitation of this indicator is that it is a measure of water quality in terms of public health and potential for disease transmission but it is not geared towards measuring the ecological health of the coastal waters. Most of the water quality testing performed for shellfish waters classifications is of coliform bacteria. Coliform bacteria are indicators of human waste. While this is very useful for public health reasons, it does not tell us how organisms in the bay and ocean are doing.

Discussion

Harvestable acreage in New Jersey has increased each year for the past 13 years. New Jersey has received national recognition as the state with the greatest amount of restored waters for shellfish harvesting for the period of 1990-1995 (NOAA, National Shellfish Register). This positive trend reflects the efforts at the state and local government levels to regionalize and improve wastewater treatment and thereby reduce the impact of point sources of pollution to the coastal waters. Efforts by government agencies and by citizen action groups have resulted in reductions of nonpoint sources of pollution as well.

Strategies used over the past 25 years were effective as evidenced by the trend described above. However, these strategies were based on control of point sources of pollution. Further improvements to New Jersey's shellfish harvesting waters will depend on successful strategies for addressing nonpoint sources of pollution. The Department of Environmental Protection has developed a Coastal Nonpoint Source Monitoring Strategy that, when implemented, will provide the necessary data for identifying pollution sources and relating those sources to use impairments (such as restrictions on shellfish harvest). Establishment of no discharge zones will also help to address nonpoint source pollution. No discharge zones prohibit the discharge of treated or untreated boat wastes into surface waters. No discharge zone status has been achieved for the Manasquan River and application has been made for the Shark River to receive no discharge zone status as well.

The Department has become increasingly effective in reducing unpermitted discharges to coastal waters. These efforts will reduce the number of emergency closures of shellfish waters due to these discharges.

Milestone: Reduce or control nitrate levels in ground water.

Indicator: Status and Trends of Nitrate Loads to Ground Water; Estimated Loads From Septic Systems

Type of Indicator: Cause

Between 1970 and 1990 New Jersey s population increased by more than 500,000 persons; a 7.1% increase. During this same period, the number of onsite sewage disposal systems (septic systems) in the state decreased by about 70,000; a 16% decrease. The decrease in the number of onsite disposal systems is the result of the construction of municipal sewer systems. When viewed on a statewide basis, there are fewer septic systems and decreased nitrate mass loading, but this is not true for all counties or municipalities. Counties that were primarily rural in 1970 have become more developed and nitrate mass loading from the septic systems has increased since 1970. These developing counties are at risk from new nitrate loading from septic systems and from associated impacts of suburban development. Without careful planning, increased nitrate loading from septic systems is likely to create additional burdens on ground water and surface water in these rapidly developing areas of the state.

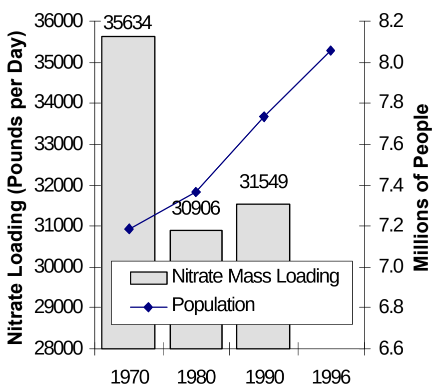


Figure 1. Nitrate loading to ground water from septic systems in New Jersey over three decades, compared to population growth.

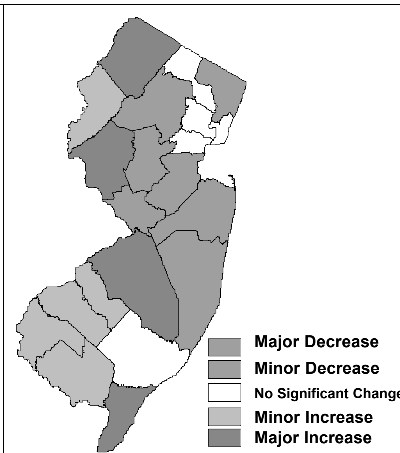


Figure 2. Change in nitrate loading to ground water from septic systems in New Jersey counties, between 1970 and 1990.

Data Description

New Jersey's ground water has nitrate concentrations that tend to be far below the drinking water standards. Statewide ambient nitrate levels typically occur at less than 1 mg/L, whereas the federal drinking water standard is 10 mg/L. Any level of nitrate above the natural ambient level represents a concern that human activities are having a negative impact on water quality. Drinking ground water that contains elevated levels of nitrate poses a health risk for humans. The ecological health of surface water is at risk from high levels of nitrate because it enhances the harmful process of *eutrophication,* especially when phosphates are abundant. In New Jersey, the major sources of nitrate mass loading to waters of the state (measured in pounds per year) are natural sources, agriculture, fertilizer impacts from suburban development, and septic systems.

The "natural" sources of nitrate are plant and animal decay and precipitation. These natural sources are ecologically important and they are not normally at levels likely to cause pollution problems. However, natural sources from waterfowl (Canada geese) are increasing in some areas and effective controls are elusive. Natural loading from precipitation is typically about 1 pound per year per acre in New Jersey, but due to air pollution, it may be increasing. Reduction of air pollution sources requires additional control of automobile emissions, which is a significant task. In general, natural sources of nitrogen may be increasing due to the impact of human activities, but they are still quite low and can be tolerated by the global ecosystem.

Agriculture, through overuse of fertilizers or improper management of animal wastes, can cause significant loading of nitrogen into streams and ground water. Studies conducted by the United States Geological Survey indicate that agricultural areas in the coastal plain typically have elevated ground water nitrate levels. However, United States Department of Agriculture initiatives are continuing to encourage and educate farmers to practice nitrogen management. Suburban development results in substantial use of lawn fertilizer. As suburbia grows, so too does lawn fertilizer use, but it is not clear by how much. Universities recommend using about 3 pounds of nitrogen per 1,000 square feet of lawn. This amounts to about 130 pounds per acre. Not all the nitrogen is nitrate and not all of it enters the ground water, but much of it typically does. Future studies by NJDEP will attempt to determine the actual mass loading from this source. If it is found to be excessively high, future NJDEP initiatives will provide guidance and encourage prudent use of lawn fertilizers in certain areas.

Nitrate loading from domestic septic systems is another important source, and it is not currently being controlled. Loading from septic systems could be controlled, though not easily, through planning and establishment of zoning that limits where septic systems are located, how they are constructed, and the number of onsite systems that are located in a given area. Large-flow onsite sewage disposal systems like strip malls, schools, and small businesses located in areas not served by public sewers also generate significant nitrate loading. These facilities are being controlled and must maintain nitrate loading at acceptable levels since they are required to comply with NJPDES permits issued by the NJDEP.

It is the nitrate loading from domestic septic systems that is emphasized in this report. This is because the source is not currently being controlled and it represents such a large mass loading contribution in some areas.

Environmental Characteristics of the Septic System

Modern domestic septic systems, when properly constructed and operated safely, control pathogens, thereby protecting against epidemics and outbreaks of various diseases. Pathogens and ammonia are only a concern when a septic system is improperly constructed or operated. Contrary to popular belief, even properly functioning septic systems generate a certain amount of nitrate pollution. When conventional septic systems operate properly, they effectively convert organic nitrogen first to ammonia nitrogen, then to the nitrate form of nitrogen. Thus, nitrate nitrogen is the nutrient or pollutant most commonly identified when people talk about the pollution risk from septic systems.

Each domestic septic system in New Jersey is estimated to discharge about 32 pounds of nitrate nitrogen annually. This mass loading rate is based on the amount of total nitrogen produced by each person and the conversion of total nitrogen to nitrate nitrogen that occurs in the soils. A simple way to calculate mass loading is to multiply three factors together; the number of people per home, the annual flow, and the concentration of nitrate. Applying these factors, annual nitrate loading from each home septic system equals 14.49 kg, or 32 pounds, since there are 2.24 pounds per kg. The equation for this mass balance is provided below Table 1.

Nitrate nitrogen generated by septic systems is water-soluble and easily percolates through the ground and enters the ground water. This increases the nitrate concentration of ground water to some extent, but much of the nitrate entering the ground does not go deeply, and it emerges into surface water (streams, lakes) as base flow. Therefore, when ground water has elevated levels of nitrate, surface water may also become contaminated.

Nitrate is considered to be a non-degradable or "conservative" pollutant in ground water. It degrades only slightly by the biological process of *denitrification*, but conditions conducive to *denitrification* (low oxygen content, high organic matter content) rarely occur near properly sited septic systems. Conservative pollutants can only be attenuated (minimized) by dilution or advanced treatment. Thus, to reduce the nitrate risk it is necessary to provide adequate lot sizes for dilution or to institutionalize onsite sewage disposal systems with advanced treatment. At this time, neither strategy is being actively implemented in New Jersey for domestic onsite sewage disposal systems, except when "50 or More Realty Improvement" certifications are issued by the Department of Environmental Protection (NJDEP)[2] because these certifications limit the number of lots that can be built on a subdivision to the number that are protective of ground water and surface water quality standards. The NJDEP is aware that strategies to control the risk from septic systems are important if we are to protect our water supplies and they will likely become more widely implemented in the future.

Data Characteristics

Official United States census data were reviewed for all New Jersey counties. The census reports provided the number of septic systems per county. Data obtained from the 1970, 1980, and 1990 census reports allows one to review trends over time.

In order to simplify display of the data, counties were placed into several trend classes, based on whether they had an increase or decrease in the number of septic systems. A *major increase* means that over 500 pounds per day more nitrate is being generated on a daily basis. A minor increase means that between 100 and 500 pounds per day more nitrate is being generated on a daily basis. A *major decrease* means that more than 500 per day less nitrate is being generated on a daily basis. A *minor decrease* means that between 100 and 500 pounds less nitrate is being generated on a daily basis. No *significant change* is indicated when less than 100 pounds per day increase or decrease is observed.

The data are available from the Bureau of Nonpoint Pollution Control by calling (609) 292-7021.

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[2] N.J.S.A. 58:11-25.1. Subdivision approval to cover 50 or more realty improvements; certification of proposed water supply and sewerage facilities

Data Strengths and Limitations

The existing data regarding numbers of septic systems in New Jersey is based on United States census information. At the time this report is written, there is no updated information regarding the trends after 1990. At this time, the census data are the only available data compiled to assess statewide statistics even though the local health departments maintain records of the number of septic systems they permit. In the future, better record keeping by the NJDEP and better coordination with the local health departments may enable a more precise and timely tally of trends.

Nitrate loading is not a measured value but is an estimate. It is estimated based on a reasonable assumption that each home is occupied by 3.5 people, that each person generates 75 gallons per day of septic system wastewater and that the septic effluent enters the groundwater at a concentration of 40 mg/L. Although these numbers are similar to other published data from affluent areas of the United States, there are other ways to calculate loading rate which could result in slightly higher or lower mass loading values. For example, new data suggests that there may be only 3 persons per home (or less) and that they each use about 85 gallons of water per day. The NJDEP is studying these trends and will modify the mass loading estimates, if necessary, in the future.

Discussion

Between 1970 and 1990 New Jersey's population increased from 7.2 million to 7.7 million and it is estimated as over 8 million in 1996. During this same period, the number of septic systems decreased from 404,231 to 336,310. Consequently the nitrate loading to ground water from septic systems has generally decreased by over 4,100 pounds per day (Figure 1). This reduction occurred because of the increased availability of municipal sewer systems. At least from the septic system source, ground water all over the State is becoming cleaner with respect to nitrate, but this is not necessarily the case in all counties and municipalities.

Further evaluation of the data (Figure 2) reveals that some counties had a net reduction of nitrate loading, measured in pounds per day, while others had a net increase in loading. Counties that were mostly rural in 1970 have become more developed and have higher nitrate loading than in 1970. These once rural counties are Sussex, Hunterdon, Burlington, Cape May, Cumberland, Warren, Salem, Camden, and Gloucester. The developing counties may be at risk from the pressures of new nitrate loading and without careful planning, the nitrate loading is likely to create additional burdens on ground water and surface water in these areas. NJDEP is currently considering planning strategies in conjunction with State Development and Redevelopment Plan objectives to encourage environmentally sound development and to ensure that septic system density does not impair uses of the water resources. In addition, NJDEP is evaluating strategies for enabling the use of advanced treatment technologies that will control or minimize the pollutant loading from septic system effluent.

Table 1. Estimated nitrogen loading in New Jersey, based on the number of homes using septic systems.

County	Number of Homes 1990	Homes with Septic Systems			Nitrate Loading (Pounds per Day)			Nitrate Loading Change (Pounds per Day)
		1970	1980	1990	1970	1970	1990	
ATLANTIC	106877	19774	19192	20784	1743	1692	1832	89.0
BERGEN	324817	48589	19303	16871	4283	1702	1487	-2796.0
BURLINGTON	143236	17614	21589	23973	1553	1903	2113	560.6
CAMDEN	190145	10820	12194	12176	954	1075	1073	119.5
CAPE MAY	85537	10820	10134	16601	954	893	1463	509.6
CUMBERLAND	50297	15853	18381	20682	1397	1620	1823	425.7
ESSEX	298710	2717	1244	1657	240	110	146	-93.4
GLOUCESTER	82459	17865	16867	19796	1575	1487	1745	170.2
HUDSON	229682	676	591	834	60	52	74	13.9
HUNTERDON	39987	16653	20626	24408	1468	1818	2152	683.6
MERCER	123666	9861	10438	7714	869	920	680	-189.3
MIDDLESEX	250174	10956	6881	5659	966	607	499	-466.9
MONMOUTH	218408	52686	23312	21446	4644	2055	1891	-2753.9
MORRIS	155745	48605	47690	46170	4285	4204	4070	-214.7
OCEAN	219863	46973	34169	25405	4141	3012	2240	-1901.3
PASSAIC	162512	15515	16980	15761	1368	1497	1389	21.7
SALEM	25349	8110	9598	10409	715	846	918	202.7
SOMERSET	92653	17618	14856	12371	1553	1310	1091	-462.5
SUSSEX	51574	19739	32794	39724	1740	2891	3502	1761.7
UNION	187033	958	548	862	84	48	76	-8.5
WARREN	36589	11829	13211	14587	1043	1165	1286	243.1
Entire State	3075313	404231	350598	357890	35634	30906	31549	-4085.1

$$\text{Nitrate Loading} = 3.5\,\frac{\text{persons}}{\text{Home}} * 75\,\frac{gallons}{day * person} * 365\,\frac{day}{year} * 3.78\,\frac{L}{gallon} * 40\,\frac{mg}{L} * 1\,\frac{kg}{1*10^6\,mg} = 14.49\,\frac{kg}{year * Home}$$

Introduction - Drinking Water

In New Jersey, public drinking water systems test for approximately 90 contaminants. There are two main types of public water systems: community water systems and noncommunity water systems. A community water system serves at least 15 service connections used by year-round residents or serves at least 25 year-round residents (e.g., town, a mobile home park). In New Jersey, there were 616 community water systems active during 1998. Noncommunity water systems do not serve permanent residents and are further categorized into nontransient noncommunity and transient noncommunity. A nontransient noncommunity water system serves at least 25 of the same persons over six months per year (e.g., schools, office buildings). A transient noncommunity water system serves at least 25 people per day but the people are different each day (e.g., highway rest stop, motel). In New Jersey, there were 4,005 noncommunity water systems active during 1998: 1,015 nontransient noncommunity water systems and 2,990 transient noncommunity water systems.

The major contaminant groups monitored in public water systems are microbiological, turbidity, disinfectant residual, inorganic chemicals including lead and copper, volatile organic chemicals, synthetic organic contaminants including pesticides, radiological contaminants, and disinfection byproducts. However, not all public water systems test for these contaminants. Major factors used to determine the type of contaminants that need to be monitored in a public water system are the type of water system (as described above), the source of the drinking water (ground water or surface water), the number of people served by the water system, the vulnerability of the water source(s) to contamination, and previous test results.

The only contaminants that are monitored in all public water systems in New Jersey are microbiological contaminants and nitrate, an inorganic chemical. Only community water systems are required to monitor for radiological contaminants and disinfection byproducts. Both community and nontransient noncommunity water systems monitor for the remaining contaminants. New Jersey adopts all federal drinking water standards and regulations by reference (40 CFR 141). However, New Jersey regulations contain additions and clarifications that are specific to this state. According to New Jersey statute (N.J.S.A. 58:12A-13(b)), when standards are developed by both federal and state drinking water agencies, the more stringent standard applies. This is important in New Jersey because 13 drinking water standards developed by NJDEP are lower than EPA standards. Five additional drinking water contaminants regulated in New Jersey do not have federal drinking water standards.

A drinking water standard, or “maximum contaminant level (MCL),” is the highest concentration of a contaminant that is allowed in drinking water. An “action level,” which is different than a maximum contaminant level, applies only to the concentration of lead or copper in water and determines the corrosion control treatment that a water system is required to install.

Until the late 1980's, nearly all drinking water sampling took place at the consumer’s tap in order to measure directly what the consumer was drinking. Today, only microbiological contaminants, disinfection byproducts, lead, copper, asbestos (sometimes) and radiological contaminants are sampled at the consumer’s tap. Except for radiological contaminants, these contaminants are associated with water quality problems that may develop in the water distribution system. The distribution system sampling location for radiological contaminants is expected to be revised in future EPA regulations. When required by regulation to be sampled, inorganic chemicals, volatile organic chemicals, synthetic organic contaminants, turbidity and disinfectant residuals are monitored by each community and nontransient noncommunity water system at points-of-entry to the water distribution system after treatment. These contaminants are closely related to source water quality, as are the radiological contaminants. In general, community water systems have multiple points-of-entry and nontransient noncommunity water systems and transient noncommunity water systems usually have one point-of-entry. Water systems with multiple points-of-entry must submit test results for each point-of-entry to represent all the water sources used.

State or federal laws and regulations do not directly regulate testing of wells that serve individual homes or small businesses, referred to as private wells or domestic wells. Testing of these sources of drinking water is the responsibility of the owner. The maximum contaminant levels developed for public water systems are used to assess the drinking water quality of private wells.

A selection of the most significant environmental indicators for the drinking water program is presented on the following pages. The indicators describe the status of drinking water quality in 1998. Trends in the environment were noted whenever the data were available and assessed. The full suite of drinking water environmental indicators may be found in the FY1999-2001 Performance Partnership Agreement (June 1999). The following are highlights of the public drinking water system indicators in New Jersey.

- *Over 97% of public water systems that sampled for total coliform bacteria in 1998 (and over 95% of the population served) met the microbiological drinking water standard for total coliform bacteria.*

- *Over 92% of community and nontransient noncommunity water systems that sampled for chemical parameters in 1998 met the chemical drinking water standards.*

- *There have been no outbreaks of waterborne disease due to disease-causing microorganisms in drinking water in New Jersey since 1989. The July 1989 outbreak was in a transient noncommunity water system at a campsite. Eight persons were infected with an unidentified pathogen.*

Goal: Every Person in New Jersey Will Have Safe Drinking Water

This goal was developed to recognize the importance of clean drinking water for all New Jersey residents at all times. Public drinking water systems serve approximately 87% of the State's estimated 1995 population of 7,750,000. Wells that serve individual homes or small businesses, referred to as private wells or domestic wells, serve the remainder of the population.

Milestone: By 2005, 95% of the public water systems (and 95% of the population served) will provide water that meets the microbiological drinking water standards

This milestone measures the progress of all public water systems in New Jersey towards delivering water that meets the microbiological drinking water standard at all times. The microbiological drinking water standard is measured as "total coliform bacteria."

Introduction to Milestone

Microbiological testing is a key component of the New Jersey drinking water program. The 616 community water systems test for "total coliform bacteria" monthly; the 4005 noncommunity water systems test for "total coliform bacteria" during each calendar quarter of operation. The coliform group of bacteria is known as indicator bacteria. They do not necessarily cause disease, but can indicate the possible presence of other potentially harmful microorganisms. The absence of coliform bacteria is used to indicate acceptable microbiological drinking water quality. The number of samples collected by each community water system is based on the population served in accordance with the Total Coliform Rule (40 CFR 141).

A "monthly maximum contaminant level violation" occurs when either five percent of the samples for systems taking more than 40 samples per month or no more than one positive sample for systems taking less than 40 samples per month contain coliform bacteria. An "acute maximum contaminant level violation" occurs when a sample shows that there is total coliform in the water and upon further examination of that same sample, either *Escherichia coli (E. coli)* or fecal coliform bacteria are detected and follow up samples contain total coliform, or if the initial sample does not contain fecal coliform or *E. coli* but a follow up sample drawn from the same location as the first is positive for either *E. coli* or fecal coliform as well. .

The total coliform drinking water standard may provide a false sense of microbiological safety in the drinking water because not all types of waterborne disease can be detected with the total coliform test. For example, *Giardia* and *Cryptosporidium* parasites that have been associated with disease outbreaks throughout the world, may be present when a coliform test is negative.

Environmental Indicators for this Milestone

The following indicator is being reported to measure progress in meeting this milestone.

1. Percent of public water systems (populations) providing drinking water that meets all microbiological drinking water standards throughout the year **(Type of Indicator: Condition)**

Another potential indicator for this milestone is:

. *For CWS, number (%) of months without an acute (fecal) MCL violation and without a monthly total coliform MCL violation per year"* (Type of Indicator: Condition)

Milestone: By 2005, 95% of the public water systems (and 95% of the population served) will provide water that meets the microbiological drinking water standards throughout the year

Indicator: Percent of Public Water Systems (and Percent of Population Served) Providing Drinking Water that meets All Microbiological Drinking Water Standards Throughout the Year

Type of Indicator: Condition

Over 97% of public water systems that sampled for total coliform bacteria in 1998 (and 95% of the population served) met the microbiological drinking water standard for total coliform bacteria. Trend data are found in Figure 2.

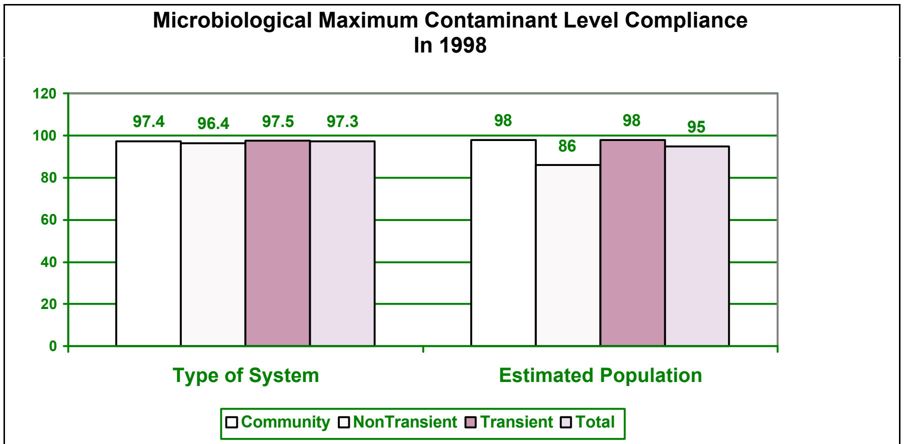

Figure 1: Percent of community water systems, nontransient noncommunity water systems, transient noncommunity water systems and total public water systems that met the microbiological drinking water standard in 1998. Estimated percent of the population served by water systems that meet the microbiological standard throughout the year are also presented.

Data Description

This indicator shows that in 1998 the microbiological milestone of "Ninety-five percent of the public water systems (and 95% of the population served) will provide water that meets the microbiological drinking water standards throughout the year" was met. Total coliform bacteria violation data are a measure of the microbiological safety of drinking water.

Compliance with both the monitoring requirements and the maximum contaminant level insures that the water supplies are continually delivering water of acceptable microbiological quality.

Data Characteristics

The data used for this indicator were collected in 1998 according to the Total Coliform Rule (40 CFR 141.21). Water systems collected the samples from their customer's drinking water taps according to an approved sampling plan. The samples were analyzed by drinking water laboratories certified by the State of New Jersey using EPA approved analytical methodologies. Water systems have been routinely collecting microbiological data since 1979 when the New Jersey Safe Drinking Water Act Regulations were adopted. The microbiological data are stored in a database maintained by the Bureau of Safe Drinking Water and can be obtained by calling (609) 292-5550.

Data Strengths and Limitations

The strength of the microbiological data is that it is collected from all public water systems throughout the United States and is a direct measure of the sanitary quality of the water. The microbiological violation data, however, are managed differently among states.

The microbiological maximum contaminant level was initially one coliform per 100 milliliter sample. In 1990, a new microbiological standard was adopted: the absence of coliform bacteria in a 100 milliliter sample. See 40 CFR 141.63 for a complete discussion of the microbiological maximum contaminant level.

The microbiological water quality data collected each month for community water systems or quarterly for noncommunity water systems may provide a false sense of microbiological safety in the drinking water because not all types of waterborne disease can be detected with the total coliform test. For example, *Giardia* and *Cryptosporidium*, parasites that have been associated with disease outbreaks throughout the world, may be present in the absence of coliform bacteria.

Discussion

Over 97% of public water systems that sampled for total coliform bacteria in 1998 (and 95% of the population served) met the microbiological drinking water standard for total coliform bacteria.

In 1998, 100% of the community water systems (616), 89% of the nontransient noncommunity water systems (900) and 91% of the transient noncommunity water systems (2,717) were monitored for total coliform bacteria. All people served by community water systems and 76% of the population served by noncommunity water systems were served by systems that monitored.

Of the community water systems that monitored in 1998, over 97% of the systems (and over 98% of the population served) were in compliance with the total coliform maximum contaminant level. This percentage of community systems that provided water that meets microbiological standards exceeded the milestone that was established for 2005. The noncommunity water systems that sampled also exceeded the milestone for 2005, however, the estimated population served by noncommunity water systems in compliance with the microbiological maximum contaminant level was 94%, which falls slightly short of the goal for the year 2005. See Figure 1.

This analysis of the microbiological maximum contaminant level data shows that monitoring compliance is good but could be improved for the noncommunity water systems. In addition, there is a need to increase the population served by noncommunity water systems with no microbiological maximum contaminant level violations.

New Jersey public water systems have achieved the milestone for microbiological drinking water quality set for the year 2005. Between 97 and 99 percent of public water systems that sampled for total coliform bacteria between 1995 and 1998 (and between 93% and 96% of the population served) met the microbiological drinking water standard for total coliform bacteria.

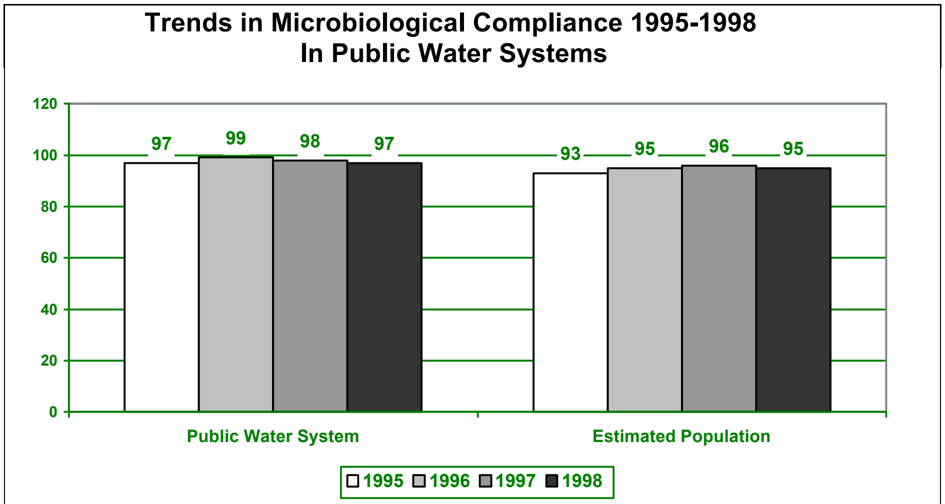

Figure 2: Trends in microbiological compliance 1995-1998

Data Description

This indicator shows that New Jersey public drinking water systems have consistently achieved the microbiological milestone of 95% of the public water systems (and 95% of the population served) provide water that meets the microbiological drinking water standard throughout the year. Since 1996, the milestone for population served has been met as well. Total coliform bacteria violation data are a measure of the microbiological safety of drinking water.

A complete discussion of the microbiological data used to develop this trend is described in the previous section.

Goal: Every Person in New Jersey Will Have Safe Drinking Water

This goal was developed to recognize the importance of clean drinking water for all New Jersey residents at all times. Public drinking water systems serve approximately 87% of the State's estimated 1995 population of 7,750,000. Wells that serve individual homes or small businesses, referred to as private wells or domestic wells, serve the remainder of the population.

Milestone: By 2005, 95% of the public water systems will provide water that meets the New Jersey chemical and radiological drinking water standards.

This milestone measures the progress of all public water systems in New Jersey towards delivering water that meets the chemical drinking water standards at all times.

Introduction to the Milestone

In order to determine the safety of the drinking water served by public water systems, test results from the following major chemical contaminant groups needed to be evaluated: disinfectant residual, turbidity, inorganic chemicals including lead and copper, volatile organic chemicals, synthetic organic contaminants including pesticides, radiological contaminants, and disinfection byproducts. The chemical regulations require that different types of water systems perform different testing at different frequencies. A summary of these sampling requirements follows.

Each year, annual samples are required to be taken for nitrate by nearly all public water systems. Water systems that purchase all of their drinking water are not required to sample for nitrate because the water system that sells the water is responsible for testing the water. The Surface Water Treatment Rule samples, which are tested for turbidity and disinfectant residuals, are collected from all public water systems using a surface water source or a ground water source under the direct influence of surface water. Lead and Copper Rule samples are collected from community water systems and nontransient noncommunity water systems at locations most vulnerable to lead contamination; faucets that have not been used at least six hours before sample collection. The samples for radiological contaminants (community water systems only) and disinfection byproducts (community water systems serving more than 10,000 people) are also collected from the water distribution system, using different sampling protocols.

Community water systems and nontransient noncommunity water systems sample for the volatile organic chemicals, synthetic organic contaminants and inorganic chemicals at the point-of-entry to the water distribution system. A point-of-entry is the place where the drinking water enters the water distribution system after treatment, if any. In general, community water systems usually have multiple points-of-entry and nontransient noncommunity water systems and transient noncommunity water systems usually have a single point-of-entry.

For systems using ground water sources, inorganic chemicals were tested once at each point-of-entry between 1996 and 1998. The volatile organic chemicals were tested either quarterly, annually or once between 1996 and 1998 depending on the susceptibility of the source water to contamination, past test results, and system size. A representative sample of source waters continued to be tested between 1996 and 1998 for synthetic organic chemicals and pesticides. Surface water systems sample annually for inorganic chemicals and volatile organic chemicals and are selectively tested for synthetic organic chemicals or pesticides. Those water systems that totally bulk purchase their drinking water, however, are not required to sample for volatile organic chemicals, synthetic organic chemicals including pesticides and inorganic chemicals. Therefore, in 1998, each water system and point-of-entry had an individually designed sampling schedule.

The drinking water standards established by EPA are adopted by NJDEP. The 1983 amendments to the New Jersey Safe Drinking Water Act established a NJDEP advisory body, the New Jersey Drinking Water Quality Institute, to recommend drinking water standards for a list of 22 synthetic organic chemicals based on specific risk assessment guidance. Currently, there are 12 drinking water standards for volatile organic chemicals in New Jersey which are more stringent than federal standards and there are five volatile organic chemicals that are regulated in New Jersey but not by the EPA.

Environmental Indicators for this Milestone

The following indicator is being reported to measure progress in meeting this milestone.

1. Percent of public water systems (populations) providing drinking water that meets all New Jersey chemical drinking water standards throughout the year **(Type of Indicator: Condition)**

Milestone: By 2005, 95% of the public water systems will provide water that meets the New Jersey chemical drinking water standards.

Indicator: Percent of Public Water Systems providing Drinking Water that meets All New Jersey Chemical and Radiological Drinking Water Standards throughout the Year.

Type of Indicator: Condition

Over 96% of public water systems that sampled for chemical parameters in 1998 met the New Jersey drinking water standards. Over 92% of community water systems and nontransient noncommunity water systems that sampled for chemical parameters in 1998 met the chemical drinking water standards. Trend data are presented in Figure 4.

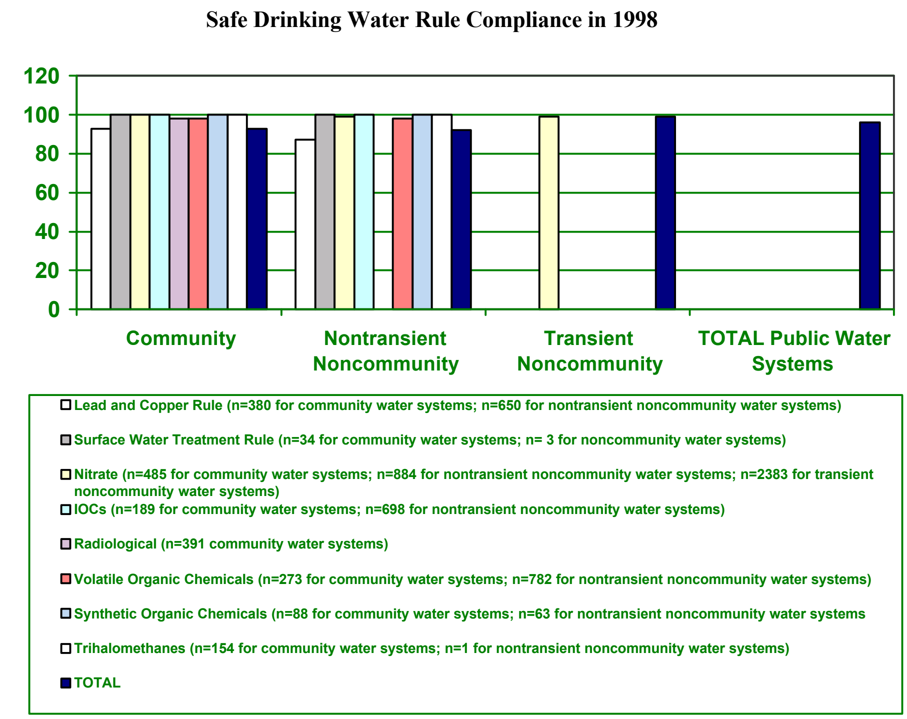

Figure 3: The percent of public water systems that sampled in 1998 and were in compliance with the chemical and radiological New Jersey drinking water standards.

Data Description

Maximum contaminant level violation data and action level exceedence data were used as measures of the chemical and radiological safety of drinking water in 1998. A maximum contaminant level violation is generally issued after an initial sample exceeds the maximum contaminant level and subsequent quarterly monitoring shows that the average concentration of a contaminant is at or above the maximum contaminant level. An action level exceedence occurs when a water system does not meet the lead and/or copper action level for two consecutive six-month sampling periods.

The indicator for chemical drinking water standard compliance is presented separately for community water systems and nontransient noncommunity water systems.

Data Characteristics

The data used for this indicator were collected in 1998 in accordance with federal and state regulations. Safe Drinking Water Act violations for each group of contaminants were calculated in accordance with federal and state regulations. Drinking water samples were collected by the public water systems and analyzed at laboratories certified by the State of New Jersey using EPA approved analytical methodologies.

This indicator was developed for 1998 by first determining which water systems sampled for 1) the Lead and Copper Rule, 2) the Surface Water Treatment Rule, and 3) the chemical (volatile organic chemicals, synthetic organic chemicals, inorganic chemicals including nitrate, and disinfection byproducts) and radiological rules of the Safe Drinking Water Act. Next, the number of community water systems and nontransient noncommunity water systems that violated the drinking water standards for each contaminant group were compiled. The number of maximum contaminant level violations or action level exceedences was divided by the number of systems that sampled in 1998. This provided the percentage of systems that sampled in 1998 with maximum contaminant level or action level exceedences for each rule.

Some chemical data have been collected since 1979 when the New Jersey Safe Drinking Water Act Regulations were adopted. Since then, new state and federal statutes and regulations have expanded the list of contaminants, changed some of the original maximum contaminant levels, and altered the frequency and location of sampling (40 CFR 141, N.J.A.C. 7:10-1 *et seq.*).

The data are stored in a database maintained by the Bureau of Safe Drinking Water that can be obtained by calling (609) 292-5550.

Data Strengths and Limitations

The strength of the chemical data is that the results are collected from public water systems throughout the United States. The chemical violation data, however, are managed differently among states.

New Jersey has a drinking water standard setting process established by the 1983 amendments to the New Jersey Safe Drinking Water Act. This has resulted in 12 New Jersey standards that are more stringent than those set by EPA and five chemicals regulated by NJDEP that are not regulated by EPA.

Not all water systems or points-of-entry were required to sample for all chemical parameters in 1998. The chemical drinking water quality indicator is based on those systems that submitted results during 1998.

Several different types of drinking water data have been combined to develop this indicator. One of the difficulties with calculating this indicator is that not all drinking water sampling rules apply to all public water systems. For example, the Surface Water Treatment Rule only applies to 37 of the community and nontransient noncommunity water systems; nitrate monitoring is required of all 4005 public water systems.

For the other rules, it is also difficult to determine if the overall chemical indicator represents an overestimation or underestimation of the number of chemical violations in New Jersey public water systems.

For some parameters, such as disinfection byproducts, the test results represent the water quality in the water distribution system. For other parameters such as volatile organic chemicals, a sampling schedule is issued to each point-of-entry to the water distribution system individually. Depending on the size and configuration of the water system, there may be several test results that represent the quality of the drinking water for that system.

Discussion

Ninety-four percent of community water systems, 91 percent of nontransient noncommunity water systems, and over 99 percent of transient noncommunity water systems met all NJ chemical and radiological drinking water standards in 1998. A graphical presentation of the data, as seen in Figure 3, shows the percent of community water systems and nontransient noncommunity water systems that complied with the Lead and Copper Rule, the Surface Water Treatment Rule and the chemical rules for inorganic chemicals, volatile organic chemicals, synthetic organic chemicals including pesticides, and radiological parameters. In addition, this figure shows the percent of systems that sampled with no violations of the chemical rules. The milestone of 95% of the water systems meeting the chemical drinking water standards by the year 2005 has not yet been met for either community water systems or nontransient noncommunity water systems.

New Jersey public water systems have not achieved the milestone for chemical/ radiological drinking water standards. Between 1995 and 1998, the percent of public water systems in compliance with all chemical and radiological drinking water standards increased from 86% to 96 %.

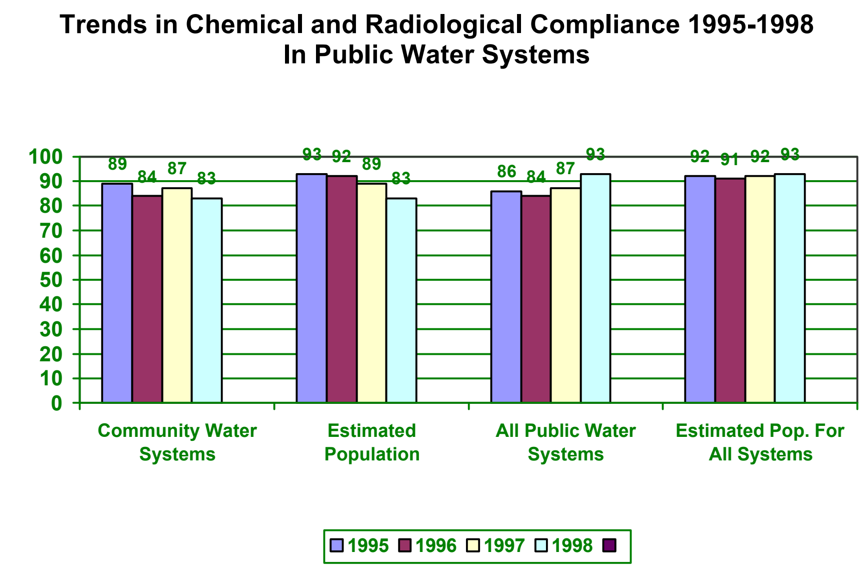

Figure 4: Chemical and radiological rule compliance 1995-1998 in public water systems.

Data Description

Maximum contaminant level violation data and action level exceedence data from 1995 to 1998 were combined and used as measures of the chemical and radiological safety of drinking water. A maximum contaminant level violation is generally issued after an initial sample exceeds the maximum contaminant level and subsequent quarterly monitoring shows that the average concentration of a contaminant is at or above the maximum contaminant level. An action level exceedence occurs when a water system does not meet the lead and/or copper action level for two consecutive six-month sampling periods. A complete description of the data used to develop these trends is in the previous section.

Subgoal 6: The concentrations of volatile organic chemicals in finished drinking water shall be below the maximum contaminant levels.

Volatile organic chemicals are a group of organic chemicals that have been detected in approximately 20% of all community water systems in the United States. Exposure to these chemicals at sufficient concentrations may result in adverse health effects which include cancer and/or systemic toxicity. The EPA and New Jersey have established maximum contaminant levels for a total of 26 volatile organic chemicals.

Milestone: No public water system will have levels of volatile organic chemicals greater than the maximum contaminant levels by 2005.

New Jersey has made progress in reducing exposure to this group of chemicals.

Introduction to the Milestone

Volatile organic chemicals are of concern because exposure to these chemicals at sufficient concentrations may result in adverse health effects that include cancer and/or systemic toxicity. Maximum contaminant levels (MCLs) have been developed separately for each volatile organic chemical of concern based on its potential to cause adverse human health effects. In 1989, New Jersey under the 1983 Amendments to the New Jersey Safe Drinking Water Act adopted MCLs for 17 volatile organic chemicals. New Jersey was one of the first states in the nation to have a comprehensive program to both monitor and develop standards for volatile organic chemicals in drinking water. The standards promulgated by New Jersey in 1989, included one contaminant which is not regulated by EPA, as well as 13 contaminants for which the New Jersey standards are lower than the federal standards for the same chemical (See Table 1). These standards were modified, expanded, and readopted in 1996.

Environmental Indicators for this Milestone

The following indicators are being reported to measure progress in meeting this milestone:

1. Number and percent of community water systems (population) with concentrations of volatile organic chemicals greater than the maximum contaminant levels and with detectable concentrations of volatile organic chemicals and with concentrations of volatile organic chemicals less than the maximum contaminant level. **(Type of Indicator: Condition)**

2. Number and percent of points-of-entry with concentrations of volatile organic chemicals greater than the maximum contaminant level and with detectable concentrations of volatile organic chemicals less than the maximum contaminant levels (reported separately for surface water and groundwater. “ **(Type of Indicator: Condition)**

Other potential indicators for this milestone include:

1. *"Number of point source dischargers (POTWs and industrial) upstream of potable water intakes."* (Type of Indicator: Cause)
2. *"Pounds of VOCs discharged by point sources upstream of intakes."* (Type of Indicator: Cause)

3. "Number of hazardous waste sites in wellhead protection areas." (Type of Indicator: Cause)
4. "Number of hazardous waste sites with confirmed contamination of groundwater." (Type of Indicator: Cause)

Table 1: Comparison of New Jersey maximum contaminant levels with Federal maximum contaminant levels for volatile organic chemicals, in effect 1989 to the present3

Volatile Organic Chemicals	NJ MCL (ppb) 1989	NJ MCL (ppb) 1996*	Federal MCL (ppb)
Benzene	1	1	5
Carbon Tetrachloride	2	2	5
Chlorobenzene	4	50	100
o-Dichlorobenzene	600	600	600
m-Dichlorobenzene	600	600	---
p-Dichlorobenzene	75	75	75
1,1-Dichloroethane	--	50	--
1,2-Dichloroethane	2	2	5
1,1-Dichloroethylene	2	2	7
cis-1,2-Dichloroethylene	10	70	70
trans-1,2-	10	100	100
1,2-Dichloropropane	---	---	5
Ethylbenzene	---	---	700
Methyl *t*-butyl ether	--	70	--
Methylene chloride	2	3	5
Napthalene	--	300	--
Styrene	---	---	100
1,1,2,2-Tetrachloroethane	--	1	--
Tetrachloroethylene	1	1	5
Toluene	---	---	1000
Trichlorobenzene(s)	8	9	70
1,1,1-Trichloroethane	26	30	200
1,1,2-Trichloroethane	--	3	5
Trichloroethylene	1	1	5
Vinyl chloride	2	2	2
Xylenes	44	1,000	10,000

* All federal drinking water standards are automatically adopted into New Jersey regulations. New Jersey has also developed drinking water standards in accordance with PL 83-523. The standards promulgated by New Jersey in 1996 include five contaminants that are not regulated by EPA, as well as 12 contaminants for which the New Jersey standards are lower than the federal standards for the same chemical. The more stringent number is used for the regulation of drinking water. Four chemicals have only EPA standards which, as stated above, are in full effect in New Jersey by regulation.

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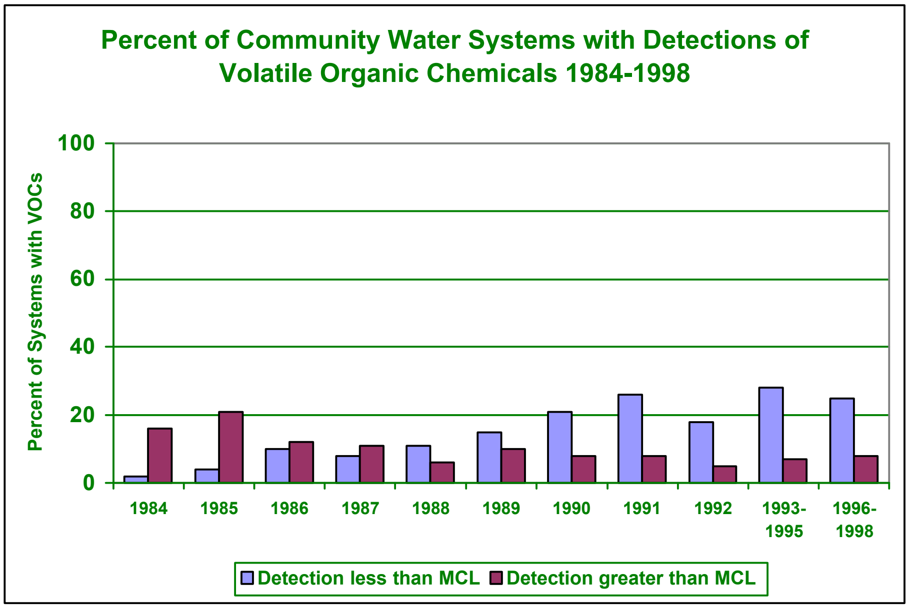
3 Several of the New Jersey drinking water standards in effect, 1989-1995, were modified in the New Jersey regulations that were adopted November 18, 1996.

Milestone: In the period 1993-2005, reduce the number of community water systems and nontransient noncommunity water systems with volatile organic chemicals greater than their maximum contaminant levels by 50%.

Indicator: Percent of community water systems with detectable concentrations of volatile organic chemicals and with concentrations of volatile organic chemicals above their maximum contaminant level

Type of Indicator: Condition

Between 1984 and 1998, the percent of community water systems with concentrations of volatile organic chemicals greater than the maximum contaminant level has fallen from roughly 20% to 8%. Detection of a volatile organic chemical above the maximum contaminant level does not always result in a maximum contaminant level "violation." In 1998, less than one percent of the community water systems that sampled had maximum contaminant level violations of the Safe Drinking Water Act for volatile organic chemicals.



Data Description

This indicator is a direct measure of progress towards meeting the milestone for community water systems. Starting in 1984, New Jersey began collecting data on the occurrence of volatile organic chemicals in drinking water. The data show a decrease in the number of systems with samples exceeding the maximum contaminant level (MCL), in the time period from 1984-1998, from 20% to 8%.

Data Characteristics

Occurrence data for volatile organic chemicals in finished drinking water has been collected since 1984 in New Jersey. From 1984 through 1992, the samples were collected in the distribution system. Federal rules that went into effect in 1993 changed the sampling site from the water distribution system to the point-of-entry to the water distribution system, so that the sampling would occur closer to the potable water source. The number of samples required from each water system was changed, too. Each point-of-entry is now assigned a sampling schedule that ranges from quarterly sampling to sampling once every three years, depending upon past data and the susceptibility of the water source to contamination.

In 1984, all systems were required to sample for 17 volatile organic chemicals twice a year. Federal rule changes that took effect in 1993 increased the number of regulated contaminants in drinking water to 22; new rules that went effect in November 1996 further increased the number of volatile organic chemicals monitored to 26.

Samples are analyzed by New Jersey State certified laboratories and submitted to the Bureau of Safe Drinking Water. Analysis is performed using EPA Methods 502.2, 524.2, or a combination of 502.1 and 503.1. The detection limit for each volatile organic chemical is 0.5 ppb. For further information, contact the Bureau of Safe Drinking Water at (609) 292-5550.

Data Strengths and Limitations

Interpretation of the data on volatile organic chemical occurrence is complicated by the fact that improvements in analytical capability over time have resulted in lower detection limits for this class of chemicals. An increase in the frequency of detection of trace levels of volatile organic chemicals over time does not necessarily mean that there has been deterioration in the water quality in New Jersey.

New Jersey's data on detections of volatile organic chemicals in finished drinking water is not directly comparable to the data generated by other states, since New Jersey, like some other states, has developed its own MCLs for this group of chemicals. Of the 26 volatile organic chemicals regulated in New Jersey, between 1993-1998, EPA does not regulate five contaminants, and 12 contaminants have New Jersey MCLs that are lower than the federal MCLs for the same chemical.

Discussion

From examining the data on volatile organic chemicals in drinking water, it is apparent that New Jersey has made considerable progress in limiting exposure to this group of contaminants. Additional progress will be needed if the milestone is to be met in 2005.

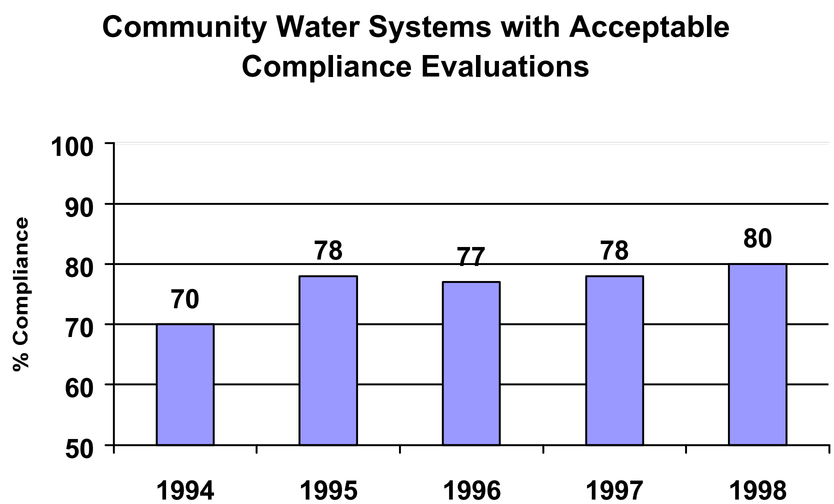
Although there were 616 community water systems in New Jersey at the end of 1998, only 555 water systems were required to sample between 1996 and 1998. The remaining 61 systems purchased water from other supplies that have already been tested. Of the 555 systems required to sample between 1996-1998, 516 systems, 93%**,** sampled for volatile organic chemicals between 1996 and 1998. The data for 1996-1998 are only comparable to the 1993-1995 bar on the graph since the other data points include all of the community water systems with the following exception: Five additional contaminants have drinking water standards that began to be monitored in 1997. These contaminants include four contaminants not regulated by the federal government (1,1-dichloroethane, methyl t-butyl ether, naphthalene, and 1,1,2,2-tetrachloroethane), and one for which the New Jersey standard is lower than the federal standard (1,1,2-trichloroethane). One of these newly regulated chemicals, methyl tertiary butyl ether (MTBE), is one of the most commonly detected volatile organic chemicals. If the New Jersey drinking water data were analyzed using the federal standards, the number of water systems with volatile organic chemicals greater than the maximum contaminant levels would be lower because, in general, New Jersey's drinking water standards are lower than the federal standards.

Milestone: By 2000, 90% of public water systems will have compliance evaluations that are acceptable

Indicator: Percent of Community Water Systems Inspected in 1994 through 1998 that have Acceptable Compliance Evaluations.

Type of Indicator: Condition

In 1998, 80% of the complete compliance evaluations performed on community water systems were "acceptable." This was an increase in the percent that were rated "acceptable" in 1994.[4]



Data Description

An acceptable evaluation indicates that the community water system was meeting federal and state statutes and regulations.

Data Characteristics

Compliance evaluations were tracked by state fiscal year 1994 (July 1, 1993 through June 30, 1994) and 1995 (July 1, 1994 through June 30, 1995). The database containing the community water system inspection information is generated and maintained by the Water Compliance and

4 In State fiscal year 1994, 298 complete inspections of community water systems were conducted. In State fiscal year 1995, 430 complete inspections of community water systems were conducted.

Enforcement Element and may be obtained by calling (609) 984-5855. The date of the last inspection for any given community water system is tracked by the Bureau of Safe Drinking Water and may be obtained by calling (609) 292-5550.

Data Strengths and Limitations

In state fiscal year 1994, 298 complete community water systems inspections were done; for state fiscal year 1995, 430 complete inspections were done. The Enforcement Element rates facilities as "acceptable," "conditionally acceptable," or "unacceptable." Systems that are rated "acceptable" or "conditionally acceptable" are considered "in compliance" and systems that are "unacceptable" are "not in compliance." The percentages reported are based on the number of systems "in compliance" versus the total number of inspections conducted in a calendar year. A weakness in this indicator is that the Enforcement Element inspects each facility once during each state fiscal year, and the indicator is based on the number of inspections conducted during a calendar year, the total number of inspections may be slightly higher or lower than the actual number of systems in the State.

Discussion

The figure represents the percent of community water system evaluations in 1994 through 1998 that are "in compliance." Based on 1998 data, the milestone for community water systems has not yet been met, but the percentage has improved since 1994.

Since the compliance evaluation inspection ratings may be "unacceptable" for deficiencies other than water quality or maximum contaminant level violations, the raw numbers do not indicate the potability of the water delivered to consumers or a direct increase or decease in the quality of delivered water from year to year.

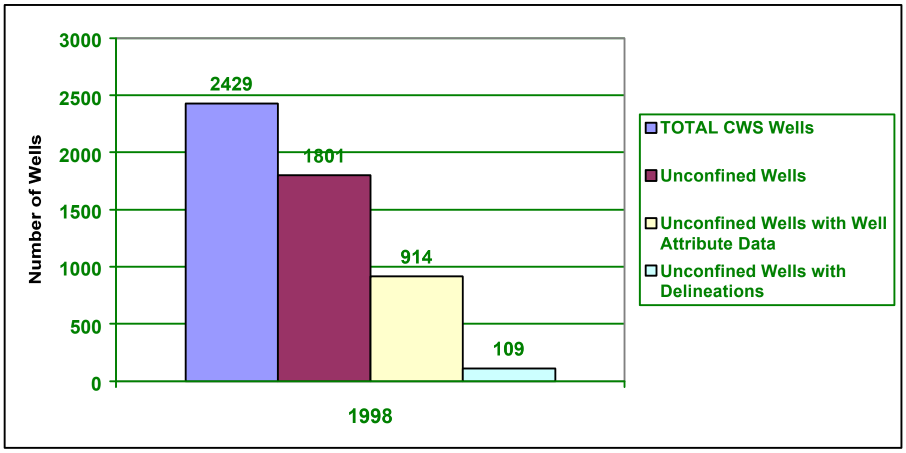
Milestone: By 2005, 50% of all public water systems will have fully implemented source water protection plans.

Indicator: Percent of Community Water System Wells with Delineated Well Head Protection Areas

Type of Indicator: Response

Of the 2,429 community water system wells in New Jersey, 1,801 wells (75%) are drilled into unconfined aquifers and will need to have a well head protection delineation. At the present time, 109 (6.1%) of the wells have delineated wellhead protection areas.

Status of Wellhead Protection Area Delineations for Community Water System Wells



Data Description

This indicator is a baseline measure of the progress of the department in implementing its Source Water Assessment Program for ground water systems. The first step in the development of source water assessments for ground water sources is the delineation of the 2 year, 5 year, and 12 year time of travel area around each well.

Data Characteristics

All community water system wells have been accurately located using a Geographic Positioning System (GPS). The department is now in the process of collecting information on the well attributes (depth, screening interval, and aquifer pumping capacity) for these wells. Currently the department has complete well attribute data on 914 wells (51%) and partial attribute data on many others. Over the next year, a major task of the source water assessment program is to develop this well attribute data.

There are two types of wells, confined and unconfined. For confined wells, the New Jersey Safe Drinking Water regulations require the owner to acquire and control a circular area with a radius of 50 feet around the well. It has been determined that 628 community water system wells are located in confined aquifers. Wells located in confined aquifers are protected from pollution at the land surface or are not sensitive to contamination from anthropogenic activities. The remaining 1,801 wells either are unconfined or there is insufficient information available to determine confinement (1,624 are unconfined and 177 have unknown confinement). Unconfined wells are sensitive to contamination by activities at the land surface.

For all wells located in unconfined aquifers, a well head protection area will be developed. The model used to define a well head protection area for a given community water system well is called the measured gradient model. (NJGS, 1998). This model delineates time-related capture zones around pumping wells in homogeneous aquifers with uniform ground water flow. All data are stored on the Geographic Information System (GIS) at NJGS. The delineations will eventually be made available on NJDEP's GIS system.

Data Strengths and Weaknesses

<u>Well locations</u>: The data collected using the Global Positioning System geographic positioning will provide an accurate statewide coverage of all community water systems and, eventually, all noncommunity water system on GIS with an accuracy of three to five feet from ground truth.

<u>Well Attribute Data</u>: Development of a well head protection area requires information about well construction, well depth, length of screening or open interval, capacity, and the aquifer system into which a well is drilled. This information is found in the well

drilling records. These well drilling records are poor for older wells, but the accuracy has improved for new wells.

Well Delineation: Research by NJGS has shown that for the short times of travel, between 2 years, 5 years, and 12 years, the measured gradient model is a good first approximation. This model is a two dimensional model of the surface area around the well. The weakness of the model is that it does not take into account well interference, hydrologic boundaries, aquifer heterogeneity and aquifer anisotropy, which are all factors that may be applied in more advanced delineation methods.   This weakness may be even more pronounced in the bedrock aquifers of northern New Jersey.

Discussion

The Well Head Protection Program is designed to protect source waters used for drinking water. All of the 2,429 community water system wells have been located using a GPS. Of the 2,429 wells, 1,801 (74%) are located in unconfined aquifers and will need well head protection areas delineated. At the end of 1998, well head protection delineations were completed for 109 wells or 6.1% of the unconfined wells in New Jersey.

Work is currently in progress to locate noncommunity water system wells. A database for locational and well attribute information is being developed. Approximately 28% of the noncommunity water system wells have been located using GPS techniques.

Reference

New Jersey Geological Survey (1998). *Draft Guidance for Well Head Protection Area Delineations in New Jersey.* New Jersey Department of Environmental Protection, Division of Science, Research, and Technology, 23 pp

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LAND & NATURAL RESOURCES

Introduction

Although New Jersey is one of the smallest and most densely populated states in the United States, it is ecologically unique. The state overlaps very different northern and southern plant and animal communities; its ecosystems are among the most complex and diverse in the nation. New Jersey's five physiographic regions range from mountainous areas in the Valley and Ridge and Highlands regions in the north to the gentle ridges and fertile soils of the Piedmont Region stretching from the Hudson River south and west through Pennsylvania. These regions support northern plant and animal community types. The Inner and Outer Coastal Plain Regions are the most easterly and southern parts of New Jersey. This vast area of sandy, unconsolidated soil is host to diverse habitats including the Pinelands National Reserve, extensive salt marshes and freshwater wetlands, and the Atlantic coast barrier islands and bays. These two regions include nearly 60% of New Jersey's land mass and support southern plant and animal community types.

Ecosystem integrity is a measure of the capacity of ecosystems to renew themselves. It is the degree to which all ecosystem elements - species, habitats, and natural processes - are intact and functioning well enough to ensure sustainability and long-term adaptation to changing environmental conditions and human uses. Many ecological communities within New Jersey are healthy and vibrant, while others require restoration and improved management to reverse declining environmental health. One sign of the fragile nature of our habitat is the number of threatened or endangered species that live in NJ.

NJ has 2,117 known native plant species. Approximately 30% of those are categorized as species of conservation concern. In other words, nearly one in every three native plants in NJ is at risk of becoming increasingly rare or extinct – 15% are also listed as endangered. Swamp pink, a flowering wetlands plant, is an example of a species that is found on the Federal and State Endangered Plant Species lists.

NJ is home to 90 species of mammal, 79 reptile and amphibian species, and more than 400 species of fish. Approximately 325 species of birds inhabit NJ; 1.5 million shorebirds and as many as 80,000 raptors make migratory stopovers in NJ each year. Like plant species, about one-third of the known vertebrate animal species are classified as either rare or endangered. The peregrine falcon and bog turtle are examples of species on both the Federal and State Endangered Species lists.

To address the continuing concerns over the loss of open space and its associated impacts on quality of life, habitat impacts, air and water quality, and the continued stress on New Jersey's flora and fauna, the NEPPS Land and Natural Resources (LNR) overarching goal states: Maintain, enhance, and restore functioning ecosystems and sustainable communities.

This overarching goal is further defined by nine key issue area subgoals within three structural components: Ecosystem Structural Integrity; Ecosystem Biotic Integrity; and NJ Lands. Subcomponents under Ecosystem Structural Integrity include Wetlands;

Headwaters and Riparian Corridors; Coastal Resources and Flood-prone Areas; Soil Erosion and Soil Contamination; Forest Resources; and Patterns in Land Development. Ecosystem Biotic Integrity is addressed through Biodiversity; while NJ Lands include Open Space and Environmentally Damaged Land.

LNR initial efforts have centered on development of those indicators with the broadest possible application. Many NJDEP programs have made significant progress on approximately 15 research and data development projects as the direct result of the NEPPS process. One of the most significant of these projects has been development of the update to the 1986 Land Use/Land Cover GIS coverage with data from 1995/97 aerial photography. Completion of this data set will allow for the development of a series of indicators, including, but not limited to, measurement of the loss or fragmentation of habitat, the impact of impervious cover on water quality, determination of riparian habitats coverage and relation to in-stream conditions, and impacts of changing land uses on cover types such as wetlands and forests.

Those indicators for which data were readily available, as well as identified as key by NJDEP stakeholders, are reported for the first time. Overall, NJDEP has reported an estimated permitted net loss of 718 acres of freshwater wetlands for 1989-1999. For 1992-1998, NJDEP reports 204.18 acres of coastal wetlands were permitted to be disturbed with a concurrent 17.5 acres of creation and a projected increase in the function and value of approximately 8,900 acres of enhancement required as mitigation.

Integrating Land Use/Land Cover by Watershed - NJDEP reports on data for the Whippany-Upper Passaic-Rockaway River Watershed (known as Watershed Management Area 6 or WMA6). This watershed is located within both the Highlands and Piedmont regions of Northern New Jersey. Between 1986 and 1995, WMA6 experienced the following changes: urban-built up acreage increased by 8%; agricultural acreage decreased by 22%; forested land decreased by 7%; and wetlands decreased by 2%. Agricultural land, forested land and wetlands were predominantly converted to urban/built-up land[*].

With respect to LNR goals for this WMA in the Highlands and Piedmont region, these data relate to several key issue areas. The goal of no net loss of wetlands is not being met. Headwaters and riparian corridors and soil erosion and sedimentation are negatively influenced by increases in urban and built-up land, with some positive influences projected by increases in forested lands that were previously agricultural lands. Net loss of forested lands and forest fragmentation is not minimized. Biodiversity is affected by loss of wetlands, forested lands, and agricultural lands.

Indicators of coastal ecosystem biotic integrity show that NJ's Atlantic Coast long-legged wading birds are experiencing decline. Only 1 of 8 long-legged wading bird species, the Tri-Colored Heron, experienced population increases for the nineteen-year period 1977 to 1995. More recent data are needed to determine if 3 of the 8 species of long-legged

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[*] Additional information on the 1986-1995 Land Use/Land Cover coverage may be found on DEP's GIS webpage: www.state.nj.us/dep/gis/

waders that showed modest increases from 1985 to1995 (Glossy Ibis, Little Blue Heron, and Great Egret) are continuing to increase. In addition, more current data are needed to determine if the rare coastal species, Yellow-Crowned Night Heron and Black-Crowned Night Heron have stable or improved status.

NJDEP is making significant progress to preserve open space for current and future preservation of natural resources, biodiversity, and recreation. Data show that by the end of 1999, almost 19% of New Jersey's land area is permanently preserved. NJDEP is more than half-way toward meeting its four-year goal of preserving an additional 150,000 acres of open space. Land preservation involves not only partners at all levels of government, but also partners in the non-profit and business community. The number of counties and municipalities with open space taxes has steadily increased with 17% of NJ counties and 21% of NJ municipalities instituting an open space tax by the end of 1999.

Milestone: Achieve no net loss of wetlands by year 2005 and implement effective techniques for increased creation of wetlands.

Indicator: Status and Trends of Wetlands Impacts authorized by NJDEP

Type of Indicator: Cause

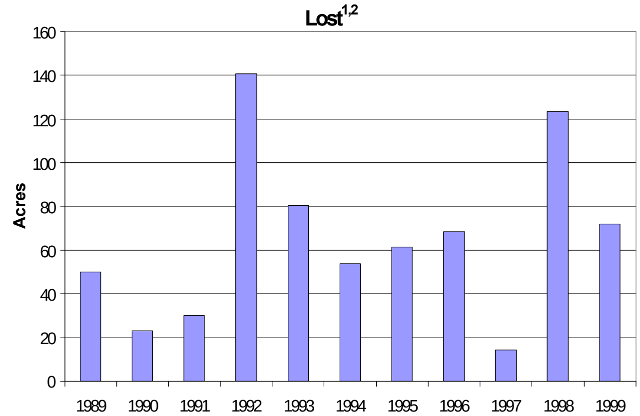
Indicator: Status and Trends of Restoration/Creation/Enhancement Projects

Type of Indicator: Response

Permitted wetlands disturbances in relation to wetland mitigation required is an indirect measure of the net change in impacted wetlands acreage in New Jersey. From July 1, 1988 to June 30, 1999, 1,638.12 acres of NJ freshwater wetlands were permitted to be disturbed, while a total of 920.12 acres of compensatory mitigation were required, resulting in an estimated permitted net loss of 718 acres of freshwater wetlands over this eleven year period.

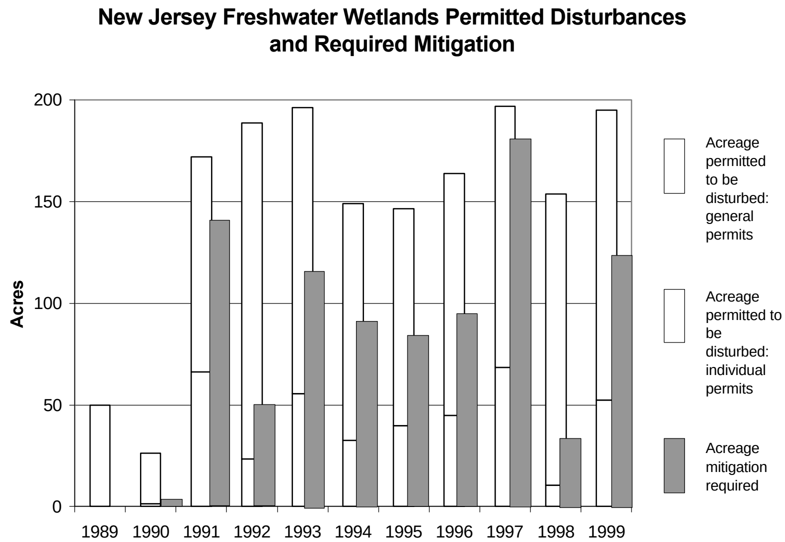
From 1992 to 1998, an estimated 204.18 acres of NJ coastal wetlands were permitted to be disturbed. Required mitigation for this disturbance consisted of approximately 17.5 acres of creation and 8,849 acres of enhancement (return of natural tidal flow to former salt hay farms). While there has been a net loss of coastal wetlands, there is projected to be an increase in the function and value of approximately 8,900 acres of coastal wetlands where enhancement and restoration projects are underway.

Net Acres of New Jersey Permitted Freshwater Wetlands Lost[1,2]



[1] Acres lost equals sum of acres disturbed pursuant to both individual and general permits minus acreage of compensatory mitigation required

[2] Data include repeat disturbances/impacts for certain activities and/or temporary disturbances which do not necessarily constitute new or additional wetlands losses.



Data Description

In the last eleven years, NJDEP permitted the disturbance of 49.93 to 196.9 acres of freshwater wetlands annually, with a mitigation requirement of 0 to 182.51 acres, annually. Assuming the 1986 freshwater wetland baseline of 739,160 acres (NJDEP Bureau of Geographic Information and Analysis), the permit data indicate approximately 0.22% of NJ freshwater wetlands have been permitted for disturbance resulting in a permit-estimated net loss of 0.09% of freshwater wetlands over this eleven year period.

For the period between January 1, 1992 to June 30, 1998, an estimated 8.74 acres of coastal wetlands were permitted to be disturbed for construction projects with 17.5 acres of compensatory mitigation required. During the same period, there was an additional loss of 195.44 acres of coastal wetlands to create channels for restoring tidal flow and construction of dikes to protect remaining structures. These activities were part of an overall project to return tidal flow to approximately 8,900 acres of diked coastal wetlands (former salt hay farms). This project was required to meet a NJPDES permit condition to enhance fish spawning habitat in the Delaware Bay Estuary.

Wetlands provide critical habitat for wildlife, filter surface water runoff, provide for flood control, and provide aquifer recharge functions. Permitted disturbances affect the ability of wetlands to perform these important ecological functions. Compensatory mitigation is the creation, enhancement, or restoration of wetlands of equal ecological value to replace the loss of wetland habitat and function because of permitted activities.

Data Characteristics

The number of acres permitted for disturbance are determined by NJDEP's Land Use Regulation Program in response to an application for said disturbances. Compensatory mitigation is not required for General Permit projects such as minor road crossings or filling of isolated wetlands, ditches, and swales ($\leq$ 1 acre). General Permits for activities involving investigation, cleanup or removal of hazardous substances requires mitigation. Individual Permits are required for proposed activities that exceed the minimum requirements of a General Permit. Individual Permit projects usually requires compensatory mitigation at a ratio of 2 acres mitigation for every wetland acre disturbed. Permitted coastal wetland projects in the coastal area usually require compensatory mitigation at a ratio of 2:1. Mitigation for both coastal and freshwater wetlands were estimated by examining the mitigation database maintained by the Land Use Regulation Program.

The data presented within are available through the NJDEP Land Use Regulation Program and can be obtained by calling (609) 292-0060.

Data Strengths and Limitations

The data are valuable in that they track totals of wetland acreage permitted disturbance from the effective date of the New Jersey Freshwater Wetlands Protection Act (1988) through New Jersey's assumption of the 404 Program of the Federal Clean Water Act (1993). The data continue to improve in tracking yearly status and trends over time as New Jersey began assumption for the freshwater wetlands program after 1993.

Key limitations to the data include verifying the actual disturbances and respective mitigation. Permittees do not necessarily conduct the regulated activity, even if they have a permit to do so. In some cases, permits are required for repeat disturbances to the same site (for repair, rehabilitation, replacement, maintenance or reconstruction of any previously authorized currently serviceable structure or fill lawfully existing prior to 7/1/88) and/or temporary disturbances, which do not necessarily constitute new or additional wetlands losses. Therefore, the actual acreage disturbed may indeed be less than reported herein. Conversely, without field verification and delineation, activities may have taken place which affect greater acreage than permitted, either through greater acreage disturbed, unintended secondary hydrologic impacts, and/or failure to properly mitigate. The mitigation database is currently being updated to include additional information. A field research project was initiated in July 1999 to verify mitigation acreage and success statewide. The results of these efforts will affect the estimated mitigation acreages provided herein.

Data on the impacts to wetlands as a result of exemptions specified in the New Jersey Freshwater Wetlands Protection Act are not included in this indicator. Regulatory authority for wetlands permits within the Hackensack Meadowlands is under the jurisdiction of the U.S. Army Corps of Engineers and therefore, data for permitted wetlands activities within the Hackensack Meadowlands are not accounted for. Other exemptions not reported include: ongoing farming activities such as construction or maintenance of farm ponds or irrigation ditches and maintenance of farm or forest roads; projects for which preliminary site plan or subdivision applications received preliminary approvals prior to the effective date of the Act (7/1/88); projects for which preliminary site plan or subdivision applications were submitted prior to June 8, 1987 (at which time Governor Kean issued a moratorium on construction in wetlands until FWWPA signed); and permit applications that were approved by the Army Corps of Engineers prior to the effective date of the Act.

In addition to the causes listed above, the loss of wetlands due to illegal activities is not addressed in this indicator.

Discussion

In order to understand the NJDEP data, it is important to recognize that New Jersey's wetlands have been drained and filled since settlement by Europeans began in the 1600s (Fretwell et al. 1996). Dahl (1990) estimated that NJ lost 39% of its wetlands between the 1870s and 1970s; while Tiner (1985) estimated that NJ may have lost at least 20% of its wetlands resources since the mid-1900s. In response to these dramatic losses, New Jersey passed its own Freshwater Wetlands Protection Act in 1987, considered to be one of the most, if not the most, stringent wetland laws in the nation. This Act provided NJDEP with regulatory powers beyond that of Federal law (Torok et al. 1996).

Approximately 19% of New Jersey's land base is wetlands. Current data indicate that based upon 1986 aerial photography, NJ has 739,160 acres of freshwater wetlands which comprise approximately 15% of New Jersey's 4,984,338 acres of land. Based upon USFWS estimates (from 1977), there are approximately 209,269 acres of tidal wetlands in New Jersey or approximately 4% of New Jersey lands. NJDEP is expected to have more accurate information on total wetlands acreage in New Jersey based upon 1995/97 aerial photography (photo-interpreted to Land Use/Land Cover classification) by Fall 2000. [Note, however, that direct comparison of permit data with any losses indicated by the Land Use/Land Cover data is inappropriate because of differences in the time frames for which the data are recorded; lack of data on activities exempted from the NJ Freshwater Wetlands Protection Act; and lack of data on violations.]

The current indication is that the overall trend is to permit wetland disturbances in New Jersey with a net loss of wetland acreage. This paradox results from a lack of regulatory authority to require compensatory mitigation for every type of disturbance. More accurate numbers regarding mitigation site acreages and evaluation of mitigation site success should provide better understanding of the accuracy of this indicator. NJDEP is investigating the availability and applicability of new housing starts and new construction as an additional cause indicator to provide a more complete picture of the status and trends with respect to wetlands resources for New Jersey.

Implementation of NJDEP's *Strategic Plan 1998-2001* strategies for increasing and enhancing wetland acreage by 2005 is intended to improve NJDEP's ability to meet wetlands goals. These wetlands strategies include 1) *accelerate use of credits held by the Wetlands Mitigation Bank*; 2) *continue to require mitigation in Individual Permits and expand mitigation requirements into certain General Permits*; and 3) *Coordinate with other state and federal agencies to acquire funding to create and enhance wetlands in areas impacted by agricultural, transportation and other development activities.*

References

Dahl, T.E. 1990. Wetlands - losses in the United States 1780s to 1980s. Washington, D.C.: US Fish and Wildlife Service, Report to Congress, 13 pp.

Fretwell, J.D., J.S. Williams, and P.J. Redman. 1996. National Water Summary on Wetland Resources. U.S. Geological Survey Water-Supply Paper 2425. P.279-284.

Tiner, R.W., Jr. 1985. Wetland of New Jersey. U.S. Fish and Wildlife Service, National Wetlands Inventory, Newton Corner, MA. 117 pp.

Torok, L.S., S. Lockwood, and D. Fanz. 1996. Review and comparison of wetland impacts and mitigation requirements between New Jersey, USA, Freshwater Wetlands Protection Act and Section 404 of the Clean Water Act. Environmental Management 20 (5):741-752.

Integrated Land and Natural Resources Watershed Indicators

Wetlands Milestone: Achieve no net loss of wetlands by year 2005 and implement effective techniques for increased creation of wetlands.
Indicator: Status and Trends of Land Cover Change Type of Indicator: Cause
Indicator: Status and Trends of Wetlands Acreage Type of Indicator: Condition

Wetlands Objective: Improve quality and function of coastal/freshwater wetlands and implement effective techniques for increased enhancement of wetlands.
Indicator: Status and Trends of Land Cover Change Type of Indicator: Cause

Headwaters and Riparian Corridors Milestone: Maintain and restore vegetative bank cover and buffers adjacent to headwaters and stream corridors by 2005.
Indicator: Status and Trends of Land Cover Change Type of Indicator: Cause

Soil Erosion and Soil Contamination Objective: Minimize long-term erosion and sedimentation.
Indicator: Status and Trends of Land Cover Change Type of Indicator: Cause

Forest Resources Objective: Achieve no net loss of forest lands in New Jersey.
Indicator: Status and Trends of Land Cover Change Type of Indicator: Cause
Indicator: Status and Trends of Forest Acreage Type of Indicator: Condition

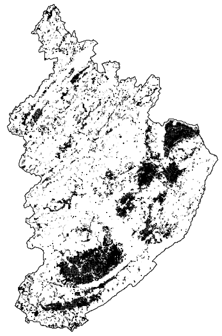
Forest Resources Objective: Maintain and restore healthy and diverse forest lands, including critical forest communities.
Indicator: Status and Trends of Forest Acreage Type of Indicator: Cause

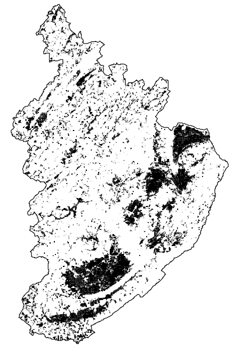
Forest Resources Objective: Maintain forest fragmentation and work toward interconnected forest lands.
Indicator: Status and Trends of Forest Acreage Type of Indicator: Cause
Indicator: Status and Trends of Land Cover Change Type of Indicator: Cause

Biodiversity Objective: Maintain and enhance healthy and diverse populations of native plants and natural communities, including their habitats.
Indicator: Status and Trends of Land Cover Change Type of Indicator: Cause

Biodiversity Objective: Maintain diversity and optimum distribution and density of NJ s aquatic and terrestrial species and their habitats.
Indicator: Status and Trends of Land Cover Change Type of Indicator: Cause

Error! Not a valid link.***1986 Wetlands in WMA6*** ***1995 Wetlands in WMA6***





WMA6 Wetlands Net Change (Loss) 1986-1995

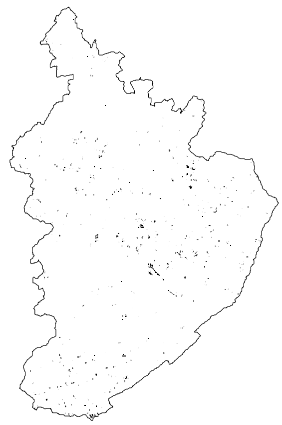


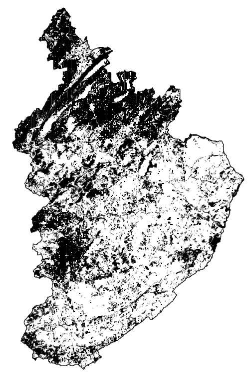
Table 2: Wetlands Conversion 1986-1995

1986 Wetlands Changed To	**Acres**	**Percent**
Agricultural Land	10	1.15%
Barren Land	30	3.49%
Forest Land	<1	0.04%
Urban/Built-Up Land	770	89.71%
Water	48	5.62%
Wetlands Acres that Changed LU/LC Type	859	
1995 Wetlands not Present in 1986 (Gain)	42	

Net Loss of Wetlands 1986-1995

1986 Forested Land in WMA6

1995 Forested Land in WMA6



WMA6 Forested Land Net Change (Loss) 1986-1995

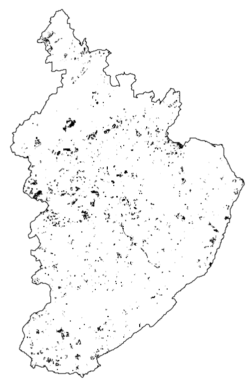


Table 3. Forested Land* Conversion 1986-1995

1986 Forested Land Changed To	**Acres**	**Percent**
Agricultural Land	94	1.42%
Barren Land	826	12.45%
Urban/Built-Up Land	5690	85.74%
Water	18	0.28%
Wetlands	7	0.11%
Forest Acres that Changed LU/LC Type	6635	
1995 Forest not Present in 1986 (Gain)	574	
Net Loss of Forest 1986-1995	6061	

*** Forested Land does not include Forested Wetlands**

1986 Forested Land & Forested Wetlands in WMA6

1995 Forested Land & Forested Wetlands in WMA6

WMA6 Forested Land & Forested Wetlands Net Change (Loss) 1986-1995

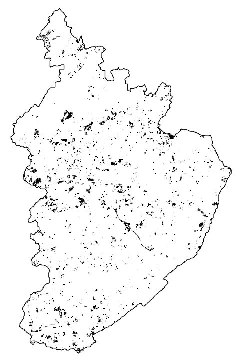
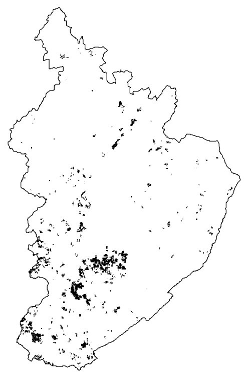


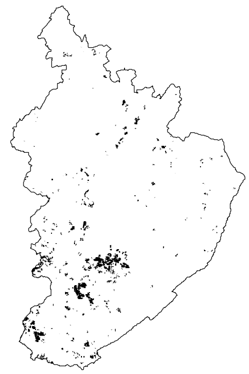
Table 4. Total Forested Land Conversion:

1986 Forested Land and Forested Wetlands Changed To	**Acres**	**Percent**
Agricultural Land	95	1.22%
Barren Land	844	10.91%
Urban/Built-Up Land	6292	81.33%
Water	56	0.72%
Other Wetlands	450	5.81%
Total 1986 Forest & Forested Wetlands that Changed LU/LC Type	7737	
1995 Forest & Forested Wetlands not Present in 1986 (Gain)	574	
Net Loss of Forest and Forested Wetlands 1986-1995	7163	

1986 Agricultural Land in WMA6



1995 Agricultural Land in WMA6



WMA6 Agricultural Land Net Change (Loss) 1986-1995

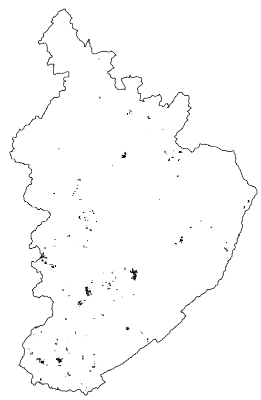
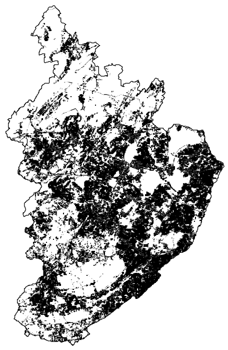


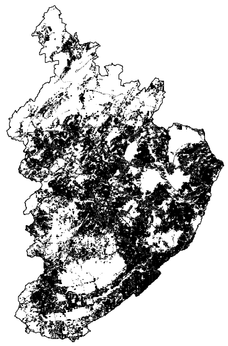
Table 5. Agricultural Land Conversion

1986 Agricultural Land Changed To	**Acres**	**Percent**
Barren Land	162	10.94%
Forested Land	250	16.85%
Urban/Built-Up Land	1060	71.51%
Water	3	0.19%
Wetlands	8	0.51%
Agricultural Acres that Changed LU/LC Type	1483	
1995 Agricultural Land not Present in 1986 (Gain)	131	
Net Loss of Agricultural Land 1986-1995	1352	

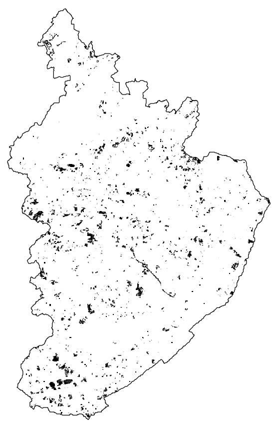
1986 Urban/Built Up Land in WMA6



1995 Urban/Built Up Land in WMA6



WMA6 Urban/Built Up Land Net Change (Gain) 1986-1995



Data Description

From 1986-1995, the following changes to the Upper Passaic-Whippany-Rockaway Watershed Management Area (WMA6) occurred:

<u>Overall Watershed Change</u>

With respect to the approximately 236,222 acres in WMA6:

- Approximately 7% of the land changed land use/land cover type.

- The greatest net increase in land type with respect to total WMA6 acreage is in urban/built-up land; approximately 3.3% greater overall WMA6 acreage in 1995 than 1986.

- The greatest net loss in land type with respect to total WMA6 acreage is in forested land; approximately 2.6% less overall WMA6 acreage in 1995 than 1986.

When comparing acreages within cover type between 1986 and 1995:

- Barren land increased by 27% above its 1986 acreage.

- Urban/Built-up land increased by 8% above its 1986 acreage.

- Agricultural land decreased by 22% below its 1986 acreage.

- Forested land decreased by 7% below its 1986 acreage.

- Wetlands decreased by approximately 2% below their 1986 acreage.

<u>Wetlands Change</u>

- There is a net loss of wetlands in WMA6 during this nine-year period; approximately 2% loss from the 1986 acreage.

- Approximately 64% of gains in wetland acreage were in the category of disturbed wetlands.

- Approximately 90% of wetlands that were changed from 1986-1995 were converted to urban/built-up land.

- Approximately 3.5% of wetlands that were changed from 1986-1995 were converted to barren land.

- Proportionally, wetlands account for approximately 17% of the total WMA6 acreage in both 1986 and 1995; there is a 2% net loss of wetlands between 1986 and 1995 indicating potential impacts to habitat, biodiversity, and water quality.

Forested Land Change

- There is 7% less forest in 1995 than in 1986 in WMA6.

- Approximately 86% of forested lands that were changed from 1986-1995 were converted to urban/built-up land.

- Approximately 12.5% of forested lands that were changed from 1986-1995 were converted to barren land.

- Approximately 1.4% of forested lands that were changed from 1986-1995 were converted to agricultural land.

- Proportionally, forested land accounted for approximately 36% of the total WMA6 acreage in 1986 and 33% of the total WMA6 acreage in 1995; there is a 7% net loss of forested land between 1986 and 1995, indicating potential impacts to forest resources including loss of forest health, forest biodiversity, and fragmentation; as well as potential impacts to water quality.

Forested Lands and Forested Wetland Change

- When combining forested lands and forested wetlands, 6.09% of total forested lands and forested wetlands were changed to other land type categories (including other types of wetlands).

- Approximately 81% of forested lands and forested wetlands that were changed from 1986-1995 were converted to urban/built-up land.

- Approximately 11% of forested lands and forested wetlands that were changed from 1986-1995 were converted to barren land.

- Approximately 5.8% of forested land and forested wetlands that were changed from 1986-1995, were converted to other wetlands types: approximately 83% of these other wetlands were disturbed wetlands.

- Approximately 1.2% of forested lands and forested wetlands that were changed from 1986-1995 were converted to agricultural land.

Agricultural Land Change

- Approximately 22% of the agricultural land present in 1986 was lost by 1995 in WMA6.

- Approximately 72% of the agricultural lands that were changed from 1986-1995 were converted to urban/built-up land.

- Approximately 17% of the agricultural lands that were changed from 1986-1995 were converted to forested land.

- Approximately 11% of the agricultural lands that were changed from 1986-1995 were converted to barren land.

- Proportionally, agricultural land accounted for almost 2.6% of the total WMA6 acreage in 1986 and 2% of the total WMA6 acreage in 1995, indicating a 22% net loss of agricultural land between 1986 and 1995. Agricultural land can provide important habitat for wildlife species, including open fields to provide raptors with access to prey resources. 72% of the lost agricultural land was converted to urban/built-up land and almost 11% was converted to barren land; the loss of habitat in this direction has implications for water quality as impervious surface cover has most likely increased. Conversely, almost 17% of the lost agricultural land was converted to forested land, presumably with an increase in biodiversity and wildlife habitat. Assuming this increase in forested land will also result in reduced application of agricultural fertilizers and pesticides, this increase should result in water quality improvements.

Data Characteristics

NJDEP is currently updating the 1986 land use/land cover data layer using 1995/97 digital imagery based upon aerial photography classified using a modified Anderson system. This classification system (Anderson, et al., 1976), modified in 1998 (NJDEP, 1998), is a hierarchical land use and land cover classification system with primary categories for: urban or built-up land; agricultural land; forest land; water-wetlands; and barren land. The analyses presented here for WMA6 are based upon the first updates recently received by NJDEP. The updates are being completed on a watershed-by-watershed basis and will be made publicly available on the Internet upon internal NJDEP review. These initial postings should be considered DRAFT FINAL because all edge matches between watersheds cannot be made until the entire state is completed in Fall 2000.

The update to the 1986 data includes reducing the minimum polygon size from 2.5 to 1 acre, adding additional categories for some land use types, and evaluating every polygon for the amount of impervious cover.

The land use/land cover categories in this analysis are defined as follows:

Agricultural Land includes all land used primarily for food and fiber production and some structures associated with this production. Cropland, pastureland, orchards, vineyards, nurseries and horticultural areas, and confined feeding operations are the primary agricultural land subtypes included in this category.

Barren Land/Altered Land is characterized by thin soil, sand or rocks and lack of vegetative cover in a non-urban setting. Vegetation, if present, is widely spaced. Barren land such as beaches and rock faces are found in nature but also result from human disturbance (these sites include mining operations, sand and gravel pits, quarries, open dumps, landfills). Barren land can also include sites cleared and/or prepared for construction and sites in the early phases of construction.

Forested Land includes any lands covered by woody vegetation other than wetlands. These lands are capable of producing timber and other wood products, and supporting many kinds of outdoor recreation. Forested Land subtypes in this category include: deciduous; coniferous; mixed deciduous-coniferous; and brushland/shrubland which are predominantly between 0 and 20 feet in height (including old fields covered primarily by grasses and some shrubs). Forested lands in this category do not include forested wetlands.

Urban/Built-Up Land includes land characterized by intensive land use where the landscape has been altered by human activities. Although structures are usually present, this land type is not restricted to traditional urban areas. Primary urban/built-up land subtypes include: residential; commercial and service; industrial; transportation, communication and utilities; industrial and commercial complexes; mixed urban or built-up; other urban or built-up (including cemeteries) and recreational lands (golf courses, zoos, marinas, picnic areas, etc.).

Water. All areas within New Jersey periodically covered by water (except for wetlands) include: streams and canals (river, creeks, canals and other linear water bodies that have a minimum width of 80 feet); natural lakes; artificial lakes and reservoirs; and bays and estuaries.

Wetlands are those areas inundated or saturated by surface or ground waters at a frequency and duration sufficient to support vegetation adapted for life in saturated soil conditions. Included in this category are naturally-vegetated swamps, marshes, bogs and savannas which are normally associated with topographically low elevations but may be located at any elevation where water perches over an aquiclude. Forested wetlands are included in this category, as opposed to the Forest Category. For this analysis, disturbed wetlands (agricultural wetlands, rights-of-way, landscaped areas, etc.) have also been included.

The data presented within are available through NJDEP's Bureau of Geographic Information and Analysis and can be obtained by calling (609) 984-2243. Additional information regarding these data sets and updates to the 1995 data availability can also be found at **www.state.nj.us/dep/gis**.

Data Strengths and Limitations

These data enable more than a baseline as to the status of land use/land cover in New Jersey; they are based upon aerial data from two points in time: 1986 and 1995. Photointerpretation has been conducted by the same organization (Aerial Information Systems, Redlands, CA) using similar methods for both time periods, thereby reducing error. NJDEP has made the 1986 data publicly available for several years, resulting in widespread use. The 1995 data will be made publicly available as they are received with the caveat that edge-matching between the watersheds will need to be completed before the data are no longer considered DRAFT. Ground-truthing has been conducted for both data layers. The 1995 data are being photointerpreted by two analysts and when concurrence on a polygon is not reached, the polygon is flagged for ground-truthing. Data are by polygon (2.5 acres minimum polygon size for 1986 and 1 acre for 1995) and can be clipped multiple ways depending upon needs of the analyst (by municipality, watershed, county, etc.). All polygons are being evaluated for impervious surface cover at 5% intervals. All polygons retain all 1986 codes as well as 1995 codes which allows for ready trend analysis from one data set. All data are fully documented and described in the digital metadata information according to national metadata standards.

Limitations include the fact that approximately 2/3 of the digital imagery is from the same flying season (March 1995). The remaining imagery is from 1997. While based on actual pre-compilations test delineations, impervious surface cover values included in the final layers are from visual estimates. 1986 data do not include impervious surface cover, therefore, quantitative trends from the two time periods cannot be made. Broad statewide indicators necessitated the use of the 6 major land use/land cover categories. The land use/land cover data, however, are available and detailed to a much higher specificity of cover type than presented here. For example, forest cover categories are further broken down based on amount of tree type (coniferous, deciduous, or mixed classes and amount of crown closure). Therefore, more refined indicators could be developed.

Although these data are appropriate for general trend information; it is critical to read and understand the associated metadata, particularly because the categories do not necessarily completely reflect environmental quality. For instance, in this broad analysis, water includes surface impoundments and agricultural ponds.

Disturbed wetlands are classified as wetlands in this analysis. Hence, when analyzing for wetlands quality and function, as opposed to quantity, it would be important to understand that disturbed wetlands would not be of the same quality as naturally occurring wetlands.

Forested wetlands are classified as wetlands, not forests, in this classification scheme. Therefore, an effort was made to add forests and forested wetlands to gain a better picture of total forested lands in WMA6. Since a small amount of acreage (0.271 acres) that was classified as wooded wetlands in 1986 changed to old field forest by 1995, the combined data sets of forests and forested wetlands do not register this as an increase in total forest acreage (i.e., Total Forest Gain in Table 4 is 0.271 acres less than Forest Gain in Table 5).

The 1995 data are to be considered DRAFT until all edge matching is complete.

Discussion

Although these data pertain to just one New Jersey watershed, a reasonable assumption is that these data are *indicators* of statewide conditions. A key relationship in the WMA6 data is that between Urban/Built-up land and Forested land. Urban/Built-up land accounted for almost 41% of WMA6 acreage in 1986 and almost 44% in 1995, while Forested land accounted for almost 36% of the WMA6 acreage in 1986 and approximately 33% in 1995. When comparing forested land conversion, much of the overall forested land change in this watershed is an increase to urban land. This relationship is consistent for wetlands and agricultural lands; i.e., the greatest change from these cover types was to urban/built-up land. This overall change in cover types indicate anthropogenic stresses in relation to the current conditions of the various land and natural resources components of WMA6.

With respect to the current land and natural resources milestones and objectives for: wetlands; headwaters and riparian corridors; soil erosion and soil contamination; forest resources; and biodiversity, these land cover changes in relation to current conditions indicate that for WMA6 (and possibly New Jersey as a whole):

- There is a net loss of wetlands and many of those wetlands that were gained were disturbed; therefore, the objectives with respect to wetlands quantity and quality are not being met.

- There are indirect indications that headwaters and riparian corridors could be negatively influenced by increases in urban and built-up lands and positively influenced by increases in forested lands that were previously agricultural lands.

- There are indirect indications that long-term erosion and sedimentation are negatively influenced by increases in urban and built-up lands and positively influenced by increases in forested lands that were previously agricultural lands.

- There is a net loss of forested lands with indirect indications that there is not overall maintenance and restoration of forested lands or minimization of forest fragmentation.

- The loss of wetlands, forested lands, and agricultural lands may indicate loss of biodiversity including native plants, natural communities, and aquatic and terrestrial species in that region.

These data are based upon land use/land cover data and provide general trends on the land and natural resources in WMA6 and whether the broad statewide goals for these key issue areas are being met.

Future Applications

These data are also important for generating hypotheses and refining the queries for key issues based upon various levels of geographic scale; providing for more precise levels of analyses such that response measures can be targeted in a biologically meaningful manner. As statewide data become available, additional analyses will be performed for all watersheds so they can be applied to NEPPS statewide, as well as directed into NJDEP's watershed characterization and assessment process. As NJDEP becomes more adept at relating sources and causes of environmental concern, management measures can become more targeted.

The analyses presented so far are preliminary and can be further refined based upon current and pending data. Land cover change in relation to stream corridors (streams and associated buffers), for example, would allow for better precision as to implications for riparian corridors, soil erosion and sedimentation, as well as water quality indicators. Further analyses would extend these relationships to the water quality data for subwatersheds.

In the future, NJDEP will look at not only total forest acreage, but the relationship between acreage and patch size to determine the amount of forest that is being fragmented. Additionally, if critical areas are defined based upon goals for ecosystem types (wetlands, forests, grasslands), native plants and natural communities; and aquatic and terrestrial species; then analyses of not only the land quantity, but the land type in relation to the species types can be made. Similarly, the relationship between ecosystem type and management measures should be refined to determine if, for instance, land preservation and acquisition is targeting the ecosystem types of concern.

Programs within NJDEP's Division of Fish and Wildlife and Division of Parks and Forestry are moving to defining critical areas as well as to determining if current preservation lands are meeting preservation goals. Therefore, refined analyses between ecosystem types, such as wetlands and land preservation type, will provide better indicators of whether response measures are targeted to meet land and natural resources goals toward healthy ecosystems.

Linkages can be made between stressors, conditions, and the NJ State Development and Redevelopment Plan to determine if trends in development and redevelopment are consistent with the milestones and objectives for healthy ecosystems defined through the NEPPS stakeholder process.

Relationship of land cover change and impervious surface cover data will also be conducted. Application of these data for both water quality and water supply will be important.

Another critical linkage may be in the relation between these data and air quality data; hypotheses generated could include the relationship between forest loss and changes in air quality and indications for climate change.

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N.J. Department of Environmental Protection (NJDEP), 1998. Land Use Land Cover Classification System. Trenton, NJ, Office of Information Resource Management, Bureau of Geographic Information and Analysis, 36 pages.

Milestone: By the year 2008, the State s rare, threatened and endangered species populations will be stable or have improved status.

Objective: Maintain diversity and optimum distribution and density of NJ s aquatic and terrestrial species and their habitats.

Objective: Reduce contaminant concentrations in biota to below adverse effects thresholds.

Objective: Maintain and enhance aquatic life designated uses in assessed tidal waters.

Indicator: Status and Trends of Atlantic Coast Long-Legged Wading Bird Populations

Type of Indicator: Condition

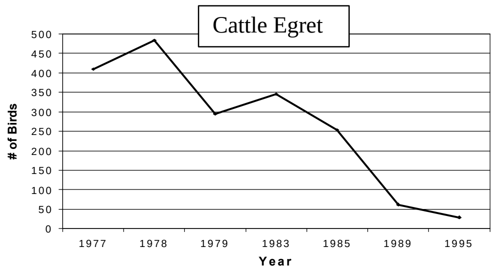
Populations of Atlantic Coast long-legged wading birds provide several biodiversity indicators including direct measures of coastal ecosystem biodiversity and indirect measures of contaminants in biota. Direct measures of rare species populations include the Yellow-Crowned Night Heron (an Endangered Species in New Jersey) and the Black-Crowned Night Heron (a Threatened Species in New Jersey). Long-legged wading birds also provide an indicator of aquatic life designated use for tidal systems.

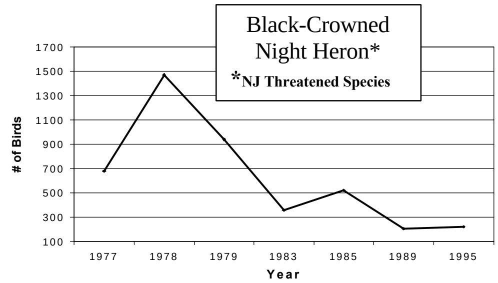
Long-term trends for the 19-year period (1977-1995) show that 5 out of 8 long-legged wading birds species (including two rare species) along New Jersey s Atlantic Coast have had declining populations (Cattle Egret, Black-Crowned Night Heron, Yellow-Crowned Night Heron, Snowy Egret, and Glossy Ibis). During this same 19-year period, 2 out of 8 species have had no real long-term trends (Little Blue Heron and Great Egret), while only 1 of 8 species (Tri-Colored Heron) has had a population increase.

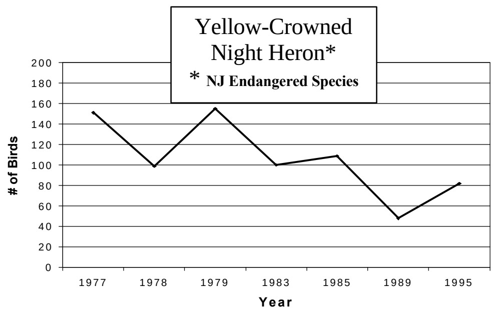
More recent trends for the 10-year period (1985-1995) show Cattle Egrets are declining. While 4 out of the 8 species (Black-Crowned Night Heron, Yellow-Crowned Night Heron, Snowy Egret, and Tri-Colored Heron) do not show more recent trends of increasing or decreasing populations, the Black-Crowned Night Heron failed to recover from a major population decline. These more recent data show that 3 out of 8 species of long-legged wading birds (Glossy Ibis, Little Blue Heron, and Great Egret) had a modest population increase.

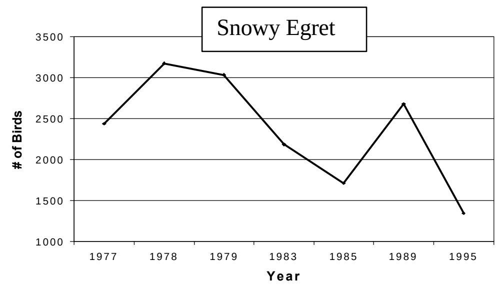
Black-Crowned Night Herons declined dramatically up until 1989 and have failed to show any significant recovery. Yellow-Crowned Night Herons are at low numbers (≤ 110 birds were reported for 5 of 7 observations in 19 years). More recent data are needed to conclude if these rare coastal indicator species populations are stable.

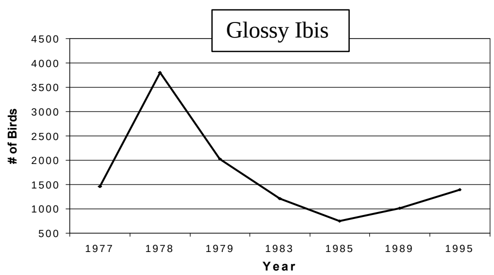
New Jersey Atlantic Coast Long-Legged Wading Bird Populations, 1977-1995

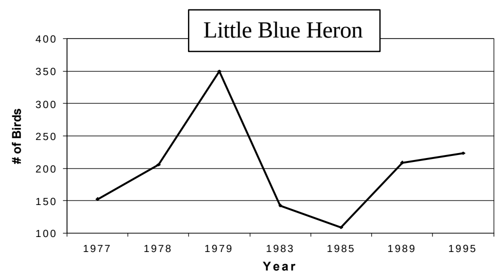


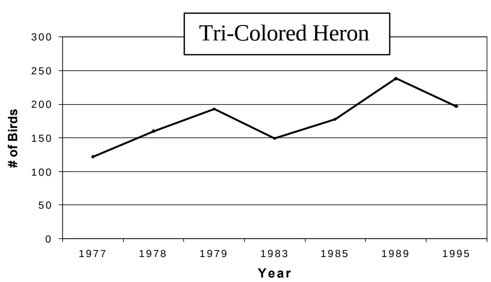


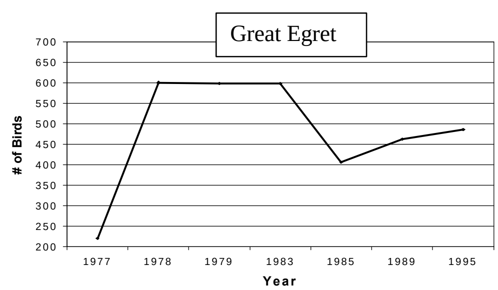












Data Description

Trends of colonial nesting waterbird populations provide several measures of environmental quality: resource abundance and health; indirect indicators of organic contaminants and heavy metal concentrations; and levels of human disturbance.
The New Jersey Department of Environmental Protection, Division of Fish and Wildlife has monitored the nesting populations of 14 colonial waterbird species through a combination of ground and aerial surveys for the past two decades.

Data for 8 species of long-legged wading birds (Cattle Egret, Black-Crowned Night Heron, Yellow-Crowned Night Heron, Snowy Egret, Glossy Ibis, Little Blue Heron, Tri-Colored Heron, and Great Egret) have been presented because they represent a feeding and nesting guild of colonial water birds in the Atlantic Coastal ecosystem

Data Characteristics

Concerns about declining species populations (from pesticide contamination and habitat loss) were the impetus for NJDEP's Division of Fish and Wildlife beginning surveys of colonial nesting waterbirds in the late 1970s. Investigators searched salt-marsh and scrub-shrub habitats between the Garden State Parkway and the developed sections of barrier islands from a Bell Jet Ranger helicopter flying at altitudes ranging from 30 to 100 meters above the ground.

After completion of the initial survey in 1977, the maps prepared during the survey were used to help guide subsequent surveys. Each flight carried three observers who directed the pilot, located colonies, counted birds, recorded data and mapped approximate colony boundaries. Birds were counted by circling slowly or hovering near the colony. All adults in the nesting colony were counted except those that were obviously not engaged in nesting (e.g., loafing on nearby shoreline). Aerial surveys were conducted in 1977, 1978, 1979, 1983, 1985, 1989 and 1995. Because aerial surveys did not cover some areas of barrier islands, counts of Yellow-Crowned Night Herons nesting on barrier islands were supplemented with ground counts.

The data presented herein are available through the Endangered and Nongame Species Program within the Division of Fish and Wildlife (609-292-9400).

Data Strengths and Limitations

Analysis and interpretation of survey data would clearly benefit from more frequent surveys. The data presented here show that variability in counts between surveys is high for many species. Ideally, surveys should be performed annually. Periodically repeating all or a portion of the survey within years would help assess some of the sources of variability and aid in data interpretation. The primary factor determining when surveys have been conducted in the past has been the availability of funding. Most of the surveys to date have been supported by federal funding (National Biological Survey – now USGS

Biological Resources Division, U.S. Fish and Wildlife Service, and National Oceanic and Atmospheric Administration).

Aerial surveys are limited to the Atlantic coastal area from Cape May to Point Pleasant. Although this represents the vast majority of long-legged wading bird colonies in the state, important nesting areas are also known in the New York Harbor and Delaware Estuary, areas not included in the current analysis. In addition, unknown or undiscovered colonies probably also exist along the Southern Delaware Estuary, Navesink and Shrewsbury Rivers, Hackensack Meadowlands, and other areas not covered by the aerial survey. Data from these areas would contribute considerably to our understanding of statewide populations, and are necessary for understanding more local trends.

Over the past decade Yellow-Crowned Night Herons have begun nesting in relatively urban and suburban habitats in the Tidewater areas of Virginia (Watts 1989, 1991). Colonies often consist of 2-3 nests that are not associated with other herons. Over the past five to ten years, similar nesting situations have been observed in developed areas of the Raritan estuary. As a result of their small size, isolation, and occasional location in urban or suburban habitats, Yellow-Crowned Night Herons nesting in locations such as described above would probably not be detected on aerial surveys. Therefore count data presented here may not adequately reflect current populations levels or trends.

To gain better understanding of the factors leading to population changes, more information is also needed on nesting success and productivity for each species. Nesting studies that assess nest and brood fate at selected sites would be extremely beneficial in this regard. Long-term (>5 year) monitoring of nesting is necessary to characterize and quantify the factors influencing breeding outcome.

In addition to general demographic studies, applied studies designed to investigate specific factors affecting breeding success and to evaluate specific management alternatives are also needed. Such studies should broadly include evaluation of pesticide and contaminant loadings and effects; studies of the effects of human disturbance on breeding and foraging, especially the effects of personal watercraft; studies evaluating predator control techniques; and studies of habitat use.

Discussion

Colonial nesting waterbirds represent prominent members of estuarine ecosystems. They are important predators, feeding near the top of the food chain on a wide variety of forage fish, and on marine invertebrates such as small crabs and mollusks. As relatively long-lived, high-level predators, colonial nesting waterbirds serve as valuable indicators of environmental quality, including: resource abundance and health; levels of toxic substances such as organic contaminants and heavy metals; and levels of human disturbance.

Estuarine ecosystems are, in turn, extremely important to colonial waterbirds. Estuarine open water and wetland habitats supply the primary, and in some cases, the only feeding habitats for most colonial waterbird species in the mid-Atlantic region. Estuarine areas, particularly islands, also provide critical nesting habitat.

Monitoring of colonial waterbird populations also provides important information for assessing impacts of coastal development projects that may affect waterbird habitat. The mapping of the nesting areas delineates the most current nesting colony boundaries

Consistent with New Jersey data, several sources suggest that Snowy Egrets and Black-Crowned Night Herons may be declining throughout the Eastern U.S. Analysis of trends in Maryland, between 1985 and 1995, show a decrease in Snowy Egret numbers (Brinker et al., 1996). Parsons' (1996) review of trends in colonial nesting long-legged wading birds from Delaware to Maine suggests a declining trend for both Snowy Egrets and Black-Crowned Night Herons. Erwin (1995) cites similar evidence for Virginia and Florida.

Maryland surveys also indicate declining Glossy Ibis numbers between 1985 and 1995. Although more recent New Jersey data show a modest increase in Glossy Ibis numbers, Erwin (1995) cautions that ibis species are particularly mobile and that population monitoring requires a coordinated regional approach.

Based on preliminary research in the Delaware Estuary and other estuaries in the Northeast, Parsons (1997) postulated that contemporary pesticides such as organophosphates and carbamates may affect long-legged wading birds exposed through consumption of contaminated food. Depressed cholinesterase levels in birds exposed to these pesticides may be leading to adverse behavioral changes that, in turn, could reduce nesting success. Current information is insufficient to establish a clear link between behavioral changes or nesting productivity and exposure to cholinesterase-inhibiting chemicals. Parsons' findings should, however, prompt further investigation into possible links between modern pesticides and wading bird reproductive success. Given their documented effects on avian reproduction, the possible role of more persistent environmental contaminants such as organochlorine compounds and heavy metals must also be considered when examining colonial waterbird population trends.

Although there is considerable variability among species in their sensitivity to disturbance, nesting success of all colonial waterbirds can be severely reduced by specific types and excessive levels of human activity. The burgeoning use of personal watercraft ("Jet Skis") is a particular concern (Burger, 1998 and Carney and Sydeman, 1999). These watercraft allow access to very shallow and narrow waterways not accessible to larger boats. This has lead to increased disturbance of previously isolated nesting colonies and increased interference with feeding activities, especially of long-legged wading birds.

Nesting sites for more sensitive species and especially for those containing endangered or threatened species should be protected from human disturbance. All nesting sites for terns, skimmers, and long-legged wading birds that are susceptible to human disturbance should be designated as "sanctuaries." The designation should include a buffer of at least 50 meters surrounding the nesting site.

These areas should be off-limits to any type of human access, including watercraft during the nesting season (approximately April to July). While existing laws protecting endangered, threatened, and other nongame species prohibit "harassment" of these birds, in practice, enforcement is difficult because actual harassment and/or intent to harass must usually be demonstrated. Regulations specifically prohibiting human access to nesting areas and important feeding areas could probably be developed under existing statutes.

Given the near elimination of scrub-shrub and wooded habitats from New Jersey's barrier islands, dredged material islands have become a primary nesting habitat for long-legged wading birds in New Jersey. Currently, creation of new nesting habitat from dredged material disposal occurs by chance, not by design. Typically, when the interval between use of dredged material sites is long, natural succession leads to habitats that are suitable for nesting by long-legged wading birds. Ironically, once waders colonize a site, future use of the site for disposal can be blocked by their presence.

A more proactive approach to dredged materials management through creation of available nesting habitat would help reduce conflicts between dredging operations and habitat protection. Given the shortage of suitable nesting sites, coupled with the shortage of acceptable disposal sites faced by state and federal agencies responsible for waterway maintenance, such an approach could help address both needs. Site design specifically geared towards nesting habitat creation can improve habitat suitability and the interval between disposal use and suitability for nesting can be shortened by planting of appropriate woody vegetation.

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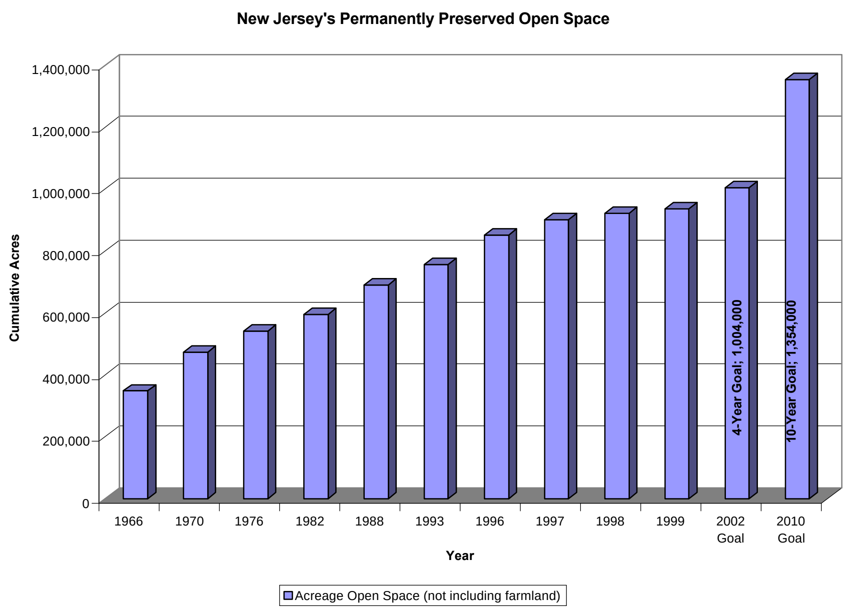
Milestone: Federal, State, and local programs will strive to preserve and protect through fee simple acquisition or other means an additional 300,000 acres of open space and farmland by the year 2002 and a total of 1,000,000 acres of open space and farmland by 2010*.

Indicator: Acres of Permanently Protected Open Space

Type of Indicator: Condition

* Half of the acreage to be preserved will be open space and half will be farmland. The preservation of farmland is the responsibility of the NJ Department of Agriculture. Thus, the responsibility of NJDEP will be to preserve 150,000 acres of open space by 2002 and 500,000 acres by 2010.

Acres of dedicated open space owned and managed by the Federal, Interstate, State, County, and Municipal governments, as well as open space acquired by Not-For-Profits organizations using state funding have steadily increased since 1966 with an estimated 936,231 acres (or 19% of NJ land) preserved as of 1999.



Data Description

By the end of 1999, New Jersey had an estimated 936,231 acres of permanently protected open space, including lands managed by federal, state and local governments, interstate agencies and nonprofit organizations. Based upon the estimated 4,984,338 acres of land in New Jersey, 19% of NJ lands are permanently preserved. The Governor's Council on New Jersey Outdoors found that New Jersey required an additional one million acres (half of which would be farmland protected through Department of Agricultural program) of public open space and recreation areas to meet present and future needs. (See *Interim Report of Governor s Council on New Jersey Outdoors, May 1997*). Subsequently, in her second inaugural address, Governor Whitman launched an initiative with the goal of preserving one million additional acres of open space (to the 854,000 acres that had already been preserved as of the May 1997 report date) by 2010 with the first 300,000 acres (half of which would be farmland protected through Department of Agricultural program) to be preserved by 2002. These data show that New Jersey is making progress toward meeting both the 2002 and 2010 goals of open space preservation. NJDEP is more than half-way toward meeting its four-year goal of preserving an additional 150,000 acres of open space.

Preservation of open space is critical for current and future protection of natural resources, biological diversity and recreation. NJDEP manages 67% of all public land preserved in New Jersey. The Division of Parks and Forestry is steward for 53 parks, forest and recreational areas; 57 historic sites and districts; 42 natural areas; marinas; and other facilities encompassing 342,894 acres. The Division of Fish and Wildlife manages 107 Wildlife Management Areas, totaling 254,432 acres. Counties and municipalities manage 17% of open space, the federal government manages 12%, and nonprofit organizations hold about 4% of all preserved lands. Nationally, New Jersey ranks first for land preserved by the State as a percent of the land area of the state; however, other states (particularly Western states) have a larger percentage of conservation and recreation lands managed by the federal government.

The data provided herein are from NJDEP's Green Acres Program and are available by calling (609) 984-0500.

Data Characteristics

The NJDEP Green Acres Program maintains the open space acreage data in two databases, one for the state lands acquisition program and another for the local lands acquisition program. Acreage in the state acquisition program is recorded and counted as the projects close and deeds are filed. Acreage in the local acquisition program (including grants to non-profits) is recorded and counted initially when the appropriation bill is signed and grants/loans approved. If changes to acreage purchased by the local government or non-profit agency are realized, they are recorded as they are received.

Data Strengths and Limitations

The strengths are that data are taken directly from the project files and reflect actual acreage.

One of the key limitations to the data is that they do not include farmland protected under the New Jersey Department of Agriculture's Farmland Preservation Program. Another limit is that the actual amount of preserved open space may be underreported, as data from nonprofit lands, such as donated lands, are not recorded**.**

Discussion

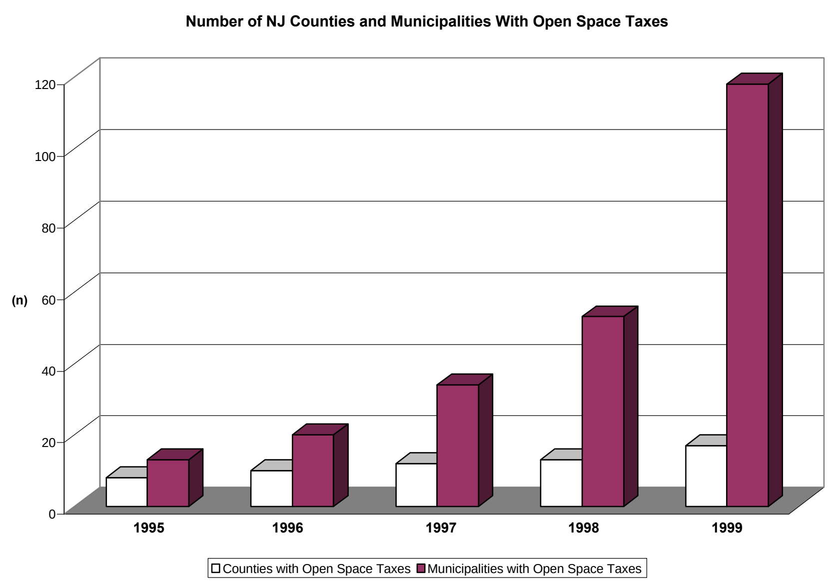
The trend toward increasing open space preservation demonstrates that NJ is moving toward its short-term goal of an additional 300,000 acres of open space preserved by 2002 and an additional 1,000,000 acres by 2010. In 1998, New Jersey voters approved a constitutional dedication of $98 million of annual funds for ten years and over $1 billion in bond financing to support open space preservation. Passage of the Garden State Preservation Trust Act in June 1999, established this stable source of funding. Funding for open space, farmland, and historic preservation became available in Fiscal Year 2000 and will continue through Fiscal Year 2009. Given the lag time between appropriation of funds and actual closings, acquisitions and easement purchases are not expected to be finalized until 2010.

Milestone: Federal, State, and local programs will strive to preserve and protect through fee simple acquisition or other means an additional 300,000 acres of open space and farmland by the year 2002 and a total of 1,000,000 acres of open space and farmland by 2010.

Indicator: Number of Counties and Municipalities with Open Space Taxes

Type of Indicator: Response

The number of New Jersey counties and municipalities with open space taxes has continued to increase steadily over the past five years with a total of 17 counties (81% of New Jersey s 21 counties) and 118 municipalities (21% of NJ s 566 municipalities) providing funds for open space preservation, as of 1999.



Data Description

In the last five years, the number of counties and municipalities with open space taxes has increased steadily from 8 counties and 13 municipalities in 1995 to 17 counties and 118 municipalities in 1999. As of 12/31/97, local governments (county and municipal) have reported spending $24.8 million to preserve 26,335 acres of open space and farmland statewide. These are local governments that are either assessing a tax, bonding for open space, or have a specific budget appropriation for open space.

Local governments have come to realize that open space preservation should be an integral component of community planning. Open space preservation enhances the quality of life within a community, protects natural resources, provides opportunity for outdoor recreation and helps communities to avoid the excessive service costs associated with poorly planned sprawl development. By preserving open space, communities help to channel development to appropriate areas, thereby fostering economic growth that is compatible with community character. Similar to other important investments communities make to provide public infrastructure, such as roads and schools, it also makes sense to insure that fiscal resources are set aside for preservation of open space. Local governments have turned to dedicated open space taxes as a way to fund their land preservation programs.

Data Characteristics

Open space tax data are collected annually by NJDEP's Green Acres Program via a mailed survey to local governments with open space taxes. The above data regarding the amount of local government spending and related acreage preserved were developed through a 1997 Green Acres Program survey of 46 New Jersey local governments (counties and municipalities) which assessed an open space tax or had an open space funding program in 1997. Additional data on open space taxes are collected from a variety of sources: newspapers; local contacts; and through the individual county clerk's offices who are responsible for ballot questions.

All data provided herein are from NJDEP's Green Acres Program and are available by calling (609) 984-0500. The results of the Green Acres survey noted above are published in *Local Government Open Space Funding Programs in New Jersey,* NJDEP Green Acres Program, October 1998.

Data Strengths and Limitations

Local government spending and related acreage preserved was based upon the 1997 Green Acres survey of counties and municipalities as described above. These values are probably underreported for several reasons. At the time of the survey, 11 counties and 34 municipalities collected open space taxes; however, 1 county and 15 municipalities did not respond to the survey. In addition, the number of counties and municipalities implementing open space taxes for preservation purposes has increased by 6 and 84, respectively, since the survey was first conducted in 1997.

Starting in 1999, all open space tax data will be collected by the Department of Community Affair's Division of Local Government Services. One of the data strengths for this information is that reporting to the Department of Community Affairs is required by law and the data is prepared by local finance officials.

Discussion

In 1989, the New Jersey legislature enacted PL. 1989 Chapter 30 that empowered counties to assess a tax approved by public referendum for open space preservation. For municipalities, N.J.S.A. 19:37-1 et seq. authorizes New Jersey municipalities to submit a referendum to the voters in order to ascertain voter sentiment on policy pertaining to the governance of the municipality. These laws allowed local governments to establish a source of open space funding that was approved by public referendum and would provide a consistent revenue stream for open space preservation. Local governments were able to design their tax to fit their individual open space needs. Some focused on land preservation for recreation and conservation purposes, some targeted farmland, and some did both . The referendums also provided for not only fee simple acquisition but also easement and development rights purchases. In 1997, P.L.1997 Chapter 24 repealed and consolidated previous open space tax legislation and broadened the use of open space tax funds to include park development and maintenance and historic preservation, and many local governments have included these elements in their open space programs.

In order to provide continued support to local governments for their progressive open space policies, the Green Acres Program initiated a funding category for land acquisition, the Planning Incentive. Under the Planning Incentive, local governments that have and are collecting and expending an open space tax, or alternative funding mechanism equivalent to a tax, and have also adopted an Open Space and Recreation Plan are eligible to receive funding in the form of a 50% grant and 50% loan to acquire land for recreation and conservation purposes.

The advantage of the Planning Incentive funding over the other Green Trust application process is that a local government can use its Open Space and Recreation Plan as its application and receive funding for the acquisition of properties identified in the plan. Once Green Acres has approved a local government's Open Space and Recreation Plan, the local government can acquire sites without separate applications for each property, which results in a significant time and cost savings.

SITE REMEDIATION

Introduction

Historically, the Site Remediation Program (SRP) based its reporting on the number of remedial phases completed at sites in New Jersey. Remedial phases include the preliminary assessment, the site investigation, remedial investigation and remedial action. While this information did provide some indication of the progress of remediation, it did not provide specific environmental information. The environmental indicators included in this report provide information on the environmental media impacted by known contaminated sites including impacts on ground water, soil, surface water and air and information about the condition of sites after remediation is completed.

The development of indicators has driven the SRP to develop new data management approaches and systems. The program has begun the collection of environmental data in electronic format and has made mapping the locations of sites a priority. In the recent past, the program measured progress only by tracking documents and reports submitted by the person conducting remediation. Today, the program requires, for most cases, the submission of analytical data in an electronic format which is compatible with the Department's geographic information system (GIS). In the near future, the program anticipates that case managers will use electronic data to better manage remedial activities at sites. Through the NEPPS process SRP is striving to give the EPA and the public a more complete and accurate picture of how environmental media have been impacted by known contaminated sites and how SRP activities are being used to mitigate those impacts across the state.

During a site investigation, the person responsible for conducting the remediation identifies potential areas of contamination and conducts analytical sampling to confirm whether or not contamination is present. Because contaminants often migrate both horizontally and vertically, and from one medium to another, the nature and extent of contamination must be determined. The program uses criteria that are based on the protection of human health. Sites with impacts to sensitive ecological areas also must use criteria that will be protective of ecological receptors. Remedial actions are taken to remove, mitigate, or control the contamination so that public health and environment are protected.

The following information discusses selected SRP environmental indicators for which adequate data are available for reporting. In order to improve access to this data, SRP is also in the process of setting up an environmental indicators GIS project. It will be available through the DEP Webpage and will be viewable without GIS software. Initially, this GIS project will focus on a number of the ground water related indicators such as the location and extent of ground water classification exception areas, but will be expanded over time to include other SRP environmental indicators.

Objective: Clean up, mitigate or control contaminated ground water at/from SRP sites.

Indicator: Known Locations of Sites where Ground Water exceeds Criteria Specified in the Ground Water Quality Standards

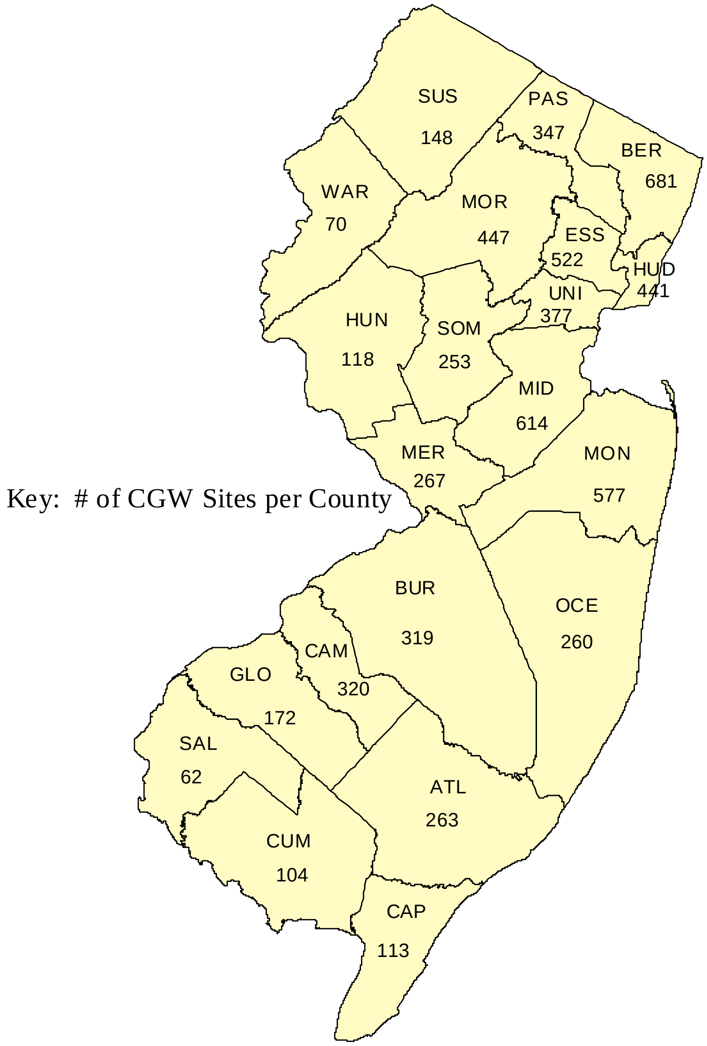
Type of Indicator: Cause

The total number of SRP sites in New Jersey where one or more ground water criteria are known to be exceeded [referred to as contaminated ground water (CGW) sites] is approximately 6,475 as of 6/30/99. This is about 64% of the current total universe of the known contaminated sites (10,047 sites). The number of CGW sites in each county is shown in map form on SRP Figure 1. The CGW sites that are mapped on GIS are shown on SRP Figure 2. Approximately 80% of the 6,475 CGW sites have currently been mapped on GIS. The mapped sites are a subgroup of the 1997 Known Contaminated Sites in NJ database, which was used to create the GIS coverage. This coverage only includes site locations, not the areal extent of ground water contamination. For this 1997 GIS coverage, individual site locations in relation to various GIS coverages (county and municipal boundaries, major and county roads, surface water bodies, etc.) will be available to view over the Internet through SRP's Environmental Indicators (EI) GIS Project.

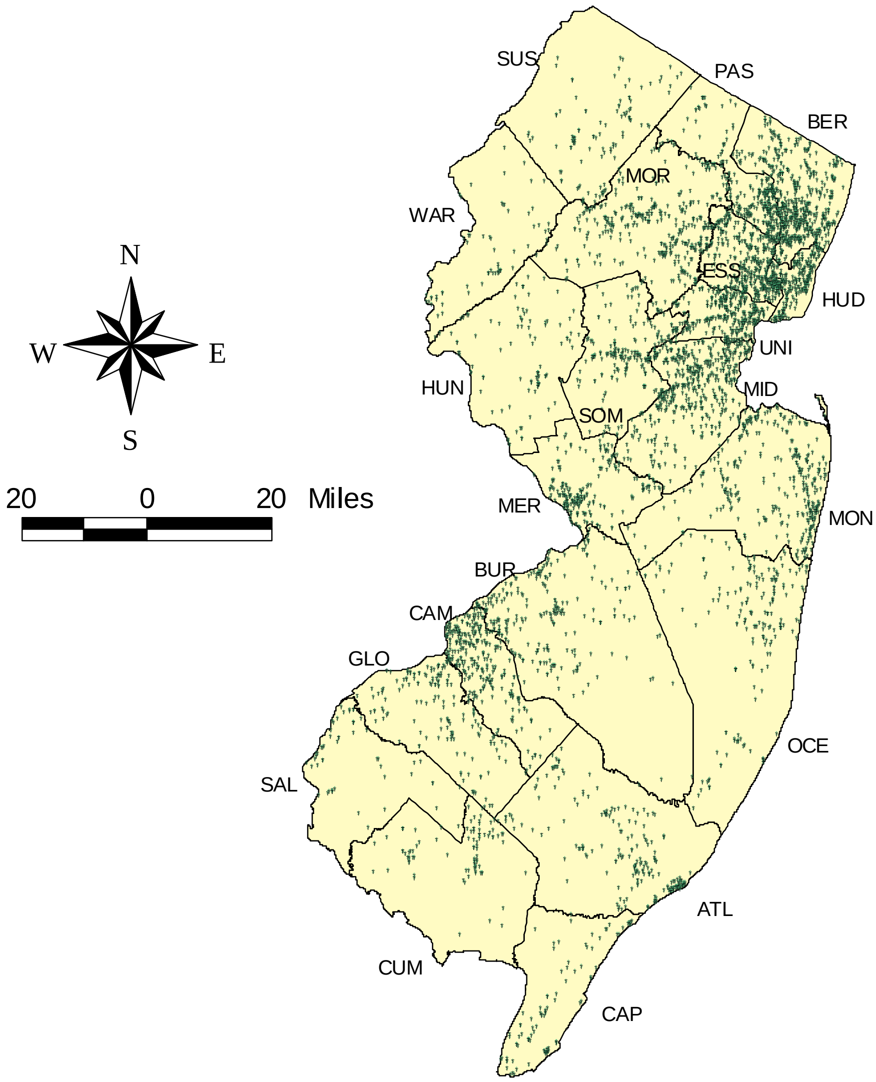
Data Description

The existence of a CGW site in a specific location indicates that one, or several, "causes" of ground water contamination exist, or existed, in that area. Figure 1 includes the number per county of all known CGW sites in NJDEP databases. Figure 2, and viewing these locations using the GIS project, provides an indication of the locations and distribution of sources, or former sources, of ground water contamination and where they are in relation to other geographic features. Figure 2 does <u>not</u> give any information on the size of the area of ground water contamination at each of these sites.

SRP's EI GIS project is supposed to be made available on the Internet in the future. When it is, GIS software will not be needed to access GIS based information and use it to evaluate the location and distribution of these sites. Identifying a site as a CGW site does not necessarily mean that the source of the contamination is, or was, on the mapped site; the source could have been on an upgradient property in some situations. In addition, identifying a site as a CGW site does not give any information about the current extent or depth of that contamination. In many cases, the area of contamination is relatively small and at a shallow depth and often within the site's property boundaries. In the GIS project, the SRP bureau that has more detailed information about the extent of contamination is identified in data tables associated with each site location. The telephone numbers for each of those bureaus will be given in the introductory information for the project.



SRP Figure 1 - Number of Contaminated Ground Water (CGW) Sites as of June 1999



SRP Figure 2 - Locations of Contaminated Groundwater Sites

As of January 1997

Data Characteristics

Identification of whether ground water contamination exists at a known contaminated site is based on a SRP designation called a site's remedial level. Remedial levels range from an "A" level site up to a "D," with the "C" level being subdivided into C-1 through C-3. The C-2, C-3 and D level sites are those known to have contaminated ground water at the site. The accuracy of this designation depends on what data are available at the time the remedial level is established and can be changed when new data become available. Thus the larger number of CGW sites reported as of 6/30/99 (6,475) versus the number in the 1998 report (5,246) may be due to new data becoming available at already known contaminated sites as well as discovery of new sites. Site remedial level was identified from the NJDEP Comprehensive Site List (CSL) database which includes SRP's most current data.

The known contaminated site locations in Figure 2 and in our GIS project were last updated in January 1997. They were mapped using various methods such as global positioning system (GPS), matching of the address to the mapped location, locating the site in the area included in the zip code of the site's address, and latitude/longitude of the site. When viewing the SRP EI GIS project the site location method used can be displayed in a data table. This table also includes the site address, remedial level, SRP bureau to contact for additional information, and other data linked to the site location.

Data Strengths and Limitations

The accuracy of a site's remedial level, and thus its inclusion in the CGW site universe, is based not only on whether current and accurate ground water data are available but also on when the remedial level was last updated. Newly discovered ground water contamination at a site will not usually be reflected in the CSL database.

Sites in the GIS coverage that were mapped using GPS and the address matching technique are relatively accurate, however, those mapped using the zip code area can be mislocated by several miles. As a result, any user should confirm that the location is mapped accurately before making any conclusions based on a site's proximity to a point of ground water use or discharge.

As stated above, the GIS coverage currently includes only the January 1997 known contaminated site list, thus more recently identified SRP sites (which are included in our CSL database) are not on SRP Figure 2 and will not be included in the CGW site coverage in SRP EI GIS project until it is updated.

Discussion

SRP Figure 2 reveals a higher density of CGW sites in the more industrial areas of the state (the northeast, Trenton, Camden, Atlantic City, and Vineland areas) and along major highways and secondary roads. About 59% of the CGW sites are in the seven northeastern counties of Bergen, Passaic, Essex, Hudson, Union, Middlesex, and

Monmouth (3,779 sites). Although Camden is one of the smaller counties in southern NJ, it has the largest number of CGW sites (320) of the southern counties. The largest southern county, Burlington, has 319 CGW sites predominantly in the northwestern half of the county. Salem County has the smallest number of CGW sites in the state (62). It should be noted that the northeastern counties, which have the highest density of CGW sites, do not rely heavily on ground water as their source of potable water.

The scale of Figure 2 gives the impression that a large percentage of the state's ground water is contaminated, however this map should not be viewed as a quantitative depiction of the extent of contamination at any of the mapped points. If the triangles could be drawn to a scale representing the size of the area of contamination, the vast majority of them (probably all of them) would not be visible on a map with the scale of Figure 2.

The main purpose of SRP's EI GIS project is to make available GIS data more accessible to the general public, various government agencies and other interested parties. Any evaluation of potential risks posed by a contaminated site that is done using the EI GIS project must be considered very preliminary and nonconclusive due to the limited accuracy of site location and the minimal information available on GIS about the size and depth of the areas of contaminated ground water. The project can be used to get a general idea of the location of CGW sites in a particular area, the names of the sites, and how to get additional information from SRP about ground water contamination at those sites.

Currently, SRP staff evaluates the proximity of contaminated ground water sites to users of ground water, such as potable wells, during two different stages in the "life" of a site. The first evaluation is a very general one and is done to determine the priority or ranking of the site which determines how quickly a site is assigned to a case manager for a detailed analysis. Most of the 6,475 CGW sites have been through this first evaluation. Sites that have already significantly affected potable wells are assigned immediately. The second evaluation is done after a site is assigned; it is a detailed analysis of site-specific risks posed by the site after which actions are taken to mitigate those risks.

SRP is in the process of improving the accuracy of site locations already mapped on GIS. Current estimates are that the 1999 known contaminated site list may be added to the GIS coverage during 2000 if staff work load permits. Work needs to progress toward improving site remedial level accuracy in the CSL database in order to continue using this process to define the universe of contaminated ground water sites. Methods for using electronically submitted data to more easily update SRP databases and develop new indicators are being explored.

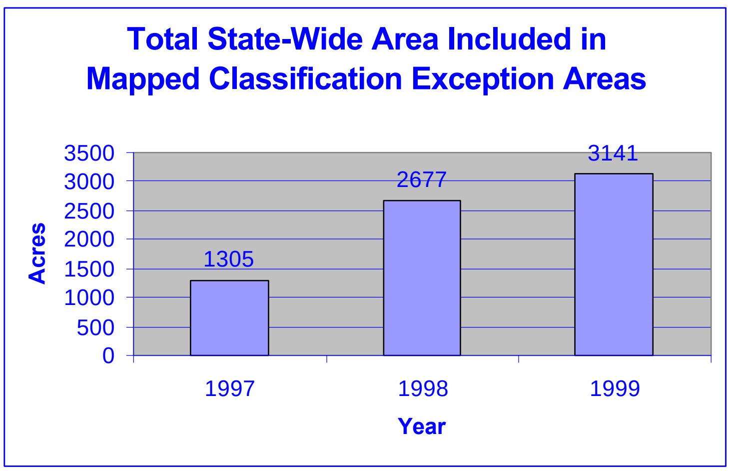
Objective: Clean up, mitigate or control contaminated ground water at/from SRP sites.

Indicator: Classification Exception Area (CEA) Areal Extent (Acres) and % Change in Size over 5 Years

Type of Indicator: Condition

A Classification Exception Area (CEA) established by SRP is a localized area associated with a contaminated site where ground water currently exceeds ground water quality criteria for specified constituents (i.e. the current extent of the plume) and includes, if appropriate, any additional area into which those contaminants are expected to migrate (i.e. the predicted farthest extent of the plume) during the remedial action. Site specific modeling is used to predict the farthest extent of the ground water contamination and how long the contamination will exist; these predictions define the size and duration of a CEA. CEAs are established any time after a ground water remedial decision is made, usually during implementation of the remedy. Individual CEA sizes at specific sites can be viewed on the Internet when the EI GIS project becomes available; the current average size of all mapped CEAs is 4.5 acres. The total statewide area included within the 699 CEAs mapped on GIS as of June 30, 1999, was 3,141 acres. (Note: not all established CEAs have been mapped on GIS.) As reported last year for CEAs mapped by the end of June 1998, this total statewide area was 2,677 acres. In October 1997, the total statewide area of mapped CEAs was approximately 1,305 acres.

In the year 2002, SRP plans to start reporting data on percent change in total statewide CEA area for only the mapped CEAs established in 1997. In 2003, the universe of CEAs established in 1998 will be evaluated for percent change in the total summed area.



Data Description

The areal extent of a CEA refers only to its horizontal dimensions and includes the current plume and predicted maximum extent that the plume will ever migrate from the site associated with the CEA based on the chosen remedial action. The size of this area indicates the maximum magnitude of the impact on ground water from a particular site and is thus an indicator of the "condition" of ground water quality on a site, or local, scale.

The total state-wide area included in all CEAs (displayed in the above graph) is an approximate measure of the area where ground water contamination has been evaluated for risks to receptors and is being remediated in some fashion to address those risks. The total area included in all CEAs mapped is the sum of all the applicable individual CEA areal extents mapped to date.

Data Characteristics

CEAs are mapped on our GIS coverage as both point locations and as polygon areas. When using the GIS project, the polygons can only be viewed after zooming-in to view the area immediately surrounding the CEA. When viewing an individual CEA polygon, a data table can be accessed which contains the list of contaminants included in the plume at this site and some other related CEA data.

Data Strengths and Limitations

A recently passed state statute requires periodic evaluations of the effectiveness of institutional controls and submittal of certifications by responsible parties that the controls are still effective. Since CEAs are an institutional control, this requirement may help SRP maintain the accuracy of CEA information.

As mentioned in the 1998 Annual Report, at most sites where ground water remedial decisions were made prior to 1995, the Department does not plan to establish CEAs unless a significant change is made in the chosen remedy. This means that the area of ground water contamination being remediated under state approved programs is actually greater than the state-wide CEA area extent presented in this report.

Discussion

CEA areal extent can be used to evaluate the condition of ground water in New Jersey on a site specific scale (using GIS), on a state-wide scale by summing all mapped CEA areas, and it can be used to evaluate changes over time. SRP plans to compare the total area of a specified universe of CEAs (e.g., those mapped CEAs established during 1998) to the total area of the same group of CEAs five years later. Changes in this total would be caused by eliminating existing CEAs in that universe and/or changes in sizes of individual CEAs. If CEAs were originally done appropriately, and are being eliminated from the database at the end of their actual duration, the total for this same universe of sites should decrease, although five years may be too soon to see a significant change. If a CEA is done for an interim ground water remedy, the CEA for a particular site may increase in size when the final remedy is chosen. The majority of CEAs are established during implementation of the final remedy, so the impact of doing CEAs for interim remedies on this total sum of areal extents should be minimal. In 2004, the Site Remediation Program plans to evaluate changes in the universe of mapped CEAs established in 1999.

As explained in the 1999 NEPPS Annual Performance Report (under SRP subgoal 1), a new CEA database is being created for use by the Water Supply Element to assist in the permitting of potable and other wells. CEA data will also be made available to well drilling companies to further reduce the possibility of installing potable wells too close to CEAs. The linkage of this new CEA database with the existing database will allow easy sorting of CEA data. Therefore, we may be able to compare various subgroups within the universes of CEAs. For example, we could compare changes in the total CEA area only at sites that are in ground water use areas, or just at sites with a certain type of ground water remediation (active or natural). These types of analyses would allow more detailed evaluation of how this indicator measures our progress toward the ground water objective and subgoal. The ongoing efforts to improve the Department's CEA information and databases should help to improve the usefulness of this indicator for measuring SRP progress in this area. Use of electronic data to improve this indicator will be evaluated in the future.

Objective: Clean up, mitigate or control contaminated ground water at/from SRP sites

Indicators: 1. Location and Distribution of CEAs throughout the State (Indicates Final or Interim Ground Water Remedy Decision was made)
2. Percent of Known Sites with Ground Water Contamination where CEAs are established

Type of Indicators: Response

*The total number of CEAs established was **896** as of 6/30/99. Figure 3 includes a listing of the number of CEAs established in each county and a statewide view of mapped CEA location and distribution (699 were mapped). Specific CEA location, distribution within a particular area (state, county, municipality, watershed management area), specific ground water contaminants, and other CEA data, can be viewed (for mapped CEAs) when the SRP EI GIS project becomes available.*

As of 6/30/99, CEAs were established at approximately 14% of the known CGW sites.

Data Description

Although CEAs can be established any time after a remedial decision is made, they are usually established during implementation of the chosen remedy for the ground water contamination. For that reason, these two indicators measure SRP's progress in making remedial decisions for ground water and give an indication of the amount of ground water remedial work yet to be accomplished.

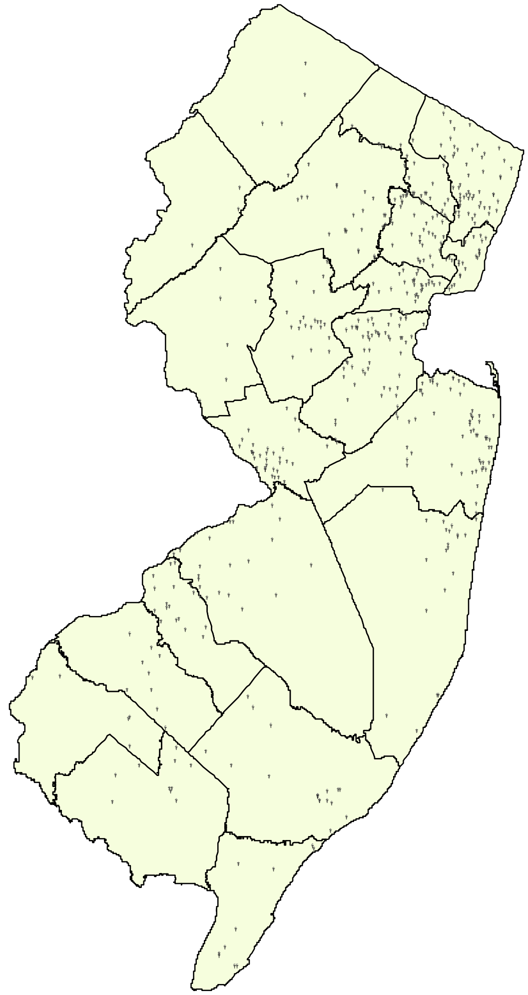
Data Characteristics/Data Strengths and Limitations

The same information on CEAs for the ground water condition indicators discussed previously applies to both these indicators as well.

Discussion

CEAs are established regardless of whether the chosen remedy is active or natural remediation. Some stakeholder feedback regarding CEAs indicates that many people equate establishment of a CEA with approval of a natural attenuation remedy for ground water, but CEA establishment alone does not mean natural attenuation was chosen for a site's remedy. Natural attenuation should only be approved if sources of the contamination are remediated and if it is protective of all current and planned future uses of ground water within the area that would be included in the CEA. Regardless of the type of remedy chosen, most of the area included in CEAs is the existing area of contamination. CEA establishment does not mean that large areas of clean ground water are allowed to become contaminated in the future. CEA establishment does mean that the contamination has been evaluated and any risks to receptors have been, or are being mitigated. Thus establishing a CEA is an indicator of progress toward the ground water subgoal and objective.

COUNTIES	ESTABLISHED CEAs
Sussex	10
Passaic	37
Bergen	96
Warren	7
Morris	45
Essex	83
Hudson	43
Hunterdon	14
Somerset	39
Union	53
Middlesex	99
Mercer	51
Monmouth	92
Burlington	44
Ocean	37
Camden	46
Gloucester	18
Atlantic	36
Salem	9
Cumberland	16
Cape May	21
Total	896



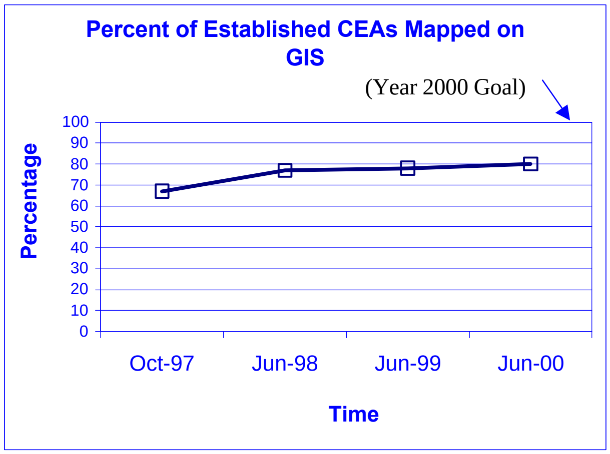
SRP Figure 3 - Number of Established CEAs
and Location of Mapped CEAs as of June 1999

Milestone: By January 1, 2000, all established CEAs will be mapped on GIS.

Indicator: Percent of Total established CEAs that are mapped on GIS

Type of Indicator: Response

As of June 30, 1999, 78% of the CEAs that were established were mapped on GIS. This percentage indicates the accuracy of the CEA condition indicator of total statewide area included in all CEAs and the response indicator of location and distribution of CEAs (Figure 3) discussed previously. It also measures SRP's efforts to make CEA data more easily available to GIS users, stakeholders, and the general public.



Data Description and Characteristics

This indicator measures our efficiency in getting established CEAs onto GIS so the information can be made available to GIS users and eventually to Internet users.

Data Strengths and Limitations/Discussion

The milestone of having all currently established CEAs mapped on GIS is not likely to be attainable in the near future due to inefficiencies in processing the information. SRP will continue to work toward minimizing the lag time between establishment and mapping of CEAs. This milestone will likely be modified in the next NEPPS Performance Partnership Agreement.

Objective: Clean up, mitigate or control contaminated soil at Site Remediation Program sites.

Indicator: Locations of Sites where Soil Contamination exceeds the Soil Cleanup Criteria

Type of Indicator: Condition

As Of June 30, 1999, there are 10,047 sites with some degree of soil contamination under the purview of the Site Remediation Program. A listing of these sites is provided by county (see table below) and state map showing site locations is provided in figure 4.

Locations of Sites with Soil Contamination by County

Atlantic	445	Middlesex	838
Bergen	993	Monmouth	902
Burlington	484	Morris	740
Camden	457	Ocean	359
Cape May	150	Passaic	558
Cumberland	152	Salem	94
Essex	860	Somerset	354
Gloucester	247	Sussex	280
Hudson	794	Union	609
Hunterton	216	Warren	126
Mercer	389		

Data Description

This condition indicator demonstrates that the majority of sites with soil contamination occur in those counties that have historically been highly developed, both with industry and population and generally follow transportation corridors.

Data Characteristics

The data used for this and a number of other indicators discussed below are derived from computerized site tracking systems that are used by the Site Remediation Program to track administrative information such as the site name, address and dates that reports are submitted to the Department. Currently, these systems are being upgraded so that in the future they will include a variety of technical site information such as what environmental media are impacted, what contaminants are present and what remedies are applied to eliminate or reduce risks to human health or environmental receptors.

SRP Figure 4. Locations of sites with known soil contamination

Data Strengths and Limitations

This condition indicator provides a good idea of the distribution of soil contaminated sites overall but does not provide any information on the nature or extent of that contamination.

Discussion

The total number of sites has increased from the 1997/1998 Annual Performance Report by 1,706 sites. This increase in sites is due in part to the success of the voluntary cleanup and the brownfields programs that have encouraged both responsible parties and volunteers to evaluate and remediate contaminated sites. The number of voluntary cleanups also is related to the state's economy. There appears to be a relationship between periods of economic growth and a higher number of real estate transactions that often initiate site investigation and cleanup.

The number of sites with soil contamination provides us with a snapshot in time of how many sites are in the state and how they are distributed. This information over time provides trends that relate, in part, to program policies and initiatives.

Objective: Clean up, mitigate or control contaminated soil at Site Remediation Program sites.

Indicator: Number of Actions achieving Unrestricted Use, Limited Restricted Use and Restricted Remedial Actions

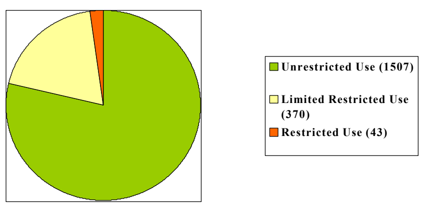
Type of Indicator: Response

Since the beginning of the Site Remediation Program until June 30, 1999, there have been 10,526 areas of concern (partial sites) and sites that have received a no further action letter from the Department. A no further action letter indicates that contamination at the site or area of concern has been cleaned up, mitigated or controlled. In the last few years, the site remediation program has begun to relate no further action letters with the type of remedial action conducted. The type of remedial action conducted is related to the soil cleanup criteria that are achieved. An unrestricted use remediation indicates that any future use of the site or area of concern, including residential, is appropriate (1,507 sites/partial sites). A limited restricted use remediation indicates that some contamination remains and that an institutional control (deed notice) is needed to ensure appropriate use of the property in the future (370). A restricted use of the property indicates that an engineering control (i.e., a type of physical control such as a cap or a fence) is needed to ensure that no one can come into contact with remaining contamination (43).

The number of sites and areas of concern in each category provides information regarding the end result of remediation activities in the state. A map showing the location of these sites is expected to be included in a future report.

Remedial Action Types at Contaminated Sites

Includes whole and partial site remediations



Data Description

This response indicator shows that since this type of information has been collected by the program, there have been unrestricted remediations implemented at many more sites or areas of concern than those with limited restricted or restricted use remedies. The majority of the 8,606 no further action letters were issued before the type of remedial action was electronically tracked. However, the program believes that the majority of these remedial actions completed before computer tracking were whole site, unrestricted remedial actions.

Data Characteristics

See discussion for the condition indicator “Locations of sites where soil contamination exceeds the soil cleanup criteria."

Data Strengths and Limitations

Until recently, information regarding the remedial action type, which relates to how the site can be used after the remedial action, was not tracked electronically and therefore, is not readily available. Because of this, the majority of sites that received no further action letters (8,606) since the program's inception in the late 1970s are indicated by as "not specified" in the pie chart above. The breakdown of remedial outcome at the "not specified" sites is not known, however, many of the cleanups conducted in the 1970s and 1980s were full site cleanups. Other limitations of the data include incomplete or inaccurate data entry in the program’s computerized tracking system. More comprehensive tracking systems are currently under development that will improve the quality of the site information tracked by the program.

Objective: Clean up, mitigate or control contaminated soil at Site Remediation Program sites.

Indicator: Number of Sites where no Further Action is required for the Entire Site

Type of Indicator: Response

As of June 30, 1999, 312 sites have received a no further action letter for remediation of the entire site .

Data Description

This response indicator provides important information about the extent of remediation conducted at a site. A remediation at an entire site would have evaluated all potential areas of concern and, in general, would pose less risk than sites that have not been fully evaluated. Sites that have an "area of concern" designation (4,923) would have been remediated for a specified area of contamination. For example, many of these sites are underground storage tank sites, such as gas station and homeowner tanks, where the remediation of the site was limited to a leaking tank.

Data Characteristics

See discussion for "Known Locations of Sites where Ground Water Exceeds GWQS" indicator.

Data Strengths and Limitations

Information about whether a remediation was conducted at the whole site or at part of the site was not tracked electronically until recently. No conclusions can be drawn about the 5,291 sites for which information about the remedial action type was not required to be recorded in the tracking system.

Discussion

It is only within the last few years that the Site Remediation Program began to electronically track whether remedial actions addressed an entire site or addressed part of a site (i.e., an area(s) of concern). Because of this, entire site or area of concern remedial status is only known for approximately 50% (5,235) of the total number of completed remedial actions. Of these completed remediations, the vast majority (94% or 4,923) addressed one or more areas of concern at a site.

Comparing whether a remediation addressed the entire site or one or more areas of concern, and what types of remedial action were conducted, reveals that 98% of the remedial actions that achieved unrestricted use levels were conducted at partial sites or areas of concern.

Objective: Clean up, mitigate or control contaminated air emanating at/from SRP sites.

Indicator: Number of Sites where Indoor Vapor Problems (Acute and Chronic) Exist

Type of Indicator: Condition

The number of sites where acute indoor vapor problems exist is 32; the number of cases where chronic problems exist is unknown.

Data Description and Characteristics

The acute case number represents sites where immediate action by the Department was deemed necessary to mitigate direct exposure from hazardous vapors in indoor air. The data were obtained from the immediate environmental concern database and were verified as of June 30, 1999.

Data Strengths and Limitations/Discussion

In addition to acute indoor vapor problems, discharges to air can also have chronic or long-term effects on human health and the environment. Determining the number of sites where chronic or low-level concerns exist has been problematic. Presently a database does not exist to track on-going vapor problems from cases that are assigned to the Site Remediation Program. It is expected that in the future, the SRP data management system will track the concentration of contaminants in the air samples taken during site investigations. However, no definitive criteria of standards for chronic health impact from the discharge of contaminants to air have been developed to date. The development of standards for the inhalation pathway is on-going as part the larger soil remediation standard rulemaking effort.

Objective: Clean up, mitigate or control contaminated air emanating at/from SRP sites.

Indicator: Number of Sites where Indoor Vapor Problems (Acute) have been Mitigated or Remediated

Type of Indicator: Response

Receptor control has been completed at all 32 cases with acute vapor hazards.

Discussion

The hazardous indoor vapors are generally sites where gasoline is present as free product on the ground water table. Gas vapors can migrate from the water table into basements, utility vaults or other confined spaces. Hazards from these conditions include the inhalation of hazardous vapors as well as the possibility of explosion.

Of the 30 reported acute vapor cases last year, 20 cases have been completely remediated and closed out. An additional 12 new cases involving vapor concerns were reported this year. It is important to note that all 32 cases have some measure of source control and the remediations are on-going.

Objective: Remove or control ongoing sources, contaminated media and hazardous substances at inactive Site Remediation Program sites.

Indicator: Number of Sites awaiting Assignment to a Cleanup Program that may contain an ongoing Source of Contamination.

Type of Indicator: Cause

As of June 30, 1999, 1,411 sites which have some known soil contamination, are not currently assigned to a cleanup program. In addition, there are 291 known occurrences of ground water contamination, where the source of the contamination has not yet been identified.

Data Description

This cause indicator provides information about the number of sites where the site remediation program needs to identify the nature and extent of contamination and a potential responsible party to initiate remediation. The Site Remediation Program is proceeding with the ranking of sites based on Remedial Priority Score for remediation using public funds.

Data Characteristics

See discussion for the above cause indicator.

Data Strengths and Limitations

The unassigned sites are those that the Department knows about. It is likely that there are other contaminated sites that could have uncontrolled discharges to the environment that remain unidentified by the Department.

Discussion

For the 1,411 sites identified above, the NJDEP does not know whether the risks they may pose have been mitigated or not. Of the 291 known occurrences of ground water contamination with unknown sources, risks to human health have been, or are being, mitigated at all of these that are immediate environmental concern (IEC) cases in accordance with the NJDEP standard operating procedure for IEC cases. In addition, of those 291 unknown source cases, approximately 66 are currently being investigated to identify the source or sources.

SOLID/HAZARDOUS WASTE

Introduction

New Jersey has regulated the handling of solid and hazardous waste since 1970 pursuant to the Solid Waste Management Act. Solid waste management regulations established environmental controls for waste management practices, planning and financing of facilities and systems for waste reduction, recycling, resource recovery, destruction and disposal, and economic regulation and integrity review of the entities involved.

New Jersey's hazardous waste management regulations parallel the Federal hazardous waste regulations promulgated pursuant to the Resource Conservation and Recovery Act of 1976 and the Hazardous and Solid Waste Amendments of 1984. They provide for the identification of waste classified as hazardous; the registration of hazardous waste generators; transporters and treatment, storage and disposal facilities; the establishment of the cradle-to-grave manifest tracking system for all hazardous waste shipments; as well as environmental controls on hazardous waste management facilities.

Solid and hazardous waste management in New Jersey is a comprehensive regulation of the following: registration, operation and maintenance of solid and hazardous waste generators; establishment of the criteria for siting new major hazardous waste facilities; the disclosure and integrity review of solid and hazardous waste facilities and transporters; and the implementation of various statutory loan programs to finance construction and operation of environmentally sound resource recovery facilities and sanitary landfills; and the creation and expansion of legitimate commercial recycling businesses.

A selection of significant environmental indicators for solid and hazardous waste management is presented on the following pages, including solid waste generated per capita, as well as recycling rates for various waste categories.

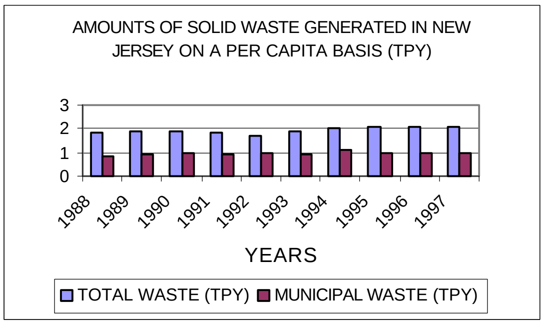
Objective: Maintain and improve solid waste minimization.

Indicator: Amounts of Solid Waste Generated in New Jersey on a Per Capita Basis

Type of Indicator: Response

The data indicate that the total waste stream and the municipal waste stream generation rates have increased only marginally from one year to the next. The per capita generation rates seem to be leveling off at approximately 2 tons per year (TPY) for the total waste stream and 1 TPY for the municipal waste stream.

Year	**Population**	**Total Waste** (TPY)	**Per Capita** (TPY)	**Municipal Waste** (TPY)	**Per Capita** (TPY)
1988	7,712,333	14,085,000	1.83	6,641,000	.86
1989	7,726,089	14,355,000	1.86	7,171,000	.93
1990	7,747,750	14,757,000	1.9	7,513,000	.97
1991	7,783,864	14,321,000	1.84	7,300,000	.94
1992	7,826,254	13,228,000	1.69	7,445,000	.95
1993	7,873,468	14,832,000	1.88	7,435,000	.94
1994	7,916,143	15,918,337	2.01	7,840,295	.99
1995	7,962,255	16,750,213	2.10	8,059,169	1.01
1996	8,007,905	16,900,288	2.11	7,849,254	.98
1997	8,058,384	16,908,946	2.10	7,985,833	.99



Data Description

The approximate amounts of solid waste generated in New Jersey are listed above in two categories and on a per capita basis: total tons generated and total tons of municipal waste generated in tons per year (TPY). The municipal waste figures represent that portion of the total waste stream generated by households, commercial establishments and institutions. The population estimates are from the U.S. Department of Energy. Solid waste facilities submit monthly reports and recycling centers submit annual reports of operations. Scrap metal shredding facilities submit biannual recycling tonnage reports.

Additional data are collected from industry sources, such as the Institute of Scrap Recycling Industries (ISRI) and the New Jersey Auto and Metal Recycling Association (AMRA).

Data Characteristics

The solid waste generation and recycling data are compiled annually by the Division of Solid and Hazardous Waste, Bureau of Recycling and Planning. These data are available on the NJDEP web page (http://www.state.nj.us/dep/recycle). Information concerning these data can be obtained by writing or calling the Bureau of Recycling and Planning at 401 East State Street, P.O. Box 414, Trenton, New Jersey 08625; (609) 984-3438.

Data Strengths and Limitations

Solid waste facilities are required to report data as a part of their operating permits. Municipalities are required to report recycling data on an annual basis through provisions of the 1987 "New Jersey Statewide Mandatory Source Separation and Recycling Act." The Act also contains provisions for the distribution of approximately $5 million annually as grants to the municipalities for documented recycling activities, based on those reports. In 1996, the funding mechanism for the grants sunsetted, although the annual reporting requirements remained. However, since for many years there was the expectation of grant funding upon submittal of recycling data, many municipalities have either not reported at all or filed incomplete reports once that grant funding expired.

The Department has been moving, through the regulatory process and by voluntary agreements, to supplement, or in some cases to replace, the reporting of recycling tonnages by municipalities. Since the municipalities have historically marketed their recyclable materials locally or regionally, these markets (primarily Class A, B, and C recycling centers) have recently been either called upon (through voluntary agreements) or required (through regulations) to report, on an annual basis, those tonnages of recyclable materials brought to them by various municipalities.

Discussion

The data indicate that the total waste stream generation in New Jersey has increased slightly between 1996 and 1997; the per capita total solid waste generation has increased slightly. The municipal waste portion of the total waste stream also increased in 1997 and the per capita municipal waste generation increased slightly. It is suspected that the generation rates, as reported, are reflective of surging economic conditions. The Department will attempt to link economic indicators and waste generation figures in future reports.

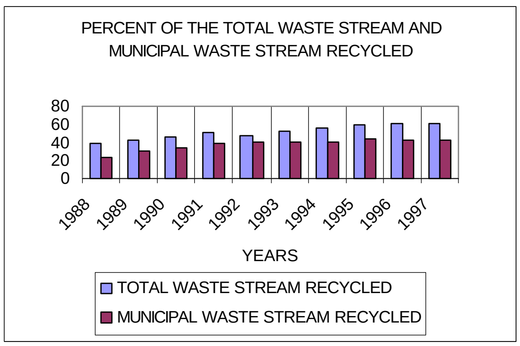
Milestone: By the end of the Year 2000, recycling rates of 65% of the total waste stream and 50% of the municipal waste stream will be achieved and maintained thereafter.

Indicator: Percent of the Total Waste Stream and Municipal Waste Stream Recycled

Type of Indicator: Response

New Jersey achieved a recycling rate of 60.8% of the total waste stream and 42.8% of the municipal waste stream in 1997.

Year	% Total Waste Stream Recycled	% Municipal Waste Stream Recycled
1988	39.0	23.0
1989	43.0	30.0
1990	46.2	33.8
1991	50.2	38.9
1992	47.5	41.6
1993	52.8	41.3
1994	56.5	41.5
1995	60.3	44.5
1996	60.6	42.0
1997	60.8	42.8



Data Description

The municipal waste figures represent that portion of the total waste stream generated by households, commercial establishments and institutions. Each municipality in New Jersey is required to submit recycling tonnage reports on an annual basis, pursuant to provisions of the Recycling Act. Recycling centers Classes A, B, C, and D (Class A centers recycle traditional materials such as glass, aluminum and paper; Class B centers recycle non-traditional materials such as construction and demolition wastes; Class C centers recycle compostable materials; and, Class D centers recycle universal wastes such as used oil.) submit annual reports of operations. Scrap metal shredding facilities submit biannual recycling tonnage reports. Additional data are collected from industry sources such as ISRI and AMRA. This information is compiled into a data base in order to determine the percent of the waste streams recycled.

Data Characteristics

The solid waste disposal and recycling data (which equates to total generation rates) are compiled annually by the Division of Solid and Hazardous Waste, Bureau of Recycling and Planning. These data are available on the NJDEP web page (http://www.state.nj.us/dep/recycle). Information concerning these data can be obtained by writing or calling the Bureau of Recycling and Planning at 401 East Street, P.O. Box 414, Trenton, New Jersey 08625; (609) 984-3438.

Data Strengths and Limitations

Solid waste facilities are required to report data as a part of their operating permits. Municipalities are required to report recycling data on an annual basis through provisions of the 1987 "New Jersey Statewide Mandatory Source Separation and Recycling Act." The Act also contains provisions for the distribution of approximately $5 million annually as grants to the municipalities for documented recycling activities, based on those reports. In 1996, the funding mechanism for the grants sunsetted, although the annual reporting requirements remained. However, since for many years there was the expectation of grant funding upon submittal of recycling data, many municipalities have either not reported at all or filed incomplete reports once that grant funding expired.

The Department has been moving, through the regulatory process and by voluntary agreements, to supplement, or in some cases to replace, the reporting of recycling tonnages by municipalities. Since the municipalities have historically marketed their recyclable materials locally or regionally, these markets (primarily Class A, B, and C recycling centers) have recently been either called upon (through voluntary agreements) or required (through regulations) to report, on an annual basis, those tonnages of recyclable materials brought to them by various municipalities.

Discussion

The state's 1997 overall recycling numbers continue to indicate increased recycling, however, not all materials monitored by the Department showed an increase. In 1997, the state recycled over 10.2 million tons of solid waste, resulting in a total recycling rate of 60.8% and a municipal solid waste recycling rate of 42.8%. The national average recycling rate for municipal solid waste is reported to be approximately 27%. To maintain and increase the recycling rates achieved in 1997, the Department implemented its first-ever outreach campaign in movie theatres statewide. The campaign congratulated citizens for participating in recycling efforts and encouraged them to purchase recycled products. The outreach program was seen by an estimated 3 million people. Also, the

Department, in conjunction with Rutgers University, developed and distributed a manual entitled "Practical Recycling Economics: Making the numbers work for your program". The manual is intended to provide practical tools for municipal officials to understand, evaluate and reduce the cost associated with curbside recycling services.

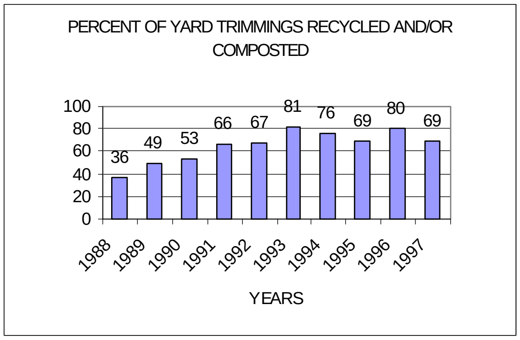
Milestone: By the year 2000, recycling and/or composting rates of 90% or greater of the yard trimmings will be achieved and maintained thereafter.

Indicator: Percent of Yard Trimmings Recycled and/or Composted.

Type of Indicator: Response

New Jersey achieved a recycling and/or composting rate of 69.06% of the yard trimmings in 1997. These data indicate that the percent of yard trimmings recycled and/or composted in 1997 declined 10.8% from the previous year.

Year	**%Yard Trimmings** Recycled
1988	36.0
1989	49.0
1990	53.0
1991	66.0
1992	67.0
1993	81.0
1994	76.4
1995	69.5
1996	79.9
1997	69.1



Data Description

Each municipality in New Jersey participates in the submission of annual recycling tonnage reports pursuant to the Recycling Tonnage Program. Recycling centers Classes A, B, C, and D (Class A centers recycle traditional materials such as glass, aluminum and paper; Class B centers recycle non-traditional materials such as construction and demolition wastes; Class C centers recycle compostable materials; and, Class D centers recycle universal wastes such as used oil.) submit annual reports of operations. Scrap metal shredding facilities submit biannual recycling tonnage reports. Additional data are collected from industry sources such as ISRI and AMRA. This information is compiled into a database in order to determine the percent of construction and demolition waste materials recycled.

Data Characteristics

The solid waste generation and recycling data are compiled annually by the Division of Solid and Hazardous Waste, Bureau of Recycling and Planning. These data are available on the NJDEP web page (http://www.state.nj.us/dep/recycle). Information concerning this data can be obtained by writing or calling the Bureau of Recycling and Planning at 401 East Street, P.O. Box 414, Trenton, New Jersey 08625; (609) 984-3438.

Data Strengths and Limitations

Solid waste facilities are required to report data as a part of their operating permits. Municipalities are required to report recycling data on an annual basis through provisions of the 1987 "New Jersey Statewide Mandatory Source Separation and Recycling Act." The Act also contains provisions for the distribution of approximately $5 million annually as grants to the municipalities for documented recycling activities, based on those reports. In 1996, the funding mechanism for the grants sunsetted, although the annual reporting requirements remained. However, since for many years there was the expectation of grant funding upon submittal of recycling data, many municipalities have either not reported at all or filed incomplete reports once that grant funding expired.

The Department has been moving, through the regulatory process and by voluntary agreements, to supplement, or in some cases to replace, the reporting of recycling tonnages by municipalities. Since the municipalities have historically marketed their recyclable materials locally or regionally, these markets (primarily Class A, B, and C recycling centers) have recently been either called upon (through voluntary agreements) or required (through regulations) to report, on an annual basis, those tonnages of recyclable materials brought to them by various municipalities.

Discussion

As noted above, these data indicate that the percent of yard trimmings recycled and/or composted in 1997 declined 10% to a 69.1% recycling rate from the previous year. This decline may be a result of fewer municipalities reporting recycling data to the state which, as noted above, is being addressed by the Department.

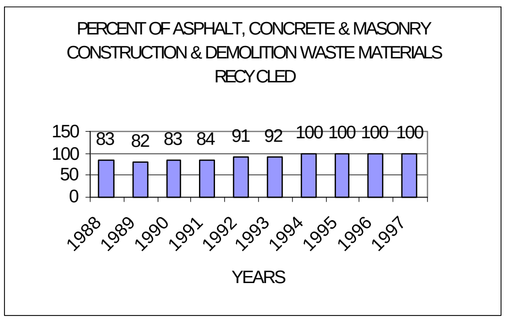
Milestone: By the year 2000, recycling rates of 50% of the asphalt, concrete and masonry portion of the construction and demolition waste stream will be achieved and maintained thereafter.

Indicator: Percent of Asphalt, Concrete and Masonry Construction and Demolition Waste Materials Recycled

Type of Indicator: Response

New Jersey maintained a recycling rate of 100% of the asphalt, concrete and masonry construction and demolition waste materials in 1997.

Year	% Asphalt, Concrete and Masonry Construction and Demolition Waste Recycled
1988	83
1989	82
1990	83
1991	84
1992	91
1993	92
1996	100
1995	100
1996	100
1997	100



Data Description

Each municipality in New Jersey participates in the submission of annual recycling tonnage reports pursuant to the Recycling Tonnage Program. Recycling centers Classes A, B, C, and D submit annual reports of operations (Class A centers recycle traditional materials such as glass, aluminum and paper; Class B centers recycle non-traditional materials such as construction and demolition wastes; Class C centers recycle compostable materials; and, Class D centers recycle universal wastes such as used oil).

Scrap metal shredding facilities submit biannual recycling tonnage reports. Additional data are collected from industry sources, such as ISRI and AMRA. This information is compiled into a database in order to determine the percent of construction and demolition waste materials recycled.

Data Characteristics

The solid waste generation and recycling data are compiled annually by the Division of Solid and Hazardous, Bureau of Recycling and Planning. These data are available on the NJDEP web page (http://www.state.nj.us/dep/recycle). Information concerning these data can be obtained by writing or calling the Bureau of Recycling and Planning at 401 East State Street, P.O. Box 414, Trenton, New Jersey 08625; (609) 984-3438.

Data Strengths and Limitations

Solid waste facilities are required to report data as a part of their operating permits. Municipalities are required to report recycling data on an annual basis through provisions of the 1987 "New Jersey Statewide Mandatory Source Separation and Recycling Act." The Act also contains provisions for the distribution of approximately $5 million annually as grants to the municipalities for documented recycling activities, based on those reports. In 1996, the funding mechanism for the grants sunsetted, although the annual reporting requirements remained. However, since for many years there was the expectation of grant funding upon submittal of recycling data, many municipalities have either not reported at all or filed incomplete reports once that grant funding expired.

The Department has been moving, through the regulatory process and by voluntary agreements, to supplement, or in some cases to replace, the reporting of recycling tonnages by municipalities. Since the municipalities have historically marketed their recyclable materials locally or regionally, these markets (primarily Class A, B, and C recycling centers) have recently been either called upon (through voluntary agreements) or required (through regulations) to report, on an annual basis, those tonnages of recyclable materials brought to them by various municipalities.

Discussion

In 1997, for the fourth year in a row, New Jersey reported a 100% recycling rate for asphalt, concrete and masonry construction and demolition waste materials. If the current trend in the recycling of the asphalt, concrete and masonry portion of the construction and demolition waste stream continues, the Department may report on other portions of this waste stream in future reports.

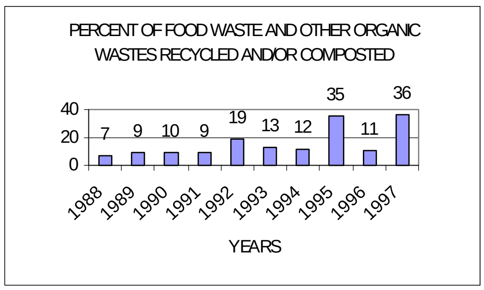
Milestone: By the year 2000, recycling and/or composting rates of 50% of the food waste and other organic wastes will be achieved and maintained thereafter.

Indicator: Percent of Food Waste and Other Organic Wastes Recycled and/or Composted

Type of Indicator: Response

New Jersey achieved a recycling and/or composting rate of 36.4% of the food waste and other organic wastes in 1997.

Year	% Food Waste Recycled And/or Composted
1988	7.0
1989	9.0
1990	10.0
1991	9.0
1992	19.0
1993	13.0
1994	11.5
1995	35.2
1996	11.0
1997	36.4



Data Description

Each municipality in New Jersey participates in the submission of annual recycling tonnage reports pursuant to the Recycling Tonnage Program. Recycling centers Classes A, B, C, and D submit annual reports of operations (Class A centers recycle traditional materials such as glass, aluminum and paper; Class B centers recycle non-traditional materials such as construction and demolition wastes; Class C centers recycle compostable materials; and, Class D centers recycle universal wastes such as used oil).

Data Characteristics

The solid waste generation and recycling data are compiled annually by the Division of Solid and Hazardous Waste, Bureau of Recycling and Planning. These data are available on the NJDEP web page (http://www.state.nj.us/dep/recycle). Information concerning these data can be obtained by writing or calling the Bureau of Recycling and Planning at 401 East Street, P.O. Box 414, Trenton, New Jersey 08625; (609) 984-3438.

Data Strengths and Limitations

Solid waste facilities are required to report data monthly as a part of their operating permits. Municipalities are required to report recycling data on an annual basis through provisions of the 1987 "New Jersey Statewide Mandatory Source Separation and Recycling Act." The Act also contains provisions for the distribution of approximately $5 million annually as grants to the municipalities for documented recycling activities, based on those reports. In 1996, the funding mechanism for the grants sunsetted, although the annual reporting requirements remained. However, since for many years there was the expectation of grant funding upon submittal of recycling data, many municipalities have either not reported at all or filed incomplete reports once that grant funding expired.

The Department has been moving, through the regulatory process and by voluntary agreements, to supplement, or in some cases to replace, the reporting of recycling tonnages by municipalities. Since the municipalities have historically marketed their recyclable materials locally or regionally, these markets (primarily Class A, B, and C recycling centers) have recently been either called upon (through voluntary agreements) or required (through regulations) to report, on an annual basis, those tonnages of recyclable materials brought to them by various municipalities.

Discussion

The data indicate that in 1997 New Jersey experienced a 25% increase in the percent of food waste recycled compared to the previous year. However, as the data indicate, the food waste recycling market has been fluctuating in recent years. This may be due to the lack of commercial food waste composting facilities. The single largest market for recycled food waste are the swine producers in Gloucester County. Data collection from this sector has been problematic, however the Department is attempting to address this reporting problem.

PESTICIDES

Introduction

The use of pesticides (a generic term that encompasses insecticides, herbicides, fungicides, etc.) is a particularly complex issue in New Jersey. While pesticides are recognized as a legal means of controlling pests, their use also represents the introduction of hazardous and potentially harmful materials into the environment. This is significantly different from other environmental situations where the material may be viewed solely as a pollutant. New Jersey, being the most densely populated state in the nation, has many different patterns of pesticide use in close proximity to each other. Agricultural fields, formerly surrounded by other agricultural fields, are now surrounded by housing developments. Golf courses are built on former agricultural lands or are adjacent to wetlands. Homeowners attempt to maintain their lawns while their neighbors may object to unwanted exposure to pesticides. Indoor and structural pest control is also a major factor in New Jersey.

The use of pesticides affects nearly every New Jersey citizen. Pesticides are used in the control of pests in many different settings: food production and storage, turf and landscaping, and structural protection. All of these situations create a need that the risks and benefits related to pesticides be placed in balance. The NJDEP has sought, through its efforts, to ensure that those who choose to apply pesticides do so in a safe and proper manner, thereby minimizing pesticide exposure for the public and environment and reducing the potential for adverse impacts from pesticide use.

The cornerstone of these efforts is the adoption and implementation of Integrated Pest Management (IPM) methods. The IPM approach calls for a systematic hierarchy of control measures with pesticide use, when other methods (physical, cultural, etc.) prove inadequate, for acceptable control of the pest. This approach provides the potential for significant use reduction and associated potential exposure reduction resulting in an overall reduced risk. IPM does not call for the elimination of pesticides but places them within an overall framework of pest control. When the decision to use pesticides is made, the pesticides with the least harmful impact on humans and the environment should be employed.

Present pesticide indicators use the data collected by the NJDEP Pesticide Use Survey process. These surveys, which encompass 100% of the registered pesticide users in New Jersey (excluding only homeowners), provide the starting point for both the assessment of risk and the determination of impact. These data are specific for New Jersey and represent New Jersey citizens' response to the situations and pest pressures surrounding them.

Agricultural pesticide use represents approximately 60% of pesticide use in New Jersey. The data obtained since 1985 from New Jersey growers indicate a downward trend of pesticide use. While this trend is encouraging, it cannot be directly attributed to factors such as an increase of IPM. New Jersey is constantly undergoing development and the reduction of farmland may lead to a decrease of statewide pesticide use. The use of newer pesticides, requiring less applied amounts to perform the same standard of control as older pesticides, is another factor not taken into consideration with this indicator.

Exterior pesticide use (including lawn care, mosquito control, golf course, and right-of-way pesticide use) accounts for 30% of pesticide use. The baseline data for this indicator are also presented. Another 10% of New Jersey pesticide use is represented by indoor pesticide and termiticide use around homes and offices; an indicator for this issue is under development.

The “higher risk” indicator evaluates progress towards the IPM milestone through measuring the use of pesticides in New Jersey agriculture, which is considered to pose a “higher risk” to human and environmental health. The data incorporated include the total amount of “higher risk” pesticides applied as categorized by EPA. These include significant risks to human and environmental health including carcinogenicity, high acute toxicity, and ground water-leaching potential. While there is a reduction in the use of these “higher risk” pesticides, it is mostly due to the restriction and/or elimination of the highly acute toxic pesticides. More work needs to be done in the identification and use of alternatives to the “higher risk” pesticides.

A condition indicator is in place that examines a yearly tally of pesticide detections from the NJDEP/ Pesticide Control Program (PCP) ground water monitoring well network. As effective IPM programs become more widely practiced in all areas of pesticide use, a decrease of detections should be observed over time since non-ground water leachers should be chosen versus known leachers. The initial network consists of 13 monitoring wells. The New Jersey Private Pesticide Survey, completed every three years by growers, was the primary factor in deciding where the ground water monitoring wells would be installed. Over time, more wells will be added to reach a statewide network of 200 wells. Existing NJDEP wells will be examined for candidates for inclusion in the pesticide-monitoring network.

As stated earlier, effective pesticide regulation consists of balancing risks and benefits. The NJDEP is committed to expanding its efforts. Programs are in place to examine pesticide residues in New Jersey-grown produce, monitor for pesticide residues in surface water and protect farmworkers from adverse impacts of pesticides. As these and other projects provide data, appropriate indicators will be developed to measure the environmental progress.

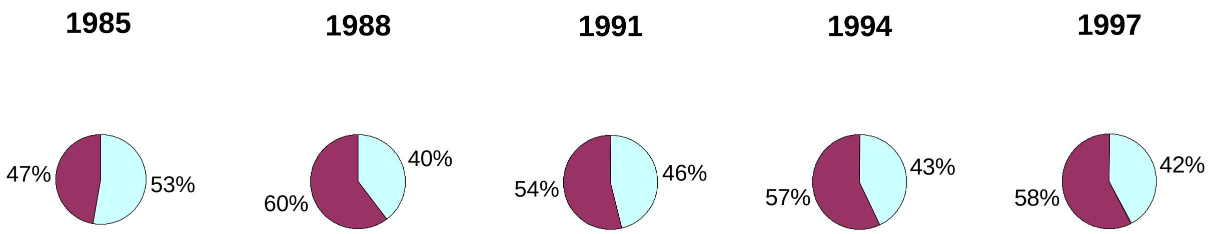
Milestone: By 2005, all pesticide applicators will use Integrated Pest Management (IPM) techniques.

Indicator: "Higher Risk" Pesticide Use

Type of Indicator: Cause

This indicator evaluates progress towards the IPM milestone through measuring the use of pesticides in New Jersey agriculture considered to pose a "higher risk" (HR) to human and environmental health. The data incorporated include the total amount of "higher risk" pesticides applied in agriculture by licensed applicators. These data are obtained from the PCP's pesticide use survey procedure.

HR pesticide totals within the total of pesticides used in agriculture, according to the PCP's use surveys, are indicated as follows (HR compounds are represented with the lighter shade):



The compounds considered HR pesticides for the purposes of this indicator and their amounts (in pounds active ingredient), as they appear in the surveys, are listed below. For type, H = herbicide, I = insecticide, F = fungicide, and GI = growth inhibitor.

	Type	1985	1988	1991	1994	1997
Acetochlor	H	0	0	0	2723	46171
Acifluorfen	H	3123	2961	3681	4080	2688
Alachlor	H	84462	49050	35323	48945	30143
Aldicarb	I	3589	3403	6	0	0
Amitrole	H	10	8	0	0	0
Atrazine	H	58857	45812	57128	58790	45700
Azinphos-methyl	I	32290	26034	24534	22609	20559
Bendiocarb	I	57	90	98	94	13
Bifenthrin	I	0	32	107	56	88
Bromacil	H	9	2	21	0	0
Captafol	F	23376	8709	231	0	10
Captan	F	60709	63943	113392	84209	74510
Carbofuran	I	33492	29954	19956	10353	6930
Carbophenothion	I	3	0	0	0	0
Chloramben	H	4235	5926	1063	69	0
Chlorethoxyfos	I	0	0	0	0	508

Chlorothalonil	F	24084	40723	90829	92404	82403
Clopyralid	H	0	0	0	0	5
Coumaphos	I	0	0	4	0	0
Cyanazine	H	24545	17143	21374	18233	20551
Cyhalothrin	I	0	0	0	0	0
Cyproconazole	F	0	0	0	0	0
Dalapon	H	17	8	0	0	0
Daminozide	GI	1115	1783	384	427	822
DCPA (metabolites)	H	15554	20656	24968	24376	18475
Dicamba	H	2910	4331	3990	5723	5121
Dichloropropene	I	2255	0	25106	0	0
Dichlorvos	I	440	28	7	11	8
Dinoseb	H	11580	540	0	0	0
Disulfoton	I	333	274	2047	1112	600
Endosulfan	I	40032	18227	14434	9172	7362
Endothall	H	1	0	0	0	0
Ethion	I	3696	114	0	1	2
Ethoprop	I	0	808	105	296	554
Etridazole	F	265	471	1794	360	665
Fenaminosulf	F	155	1541	0	0	0
Fenamiphos	I	725	501	91	1224	640
Fensulfothion	I	3099	4437	0	0	0
Flucythrinate	I	0	1	0	0	0
Folpet	F	1521	221	8	0	0
Fomesafen	H	0	0	0	508	2670
Fonofos	I	2528	1551	1160	1400	2546
Formetanate	I	1494	1239	1586	680	298
Hexazinone	H	676	755	498	487	392
Imazaquin	H	100	1476	1600	2642	565
Imazethapyr	H	2	61	419	612	784
Isazofos	I	0	0	1477	453	117
Isofenphos	I	562	1084	73	12	2
Lactofen	H	0	402	106	133	569
Lead Arsenate	I	32	0	0	0	0
Lindane	I	333	336	253	4095	206
Linuron	H	42615	28191	31155	24132	7312
Mancozeb	F	90542	79473	27620	53649	52808
Metalaxyl	F	7411	10385	21312	15160	9974
Methamidophos	I	3615	5862	1796	0	209
Methiocarb	I	97	40	16	8	30
Methomyl	I	42293	24683	29331	28089	18161
Metiram	F	17612	21460	1007	2866	2961
Metolachlor	H	72691	98379	144418	137387	116167
Metribuzin	H	2167	3549	3020	9182	2344
Metsulfuron	H	0	0	0	0	4
Mevinphos	I	2507	5151	3085	1364	0
Mexacarbate	I	12	3	0	1	0
Naled	I	20	11	0	0	269
Nicotine	I	401	26	45	11	24
Oxamyl	I	20179	13084	14157	6954	2427
Parathion	I	49575	30784	15633	13	0
Parathion-methyl	I	4681	4945	4849	6635	2018
Phorate	I	987	6889	1600	901	625
Phosphamidon	I	1361	243	244	5	2
Picloram	H	7	0	1	1	5

Prometon	H	267	92	24	85	56
Propargite	I	91	943	1271	389	4
Propoxur	I	0	0	1	10	1
Simazine	H	8866	3311	4691	5846	7346
Tebuthiuron	H	0	5	13	1	0
Terbacil	H	3450	13193	4585	2318	2213
Terbufos	I	9042	4906	4424	4023	6663
Triclopyr	H	0	3	45	19	32
TOTAL HRs:		822755	710246	762196	695338	604332
TOTAL Others:		734424	1072935	886930	918531	827674
TOTAL YEAR:		1557179	1783181	1649126	1613869	1432006

Data Description

This indicator is a measure of the proportion of higher risk pesticides in relation to the total amount of all agricultural pesticides applied in a particular year. For the purposes of this indicator, higher risk pesticides include those pesticides classified as A or B carcinogens, classified as Toxicity Class I, and/or considered a potential threat to groundwater. Proportion percentages will indicate an increase, decrease or little change of higher risk pesticide use over the course of time (the survey is conducted every three years.) IPM typically results in decreased use of the more hazardous pesticides.

This indicator is not a measure of potential risk to human health.

Data Characteristics

For the purposes of reports and this indicator, pesticide amounts indicated are in terms of active ingredient converted from the applicators' reported raw amounts. When the pesticide use surveys are conducted, applicators report their amounts used in "raw" numbers from the can or bag. A pesticide product, however, contains anywhere from 0.01 - 100% of active ingredient. An applicator using 400 pounds of material in a season may only be putting down 100 pounds of active ingredient.

Data Strengths and Weaknesses

The PCP's pesticide use surveys represent a use census rather than a probabilistic survey due to the fact that they are backed by regulations and therefore present a more complete picture than voluntary surveys. This regulatory authority provides an accuracy and level of response that is difficult to duplicate in a voluntary survey. A 90% return rate is targeted for all surveys with most surveys coming in between 91-95%. These numbers are more than sufficient to get an overview of the big picture concerning pesticide use in New Jersey.

A weakness of this indicator could be the EPA carcinogen classification scheme. There are many new (and some older) pesticides that have not been adequately tested and are therefore put into Group D. D-classified pesticides could move to another group within a month or a few years depending upon when these tests are concluded. B- and C-classified compounds could also be assigned a new rank over time with further laboratory trials, however this is more unlikely. For the purposes of this indicator, compounds included as higher risk were classified A or B as of the development of the indicator.

A second weakness of this indicator could conceivably be the selection of pesticides considered highly toxic. Setting the mark at 100 mg/kg or less is arbitrary – compounds with higher LD50s could also be considered highly toxic. Here, too, the focus is on laboratory animals (rats). This indicator does not provide any information regarding toxic effects on humans or wildlife.

A third weakness of this indicator could be the selection of pesticides considered to be ground water leachers. Concerning the list selected for this indicator, most sources agree the pesticides represented are known or potential ground water leachers. Other compounds are rated differently according to what source is referenced. For the purposes of this indicator, the two main references used were the US Environmental Protection Agency and the US Soil Conservation Service. If both sources agreed a compound showed a high potential to leach, that compound was included on the HR list.

Regardless of all the weaknesses listed above, however, a strength of this indicator is its direct association with documented scientific studies and EPA's evaluation process.

Discussion

Pesticide use in New Jersey agriculture represents about 60% of all pesticide use in the state. The term "agriculture" refers to the farming of food crops, sod and ornamental flora. Greenhouse and nursery pesticide use is also included in the agriculture group.

Agricultural pesticide information is collected every three years by the Pesticide Control Program through a pesticide use survey. These surveys are performed under the authority of the New Jersey Pesticide Control Code, N.J.A.C. 7:30-10.8, requiring applicators to submit use records to the state when requested. All records submitted include general and restricted use pesticides. The first survey conducted was for 1985 agricultural pesticide use. Four have followed since then – 1988, 1991, 1994 and 1997.

An average of 200 chemical compounds make up the various pesticide types used from year to year to control pests in New Jersey agriculture. Pesticide types include herbicides, insecticides, fungicides, growth inhibitors, fumigants, bactericides, rodenticides and miscellaneous compounds such as synergists. Possible detrimental risks to human and environmental health, including carcinogenicity, toxicity, and ground water leaching potential, are connected with this wide variety of compounds. The pesticides exhibiting a higher risk in at least one of these areas are included in this indicator.

<u>Carcinogenicity:</u>

Some of these chemical compounds used for pest control have been shown to cause cancer in laboratory animals. The EPA has developed a chemical classification scheme based on carcinogenic potential as follows:

Group A: Human carcinogen – sufficient evidence in epidemiology studies to support causal association between exposure and cancer

Group B: Probable human carcinogen – limited evidence in epidemiologic studies (Group B1) and/or sufficient evidence from animal studies (Group B2)

Group C: Possible human carcinogen – limited evidence from animal studies and inadequate or no data in humans

Group D: Not classifiable – inadequate or no human and animal evidence of carcinogenicity

Group E: No evidence of carcinogenicity for humans – no evidence of carcinogenicity in at least two adequate animal tests in different species or inadequate epidemiologic and animal studies.

For the purposes of this indicator, pesticides classified as Group A or B are included on the HR list. Pesticides falling into Group A are no longer in use and have not been since the mid-1980s (the last A-classified compound to appear in the surveys was lead arsenate in 1985.) Pesticides falling into Group B are still in use. In a few instances it is not the parent compound but a metabolite of the parent that is responsible for that chemical's B classification. B-classified pesticides do represent a risk to human health due to their carcinogenic potential and their routine use on food crops in agriculture.

<u>Toxicity</u>:

Exposure to pesticides considered highly poisonous can result in sickness or even death. Proper precautions in the handling of pesticides with a high acute toxicity usually prevent damaging exposures. Accidental exposures for whatever reason, however, are possible. For the purposes of this indicator, the pesticides included are those with an oral LD50 (rat) of <100 mg/kg AND considered a Toxicity Class I compound by EPA.

Ground Water Leaching Potential:

Some pesticides have the potential to seep into ground water and eventually pollute water supplies. For the purposes of this indicator, the pesticides included are those:

a. identified (since 1985) by the USEPA to have the greatest potential for leaching into and contaminating groundwater, and/or
b. detected in the ground water of multiple states, and/or
c. considered very likely to leach according to their soil half-life, water solubility and sorption coefficient values.

Since 1988 there has been no significant decrease of higher risk pesticide use in New Jersey as compared with the total amount of pesticides used. A significant reduction did occur between 1985-1988, however.

BREAKDOWN OF PESTICIDES BY RISK FACTOR

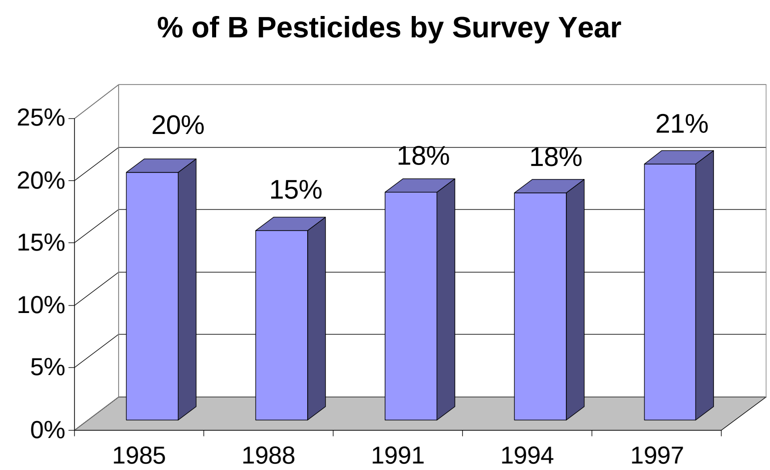
Carcinogenicity:

The B-classified pesticides and their amounts (in pounds active ingredient), as they appear in the surveys, are listed below. Lead arsenate, an A-classified material by the EPA, is included:

		1985	1988	1991	1994	1997
Acetochlor	H	0	0	0	2723	46171
Acifluorfen	H	3123	2961	3681	4080	2688
Alachlor	H	84462	49050	35323	48945	30143
Amitrole	H	10	8	0	0	0
Captafol	F	23376	8709	231	0	10
Captan	F	60709	63943	113392	84209	74510
Chlorothalonil	F	24084	40723	90829	92404	82403
Cyproconazole	F	0	0	0	0	0
Daminozide	GI	1115	1783	384	427	822
Dichloropropene	I	2255	0	25106	0	0
Etridazole	F	265	471	1794	360	665
Folpet	F	1521	221	8	0	0
Lactofen	H	0	402	106	133	569
Lead Arsenate	I	32	0	0	0	0
Lindane	I	333	336	253	4095	206
Mancozeb	F	90542	79473	27620	53649	52808
Metiram	F	17612	21460	1007	2866	2961
Propargite	I	91	943	1271	389	4
Propoxur	I	0	0	1	10	1
TOTAL:		309530	270483	301006	294290	293960
ALL OTHERS:		1247649	1512698	1348120	1319579	1138046
TOTAL P USE:		1557179	1783181	1649126	1613869	1432006

Since 1985, there has been no significant decrease of B-classified pesticide use in New Jersey as compared with the total amount of pesticides used. This is due to the significant increase in use of captan and chlorothalonil while other pesticides show use decrease. Adequate replacements need to be identified and adopted by agricultural users.

B-classified pesticide percentage totals within the total of pesticides used in agriculture, according to the Pesticide Control Program's use surveys, are indicated as follows:



Toxicity:

The highly toxic pesticides and their amounts (in pounds active ingredient), as they appear in the surveys, are listed below:

		1985	1988	1991	1994	1997
Aldicarb	I	3589	3403	6	0	0
Azinphos-methyl	I	32290	26034	24534	22609	20559
Bendiocarb	I	57	90	98	94	13
Bifenthrin	I	0	32	107	56	88
Carbofuran	I	33492	29954	19956	10353	6930
Carbophenothion	I	3	0	0	0	0
Chlorethoxyfos	I	0	0	0	0	508
Coumaphos	I	0	0	4	0	0
Cyhalothrin	I	0	0	0	0	0
Dichlorvos	I	440	28	7	11	8
Dinoseb	H	11580	540	0	0	0
Disulfoton	I	333	274	2047	1112	600
Endosulfan	I	40032	18227	14434	9172	7362
Endothall	H	1	0	0	0	0
Ethion	I	3696	114	0	1	2
Ethoprop	I	0	808	105	296	554
Fenaminosulf	F	155	1541	0	0	0
Fenamiphos	I	725	501	91	1224	640
Fensulfothion	I	3099	4437	0	0	0
Flucythrinate	I	0	1	0	0	0
Fonofos	I	2528	1551	1160	1400	2546
Formetanate	I	1494	1239	1586	680	298
Isazofos	I	0	0	1477	453	117
Isofenphos	I	562	1084	73	12	2
Lactofen	H	0	402	106	133	569
Lead Arsenate	I	32	0	0	0	0
Methamidophos	I	3615	5862	1796	0	209
Methiocarb	I	97	40	16	8	30
Methomyl	I	42293	24683	29331	28089	18161
Mevinphos	I	2507	5151	3085	1364	0

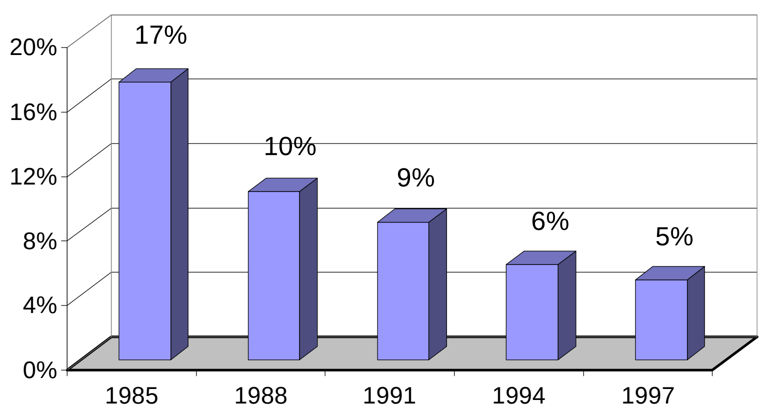
Mexacarbate	I	12	3	0	1	0
Naled	I	20	11	0	0	269
Nicotine	I	401	26	45	11	24
Oxamyl	I	20179	13084	14157	6954	2427
Parathion	I	49575	30784	15633	13	0
Parathion-methyl	I	4681	4945	4849	6635	2018
Phorate	I	987	6889	1600	901	625
Phosphamidon	I	1361	243	244	5	2
Terbufos	I	9042	4906	4424	4023	6663

Dinoseb, endothal and lactofen are the only herbicides represented in this indicator and fenaminosulf is the only fungicide. All the other compounds included in the chart are insecticides. Fumigants were not included since they are used in enclosed, sealed areas.

Since 1985, there has been a significant decrease of pesticides showing high toxicity. This is due to a reduction in use or an elimination of the products containing certain active ingredients on the list. Less acutely toxic alternatives have replaced the more acutely toxic Class I pesticides.

Highly toxic pesticide percentage totals within the total of pesticides used in agriculture, according to the Pesticide Control Program's use surveys, are indicated as follows:

% of High Toxicity Pesticides by Survey Year



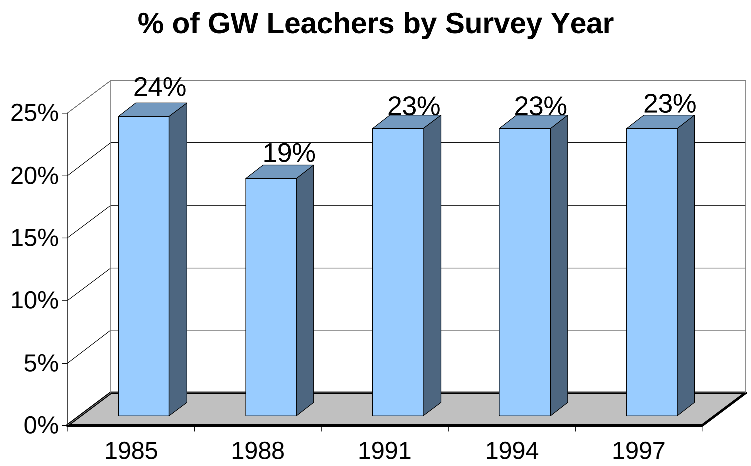
<u>Ground Water Leaching Potential</u>:

The high-potential leaching compounds and their amounts (in pounds active ingredient), as they appear in the surveys, are listed below.

		1985	1988	1991	1994	1997
Acetochlor	H	0	0	0	2723	46171
Alachlor	H	84462	49050	35323	48945	30143
Aldicarb	I	3589	3403	6	0	0
Atrazine	H	58857	45812	57128	58790	45700
Bromacil	H	9	2	21	0	0
Carbofuran	I	33492	29954	19956	10353	6930
Chloramben	H	4235	5926	1063	69	0
Clopyralid	H	0	0	0	0	5
Cyanazine	H	24545	17143	21374	18233	20551
Dalapon	H	17	8	0	0	0
DCPA (metabolites)	H	15554	20656	24968	24376	18475
Dicamba	H	2910	4331	3990	5723	5121
Dinoseb	H	11580	540	0	0	0
Fomesafen	H	0	0	0	508	2670
Hexazinone	H	676	755	498	487	392
Imazaquin	H	100	1476	1600	2642	565
Imazethapyr	H	2	61	419	612	784
Linuron	H	42615	28191	31155	24132	7312
Metalaxyl	F	7411	10385	21312	15160	9974
Metolachlor	H	72691	98379	144418	137387	116167
Metribuzin	H	2167	3549	3020	9182	2344
Metsulfuron	H	0	0	0	0	4
Picloram	H	7	0	1	1	5
Prometon	H	267	92	24	85	56
Simazine	H	8866	3311	4691	5846	7346
Tebuthiuron	H	0	5	13	1	0
Terbacil	H	3450	13193	4585	2318	2213
Triclopyr	H	0	3	45	19	32
TOTAL GWs:		377502	336225	375610	367592	322960
TOTAL OTHER:		1179677	1446956	1273516	1246277	1109046
TOTAL ALL:		1557179	1783181	1649126	1613869	1432006

Since 1985, there has been no significant overall decrease of pesticides with a strong potential to leach in New Jersey. This is due in part to an increased use of identified GW leachers as replacements for other GW leachers. Adequate replacement pesticides need to be identified and adopted by the agricultural community. Herbicides easily dominate the use of leachable pesticides.

Ground water leacher pesticide percentage totals within the total of pesticides used in agriculture, according to the Pesticide Control Program's use surveys, are indicated as follows:



% of GW Leachers by Survey Year
25%
20%
15%
10%
5%
0%
24%
19%
23%
23%
23%
1985
1988
1991
1994
1997

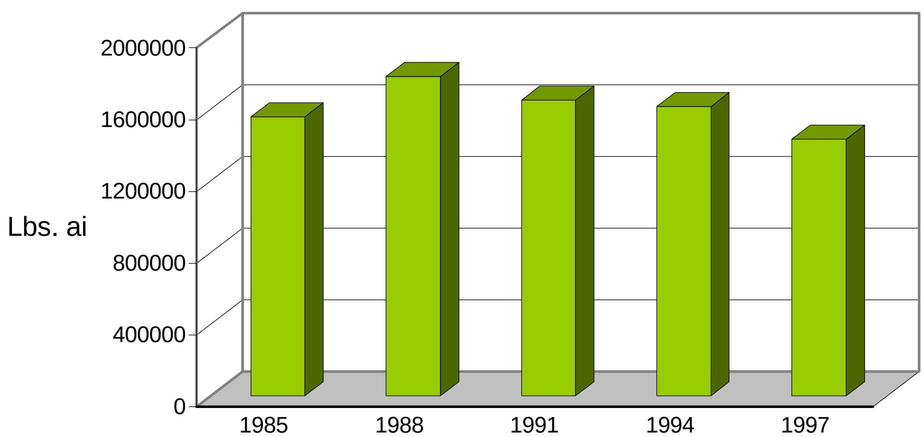
Milestone: By 2005, all pesticide applicators will use Integrated Pest Management (IPM) techniques to help reduce overall pesticide use and risk.

Indicator: Agricultural Pesticide Use

Type of Indicator: Cause

This indicator evaluates progress towards the IPM milestone through measuring the total use of pesticides in New Jersey agriculture. The data incorporated include the total amount of pesticides used in agriculture by licensed applicators. These data are obtained from the PCP's pesticide use survey procedure.

Total Pesticide Amounts - Agricultural Use Survey



Agricultural Pesticide Use by lbs. of Active Ingredient

1985	1988	1991	1994	1997
1,557,179	1,783,181	1,649,126	1,613,869	1,432,006

Data Description

This indicator measures the total agricultural pesticide use from survey years. Amounts will indicate an increase, decrease or little change of pesticides used over the course of time (the survey is conducted every three years.) IPM typically results in decreased use of pesticides.

This indicator is not a measure of potential risk to human or environmental health as there are other factors at work in those scenarios.

Data Characteristics

For the purposes of reports and this indicator, pesticide amounts indicated are the amounts of active ingredient, which are converted from the applicators' reported raw amounts. When the pesticide use surveys are conducted, applicators report their amounts used in "raw" numbers from the can or bag. A pesticide product, however, contains anywhere from 0.01 - 100% of active ingredient. An applicator using 400 pounds of material in a season may only be putting down 100 pounds of active ingredient.

Data Strengths and Weaknesses

The Pesticide Control Program's pesticide use surveys represent a use census rather than a probabilistic survey due to the fact that they are backed by regulations and therefore present a more complete picture than voluntary surveys. This regulatory authority provides an accuracy and level of response that is difficult to duplicate in a voluntary survey. A 90% return rate is targeted for all surveys with most surveys coming in between 91-95%. These numbers are more than sufficient to get an overview of the total picture concerning pesticide use in New Jersey.

A weakness of this indicator is its inherent broadness. A downward trend of pesticide use, if seen over the years, cannot be solely attributed to an increase of IPM. New Jersey is constantly undergoing development and the reduction of farmland may lead to a decrease of statewide pesticide use. Newer pesticides requiring less applied amounts to perform the same standard of control as older pesticides is another factor not taken into consideration with this indicator.

Discussion

Pesticide use in New Jersey agriculture represents about 60% of all pesticide use in the state. The term "agriculture" refers to the farming of food crops and ornamental flora. Greenhouse and nursery pesticide use is also included in the agriculture group.

The Pesticide Control Program, through a pesticide use survey, collects agricultural pesticide information every three years. These surveys are performed under the authority of the New Jersey Pesticide Control Code, N.J.A.C. 7:30-10.8, requiring applicators to submit use records to the state when requested. All records submitted include general and restricted use pesticides. The first survey conducted was for 1985 agricultural pesticide use. Four have followed since then at the time of this writing – 1988, 1991, 1994 and 1997.

An average of 200 chemical compounds make up the various pesticides used from year to year to control pests in New Jersey agriculture. Pesticide types include herbicides, insecticides, fungicides, growth inhibitors, fumigants, bactericides, rodenticides and miscellaneous compounds such as synergists. Possible detrimental human and environmental health effects are connected with this variety of compounds. Carcinogenicity is the greatest public concern associated with pesticides. Some of these chemical compounds used for pest control have been shown to cause cancer in laboratory animals. Another concern is the possibility of sickness or even death of persons when exposed to those pesticides considered highly poisonous. Proper precautions in the handling of pesticides with a high acute toxicity usually prevent damaging exposures. Accidental exposures for whatever reason, however, are possible. A third public fear is the possibility of pesticides seeping into ground water and eventually polluting water supplies.

What commodities are receiving what pesticide applications is part of the surveys. Below is a list of commodities appearing in the agricultural pesticide use survey. 1985 has been omitted due to the broadness of that survey's commodity list (for example, there were no individual vegetable grouping like peppers, eggplants and beans/peas; only "vegetable".) The 1988 and 1991 commodity lists varied somewhat from the 1994 and 1997, but are still comparable on a year to year basis.

The category "no code" seems to be growing from year to year. Many ubiquitous crops grown by NJ farmers do not show up on the survey (carrots, onions, melons, etc.) and the applicators are instructed to write in "other not listed." These are valid no codes. Other growers, however, neglect to include the treated commodity. As of the 1997 survey, these will be passed on to the PCP's compliance section.

Pesticide Use by Commodity, according to Survey Year

CROP	1988	1991	1994	1997
Apples	212485	151840	167590	104314
Peaches	533315	430607	268601	301334
Other Tree Fruit	9576	3156	6216	7362
Blueberries	44858	61999	80525	62984
Cranberries	27150	63931	56992	69396
Strawberries	5865	7412	4936	4821
Grapes	3678	1881	1499	1458
Sweet Corn	32835	43581	43552	33668
Field Corn	143522	164766	192373	188001
Grains	3973	3973	2758	3193
Soybeans	119317	150552	168908	129356
Beans/Peas	28181	22112	17381	7557
Asparagus	--	2565	3299	3655
Cucumbers	--	22711	20131	29538
Tomatoes	--	80404	60522	44628
Other Solan. Crops	80787	60307	--	--
Vine Crops	39060	--	--	--

Peppers	--	--	50694	61732
Eggplants	--	--	18255	21998
Potatoes	211865	114968	135752	27081
Chinese Veg	--	9416	16132	10289
Cabbage	--	--	15903	8219
Cauliflower	--	--	1204	438
Broccoli	--	--	4555	2108
Brussel Sprouts	--	--	735	1156
Other Cole	42897	22968	15268	2416
Lettuce	--	--	20453	17327
Spinach	--	--	11605	7981
Leafy Green	--	--	7874	10260
Other Leafy	93982	38280	1176	3305
Hay/Alfalfa	--	6289	3954	4853
Sod	20888	19496	13948	13562
Ornamentals	81599	90965	55157	64812
Livestock	29	415	1532	2
NO CODE	6289	74532	144391	183179
TOTAL:	1783181	1649126	1613869	1432006

Amounts are expressed as pounds of active ingredient (a.i.).

Milestone: By 2005, all pesticide applicators will use Integrated Pest Management (IPM) techniques to help reduce overall pesticide use and risk.

Indicator: Exterior Pesticide Use

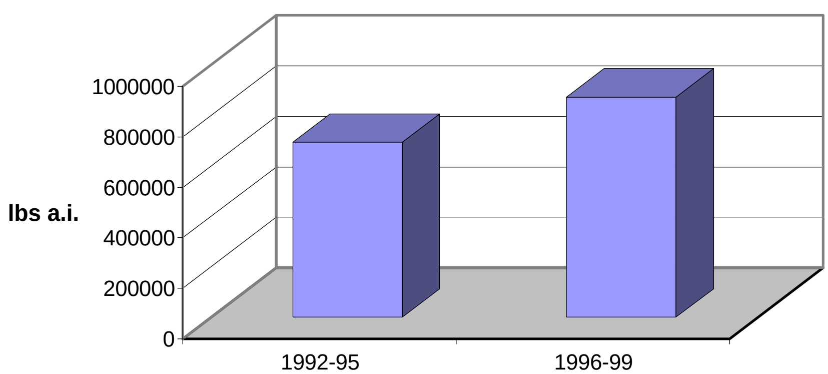
Type of Indicator: Cause

This indicator evaluates progress towards the IPM milestone through measuring the total use of exterior pesticides, other than agriculture, in New Jersey. The data incorporated include the total amount of pesticides applied to exterior sites, excluding agriculture, by licensed applicators, during a specified time. These data are obtained from the PCP's pesticide use survey procedure.

1992-95	1996-00
694,846 lbs. a.i.	873,382 lbs. a.i.
Surveys included: 1992 Right-of-Way 1993 Golf Course 1993 Mosquito 1995 Lawn Care	Surveys included: 1996 Golf Course 1998 Lawn Care 1998 Mosquito 2000 Right-of-Way*

* Information not currently available; use estimated from 1992 survey

Exterior Pesticide Use Totals



Data Description

This indicator estimates the total pesticide use from lawn care, right-of-way, golf course and mosquito control pesticide use in a given span of time. Amounts will indicate an increase, decrease or little change of highly toxic pesticides used over the course of time. IPM typically results in decreased use of pesticides.

This indicator is not a measure of potential risk to human or environmental health as there are other factors at work in those scenarios.

Data Characteristics

For the purposes of reports and this indicator, pesticide amounts indicated are the amounts of active ingredient, which are converted from the applicators' reported raw amounts. When the pesticide use surveys are conducted, applicators report their amounts used in "raw" numbers from the can or bag. A pesticide product, however, contains anywhere from 0.01 - 100% of active ingredient. An applicator using 400 pounds of material in a season may only be putting down 100 pounds of active ingredient.

Data Strengths And Limitations

The Pesticide Control Program's pesticide use surveys represent a use census rather than a probabilistic survey due to the fact that they are backed by regulations and therefore present a more complete picture than voluntary surveys. This regulative authority provides an accuracy and level of response that is difficult to duplicate in a voluntary survey. A 90% return rate is targeted for all surveys with most surveys coming in between 91-95%. These numbers are more than sufficient to get an overview of the total picture concerning pesticide use in New Jersey.

A weakness of this indicator is its inherent broadness. A downward trend of pesticide use, if seen over the years, cannot be solely attributed to an increase of IPM. New Jersey is constantly undergoing development and the reduction of farmland may lead to a decrease of statewide agricultural pesticide use. The reduction of farmland usually is balanced by an increase in housing development. More housing is accompanied by additional infrastructure development such as roads. Minor pest problems may become major in use areas of significant population growth, as is the case with black flies along the Delaware River.

Discussion

Pesticide use in New Jersey agriculture represents about 60% of all pesticide use in the state by licensed applicators. The term "agriculture" refers to the farming of food crops and ornamental flora. Greenhouse and nursery pesticide use is also included in the agriculture group. This information is covered in a separate indicator. Another 10% of New Jersey pesticide use is represented by indoor pesticide and termiticide use around homes and offices. This only includes pesticides applied by licensed applicators – the PCP does not monitor homeowner pesticide use.

The remaining 30% of use is represented in this indicator. This number includes information collected from various use surveys, including lawn care, mosquito control, golf course and right-of-way pesticide use.

The Pesticide Control Program, through pesticide use surveys aimed at specific areas of use, collects pesticide information in various years. These surveys are performed under the authority of the New Jersey Pesticide Control Code, N.J.A.C. 7:30-10.8, requiring applicators to submit use records to the state when requested. All records submitted include general and restricted use pesticides. Currently, the following pesticide use surveys have been conducted:

1990, 1995 Lawn Care
1990, 1993, 1996 Golf Course
1993 Mosquito Control
1992 Right-of-Way

The following surveys are currently planned or in progress:

1998 Lawn Care
1998 Mosquito Control
1999 Right-of-Way

An average of 100 chemical compounds make up the various pesticides used in these four areas of New Jersey pesticide use. Pesticide types include herbicides, insecticides, fungicides, growth inhibitors, fumigants, bactericides, rodenticides and miscellaneous compounds such as synergists. Possible detrimental human and environmental health effects are connected with this variety of compounds. Carcinogenicity is the greatest public concern associated with pesticides. Some of these chemical compounds used for pest control have been shown to cause cancer in laboratory animals. Another concern is the possibility of sickness or even death of persons when exposed to those pesticides considered highly poisonous. Proper precautions in the handling of pesticides with a high acute toxicity usually prevent damaging exposures. Accidental exposures for whatever reason, however, are possible. A third public fear is the possibility of pesticides seeping into ground water and eventually polluting water supplies.

For this indicator, the total pesticide amounts (in pounds active ingredient), as they appear in the various surveys, are grouped into four-year slots. Each slot will contain the results obtained in one lawn care, right-of-way, mosquito control and golf course survey.

Milestone: By 2005, all pesticide applicators will use Integrated Pest Management (IPM) techniques.

Indicator: Pesticide Detections above Response Levels in Ground Water

Type of Indicator:Cause

This indicator evaluates progress towards the IPM milestone through measuring the number of pesticide detections exceeding Pesticide Management Plan (PMP) response levels from the PCP's ground water monitoring wells.

Data Description

This indicator is a yearly tally of pesticide detections from the PCP ground water monitoring well network and a count of how many of those detections exceed the New Jersey PMP (ground water) response levels. As effective IPM programs become more widely practiced in all areas of pesticide use, a decrease of detections exceeding the trigger levels should be observed over time.

This indicator is not a measure of potential risk to human health.

Data Characteristics

All PCP well samples are analyzed at the PCP's pesticide laboratory. Acetochlor, alachlor, atrazine, cyanazine, metolachlor and simazine, all EPA recognized ground water leachers, were the parameters routinely analyzed for – using a gas chromatograph equipped with a nitrogen/phosphorous detector. Samples were also analyzed for non-targeted pesticides using an ion trap gas chromatograph/mass spectrometer.

Data Strengths and Weaknesses

The simplicity of this indicator is probably its greatest asset. More pesticide detections over the years indicate an IPM deficiency in protecting sub-surface aquifers; less detections indicate a success of IPM or an overall change of the pesticides in use.

A weakness of this indicator might be the limited scope covered by the monitoring wells. Still, most are located in high use agricultural areas.

Discussion

An average of 250 chemical compounds make up the various pesticide types used from year to year to control pests in New Jersey. Pesticide types include herbicides, insecticides, fungicides, growth inhibitors, fumigants, bactericides, rodenticides and miscellaneous compounds such as synergists. Possible detrimental human and environmental health effects are connected with this wide variety of compounds, and a great concern with the general public is whether or not these chemicals are leaching into groundwater and eventually contaminating drinking water supplies.

As part of the EPA's ground water protection initiative, a series of monitoring wells were installed across central and southern New Jersey under the direction of the NJDEP PCP. The wells are shallow (20-30 feet), reaching into subsurface aquifers and sampled annually to obtain a data set on pesticide detections, if any, and if so, direct the PCP to the problem chemicals and areas.

Thirteen wells were installed for the network in 1997. Eleven are located in the southern part of New Jersey and cover Burlington, Camden, Gloucester, Atlantic, Cumberland and Salem counties. Two wells are located in the mid-section of the state, covering Middlesex and Monmouth counties. All wells were installed and developed in cooperation with NJDEP/NJGS (New Jersey Geological Survey.)

The sites for these thirteen wells were selected according to 1) pesticide use by municipality according to the PCP's agricultural pesticide use survey, 2) the location of state-owned roads, and 3) visual inspection of proposed sites to determine suitability. The New Jersey Private Pesticide Survey, completed every three years by growers for the PCP, was the primary factor in deciding where the ground water monitoring wells would be installed.

As of October 1999, nine additional wells were added to the network. These wells are similar to the original thirteen in design and location and were also installed by the NJDEP/NJGS for various monitoring purposes. They compliment the original PCP's well network. However, none of the wells are located in the northern New Jersey counties. Efforts are underway to expand the network throughout the agricultural areas of the state, north and south, either by using existing wells or installing new monitoring wells.

New Jersey Groundwater PMP

In the early 1990's, the EPA developed a pesticides and groundwater strategy to provide States with the opportunity to manage the use of pesticides in ways that protect ground water resources. Through the implementation of PMPs, States may promote the environmentally sound use of pesticides that might otherwise pose a risk to groundwater resources. PMPs are required to address the use of pesticides in all areas, including rural and urban areas.

The New Jersey Groundwater PMP is currently being developed. Included in the plan are compounds targeted by EPA as high-risk groundwater leachers (listed below) and acetochlor, added due to its high leaching potential and substantial use as a substitute for alachlor and metolachlor in New Jersey.

National Reference Levels indicate the chemical levels in groundwater considered an unreasonable risk to man or environment based on federal and state water quality standards. The PMP Response Levels are levels of detection in ground water where response actions are necessary to reduce levels. Under the New Jersey PMP, 30% of the national reference levels have been proposed as response levels.

Pesticide	**National Reference Levels**	**PMP Response Levels**
Acetochlor	8 ug/l	2.4 ug/l
Alachlor	2 ug/l	0.6 ug/l
Atrazine	3 ug/l	0.9 ug/l
Cyanazine	1 ug/l	0.3 ug/l
Metolachlor	70 ug/l	21 ug/l
Simazine	4 ug/l	1.2 ug/l

On a yearly basis, this indicator will chart detections exceeding PMP response levels from the PCP's well monitoring network.

1998 Sampling Results

A total of 54 samples (not including 15 trip blanks) were taken between February and December of 1998. Eight of the 54 samples showed detections. The details of these detections are listed below.

Pesticide Residue	Frequency (of 54)	Range (ug/l)
Acetochlor	1	0.31
Alachlor	1	0.056
Atrazine	4	0.019 - 0.11
Bromacil	1	1.4
Metolachlor	5	0.19 – 1.6
Simazine	5	0.17 – 1.8