Agenda #6a

Report to the Town of Chapel Hill
from the
Technical Advisory Committee
on the
Town of Chapel Hill Land Use Management Ordinance,
Stream Definitions and Verification Criteria

Recommendations for Revisions in Stream Definitions and Field Verification Methods

Prepared June 5, 2003

Presented June 23, 2003

Summary of Recommendations

1. Revise definitions in the Land Use Management Ordinance.
   A. Adopt the definitions of channel, streams, modified streams, and ditch contained in the North Carolina water quality rule: Neuse River Basin: Nutrient Sensitive Waters Management Strategy: Protection and Maintenance of Existing Riparian Buffers.
   B. Delete the definition for 'stream channel'.
   C. Add the definition of 'normal rainfall'.
   D. Delete the definition of 'normal flow'.
   E. Delete the definition of 'perennial surface waters'.
   F. Revise the definition of 'perennial water body'.
   G. Delete the definitions of 'stream buffer' and 'watershed buffer' and add a more general definition of 'riparian buffer' that covers all instances of regulated riparian zones.
   H. Revise the definition of 'stream bank'.
   I. Revise the definition of 'water course' for completeness and consistency with the new or revised definitions noted above.
   J. Revise the definition of 'surface water' for completeness and consistency with the new or revised definitions above.

2. Delete the references to maps that are in some of the current definitions of types of surface waters and add a paragraph on applicability of the Resource Conservation District rules in section 3.6.3(a) that refers to use of maps combined with field evaluation methods to determine the presence of regulated surface waters.

3. Intermittent Stream Field Evaluation Method: Adopt the current version of the NC Division of Water Quality (NCDWQ) Stream Classification Method for field evaluation of intermittent streams with a minimum score of 19 points.

4. Perennial Stream Field Evaluation Method: Adopt the following two part method:
   A. Use the current version of the NCDWQ Stream Classification Method with a minimum score of 30 points to make a tentative determination of the stream origin and type.
   B. Conduct a survey of macroinvertebrate organisms in the vicinity of the tentative stream origin to determine the presence and relative abundance of biological indicators of perennial flow.

5. Include specific policies on stream evaluations for streams or stream reaches that appear to be functioning lotic (flowing aquatic) systems but are natural variants that may not precisely fit the appropriate stream type definition or may not meet the minimum criteria for the appropriate stream type.

6. Include specific policies on stream evaluation for streams that have been significantly altered or degraded due to urbanization or other anthropogenic impacts.

7. Identify and refer to the stream origin field verification procedures in the Land Use Management Ordinance but do not include the detailed procedures in the ordinance.

8. Implement an appeals procedure for contested stream evaluations that utilizes environmental professionals who are knowledgeable and experienced in stream evaluation.

9. Implement a policy for the length of time for which a particular stream evaluation stands for regulatory purposes.

10. Implement a policy that allows for re-evaluation of stream origins that were determined prior to the enactment of the current Land Use Management Ordinance on January 27, 2003 and the stream definitions and stream origin determination methods in current use for that ordinance.

Technical Advisory Committee

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Introduction

The Technical Advisory Committee (TAC) is a group of university faculty and environmental professionals in both government and the private sector who are knowledgeable in the scientific issues of defining and identifying small streams and the policy issues of stream riparian buffer regulations. The TAC was invited by the Town of Chapel Hill to review and recommend revisions to, if needed, the definitions of stream types and field criteria for identifying those stream types that are contained in the Town's Land Use Management Ordinance.

This report provides recommendations for revisions to the Land Use Management Ordinance that are designed to:

1. Improve consistency of the stream definitions and field verification procedures with those used by the NC Division of Water Quality (NCDWQ) in applying riparian buffer rules in the Neuse and Tar-Pamlico River Basins.
2. Provide field verification procedures that utilize a broader range of stream characteristics and more detailed descriptions of indicators than currently used.
3. Address the unique characteristics of altered and degraded urban streams in making stream origin determinations.
4. Provide an appeals procedure for contested stream determinations.

To avoid confusion about terminology in the recommendations outlined below, several terms are defined here:

1. 'Stream type' means ephemeral, intermittent, or perennial stream. The terms 'ditch' or 'modified stream' will be used when referring to those types of channel features. A modified stream, of course, will also be one of the three stream types.

2. 'Stream origin' refers to the point or zone of origin of a stream type. The origins of intermittent and perennial streams are often transition zones rather than relatively abrupt changes in the stream character. However, for purposes of applying riparian buffer regulations, a stream origin must be designated at a point on the channel. Intermittent streams in the Piedmont commonly occur as a transition from an upstream ephemeral reach (E/I point). However, intermittent stream origins may occur at a slope wetland, a spring, or at a point on a slope where dispersed overland stormflow concentrates to form a channel and there may not be a distinct ephemeral stream upslope of the intermittent stream origin. Perennial streams in the Piedmont commonly occur as a transition from an upstream intermittent reach (I/P point). However, perennial stream origins may occur as a transition from an ephemeral reach (E/P point) or from a spring where there is no distinct channel upslope of the perennial stream origin. Streams and modified streams in the urban environment often begin at stormwater discharge points where the upstream portion of the original stream has been piped or filled.
3. 'Stream evaluation' refers to the process of making a field determination of the type of channel feature present and the origin of that feature. For example, perennial stream evaluation means determining the origin and verifying the type of a perennial stream.

Recommendations

1. **Revisions to Definitions in the Land Use Management Ordinance**

   A. **Stream Definitions:** Adopt the definitions of channel, streams, modified stream, and ditch contained in the North Carolina water quality rule: Neuse River Basin: Nutrient Sensitive Waters Management Strategy: Protection and Maintenance of Existing Riparian Buffers (15A NCAC 2B .0233) (Neuse Buffer Rule) (http://h2o.enr.state.nc.us/admin/rules/rb010102.pdf).

   'Channel' means a natural water-carrying trough cut vertically into low areas of the land surface by erosive action of concentrated flowing water or a ditch or canal excavated for the flow of water.

   'Stream' means a body of concentrated flowing water in a natural low area or natural channel on the land surface.

   'Ephemeral (stormwater) stream' means a feature that carries only stormwater in direct response to precipitation with water flowing only during and shortly after large precipitation events. An ephemeral stream may or may not have a well defined channel, the aquatic bed is always above the water table, and stormwater runoff is the primary source of water. An ephemeral stream typically lacks the biological, hydrological, and physical characteristics commonly associated with the continuous or intermittent conveyance of water.

   'Intermittent stream' means a well-defined channel that contains water for only part of the year, typically during winter and spring when the aquatic bed is below the water table. The flow may be heavily supplemented by stormwater runoff.

An intermittent stream often lacks the biological and hydrological characteristics commonly associated with the continuous conveyance of water.

'Perennial stream' means a well-defined channel that contains water year round during a year of normal rainfall with the aquatic bed located below the water table for most of the year. Groundwater is the primary source of water for a perennial stream, but it also carries stormwater runoff. A perennial stream exhibits the typical biological, hydrological, and physical characteristics commonly associated with the continuous conveyance of water.

'Modified natural stream' means an on-site channelization or relocation of a stream and subsequent relocation of the intermittent or perennial flow as evidenced by topographic alterations in the immediate watershed. A modified natural stream must have the typical biological, hydrological, and physical characteristics commonly associated with the continuous conveyance of water.

'Ditch or canal' means a man-made channel other than a modified natural stream constructed for drainage purposes that is typically dug through inter-stream divide areas. A ditch or canal may have flows that are perennial, intermittent, or ephemeral and may exhibit hydrological and biological characteristics similar to perennial or intermittent streams.

B. **Delete the definition for 'stream channel':** That phrase is redundant since the definitions of stream types and ditch in 1.A. above are inclusive of the concept of 'channel' when appropriate.

C. **Add the definition of 'normal rainfall':** The term is included in the definition of perennial stream and is a standard term used by the National Climatic Data Center of the National Oceanic and Atmospheric Administration (NCDC) to refer to a 30-year mean of rainfall. The normals are computed every 10 years for the most recent 30-year period, the most recent data being that for the period 1971-2000. Both the NCDC and the National Water and Climate Center of the Natural Resources Conservation Service (NWCC) provide data on normal temperature and rainfall for all climate stations in North Carolina: (NCDC) http://www5.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl?directive=prod_select&subrnum= ; (NWCC) http://www.wcc.nrcs.usda.gov/climate/wetlands.html

D. **Delete the definition of 'normal flow':** This is not a standard hydrologic term. If the applicability of the term became germane to a specific regulatory situation, then extensive rainfall and streamflow data would be required to determine whether normal flow existed in a particular stream.

E. **Delete the definition of 'perennial surface waters':** This definition is similar to and redundant with the definition of 'perennial water body'. See below.

F. **Revise the definition of 'perennial water body':** This definition is consistent with that in the Neuse Buffer Rule. However, the policy on what type of channel constitutes '… part of a natural drainageway, (i.e., connected by surface flow to a stream)….' is not clearly specified in the Neuse Buffer Rule. The policy that was originally approved by the Neuse Buffer Rules Stakeholders Committee and is applied by NCDWQ is that the connection of a regulated perennial water body to the stream network must be an intermittent or perennial stream. That policy eliminates small ponds that occur at a relatively high elevation on the landscape and are hydrologically isolated from the stream network except for occasional discharges of stormflow. So, it is recommended that the phrase 'connected by surface flow to a stream' be revised to read 'connected to the stream network by an intermittent or perennial stream or modified stream'.

G. **Delete the definitions of 'stream buffer' and 'watershed buffer' and add a more general definition of 'riparian buffer' that covers all instances of regulated riparian zones.** 'Riparian zone' is a standard ecological term that refers to the terrestrial zone adjacent to any water body. "Riparian buffer' also has become widely accepted to mean a vegetated riparian zone that provides a buffer between a water body and an adjacent area in which the natural vegetation has been converted to some other use.

H. **Revise the definition of 'stream bank':** The current definition includes the ill-defined and non-standard term 'normal stream flow'. It is recommended that 'stream bank' be defined in accordance with the bankfull elevation. Bankfull is a standard geomorphic term widely used in the scientific, government, and environmental consulting communities and there are standard methods for determining the bankfull elevation from indicators in a stream (Leopold 1994, Rosgen 1996). Bankfull is a standard term used in the NCDWQ Stream Classification Method and determining bankfull elevation is part of the training course for use of the method.

I. **Revise the definition of 'water course' for completeness and consistency with the new or revised definitions noted above.**

J. **Revise the definition of 'surface water' for completeness and consistency with the new or revised definitions noted above.**

2. **Delete the references to maps that are in some of the current definitions of types of surface waters and add a paragraph on applicability of the Resource Conservation District rules in section 3.6.3(a) that refers to the use of maps and field evaluation methods to determine the presence of regulated surface waters.** Two issues should be addressed in this policy statement:
   A. The maps that will be used as reference sources for the determination of the locations of regulated surface waters.
   B. Field verification of the presence of surface waters and stream origins will take precedence over map depictions for features: (1) that are not accurately represented on the maps, (2) that are present but not shown on the maps, and (3) that are shown on the maps but are not present on the ground.

3. **Intermittent Stream Field Evaluation Method:** Adopt the current version of the NCDWQ Stream Classification Method for field evaluation of intermittent streams with a minimum score of 19 points. The field form and the Internal Guidance Manual (Version 2.0, January 19, 1999) are included in Appendix 1 (http://h2o.enr.state.nc.us/ncwetlands/strmfrm.html).

4. **Perennial Stream Field Evaluation Method:** Adopt the following two-part method:
   A. Use the current version of the NCDWQ Stream Classification Method with a minimum score of 30 points to make a tentative determination of the stream origin and stream type.
   B. Conduct a survey of macroinvertebrate organisms in the vicinity of the tentative stream origin to determine the presence and relative abundance of biological indicators of perennial flow. Adopt a procedure similar to that approved by NCDWQ for the stream inventory conducted in Greensboro in 2000/2001: Modified NCDWQ Stream Classification Method for Intermittent-Perennial Breakpoints for Stream Identification and Mapping for Water-Supply Watershed Protection, MACTEC Engineering and Consulting, Inc. (formerly LAW Engineering and Environmental Services, Inc.) Project 30440-0-0307. A summary of that method is included below in Appendix 2.

5. **Include specific policies on stream evaluations for streams or stream reaches that appear to be functioning lotic (flowing aquatic) systems but are natural variants that may not precisely fit the appropriate stream type definition or may not meet the minimum criteria for the appropriate stream type:**
   A. Discontinuous segments of stream channel in small streams where base flow occurs underground and there is no longer a well-defined channel. This may occur where:
      1) Base flow continues in large subsurface channels (pipe flow) between reaches that have a well-defined channel.
      2) There is a decrease in slope gradient that causes extensive deposition of coarse sediment and base flow occurs as dispersed subsurface flow until an increase in slope gradient results in the resumption of the channel.
      3) There is a decrease in slope gradient where a stream enters the flood plain of a larger stream that results in base flow occurring as dispersed subsurface flow and stormflow occurring as dispersed overland flow.
   B. Small, spring-fed streams that have significant hydrologic and biologic evidence of intermittent or perennial flow but do not have a well-developed channel. Such streams often score below 19 points on the NCDWQ Stream Evaluation Method due to the lack of high volume, high energy flows that produce many of the geomorphic indicators in the Stream Evaluation Method.
   C. Multiple channels or multi-thread channels that are depicted on maps as a single channel
      1) Two or more closely spaced, parallel channels in the vicinity of the stream origin.
      2) Multi-thread channels are reaches where a single, well-defined channel enters a reach where flow occurs in a series of several interconnected, more or less parallel channels.

6. **Include specific policies on stream evaluation for streams that have been significantly altered or degraded due to urbanization or other anthropogenic impacts:**
   A. Unstable, degraded, and scoured streams that do not exhibit the typical geomorphic features and/or biological indicators of stable, relatively unaltered streams.

B. Modified streams – provide examples of specific types of features that will be subject to the buffer requirements of the Land Use Management Ordinance.
C. Streams that begin at stormwater discharge points or the discharge outlets of piped streams.

7. **Identify and refer to the stream origin field verification procedures in the Land Use Management Ordinance but do not include the detailed procedures in the ordinance.** It is recommended that the stream origin field verification procedures be a stand-alone document that is not part of the ordinance in order to provide more flexibility for revisions over time as experience is gained in the use of the initially adopted procedures.

8. **Implement an appeals procedure for contested stream evaluations that utilizes environmental professionals who are knowledgeable and experienced in stream evaluation:** It is recommended that a permanent Surface Water Determination Appeals Board of experienced stream professionals who are not Town employees be appointed to serve as a technical appeal body. The appeals board should consist of a minimum of 3 individuals so that knowledge and experience in each of the three elements of stream evaluation are represented when any stream evaluation is conducted: stream geomorphology and soils, stream hydrology, and stream biology (particularly macroinvertebrates).

9. **Implement a policy for the length of time for which a particular stream evaluation stands for regulatory purposes:** Such a policy should include two elements, a time frame and reference to hydrologic changes. It is recommended that a stream evaluation stand for 5 years unless significant hydrologic alteration occurs in the catchment of the stream that could rapidly alter its character or the location of its origin.

10. **Implement a policy that allows for re-evaluation of stream origins that were determined prior to the enactment of the current Land Use Management Ordinance on January 27, 2003 and the stream definitions and stream origin determination methods in current use for that ordinance.** This refers to what is popularly called a 'grandfathering' provision when new regulations are enacted. The policy should specify under what conditions a previously determined stream origin will stand and what conditions will provide for a re-evaluation under the current ordinance provisions.

Appendix 1: NCDWQ Stream Classification Method

The NCDWQ Stream Classification Method is a field procedure for determining the origin of the regulated stream for the purpose of applying riparian buffer rules (http://h2o.enr.state.nc.us/ncwetlands/strmfrm.html). The field form (NCDWQ Stream Classification Form) and the Internal Guidance Manual for use of the form are included below. The method was originally developed by Eric Fleek of the NCDWQ Wetlands/401 Unit and subsequently was reviewed, tested, and revised by the NC Stream Technical Advisory Committee. Used in two different river basins in NC, the Neuse and Tar-Pamlico, and the Randleman Reservoir watershed for buffer rule applications, the procedure has been tested in all three physiographic regions of NC, is routinely used in the Piedmont and Coastal Plain regions for buffer rule applications and throughout the state for 401 certification applications. State regulatory personnel involved in buffer rule field applications are required to successfully complete a training and certification workshop conducted by NCDWQ to ensure consistent application of the method. Fred Royal has successfully completed that training.

The Stream Classification Method consists of a series field indicators that are evaluated in a reach of the stream in question and awarded points in accordance with presence and degree of development or expression of each indicator. If the stream attains a total of 19 or more points, then the reach is judged to be at least intermittent and therefore, subject to the buffer rule. In practice, experienced field personnel select a tentative stream origin and then assess the channel both upstream (if present) and downstream of the origin using the Stream Classification Form to verify the origin determination. The field indicators are evaluated in a reach of the stream 50 ft or more in length to determine the average condition in the reach.

Three different types of field indicators, geomorphology, hydrology, and biology are organized into two main groups: primary field indicators and secondary field indicators. The geomorphology indicators assess the degree of channel development. The hydrology indicators focus on the presence of base flow or indicators of the flow regime. The biology indicators focus on the presence of aquatic versus terrestrial plants and the presence of aquatic animals.

NCDWQ Stream Classification Form

Project Name:	River Basin:	County:	Evaluator:
DWQ Project Number:	Nearest Named Stream:	Latitude:	Signature:
Date:	USGS QUAD:	Longitude:	Location/Directions:

PLEASE NOTE:** ***If evaluator and landowner agree that the feature is a man-made ditch, then use of this form is not necessary. Also, if in the best professional judgment of the evaluator, the feature is a man-made ditch and not a modified natural stream—this rating system should not be used*

Primary Field Indicators: **(Circle One Number Per Line)**

I. Geomorphology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Riffle-Pool Sequence?	0	1	2	3
2) Is The USDA Texture In Streambed Different From Surrounding Terrain?	0	1	2	3
3) Are Natural Levees Present?	0	1	2	3
4) Is The Channel Sinuous?	0	1	2	3
5) Is There An Active (Or Relic) Floodplain Present?	0	1	2	3

6) Is The Channel Braided?	0	1	2	3
7) Are Recent Alluvial Deposits Present?	0	1	2	3
8) Is There A Bankfull Bench Present?	0	1	2	3
9) Is a Continuous Bed & Bank Present?	0	1	2	3
*(*__NOTE__: If Bed & Bank Caused By Ditching And __WITHOUT__ Sinuosity Then Score=0*)*				
10) Is a 2nd Order Or Greater Channel (As Indicated On Topo Map ***And/Or*** In Field) Present?	***Yes***=3		***No***=0	

PRIMARY GEOMORPHOLOGY INDICATOR POINTS: _____

II. Hydrology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Groundwater Flow/Discharge Present?	0	1	2	3

***PRIMARY HYDROLOGY INDICATOR POINTS*:_____**

III. Biology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Are Fibrous Roots Present In Streambed?	3	2	1	0
2) Are Rooted Plants Present In Streambed?	3	2	1	0
3) Is Periphyton Present?	0	1	2	3
4) Are Bivalves Present?	0	1	2	3

PRIMARY BIOLOGY INDICATOR POINTS: _____

Secondary Field Indicators: (Circle One Number Per Line)

I. Geomorphology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Head Cut Present In Channel?	0	.5	1	1.5
2) Is There A Grade Control Point In Channel?	0	.5	1	1.5
3) Does Topography Indicate A Natural Drainage Way?	0	.5	1	1.5

SECONDARY GEOMORPHOLOGY INDICATOR POINTS: _____

II. Hydrology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is This Year's (Or Last Year's) Leaflitter Present In Streambed?	1.5	1	.5	0
2) Is Sediment On Plants (Or Debris) Present?	0	.5	1	1.5
3) Are Wrack Lines Present?	0	.5	1	1.5
4) Is Water In Channel ***And*** >48 Hrs. Since Last ***Known*** Rain? *(*NOTE: If Ditch Indicated In #9 Above Skip This Step And #5 Below*)*	0	.5	1	1.5
5) Is There Water In Channel During Dry Conditions ***Or*** In Growing Season)?	0	.5	1	1.5
6) Are Hydric Soils Present In Sides Of Channel (Or In Headcut)?	***Yes****=1.5*		***No***=0	

SECONDARY HYDROLOGY INDICATOR POINTS: _____

III. Biology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Are Fish Present?	0	.5	1	1.5
2) Are Amphibians Present?	0	.5	1	1.5
3) Are Aquatic Turtles Present?	0	.5	1	1.5
4) Are Crayfish Present?	0	.5	1	1.5
5) Are Macrobenthos Present?	0	.5	1	1.5
6) Are Iron Oxidizing Bacteria/Fungus Present?	0	.5	1	1.5
7) Is Filamentous Algae Present?	0	.5	1	1.5

8) Are Wetland Plants In Streambed?	**SAV**	**Mostly OBL**	**Mostly FACW**	**Mostly FAC**	**Mostly FACU**	**Mostly UPL**
(__NOTE:__ If Total Absence Of All Plants In Streambed As Noted Above Skip This Step __UNLESS__ SAV Present*).*	2	1	.75	.5	0	0

SECONDARY BIOLOGY INDICATOR POINTS: _____

TOTAL POINTS* (Primary + Secondary) = _____ (*If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)

Notes:

INTERNAL GUIDANCE MANUAL

N.C. DIVISION OF WATER QUALITY STREAM CLASSIFICATION METHOD

January 19, 1999
Version 2.0

Introduction

This stream evaluation method is intended to distinguish ephemeral channels from intermittent channels. The numerical rating system format was developed based on repeated requests from the regulated community for an objective method of stream evaluation. The 19 point minimum score for determining an intermittent channel was based on the results of over 300 individual field trials conducted in the Piedmont and Coastal Plain portions of the Neuse River Basin during May, June, July and August of 1998, as well as field testing conducted during December 1998 and January 1999. The four tiered weighted scale used for this system is in response to the intrinsic variability of stream channels. The score ranges were developed in order to better assess the often gradual (and sometime variable) transition of streams from ephemeral to intermittent.

Previous versions of this form used a 'yes'/ 'no' format and was found by NCDWQ staff and by the regulated community to be inadequate to properly encompass and assess the natural variability encountered when making stream determinations in the field. Moderate characters are intended as an approximate qualitative midpoint between the two extremes of Absent and Strong. The remaining qualitative description of Weak represents gradations that will often be observed in the field. The 'in between grades' are intended to allow the evaluator the required flexibility in assessing inherently variable features. In addition, the small increments in scoring between gradations will help reduce the range in scores between different evaluators.

How To Use The Classification

I. The Classification Form

The four tiered weighted scale is designed to encompass the range in variability of each character likely to be observed in the field. The Primary and Secondary indicators are weighted to reflect the relative importance that each character has in determining Intermittent channels from Ephemeral channels. Absent, Weak, Moderate, and Strong are defined below. **These definitions are intended as guidelines**. Personal experience and best professional judgment should also be employed in conjunction with these guidelines when evaluating streams. The evaluator must select the most appropriate number for each variable—selection between those in the form is not allowed.

Absent: The character is not observed. (On a scale of 1 to 10, Absent = 0)

Weak: The character is present but you have to search intensely (i.e., ten or more minutes) to find it. (On a scale of 1 to 10, Weak =1, 2, or 3).

Moderate: The character is present and observable with mild (i.e., one or two minutes) searching. (On a scale of 1 to 10, Moderate = 4, 5, or 6).

Strong: The character is easily observable. (On a scale of 1 to 10, Strong = 7 to 10).

Examples:

(**These are intended as guidelines and the numbers given are provided only for a general reference. The numbers **should not necessarily** be taken literally**).

Fish: Absent: No fish, even after an intense 10 minute search of a large (e.g., 200') linear stretch of stream. Fish sampling should be conducted visually and with a dip net.
Fish Weak: One or two fish found after an intense search.
Fish Moderate: After a mildly intensive search (i.e., 1 or 2 minutes), you see four or five individual fish, **or** one small school.
Fish: Strong: Upon casual observation, you see a half dozen fish **and/or** two or three small schools.

Meanders: Absent: The stream is straight.
Meanders: Weak: Nearly all of the stream is straight, only one or two very small bends.
Meanders: Moderate: Most of the stream is straight although there are a few bends. One or two of these bends may be large.
Meanders: Strong: Large portions of the stream bend. The bends will mostly be large or exaggerated.

II. Field Use Of The Classification System

***A*. Channel Assessment Methodology**

Streams are drainage features that change from ephemeral to intermittent to perennial along a gradient or continuum—often times with no single distinct point demarcating these transitions. In order to determine ephemeral streams from intermittent ones using this classification system, the field evaluator must exercise caution. Determinations must not be made at one point without first walking up and down the channel. This initial examination allows the evaluator to examine and study the nature of the channel, make judgments about what is happening in the watershed, and make mental notes (based on the characters used in the classification form) about where along the reach in question the channel likely changes from ephemeral to intermittent. As a general rule of thumb, several hundred feet (sometimes much more) of channel should be walked to make these determinations. It is not possible to make decisions regarding ephemeral versus intermittent from evaluating a single point along the channel.

B. Addressing Weather Induced Variability

As channels convey water, their rate and duration of flow is influenced by recent and long-term weather. In order to 'filter' out some of this variability, it is **STRONGLY** recommended that field evaluations be conducted at least 48 hours after the last known rainfall. However, please note that the classification method has been designed with enough built in redundancy to allow for reasonably accurate ratings even after a recent rainfall.

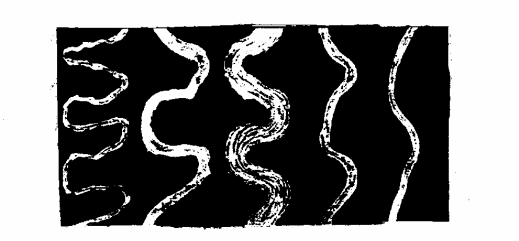
Primary Indicators
I. Geomorphology

1) Riffle-Pool Sequence. Pools: Areas of slow moving water. These usually form where the stream widens. Riffles: Shallow areas extending across the streambed where the water moves faster. Usually these areas occur when the stream narrows. Sometimes this faster moving water runs over small rocks, cobble or pebbles (although rocks aren't always needed for a riffle).

2) USDA Texture In Streambed: Is the material comprising the bottom of the stream different than the material comprising the surface of the ground surrounding the stream? (For example: Are there small pebbles, gravel or sand in the stream whereas the surrounding land is covered with leaves or topsoil, etc.)?

3) Natural Levees: Are there large 'mounds', 'hills', or broad low 'ridges' of sand or silt deposited parallel (or nearly so) to the stream on its floodplain and adjacent to one or both of its banks? These features may be covered with trees and shrubs or they may be barren sand or silt.

4) Sinuosity: Does the stream bend? Are there curves in the stream? These bends or curves can be small or large. More formally, sinuosity is the ratio of the length of the channel to the down valley distance (i.e., 1:1 = straight channel).



5) Active (Or Relic) Floodplain: A flat (or nearly flat) lowland that borders a stream, is covered by its waters at flood stage, and is built of organic matter and/or alluvium due to overbank deposition. These areas may have plants adapted to wet areas growing on them. Small floodplains can be found 'inside' the stream's banks in deeply incised channels. More frequently, floodplains are outside of the stream's banks.

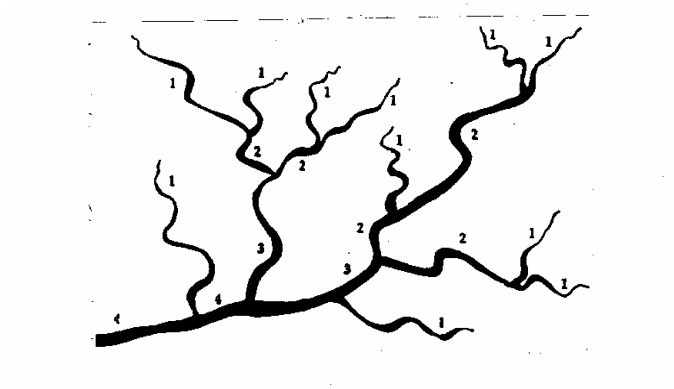
6) Braided Channels: Are there more than one small stream channels that cross or 'braid' over one another. This usually occurs in areas where the land flattens significantly and where there is abundant sediment supply in a wide streambed with shallow water flow.

7) Recent Alluvial Deposits: Are there recent deposits or accumulations (in the stream or on adjacent floodplains) of sand, silt, cobble, or gravel?

8) Bankfull Bench: When you look at the side of the streambank is there a nearly continuous 'bench' eroded into the channel which has accumulated sand or silt. This area is often covered with plants. In dry times when the stream is low, you can often see it part way up the bank. In wet times you may not be able to see it as the stream will be flowing over the bench.

9) Bed And Bank: Is the water in the stream in a well-defined channel surrounded or 'contained' by a higher bank area. In small streams the bank may be very low (sometimes only a few inches) and may not necessarily be a continuous feature.

10) 2nd Order Or Greater Channel: To your knowledge (you can look at SCS County Soils Survey Maps or U.S. Geological Survey Maps, or use field observations) is the channel that you are looking at have one (or more) other channels flowing into it?



Primary Indicators
II. Hydrology

1) Ground Water: Seeps: Usually seeps have water dripping or slowly flowing out from the ground or from the side of a hill. Water Table: If you dig a hole in the ground near the stream (not in the streambed) of approximately a foot deep and water fills it (usually this will be a slow process) the water table is high and may help keep the stream flowing in dry seasons. High water tables are most common in the Coastal Plain.

Primary Indicators
III. Biology

1) Fibrous Roots: When you look in the bottom (or edge) of the stream, are there very small (almost 'hair-like') roots there? Fibrous roots do not include roots larger than half the thickness of a finger and are not generally 'woody' in appearance or consistency.

2) Rooted Plants In Streambed: Are there plants growing in the **bed** of the stream? Plants growing on any part of the bank of the stream should not be counted.

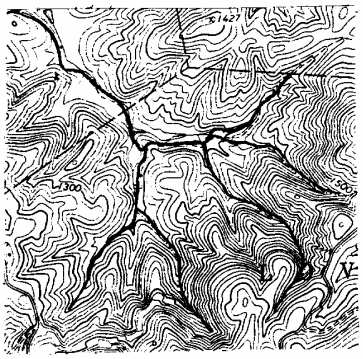
3) Periphyton: When you look on rocks, logs, plants, or twigs in the water is there a 'slimy' or 'spongy-leafy' growth of algae or very small plants present? Usually the color is a brown-green or dark brown, although this growth can take on the color of the silt or sediment present in the stream.

4) Bivalves: Are there clams or mussels in the stream? To look for them, dig around in the streambed or look for them where plants are growing in the streambed. Also, look for empty shells washed up on the bank. Some bivalves (e.g., Fingernail clams) can be pea-sized or smaller.

Secondary Indicators
I. Geomorphology

1) Head Cut: An abrupt vertical drop in the bed of a stream channel. It often resembles a small intermittent waterfall (or a miniature cliff). Intermittent streams sometime start at these areas.
2) Grade Control Point: Often this feature is distinguished by a large rock outcrop in the channel or by a large root which extends across the channel. These structures separate an abrupt change in grade of the stream bed.

3) Topography Indicating A Natural Drainage Way?: When looking at the local topography in the field (or on a U.S. Geological Survey Map) does the land slope towards the channel (or are the contour lines fairly close together and roughly sinuous in shape and thereby indicating a 'draw'?). In other words, does the land have slopes that seem to drain to or indicate a natural drainage way?



Secondary Indicators
II. Hydrology

1) This (Or Last's) Years Leaf litter Present In Streambed: Are there leaves (freshly fallen, or some may be 'blackish' in color and/or partially decomposed) present in the streambed?

2) Sediment On Plants (Or Debris): Are plants (or rocks, logs, or other debris) in the stream (or on the streambank or flood plain) stained white, gray, red, brown, or reddish-brown with sediment?

3) Wrack Lines: Are twigs, sticks, logs, leaves, or other floating material (including litter such as plastic soda bottles, beer cans, styrofoam, etc.) piled up on the upstream side of obstructions in the stream, on the streambank, and/or in the floodplain?

4) Water In Channel >48 Hrs. Since Last Known Rainfall: Intermittent streams do not always have water in them. Water in intermittent channels may linger in pools or holes in the streambed. A good rule of thumb for distinguishing intermittent streams from ephemeral ones is if they have water in them for more than 48 hours since the last rain.

5) Water In Channel During Dry Conditions Or In growing Season? Intermittent streams do not always have water in them. Look for water in pool areas or in holes in the streambed. Another good rule of thumb for differentiating ephemeral streams from intermittent ones is if they have water in them during dry (drought) conditions or during the growing season.

6) Hydric Soils In Sides Of Channel (Or In Headcut): Are hydric soils present in the sides of the channel or in the headcut? Use a soil auger to sample these areas for hydric soil indicators.

Secondary Indicators
III. Biology

1) Are Fish Present: Look for fish in pools or other areas of standing water in the stream. In addition, look under overhangs in the bank, near tree roots, on the downstream side of rocks or other large obstructions, or in and around plants.

2) Are Amphibians Present: Look for frogs near the bank and in the water (also look for tadpoles in the water). Salamanders may also be found under rocks, logs, or leaf packs in the stream or in very moist leaf litter, moss, or logs (and under rocks) next to the stream.

3) Are Aquatic Turtles Present: Look for turtles on rocks or logs in the stream or in and around rocks and logs in areas adjacent to the stream. Also look for turtles basking in areas exposed to sunlight.

4) Crayfish: Look for crayfish in small pools, under rocks, under logs, sticks or within leaf packs in the stream. Additionally, look for small holes in the muddy streambank or look for distinct 'chimneys' (roughly cylindrical chimneys) on the muddy bank.

5) Macrobenthos: Look under rocks, logs, twigs, and leaf packs. Also look under the streambank and in (and on) any vegetation in the stream. If you have a dip net, drag it around the streambank and in any vegetation or leaf packs present. If you have a kick net set it up downstream of any riffles and kick (and 'wash') the rocks in the riffle so that the material disturbed is caught in the downstream net. The use of nets for this step is strongly recommended.

6) Iron Oxidizing Bacteria/Fungus: In slow moving (or stagnant) areas of the stream are there clumps of 'fluffy' rust-red material in the water? Additionally, on the sides of the bank (or in the streambed) are there red or rust colored stains (usually an 'oily sheen' or 'oily scum' will accompany these areas) on the soil surface? These features are often (although not exclusively) associated with groundwater.

7) Filamentous Algae: In slow moving areas (or in pools or stagnant areas) are floating green algae (usually not attached to rocks or logs) present?

8) Wetland Plants In Streambed: Are plants usually associated with wet areas present in the streambed? For example, cattails or black willow? (For determining OBL, FACW, FAC, FACU, or UPL **See Appendix I)** . Submerged aquatic vegetation (SAV) includes rooted plants that generally grow totally submerged under the water's surface.

Appendix 2: Perennial Stream Origin Evaluation Method

Dave Penrose, NCDWQ Wetlands/401 Unit, proposed a procedure for determining perennial stream origins in the course of planning a project to inventory and map intermittent and perennial stream origins in the City of Greensboro, NC. An assessment of aquatic animals is coupled with an assessment of the stream using the Stream Classification Method. Macroinvertebrates and other aquatic animals that commonly inhabit streams with perennial flow are divided into primary and secondary indicators. The new biotic assessment procedure was approved by NCDWQ for Greensboro's stream inventory but awaits further testing in other areas of the state.

The field teams relied on the presence of key biological indicators to determine the perennial start point of stream channels. Biological survey methods were based on the Ephemeroptera, Plecoptera, and Trichoptera (EPT) Method (DWQ, 1997) and the DWQ Biological Reconnaissance Form (DWQ, 2000[2]). This method is designed as a rapid sampling technique and is not intended to be an exhaustive biological survey. The collection method focused on the identification of Primary and Secondary Perennial Indicators of the benthic community that typically require perennial conditions. Once indicator organisms were found, the field team supplemented the perennial determination with an evaluation of the channel using the DWQ Stream Classification Method along with additional data and field observations. Since many of the biological indicators are intolerant of the environmental stresses typically encountered in urban conditions, highly modified and impacted urban streams necessitated less reliance upon biology for establishment of the perennial start point. In highly impacted systems where biology was correspondingly weak, geomorphologic and hydrological indicators gathered via the DWQ Stream Classification Method along with pertinent, documented field observations took precedence in the determination of IP or EP transition points.

The perennial stream origin was established at the point where key biological indicators, if present, were located. The field team then evaluated the reach downstream using Version 2.0 of the DWQ Stream Classification Method along with additional information and field observations. The channel was evaluated for approximately 200 feet or until an obvious geomorphologic feature and/or change was encountered, whichever occurred first. A rating score was documented for each IP and EP. Once the point was established, it was marked and recorded using a hand-held GPS unit.

A partial list of the primary and secondary aquatic indicators used to make the determination of perennial stream origins is provided below:

Primary Indicators	Secondary Indicators
Mayflies (Ephemeroptera) Baetidae *Stenonema spp.* Stoneflies (Plecoptera) *Eccoptura spp.* Caddisflies (Trichoptera) Hydropsychidae *Psilotreta spp.* *Neophylax spp.* *Diplectrona spp.* *Chimarra spp.*	Hellgrammites (Corydalidae) Snails (Gastropoda) Crayfish (Decapoda) Leeches (Hirudinea) Clams (Bivalvia) Beetles (Coleoptera) Two-lined salamander (*Eurycea bislineata*)

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