Classification of NJ Trout Waters

Overview

The high water quality and habitat standards necessary for the survival and successful reproduction of trout have made them a useful indicator of stream health. In 1968, the process of identifying and classifying New Jersey waters according to their suitability to support trout was initiated under Federal Aid Grant F-48-R. Over the course of the next five years a classification system for New Jersey waters was developed based upon sampling completed under this study. This system classified the state's waters as trout production (natural reproduction occurring), trout maintenance (ability to support trout year round, but no reproduction documented, and non-trout (habitat and/or water quality are not conducive to the presence of trout or trout associated species). The Bureau's classification system, although already in use by various programs within the Department, was formally recognized in 1981 under the State's newly adopted *Surface Water Quality Standards*.

As the name implies, the *Surface Water Quality Standards* includes statements of policy, designated use classifications and corresponding water quality criteria, and surface water classifications. The Clean Water Act of 1972 protects waters based upon their pre-existing use, so although waters may suffer severe impacts from surrounding land uses ultimately effecting the biotic community its classification is never downgraded. The suitability of a waterway to support trout affects the stringency of the standards set. Trout production waters are awarded Category I status, one of the Department's highest levels of protection which mandates an anti-degradation standard for a number of identified water quality parameters. The Department's Land Use Regulation Program, through Stream Encroachment, Freshwater Wetlands, and the more recently developed storm water rules acknowledge the fragile nature of these ecosystems and provide additional protective measures.

Although a vast amount of work has been accomplished in classifying New Jersey waters, waters continue to be classified and reclassified according to their trout supporting capabilities, when justified by additional field investigation data collected by the Bureau. The official surface water classification of waters is changed by the NJDEP's Bureau of Water Quality Standards and Assessment through an established rule making process.

Background

Visual assessments of trout streams in New Jersey were recorded in the late 1800's, and a more extensive inventory of trout resources was conducted from 1918 to 1920. The first water quality standards adopted by a New Jersey State agency (Department of Health), in 1964, recognized the importance of trout as an indicator of high water quality by including a special provision for trout waters. The process of identifying and classifying New Jersey's trout waters, however, began in earnest in 1968 with the initiation of Job III-1 under D.J. Project No. F-20-R, Research in Trout Management. The development of electrofishing as a technique for capturing fish, in the 1950's and 1960's, greatly facilitated this effort.

Over a five year span, data was collected under Job III-1, "Ecological Survey of NJ 'Trout' Streams and Tributaries." Under Job III-2, "Classification of New Jersey Trout Streams," the data collected from 95 sampling sites were used to develop a methodology for characterizing a stream's ability to support trout. The methodology classifies the state's waters based on the occurrence of naturally reproducing trout and the presence or absence of trout and trout associated species. A list of waters and their trout waters classifications was prepared (Soldwedel, 1979) and the report was disseminated and filed with the DEP's. Division of Water Resources, Bureau of Water Pollution Control. In 1981 DEP, although already providing protection to trout streams through its regulatory programs, further recognized the importance of maintaining and preserving trout waters by incorporating the classification system developed by NJDFW into the state's *Surface Water Quality Standards* (N.J.A.C. 7:9B et seq.).

Surface Water Quality Standards

New Jersey's *Surface Water Quality Standards* is perhaps the strongest line of defense in protecting open state waters. The document establishes surface water criteria for approximately 120 substances and water quality parameters such as pH, temperature, dissolved oxygen, and dissolved solids according to stream classification. Criteria for certain substances (temperature, dissolved oxygen, and suspended solids) are more stringent for trout waters than for nontrout waters. The document also defines and provides the classification of waters throughout the state.

The general classification applied to freshwaters of the state is FW. Waters located wholly within state or federal land or special holdings are typically classified as FW1. These waters receive the highest protection possible and shall be maintained as to quality in their natural state. All other surface freshwaters (excluding the Delaware River and Pinelands waters) are classified FW2. Waters are then further classified according to their suitability to support trout.

TP - Trout production	Waters designated [at N.J.A.C. 7:9B-1.15(b) through (g)] for use by trout for spawning or nursery purposes during their first summer.
TM - Trout maintenance	Waters designated [at N.J.A.C. 7:9B-1.15(b) through (g)] for the support of trout throughout the year.
NT - Nontrout	Freshwaters that have not been designated [in N.J.A.C. 7:9B-1.15(b) through (h)] as trout production or trout maintenance. These waters are generally not suitable for trout because of their physical, chemical, or biological characteristics, but are suitable for a wide variety of other fish species.

Fresh waters classified as FW2 may be further designated as "Category One Waters" (C1) for the purposes of implementing anti-degradation policies (N.J.A.C. 7:9B-1.5(d)). These policies protect C1 waters from measurable changes to the existing water quality. These waters can be identified because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional water supply significance, or exceptional fisheries resource(s). These waters may include but are not limited to:

1) Waters originating wholly within Federal, interstate, State, county or municipal parks, forests, fish and wildlife lands, and other special holdings that have not been designated as FW1.
2) Waters classified as FW2 trout production and their tributaries;
3) Surface waters classified as FW2 trout maintenance or FW2 non trout that are upstream of waters classified as FW2 trout production;
4) Shellfish waters of exceptional resource value;
5) Other waters and their tributaries that flow through, or border, Federal, State, county, or municipal parks, forests, fish and wildlife lands and other special holdings.

"Category Two waters" (C2) means those waters not designated as outstanding national resource waters or Category One. The surface water classification for individual waters can be found in N.J.A.C. 7:9B-1.15.

Although many New Jersey waters have been identified and classified, changes to individual surface water classifications continue to be made. NJDEP may initiate reclassification proceedings or entertain petitions for reclassifying specific segments under N.J.A.C. 7:9B-1.11. The NJDFW's Bureau of Freshwater Fisheries is responsible for collecting data for classification purposes and verification of third party data. This work is performed under Grant No. F-48-R, Project II "Investigations and Management of Coldwater Fisheries," Job 2 "Classification of New Jersey Trout Waters." When supported by field investigation data, the NJDFW formally requests classification changes to individual waters by providing supporting technical documentation to the DEP office responsible for promulgating changes to the SWQS (currently the Office of Environmental Planning Standards, Assessment and Modeling). These recommendations are then incorporated into an established rule making process with a required public comment period.

A three-part report prepared by NJDFW lists by sub-watersheds the trout production, trout maintenance and nontrout waters that have been surveyed and classified by the Bureau according to their trout supporting capabilities; the reproducing trout species in each trout production water; and waters which have been proposed for reclassification but have not been adopted in the Surface Water Quality Standards through a rule making process (Appendix C). This report is periodically updated when new classifications are adopted or when warranted by additional survey data.

Recognition of Trout Waters in NJDEP Regulatory Programs

A variety of regulatory programs administered by NJDEP give special consideration to designated trout waters. The Land Use Regulation program through its stream encroachment and freshwater wetlands permits recognize the surface water classifications for trout production and trout maintenance waters, as well as trout-stocked waters. Additional protection is afforded by minimizing project impacts through design modifications, timing restrictions and increased buffer requirements. The Environmental Review Program staff within the Division of Fish and Wildlife review stream encroachment and freshwater wetland applications to minimize environmental impacts to for all water sof the state.

New Jersey's Pollutant Discharge Elimination System (NJPDES) Program protects New Jersey's ground and surface water quality by assuring the proper treatment and discharge of wastewater (and its residuals) and stormwater from various types of facilities and activities. To accomplish this, permits are issued limiting the mass and/or concentration of pollutants which may be discharged into ground water, streams, rivers, and the ocean. The classification of a waterway affects the concentration and types of pollutants allowed to be discharged. Specifics to the protection of trout waters through these and other Department programs is further elaborated within the Management of Habitat section of this plan.

Classification Methodology

Lakes

Lakes are classified as trout maintenance or nontrout according to their ability to support trout year round. Trout survival in lakes is dependent upon summer water quality conditions, which can reach critical levels during the summer months. Lakes are surveyed mid-August when maximum annual temperature levels are reached and dissolved oxygen levels are typically at the lowest levels. To support trout lakes must have, throughout the year, a layer of water with favorable conditions of temperature (21° C or less) and dissolved oxygen (4 mg/l or greater). Surveyed lakes that meet this criteria are classified as trout maintenance.

Streams

Streams are classified based on the documented occurrence of natural reproduction, and the presence or absence of trout and/or trout associated species. Streams which lack naturally reproduced trout in their first year of life are classified as trout maintenance or non-trout based upon the stream's total fish population.

Trout Production – Young-of-the-year trout must be documented within the sampled stream segment. Young-of-the-year (y-o-y) trout can be visually distinguished from older trout in the field, based upon their size (typically less than 100 mm in length.

Trout Maintenance – *Incidence of Occurrence* of trout and/or trout associated species > 20 %.

Non–Trout - *Incidence of Occurrence* of trout and/or trout associated species < 20%.

The *Incidence of Occurrence* (I.O.) was initially developed based upon fisheries data collected during the trout classification study in 1968 – 1971. It was later modified in 1973 as sampling efforts continued and additional data became available. The number of incidences that the species was found to inhabit a stream with a naturally reproducing trout population was proportionally compared to the total number of stream segments in which the species was found to occur. The result was an *Incidence of Occurrence*, expressed as a percentage, for that particular species with reproducing trout populations (Table 4). The higher the *Incidence of Occurrence* the greater the species' "association" with trout.

TABLE 4.— Incidence of Occurrence (I. O.) of selected species in association with naturally reproduced trout (revised 1973).

	Naturally reproducing trout		**Incidence of Occurrence**
Fish Species	**Present**	**Absent**	**(%)**
slimy sculpin - *Cottus cognatus*	10	1	90.9
longnose dace - *Rhinichthys cataractae*	29	48	37.7
blacknose dace - *Rhinichthys atratulus*	69	146	32.1
creek chub - *Semotilus atromaculatus*	35	79	30.7
white sucker - *Catostomus commersoni*	51	217	19.0
fallfish - *Semotilus corporalis*	9	42	17.6
pumpkinseed - *Lepomis gibbosus*	35	185	15.9
rock bass - *Ambloplites rupestris*	5	28	15.6
American eel - *Anguilla rostrata*	30	183	14.1
tessellated darter - *Etheostoma olmstedi*	18	116	13.4
goldfish - *Carassius auratus*	2	16	11.1
smallmouth bass - *Micropterus dolomieu*	4	37	9.7
common shiner - *Luxilis cornutus*	10	100	9.1
largemouth bass - *Micropterus salmoides*	9	93	8.8
redfin pickerel - *Esox americanus*	7	85	7.6
brown bullhead - *Ameiurus nebulosus*	7	94	6.9
bluegill - *Lepomis macrochirus*	6	86	6.5
redbreasted sunfish - *Lepomis auritus*	9	134	6.3
satinfin shiner - *Cyprinella analostana*	1	18	5.3
eastern mudminnow - *Umbra pygmaea*	2	39	4.9
cutlips minnow - *Exoglossum maxillingua*	1	26	3.7
chain pickerel - *Esox niger*	2	56	3.4
golden shiner - *Notemigonus crysoleucas*	2	101	1.9
creek chubsucker - *Erimyzon oblongus*	1	91	1.1
banded killifish – Fundulus diaphanus	0	22	0.0
stonecat – *Noturus flavus*	0	20	0.0
common carp - *Cyprinus carpio*	0	20	0.0
yellow perch - *Perca flavescens*	0	20	0.0

An I.O. of 20% has been established as the minimum value that would classify a species as being "trout-associated." To determine the I.O., the I.O. values for each species found in the survey are summed and then divided by the total number of species present to obtain an average I.O. An value of 20% or greater yields a trout maintenance classification and a value less than 20%yields non-trout.

For example, consider the following three hypothetical cases:

Stream A	
Species	**Incidence of Occurrence (%)**
brown trout	100.0
white sucker	19.0
blacknose dace	32.1
creek chub	30.7
Total	**181.8**

The average I.O. for this stream is 45.4%. Because this value exceeds 20.0% this stream would be classified as trout maintenance.

Stream B	
Species	**Incidence of Occurrence (%)**
brown trout	100.0
pumpkinseed	15.9
redfin pickerel	7.6
mudminnow	4.9
carp	0.0
killifish	0.0
stonecat	0.0
Total	**128.4**

The average I.O. for this stream is 18.3%. Because this value is less than 20.0% this stream would be classified as nontrout, despite the presence of brown trout.

Stream C	
Species	**Incidence of Occurrence (%)**
blacknose dace	32.1
creek chub	30.7
pumpkinseed	15.9
tessellated darter	13.4
Total	**92.1**

If trout are not found, a stream may still qualify for a trout maintenance classification if a significant number of trout associated species are found. The average I.O. for this stream is 23.0%. Because this value exceeds 20.0% this stream would be classified as trout maintenance (despite the absence of trout) because of the presence of sufficient numbers of trout associated species.

The data collected at a particular sampling site is then projected to cover larger sections of stream on the basis of similar chemical and physical conditions. For ease in identifying particular stretches, the boundaries of classified stream segments, to the extent possible, are described using physically identifiable structures such as road crossings, base of dams, or the confluence with other waters. Survey data collected is entered into the Bureau's Fisheries Management Database (FishTrack).

Field Sampling Protocol

Lakes

Dissolved oxygen and temperature profiles are performed during mid –August at the deepest point of the impoundment using a YSI Model 85 meter. For QA/QC purposes oxygen meters are re-verified on a monthly basis against a Winkler Titration of deionized water samples. The re-verification procedure is also repeated after any atypical field readings to verify the meter is functioning properly. Meters are field calibrated prior to each use according to the manufacturer specifications.

Streams

As with lakes the summer months are a critical time period for trout survival due to elevated temperatures, lower dissolved oxygen concentrations, and reduced flows. Streams are sampled from June through mid September of each year using electrofishing gear. Electrofishing provides for the safe, effective sampling of resident fishes with limited associated mortality. Prior to 1980, A.C. electrofishing equipment was used to sample stream fish populations. This sampling gear consisted of two or three paddle-type electrodes powered by a gas generator and operated by a four to six person crew (two or three electrode-bearers, one or two netters, and one generator operator). With technological advances in electrofishing gear, D.C. electrofishing equipment, powered by battery or generator, has been used almost exclusively since 1980. A battery-powered D.C. backpack unit, having one paddle-type electrode and used by an operator and one or two netters, has been in used since 1980 to sample small streams. On larger streams a gas generator is used in conjunction with a conversion box (to convert A.C. to D.C.), two or three electrodes, and a five to seven person field crew.

The standard sampling distance, which has been used during and since the original stream surveys, is 182.9 meters (600 feet). This length was occasionally shortened when trout reproduction was found or when conditions such as an abundance of warmwater species or physical stream conditions indicated that trout would not be found. Occasionally a prospective stream or site would not be sampled based upon a visual, water temperature, or pH check that indicated conditions unsuitable for trout. Lack of water, excessive turbidity, temperatures in excess of 24°C, and extremely low pH values (4.0 or less) would result in sampling site rejection. Since 2001, in an effort to standardize data collection efforts across various research and field inventories a distance of 150 meters was established and is used on streams when young-of-the-year trout are encountered. Since the development of the Incidence of Occurrence was based on a sampling distance of 182 meters (600 feet) this distance is still used for classifying streams when young of the year trout are not encountered.

Opportunity – Interpolate data collected for Incidence of Occurrence development to determine if any modification to the Incidence is required to reduce the sampling distance from 182 meters to 150 meters. The reduction of sampling distance would allow for consistent sampling protocols between various research projects.

Sampling methods follow those outlined by Kurtenbach (Kurtenbach, 1994) and as defined in the EPA manual "Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers" (Barbour 1999) and are consistent, for comparative purposes, with data collection efforts for other projects. All sites are sampled under typical stream flows during the months of June through September. Electrofishing gear is used to provide pulsed direct current to collect fishes. Settings on each of the stream units vary depending on the conductivity and flow conditions at each site, output usually ranges from 3 to 4 amperes. A typical backpack field crew consists of three persons, one to wear the backpack and netters. Stream widths exceeding the capabilities of one backpack unit are either sampled with two backpack teams traveling in tandem or with a two-paddle streamside generator. The type of unit selected is based upon stream width, depth, and contour of the stream environment. One up-stream pass is made through the sample stretch. The sample stretch length is 150 meters for streams having naturally reproducing trout populations and 182 meters (600 feet) for trout maintenance or non trout waters. Sampling time averages approximately 2.5 hours per site.

All fish encountered are collected without bias to species or size. Fishes with lengths greater than 20 mm are identified to the species level, counted, and examined for disease or anomalies. Anomalies such as visible lesions, tumors, skeletal anomalies, and fin damage may be an indication of impaired conditions. Any obvious injuries due to electrofishing are noted, but not considered anomalies. Total length measurements are taken on all trout and other game species. Data is recorded on the Bureau's Supplemental Field Survey Sheet-Fish Samples (Appendix D). Retained specimens are preserved in 10% formalin solution in the field. Specimens are then transferred to a 70% ethanol solution for long-term preservation 2-3 weeks after initial collection.

In addition to fish collection, basic physical and chemical parameters of the stream environment are also measured and recorded on the Bureau's Stream Survey Data Sheet (Appendix D). All physical and chemical data are collected one-time-only, thus no long-term data is collected. Physical parameters included stream depth, stream width, substrate type, and shade index. YSI Model 85 and YSI Model 60 meters are used to determine chemical parameters such as dissolved oxygen, temperature, salinity, conductivity, and pH. For QA/QC purposes oxygen meters are re-verified on a monthly basis against a Winkler Titration of deionized water samples. The re-verification procedure is also repeated after any atypical field readings to verify the meter is functioning properly. Meters are field calibrated prior to each use according to the manufacturer specifications. Alkalinity and specific conductance data have been collected since 2002. In-house laboratory staff determine alkalinity via titration. The reference temperature and temperature coefficient for specific conductance are 25°C and 1.91% respectively.

A stream habitat assessment is also conducted at each site, in accordance with criteria established by the EPA (EPA 1999). The habitat assessment is intended to evaluate various aspects of the aquatic habitat, surrounding terrestrial environment, and potential anthropogenic factors that may impact the aquatic biota of the stream. Habitat Assessments have been designed for two stream types - high gradient (riffle/run prevalent) and low gradient (glide/pool prevalent) streams. High Gradient Habitat Assessments are conducted on most streams north of the Fall line, in the Piedmont, Highlands, and Appalachian Valley and Ridge physiographic provinces. Natural high-gradient streams have substrates composed primarily of coarse sediment particles (i.e. gravel or larger) or frequent coarse particulate aggregations along stream reaches. Low gradient habitat assessments are conducted on streams in the Coastal Plain and in other moderate to low gradient landscapes. Natural low gradient streams have substrates of fine sediment or infrequent aggregations of more coarse (gravel of larger) sediment particles along stream reaches. Data are recorded on the Bureau's Low Gradient Habitat Assessment Data Sheet and High Gradient Habitat Assessment Data Sheet (Appendix D).

For the habitat assessment, ten specific physical parameters are assessed. For a low gradient stream the parameters are: epifaunal substrate, pool substrate, pool variability, sediment deposition, channel flow status, channel alteration, channel sinuosity, bank stability, vegetative protection, and riparian vegetative zone width. The assessment for a high gradient stream substitutes pool substrate, pool variability, and channel sinuosity with embeddedness, velocity/depth regime, and frequency of riffles or bends. The first five parameters of each assessment are assessed within the stretch of the stream electrofished. Assessments of the five remaining variables are based upon a larger stream reach that extends 150 meters upstream and downstream of the electrofished stretch. Each assessment variable is divided into four condition categories: optimal, sub-optimal, marginal, and poor, each with established criteria. Twenty points are allotted for each of the ten variables resulting in a maximum score of 200. The left and right banks of a stream, determined by facing downstream, are assessed separately for bank stability, vegetative protection, and riparian vegetative zone width. Biologists from the Bureau of Freshwater Fisheries have received habitat assessment training from EPA staff.

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Management of Habitat

Overview

The future of coldwater fishes in New Jersey, particularly salmonids, will depend heavily upon managing their habitat and sustaining the health of ecosystems critical to their survival. In the face of human activities that continually disrupt the natural processes occurring within watersheds, this will be at times a daunting task for resource managers. Threats to New Jersey's coldwater resources and the continued survival of trout are warm summer water temperatures and degradation of the physical features of stream channels. Environmental regulations aid in balancing the needs of a natural environment with those of society.

Coldwater Fish Habitat

To survive, fish need a healthy environment that satisfies their life requirements. Fish habitat is aquatic space, as determined by chemical, physical, and biological factors. Habitat characteristics play a key role in determining fish assemblages (fish species and their numbers, and sizes). Habitat also influences biotic interactions (competition, predation) that affect fish communities. Three habitat factors that affect the distribution and abundance of trout in streams and lakes are water quantity, water quality, and in-stream habitat. The influence of these factors upon trout is described below in general terms with distinction made between flowing and standing waters. Additional information on habitat requirements necessary for survival of trout can be found under the Trout Life History and Ecology section of within this plan.

Habitat Factors Affecting Trout in Streams

<u>Water Quantity</u>

Streamflow is the volume of water flowing past a cross-section of the stream channel per unit time and is often expressed as cubic feet per second (ft^3/sec). Both overland runoff and groundwater are major sources of water inputs to streams. Many streams continue to flow even during periods when there is no rainfall or overland runoff and these are called perennial streams. Groundwater inputs (from the water table) often constitute much of the base flow (flow not the result of rainfall that creates surface runoff), particularly in headwater reaches of NJ streams where wild trout occur.

Streamflow generally follows predictable seasonal patterns (high spring flows and low summer flows) and can also experience short-term variability. High flows can be beneficial in terms of scouring pools, introducing woody debris, sorting streambed materials, and serving as cues for fish migration and spawning. Unfortunately, land use changes can significantly alter natural flow regimes by increasing overland runoff that causes disruptive or damaging flows. For example, increases in impervious surface within a watershed (buildings, roads, parking lots, etc) can result in flow extremes that lead to flooding, bank scouring, and habitat destruction. On the opposite end of the scale, extreme low flows can stress the fish community by reducing living space and impacting biotic interactions (feeding difficulties, increased vulnerability to predation, etc.). Stream flow can also affect other habitat factors important to trout such as water temperature and water quality.

Water Quality

Factors that determine water quality, such as water temperature, pH, turbidity, dissolved oxygen, alkalinity, dissolved nutrients, and presence or absence of anthropogenic toxicants can directly affect fishes or indirectly affect them through effects on food production (Orth and White 1999). Geology plays a major role in determining water quality, and other factors such as climate, stream geomorphology, watershed characteristics, and man's activities are also important. Water temperature is considered the primary factor limiting trout distribution and survival in New Jersey streams.

Many streams statewide that might otherwise consistently sustain trout year round fail to do so because ambient summer water temperatures exceed 21°C. Trout may find areas of thermal refugia during the summer (springs and groundwater upwelling) when summer water temperatures approach stressful levels. Riparian vegetation that shades water surface plays a critical role in maintaining cold summer water temperatures, particularly in smaller streams. As streams increase in size the ability of near stream vegetation to shade the stream decreases. Streamside vegetation also helps filter overland runoff before it reaches the stream. New Jersey streams that have cold water year round usually do not experience problems related to dissolved oxygen.

Alkalinity and pH can also affects a stream's suitability for trout. Some regions of the state have naturally occurring low pH and alkalinity levels. The ambient pH of waters in the south Jersey Pinelands (a region 1.1 million acres in size that occupies 22 percent of New Jersey's land area) is below 5.5 which is a deterrent to maintaining a short-term seasonal trout fishery through hatchery supplementation. The headwaters of north Jersey streams, particularly those in the Ridge and Valley physiographic province (Figure 1, p. 13) may also experience low pH levels due to the region's geology and soils. Low pH can also increase the toxicity of trace metals (i.e. aluminum) that are leached from the soil or come from airborne sources. When the buffering capacity of a stream is poor, as reflected by low alkalinity, a stream's susceptibility to acidification increases. The majority of the state's trout streams are low in alkalinity and relatively unfertile due to their association with sandstone, shale, and other noncarbonate rocks. These relatively unfertile streams are termed freestone streams. Limestone bearing rock formations that can increase alkalinity are known to occur in some watersheds, most notably the Paulinskill River. The impact this has on local fish production has not been examined.

Opportunity – Use existing or available water chemistry and geology data to identify trout streams that are potentially high in productivity and may have the potential to provide a more desirable fishery in terms of fish size or quantity through specialized management.

Physical Characteristics of the Stream Channel

Stream channels are dynamic and diverse, molded by unidirectional water movement and the transport of materials over geological formations. Channel features that influence trout abundance and size are channel sinuosity (meandering), pool-riffle sequences, water depth, substrate (bed materials), and cover.

Stream Habitat Threats & Concerns

Dams – Water impounded by an on-stream dam can eliminate or negatively impact riverine habitat both upstream and downstream of the barrier. Impounded water is susceptible to excessive warming during the summer, and warm water can cause stressful or lethal water temperatures for coldwater fishes residing in both the impounded area and downstream. Silt and sediment that collect behind the dam can impact in-stream habitat by smothering spawning sites and macroinvertebrate species that are important prey items for fishes. Downstream flow can also be reduced, particularly during the summer and periods of drought. Dams are potential barriers to fish movement, and this is a particular concern on streams that have spawning populations of trout, which may affect their ability to migrate upstream to reach spawning grounds. For these reasons the construction of on-stream dams on coldwater should not be allowed or greatly discouraged.

Whether built for recreation, water diversion, hydropower, potable water, flood control, or other reasons, manmade dams are responsible for damaging more trout habitat in New Jersey streams than would first seem apparent. Many on-stream dams built long ago to harness the power of water, such as mill dams and diversion dams, still exist today despite having outlived their usefulness. The Musconetcong River is a prime example of a trout stream whose physical habitat and water quality has been impacted or eliminated by antiquated on-stream dams. Nonfunctional dams such as these should be demolished (or breached) whenever possible and practical, and the stream restored to its original condition.

Finding solutions to problems caused by existing manmade ponds, lakes, and reservoirs, that currently provide a useful function to their owners but also impact coldwater resources, can be more challenging because permanent dam removal is not usually an option. To resolve a problem it may be necessary to develop a set of practices tailored to the specific situation, that are designed to avoid or minimize aquatic resources impacts. For example, the manipulation of water in a series of potable water supply reservoirs in the Pequannock River watershed has resulted in fluctuations in the quantity and quality of water released downstream (insufficient in-stream flows, primarily during the summer, or the release of excessively warm water, anoxic water, or water laden with hydrogen sulfide), that has caused mortality of wild brown trout.

When maintaining minimum flows during the summer, the release of cold water from the hypolimnion, rather than warmer surface water, is sought in order to maintain coldwater aquatic resources downstream. However, the benefit of a coldwater release may be negated if this water is deficient in dissolved oxygen, especially when laden with hydrogen sulfide. When unusual conditions such as this prevail, a bottom water release may not be in the best interests of the resource and modification of the release regime may be warranted (i.e. aeration of reservoir releases through air injection or mechanical agitation, mixing of surface and bottom waters, siphon, spillway modification, aeration weir, etc.). For the Pequannock River situation, an adaptive management strategy is being employed, with DFW, sister DEP agencies, conservation organizations, and the owner partnering to explore alternatives and develop a long-term solution to this problem.

Manmade structures are not the only type of dams that pose serious threats to the state's trout streams. Over the last few years, the DFW has increasing received complaints from conservation groups concerning the presence of beaver dams on some of the state's best trout streams, particularly in the Big Flatbrook, Pequannock River, and Van Campens Brook watersheds. Significantly elevated stream temperatures, as a result of beaver dams, have been documented by the Pequannock River Coalition on streams in the Pequannock River watershed. Staff from the Bureau of Freshwater Fisheries and DFW's Wildlife Control work cooperatively to address and resolve problems caused by beaver dams, which has resulted in the selective removal of beaver dams to restore trout habitat.

In-stream flow Maintenance of in-stream flows, particularly during periods of drought, is a concern. Water withdrawals for agricultural and other uses that coincide with dry weather can diminish flows on streams whose flows are already reduced. See also "Dams."

Loss of wetlands and buffers These areas are invaluable in maintaining flow and filtering runoff. The loss or diminished function of these areas, particularly those closely associated with trout production streams, would be detrimental.

Loss of nearstream vegetation The removal or loss of nearstream vegetation, particularly on the headwaters of trout stream, can result in undesirable thermal warming patterns. Construction activities in stream corridors such as road widening, bridge and culvert construction, etc. have resulted in short term or permanent losses of nearstream vegetation. Livestock grazing that destroys nearstream vegetation, causing unstable banks, has been observed along trout production streams and could be prevented or minimized through fencing.

Roadway culverts Improperly designed or installed culverts can prevent or impede fish passage and can be particularly problematic during low and high flow situations. In-stream fish habitat can also be lost if native substrate is not re-established in the culvert

Nonpoint source pollution Land disturbances within the watershed can increase pollutants. Runoff from roadways and a variety of sources may not pass through quality basins or other filtering devices prior to entering the stream. Pollutants such as road salts, oil and grease, and other contaminants can be problematic for trout. Silt is frequently a primary constituent of nonpoint pollution and is a major threat to the state's trout resources. Runoff from poor farming practices and land disturbances are major contributors of silt.

Point source pollution Discharges emanating from a point sources, such as wastewater from treatment plants, noncontact cooling water, etc can cause summer thermal alterations and increased pollutant loads that can stress or kill trout.

Channelization, channel relocation and stream cleaning The first of these two activities are occasionally performed as part of stream crossing and road widening projects. Municipalities, county Mosquito Commissions, and farmers are probably most active in stream cleaning activities intended to improve runoff patterns. These small-scale projects can cause localized damage by leaving a uniform stream bottom devoid of cover and structure for fish. Beneficial woody debris, that should be left in the stream channel unless causing a significant blockage, may often be removed under the guise of stream cleaning.

Global warming Climatic changes associated with global warming may pose a problem for those trout streams in New Jersey where summer water temperatures approach critical levels for trout survival.

Habitat Factors Affecting Trout in Ponds & Lakes

Water Quantity
Water quantity, in and of its self, is generally not considered limiting for trout in most New Jersey ponds and lakes, but can be affected by demands for drinking water.

Water Quality
External factors, such as geology, land use (human disturbance), and climate, largely determine the water quality of ponds and lakes. As with streams, prevailing low pH that occurs in certain regions (Pinelands and Ridge and Valley) limits trout survival and opportunities to establish trout fisheries in these areas through stocking is therefore limited. In most New Jersey ponds and lakes seasonal variations in temperature and dissolved oxygen play the biggest role in determining their ability to support trout year round.

During the spring these water quality parameters are generally not limiting for trout. However, as spring progresses rising air temperatures cause surface waters to warm to levels that can not be tolerated by trout. This scenario occurs on all but the smallest of spring fed ponds statewide. During the summer, decomposing organic material depletes oxygen in the bottom waters. Although cold water temperatures suitable for trout are present in the bottom waters of many moderately deep lakes in the summer, satisfactory dissolved oxygen levels are typically absent. Consequently few standing waters in New Jersey have the ability to consistently support trout year round. A number of northern lakes that had good holdover trout fisheries 30 to 40 years ago (Lake Hopatcong, Swartswood Lake, Cranberry Lake, Mountain Lake) have seen their trout fisheries decline, presumably as a result of nutrient inputs arising from watershed development that have accelerated eutrophication. Only a handful of deeper lakes and reservoirs statewide are able to consistently maintain favorable water quality for trout in the summer.

Physical Characteristics
Trout habitat in lakes is influenced by lake morphometry (shape and contour), with depth the primary consideration in New Jersey waters. While natural lakes and ponds do occur, more often than not standing waters have been artificially formed (and natural lakes increased in size) through dam construction. Lakes less than 30 to 40 feet deep rarely support trout in the summer due to water quality conditions. Even lakes as deep as 50 or 60 feet may experience water quality problems. Substrate plays a minor a role in influencing coldwater spawning habitat in New Jersey lakes. Only lake trout, an introduced salmonid species, is know to reproduce successfully (in Round Valley Reservoir) by spawning over the boulders at the dams.

Lake Habitat Threats & Concerns

Eutrophication Man's activities in the watersheds of many New Jersey lakes have accelerated the rate of eutrophication, which influences the availability of summer trout habitat. The owners of several lakes (Swartswood Lake and Culvers Lake) are trying to control the cycling of nutrients through the operation of a hypolimnetic aeration system. This system is capable of increasing the volume of summer trout habitat, but has had minimal success in doing so at Swartswood Lake.

Opportunity – The DFW should work more closely with the N. J. Division of Forestry and Parks to determine if operational changes regarding the hypolimnetic aeration system at Swartswood Lake would result in an improvement in summer trout habitat.

Water level fluctuations The demand for water, particularly drinking water, will likely increase in the future and cause greater variability in the water levels of reservoirs that sustain trout year round. While not currently considered a significant problem, this has the potential to disrupt the fisheries in Round Valley and Merrill Creek Reservoirs.

Zebra mussel This invasive, exotic mussel has not been documented in New Jersey. However, New Jersey anglers boat in waters of other states (NY and PA) that contain this species and could unwittingly transport this undesirable bivalve to New Jersey. The zebra mussel reproduces prolifically and could adversely affect spawning habitat for lake trout in Round Valley if a population became established. Because they are filter feeders they could also dramatically affect the plankton population, which in turn could negatively impact the alewife forage base that the salmonids depend upon.

Habitat Protection Through Regulatory Programs

New Jersey has a variety of regulatory programs governing activities that affect environmental quality, which are administered by the Department of Environmental Protection.

Surface Water Quality Standards

New Jersey's *Surface Water Quality Standards* (SWQS) is perhaps the strongest line of defense in protecting open state waters. This legislation establishes surface water criteria for approximately 120 substances and water quality parameters such as pH, temperature, dissolved oxygen, and dissolved solids that can vary according to stream classification. Criteria for certain substances (temperature, dissolved oxygen, and suspended solids) are more stringent for trout waters than for nontrout waters and applicable limits depend upon on a waterway's classification. Trout production waters are designated as Category I, one of the Department's highest levels of protection, which mandates an anti-degradation standard for a number of identified water quality parameters. The importance of the Surface Water Quality Standards is emphasized by devoting an entire section of this plan to the classification of trout waters, which describes the state's stream classification system which is an integral part of the SWQS. The SWQS are administrated by DEP's Bureau of Water Quality Standards and Assessment.

Stormwater Program

In 2004, new stormwater rules established a comprehensive framework for addressing water quality impacts associated with existing and future stormwater discharges.
The newly adopted Stormwater Management Rules emphasize low impact building techniques that will prevent and minimize impacts on new development sites by using both structural and non-structural techniques such as minimizing land disturbance, minimizing impervious cover, infiltration basins, and vegetative filters. These rules set forth the required components of regional and municipal stormwater management plans and establish the stormwater management design and performance standards for new (proposed) development. The design and performance standards for new development include groundwater recharge, runoff quantity controls, runoff quality controls, and buffers for Category One waters (NJDEP website 2005). The rules will minimize the impacts on trout production streams by controlling development within a 300-foot buffer around high quality waters that include trout production waters.

Highlands Protection

In August 2004, the Highlands Water Protection and Planning Act was signed in order to preserve open space and protect the state's greatest diversity of natural resources including the precious water resources that supply drinking water to more than half of New Jersey's families. The Highlands Preservation Area, over 800,000 acres spanning portions of seven counties and 88 municipalities, encompasses a large majority of New Jersey's trout production waters. This historic law will protect drinking water for over 5.4 million people, preserve open space and provide effective regional planning for the Highlands region. The law will be implemented by the *Highlands Water Protection and Planning Council*, a public body charged with developing a regional master plan, performing land use functions and protecting the region's critical environmental areas and high resource lands. Many of the state's coldwater resources can be found in this mountainous region, particularly trout production streams, which should reap the benefits of this important legislation.

Stream Encroachment Program (Floodplain Control)

Many construction activities proposed within floodplains and adjacent to open waters (streams and lakes) are required to obtain stream encroachment permits. Stream crossings, stormwater discharges, placement of structures, dredging, and stream cleaning projects are examples of different types of regulated activities. Over 1,000 project applications received by DEP's Land Use Regulation Program are forwarded annually to DFW's Office of Environmental Review for review and comment. Technical comments solicited from staff experts are coordinated through this office and returned to the appropriate agency responsible for permit issuance. Recommendations involving timing restrictions, fish passage designs for culverts, and buffers are prime examples of ways in which the DFW attempts to minimize disturbances and impacts on fish and wildlife resources.

Timing restrictions are a particularly important tool that is frequently employed to minimize the impacts of regulated land use activities on the state's coldwater resources. Near or in-stream sediment generating activities, typically prohibited during critical time periods to avoid or reduce the impacts of sediment on the aquatic biota and recreational opportunities, are as follows:

Stream Classification	Timing Restriction
Trout production waters	September 15 to March 15
Trout maintenance or trout stocked waters	March 15 to June 15
Non-trout waters	May 1 to June 30

The DFW also provides recommendations for the designs of culvert crossings to help minimize project impacts and ensure adequate fish passage is incorporated into the design. For trout production streams, full spans (bridges) are recommended to maintain critical substrate and to provide unimpeded fish passage. Much less preferred, three sided and box culverts may be used in trout maintenance and non-trout streams. The impact of a box culvert can be minimized, to a certain degree, by placing the culvert floor below grade and back filling with stockpiled native stream substrate material. The DFW also discourages the use of rip rap within the stream channel because the rock used is often oversized to protect against damaging for heavy storm events and can an impediment to fish passage.

Freshwater Wetlands Program

Environmentally sensitive freshwater wetlands are regulated through the Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A). Transition areas (buffers) around freshwater wetlands in trout production watersheds are increased to150 feet, while wetlands associated with trout maintenance waters receive protection through a 50-foot buffer zone. Wetland preservation is especially important in watersheds where small trout production streams occur because wetlands filter stormwater runoff and maintain and supplement stream flows.

Pesticide Control Program

Many New Jersey lakes suffer from accelerated rates of eutrophication, which is often evidenced by the presence of extensive aquatic vegetation growth within the waterway. As a result, the application of herbicides for aquatic vegetation control is quite common throughout the state. One common herbicide treatment for algae is copper sulfate and trout are intolerant of even very low concentrations of copper. Working closely with the Pesticide Control Program staff, DFW biologists identify trout production, trout maintenance, and trout stocked water where the use of copper sulfate may prove problematic. Through the use of timing restrictions, and reduced herbicide concentrations impacts to the State's trout streams are minimized.

Habitat Preservation

Due to the rapid pace of land development in New Jersey (Figure 3), perhaps the best way to ensure the long-term survival of coldwater resources is to purchase and set aside for posterity not just coldwater stream corridors and lakes, but adjacent riparian and upland property within the watershed. It is far easier to preserve coldwater resources than to restore them once they have been degraded. Although this may be the most cost-effective approach in the long run, property values in New Jersey continue to rise, and this form of habitat protection becomes increasingly cost prohibitive. An alternative approach may involve the purchase of conservation easements that restrict land development.

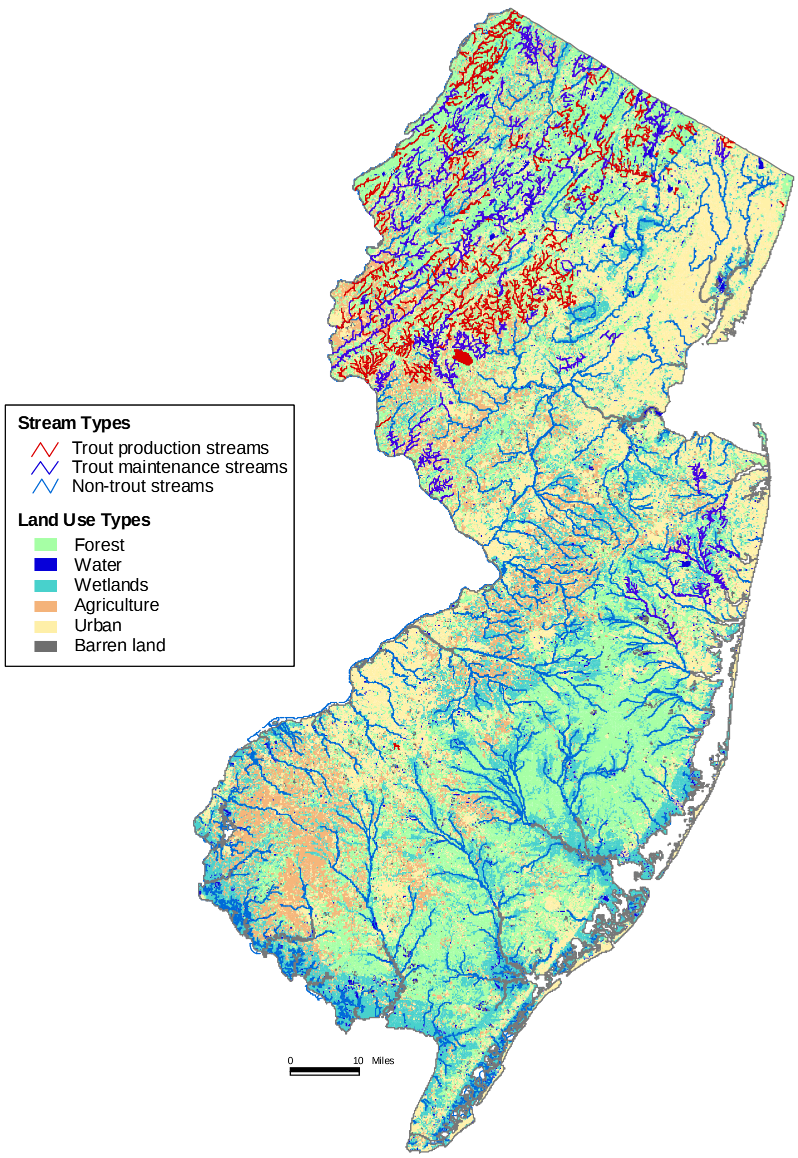

FIGURE 3. New Jersey's trout waters (2004) shown in relation to 1995-97 land use cover.

There has been significant effort statewide to preserve open space in the face of increasing land development pressures, and the state's Green Acres Program has been instrumental in this process. Green Acres serves as the real estate agent for NJDEP and acquires land, using money derived from the issue of state bonds. Acquisitions are then assigned to the DEP's divisions for management and become part of a system of state, parks, forests, natural areas, and wildlife management areas. In addition, the Green Acres Program provides low interest loans and grants to municipal and county governments to acquire open space and develop outdoor recreation facilities. Green Acres also provides matching grants to nonprofit organizations to acquire land for public recreation and conservation. A tax exemption program, also administered by Green Acres, allows eligible nonprofit organizations that own recreation or conservation land to be exempt from local property taxes if they permit public use of their private lands.

Because the owners of land purchased or exempted through Green Acres programs are required to allow public access, these types of land transactions are particularly desirable. Acquisition of river corridors is a high priority within Green Acres programs and significant acquisitions have been along major trout streams in north Jersey, most notably the Musconetcong and Pequest Rivers. Many county and local governments have also enacted an open space tax that is used to acquire land, often with Green Acres assistance. However, when land is not purchased with Green Acres funding the owner can and has limited public access.

Opportunity – Prioritize coldwater resources for the purpose of acquisition and/or easements and provide to the NJDEP Green Acres Program.

Habitat Restoration and Improvement

Restoration of habitat implies that resource damage has occurred, either at the hands of Mother Nature, mankind, or both, and that intervention is required in order to restore resource health. Restoration and improvement efforts aimed at achieving desired responses in trout populations traditionally relied upon the placement of in-stream devices. Managers today increasingly use an ecosystem approach to correct habitat degradation and deficiencies.
Many New Jersey's coldwater streams would benefit from some form of habitat restoration or improvement. In the past DFW has planned, performed and partnered on six fish habitat improvement and stream restoration projects since 1995, primarily in connection with the "Restore Our Streams" workshop. Although conservation groups and landowners often express interest in cooperative habitat restoration projects the DFW has difficulty accommodating these requests due to severe staffing and funding shortages.

Opportunity – Investigate the feasibility of using Natural Resources Damages money to fund a staffing position dedicated to the restoration and enhancement of coldwater fish habitat.

Opportunity – Work with DEP Land Use Regulation to obtain a blanket permit for habitat work that will streamline the permit process.