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Best Management Practices (BMP) Monitoring Manual—Field Guide:

Implementation and Effectiveness for Protection of Water Resources

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Best Management Practices (BMP) Monitoring Manual—Field Guide:

Implementation and Effectiveness for Protection of Water Resources

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Origin of the BMP Protocol Project

The BMP protocol project is a cooperative effort of the USDA Forest Service Northeastern Area State and Private Forestry (NA S&PF) and the Northeastern Area Association of State Foresters–Water Resources Committee (NAASF–WRC), Steven Koehn, Maryland State Forester, chairperson. The project has been funded by grants from NA S&PF and the U.S. Environmental Protection Agency (EPA).

The original concept and question sequence was developed by Roger Ryder and Tim Post of the Maine Forest Service in collaboration with David Welsch and Albert Todd of the USDA Forest Service. The Forest Service proposed the method to the NAASF–WRC and the EPA for development as a potential regional protocol. After the withdrawal of the Maine Forest Service, David Welsch served as the project coordinator through the development, testing, and implementation of the project.

State forestry agencies from Delaware, Indiana, Maine, Maryland, Massachusetts, New Hampshire, New York, Ohio, Pennsylvania, Vermont, Virginia, West Virginia, and Wisconsin, as well as the New York City Watershed Agricultural Council Forestry Program, the USDA Forest Service Northern Research Station, and the Northeastern Area State and Private Forestry, have collaborated in the development and testing of the BMP protocol.

The report generation and analysis phases of the project were developed by Kristina Ferrare of the University of Massachusetts–Amherst, Watershed Exchange and Technology Partnership.

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Chapter 1—Introduction

Section 319 of the Federal Water Pollution Control Act of 1972 (33 U.S.C. sec. 1251–1387), known as the Clean Water Act, defines the term *best management practice (BMP)* as a practice or measure that has been demonstrated to be successful in protecting the water resources of the United States from nonpoint source pollution. The BMP Protocol Project is an effort to develop a standard method for monitoring the use and effectiveness of best management practices commonly used in timber harvesting.

Background

The U.S. Environmental Protection Agency (EPA) was tasked with executing the Clean Water Act (CWA). Sections 208, 319, and 404 of the CWA require States to identify and quantify nonpoint sources of pollution as well as to develop and implement programs to address and lessen the amount of pollutants entering U.S. waters.

Forestry operations such as timber harvesting—or silvicultural activities as they are described in the CWA—are among the many activities regulated under sections 208, 319, and 404 of the CWA. Permits are required in order to conduct activities that may impact the waters of the United States. Although silvicultural activities are responsible for relatively small contributions to surface water pollution compared with other land uses, nonpoint source pollution resulting from silvicultural activities can result in the deterioration of water quality.

The CWA provides an exemption from the permitting requirement if appropriate BMPs are used and are effective in preventing adverse effects on the quality of water resources. The silvicultural exemption, as the clause is known, thus relieves silvicultural activities from the permitting requirement of the CWA if BMPs are used effectively. Monitoring is needed, however, to document the use and effectiveness of BMPs in forestry.

Over the years, litigation has attacked the silvicultural exemption, and the need to comply with Total Maximum Daily Loads has further reinforced the need for the effective use of BMPs. As a result, the EPA has been seeking BMP use and effectiveness data that is reliable and comparable among States as evidence of compliance with the provisions of the CWA.

Research studies have repeatedly shown that BMPs can be effective if applied correctly and in a timely manner.[1] To date, however, monitoring of effective BMP usage has often been sporadic, inconsistent, and largely anecdotal.

Purpose of the BMP Protocol

The specific purpose of the BMP protocol is to create an economical, standardized, and repeatable BMP monitoring process that is completely automated, from data gathering through report generation, in order to provide measured data, ease of use, and compatibility with State BMP programs.

The protocol was developed to meet the following needs:

- Document the use and effectiveness of BMPs in protecting water resources during forest harvesting operations.
- Document the degree of compliance with the Clean Water Act as well as the Coastal Zone Management Act and various State laws and regulations.
- Assess water resource protection based on the effectiveness of a collective set of BMPs rather than documenting the use of individual prescriptive methods or practices.
- Increase credibility through the measurement of results as opposed to observation and anecdotal assessments.
- Respond to public concerns regarding the potential effects of timber harvesting based on measured evidence.
- Identify opportunities for improvement in water resource protection by identifying causes of BMP failure.

[1] Kochenderfer, James N.; Hornbeck, James W. 1999. Contrasting timber harvesting operations illustrate the value of BMPs. In: Stringer, Jeffrey W.; Loftis, David L., eds. Proceedings, 12th central hardwood forest conference; 1999 February 28–March 2; Lexington, KY. Gen. Tech. Rep. SRS–24. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 128–136.

- Facilitate focused agency and industry BMP training programs by identifying problems with the implementation of individual practices.
- Identify opportunities to improve or simplify BMP practice specifications.
- Facilitate self-assessment of water resource protection efforts by States, industry, and other forestry organizations, and encourage more frequent monitoring.
- Facilitate green certification.

Description of the BMP Protocol

The BMP protocol is an automated monitoring system with three functions: data collection, data analysis, and report generation.

Data is collected using a branched question set designed to efficiently address those areas of the timber harvest with the greatest potential to impact water resources: water crossings; haul roads, log landings, and skid trails; chemical pollutants; buffer/filter strips; and wetlands.

The protocol question software was developed for use with commonly available software and hardware platforms. A variety of inexpensive pocket PC units or more costly GPS units can be used for field data collection. These field units use Windows Mobile software to link and upload data to a desktop computer. Microsoft Access, Excel, and Word—inexpensive software programs commonly available in forestry offices—are used to analyze the data and produce an automated data summary. GPS data recorded in the process permit analysis of any conceivable geographical unit.

Users can create customized reports suitable for different audiences by adding commentary and photos to the data summary to further explain results.

Features of the protocol include the following:

- State- or user-controlled statistical sample design
- Single field assessor–single visit sampling procedure
- Branched question set and data recorder program
- Computer-generated standard data summary
- Discrete georeferenced sample units
- Quality control resampling
- Analysis of potential site- and operator-associated risks by geographical area or individual timber sale
- State or user interpretation and report design
- Ability to design custom data queries

Organization of the BMP Manual

The documentation to accompany the BMP protocol software is contained in two volumes—this field guide and a desk reference. The two-volume set is informally referred to as the BMP manual.

Chapters 2 and 3 of the BMP field guide cover issues that need to be addressed before beginning data collection. Chapter 4 contains the full text of the protocol questions, which augment the abbreviated text used in the software. The appendixes address such topics as definitions of terms, training field personnel, equipment specifications, and installing the software. Chapter 4—Questions and Appendix C—Definitions should be made available to personnel in the field during data collection.

The companion BMP desk reference provides instructions for querying the data and producing standard data summaries.

Chapter 2—Administration

Sample Site Selection

The BMP protocol records conditions found on sample units within sample sites. Sample sites are timber sales and sample units are, by protocol definition, portions of timber sales. The process of sample selection begins with a selection of sample sites (timber sales). Field personnel then travel to a sample site and randomly select one or more sample units (portions of the timber sale) on which to measure and record data.

Since recordkeeping and record availability vary considerably from one State or organization to another, a specific scheme for the identification of sample sites must be developed by the individual State or organization using the protocol. Any scheme that draws an adequate random sample of timber sales from tax records, cutting plans, or other databases in the area and time period desired is considered sufficient for the protocol. Tax records, cutting permits, highway entry permits, soil and erosion control plans, forest management plans, and other records offer sources of data from which to draw a sample. Where no records exist, aerial reconnaissance has been used to locate timber harvest sites.

Since the number of samples that can be measured is usually constrained by the time, personnel, and resources available, a simple random sample is recommended. Stratification of samples is generally discouraged for protocol use unless deemed necessary to fulfill a user's unique monitoring needs.

Stratified sampling offers some advantages in reliability for addressing certain conclusions drawn from the monitoring data; however, it is more suitable for an intensive research study design. If sample sites are to be stratified, the number of samples in each stratum must be large enough to ensure statistical accuracy. A general rule is that a minimum of 30 samples per strata is required.

In a practical sense, distributing monitoring responsibility among the field workforce without stratifying may be accomplished by drawing a totally random sample and then distributing the field work among the personnel available to assess the sites.

A more detailed discussion of statistical design and sample site selection can be found in the BMP desk reference. Delineation and selection of individual sample units within the timber sale are covered in chapter 3 of this field guide.

Quality Control

Good quality control requires consistency among the various members of the sampling team in both philosophy and procedure.

When answering the protocol questions, team members should adhere to the philosophy that although economics is always a consideration in forestry activities, it remains secondary to resource protection. Once the sale area is entered or an existing road or other facility is reused by the timber sale operator, it must be considered the responsibility of the operator to control potential adverse impacts and stabilize the site. If the operator fails to do so, it will be reflected in the answers to the protocol questions.

The protocol requires remeasuring sample units at random using different sampling teams. The units should be remeasured soon after the initial sampling to reduce the possibility of changes in evidence as a result of weather-related events. Quality control resampling teams should be given the initial team's answers to the general questions G1 through G11, as well as the GPS locations of the features sampled. This will ensure that the quality control team bases its answers on the same information and remeasures the exact same location.

The sample unit coding system enables a given sample unit number to be coded as a new sample unit and again as a quality control sample unit. A reconciliation of the data collected by both sampling teams can then be made to locate errors and ensure consistency of measurement among field personnel. If there are numerous inconsistencies, it may be necessary to bring all of the sampling teams together for additional training.

Quality control resampling was conducted during the testing of the protocol. Fifty-six quality control samples were drawn from the original 631 sample units for remeasurement. Results of this quality control resampling can be found in the BMP desk reference.

Recordkeeping

The procedure for uploading sample unit data to a desktop computer is included in appendix A. It is recommended, however, that the following additional records be kept:

- A **sample file** containing sample unit number, date, and field crew
- A **quality control file** containing quality control sample number, date, and field crew
- A **quality control reconciliation file** containing sample unit and quality control sample unit numbers, field crews, date of sample reconciliation, results of the reconciliation, and any training needs indicated
- A **training file** containing field crews and dates of any additional training provided

See Data Archiving (page 5) for recommendations on archiving sample unit data.

Field Personnel

Qualifications

Field personnel should have a thorough working knowledge of forest and timber sale access system design and layout, with emphasis on water resource protection, forest road construction, and soil stabilization. On-the-ground experience in timber sale administration is desirable.

Training

Training and experience contributes to effective implementation of the protocol. Training for participants generally takes about 2 days, with an additional day of data handling instruction for the project coordinator. A typical training schedule is provided in appendix B.

The branching nature of the questions and the conditions present on the ground limit the number of questions answered in any given sample unit, making the process simpler and more intuitive than it may appear at first glance. However, training is necessary to conduct the kind of insightful investigation that leads all participants to recognize the on-the-ground evidence and to arrive at accurate, consistent assessments.

Adhering to the Protocol

Field personnel should read and understand the protocol directions outlined in this field guide before collecting data in the field. The following items are of utmost importance to maintain the integrity of the data collected:

- Adhere to the definitions of terms found in appendix C. Do not default to personal interpretations or local usage.
- Reread the question and explanation in chapter 4 if the abbreviated version of the question displayed on the field data recorder leaves the meaning in doubt.
- Answer each question as instructed in chapter 4. Some answers may be left blank if in doubt, but all questions that include answers with "go to" instructions (e.g., go to question HB137) must be answered. Do not redefine questions and answers. Recording answers based on codes and meanings other than those in this field guide renders the data useless.
- Report only what can actually be seen on the site at the time of data collection. Do not speculate unless asked to do so in the specific question being answered.

Field Teams

The ideal field monitoring team consists of two qualified people. Two differing opinions and the discussions that ensue often result in more insightful sample unit assessments.

The use of inexperienced temporary employees is not recommended. However, including additional concerned individuals on the sampling team offers the opportunity to teach the participants and often results in greater credibility for the monitoring process.

Field Equipment

The BMP protocol is based on measurable evidence. The following equipment or equivalent is often necessary for answering the questions and making the measurements.

- Pocket PC or similar device with minimum 256 MB memory card
- BMP protocol software

- GPS unit set to read latitude and longitude in decimal degrees based on the datum WGS 84
- Clinometer with percentage scale
- Convex spherical crown densitometer
- Basal area factor (BAF) 10 prism or angle gauge
- Measuring tape (50 feet or longer)
- Folding rule or measuring stick (inches) (optional)
- Hip chain (optional)

Computer Requirements

Office Equipment

The BMP protocol is designed to operate on hardware and software typically available in most government and industrial forestry offices in order to maximize efficiency and minimize additional cost:

- Desktop (or laptop) computer with at least one USB port to connect to the pocket PC
- Windows 2000 or Windows XP operating system
- Microsoft Access, Excel, and Word programs (if using the 2002 version of Microsoft Word, download and install Service Pack 3 from the Microsoft Web Site)

Field Data Recorders

The BMP protocol software is designed to run on any pocket PC, GPS unit, or similar device using the Windows Mobile 3, 4, or 5 operating system and containing a memory card with at least 256 MB of memory. A charging device designed for vehicular use and an extra extended-life battery have proven very helpful in the field. For more information on equipment specifications, see appendix D.

Much frustration can be avoided by becoming familiar with the field data recorder prior to the protocol training and use in the field.

Make sure that the unit is equipped with a memory card and that it is in place. Charge the unit completely as directed in the owner's manual. Follow the procedure described in appendix A to load the BMP protocol software. Back up the BMP protocol program by saving it to the memory card. In the event of a dead battery, the BMP protocol can then be retrieved by changing or charging the battery and retrieving the program from the memory card.

All sample unit data should be saved to the memory card as soon as it is complete to eliminate the possible loss of data.

Data in the field data recorder are stored in several files that are combined with other data as they are uploaded to the desktop computer. **Follow the procedures in appendix A to upload files to the desktop computer. Do not upload data except by the procedures described or the files will not be combined correctly.**

Back up data files on the desktop computer under another filename before uploading additional data from the field data recorder to prevent data loss in the event of an upload malfunction.

Data Archiving

Data should be archived by recording the unaltered original file to a CD or other media, where it should remain unchanged. Only duplicate copies should be used for subsequent editing and corrections in order to preserve the original data. The edited and corrected copies may then be used to generate reports.

Information on training, crews, dates, and quality control activities as discussed under Recordkeeping (page 4) should be archived in a folder along with the sample unit data.

Protocol Software

The BMP protocol software, as well as the BMP field guide and desk reference, is available from the USDA Forest Service, Northeastern Area State and Private Forestry to State forestry agencies and other organizations that may wish to use it. Instructions for installing the software and uploading data are included in appendix A of this field guide.

Chapter 3—Procedure

Application of the Principles of Water Resource Protection

The BMP protocol assesses the underlying principles of water pollution prevention rather than tallying the presence or absence of individual BMPs. This concept facilitates consistent regional data collection across a wide array of State BMP practice specifications.

BMP principles include the following:

- Controlling water flow
- Stabilizing disturbed soil
- Managing chemical pollutants
- Minimizing biological impacts
- Planning the operation

The effectiveness of water flow control, for example, is measured by whether or not eroded soil reaches the water body and the distance it moves from its point of origin toward the water body. The protocol thus assesses the overall effectiveness of the suite of BMPs used rather than monitoring the simple installation of prescribed, individual practices, which do not necessarily guarantee success in protecting the quality of water resources.

Recording the type or mechanism of sediment delivery, the cause of sediment delivery, and the volume of sediment delivered provides information valuable in identifying or adjusting BMP practices to make them more effective. This approach is simple and cost effective to monitor, and facilitates a variety of scientifically defensible analyses.

Figure 3.1. Stream filled to bankfull. The shading in this photo depicts what a stream filled to bankfull in the spring or after a major storm might look like. Any material deposited below the bankfull elevation or on crossing structures within the bankfull width of the channel will eventually enter the water column as suspended sediment. Failure to accommodate a flow of this magnitude may result in washout of the crossing structure or adverse impacts to the channel.

Controlling Water Flow and Stabilizing Disturbed Soil

Success in applying the principles of controlling water flow and stabilizing disturbed soil is determined based on whether or not soil is moved and deposited in or near the water body. Because, by definition, water fills the bankfull channel every 1.5 years, soil is judged to have entered the water body when it is deposited inside the bankfull channel or on crossing structures within the bankfull width of the channel. Therefore, many protocol measurements are based on identification of the bankfull elevation and bankfull channel width.

It is relatively easy to make the assessment when the bankfull water level of the stream can be observed (figure 3.1). However, during periods of low flow it is necessary to identify the elevation of the water level at bankfull from indicators in the channel and along the floodplain (figure 3.2).

Having identified the bankfull indicators, it can be readily determined whether soil deposits are located within the bankfull width or below the bankfull elevation or both (figure 3.3). See appendix E for a more detailed discussion on the identification of bankfull.

Managing Chemical Pollutants

Success in applying the principle of managing chemical pollutants is determined based on evidence of chemical spills, the presence of discarded equipment, the presence and volume of chemical containers, and the relative ease with which these potential pollutants may reach surface or ground waters based on distance and soil permeability.

Figure 3.2. Bankfull indicators visible at low flow. The bankfull elevation is indicated by the first depositional flat above the channel. On very confined channels, the bankfull elevation may only be evident as the discontinuous flat depositional areas shaded on the photo.

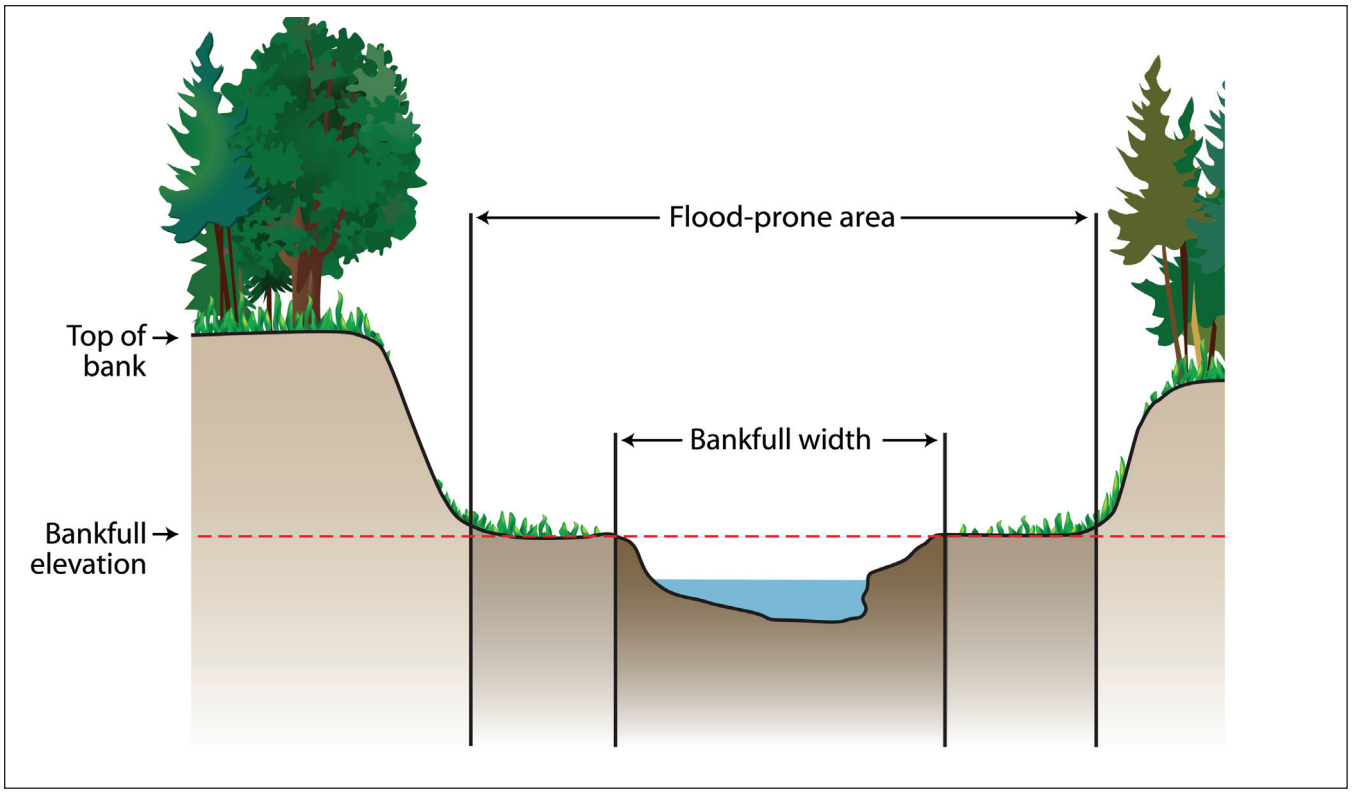


Figure 3.3. Bankfull width and bankfull elevation. This cross-section view of a stream channel depicts the bankfull width and bankfull elevation of the stream.

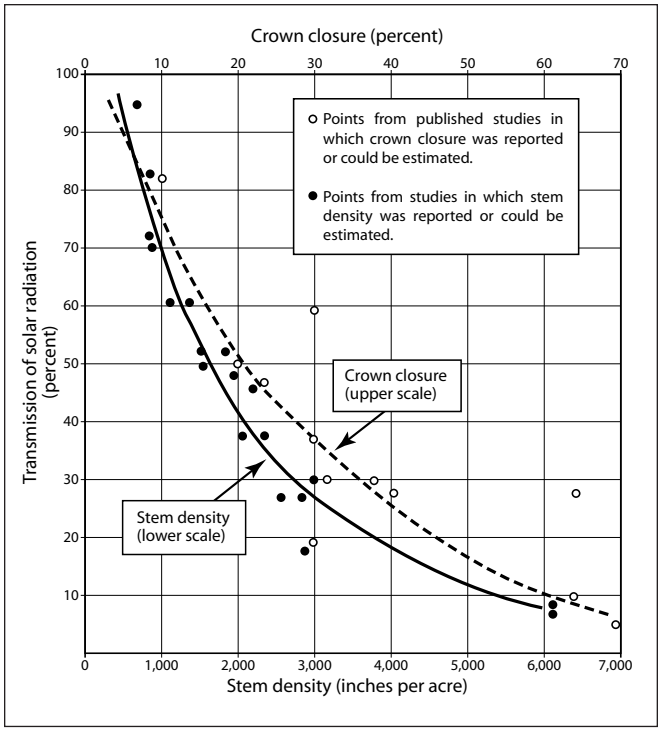


Figure 3.4. Solar gain. Heating of stream water from solar radiation is related to stand density and crown closure. (Source: Reifsnyder, W.E.; Lull, H.W. 1965. Radiation energy in relation to forest science. Tech. Bull. 1344. Washington, DC: U.S. Department of Agriculture, Forest Service. 111 p.)

Minimizing Biological Impacts

Success in applying the principle of minimizing biological impacts is determined based on maintaining stream shade to minimize solar gain, maintaining natural large woody debris, providing for potential large woody debris recruitment, and minimizing the volume of logging slash in the channel. Solar gain, or heating of the water from exposure to sunlight, is related to stand density and crown closure (figure 3.4). The BMP protocol measures crown closure and stem density as surrogates of solar gain. Potential and existing large woody debris and slash in the stream are measured as factors affecting stream habitat.

Planning the Operation

Pre-planning timber harvesting and related activities is an overarching BMP and is reflected in an assessment of the combination of all other principles. When done correctly, planning usually results in the use of fewer, more effective water resource protection practices.

Sample Unit Delineation

Note that a single timber sale may have multiple sample units within it or none at all.

The measurement of any, all, or none of the sample units in a given timber sale will be determined by the State sampling design. The evaluation of individual sample units is used to avoid the problems associated with averaging the effectiveness of BMPs across an entire sale area.

Sample units are delineated by cutting boundaries, ownership boundaries, and the crossing of natural perennial and intermittent streams and some ditches. The crossing and the approaches on both sides of the water body are assessed in the sample unit containing the water body crossing. The delineation of sample units and the features to be included within them are depicted in figure 3.5.

Neither ephemeral stream crossings nor road ditch relief culverts qualify as sample unit delineators in this protocol and are not normally sampled as water body crossings.

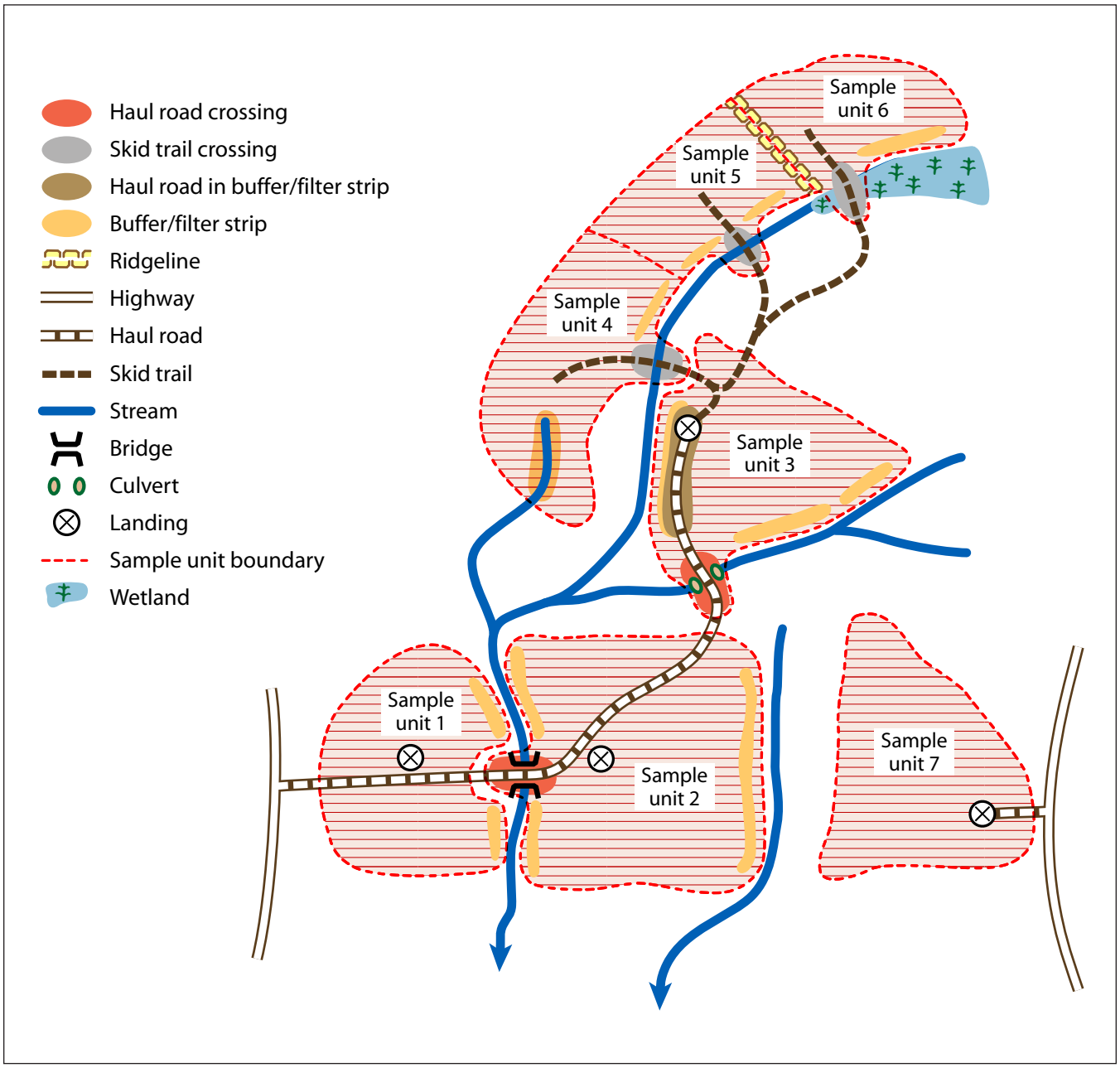


Figure 3.5. Sample unit delineation. Sample units are delineated by timber cutting boundaries, ownership boundaries, and water body crossings, as shown in this plan view.

Features

Features are specific areas or conditions within the sample unit having the greatest potential to cause impacts on water quality. Efficiency is achieved by assessing only these features in lieu of the entire sample unit area.

The protocol question set is grouped according to these features and is branched to automatically omit the questions related to features that do not exist on the ground within a specific sample unit.

Feature areas or conditions include the following:

- Water body crossing
- Haul road, log landing, or rutted, mineral soil skid trail inside the buffer/filter strip
- Chemical pollutants
- Buffer/filter strip
- Wetland crossing

Water Body Crossing

Water body crossings are evaluated by examining the crossing itself as well as the approaches to the crossing on both sides of the water body, both inside and outside of the buffer/filter strip width specified by the State BMP guidelines. These five areas will be referred to as follows throughout the protocol:

- Approach Area A–Outside the Buffer/Filter Strip
- Approach Area A–Inside the Buffer/Filter Strip
- Crossing structure
- Approach Area B–Inside the Buffer/Filter Strip
- Approach Area B–Outside the Buffer/Filter Strip

The approach areas need to be identified in a consistent manner to facilitate resampling for quality control. Therefore, Approach Area A will always be identified as the one on the left bank as the investigator faces downstream (figure 3.6).

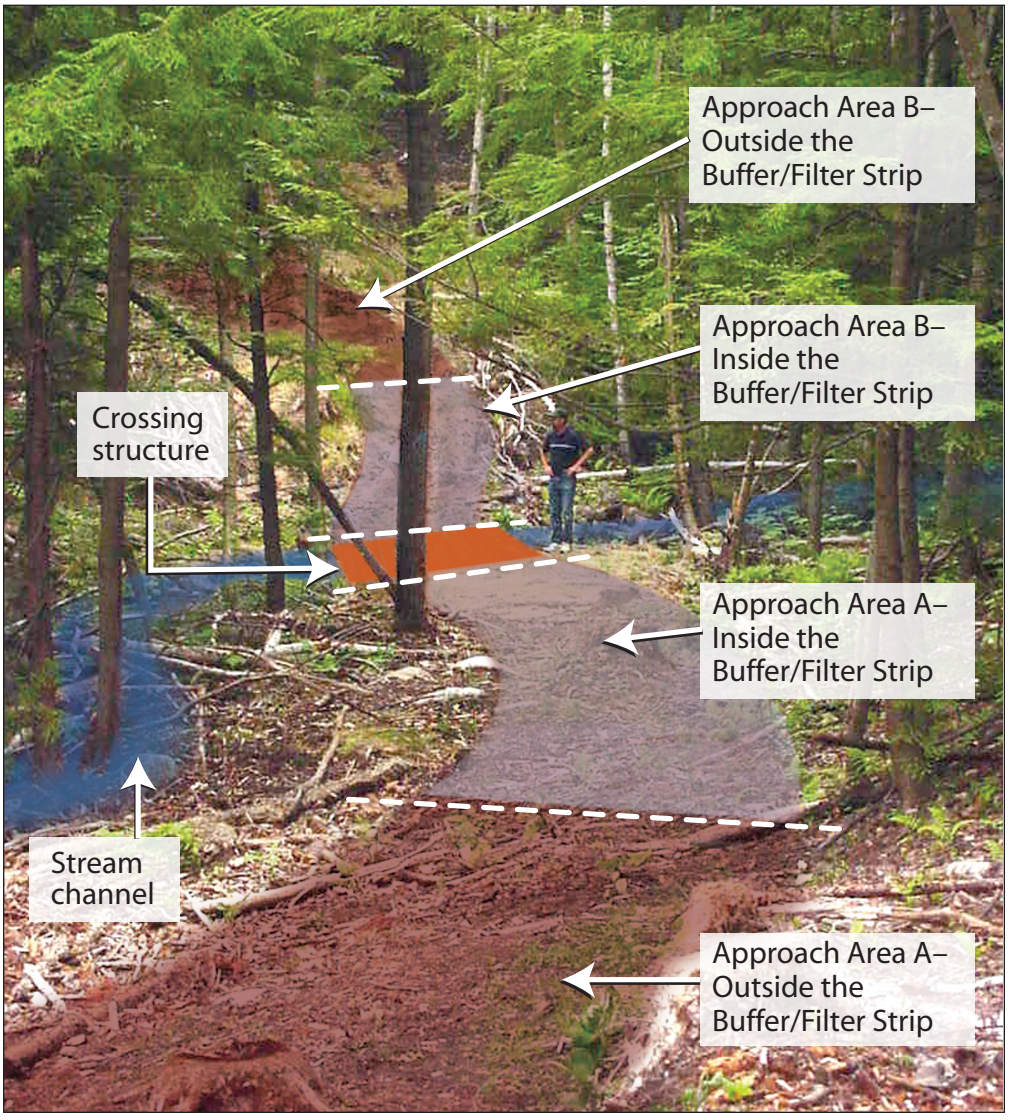


Figure 3.6. Identification of approach areas. Approach Area A is always on the left when looking downstream. (photo credit: Maine Forest Service)

Approach Areas A and B are sampled as part of the same sample unit and always as part of the sample unit being entered by the crossing. The crossing and the approaches on both sides would only exist in order to enter a new sample unit; therefore, they are sampled as part of that new sample unit.

Approach Areas Inside the Buffer/Filter Strip

The portion of the approach area that is inside the buffer/filter strip is determined by measuring inland from the top of the bank where permanent vegetation starts to a point equal to the buffer/filter strip width. On incised streams with large floodplains, the top of the bank may be some distance horizontally from the bankfull edge of the channel. The entire area between the bankfull edge of the channel and the upland edge of the buffer/filter strip width comprises the approach area inside the buffer/filter strip. On many streams, the distance between the top of the bank and the bankfull edge of the channel is negligible (figure 3.7).

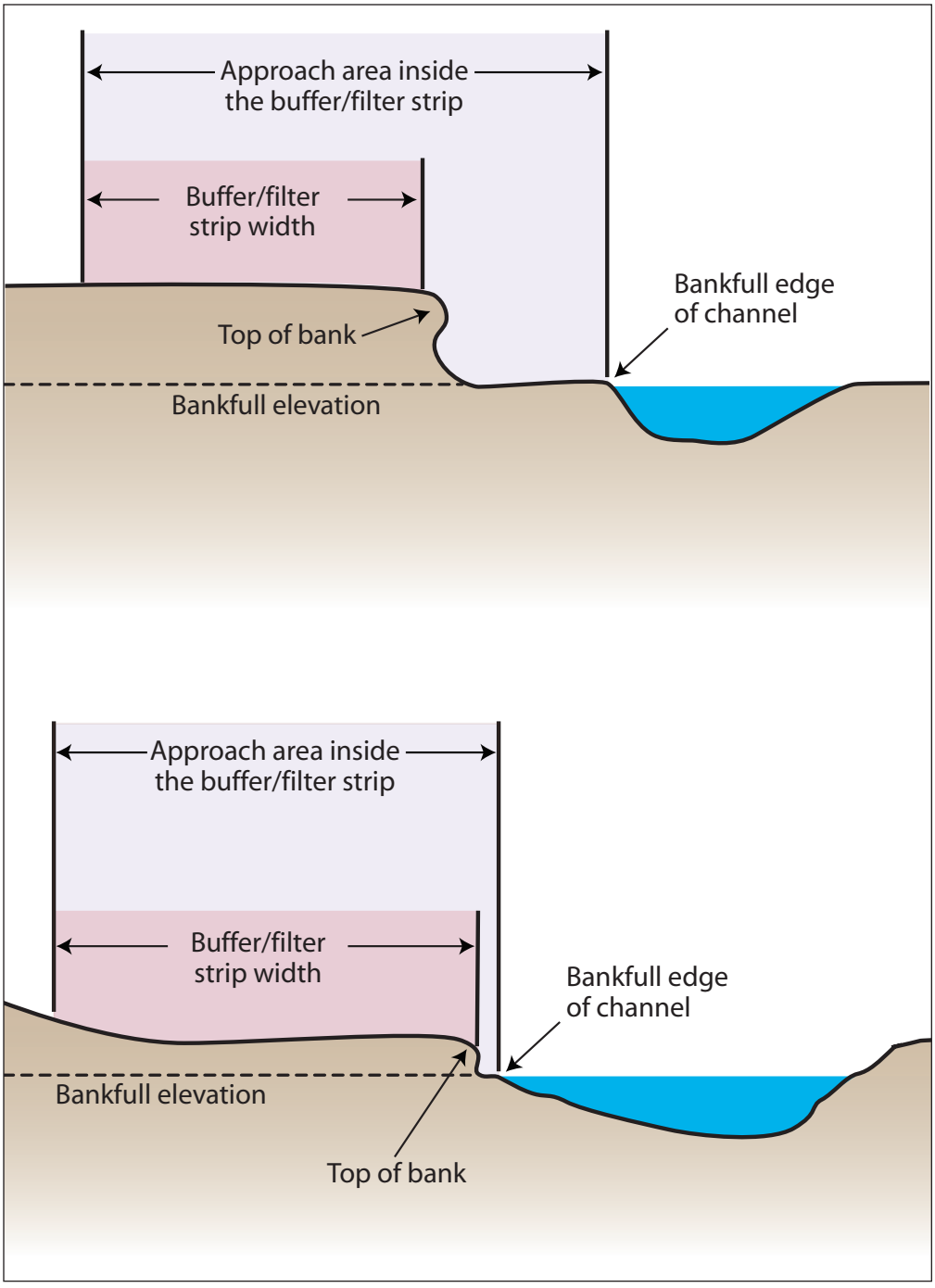


Figure 3.7. Identification of approach areas inside the buffer/filter strip. In this cross-section view of a stream channel, the approach area inside the buffer/filter strip extends from the bankfull edge of the current channel to the upland edge of the buffer/filter strip. The buffer/filter strip width is measured from the top of the bank where permanent vegetation begins and may be some distance from the edge of the current bankfull channel, particularly where a current, narrower channel is established within an older, broader channel (top). On many streams, the distance between the bankfull edge of the channel and the top of the bank may be negligible (bottom).

The buffer/filter strip width is measured perpendicular to the stream bank rather than along the centerline of the haul road or skid trail (figure 3.8). In the absence of State BMP guidelines or contractual requirements, a default buffer/filter strip width of 50 feet will be used for the purposes of this protocol.

Approach Areas Outside the Buffer/Filter Strip

The portion of the approach area that is outside the buffer/filter strip begins at the upland edge of the buffer/filter strip and extends to a point where there is a ±5 percent or greater gradient change for a minimum distance of 20 feet (figure 3.9). In areas where the grade is less than 5 percent for 500 feet or more, limit the approach area outside the buffer/filter strip to three times the buffer/filter strip width.

Crossing Structure

The crossing structure includes only those parts of the structure that are within the bankfull width of the channel. Structures or parts thereof that are outside the bankfull width of the channel are considered part of the approaches for the purposes of this protocol.

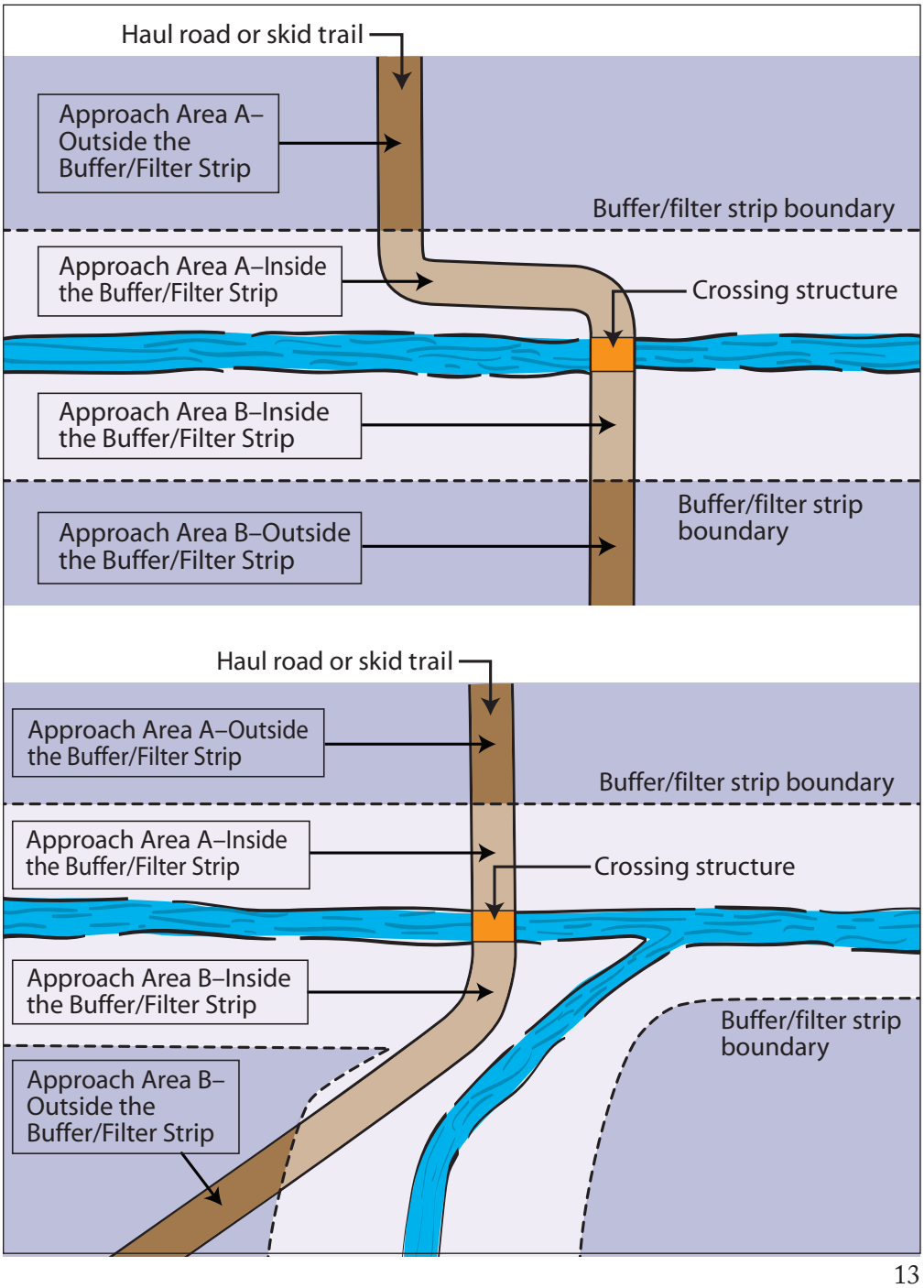


Figure 3.8. Measuring the buffer/filter strip width. The width of the buffer/filter strip is measured perpendicular to the streambank as shown in these plans views, not along the centerline of the haul road or skid trail; however, the area inside the buffer/filter strip may be determined by the presence of buffer/filter strips of more than one stream (bottom).

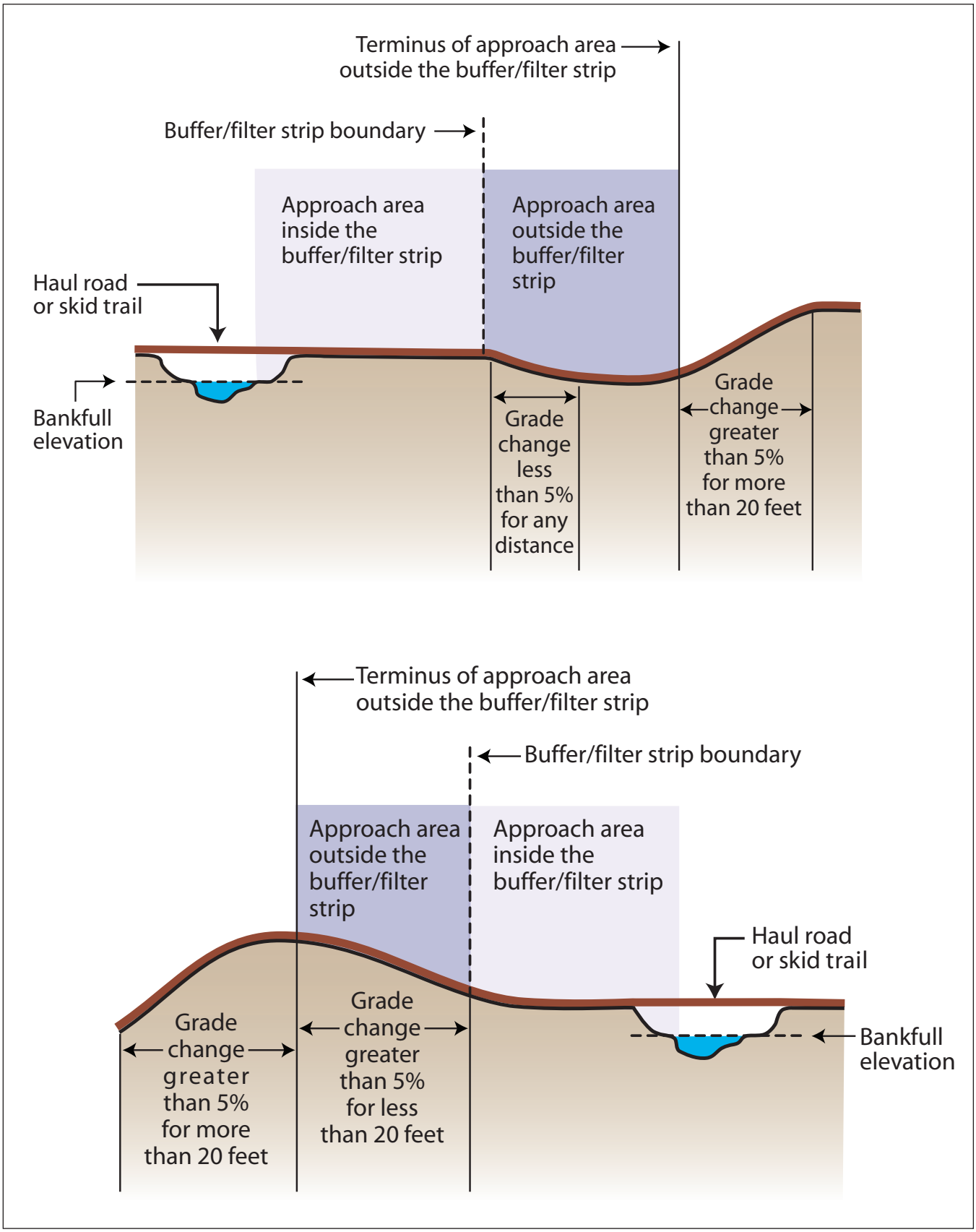


Figure 3.9. Identification of approach areas outside the buffer/filter strip. As shown in these cross-section views, the approach area outside the buffer/filter strip stops at the beginning of grade changes that are greater than 5 percent for more than 20 feet. The approach area outside the buffer/filter strip is unaffected by grade changes of any distance as long as the grade change is less than 5 percent (top). It is unaffected by grade changes that are greater than 5 percent for less than 20 feet (bottom).

Haul Road, Log Landing, or Rutted, Mineral Soil Skid Trail Inside the Buffer/Filter Strip

Haul roads, log landings, and rutted, mineral soil skid trails not associated with water body crossings are sampled when they occur inside the buffer/filter strip (figure 3.10).

Chemical Pollutants

Chemicals, containers, batteries, or other refuse should be recorded anywhere they are found within the sample unit. They tend to occur most often near log landings.

Buffer/Filter Strip

There may be a number of buffer/filter strips within a sample unit. Select one at random and begin the assessment at the downstream end.

Wetland Crossing

Wetlands are assessed only when they occur in conjunction with the haul road or skid trail crossing identified in the question set (question X12).

State- or User-Defined Entries

Twenty spaces are provided at the end of the question set for users to insert any unique data, up to 20 characters in each space, that they would like to collect.

Monitoring Tips

General Information Questions

The general information questions (G1 through G11) are often more readily answered in the office prior to going to the field or, if necessary, at the time landowner entry permission is sought.

Layout of the Crossing Feature

Questions regarding Approach Area A of the crossing feature begin with question X12. Before answering these questions in the field, use the diagrams in this chapter to locate the following boundaries:

- Bankfull channel
- Approach area inside the buffer/filter strip
- Approach area outside the buffer/filter strip with particular attention to its terminus
- Beginning and end of the crossing structure

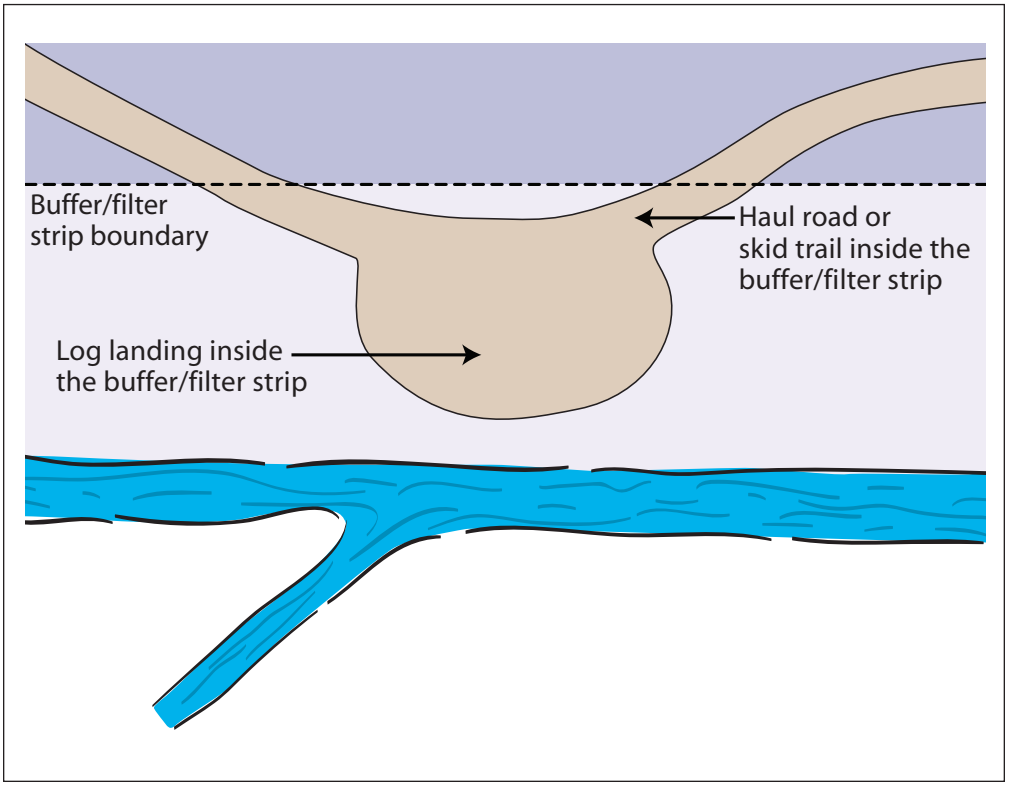


Figure 3.10. Haul road, log landing, or skid trail inside the buffer/filter strip. Haul roads, log landings, and rutted, mineral soil skid trails not associated with water body crossings are sampled when they are located within the buffer/filter strip, as shown in this plan view.

Identifying the boundaries of these features on the ground will greatly simplify answering the questions.

Dealing With an Issue in Multiple Approach Areas

When evaluating on-the-ground conditions and choosing which condition to report, always report on the most severe problem. If a given problem crosses through several areas, however, follow it through to its conclusion and then report it in the area in which it was first discovered.

Example: A rut extending from Approach Area A–Outside the Buffer/Filter Strip through Approach Area A–Inside the Buffer/Filter Strip to the stream should be reported in answer to the questions on Approach Area A–Outside the Buffer/Filter Strip. If the same rut were reported again in Approach Area A–Inside the Buffer/Filter Strip, it would be reported twice. Only different problems should be reported in Approach Area A–Inside the Buffer/Filter Strip. The objective is to prevent double reporting of a given problem.

Chapter 4—Questions

This chapter includes all of the questions and answers in the protocol software that will be answered when collecting data in the field. The text of the questions and answers in the protocol software is rather abbreviated; this chapter expands the question and answer text to make it more easily understood. Until field personnel become familiar with the questions and answers, they should refer to the expanded text in this chapter when recording data to ensure accuracy and consistency. The questions are grouped into sections as follows:

- General Information (Questions G1–G11)
- Water Body Crossing Approach Area A (Questions X12–X67)
- Crossing Structure (Questions X68–X86)
- Water Body Crossing Approach Area B (Questions X86.1–X136)
- Haul Road, Log Landing, or Rutted, Mineral Soil Skid Trail Inside the Buffer/Filter Strip (Questions HB137–HB166)
- Chemical Pollutants (Questions CP167–CP172)
- Buffer/Filter Strip (Questions B173–B191)
- Wetland Crossing (Questions W192–W197)
- State- or User-Defined Entries (Questions S1–S20)

Field personnel should understand that not all questions will be answered for each sample unit. The software will automatically skip some questions based on the answers to previous questions. Data collection will be complete as long as field personnel accurately answer all questions presented in the software program for a given sample unit. Some answers may be left blank if in doubt, but all questions that include answers with "go to" instructions (e.g., go to question HB137) **must** be answered.

General Information (Questions G1–G11)

G1 Enter the code for the State, year, sample type, and sample unit number.

State Select the two-letter State code from the drop-down menu.

Year Enter the last two digits of the sample year (e.g., 2006 = 06).

Type Select the sample type code from the drop-down menu:
N = new sample
R = remeasure of a previous sample
Q = quality control sample

Iteration Enter the iteration of the resample where:
0 = new sample (default value)
1 = first remeasurement
2 = second remeasurement
. . .
8 = eighth remeasurement

Quality control measurements are not considered remeasurements.

Number Enter the State-assigned sample number. (This number will automatically be expanded to three digits in the data recorder.)

Example: Maryland, 2006, new sample unit number 24 would be coded MD06N0024.

If this same sample unit were resampled for quality control purposes, it would code MD06Q0024.
If this same sample unit were being resampled for the first time for long-term impact or other purposes, it would code MD06R1024.

Note: Question G1 is a mandatory response question; an answer is required to exit the sample unit file.

G2 Enter the answer code indicating the landowner's approximate statewide forest land ownership class.

1. < 25 acres
2. 25+ to 50 acres
3. 50+ to 100 acres
4. 100+ to 1,000 acres
5. 1,000+ to 5,000 acres
6. 5,000+ to 10,000 acres
7. 10,000+ to 100,000 acres
8. 100,000+ acres
9. Unknown

G3 Enter the answer code indicating the landowner category.

1. Non-industrial private forest landowner
2. Industrial forest landowner
3. Public forest land
4. Other (e.g., land trust, sportsman's club)
5. Unknown
6. Nonforest use or ownership planned
7. Ownership is for investment purposes only

G4 Enter the answer code indicating landowner participation in the following programs. Starting with answer number 1, record the first answer that applies.

1. Forest activity is certified by a third-party certification program
2. Forest activity is covered by a management plan (e.g., Stewardship Plan, tax program)
3. Landowner attends forestry educational programs
4. None of the above
5. Unknown

G5 Enter the answer code indicating whether or not responsibility for BMP implementation has been assigned to a specific individual by name.

1. No
2. Forester, by written contract
3. Forester, by oral agreement
4. Logger, by written contract
5. Logger, by oral agreement
6. Unknown

In some States, responsibility is assigned by law to the landowner, logger, or State service forester. This question, however, is to determine if responsibility has also been assigned to a specific individual by oral agreement, or by name or title *in the contract*.

G6 Enter the answer code indicating logger participation in the following programs. Starting with answer number 1, record the first answer that applies.

1. State-licensed logger or logging foreman
2. Participates in a voluntary certification program (e.g., Master Logger, Sustainable Forestry Initiative)
3. Participates in continuing education seminars
4. None of the above
5. Unknown

G7 Enter the answer code that best describes the status of harvesting in the sample unit at the time of on-site monitoring. Times can be approximated.

1. Harvest is currently active
2. Harvesting was completed less than 1 year ago
3. Harvesting was completed more than 1 and less than 2 years ago
4. Harvesting was completed more than 2 years ago
5. There has been no harvesting in this sample unit in conjunction with the current timber sale
6. Unknown

G8 Enter the number of whole acres, up to 999, in the sample unit being assessed, estimating as necessary.

G9 Enter the answer code indicating the type of harvest system predominately used in this sample unit.

1. No harvesting to date (go to question CP167)
2. Ground-based system in which wood is dragged (e.g., skidders, tractors)
3. Ground-based system in which wood is carried (e.g., forwarders, trailers)
4. Cable system in which wood is dragged (e.g., high lead, jammer)
5. Cable system in which wood is suspended (e.g., standing skyline)
6. Aerial system (e.g., balloons, helicopter)
7. Road construction only; no harvest
8. Unknown

In the event that clearing or road construction has begun, the sample will be taken even if timber harvesting has not yet begun.

G10 Enter the answer code that best describes the occurrence of a rare and extreme weather event likely to influence the results of this sample unit evaluation.

1. None
2. Rain on snow
3. Rain
4. Drought
5. Unknown

Examples of rain events might include extremely intense rainstorms or extremely high volume rainfall over a short period, or above average rainfall with a high antecedent soil moisture content.

G11 Enter the answer code indicating whether BMPs are voluntary or mandatory for this sample unit. (Refer to State BMP guidelines and record as mandatory even if only some BMPs are mandatory.)

1. Voluntary
2. Mandatory

After answering question G11 continue with question X12.

Water Body Crossing Approach Area A (Questions X12–X67)

Note: Approach Area A is the approach on the left bank as the investigator faces downstream.

X12 Enter the answer code for the stream order or water body type at the crossing site. Refer to appendix C for definitions of terms. Although not ordinarily considered, if States wish to include ephemeral streams in the protocol, they will be coded zero order (answer code 8).

1. First-order stream
2. Second-order stream
3. Third-order stream
4. Fourth-order stream or larger
5. Drainage ditch systems degrading and/or draining to natural surface waters
6. Pond or lake of Federal or State significance
7. Wetland or similar area of Federal or State significance
8. Zero-order (ephemeral) stream
9. No stream crossing in this sample unit (go to question HB137)
10. Stream crossing avoided by planning (go to question HB137)

Answer codes 9 and 10 are different. Answer code 9 applies when a crossing is unnecessary either because there is no water body or because there is no harvesting on the far side of the water body. Answer code 10 applies when there is harvesting on the far side of the water body, but there is no crossing from the sample unit currently being inspected or the area is accessed from another direction without crossing the water body.

Note that if a wetland is being crossed (answer code 7), or if the stream or other water body being crossed includes a wetland, continue through the approach and crossing structure sections since wetlands logically include approaches and possibly crossing structures (as do other water body crossings). The protocol will automatically take you to questions W192 through W197, which provide additional wetland detail to the sample data.

X13 Enter the answer code indicating the water body type being crossed based on a year with normal precipitation.

1. Perennial stream, lake, or wetland
2. Intermittent stream or vernal pool
3. Ephemeral stream

X14 Enter the GPS location of the water body crossing being evaluated based on WGS 84. Enter it as **decimal degrees latitude**, including the decimal point and six decimal places.

Example: 41.736253

X15 Enter the GPS location of the water body crossing being evaluated based on WGS 84. Enter it as **decimal degrees longitude**, including the decimal point and six decimal places.

Example: 76.835937

Longitude in the United States is always a negative value. This cell has been formatted with the negative sign already in place. **Do not enter a negative sign with your data.**

X16 Enter the recommended buffer/filter strip width in whole feet, up to 999, based on State BMP guidelines.

If State BMP guidelines do not specify, enter and use 50 feet as the default value.

X17 Enter the width in whole feet, up to 999, of any legally or contractually required water resource protection strip that is greater than the State BMP guidelines.

Leave blank if none is legally or contractually required.

Use the greater of the two widths (questions X16 and X17) in determining the boundary between the approaches inside and outside the buffer/filter strip and in answering questions X18 through X86.

After completing question X17 continue with question X18.

Approach Area A–Outside the Buffer/Filter Strip

Approach Area A–Outside the Buffer/Filter Strip originates at the upland edge of the buffer/filter strip width as measured from the outer edge of the stream's bankfull width, the top of the bank above a scoured channel, or the edge of a wetland. It extends inland perpendicular to the bank to a point where there is a ±5 percent or greater gradient change that extends for a minimum distance of 20 feet (figure 3.7 on page 12).

In areas where the grade is less than 5 percent for a distance of 500 feet or more, limit the approach area outside the buffer/filter strip to three times the width of the buffer/filter strip.

Go to the point on the road or trail where the approach area inside the buffer/filter strip intersects the approach area outside the buffer/filter strip and make a mental note of the location. Proceed on to the termination point of the approach area outside the buffer/filter strip. Having noted these two boundary locations, observe the conditions on the ground and answer questions X18 through X67. Note that you may have to follow some indicators, such as rills, ruts, or gullies, into the approach area inside the buffer/filter strip or into the water body itself to answer the questions.

X18 Enter the answer code indicating whether you are evaluating a haul road or a skid trail in Approach Area A–Outside the Buffer/Filter Strip.

1. Haul road
2. Skid trail

X19 Enter the answer code that best describes the road or trail in Approach Area A–Outside the Buffer/Filter Strip.

1. Landing or yard only, adjoining maintained road
2. Road or trail profile is flat, no ditch constructed
3. Road or trail profile is inverted below the general grade of adjoining land
4. Road or trail profile includes an excavated ditch less than 1 foot deep
5. Road or trail profile includes an excavated ditch greater than 1 foot deep
6. Road or trail profile was created by cutting and filling on a side slope
7. Road or trail profile is constructed of fill material only; forest floor beneath the fill material is unexcavated

X20 Enter the answer code that best describes bearing capacity improvements used on any portion of the road or trail in Approach Area A–Outside the Buffer/Filter Strip.

1. Native material construction, no improvement evident
2. Bearing capacity improvements added, such as Geo-textile, pallets, mats, slash, corduroy
3. Permeable surfacing material added, such as gravel
4. Non-permeable paving, such as asphalt or concrete
5. Other

X21 Enter the answer code that best describes the primary adjacent land use outside Approach Area A–Outside the Buffer/Filter Strip.

1. Forest
2. Agriculture
3. Residential or commercial
4. Other

X22 Enter the answer code that best describes any soil movement in Approach Area A–Outside the Buffer/Filter Strip.

1. Trace amounts such as films or suspended sediments deposited in the water body or within the bankfull width of the channel (go to question X23)
2. Measurable amounts of sediment deposited in the water body or within the bankfull width of the channel (go to question X23)
3. Soil deposited inside the buffer/filter strip but did not reach the water body or within the bankfull width of the channel (go to question X31)
4. Soil moved into Approach Area A–Outside the Buffer/Filter Strip but did not reach the buffer/filter strip (go to question X37)
5. Soil is stabilized in Approach Area A–Outside the Buffer/Filter Strip (go to question X43)

In cases where the sediment delivery system indicates strongly that measurable volumes of sediment have been deposited in the water body but have since been washed away (see question X23), enter answer code 2 for question X22 and enter zero for question X26.

Locate the boundaries of the area in question and carefully inspect the road or trail as well as the ditches and adjoining cut or fill slopes.

Look for evidence of soil movement, such as rills, gullies, or other sediment trails. Also consider material moved by machines during construction, as well as material pushed by wheels or dragged by logs. Note the points of origin and deposit.

Depending on the time of year, it may be necessary to brush away newly fallen leaves to follow the sediment trail. Sediment occurring above or below the various leaf layers will provide clues as to whether the erosion is ongoing or occurred during a prior harvest.

Only one answer code can be entered. Consider the various problems evident and report on the worst case scenario, choosing the answer that best describes the situation.

Sediment Deposited in the Water Body from Approach Area A–Outside the Buffer/Filter Strip

X23 Enter the answer code that best describes the evidence that sediment reached the water body or within the bankfull width of the channel from Approach Area A–Outside the Buffer/Filter Strip.

1. Ditch or rut (e.g., wheel, track, log drag) terminating in the water body or within the bankfull width of the channel (go to question X24)
2. Gully terminating in the water body or within the bankfull width of the channel (go to question X24)
3. Rill terminating in the water body or within the bankfull width of the channel (go to question X24)
4. Sheet flow, sediment deposition trail, or alluvial fan terminating in the water body or within the bankfull width of the channel (go to question X26)
5. Soil slumping or dropping terminating in the water body or within the bankfull width of the channel (go to question X26)
6. Mechanical deposition of soil terminating in the water body or within the bankfull width of the channel (go to question X26)
   Example: Soil pushed into the bankfull channel or onto a bridge by machinery or dragged logs

Only one answer code can be entered. Record the worst case scenario. Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, record the predominant form. Report the evidence consistent with the definitions in appendix C for terms such as rill, gully, ditch, and rut.

X24 Enter the total length in whole feet, up to 999, of the rill, gully, ditch, or rut identified in question X23.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, measure and record the total length of the combined forms of erosion. If the rill or gully is branched, measure only the length of the main section—do not add the lengths of the branches. Accurate pacing is acceptable for measurement.

X25 Enter the midpoint cross-sectional area in whole square inches, up to 9999, of the rill, gully, ditch, or rut identified in question X23.

Locate a typical cross section at approximately the halfway point in the combined length of the rill, gully, or other formation being reported. Place a straightedge across the top of the eroded zone and measure the width and depth in inches to compute the area.

X26 Enter the currently evident volume of sediment deposited in the water body or within the bankfull width of the channel in whole cubic feet, up to 9999, by the delivery system identified in question X23.
Look upstream and downstream, and determine by color, texture, and location that the sediment deposit originates from the delivery system identified in question X23. Probe the deposit in several places to determine the average depth, and measure the length and width to determine the volume.

Leave blank if the sediment has been completely flushed away or if a reasonably accurate measurement of the existing deposit is not possible.

X27 Enter the answer code that best describes the preponderant type of sediment delivered to the water body or within the bankfull width of the channel by the delivery system identified in question X23.

1. Organic material
2. Clay (forms a ribbon 1 inch or longer)
3. Silt or loam (feels smooth but will not form a ribbon)
4. Sand (feels gritty)
5. Gravel (0.8–2.5 inches)
6. Cobble and larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

X28 Enter the answer code indicating if sedimentation can be expected to continue to occur during the next storm event based on your answers to questions X23 through X27.

1. Yes, sedimentation will continue
2. No, sedimentation will not continue
3. Unknown

X29 Enter the answer code that best describes the specific cause of sediment delivery to the water body or within the bankfull width of the channel from Approach Area A–Outside the Buffer/Filter Strip.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design of the road or trail outside the buffer/filter strip
3. Incorrect maintenance of the road or trail outside the buffer/filter strip
4. No maintenance or inadequate maintenance, or failure to add reinforcement to BMPs installed on the road or trail outside the buffer/filter strip
5. Inadequate installation of initial or additional BMPs as necessary outside the buffer/filter strip
6. Inappropriate log landing location or activities outside the buffer/filter strip
7. Inappropriate harvesting activities outside the buffer/filter strip
8. Human activities or natural events unrelated to timber harvesting
9. Erosion from a public road

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Note the difference between the *installation* of BMPs and the *maintenance* and *reinforcement* of BMPs.

X30 Enter the answer code that best describes the cause of sediment delivery to the water body or within the bankfull width of the channel from Approach Area A–Outside the Buffer/Filter Strip with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately, and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question X30 proceed directly to question X44.

Sediment Deposited Inside the Buffer/Filter Strip but Not the Water Body From Approach Area A–Outside the Buffer/Filter Strip

X31 Enter the distance from **the upland edge of the buffer/filter strip to the end of the soil deposition nearest the water body** as a percentage of the buffer/filter strip width.

Measure the slope distance in whole feet perpendicular to the bank. Divide it by the buffer/filter strip width.

Example: A sediment trail of any length that ends 5 feet from the water body inside a 50-foot buffer/filter strip would be calculated as follows:

45 feet divided by 50 feet = 90%, code = 90

X32 Enter the answer code that best describes the evidence that sediment reached the buffer/filter strip, but not the water body or within the bankfull width of the channel, from Approach Area A–Outside the Buffer/Filter Strip.

1. Ditch or rut (e.g., wheel, track, log drag) terminating in the buffer/filter strip
2. Gully terminating in the buffer/filter strip
3. Rill terminating in the buffer/filter strip
4. Sediment deposition trail, sheet flow, or alluvial fan terminating in the buffer/filter strip
5. Soil slumping or dropping terminating in the buffer/filter strip

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, record the predominant form, adhering to the definitions in appendix C.

X33 Enter the answer code that best describes the preponderant type of sediment delivered to the buffer/filter strip, but not the water body or within the bankfull width of the channel, by the delivery system identified in question X32.

1. Organic material
2. Clay (forms a ribbon 1 inch or longer)
3. Silt or loam (feels smooth but will not form a ribbon)
4. Sand (feels gritty)
5. Gravel (0.8–2.5 inches)
6. Cobble and larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

X34 Enter the answer code indicating if sedimentation can be expected to continue to occur during the next storm event based on your answers to questions X31 through X33.

1. Yes, sedimentation will continue
2. No, sedimentation will not continue
3. Unknown

X35 Enter the answer code that best describes the specific cause of sediment delivery to the buffer/filter strip, but not the water body or within the bankfull width of the channel, from Approach Area A–Outside the Buffer/Filter Strip.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design of the road or trail outside the buffer/filter strip
3. Incorrect maintenance of the road or trail outside the buffer/filter strip
4. No maintenance or inadequate maintenance, or failure to add reinforcement to BMPs installed on the road or trail outside the buffer/filter strip
5. Inadequate installation of initial or additional BMPs as necessary outside the buffer/filter strip
6. Inappropriate log landing location or activities outside the buffer/filter strip
7. Inappropriate harvesting activities outside the buffer/filter strip
8. Human activities or natural events unrelated to timber harvesting
9. Erosion from a public road

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Note the difference between the *installation* of BMPs and the *maintenance* and *reinforcement* of BMPs.

X36 Enter the answer code that best describes the cause of sediment delivery to the buffer/filter strip, but not the water body or within the bankfull width of the channel, from Approach Area A–Outside the Buffer/Filter Strip with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately, and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question X36 proceed directly to question X44.

Soil Moved but Did Not Reach the Buffer/Filter Strip or the Water Body From Approach Area A–Outside the Buffer/Filter Strip

X37 Enter the distance in whole feet, up to 999, that the soil moved from the point of origin **toward** the buffer/filter strip.

Example: Soil may move 49 feet, but only move 16 feet toward the buffer/filter strip. Enter 16.

X38 Enter the answer code that best describes the evidence that soil moved in Approach Area A–Outside the Buffer/Filter Strip but did not reach the buffer/filter strip.

1. Ditch or rut (e.g., wheel, track, log drag) terminating outside the buffer/filter strip
2. Gully terminating outside the buffer/filter strip
3. Rill terminating outside the buffer/filter strip
4. Sediment deposition trail, sheet flow, or alluvial fan terminating outside the buffer/filter strip
5. Soil slumping or dropping terminating outside the buffer/filter strip

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, record the predominant form, adhering to the definitions in appendix C.

X39 Enter the answer code that best describes the preponderant type of soil that moved in Approach Area A–Outside the Buffer/Filter Strip but did not reach the buffer/filter strip.

1. Organic material
2. Clay (forms a ribbon 1 inch or longer)
3. Silt or loam (feels smooth but will not form a ribbon)
4. Sand (feels gritty)
5. Gravel (0.8–2.5 inches)
6. Cobble and larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

X40 Enter the answer code indicating if soil movement can be expected to continue to occur in Approach Area A–Outside the Buffer/Filter Strip during the next storm event based on your answers to questions X37 through X39.

1. Yes, sedimentation will continue
2. No, sedimentation will not continue
3. Unknown

X41 Enter the answer code that best describes the specific cause of soil movement in Approach Area A–Outside the Buffer/Filter Strip.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design of the road or trail outside the buffer/filter strip
3. Incorrect maintenance of the road or trail outside the buffer/filter strip
4. No maintenance or inadequate maintenance, or failure to add reinforcement to BMPs installed on the road or trail outside the buffer/filter strip
5. Inadequate installation of initial or additional BMPs as necessary outside the buffer/filter strip
6. Inappropriate log landing location or activities outside the buffer/filter strip
7. Inappropriate harvesting activities outside the buffer/filter strip
8. Human activities or natural events unrelated to timber harvesting
9. Erosion from a public road

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Note the difference between the *installation* of BMPs and the *maintenance* and *reinforcement* of BMPs.

X42 Enter the answer code that best describes the cause of soil movement in Approach Area A–Outside the Buffer/Filter Strip with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately, and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question X42 proceed directly to question X44.

No Soil Movement in Approach Area A–Outside the Buffer/Filter Strip

X43 Enter the answer code that best describes the application of BMP principles and practices in Approach Area A–Outside the Buffer/Filter Strip.

1. Planning principles applied appropriately and effectively, thus minimizing the need for additional BMP practices; soil stabilized
2. Principles and practices applied appropriately; soil stabilized
3. Principles and practices applied inadequately; soil stabilized
4. Principles and practices not applied; soil stabilized

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

After answering question X43 and reading the explanation on the following page, continue with question X44.

Approach Area A–Inside the Buffer/Filter Strip

Approach Area A–Inside the Buffer/Filter Strip originates at the outer edge of the stream's bankfull width, the top of the bank above a scoured channel, or the edge of a wetland. It extends inland perpendicular to the bank for a distance equal to the buffer/filter strip width.

Having previously noted the point on the road or trail where the approach area inside the buffer/filter strip intersects the approach area outside the buffer/filter strip, observe the conditions on the ground between that location and the point where the road or trail reaches the bankfull edge of the channel, and answer questions X44 through X47.

Report only those conditions that originate from the approach area inside the buffer/filter strip. Conditions originating beyond the approach area inside the buffer/filter strip were reported in Approach Area A–Outside the Buffer/Filter Strip.

X44 Enter the answer code indicating whether you are evaluating a haul road or a skid trail in Approach Area A–Inside the Buffer/Filter Strip.

1. Haul road
2. Skid trail

X45 Enter the answer code that best describes bearing capacity improvements used on any portion of the road or trail in Approach Area A–Inside the Buffer/Filter Strip.

1. Native material construction, no improvement evident
2. Bearing capacity improvements added, such as Geo-textile, pallets, mats, slash, corduroy
3. Permeable surfacing material added, such as gravel
4. Non-permeable paving, such as asphalt or concrete
5. Other

X46 Enter the answer code that best describes the road or trail in Approach Area A–Inside the Buffer/Filter Strip.

1. Landing or yard only, adjoining maintained road
2. Road or trail profile is flat, no ditch constructed
3. Road or trail profile is inverted below the general grade of adjoining land
4. Road or trail profile includes an excavated ditch less than 1 foot deep
5. Road or trail profile includes an excavated ditch greater than 1 foot deep
6. Road or trail profile was created by cutting and filling on a side slope
7. Road or trail profile is constructed of fill material only; forest floor beneath the fill material is unexcavated

X47 Enter the answer code that best describes any soil movement in Approach Area A–Inside the Buffer/Filter Strip.

1. Trace amounts such as films or suspended sediments deposited in the water body or within the bankfull width of the channel (go to question X48)
2. Measurable amounts of sediment deposited in the water body or within the bankfull width of the channel (go to question X48)
3. Soil moved in Approach Area A–Inside the Buffer/Filter Strip but did not reach the water body or within the bankfull width of the channel (go to question X56)
4. Soil is stabilized in Approach Area A–Inside the Buffer/Filter Strip (go to question X62)
5. Soil movement occurs in Approach Area A–Inside the Buffer/Filter Strip but has been recorded elsewhere in the protocol (go to question X63)

In cases where the sediment delivery system indicates strongly that measurable volumes of sediment have been deposited in the water body but have since been washed away (see question X48), enter answer code 2 for question X47 and enter zero for question X51.

Locate the boundaries of the area in question and carefully inspect the road or trail as well as the ditches and adjoining cut or fill slopes.

Look for evidence of soil movement, such as rills, gullies, or other sediment trails. Also consider material moved by machines during construction, as well as material pushed by wheels or dragged by logs. Note the points of origin and deposit.

Depending on the time of year, it may be necessary to brush away newly fallen leaves to follow the sediment trail. Sediment occurring above or below the various leaf layers will provide clues as to whether the erosion is ongoing or occurred during a prior harvest.

Only one answer code can be entered. Consider the various problems evident and report on the worst case scenario, choosing the answer code that best describes the situation.

Sediment Deposited in the Water Body From Approach Area A–Inside the Buffer/Filter Strip

X48 Enter the answer code that best describes the evidence that sediment reached the water body or within the bankfull width of the channel from Approach Area A–Inside the Buffer/Filter Strip.

1. Ditch or rut (e.g., wheel, track, log drag) terminating in the water body or within the bankfull width of the channel (go to question X49)
2. Gully terminating in the water body or within the bankfull width of the channel (go to question X49)
3. Rill terminating in the water body or within the bankfull width of the channel (go to question X49)
4. Sheet flow, sediment deposition trail, or alluvial fan terminating in the water body or within the bankfull width of the channel (go to question X51)
5. Soil slumping or dropping terminating in the water body or within the bankfull width of the channel (go to question X51)
6. Mechanical deposition of soil terminating in the water body or within the bankfull width of the channel (go to question X51)
   Example: Soil pushed into the bankfull channel or onto a bridge by machinery or dragged logs

Only one answer code can be entered. Record the worst case scenario. Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, record the predominant form. Report the evidence consistent with the definitions in appendix C for terms such as rill, gully, ditch, and rut.

X49 Enter the total length in whole feet, up to 999, of the rill, gully, ditch, or rut identified in question X48.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, measure and record the total length of the combined forms of erosion. If the rill or gully is branched, measure only the length of the main section—do not add the lengths of the branches. Accurate pacing is acceptable for measurement.

X50 Enter the midpoint cross-sectional area in whole square inches, up to 9999, of the rill, gully, ditch, or rut identified in question X48.

Locate a typical cross section at approximately the halfway point in the combined length of the rill, gully, or other formation being reported. Place a straightedge across the top of the eroded zone and measure the width and depth in inches to compute the area.

X51 Enter the currently evident volume of sediment deposited in the water body or within the bankfull width of the channel in whole cubic feet, up to 9999, by the delivery system identified in question X48.

Look upstream and downstream, and determine by color, texture, and location that the sediment deposit originates from the delivery system identified in question X48. Probe the deposit in several places to determine the average depth, and measure the length and width to determine the volume.

Leave blank if the sediment has been completely flushed away or if a reasonably accurate measurement of the existing deposit is not possible.

X52 Enter the answer code that best describes the preponderant type of sediment delivered to the water body or within the bankfull width of the channel by the delivery system identified in question X48.

1. Organic material
2. Clay (forms a ribbon 1 inch or longer)
3. Silt or loam (feels smooth but will not form a ribbon)
4. Sand (feels gritty)
5. Gravel (0.8–2.5 inches)
6. Cobble and larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

X53 Enter the answer code indicating if sedimentation can be expected to continue to occur during the next storm event based on your answers to questions X48 through X52.

1. Yes, sedimentation will continue
2. No, sedimentation will not continue
3. Unknown

X54 Enter the answer code that best describes the specific cause of sediment delivery to the water body or within the bankfull width of the channel from Approach Area A–Inside the Buffer/Filter Strip.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design of the road or trail inside the buffer/filter strip
3. Incorrect maintenance of the road or trail inside the buffer/filter strip
4. No maintenance or inadequate maintenance, or failure to add reinforcement to BMPs installed on the road or trail inside the buffer/filter strip
5. Inadequate installation of initial or additional BMPs as necessary inside the buffer/filter strip
6. Inappropriate log landing location or activities inside the buffer/filter strip
7. Inappropriate harvesting activities inside the buffer/filter strip
8. Human activities or natural events unrelated to timber harvesting
9. Erosion from a public road

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Note the difference between the *installation* of BMPs and the *maintenance* and *reinforcement* of BMPs.

X55 Enter the answer code that best describes the cause of sediment delivery to the water body or within the bankfull width of the channel from Approach Area A–Inside the Buffer/Filter Strip with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately, and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question X55 proceed directly to question X63.

Soil Moved in Approach Area A–Inside the Buffer/Filter Strip but Did Not Reach the Water Body

X56 Enter the distance from **the upland edge of the buffer/filter strip to the end of the soil deposition nearest the water body** as a percentage of the buffer/filter strip width.

Measure the slope distance in whole feet perpendicular to the bank. Divide it by the buffer/filter strip width.

Example: A sediment trail of any length that ends 5 feet from the water body inside a 50 foot-buffer/filter strip would be calculated as follows:

45 feet divided by 50 feet = 90%, code = 90

X57 Enter the answer code that best describes the evidence that soil moved, but did not reach the water body or within the bankfull width of the channel, from within Approach Area A–Inside the Buffer/Filter Strip.

1. Ditch or rut (e.g., wheel, track, log drag) terminating in the buffer/filter strip
2. Gully terminating in the buffer/filter strip
3. Rill terminating in the buffer/filter strip
4. Sediment deposition trail, sheet flow, or alluvial fan terminating in the buffer/filter strip
5. Soil slumping or dropping terminating in the buffer/filter strip

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, record the predominant form, adhering to the definitions in appendix C.

X58 Enter the answer code that best describes the preponderant type of soil that was moved, but did not reach the water body or within the bankfull width of the channel, by the delivery system identified in question X57.

1. Organic material
2. Clay (forms a ribbon 1 inch or longer)
3. Silt or loam (feels smooth but will not form a ribbon)
4. Sand (feels gritty)
5. Gravel (0.8–2.5 inches)
6. Cobble and larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

X59 Enter the answer code indicating if soil movement can be expected to continue to occur during the next storm event based on your answers to questions X56 through X58.

1. Yes, sedimentation will continue
2. No, sedimentation will not continue
3. Unknown

X60 Enter the answer code that best describes the specific cause of soil movement that did not reach the water body or within the bankfull width of the channel in Approach Area A–Inside the Buffer/Filter Strip.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design of the road or trail inside the buffer/filter strip
3. Incorrect maintenance of the road or trail inside the buffer/filter strip
4. No maintenance or inadequate maintenance, or failure to add reinforcement to BMPs installed on the road or rail outside the buffer/filter strip
5. Inadequate installation of initial or additional BMPs as necessary outside the buffer/filter strip
6. Inappropriate log landing location or activities outside the buffer/filter strip
7. Inappropriate harvesting activities inside the buffer/filter strip
8. Human activities or natural events unrelated to timber harvesting
9. Erosion from a public road

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Note the difference between the *installation* of BMPs and the *maintenance* and *reinforcement* of BMPs.

X61 Enter the answer code that best describes the cause of soil movement that did not reach the water body or within the bankfull width of the channel from Approach Area A–Inside the Buffer/Filter Strip with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately, and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question X61 proceed directly to question X63.

Soil Stabilized in Approach Area A–Inside the Buffer/Filter Strip

X62 Enter the answer code that best describes the application of BMP principles and practices in Approach Area A–Inside the Buffer/Filter Strip.

1. Planning principles applied appropriately and effectively, thus minimizing the need for additional BMP practices; soil stabilized
2. Principles and practices applied appropriately; soil stabilized
3. Principles and practices applied inadequately; soil stabilized
4. Principles and practices not applied; soil stabilized

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

X63 Enter the answer code that best describes the preponderant hydrologic soil type in Approach Area A–Inside the Buffer/Filter Strip.

1. Type A (sand or gravel—feels gritty)
2. Type B/C (loams—feels crumbly)
3. Type D (silt, clay, or muck—smooth, plastic to gelatinous)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

X64 Enter the soil erodibility factor or K factor to two decimal places.

Example: soil erodibility factor = 0.66, code = 0.66

X65 Enter the gradient in percent of the road or trail in Approach Area A–Inside the Buffer/Filter Strip, measuring from the bankfull width of the water body at the crossing.

Enter + for a positive or uphill gradient and – for a negative or downhill gradient, followed by the percent grade in whole numbers.

Example: A 15-percent uphill gradient as seen from the crossing would code +15; a 17-percent downhill gradient would code –17.

X66 Enter the gradient in percent of the road or trail in Approach Area A–Outside the Buffer/Filter Strip, measuring from the upland edge of the buffer/filter strip at the crossing.

Enter + for a positive or uphill gradient and – for a negative or downhill gradient, followed by the percent grade in whole numbers.

Example: A 15-percent uphill gradient as seen from the crossing would code +15; a 17-percent downhill gradient would code –17.

X67 Enter the slope length in whole feet, up to 999, of the road or trail in Approach Area A–Outside the Buffer/Filter Strip.

After answering question X67 continue with question X68.

Crossing Structure (Questions X68–X86)

X68 Enter the answer code that best describes the traffic use at the crossing. Refer to appendix C for definitions of terms.

1. Haul road
2. Skid trail

X69 Enter the answer code that best describes the primary land use supported by the crossing.

1. Forest
2. Agriculture
3. Residential or commercial
4. Other

X70 Enter the answer code that best describes the roadway land ownership.

1. Private and associated with woodlot ownership
2. Private right-of-way
3. Public or government road system
4. Unknown

X71 Enter the answer code that best describes the crossing structure.

1. Unimproved ford
2. Improved or constructed ford
3. Pole or brush ford
4. Single culvert
5. Multiple culverts
6. Bridge or box culvert with closed top
7. Bridge or box culvert with open planked top
8. Crossing structure removed
9. Unknown or other

Where more than one structure is used in the crossing of a single wetland, report on the structure representing the worst case scenario. If no structures are used in the wetland crossing, enter answer code 9 (unknown).

X72 Enter the answer code that best describes the age of the crossing structure.

1. Existing—No construction or maintenance below the waterline (bankfull elevation) within 2 years
2. New—Ford or structure with construction or maintenance below the waterline (bankfull elevation) within 2 years
3. Structure removed (go to question X75)
4. Undetermined

X73 Enter the answer code indicating if the crossing structure is to be in place more than 3 months, or if fish or stream macroinvertebrates are present.

1. Neither fish nor macroinvertebrates present (go to question X75)
2. Fish and/or macroinvertebrates present and structure to be in place more than 3 months (go to question X74)
3. Fish and/or macroinvertebrates present and structure to be in place less than 3 months (go to question X75)
4. Unknown (go to question X75)

X74 Enter the answer code that best describes the structure bottom and stream substrate used.

1. Open bottom structure (open to the natural streambed), pole or slash ford, or structure removed
2. Closed bottom structure; natural streambed substrate material is present and continuous on the inside bottom of the structure
3. Closed bottom structure; natural streambed substrate material is not present or is not continuous on the inside bottom of the structure
4. Closed bottom structure or perched culvert outlet

X75 Enter the answer code indicating if the width of the crossing structure opening, or the stream channel in the event the structure has been removed, is equal to or greater than the prestructure bankfull channel width.

1. Width of the structure or remnant opening is equal to or greater than 1.2 times the bankfull channel width
2. Width of the structure or remnant opening is between 1.0 and 1.2 times the bankfull channel width
3. Width of the structure or remnant opening is less than the bankfull channel width

Enter answer code 2 for wetland roads with permeable layers in the road fill. Enter answer code 3 for wetland roads with culvert cross drainage.

X76 Enter the answer code indicating if the size of the crossing structure opening meets State requirements.

1. Yes, size of opening meets State requirements
2. No, size of opening does not meet State requirements
3. No State requirement
4. Structure removed, opening size undetermined

X77 Enter the answer code indicating if there is evidence of stream downcutting or scouring within 100 feet of the outlet end of the structure.

1. Evidence of scouring, widening, or downcutting exists within 100 feet of the crossing
2. No evidence of scouring, widening, or downcutting exists within 100 feet of the crossing

X78 Enter the answer code that best describes soil or fill material movement, or machine deposition of fill material associated with the crossing structure.

1. Trace amounts such as films or suspended sediments deposited in the water body or within the bankfull width of the channel (go to question X79)
2. Measurable amounts of sediment deposited in the water body or within the bankfull width of the channel (go to question X79)
3. Soil moves but does not reach the water body or within the bankfull width of the channel (go to question X85)
4. Soil stabilized at crossing (go to question X86)
5. Soil movement occurs but has been recorded elsewhere in the protocol (go to question X85)

Note that the crossing structure includes only that area within the bankfull width of the channel. Inspect the structure and any associated fill or abutments that are within the bankfull width of the channel.

Look for evidence of soil movement, such as rills, gullies, or other sediment trails. Also consider material moved by machines during construction, as well as material pushed by wheels or dragged by logs. Material on bridge decks or on the top of poled ford logs within the bankfull width of the channel is considered to be deposited in the water body. Note the points of origin and deposit.

Depending on the time of year, it may be necessary to brush away newly fallen leaves to follow the sediment trail. Sediment occurring above or below the various leaf layers will provide clues as to whether the erosion is ongoing or occurred during a prior harvest.

Only one answer code can be entered. Consider the various problems evident and report on the worst case scenario, choosing the answer that best describes the situation.

Soil Delivered to the Water Body From the Crossing Structure

X79 Enter the answer code that best describes the activity resulting in sediment delivery to the water body or within the bankfull width of the channel from the crossing structure.

1. Activity related to installation or closeout
2. Inadequate or incorrect installation or closeout
3. Instability of structure, such as undermined or crumbling abutments
4. Sizing of structure, such as size of opening or culvert length
5. Maintenance of structure
6. Natural events, such as animal activity, flooding, or channel realignment
7. Human activities not related to the harvest
8. Inappropriate or poor choice of structure type

Answer code 8 assumes that answer codes 1 through 7 do not apply.

Examples of activity related to installation or closeout (answer code 1) include filling portions of the channel when regrading banks or approaches.

Examples of incorrect installation (answer code 2) include installation on a meander bend or other unsuitable location, or failure to include appropriate components in the structure.

X80 Enter the answer code that best describes the evidence that sediment was delivered to the water body or within the bankfull width of the channel.

1. Ditch or rut (e.g., wheel, track, log drag) terminating in water body or within the bankfull width of the channel
2. Gully terminating in water body or within the bankfull width of the channel
3. Rill terminating in water body or within the bankfull width of the channel
4. Sheet flow, soil puddling, or deposition trail terminating in water body or within the bankfull width of the channel
5. Undercutting of the crossing structure
6. Soil slumping, piping, leaching, weeping, or falling from the crossing structure to within the bankfull width of the channel
7. Mechanical deposition of soil terminating in the water body or within the bankfull width of the channel
   Example: Soil pushed into the bankfull channel or onto temporary crossing structures by machinery or dragged logs
8. Overflow or total washout of the crossing structure

Only one answer code can be entered. Record the worst case scenario. Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, record the predominant form. Report the evidence consistent with the definitions in appendix C for terms such as rill, gully, ditch, and rut.

In cases where the sediment delivery system identified in question X80 indicates strongly that measurable volumes of sediment have been deposited in the water body but have since been washed away, enter answer code 2 for question X78 and enter zero for question X81.

X81 Enter the currently evident volume of sediment deposited in the water body or within the bankfull width of the channel in whole cubic feet, up to 9999, by the delivery system identified in question X80.

Look upstream and downstream, and determine by color, texture, and location that the sediment deposit originates from the delivery system identified in question X80. Probe the deposit in several places to determine the average depth, and measure the length and width to determine the volume.

Leave blank if the sediment has been completely flushed away or if a reasonably accurate measurement of the existing deposit is not possible.

X82 Enter the answer code that best describes the preponderant type of sediment delivered to the water body or within the bankfull width of the channel by the delivery system identified in question X80.

1.	Organic material	
2.	Clay	(forms a ribbon 1 inch or longer)
3.	Silt or loam	(feels smooth but will not form a ribbon)
4.	Sand	(feels gritty)
5.	Gravel	(0.8–2.5 inches)
6.	Cobble and larger	(> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

X83 Enter the answer code indicating if sedimentation can be expected to continue to occur during the next storm event based on your answers to questions X80 through X82.

1. Yes, sedimentation will continue
2. No, sedimentation will not continue
3. Unknown

X84 Enter the answer code that best describes the cause of sediment delivery to the water body or within the bankfull width of the channel from the crossing structure with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately, and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.
Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question X84 proceed directly to question X86.1.

Soil Moved but Did Not Reach the Water Body

X85 Enter the answer code that best describes the reason soil moved, but did not reach the water body or within the bankfull width of the channel, from the crossing structure with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question X85 proceed directly to question X86.1.

Quality of BMP Practices and Principles Applied for the Crossing Structure

X86 Enter the answer code that best describes the application of BMP principles and practices at the crossing.

1. Planning principles applied appropriately and effectively, thus minimizing the need for additional BMP practices; soil stabilized
2. Principles and practices applied appropriately; soil stabilized
3. Principles and practices applied inadequately; soil stabilized
4. Principles and practices not applied; soil stabilized

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

After answering question X86 and reading the explanation on the following page, continue with question X86.1.

Water Body Crossing Approach Area B (Questions X86.1–X136)

Note: Approach Area B is the approach on the right bank as the investigator faces downstream.

Approach Area B–Outside the Buffer/Filter Strip

Approach Area B–Outside the Buffer/Filter Strip originates at the upland edge of the buffer/filter strip width as measured from the outer edge of the stream's bankfull width, the top of the bank above a scoured channel, or the edge of a wetland. It extends inland perpendicular to the bank to a point where there is a ±5 percent or greater gradient change that extends for a minimum distance of 20 feet (figure 3.7 on page 12).

In areas where the grade is less than 5 percent for a distance of 500 feet or more, limit the approach area outside the buffer/filter strip to three times the buffer/filter strip width.

X86.1 Enter the recommended buffer/filter strip width in whole feet, up to 999, based on State BMP guidelines.

If State BMP guidelines do not specify, enter and use 50 feet as the default value.

X86.2 Enter width in whole feet, up to 999, of any legally or contractually required water resource protection strip that is greater than the State BMP guidelines.

Leave blank if none is legally or contractually required.

Go to the point on the road or trail where the approach area inside the buffer/filter strip intersects the approach area outside the buffer/filter strip and make a mental note of the location. Proceed on to the termination point of the approach area outside the buffer/filter strip. Having noted these two boundary locations, observe the conditions on the ground and answer questions X87 through X136. Note that you may have to follow some indicators, such as rills, ruts, or gullies, into the approach area inside the buffer/filter strip or into the water body itself to answer the questions.

X87 Enter the answer code indicating whether you are evaluating a haul road or a skid trail on Approach Area B–Outside the Buffer/Filter Strip.

1. Haul road
2. Skid trail

X88 Enter the answer code that best describes the road or trail in Approach Area B–Outside the Buffer/Filter Strip.

1. Landing or yard only, adjoining maintained road
2. Road or trail profile is flat, no ditch constructed
3. Road or trail profile is inverted below the general grade of adjoining land
4. Road or trail profile includes an excavated ditch less than 1 foot in depth
5. Road or rail profile includes an excavated ditch greater than 1 foot in depth
6. Road or trail profile was created by cutting and filling on a side slope
7. Road or trail profile is constructed of fill material only; forest floor beneath the fill material is unexcavated

X89 Enter the answer code that best describes bearing capacity improvements used on any portion of the road or trail in Approach Area B–Outside the Buffer/Filter Strip.

1. Native material construction, no improvement evident
2. Bearing capacity improvements added, such as Geo-textile, pallets, mats, slash, corduroy
3. Permeable surfacing material added, such as gravel
4. Non-permeable paving, such as asphalt or concrete
5. Other

X90 Enter the answer code that best describes the primary adjacent land use outside Approach Area B–Outside the Buffer/Filter Strip.

1. Forest
2. Agriculture
3. Residential or commercial
4. Other

X91 Enter the answer code that best describes any soil movement in Approach Area B–Outside the Buffer/Filter Strip.

1. Trace amounts such as films or suspended sediments deposited in the water body or within the bankfull width of the channel (go to question X92)
2. Measurable amounts of sediment deposited in the water body or within the bankfull width of the channel (go to question X92)
3. Soil deposited inside the buffer/filter strip but did not reach the water body or within the bankfull width of the channel (go to question X100)
4. Soil moved into Approach Area B–Outside the Buffer/Filter Strip but did not reach the buffer/filter strip (go to question X106)
5. Soil is stabilized in Approach Area B–Outside the Buffer/Filter Strip (go to question X112)
6. Soil movement occurs in Approach Area B–Outside the Buffer/Filter Strip but has been recorded elsewhere in the protocol (go to question X113)

In cases where the sediment delivery system indicates strongly that measurable volumes of sediment have been deposited in the water body but have since been washed away (see question X92), enter answer code 2 for question X91 and enter zero for question X95.

Locate the boundaries of the area in question and carefully inspect the road or trail as well as the ditches and adjoining cut or fill slopes.

Look for evidence of soil movement, such as rills, gullies, or other sediment trails. Also consider material moved by machines during construction, as well as material pushed by wheels or dragged by logs. Note the points of origin and deposit.

Depending on the time of year, it may be necessary to brush away newly fallen leaves to follow the sediment trail. Sediment occurring above or below the various leaf layers will provide clues as to whether the erosion is ongoing or occurred during a prior harvest.

Only one answer code can be entered. Consider the various problems evident and report on the worst case scenario, choosing the answer that best describes the situation.

Sediment Deposited in the Water Body From Approach Area B–Outside the Buffer/Filter Strip

X92 Enter the answer code that best describes the evidence that sediment reached the water body or within the bankfull width of the channel from Approach Area B–Outside the Buffer/Filter Strip.

1. Ditch or rut (e.g., wheel, track, log drag) terminating in the water body or within the bankfull width of the channel (go to question X93)
2. Gully terminating in the water body or within the bankfull width of the channel (go to question X93)
3. Rill terminating in the water body or within the bankfull width of the channel (go to question X93)
4. Sheet flow, sediment deposition trail, or alluvial fan terminating in the water body or within the bankfull width of the channel (go to question X95)
5. Soil slumping or dropping terminating in the water body or within the bankfull width of the channel (go to question X95)
6. Mechanical deposition of soil terminating in the water body or within the bankfull width of the channel (go to question X95)
   Example: Soil pushed into the bankfull channel or onto a bridge by machinery or dragged logs

Only one answer code can be entered. Record the worst case scenario. Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, record the predominant form. Report the evidence consistent with the definitions in appendix C for terms such as rill, gully, ditch, and rut.

X93 Enter the total length in whole feet, up to 999, of the rill, gully, ditch, or rut identified in question X92.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, measure and record the total length of the combined forms of erosion. If the rill or gully is branched, measure only the length of the main section—do not add the lengths of the branches. Accurate pacing is acceptable for measurement.

X94 Enter the midpoint cross-sectional area, in whole square inches, up to 9999, of the rill, gully, ditch, or rut identified in question X92.

Locate a typical cross section at approximately the halfway point in the combined length of the rill, gully, or other formation being reported. Place a straightedge across the top of the eroded zone and measure the width and depth in inches to compute the area.

X95 Enter the currently evident volume of sediment deposited in the water body or within the bankfull width of the channel in whole cubic feet, up to 9999, by the delivery system identified in question X92.

Look upstream and downstream, and determine by color, texture, and location that the sediment deposit originates from the delivery system identified in question X92. Probe the deposit in several places to determine the average depth, and measure the length and width to determine the volume.

Leave blank if the sediment has been completely flushed away or if reasonably accurate measurement of the existing deposit is not possible.

X96 Enter the answer code that best describes the preponderant type of sediment delivered to the water body or within the bankfull width of the channel by the delivery system identified in question X92.

1. Organic material
2. Clay (forms a ribbon 1 inch or longer)
3. Silt or loam (feels smooth but will not form a ribbon)
4. Sand (feels gritty)
5. Gravel (0.8–2.5 inches)
6. Cobble and larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

X97 Enter the answer code indicating if sedimentation can be expected to continue to occur during the next storm event based on your answers to questions X92 through X96.

1. Yes, sedimentation will continue
2. No, sedimentation will not continue
3. Unknown

X98 Enter the answer code that best describes the specific cause of sediment delivery to the water body or within the bankfull width of the channel from Approach Area B–Outside the Buffer/Filter Strip.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design of road or trail outside the buffer/filter strip
3. Incorrect maintenance of the road or trail outside the buffer/filter strip
4. No maintenance or inadequate maintenance, or failure to add reinforcement to BMPs installed on road or trail outside the buffer/filter strip
5. Inadequate installation of initial or additional BMPs as necessary outside the buffer/filter strip
6. Inappropriate log landing location or activities outside the buffer/filter strip
7. Inappropriate harvesting activities outside the buffer/filter strip
8. Human activities or natural events unrelated to timber harvesting
9. Erosion from a public road

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Note the difference between the *installation* of BMPs and the *maintenance* and *reinforcement* of BMPs.

X99 Enter the answer code that best describes the cause of sediment delivery to the water body or within the bankfull width of the channel from Approach Area B–Outside the Buffer/Filter Strip with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately, and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question X99 proceed directly to question X113.

Sediment Deposited Inside the Buffer/Filter Strip but Not the Water Body From Approach Area B–Outside the Buffer/Filter Strip

X100 Enter the distance from **the upland edge of the buffer/filter strip to the end of the soil deposition nearest the water body** as a percentage of the buffer/filter strip width.

Measure the slope distance in whole feet perpendicular to the bank. Divide it by the buffer/filter strip width.

Example: A sediment trail of any length that ends 5 feet from the water body inside a 50-foot buffer/filter strip would be calculated as follows:

45 feet divided by 50 feet = 90%, code = 90

X101 Enter the answer code that best describes the evidence that sediment reached the buffer/filter strip, but not the water body or within the bankfull width of the channel, from Approach Area B–Outside the Buffer/Filter Strip.

1. Ditch or rut (e.g., wheel, track, log drag) terminating in the buffer/filter strip
2. Gully terminating in the buffer/filter strip
3. Rill terminating in the buffer/filter strip
4. Sediment deposition trail, sheet flow, or alluvial fan terminating in the buffer/filter strip
5. Soil slumping or dropping terminating in the buffer/filter strip

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, record the predominant form, adhering to the definitions in appendix C.

X102 Enter the answer code that best describes the preponderant type of sediment delivered to the buffer/filter strip, but not the water body or within the bankfull width of the channel, by the delivery system identified in question X101.

1. Organic material
2. Clay (forms a ribbon 1 inch or longer)
3. Silt or loam (feels smooth but will not form a ribbon)
4. Sand (feels gritty)
5. Gravel (0.8–2.5 inches)
6. Cobble and larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

X103 Enter the answer code indicating if sedimentation can be expected to continue to occur during the next storm event based on your answers to questions X101 through X102.

1. Yes, sedimentation will continue
2. No, sedimentation will not continue
3. Unknown

X104 Enter the answer code that best describes the specific cause of sediment delivery to the buffer/filter strip, but not the water body or within the bankfull width of the channel, from Approach Area B–Outside the Buffer/Filter Strip.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design of road or trail outside the buffer/filter strip
3. Incorrect maintenance of the road or trail outside the buffer/filter strip
4. No maintenance or inadequate maintenance, or failure to add reinforcement to BMPs installed on road or trail outside the buffer/filter strip
5. Inadequate installation of initial or additional BMPs as necessary outside the buffer/filter strip
6. Inappropriate log landing location or activities outside the buffer/filter strip
7. Inappropriate harvesting activities outside the buffer/filter strip
8. Human activities or natural events unrelated to timber harvesting
9. Erosion from a public road

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Note the difference between the *installation* of BMPs and the *maintenance* and *reinforcement* of BMPs.

X105 Enter the answer code that best describes the cause of sediment delivery to the buffer/filter strip, but not the water body or within the bankfull width of the channel, from Approach Area B–Outside the Buffer/Filter Strip with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately, and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question X105 proceed directly to question X113.

Soil Moved but Did Not Reach the Buffer/Filter Strip or the Water Body From Approach Area B–Outside the Buffer/Filter Strip

X106 Enter the distance in whole feet, up to 999, that the soil moved from the point of origin **toward** the buffer/filter strip.

Example: Soil may move 49 feet, but only move 16 feet toward the buffer/filter strip. Enter 16.

X107 Enter the answer code that best describes the evidence that soil moved in Approach Area B–Outside the Buffer/Filter Strip but did not reach the buffer/filter strip.

1. Ditch or rut (e.g., wheel, track, log drag) terminating outside the buffer/filter strip
2. Gully terminating outside the buffer/filter strip
3. Rill terminating outside the buffer/filter strip
4. Sediment deposition trail, sheet flow, or alluvial fan terminating outside the buffer/filter strip
5. Soil slumping or dropping terminating outside the buffer/filter strip

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, record the predominant form, adhering to the definitions in appendix C.

X108 Enter the answer code that best describes the preponderant type of soil that moved in Approach Area B–Outside the Buffer/Filter Strip but did not reach the buffer/filter strip.

1. Organic material
2. Clay (forms a ribbon 1 inch or longer)
3. Silt or loam (feels smooth but will not form a ribbon)
4. Sand (feels gritty)
5. Gravel (0.8–2.5 inches)
6. Cobble and larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

X109 Enter the answer code indicating if soil movement can be expected to continue to occur in Approach Area B–Outside the Buffer/Filter Strip during the next storm event based on your answers to questions X106 through X108.

1. Yes, sedimentation will continue
2. No, sedimentation will not continue
3. Unknown

X110 Enter the answer code that best describes the specific cause of soil movement in Approach Area B–Outside the Buffer/Filter Strip.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design of road or trail outside the buffer/filter strip
3. Incorrect maintenance of the road or trail outside the buffer/filter strip
4. No maintenance or inadequate maintenance or failure to add reinforcement to BMPs installed on the road or trail outside the buffer/filter strip
5. Inadequate installation of initial or additional BMPs as necessary outside the buffer/filter strip
6. Inappropriate log landing location or activities outside the buffer/filter strip
7. Inappropriate harvesting activities outside the buffer/filter strip
8. Human activities or natural events unrelated to timber harvesting
9. Erosion from a public road

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Note the difference between the *installation* of BMPs and the *maintenance* and *reinforcement* of BMPs.

X111 Enter the answer code that best describes the cause of soil movement in Approach Area B–Outside the Buffer/Filter Strip with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately, and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question X111 proceed directly to question X113.

X112 Enter the answer code that best describes the application of BMP principles and practices in Approach Area B–Outside the Buffer/Filter Strip.

1. Planning principles applied appropriately and effectively, thus minimizing the need for additional BMP practices; soil stabilized
2. Principles and practices applied appropriately; soil stabilized
3. Principles and practices applied inadequately; soil stabilized
4. Principles and practices not applied; soil stabilized

Consider the recommendations in applicable BMP and road construction manuals including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

After answering question X112 and reading the explanation below, continue with question X113.

Approach Area B–Inside the Buffer/Filter Strip

Approach Area B–Inside the Buffer/Filter Strip originates at the outer edge of the stream's bankfull width, the top of the bank above a scoured channel, or the edge of a wetland. It extends inland perpendicular to the bank for a distance equal to the buffer/filter strip width.

Having previously noted the point on the road or trail where the approach area inside the buffer/filter strip intersects the approach area outside the buffer/filter strip, observe the conditions on the ground between that location and the point where the road or trail reaches the bankfull edge of the channel, and answer questions X113 through X116.

Report only those conditions that originate from the approach area inside the buffer/filter strip. Conditions originating beyond the approach area inside the buffer/filter strip were reported in Approach Area B–Outside the Buffer/Filter Strip.

X113 Enter the answer code indicating whether you are evaluating a haul road or a skid trail in Approach Area B–Inside the Buffer/Filter Strip.

1. Haul road
2. Skid trail

X114 Enter the answer code that best describes bearing capacity improvements used on any portion of the road or trail in Approach Area B–Inside the Buffer/Filter Strip.

1. Native material construction, no improvement evident
2. Bearing capacity improvements added, such as Geo-textile, pallets, mats, slash, corduroy
3. Permeable surfacing material added, such as gravel
4. Non-permeable paving, such as asphalt or concrete
5. Other

X115 Enter the answer code that best describes the road or trail in Approach Area B–Inside the Buffer/Filter Strip.

1. Landing or yard only, adjoining maintained road
2. Road or trail profile is flat, no ditch constructed
3. Road or trail profile is inverted below the general grade of adjoining land
4. Road or trail profile includes an excavated ditch less than 1 foot deep
5. Road or trail profile includes an excavated ditch greater than 1 foot deep
6. Road or trail profile was created by cutting and filling on a side slope
7. Road or trail profile is constructed of fill material only; forest floor beneath the fill material is unexcavated

X116 Enter the answer code that best describes any soil movement in Approach Area B–Inside the Buffer/Filter Strip.

1. Trace amounts such as films or suspended sediments deposited in the water body or within the bankfull width of the channel (go to question X117)
2. Measurable amounts of sediment deposited in the water body or within the bankfull width of the channel (go to question X117)
3. Soil moved in Approach Area B–Inside the Buffer/Filter Strip but did not reach the water body or within the bankfull width of the channel (go to question X125)
4. Soil is stabilized in Approach Area B–Inside the Buffer/Filter Strip (go to question X131)
5. Soil movement occurs in Approach Area B–Inside the Buffer/Filter Strip but has been recorded elsewhere in the protocol (go to question X132)

In cases where the sediment delivery system indicates strongly that measurable volumes of sediment have been deposited in the water body but have since been washed away (see question X117), enter answer code 2 for question X116 and enter zero for question X120.

Locate the boundaries of the area in question and carefully inspect the road or trail as well as the ditches and adjoining cut or fill slopes.

Look for evidence of soil movement, such as rills, gullies, or other sediment trails. Also consider material moved by machines during construction, as well as material pushed by wheels or dragged by logs. Note the points of origin and deposit.

Depending on the time of year, it may be necessary to brush away newly fallen leaves to follow the sediment trail. Sediment occurring above or below the various leaf layers will provide clues as to whether the erosion is ongoing or occurred during a prior harvest.

Only one answer code can be entered. Consider the various problems evident and report on the worst case scenario, choosing the answer that best describes the situation.

Sediment Deposited in the Water Body From Approach Area B–Inside the Buffer/Filter Strip

X117 Enter the answer code that best describes the evidence that sediment reached the water body or within the bankfull width of the channel from Approach Area B–Inside the Buffer/Filter Strip.

1. Ditch or rut (e.g., wheel, track, log drag) terminating in the water body or within the bankfull width of the channel (go to question X118)
2. Gully terminating in the water body or within the bankfull width of the channel (go to question X118)
3. Rill terminating in the water body or within the bankfull width of the channel (go to question X118)
4. Sheet flow, sediment deposition trail, or alluvial fan terminating in the water body or within the bankfull width of the channel (go to question X120)
5. Soil slumping or dropping terminating in the water body or within the bankfull width of the channel (go to question X120)
6. Mechanical deposition of soil terminating in the water body or within the bankfull width of the channel (go to question X120)
   Example: Soil pushed into the bankfull channel or onto a bridge by machinery or dragged logs

Only one answer code can be entered. Record the worst case scenario. Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation

Where one erosion form evolves into another in a continuous manner such as when a rill becomes a gully, record the predominant form. Report the evidence consistent with the definitions in appendix C for terms such as rill, gully, ditch, and rut.

X118 Enter the total length in whole feet, up to 999, of the rill, gully, ditch, or rut identified in question X117.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, measure and record the total length of the combined forms of erosion. If the rill or gully is branched, measure only the length of the main section—do not add the lengths of the branches. Accurate pacing is acceptable for measurement.

X119 Enter the midpoint cross-sectional area in whole square inches, up to 9999, of the rill, gully, ditch, or rut identified in question X117.

Locate a typical cross section at approximately the halfway point in the combined length of the rill, gully, or other formation being reported. Place a straightedge across the top of the eroded zone and measure the width and depth in inches to compute the area.

X120 Enter the currently evident volume of sediment deposited in the water body or within the bankfull width of the channel in whole cubic feet, up to 9999, by the delivery system identified in question X117.

Look upstream and downstream, and determine by color, texture, and location that the sediment deposit originates from the delivery system described in the question X117. Probe the deposit in several places to determine the average depth, and measure the length and width to determine the volume.

Leave blank if the sediment has been completely flushed away or if reasonably accurate measurement of the existing deposit is not possible.

X121 Enter the answer code that best describes the preponderant type of sediment delivered to the water body or within the bankfull width of the channel by the delivery system identified in question X117.

1. Organic material
2. Clay (forms a ribbon 1 inch or longer)
3. Silt or loam (feels smooth but will not form a ribbon)
4. Sand (feels gritty)
5. Gravel (0.8–2.5 inches)
6. Cobble and larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

X122 Enter the answer code indicating if sedimentation can be expected to continue to occur during the next storm event based on your answers to questions X117 through X121.

1. Yes, sedimentation will continue
2. No, sedimentation will not continue
3. Unknown

X123 Enter the answer code that best describes the specific cause of sediment delivery to the water body or within the bankfull width of the channel from Approach Area B–Inside the Buffer/Filter Strip.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design of road or trail inside the buffer/filter strip
3. Incorrect maintenance of the road or trail inside the buffer/filter strip
4. No maintenance or inadequate maintenance, or failure to add reinforcement to BMPs installed on the road or trail inside the buffer/filter strip
5. Inadequate installation of initial or additional BMPs as necessary inside the buffer/filter strip
6. Inappropriate log landing location or activities inside the buffer/filter strip
7. Inappropriate harvesting activities inside the buffer/filter strip
8. Human activities or natural events unrelated to timber harvesting
9. Erosion from a public road

Read all of the answer codes and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Note the difference between the *installation* of BMPs and the *maintenance* and *reinforcement* of BMPs.

X124 Enter the answer code that best describes the cause of sediment delivery to the water body or within the bankfull width of the channel from Approach Area B–Inside the Buffer/Filter Strip with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately, and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question X124 proceed directly to question X132.

Soil Moved in Approach Area B–Inside the Buffer/Filter Strip but Did Not Reach the Water Body

X125 Enter the distance from **the upland edge of the buffer/filter strip to the end of the soil deposition nearest the water body** as a percentage of the buffer/filter strip width.

Measure the slope distance in whole feet perpendicular to the bank. Divide it by the buffer/filter strip width.

Example: A sediment trail of any length that ends 5 feet from the water body inside a 50-foot buffer/filter strip would be calculated as follows:

45 feet divided by 50 feet = 90%, code = 90

X126 Enter the answer code that best describes the evidence that soil moved, but did not reach the water body or within the bankfull width of the channel, from within Approach Area B–Inside the Buffer/Filter Strip.

1. Ditch or rut (e.g., wheel, track, log drag) terminating in the buffer/filter strip
2. Gully terminating in the buffer/filter strip
3. Rill terminating in the buffer/filter strip
4. Sediment deposition trail, sheet flow, or alluvial fan terminating in the buffer/filter strip
5. Soil slumping or dropping terminating in the buffer/filter strip

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, record the predominant form, adhering to the definitions in appendix C.

X127 Enter the answer code that best describes the preponderant type of soil that was moved, but did not reach the water body or within the bankfull width of the channel, by the delivery system identified in question X126.

1. Organic material
2. Clay (forms a ribbon 1 inch or longer)
3. Silt or loam (feels smooth but will not form a ribbon)
4. Sand (feels gritty)
5. Gravel (0.8–2.5 inches)
6. Cobble and larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

X128 Enter the answer code indicating if soil movement can be expected to continue to occur during the next storm event based on your answers to questions X125 through X127.

1. Yes, sedimentation will continue
2. No, sedimentation will not continue
3. Unknown

X129 Enter the answer code that best describes the specific cause of soil movement that did not reach the water body or within the bankfull width of the channel in Approach Area B–Inside the Buffer/Filter Strip.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design of the road or trail inside the buffer/filter strip
3. Incorrect maintenance of the road or trail inside the buffer/filter strip
4. No maintenance or inadequate maintenance, or failure to add reinforcement to BMPs installed on road or trail inside the buffer/filter strip
5. Inadequate installation of initial or additional BMPs as necessary inside the buffer/filter strip
6. Inappropriate log landing location or activities inside the buffer/filter strip
7. Inappropriate harvesting activities inside the buffer/filter strip
8. Human activities or natural events unrelated to timber harvesting
9. Erosion from a public road

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Note the difference between the *installation* of BMPs and the *maintenance* and *reinforcement* of BMPs.

X130 Enter the answer code that best describes the cause of soil movement that did not reach the water body or within the bankfull width of the channel in Approach Area B–Inside the Buffer/Filter Strip with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately, and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question X130 proceed directly to question X132.

Soil Stabilized in Approach Area B–Inside the Buffer/Filter Strip

X131 Enter the answer code that best describes the application of BMP principles and practices in Approach Area B–Inside the Buffer/Filter Strip.

1. Planning principles applied appropriately and effectively, thus minimizing the need for additional BMP practices; soil stabilized
2. Practices and principles applied appropriately; soil stabilized
3. Practices and principles applied inadequately; soil stabilized
4. Practices or principles not applied; soil stabilized

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

X132 Enter the answer code that best describes the preponderant hydrologic soil type in Approach Area B–Inside the Buffer/Filter Strip.

1. Type A (sand or gravel—feels gritty)
2. Type B/C (loams—feels crumbly)
3. Type D (silt, clay, or muck—smooth, plastic to gelatinous)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

X133 Enter the soil erodibility factor or K factor to two decimal places.

Example: soil erodibility factor = 0.66, code = 0.66

X134 Enter the gradient in percent of the road or trail in Approach Area B–Inside the Buffer/Filter Strip, measuring from the bankfull width of the water body at the crossing.

Enter + for a positive or uphill gradient and – for a negative or downhill gradient, followed by the percent grade in whole numbers.

Example: A 15-percent uphill gradient as seen from the crossing would code +15; a 17-percent downhill gradient would code –17.

X135 Enter the gradient in percent of the road or trail in Approach Area B–Outside the Buffer/Filter Strip, measuring from the upland edge of the buffer/filter strip at the crossing.

Enter + for a positive or uphill gradient and – for a negative or downhill radient, followed by the percent grade in whole numbers

Example: A 15-percent uphill gradient as seen from the crossing would code +15; a 17-percent downhill gradient would code –17.

X136 Enter the slope length in whole feet, up to 999, of the road or trail in Approach Area B–Outside the Buffer/Filter Strip.

After answering question X136 continue with question HB137.

Haul Road, Log Landing, or Rutted, Mineral Soil Skid Trail Inside the Buffer/Filter Strip (Questions HB137–HB166)

HB137 Enter the answer code indicating if a haul road, log landing, or rutted, mineral soil skid trail not immediately associated with a water body crossing is located inside the buffer/filter strip (figure 3.10 on page 15).

1. Haul road or rutted, mineral soil skid trail is associated with a water body crossing; data has been or will be collected elsewhere (go to question CP167)
2. Haul road is inside the buffer/filter strip and is not associated with a water body crossing without first exiting and reentering the buffer/filter strip (go to question HB138)
3. Log landing (any portion) is located inside the buffer/filter strip (go to question HB138)
4. No haul road, log landing, or rutted, mineral soil skid trail is in the buffer/filter strip (go to question CP167)
5. Rutted, mineral soil skid trail is in the buffer/filter strip and is not associated with a water body crossing without first exiting and reentering the buffer/filter strip (go to question HB138)

Only one condition can be recorded. Give first priority to haul roads, second to log landings, and third to skid trails. This section is intended primarily for recording haul roads and log landings. **Skid trails should be recorded only if there are no haul roads or log landings in the buffer/filter strip, and then only if they are deeply rutted and cleared down to bare mineral soil**.

HB138 Enter the GPS location of the haul road, log landing, or rutted, mineral soil skid trail in the buffer/filter strip based on WGS 84. Enter it as **decimal degrees latitude**, including the decimal point and six decimal places.

Example: 41.736253

HB139 Enter the GPS location of the haul road, log landing, or rutted, mineral soil skid trail in the buffer/filter strip based on WGS 84. Enter it as **decimal degrees longitude**, including the decimal point and six decimal places.

Example: 76.835937

Longitude in the United States is always a negative value. This cell has been formatted with the negative sign already in place. **Do not enter a negative sign with your data**.

HB140 Enter the answer code indicating the water body type associated with the haul road, log landing, or rutted, mineral soil skid trail in the buffer/filter strip based on a year with normal precipitation.

1. Perennial stream, lake, or wetland
2. Intermittent stream or vernal pool
3. Ephemeral stream

HB141 Enter the answer code that best describes the stream order or water body type associated with the haul road, log landing, or rutted, mineral soil skid trail in the buffer/filter strip. Refer to appendix C for definitions of terms.

1. First-order stream
2. Second-order stream
3. Third-order stream
4. Fourth-order stream or larger
5. Drainage ditch systems degrading and/or draining to natural surface waters
6. Pond or lake of Federal or State significance
7. Wetland or similar area of Federal or State significance
8. Zero-order (ephemeral) stream

HB142 Enter the recommended buffer/filter strip width in whole feet, up to 999, based on State BMP guidelines.

If State BMP guidelines do not specify, enter and use 50 feet as the default value.

HB143 Enter the width in whole feet, up to 999, of any legally or contractually required water resource protection strip that is greater than the State BMP guidelines.

Leave blank if none is legally or contractually required.

Use the greater of the two widths (questions HB142 and HB143) in determining the boundary of the buffer/filter strip and in answering questions HB144 through HB166.

HB144 Enter the answer code that best describes bearing capacity improvements used on any portion of the haul road, log landing, or rutted, mineral soil skid trail inside the buffer/filter strip.

1. Native material construction, no improvement evident
2. Bearing capacity improvements added, such as Geo-textile, pallets, mats, slash, corduroy
3. Permeable surfacing material added, such as gravel
4. Non-permeable paving, such as asphalt or concrete
5. Other

HB145 Enter the answer code that identifies the log landing only, or describes the haul road or rutted, mineral soil skid trail profile present inside the buffer/filter strip.

1. Landing or yard only
2. Road or trail profile is flat, no ditch constructed
3. Road or trail profile is inverted below the general grade of adjoining land
4. Road or trail profile includes an excavated ditch less than 1 foot deep
5. Road or trail profile includes an excavated ditch greater than 1 foot deep
6. Road or trail profile was created by cutting and filling on a side slope
7. Road or trail profile is constructed of fill material only; forest floor beneath the fill material is unexcavated

HB146 Enter the answer code that best describes any soil movement inside the buffer/filter strip.

1. Trace amounts such as films or suspended sediments deposited in the water body or within the bankfull width of the channel (go to question HB147)
2. Measurable amounts of sediment deposited in the water body or within the bankfull width of the channel (go to question HB147)
3. Soil moved inside the buffer/filter strip but did not reach the water body or within the bankfull width of the channel (go to question HB155)
4. Soil is stabilized inside the buffer/filter strip (go to question HB161)

In cases where the sediment delivery system indicates strongly that measurable volumes of sediment have been deposited in the water body but have since been washed away (see question X147), enter answer code 2 for question X146 and enter zero for question X150.

Locate the boundaries of the area in question and carefully inspect the road or trail as well as the ditches and adjoining cut or fill slopes.

Look for evidence of soil movement, such as rills, gullies, or other sediment trails. Also consider material moved by machines during construction, as well as material pushed by wheels or dragged by logs. Note the points of origin and deposit.

Depending on the time of year, it may be necessary to brush away newly fallen leaves to follow the sediment trail. Sediment occurring above or below the various leaf layers will provide clues as to whether the erosion is ongoing or occurred during a prior harvest.

Only one answer code can be entered. Consider the various problems evident and report on the worst case scenario, choosing the answer that best describes the situation.

Sediment Deposited in the Water Body From Inside the Buffer/Filter Strip

HB147 Enter the answer code that best describes the evidence that sediment reached the water body or within the bankfull width of the channel from inside the buffer/filter strip.

1. Ditch or rut (e.g., wheel, track, log drag) terminating in the water body or within the bankfull width of the channel (go to question HB148)
2. Gully terminating in the water body or within the bankfull width of the channel (go to question HB148)
3. Rill terminating in the water body or within the bankfull width of the channel (go to question HB148)
4. Sheet flow, sediment deposition trail, or alluvial fan terminating in the water body or within the bankfull width of the channel (go to question HB150)
5. Soil slumping or dropping terminating in the water body or within the bankfull width of the channel (go to question HB150)
6. Mechanical deposition of soil terminating in the water body or within the bankfull width of the channel (go to question HB150)
   Example: Soil pushed into the bankfull channel by machinery or dragged logs
7. Measurable dust from concentrated, close-proximity vehicular traffic deposited in the water body or within the bankfull width of the channel (go to question HB150)

Only one answer code can be entered. Record the worst case scenario. Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, record the predominant form. Report the evidence consistent with the definitions in appendix C for terms such as rill, gully, ditch, and rut.

HB148 Enter the total length in whole feet, up to 999, of the rill, gully, ditch, or rut identified in question HB147.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, measure and record the total length of the combined forms of erosion. If the rill or gully is branched, measure only the length of the main section—do not add the lengths of the branches. Accurate pacing is acceptable for measurement.

HB149 Enter the midpoint cross-sectional area in whole square inches, up to 9999, of the rill, gully, ditch, or rut identified in question HB147.

Locate a typical cross section at approximately the halfway point in the combined length of the rill, gully, or other formation being reported. Place a straightedge across the top of the eroded zone and measure the width and depth in inches to compute the area.

HB150 Enter the currently evident volume of sediment deposited in the water body or within the bankfull width of the channel in whole cubic feet, up to 9999, by the delivery system identified in question HB147.

Look upstream and downstream, and determine by color, texture, and location that the sediment deposit originates from the delivery system identified in question HB147. Probe the deposit in several places to determine the average depth, and measure the length and width to determine the volume.

Leave blank if the sediment has been completely flushed away or if reasonably accurate measurement of existing deposit is not possible.

HB151 Enter the answer code that best describes the preponderant type of sediment delivered to the water body or within the bankfull width of the channel by the delivery system identified in question HB147.

1. Organic material
2. Clay (forms a ribbon 1 inch or longer)
3. Silt or loam (feels smooth but will not form a ribbon)
4. Sand (feels gritty)
5. Gravel (0.8–2.5 inches)
6. Cobble and larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

HB152 Enter the answer code indicating if sedimentation can be expected to continue to occur during the next storm event based on your answers to questions HB147 through HB151.

1. Yes, sedimentation will continue
2. No, sedimentation will not continue
3. Unknown

HB153 Enter the answer code that best describes the specific cause of sediment delivery to the water body or within the bankfull width of the channel from inside the buffer/filter strip.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design of the road or trail inside the buffer/filter strip
3. Incorrect maintenance of the road or trail inside the buffer/filter strip
4. No maintenance or inadequate maintenance, or failure to add reinforcement to BMPs installed on the road or trail inside the buffer/filter strip
5. Inadequate installation of initial or additional BMPs as necessary inside the buffer/filter strip
6. Inappropriate log landing location or activities inside the buffer/filter strip
7. Inappropriate harvesting activities inside the buffer/filter strip
8. Human activities or natural events unrelated to timber harvesting
9. Erosion from a public road

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Note the difference between the *installation* of BMPs and the *maintenance* and *reinforcement* of BMPs.

HB154 Enter the answer code that best describes the cause of sediment delivery to the water body from inside the buffer/filter strip with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately, and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question HB154 proceed directly to question HB162.

Soil Moved Inside the Buffer/Filter Strip but Did Not Reach the Water Body

HB155 Enter the distance from **the upland edge of the buffer/filter strip to the end of the soil deposition nearest the water body** as a percentage of the buffer/filter strip width.

Measure the slope distance in whole feet perpendicular to the bank. Divide it by the buffer/filter strip width.

Example: A sediment trail of any length that ends 5 feet from the water body inside a 50-foot buffer/filter strip would be calculated as follows:

45 feet divided by 50 feet = 90%, code = 90

HB156 Enter the answer code that best describes the evidence that soil moved from within the buffer/filter strip but did not reach the water body or within the bankfull width of the channel.

1. Ditch or rut (e.g., wheel, track, log drag) terminating in the buffer/filter strip
2. Gully terminating in the buffer/filter strip
3. Rill terminating in the buffer/filter strip
4. Sheet flow, sediment deposition trail, or alluvial fan terminating in the buffer/filter strip
5. Soil slumping or dropping terminating in the buffer/filter strip

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, record the predominant form, adhering to the definitions in appendix C.

HB157 Enter the answer code that best describes the preponderant type of soil that was moved, but did not reach the water body nor within the bankfull width of the channel, by the delivery system identified in question HB156.

1. Organic material
2. Clay (forms a ribbon 1 inch or longer)
3. Silt or loam (feels smooth but will not form a ribbon)
4. Sand (feels gritty)
5. Gravel (0.8–2.5 inches)
6. Cobble and larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

HB158 Enter the answer code indicating if soil movement can be expected to continue to occur during the next storm event based on your answers to questions HB156 through HB157.

1. Yes, sedimentation will continue
2. No, sedimentation will not continue
3. Unknown

HB159 Enter the answer code that best describes the specific cause of soil movement that did not reach the water body or within the bankfull width of the channel from inside the buffer/filter strip.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design of the road or trail inside the buffer/filter strip
3. Incorrect maintenance of the road or trail inside the buffer/filter strip
4. No maintenance or inadequate maintenance, or failure to add reinforcement to BMPs installed on the road or trail inside the buffer/filter strip
5. Inadequate installation of initial or additional BMPs as necessary inside the buffer/filter strip
6. Inappropriate log landing location or activities inside the buffer/filter strip
7. Inappropriate harvesting activities inside the buffer/filter strip
8. Human activities or natural events unrelated to timber harvesting
9. Erosion from a public road

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Note the difference between the *installation* of BMPs and the *maintenance* and *reinforcement* of BMPs.

HB160 Enter the answer code that best describes the cause of soil movement that did not reach the water body or within the bankfull width of the channel from inside the buffer/filter strip with respect to the application of principles and practices.

1. Principles and practices not applied
2. Principles and practices applied appropriately, but soil moved
3. Principles and practices applied appropriately, but inadequately maintained
4. Principles and practices applied appropriately, but degraded by activities unrelated to timber harvesting
5. Principles and practices applied inadequately or incompletely
6. Principles and practices applied inadequately, and further degraded by activity unrelated to timber harvesting
7. Activities unrelated to timber harvesting only
8. Public road maintenance or design problem

Consider the recommendations in applicable BMP and road construction manuals, including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

After answering question HB160 proceed directly to question HB162.

Soil Stabilized Inside the Buffer/Filter Strip

HB161 Enter the answer code that best describes the application of BMP principles and practices inside the buffer/filter strip.

1. Planning principles applied appropriately and effectively, thus minimizing the need for additional BMP practices; soil stabilized
2. Practices and principles applied appropriately; soil stabilized
3. Practices and principles applied inadequately; soil stabilized
4. Practices or principles not applied; soil stabilized

Consider the recommendations in applicable BMP and road construction manuals including, for example, location, vertical and horizontal centerlines and grades of haul roads and skid trails, slope and location of log landings, drainage, maintenance, and season of activities in answering the question.

HB162 Enter the answer code that best describes the preponderant hydrologic soil type inside the buffer/filter strip.

1. Type A (sand or gravel—feels gritty)
2. Type B/C (loams—feels crumbly)
3. Type D (silt, clay, or muck—smooth, plastic to gelatinous)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

HB163 Enter the soil erodibility factor or K factor to two decimal places.

Example: soil erodibility factor = 0.66, code = 0.66

HB164 Enter the slope of the log landing, if present, inside the buffer/filter strip, measuring from the point on the landing nearest the stream. If no log landing is present, leave the answer blank.

Enter + for a positive or upward slope and – for a negative or downward slope, followed by the percent grade in whole numbers.

Example: A 15-percent upward slope as seen from the point on the landing nearest the stream would code +15; a 17-percent downward slope would code –17.

HB165 Enter the gradient in percent of the haul road or rutted, mineral soil skid trail inside the buffer/filter strip from the point on the road nearest the water. If neither a haul road nor a rutted, mineral soil skid trail occurs, leave the answer blank. If both occur, record the worst case scenario.

Enter + for a positive or uphill gradient and – for a negative or downhill gradient as seen from the point on the road nearest the water body.

Example: A 15-percent uphill gradient would code +15; a 17-percent downhill gradient would code –17.

Priority for recording (in the order shown):

- Record the steeper of any road or trail gradient sloping toward (+) the water body
- Record the only road or trail gradient sloping toward (+) the water body
- Record the steeper of any road or trail gradient sloping away (–) from the water body

HB166 Enter the slope length in whole feet, up to 999, of the haul road or rutted, mineral soil skid trail slope inside the buffer/filter strip recorded in question HB165. Slope length ends at a grade change of ±5 percent sustained for a minimum of 20 feet.

Example: slope length = 95 feet, code = 095

After answering question HB166 continue with question CP167.

Chemical Pollutants (Questions C167–C172)

CP167 Enter the answer code that best describes the evidence of any lubricant, fuel, hydraulic fluid, or antifreeze spillage resulting from the harvest operation with particular attention to buffer/filter strips, water body crossings, and landings.

1. Evidence of minor dripping exists
2. Stains totaling < 10 square feet
3. Stains totaling 10–100 square feet
4. Stains totaling > 100 square feet
5. No evidence sighted

CP168 Enter the answer code indicating if discarded batteries or other potential pollutant containers are present.

1. Discarded batteries present
2. Discarded batteries and containers present
3. Containers only present, totaling more than 5 gallons
4. Containers only present, totaling less than 5 gallons
5. No containers or batteries present
6. Only trash present is unrelated to the logging activity
7. No evidence sighted in questions CP167 or CP168; record only a general location within the sample unit, such as a log landing (go to question CP171)

CP169 Enter the answer code indicating if there is evidence the material reached a surface water body

1. Yes
2. No
3. Unknown

CP170 Enter the answer code indicating the preponderant type of soil at the site where the stains or spillage were found.

1. Organic material
2. Clay (forms a ribbon 1 inch or longer)
3. Silt or loam (feels smooth but will not form a ribbon)
4. Sand (feels gritty)
5. Gravel (0.8–2.5 inches)
6. Cobble and larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay, as these components are more critical than loam in determining erosion or percolation rates.

Latitude and Longitude: Give priority to recording the latitude and longitude of any evidence found in answering question CP168 over the latitude and longitude of any evidence found in answering question CP167. At a minimum, record a general location within the sample unit.

CP171 Enter the GPS location of the chemical evidence, log landing, or other landmark within the sample unit being evaluated based on WGS 84. Enter it as **decimal degrees latitude**, including the decimal point and six decimal places.

Example: 41.736253

CP172 Enter the GPS location of the chemical evidence, log landing, or other landmark within the sample unit being evaluated based on WGS 84. Enter it as **decimal degrees longitude**, including the decimal point and six decimal places.

Example: 76.835937

Longitude in the United States is always a negative value. This cell has been formatted with the negative sign already in place. **Do not enter a negative sign with your data**.

After answering question CP172 continue with question B173.

Buffer/Filter Strip (Questions B173–B191)

B173 Enter the answer code for the water body type adjacent to the buffer/filter strip based on a year with normal precipitation.

1. Perennial stream, lake, or wetland
2. Intermittent stream or vernal pool
3. Ephemeral stream
4. No water body or buffer/filter strip (go to question W192)
5. Logging, skidding, and/or hauling activities are isolated from the buffer/filter strip by a topographic divide such as a subwatershed boundary (go to question W192)

B174 Enter the answer code for the stream order or water body type adjacent to the buffer/filter strip.

1. First-order stream
2. Second-order stream
3. Third-order stream
4. Fourth-order stream or larger
5. Drainage ditch systems degrading and/or draining to natural surface waters
6. Pond or lake of Federal or State significance
7. Wetland or similar area of Federal or State significance
8. Zero-order (ephemeral) stream

B175 Enter the answer code indicating if the water body is protected by State regulations in addition to or in lieu of Federal regulations.

1. Yes
2. No
3. Unknown

B176 Enter the width in whole feet, up to 999, of the buffer/filter strip required for this water body by State BMP guidelines, or any legally or contractually required water resource protection strip, whichever is greater.

If there are no applicable State BMP guidelines, or legally or contractually required water resource protection strip widths specified, enter and use 50 feet as the default value.

Answer questions B177 thru B186 by randomly choosing one of the buffer/filter strips within the sample unit. Record the latitude and longitude at the **downstream** end of the buffer/filter strip being sampled and walk the length of the buffer/filter strip, following the stream to its point of origin, the end of the sample unit, the end of the cutting area, a change in stream order, or 1,000 feet in length, whichever comes first. Measure the length of the buffer as you proceed to the far end.

Record the following information for only the side of the stream **inside** the sample unit or impacts originating from the sample unit.

B177 Enter the GPS location of the downstream end of the buffer/filter strip being evaluated based on WGS 84. Enter it as **decimal degrees latitude**, including the decimal point and six decimal places.

Example: 41.736253

B178 Enter the GPS location of the downstream end of the buffer/filter strip being evaluated based on WGS 84. Enter it as **decimal degrees longitude**, including the decimal point and six decimal places.

Example: 76.835937

Longitude in the United States is always a negative value. This cell has been formatted with the negative sign already in place. **Do not enter a negative sign with your data**.

B179 Enter the **number of locations** where sediment resulting from the harvest operation in the sample unit has been delivered within the bankfull width of the channel.

Leave blank if none were found.

B180 Enter cumulative **volume of sediment** in whole cubic feet, up to 999, currently evident within the bankfull width of the channel resulting from the delivery locations identified in question B179.

Look upstream and downstream, and determine by color, texture, and location that the sediment deposit originates from the delivery locations identified in question B179. Probe the deposit in several places to determine the average depth, and measure the length and width to determine the volume.

Leave blank if the sediment has been completely flushed away or if reasonably accurate measurement of the existing deposit is not possible.

B181 Enter the **number of times rills, gullies, or sediment trails** resulting from the harvest operation in the sample unit **reached more than halfway across the buffer/filter strip**, but did not reach the water body or within the bankfull width of the channel.

Leave blank if none were found.

B182 Enter the **number of pieces of naturally occurring woody debris** within the bankfull width of the channel that are greater than 4 inches in diameter at the small end and are either longer than the stream width or are anchored to the bank by roots or other means.

Leave blank if none were found.

B183 Enter the **number of pieces of woody debris resulting from the harvest** that are left within the bankfull width of the channel that are greater than 4 inches in diameter at the small end and are either longer than the stream width or are anchored to the bank by roots or other means.

Leave blank if were none found.

B184 Enter the **number of times a potential erosion channel has been gouged into the bank** by the removal of trees felled into the water body or within the bankfull width of the channel during the current harvesting activities in the sample unit.

Leave blank if none were found.

B185 Enter the answer code indicating the approximate **volume of slash resulting from harvesting activities** in the sample unit that has been left within the bankfull width of the channel.

1. Less than 100 cubic feet (approximately one pickup truck load)
2. 100–200 cubic feet
3. More than 200 cubic feet

B186 Enter the **length** in whole feet, up to 9999, of the buffer/filter strip area being monitored.

Return to the beginning of the buffer/filter strip, establish a plot in the center of each quartile of the buffer/filter strip length, and record the values of each for questions B187 thru B191. The quartile values will be automatically averaged and entered into the database.

B187 Enter as a three-digit value the **percent crown closure** measurement for each of the quartile plots as indicated by crown densiometer readings taken at the top of the streambank.

The values are averaged as each of the quartile measurements is entered, and the final average is recorded automatically as the answer to question B187. The final value may be overridden if necessary.

B188 Enter the **basal area** in square feet of each quartile plot as measured in the center of the quartile length and halfway between the streambank and the upland edge of the buffer/filter strip.

The values are averaged as each of the quartile measurements is entered, and the final average is recorded automatically as the answer to question B188. This final value may be overridden if necessary.

B189 Enter **diameter** in whole inches of the single largest leave tree on each of the four plots.

The values are averaged as each of the quartile measurements is entered, and the final average is recorded automatically as the answer to question B189. This final value may be overridden if necessary.

B190 Enter the answer code indicating if there has been a reduction in shade in the buffer/filter strip as a result of harvesting in the sample unit.

1. Shade in buffer/filter strip reduced by the harvesting in the sample unit
2. Shade in buffer/filter strip not reduced by the harvesting in the sample unit
3. No buffer/filter strip left
4. Unable to determine

B191 Enter the answer code indicating if the average shade or basal area (BA) conditions in the buffer/filter strip in the sample unit meet State requirements.

1. Shade or basal area conditions meet State requirements
2. Shade or basal area conditions do not meet State requirements
3. No State requirements

After answering question B191 continue with question W192.

Wetland Crossing (Questions W192–W197)

W192 **If the answer to question X12 indicates a wetland crossing**, enter the answer code that best describes the stabilization techniques used on any portion of the wetland crossing.

1. Frozen condition operations
2. Dry condition operations
3. Corduroy of slash and tops
4. Poles of average diameter greater than 10 inches
5. Bridge or mats
6. Multiple methods
7. Other
8. No wetland crossing (go to question S1)

W193 Enter the length in whole feet, up to 999, of the wetland crossing from upland to upland.

W194 Enter the answer code that best describes the average rutting depth of the wetland crossing.

1. Less than 6 inches deep
2. 6–12 inches deep
3. Greater than 12 inches deep

W195 Enter the answer code indicating the method used to facilitate cross drainage in the wetland road or trail prism (cross section) within the first 12 inches of soil depth.

1. Porous section in road prism
2. Culverts with dispersion ditches at 30-foot intervals or less
3. Other methods acceptable under State BMP guidelines
4. Cross drainage unacceptable under State BMP guidelines
5. Unknown

W196 Enter the answer code that best describes any sediment reaching the wetland from the approaches to the wetland crossing.

1. No sediment reached the wetland (go to question S1)
2. Trace amounts such as films or visible suspended sediments deposited in the wetland (go to question S1)
3. Measurable amounts of sediment reached the wetland (go to question W197)
4. Soil movement occurs, but has been recorded elsewhere in the protocol (go to question S1)

W197 Enter the volume in whole cubic feet, up to 999, of sediment deposited in the wetland as identified in question W196.

Leave blank if the sediment has been completely flushed away or if reasonably accurate measurement of the existing deposit is not possible.

After answering question W197 continue with question S1.

State- or User-Defined Entries (Questions S1–S20)

Twenty additional data cells are provided for States or other users to collect additional information. Each cell provides space for up to a 20-digit data entry. To use these entries, the State or other user must provide a separate list of questions and answer codes.

If no entries are to be made, go to END.

If a list of questions and answer codes is provided, answer as many questions as are provided. Leave the rest of the entries blank and go to END.

S1–S20 Enter up to 20 characters in the space provided for each question in response to State or user instructions. Entries may be answer codes, file names, comments, or any other data the user organization wishes to record.

END

Appendix A—Installing the BMP Protocol Software

The BMP protocol software actually consists of two programs. One runs on your pocket PC and allows you to collect field data. The other runs on your desktop PC. It receives field data from the pocket PC and allows you to transfer the information to an Excel spreadsheet.

This appendix describes the process of installing the BMP protocol software and uploading data from the pocket PC to the desktop PC. Six basic steps are covered. The sequence varies slightly depending on which operating system your pocket PC uses: Windows Mobile 3 or 4, or Windows Mobile 5.

Step 1: Install and set up Microsoft ActiveSync

Step 2: Install the BMP desktop program on the desktop PC

Step 3: Set up the pocket PC to work with Microsoft Access (Windows Mobile 5 units only)

Step 4: Install the BMP pocket PC program on the pocket PC

Step 5: Configure ActiveSync for the BMP program database (Windows Mobile 3 and 4 units only)

Step 6: Transfer data from the pocket PC to the desktop PC

It is important to follow the steps exactly as outlined in order for the software to operate properly.
You should have received a CD containing the BMP software files or you may download them from the Northeastern Area Web site (www.na.fs.fed.us). There are three sets of files: the pocket PC files (BMP_PocketPC_Install.exe), the desktop PC files (BMP_Desktop_Install.zip), and some files specifically for pocket PC units that use the Windows Mobile 5 operating system (Files_Needed_For_WM05.zip). In order to preserve these files, copy them to a folder on your hard drive. Save them as non-Read-only files by right clicking on the folder and selecting Properties. Then uncheck the Read-only box and select Apply.

Once you have completed all of the steps in this appendix and collected field data, you may want to report and analyze that data in more detail. The BMP desk reference includes instructions for generating standard data summaries and creating custom queries using data collected in the field. Please refer to the desk reference for more information.

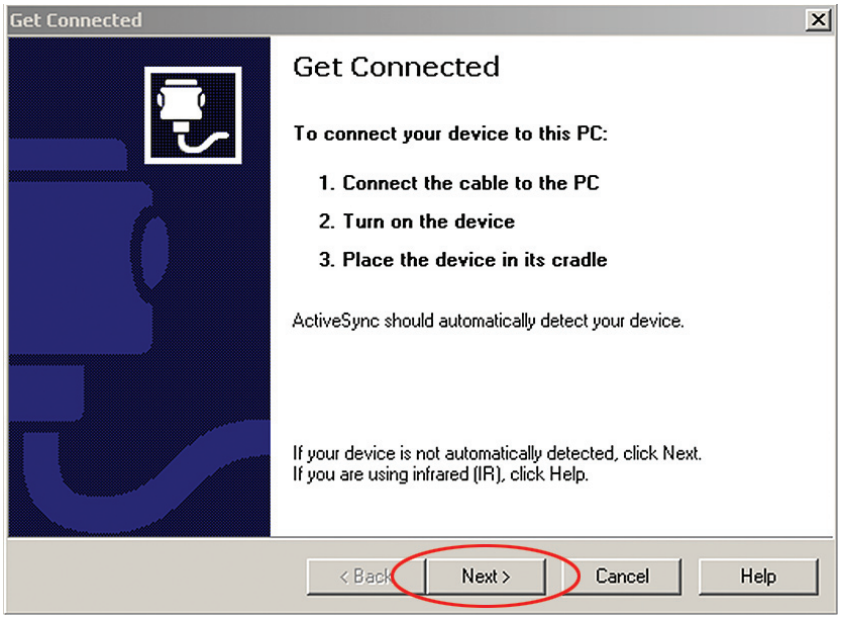
Step 1: Install and Set Up Microsoft ActiveSync

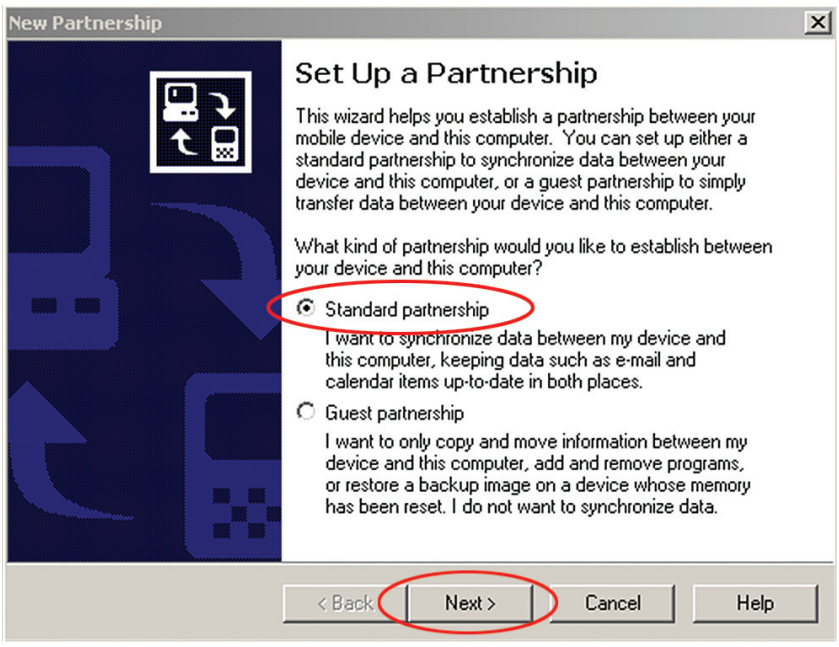
Your pocket PC came with a copy of Microsoft ActiveSync, which must be installed on your desktop PC in order to communicate with the pocket PC. The BMP program uses this mechanism to gather field data from the pocket PC.

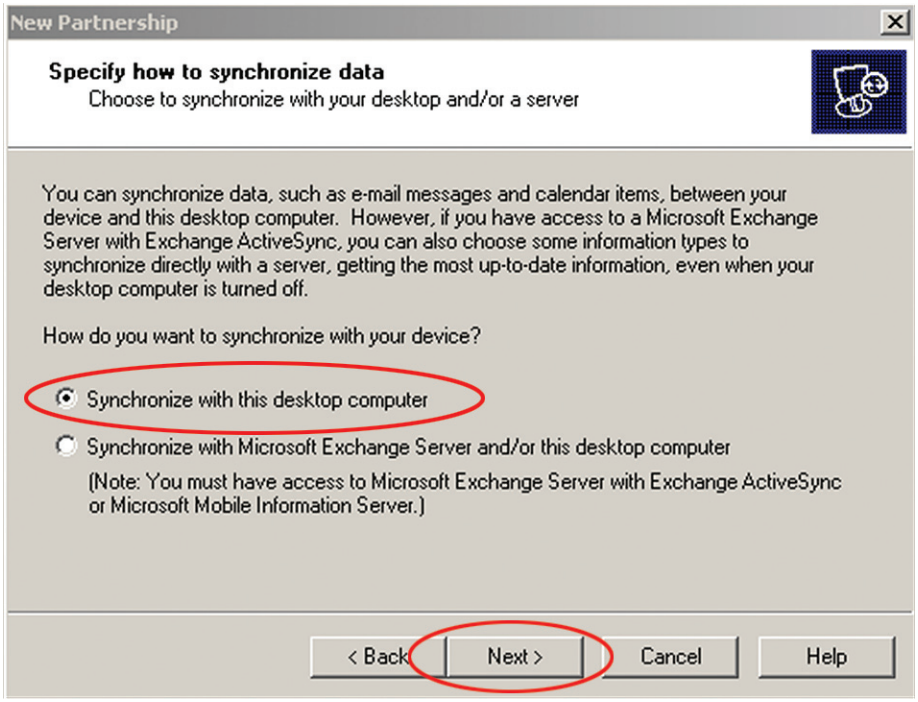
1.1 Install Microsoft ActiveSync on your desktop PC from the CD provided with your pocket PC. Follow the manufacturer's instructions.

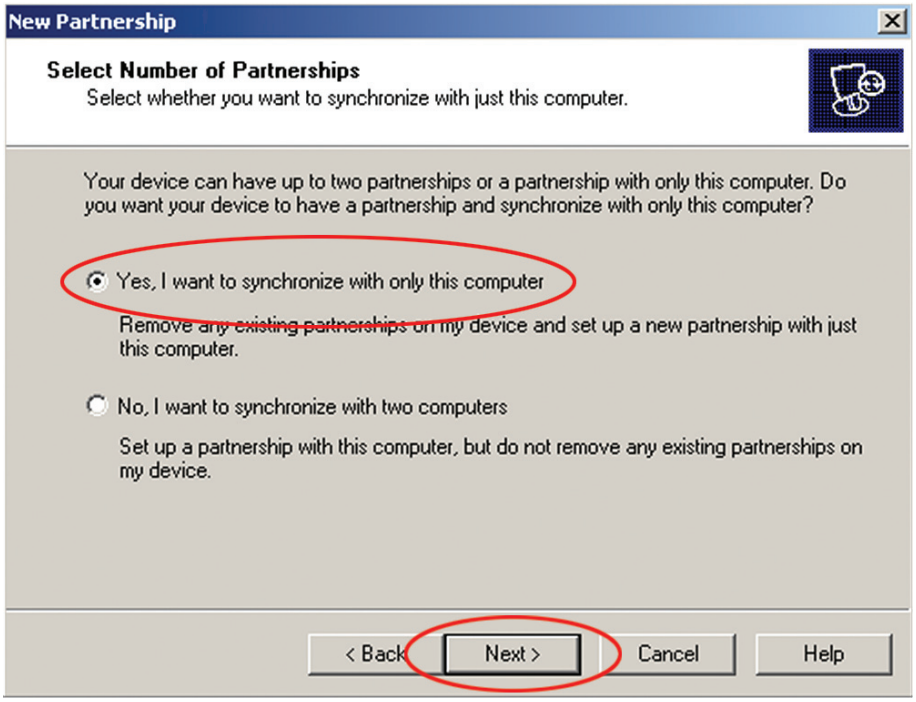
1.2 Connect your pocket PC to your computer when instructed to do so. This is typically done using some kind of "cradle" or cable and your desktop PC's serial or USB ports. Put the pocket PC in the cradle or connect the sync cable as instructed by the manufacturer.

1.3 The screen images that follow are typical of what you may see as you install and configure ActiveSync, but they may not match exactly. Follow the manufacturer's instructions that came with your unit.





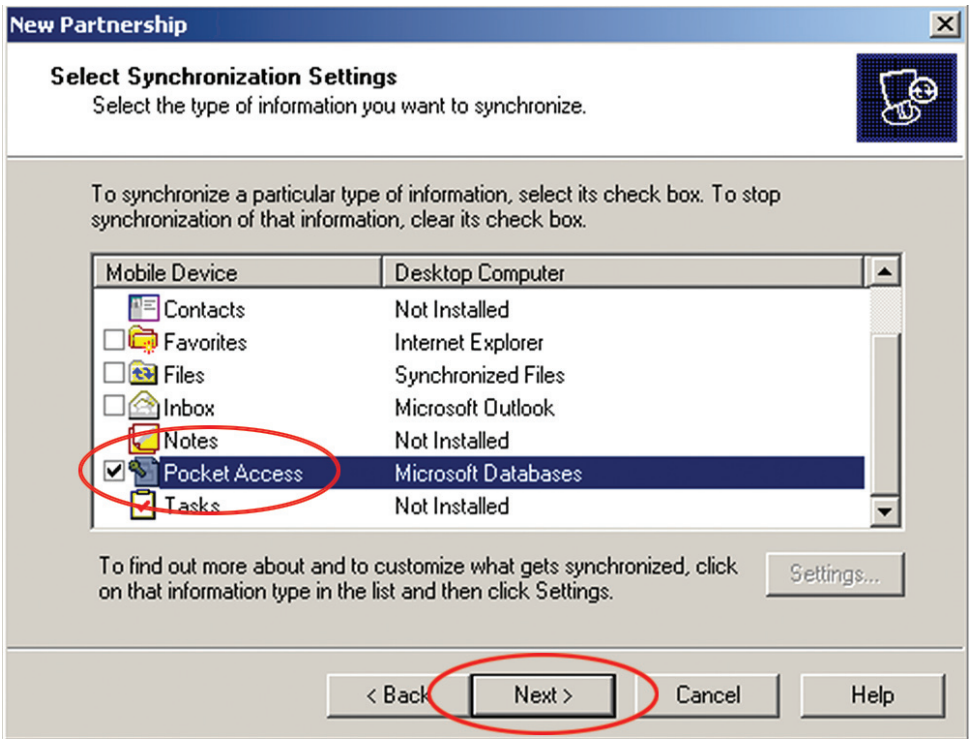


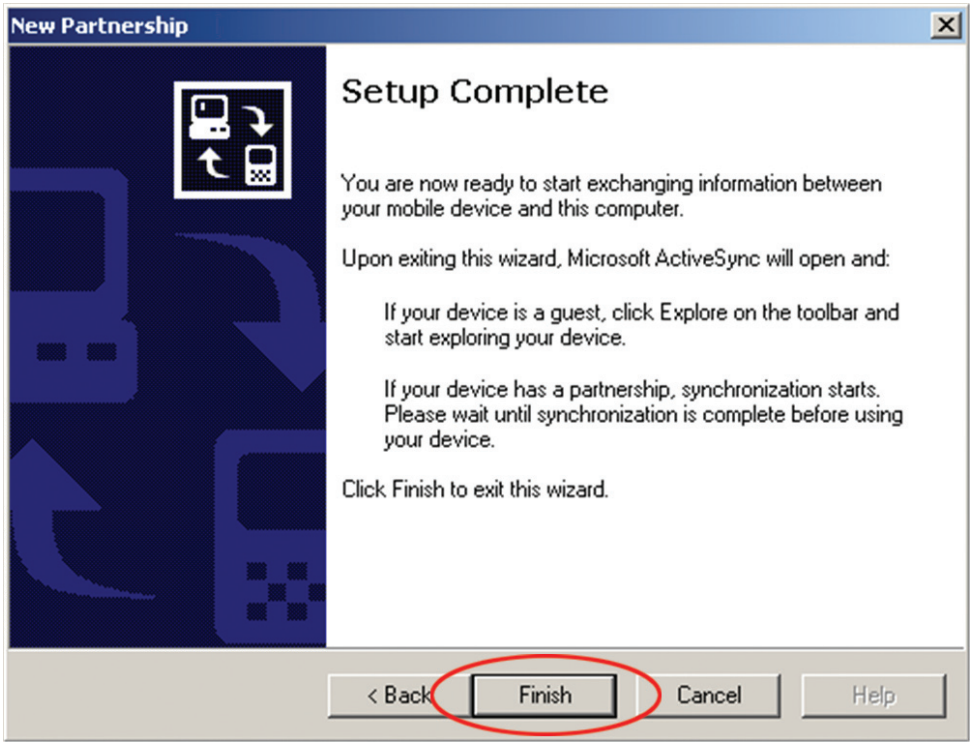


At this point, you need to synchronize ActiveSync with Pocket Access. If you choose, you may also synchronize your contacts, e-mail, or other items. These features are not necessary for the BMP program, but if you need and use them, feel free to include them here. The only downside is that it will make the synchronization process a bit slower.

Note: On units using Windows Mobile 5, you may see Pocket Access as an option, but it is not available at this point even if you select it. The instructions for enabling Pocket Access on units using Windows Mobile 5 are in step 3.

1.4 Check the box next to **Pocket Access** and select Next, then Finish.





Step 2: Install the BMP Desktop Program on the Desktop PC

The BMP protocol software includes a file called **BMP_Desktop_Install.zip.** This compressed file contains the three files you will need to install the BMP desktop program.

2.1 First, unzip the files in **BMP_PC_Install.zip** and copy them to a temporary folder somewhere on your desktop PC. It does not matter where you create this temporary folder as long as you can find it. It is probably most convenient to create it on your Windows desktop. The three files contained in the zip file are **BMP_Desktop.CAB**, **setup.exe,** and **Setup.lst**.

2.2 Open your temporary folder and double click on **setup.exe** to run it.

2.3 Follow the instructions on the screen to install the program. It will suggest installing the program to **C:\Program Files\BMP_Desktop** on your desktop PC. It is best accept that default. If you want to install the program to a different location, you may do so, but remember where you put it because you will need that information in a later step.

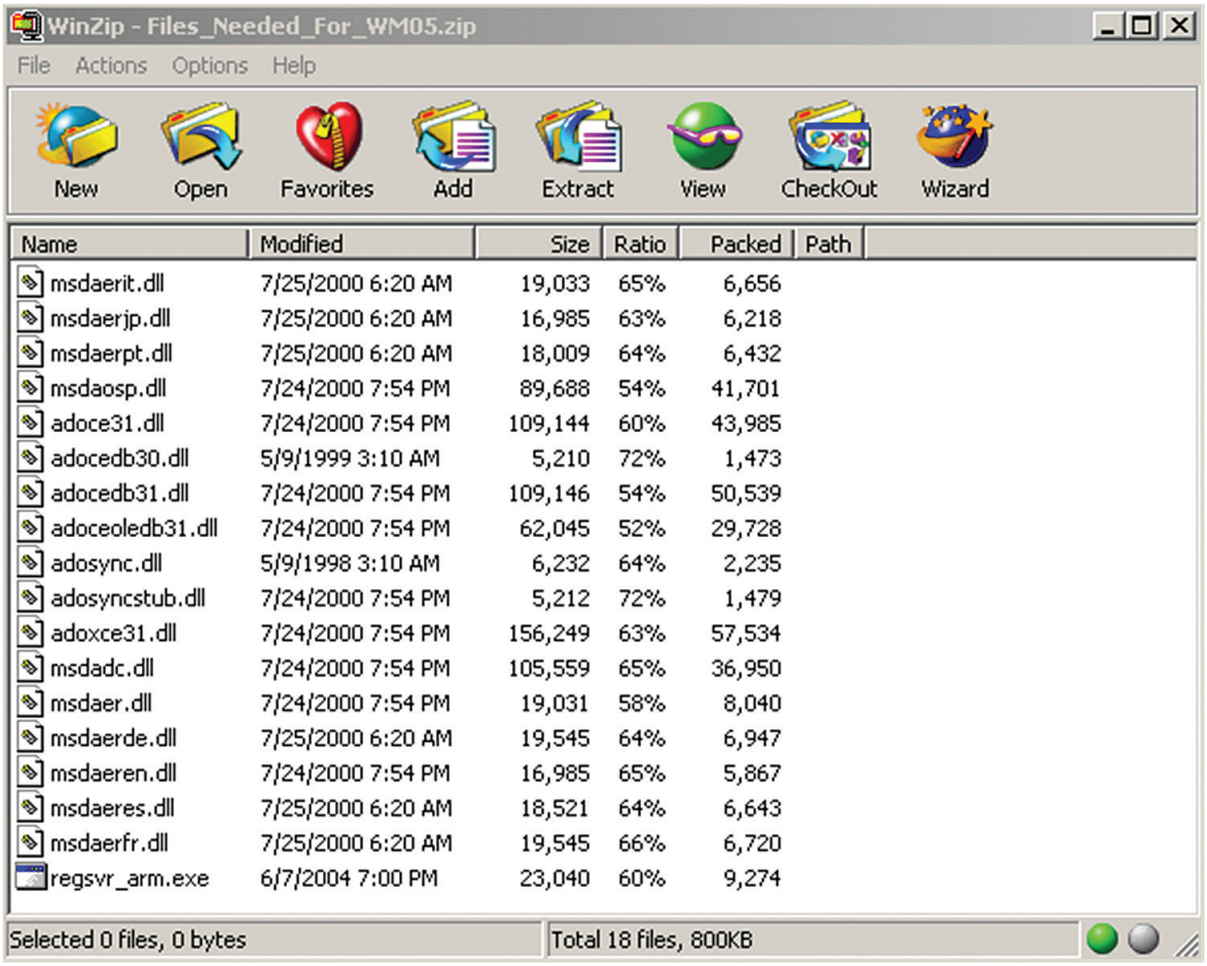
2.4 Navigate to **C:\Program Files\BMP_Desktop**. Right click on the file **BMP_Desktop.exe** and select Create Shortcut. Drag and drop the shortcut to the Windows desktop.

Step 3: Set Up the Pocket PC to Work With Microsoft Access (Windows Mobile 5 Units Only)

NOTE: Windows Mobile 3 or 4 users should skip step 3 and proceed directly to step 4. Windows Mobile 5 users must complete step 3.

The BMP protocol software includes a zip file called **Files_Needed_For_WM05.zip**. It contains 18 files that you need to copy onto your pocket PC.

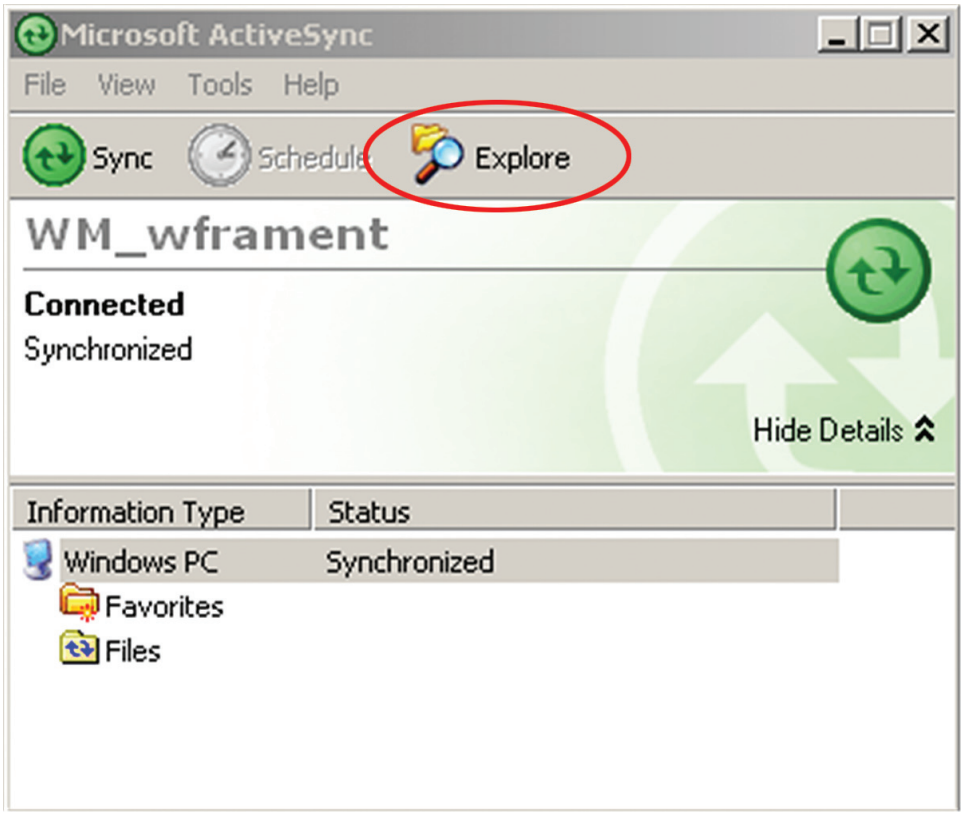
3.1 Locate **Files_Needed_For_WM05.zip** on your desktop PC and open it with WinZip or an equivalent program. If you are using WinZip, you will see a screen like the one below.



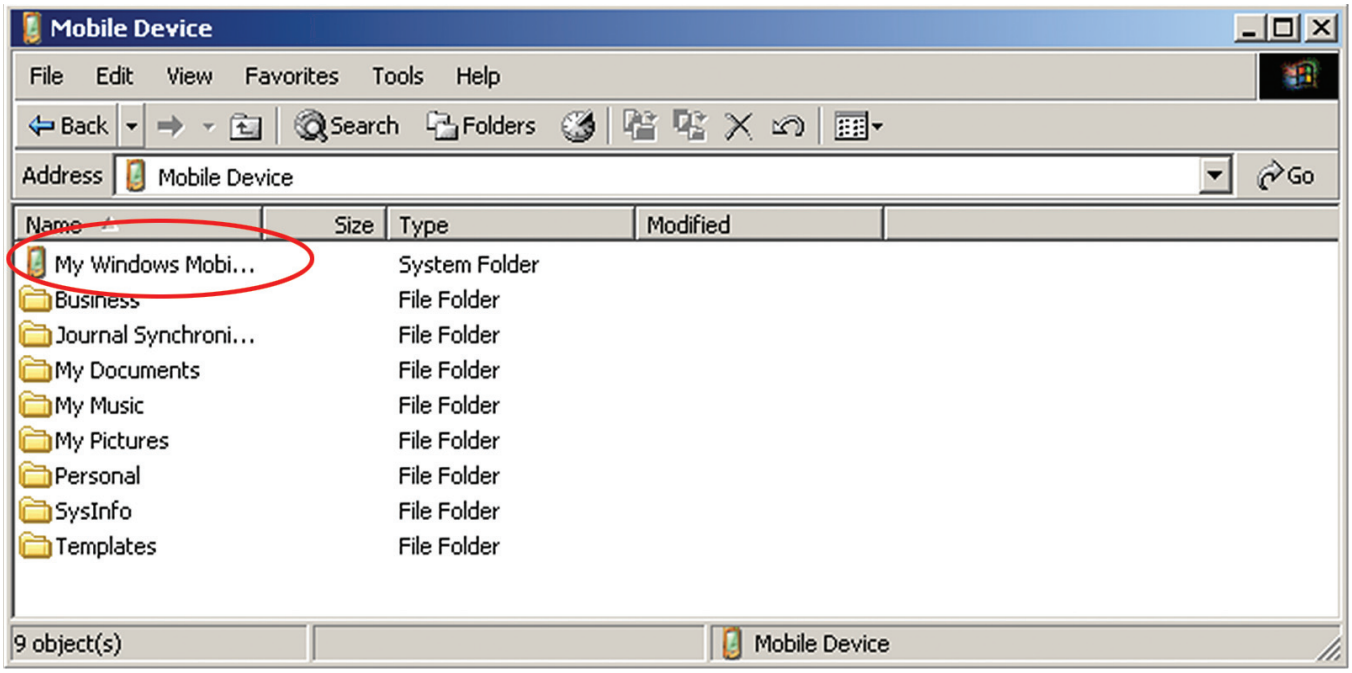
3.2 You will use the ActiveSync Explore feature to copy these 18 files to the \Windows folder on your pocket PC. Keep this WinZip window open on your desktop. Make sure that your pocket PC is connected and ActiveSync is running.

3.3 If you don't have WinZip or are unable to see the screen shown above, extract the 18 files to a folder on your desktop, using whatever "unzipping" software you have. You need to be able to select all 18 of these files to copy them to your pocket PC.

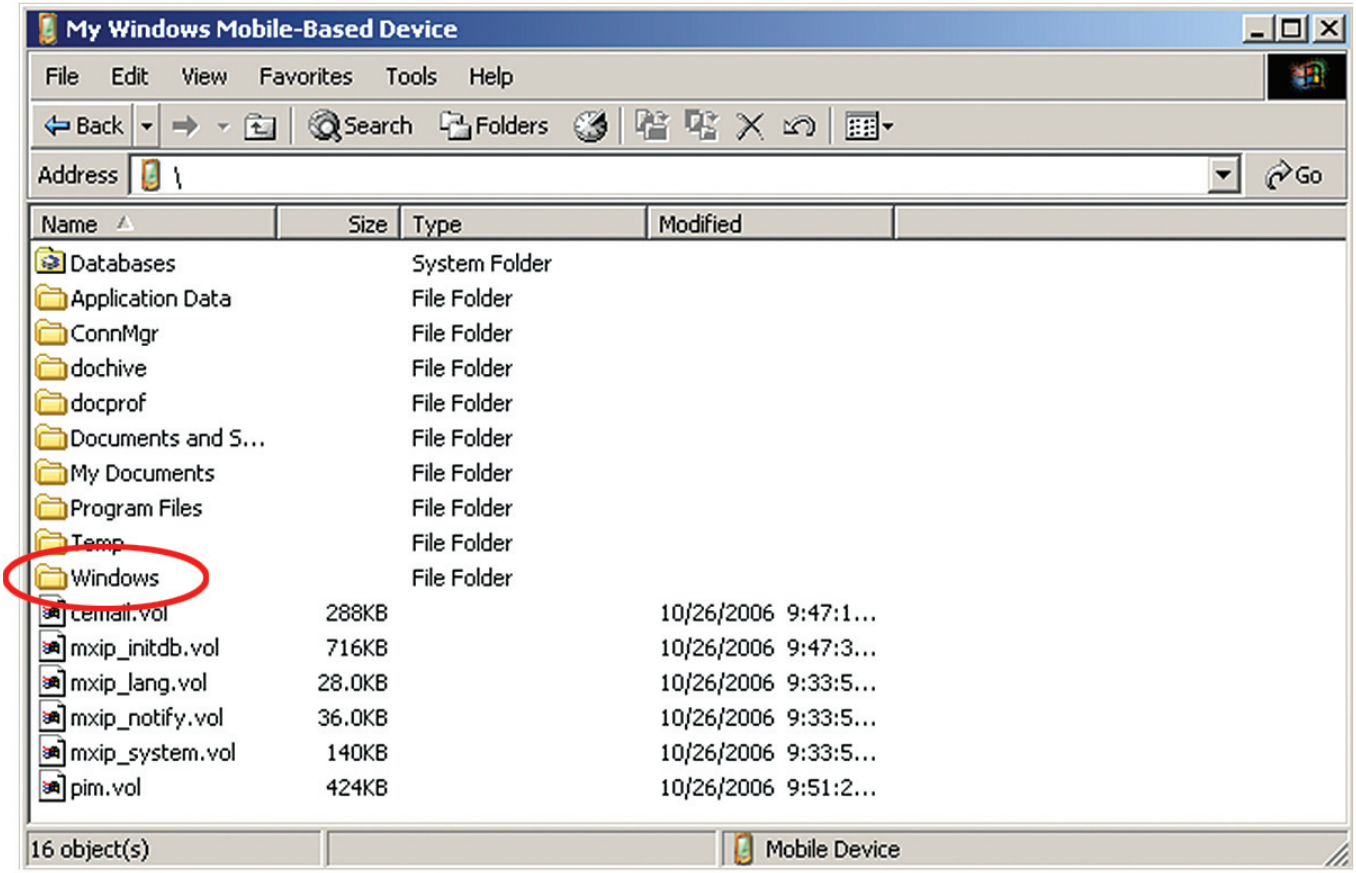
3.4 Open ActiveSync and select Explore.



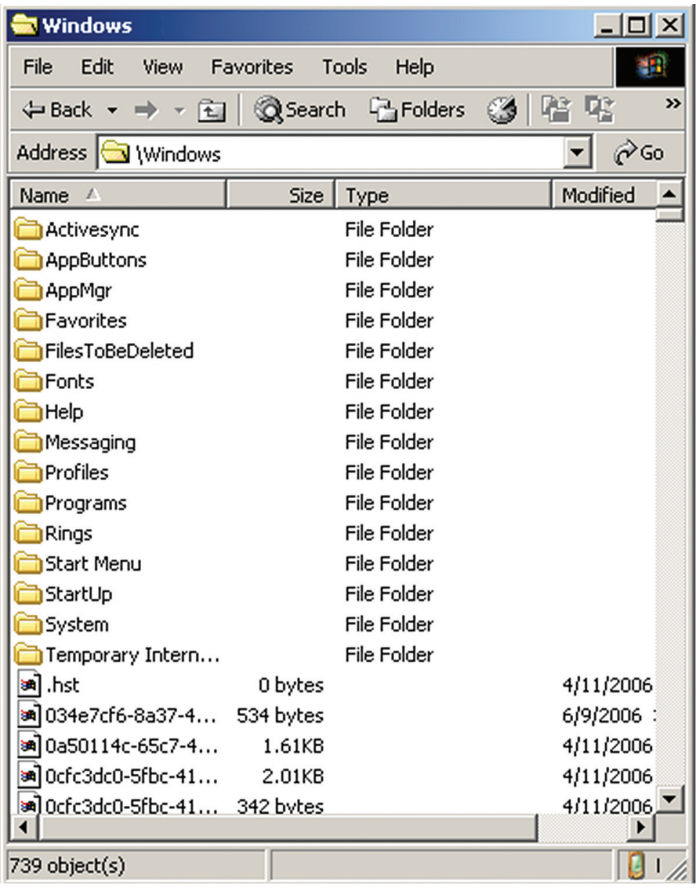
3.5 You should see a screen like the one shown below, which displays files that are on your pocket PC. Double click on **My Windows Mobile-Based Device**.

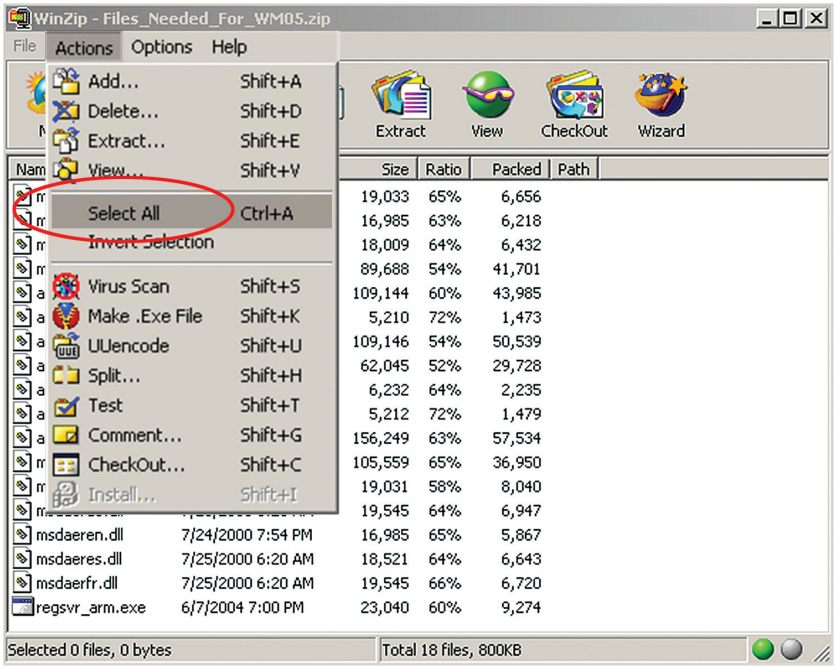


3.6 Double click on the **Windows** folder to open it.



3.7 You should now have two windows open: the **\Windows** folder you just opened (shown on the top below) and the **Files_Needed_For_WM05.zip** folder you left open previously (shown on the bottom).





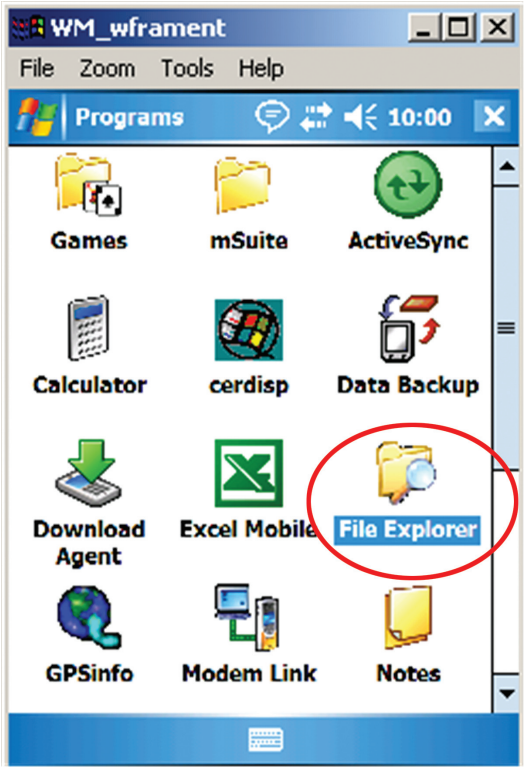
3.8 Select all 18 of the files in the **Files_Needed_For_WM05.zip** folder and drag them to the **\Windows** folder. **Do not put them into a subfolder within \Windows; put them directly into \Windows.**

3.9 Close both windows.

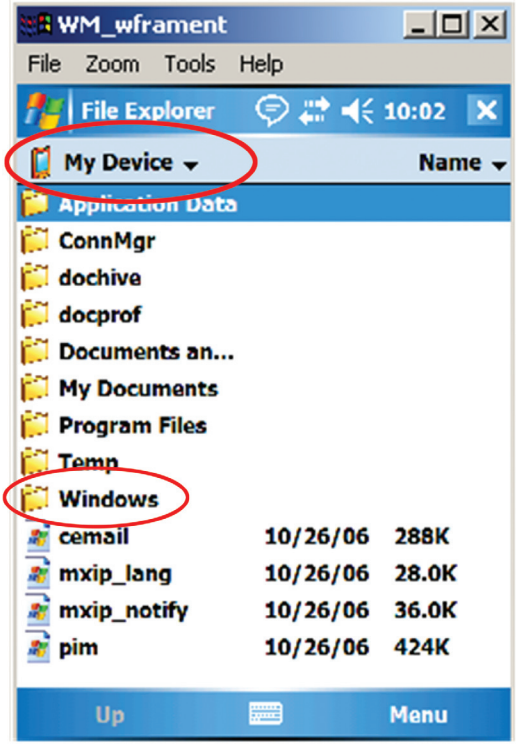
You need to "register" one of the files you just put on your pocket PC.

3.10 Remove the pocket PC from the cradle.

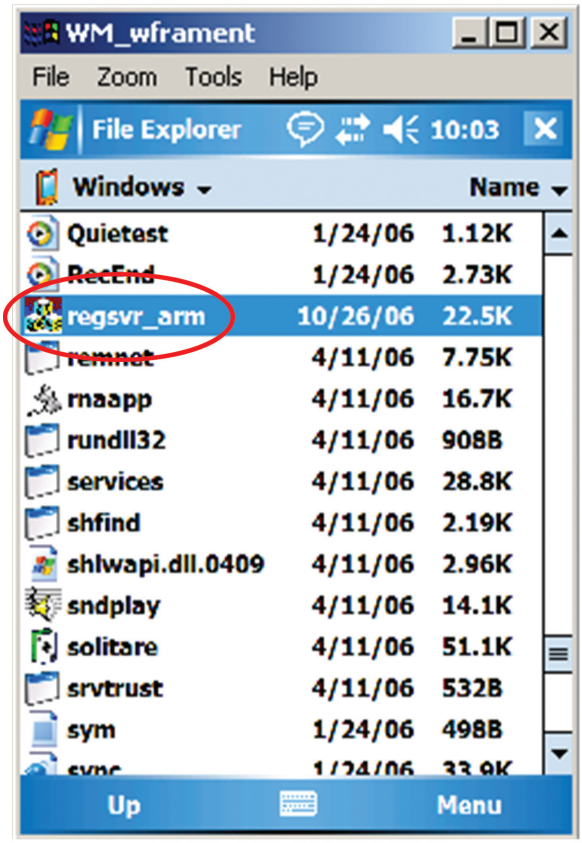
3.11 Select the Start button on the pocket PC with the stylus and select Programs to get to the screen shown below.



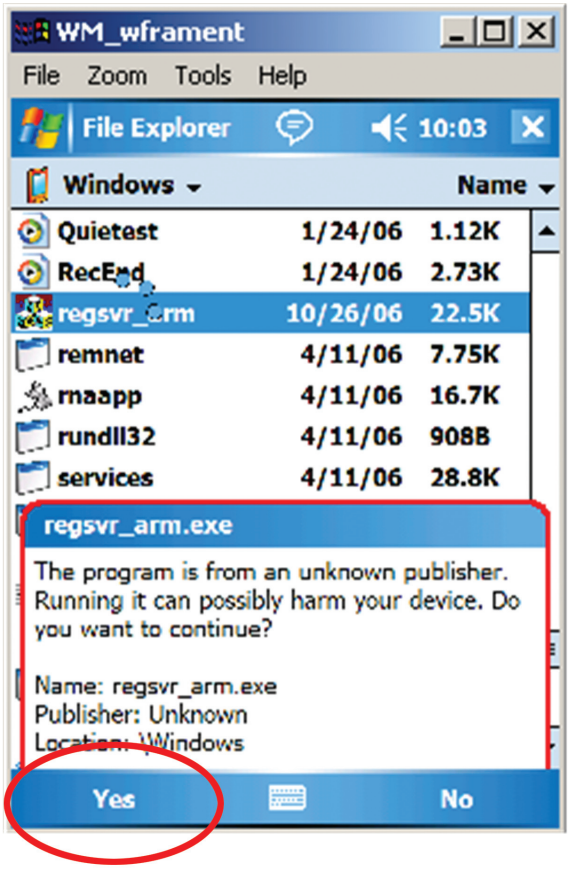
3.12 Select File Explorer, select My Device from the task bar just below File Explorer, and then select the **Windows** folder to open it.



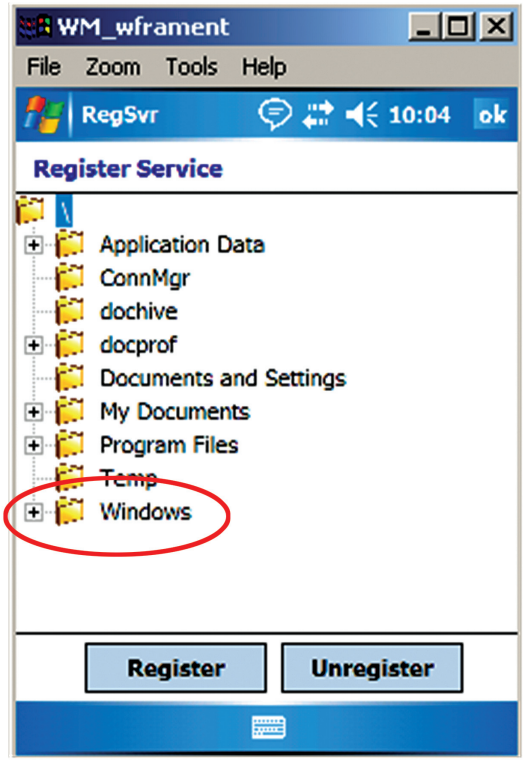
3.13 Locate the file **regsvr_arm** and select it to run it. (This is one of the 18 files you copied onto the pocket PC.)



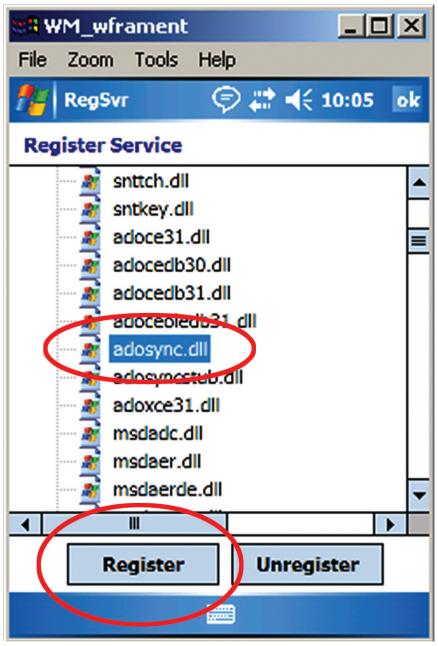
3.14 If the following message appears, select Yes.

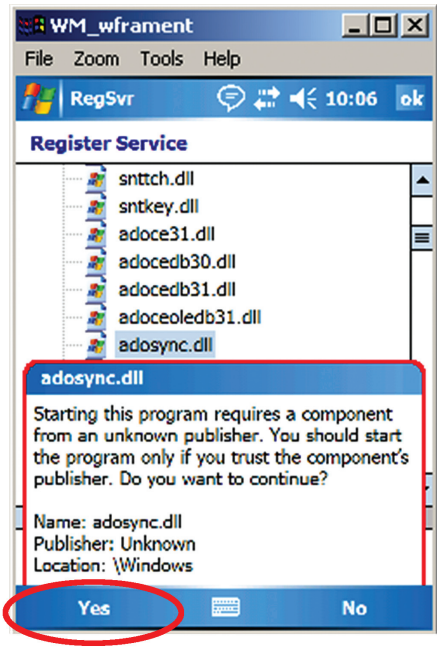


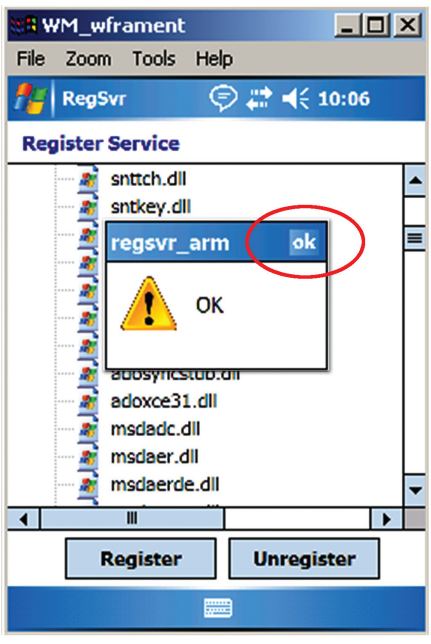
3.15 Select the plus next to the **Windows** folder to open it.



3.16 Locate the file **adosync.dll** (note that the files are not in alphabetical order). Select this file but do not open it. Select the Register button. Answer Yes and then select OK as shown in the screens below.

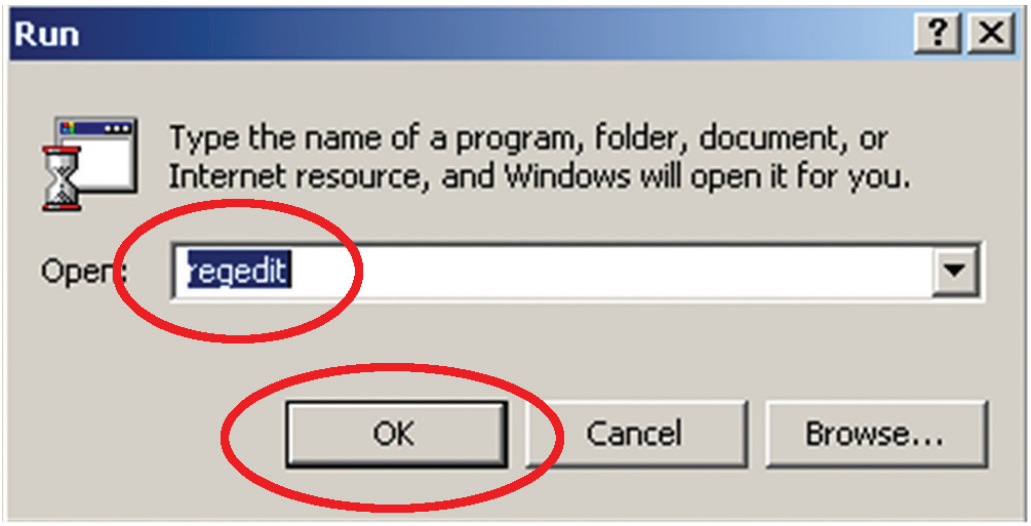




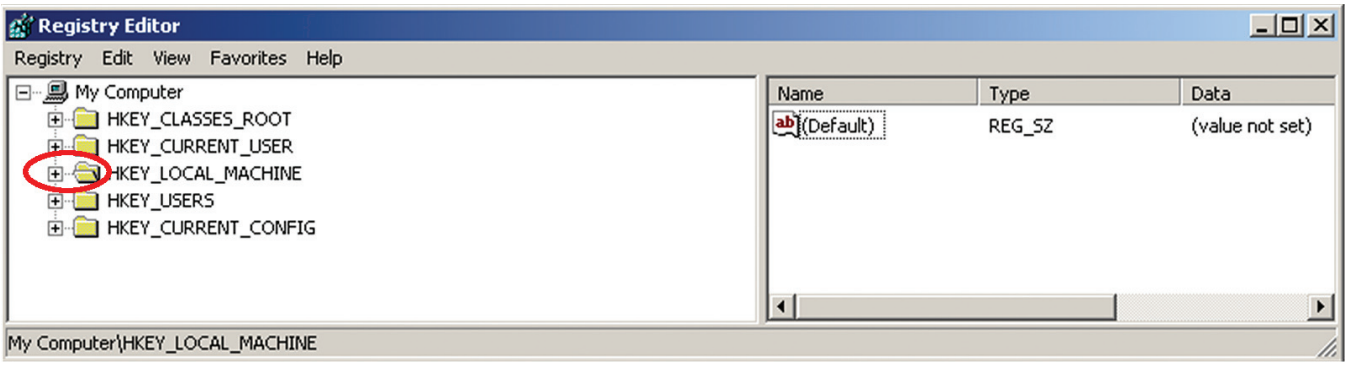


Next you have to remove a registry key from your desktop PC. **It is very important that you follow these instructions EXACTLY. Serious problems can result if you delete or change the wrong items in the Windows Registry.** If you are a computer novice, you may want to get the assistance of a more knowledgeable colleague. You may need administrative privileges to complete this step.

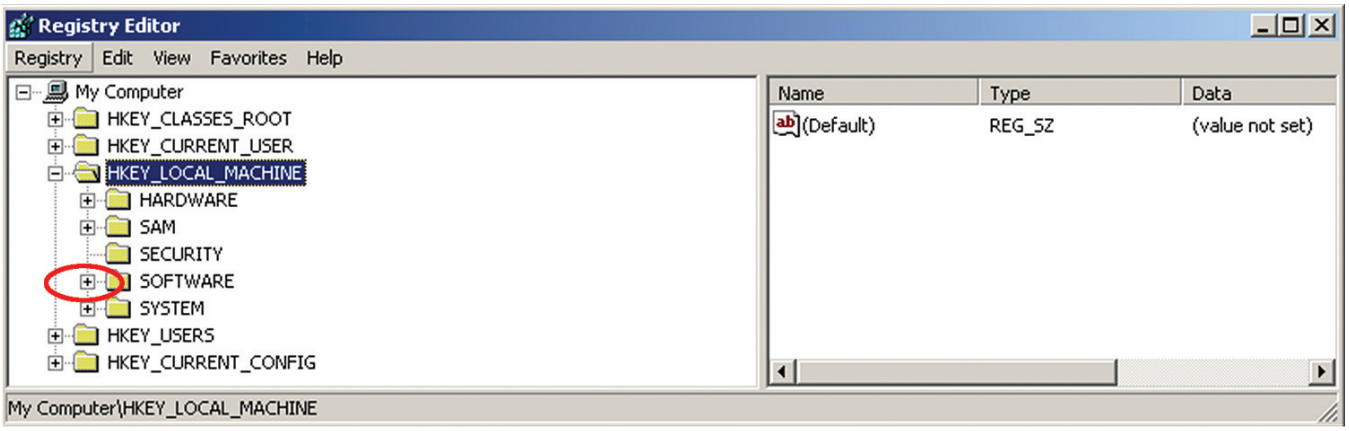
3.17 Select Start and then Run on your desktop PC. In the Run window, type "**regedit**" and select OK.



3.18 Select the plus sign to the left of the **HKEY_LOCAL_MACHINE** folder to expand it.



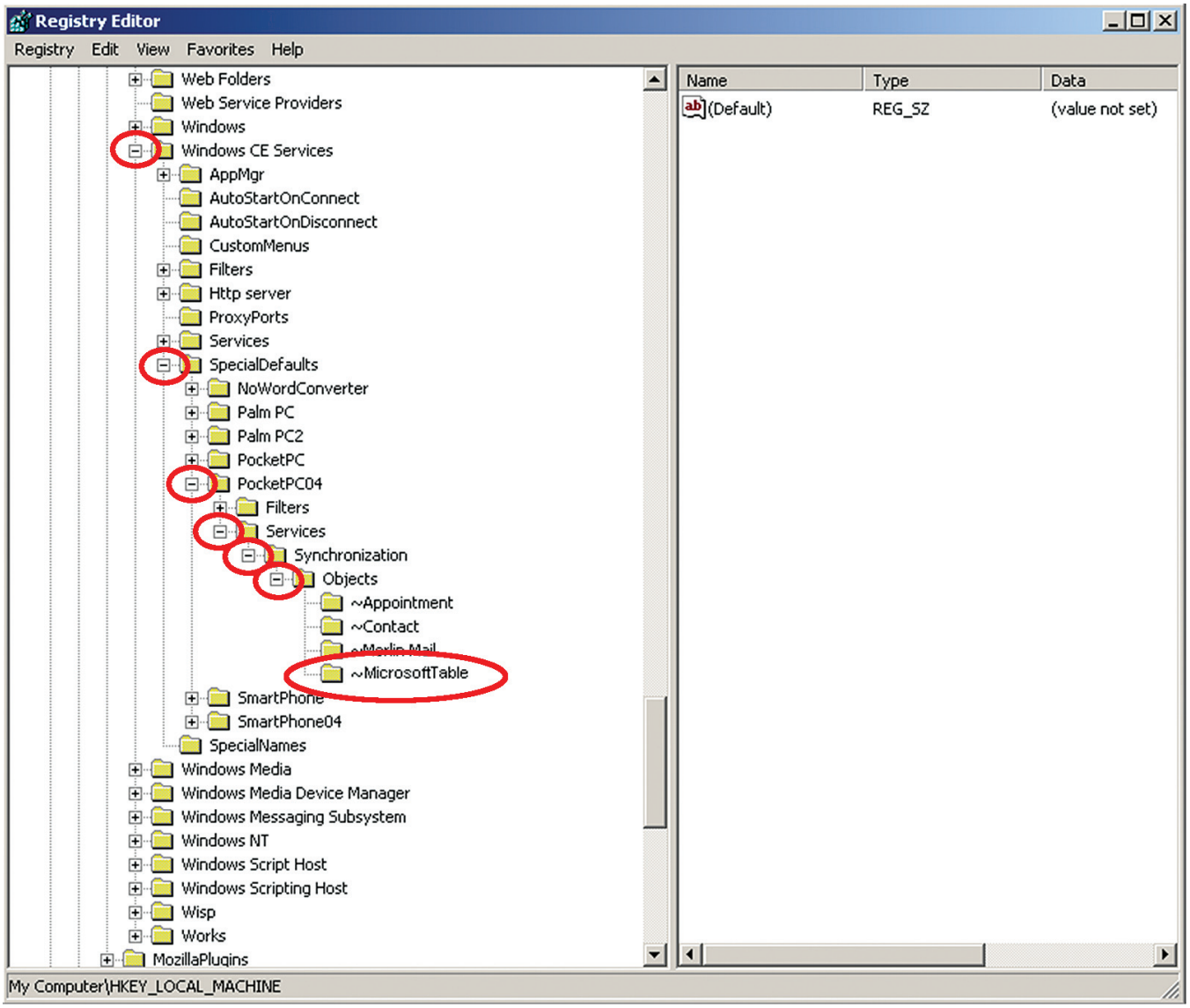
3.19 Select the plus sign next to the **SOFTWARE** folder to expand it.



3.20 Locate the **Microsoft** folder and select the plus sign to expand it. (Note: There is a long list of folders in this step, making it difficult to include a screen image. The folder names are in alphabetical order, so the correct folder can be located easily.)

3.21 Continue to expand the outline by selecting **Windows CE Services**, **SpecialDefault**s, **Pocket PC04**, **Services**, **Synchronization**, and **Objects** as shown below.

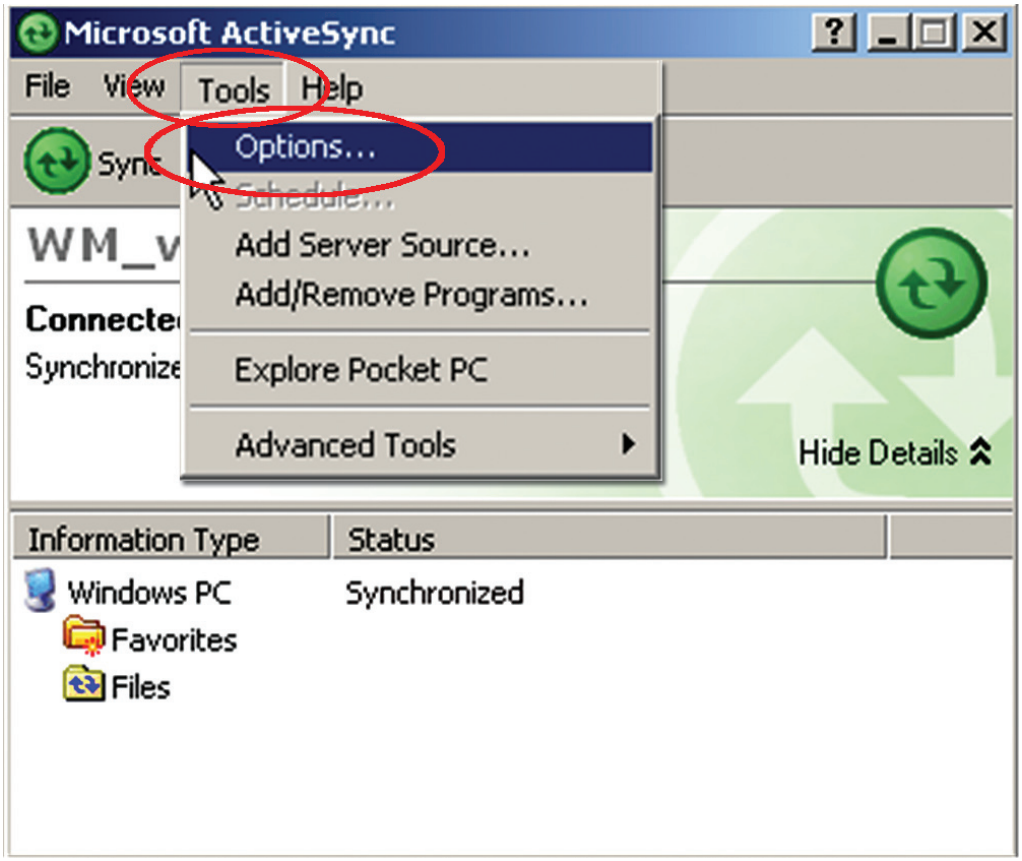
3.22 Select the **~MicrosoftTable** folder but do not open it. Press the Delete key on your keyboard to remove it.



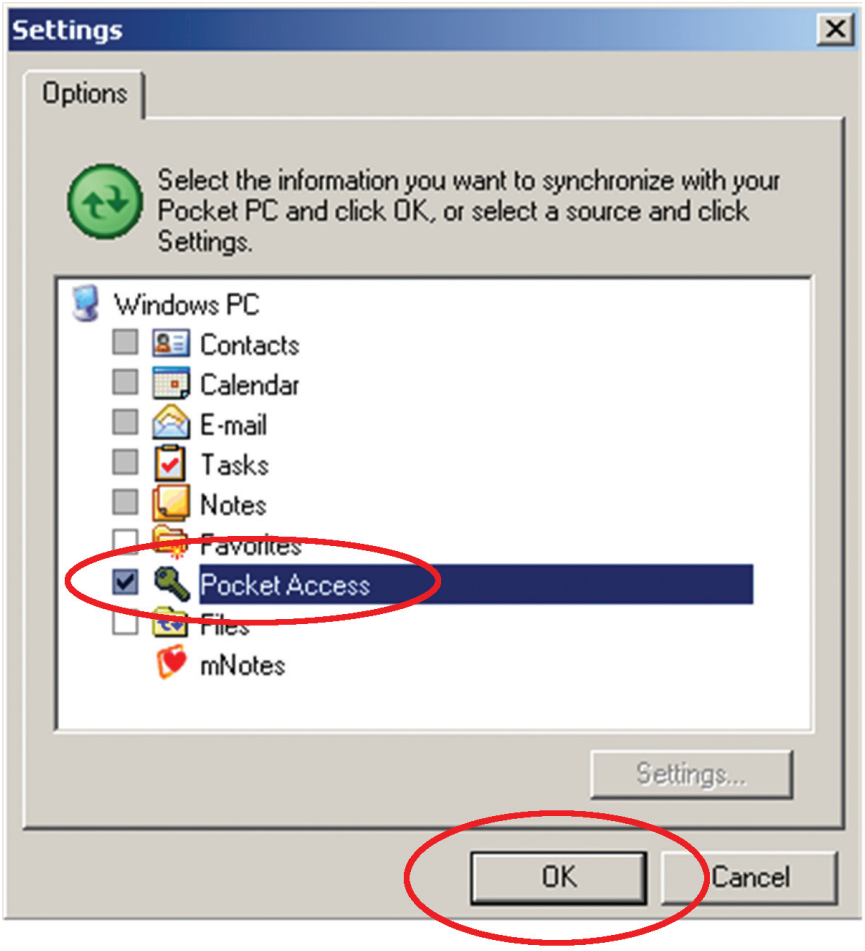
3.23 Close the Registry Editor window.

3.24 Place your pocket PC back in the cradle. ActiveSync will open on the desktop PC if it isn't open already.

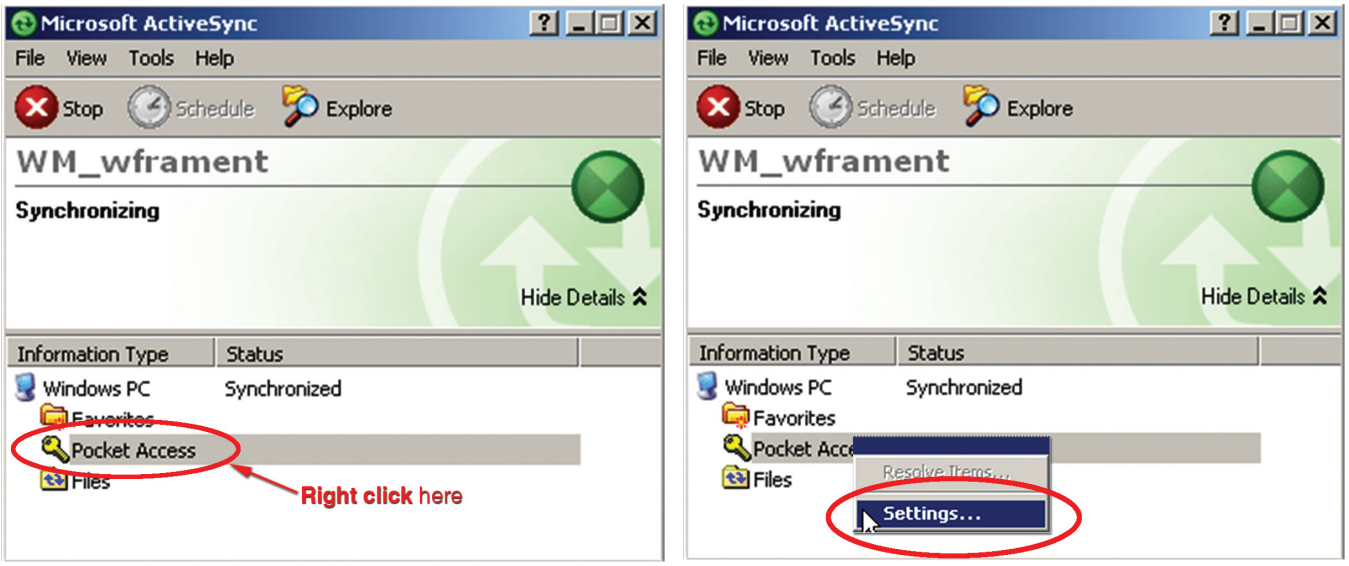
3.25 Select Tools and then Options from the ActiveSync menu.



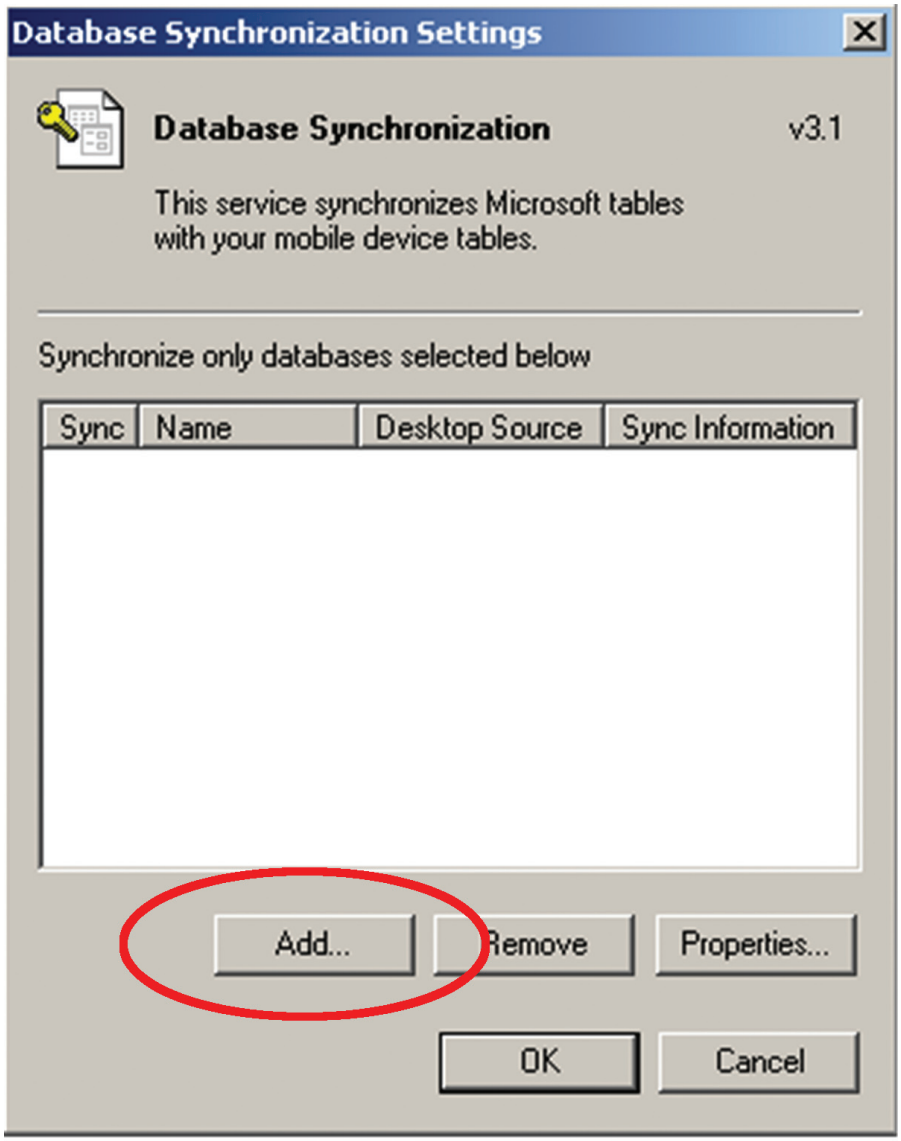
3.26 Pocket Access should be available as an option. Check the box next to it and select OK.



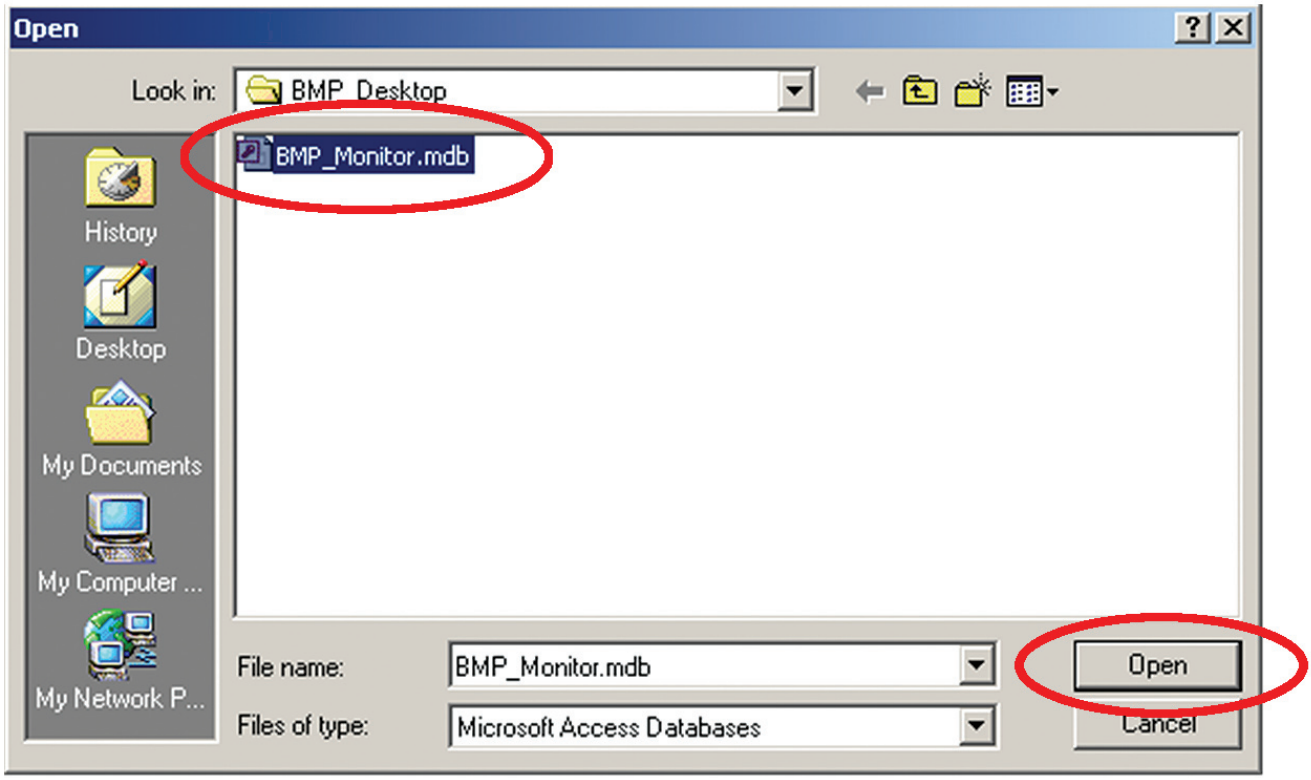
3.27 Allow time for the pocket PC to synchronize with the desktop PC (if it takes too long, try removing the pocket PC from the cradle and putting it back on). Then right click on **Pocket Access** (below left) and select Settings (below right).



3.28 Select Add.

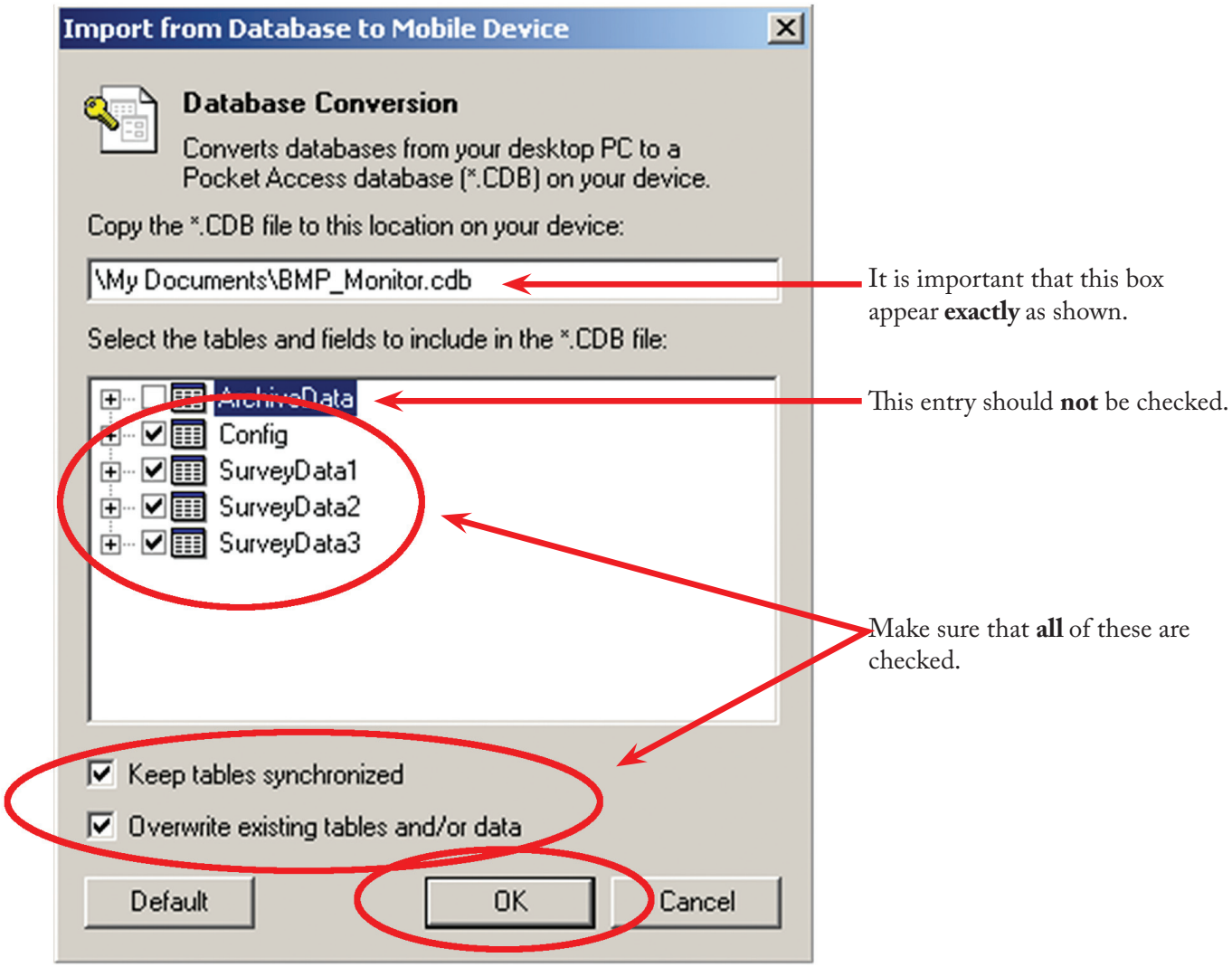


3.29 Navigate to **C:\Program Files\BMP_Desktop** and locate the file **BMP_Monitor.mdb**. Select Open.

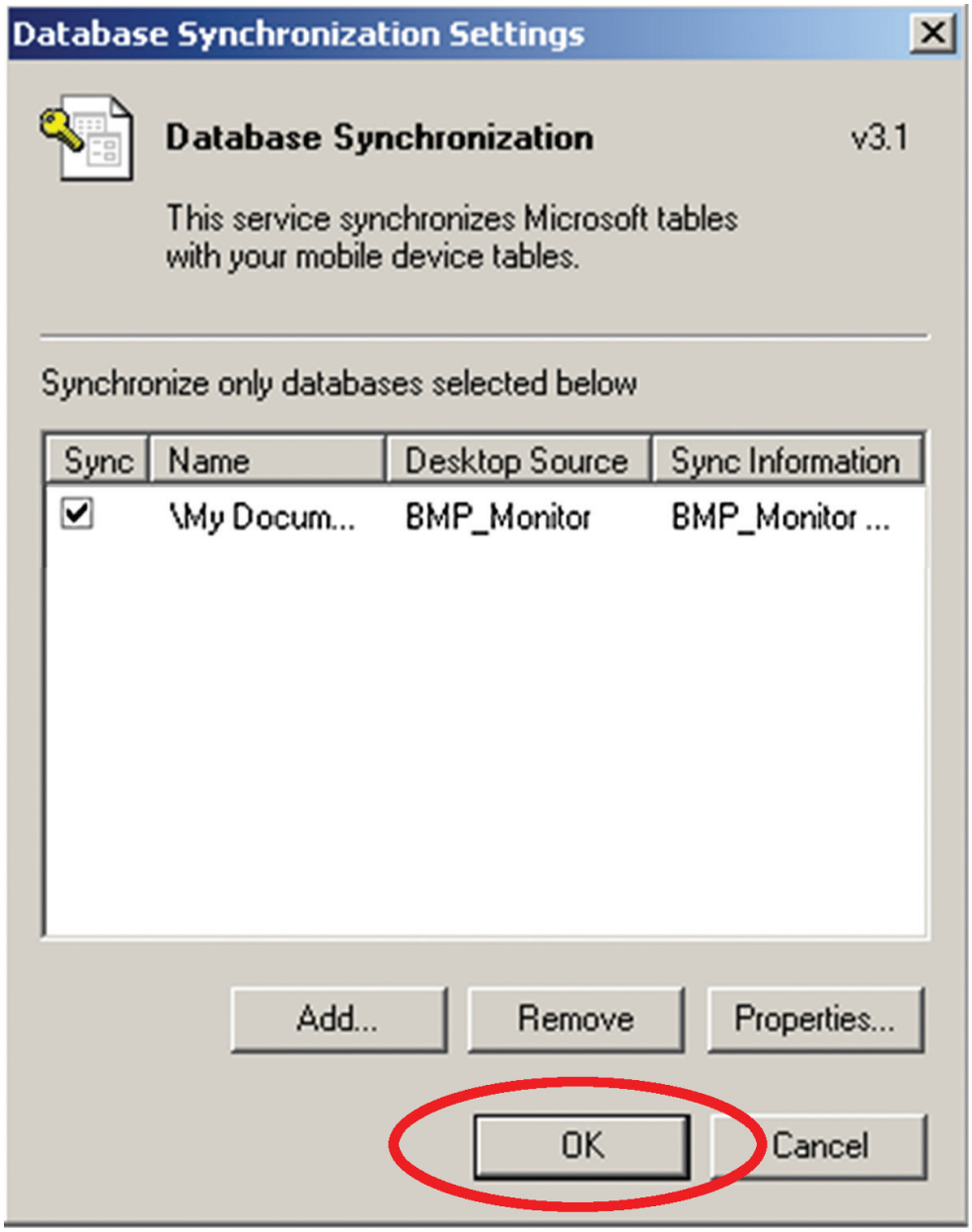


3.30 When the screen below appears, select the tables and fields to include in the *.CDB file as shown. Make sure that everything appears **exactly** as shown on this screen, including all the check boxes. **Note that the first entry should not be checked!**

3.31 Select OK. The file will be converted and copied to your pocket PC.



3.32 When the following screen appears, select OK.



Step 4: Install the BMP Pocket PC Program on the Pocket PC

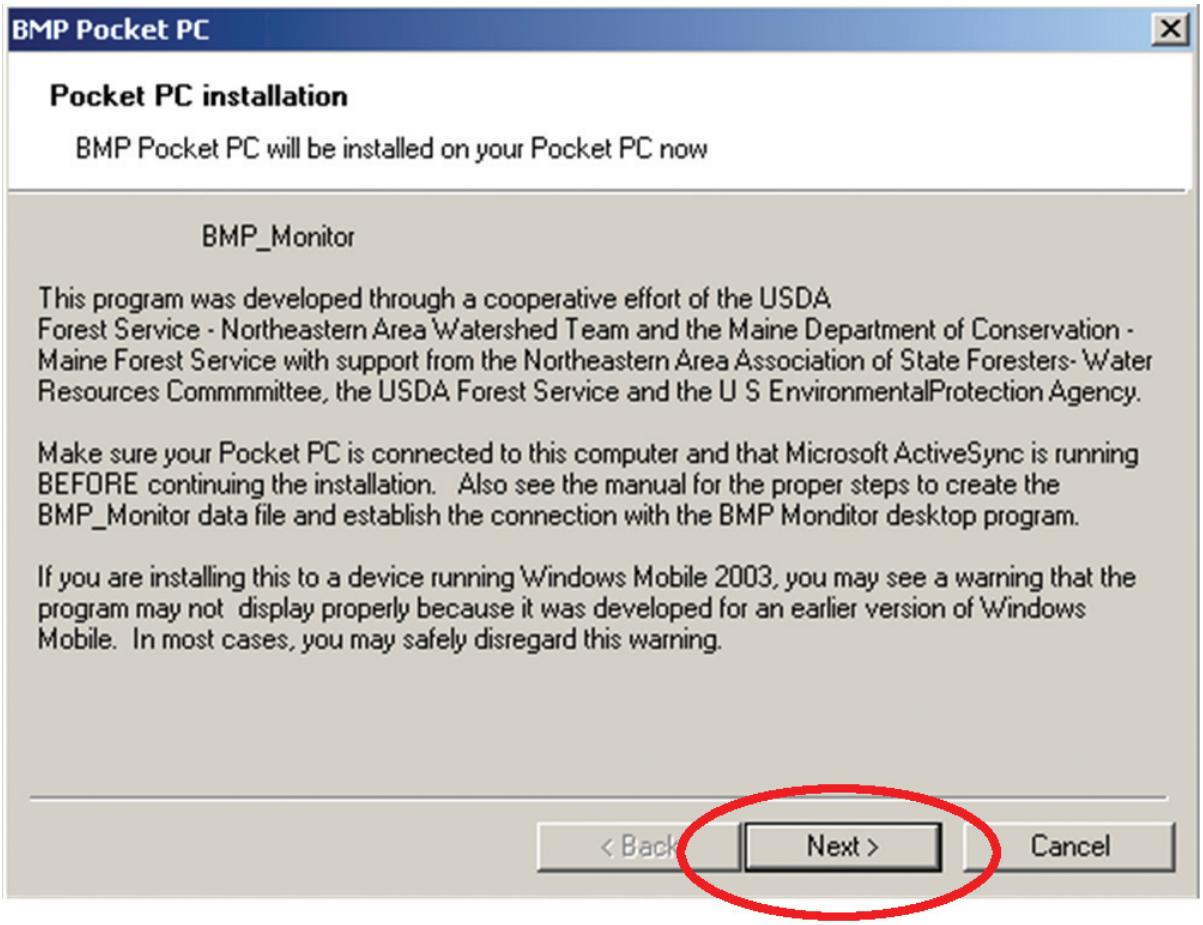
The BMP protocol software includes a file called **BMP_PocketPC_Install.exe**. This program runs on your desktop PC and installs both the BMP protocol software and the AppForge Mobile VB Runtime Booster on your pocket PC.

Note: If a previous version of the BMP pocket PC program has been installed on your pocket PC, you must use File Explorer on your pocket PC to navigate to the My Documents folder and delete the file **BMP_Monitor** before installing a new version.

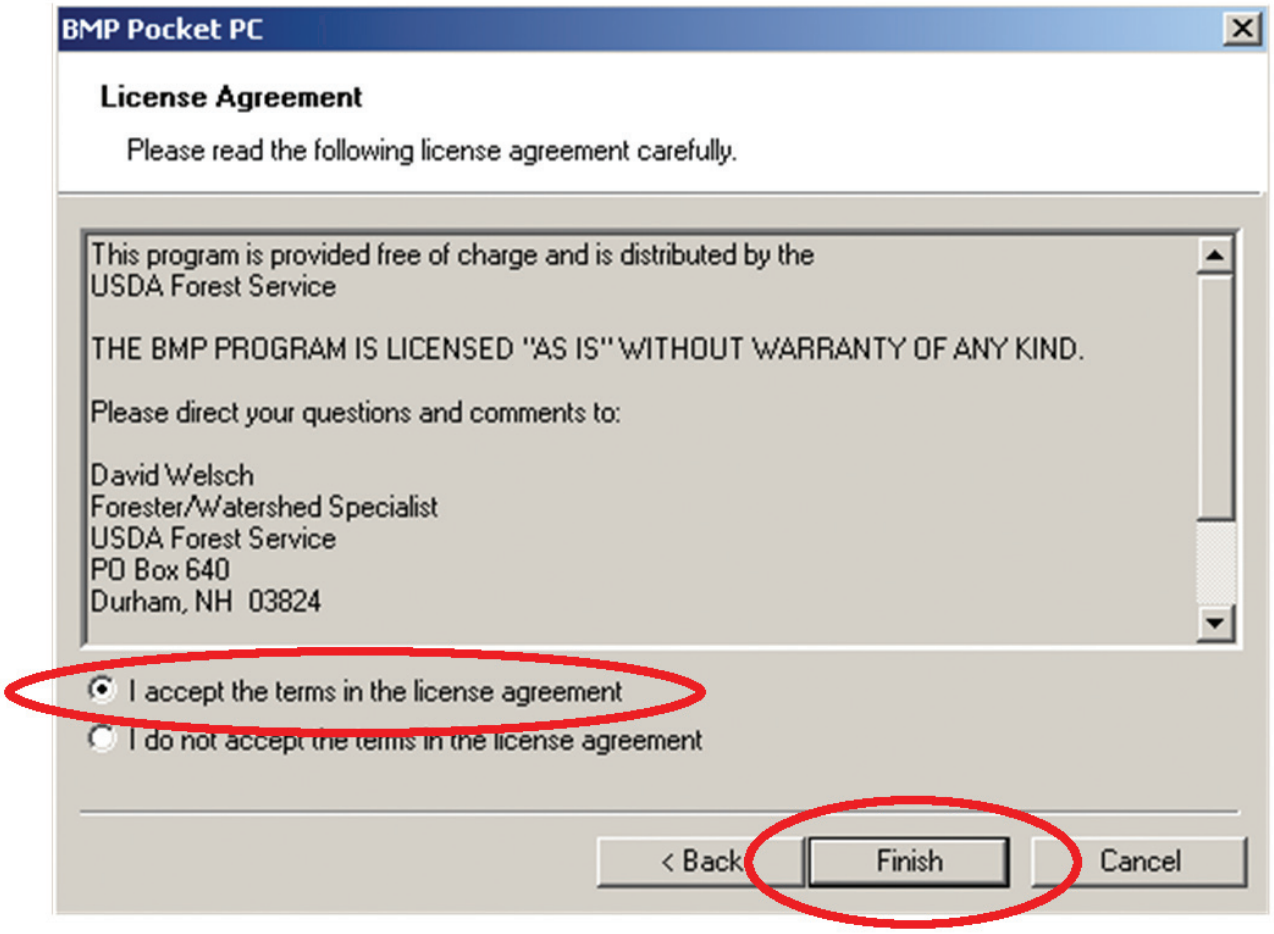
4.1 Make sure Microsoft ActiveSync is running on your desktop PC.

4.2 Place your pocket PC in the cradle (or connect the sync cable).

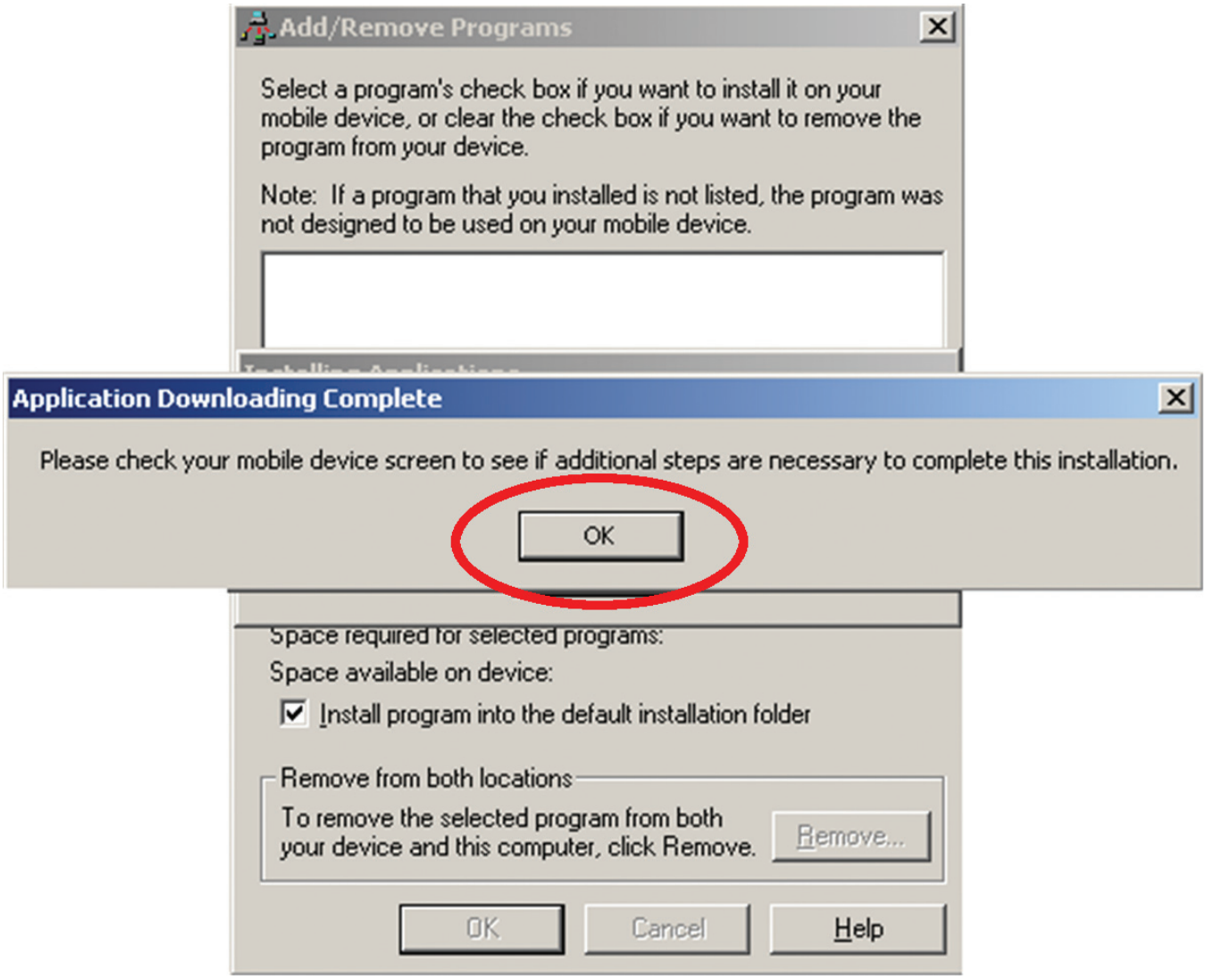
4.3 Run the **BMP_PocketPC_Install.exe** program on your desktop PC by double clicking it. When the following screen appears, select Next.



4.4 Follow the instructions on the screens that appear to complete the installation of the program on your pocket PC.



4.5 When the following screen appears, check the screen on your pocket PC and follow the instructions there before selecting OK in this window.

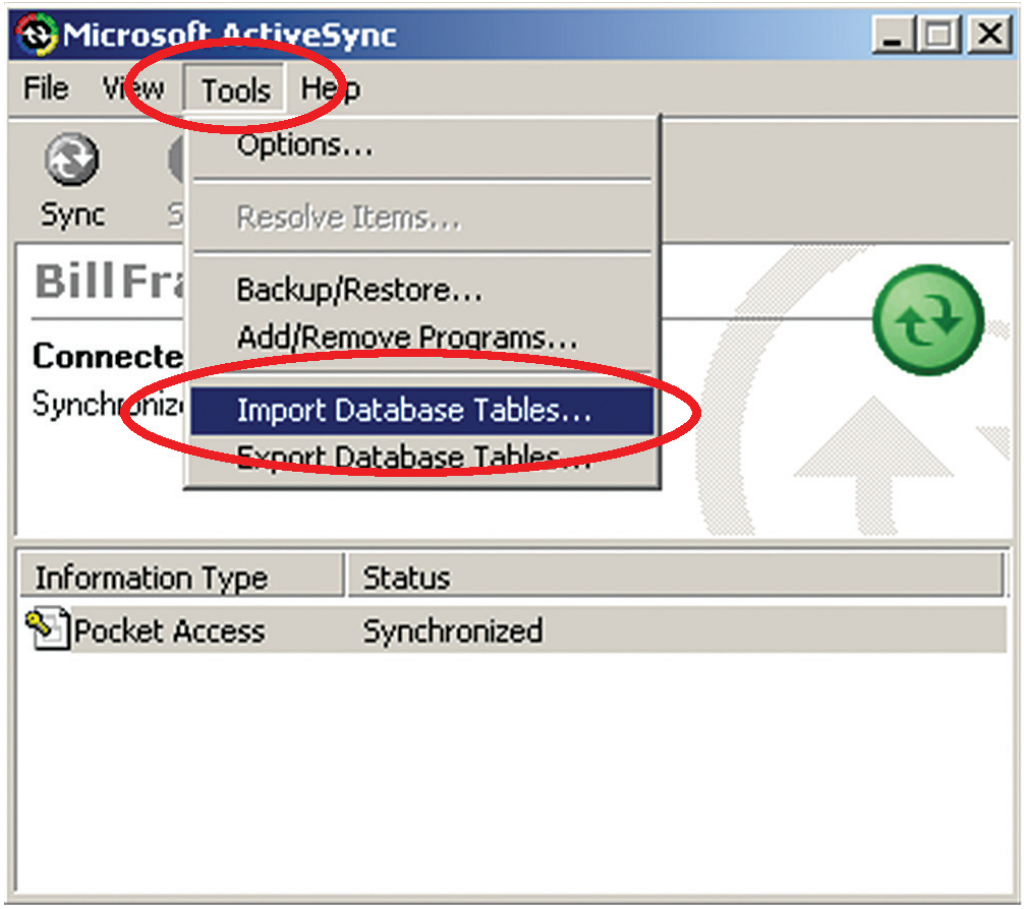


Step 5: Configure Activesync for the BMP Program Database (Windows Mobile 3 and 4 Units Only)

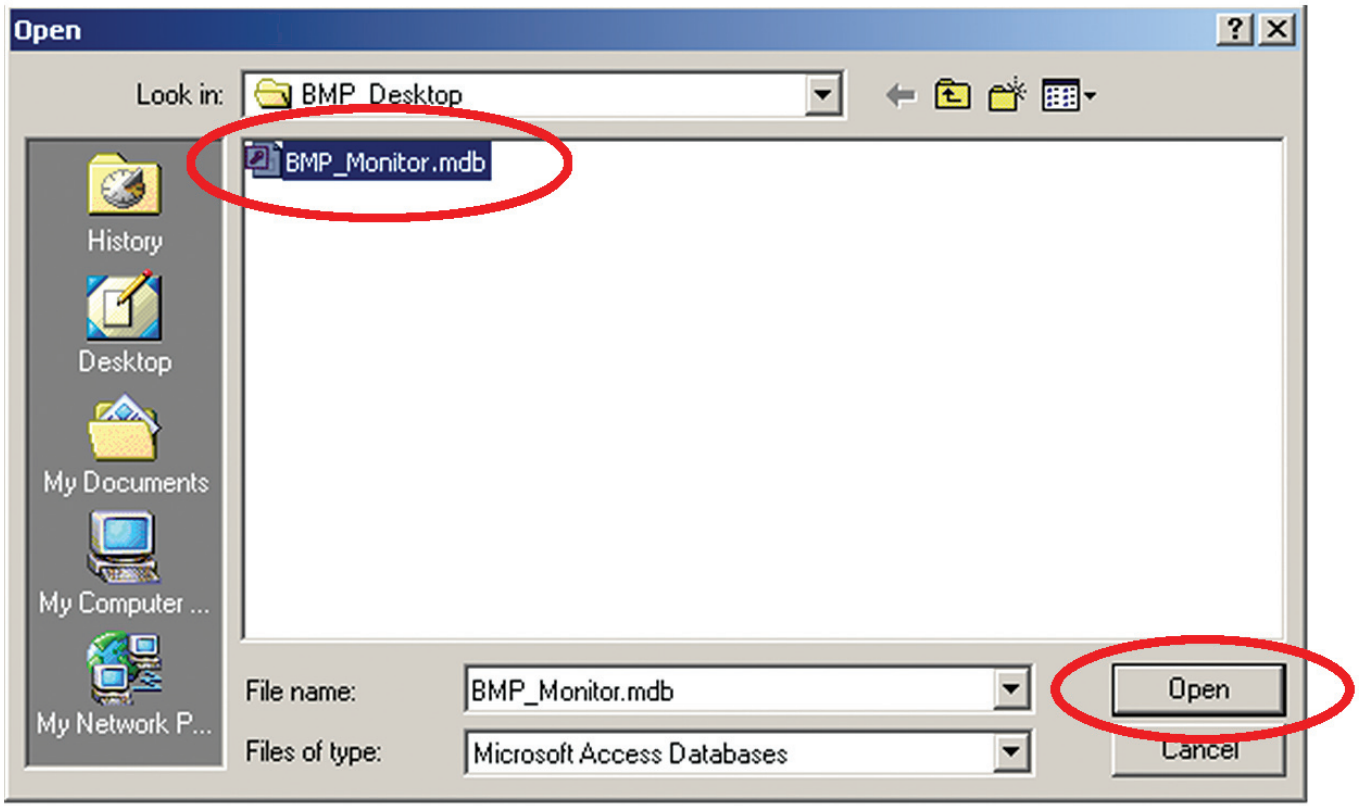
Note: This step is for Windows Mobile 3 or 4 users only. Windows Mobile 5 users should proceed to step 6.

5.1 Make sure that the pocket PC is in the cradle or connected to the sync cable. Microsoft ActiveSync should open automatically. If it doesn't, double click on the ActiveSync icon on the Windows taskbar (or select it from the Program menu).

5.2 Select Tools and Import Database Tables from the ActiveSync menu.

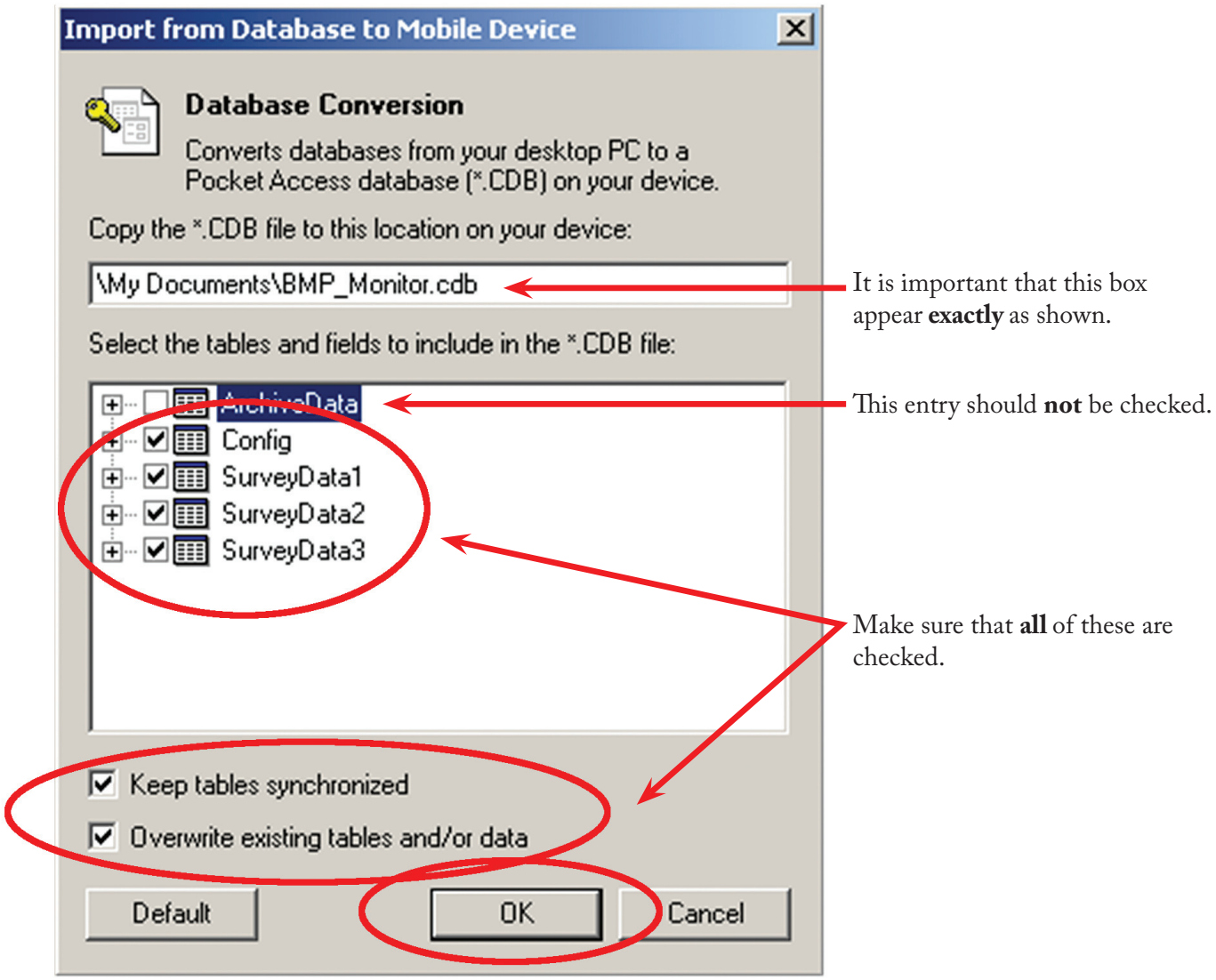


5.3 A file dialog box will appear. If you installed the BMP desktop program to the default location, navigate to **C:\Program Files\BMP_Desktop** and locate the file **BMP_Monitor.mdb**. If you installed the BMP desktop program to a different location, open that folder and locate the file there. Select Open.

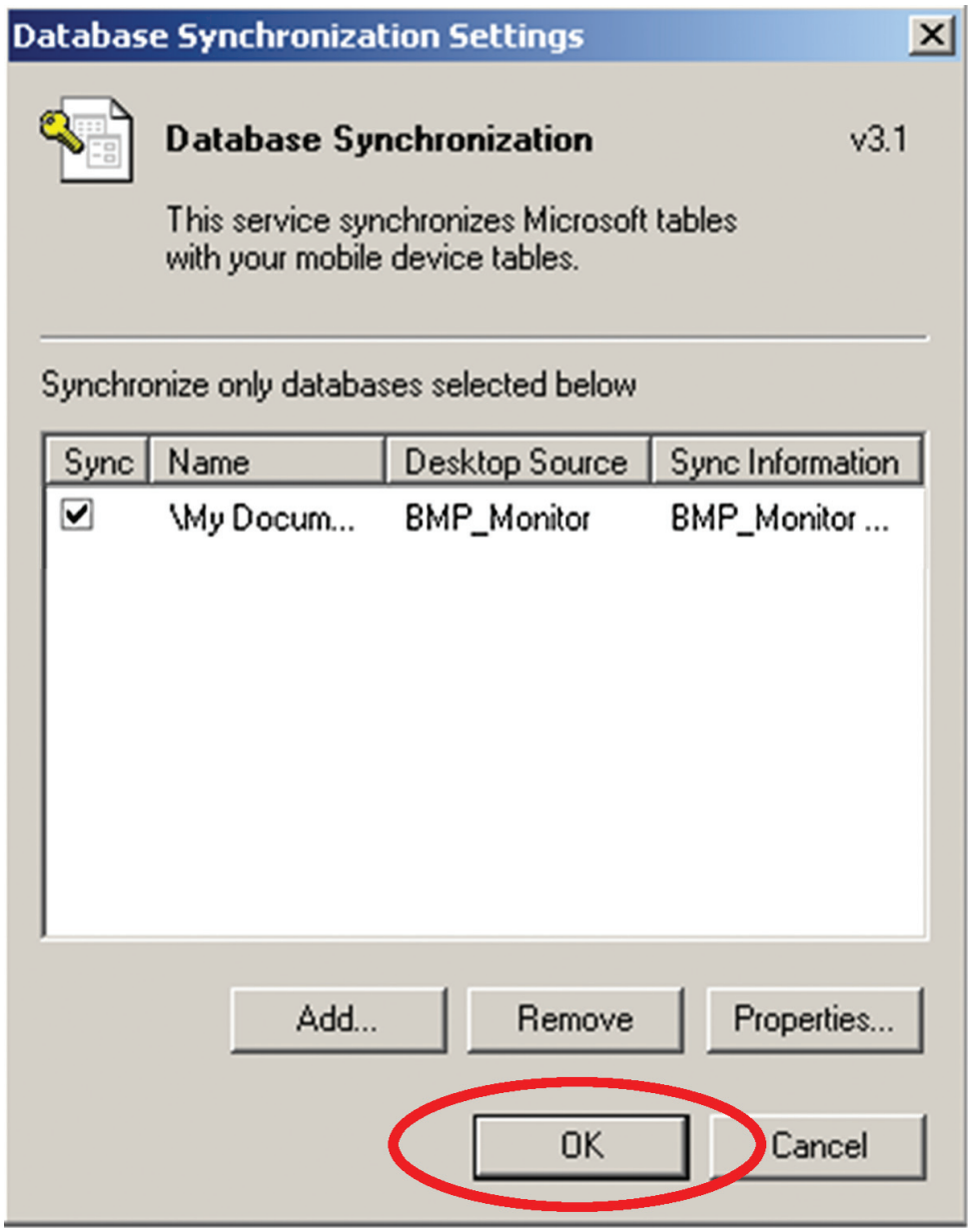


5.4 When the following screen appears, select the tables and fields to include the *.CDB file as shown. Make sure everything appears **exactly** as shown on this screen, including all the check boxes. **Note that the first entry should not be checked!**

5.5 Select OK. The file will be converted and copied to your pocket PC.



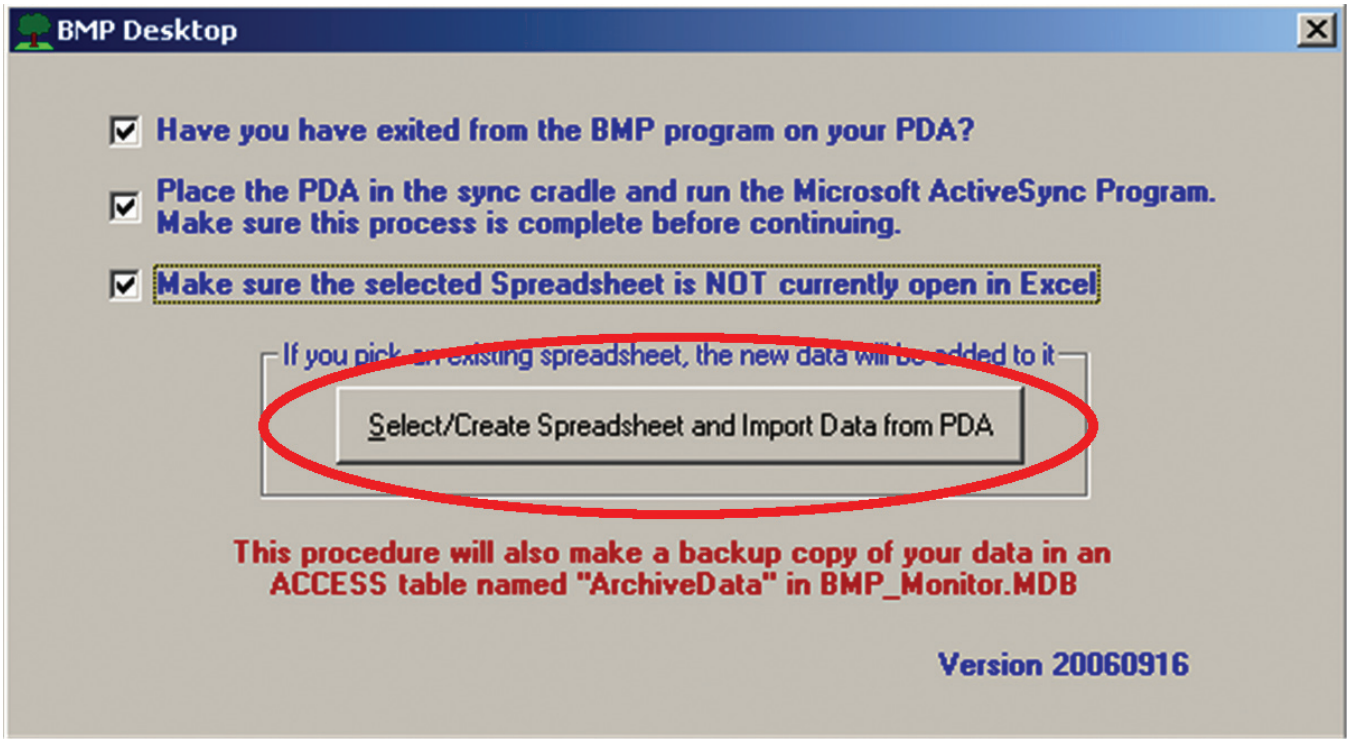
5.6 When the following screen appears, select OK.



Step 6: Transfer Data From the Pocket PC to the Desktop PC

Once you have completed steps 1 through 5, you are ready to use the BMP program to collect data in the field. When data collection is complete, you need to transfer the data from the pocket PC to a spreadsheet on the desktop PC.

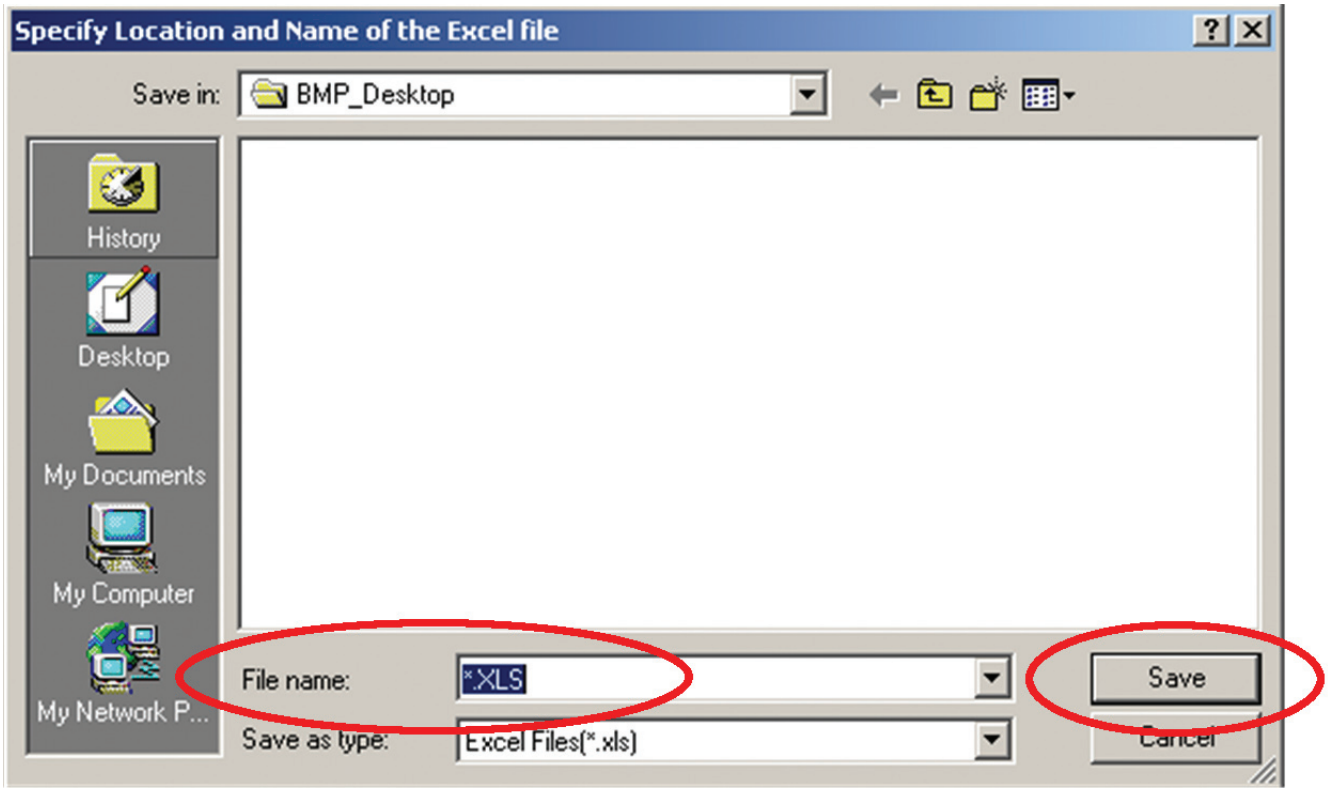
6.1 Double click on the file **BMP_Desktop.exe** on the desktop PC to run it. Complete the steps in the checkboxes shown in the screen below before attempting to upload your data. Then select Select/Create Spreadsheet and Import Data from PDA.



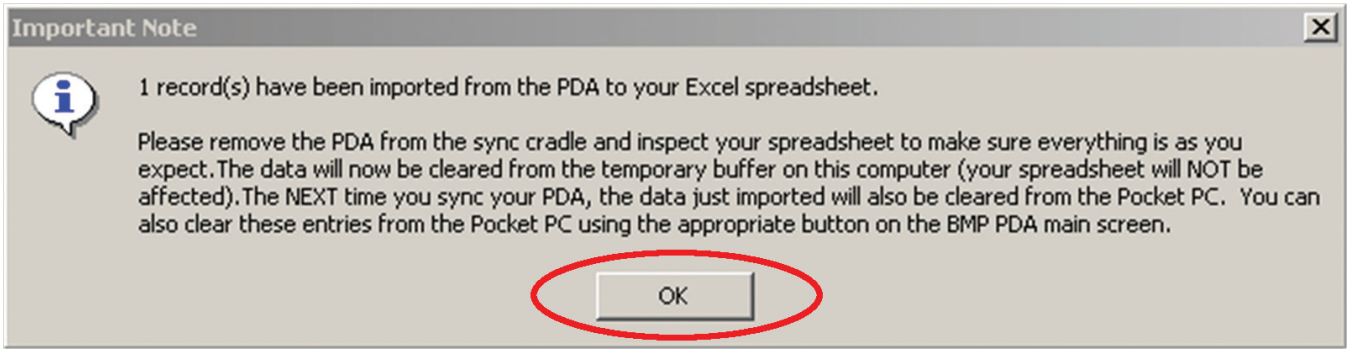
You have the choice of creating a new spreadsheet or adding data to an existing spreadsheet.

6.2 If you want to create a new spreadsheet, type in a file name and select Save. This is the only option available the first time you use the program.

6.3 If you want to add the data to an existing spreadsheet, select the file name of the spreadsheet and select Save.



6.4 If your file is downloaded successfully, you will receive a confirmation screen as shown below. Read the instructions and select OK.



After the data from the pocket PC is transferred to a spreadsheet, it is cleared from the temporary tables in the **BMP_Monitor.mdb** file on the desktop PC. All data is saved to an ArchiveData table in BMP_Monitor.mdb. The next time you perform an ActiveSync, these records will be cleared from the pocket PC if they have not already been cleared using the pocket PC's Clear ALL Data function.

Appendix B—BMP Protocol Field Training

Training is a critical component of the monitoring protocol—it is necessary to ensure that all field personnel interpret a given set of field conditions and answer the protocol questions in the same way.

Personnel

Prior to conducting the training, the State needs to designate personnel to lead the protocol process, resolve potential equipment-related issues, and record data in the field.

- Select a State BMP Protocol Project Coordinator to run the protocol within the State and maintain contact with the Northeastern Area BMP Protocol Project Coordinator.
- Select a computer support person to help install software, upload data, and resolve field problems with the data recording equipment. These tasks require some computer skills, but they can often be performed by the State BMP Protocol Project Coordinator.
- Select the field personnel, usually service foresters, to visit the sites and collect the data. Some States use service foresters while others use a smaller group of specialists or even an individual contractor. Knowledge of appropriate logging access design and construction methods is desirable.

Preparation

The following steps should be completed prior to the training session:

- Download and review the BMP field guide and desk reference.
- Review the equipment specifications in appendix D of the BMP field guide.
- Select the pocket PC equipment to be used and load the software.
- Prepare copies of the BMP field guide for all participants.
- Review the State BMP manual and regulations.

Indoor Training Session

The indoor training session should include (1) an overview of the protocol process, including objectives, questions, definitions, and products generated by the protocol software programs, and (2) installation of the protocol software on desktop and field equipment, as well as saving and uploading data.

The indoor training site should have the following equipment and facilities:

- Desktop computer, pocket PC, and pocket PC docking station or cradle for each monitoring team
- Computer (with PowerPoint), projector, screen, easel, and flip chart
- Seating adequate for the number of participants in the training group

Field Training

Site Selection

Prior to the training session, locate a series of field training sites that are currently being logged or have been logged recently, and that include the range of site conditions likely to be encountered within the State or area to be monitored. **The best training sites are worst case scenarios of logging activity, as these sites offer the greatest opportunity to see the erosion and sedimentation indicators to be recorded in the protocol**. Several training sites may be available on any given timber harvest owing to the way harvest areas are divided into sample units by the protocol.

When selecting field training sites, look for the following:

- Recently completed or active logging operations
- A variety of logging conditions representative of the conditions in the State
- Sites that include water crossings with erosion or sedimentation problems

Field Training Process

It is recommended that field personnel work in two-person teams for the first week. After training and a week of sampling, participants should convene for an additional day of training to resolve any differences in interpreting the questions and to clarify any points of concern.

The training process is slow at first, but by the end of the second day of training, most participants are completing sample units in less than an hour's time. After the first week, many participants remark on the confidence they feel in the process, indicating that they will "never look at timber sales the same way again."

Sample Training Agenda

Day 1 (½-day or less duration)

Participants: State BMP Protocol Project Coordinator and computer support person

Software installation and use:

- Installation of software on desktop computer and field data recorders
- Uploading data to the desktop computer
- Data cleanup

Random sampling procedures:

- Using State databases to randomly select field sites
- Random selection of sample units at the field site

Project oversight:

- Quality control sampling
- Establishing a Q&A decision Web site to record the answers to the questions from the field and make them available to all field sampling personnel

Day 2

Participants: State BMP Protocol Project Coordinator and field personnel

Introductions and opening statements

Introduction to the BMP protocol:

- Importance
- Clean Water Act
- Development problems and objectives
- Procedure
- Products

Questions and answers

Break

Review of protocol questions and definitions

Lunch

Field sample unit demonstration

Field sampling with field personnel participation

Day 3

Participants: State BMP Protocol Project Coordinator and field personnel

Field sampling at training sites

Lunch in the field

Field sampling at training sites (continued)

Questions and answers

Day 4

Participants: State BMP Protocol Project Coordinator and field personnel

Continue field sampling until a basic level of proficiency is attained.

Appendix C—Definitions

The terms used in this protocol generally have scientifically accepted definitions. In many cases, however, the forestry community recognizes a number of definitions for these terms. To facilitate consistency in monitoring while meeting the reporting needs of the participating State agencies, the following definitions are used for the purposes of this protocol.

Approach Area A	The haul road or skid trail approach on the left side of a water body crossing when looking downstream. It is separated into two parts: the portion of the haul road or skid trail inside the buffer/filter strip, and the portion of the haul road or skid trail outside the buffer/filter strip.
Approach Area B	The haul road or skid trail approach on the right side of a water body crossing when looking downstream. It is separated into two parts: the portion of the haul road or skid trail inside the buffer/filter strip, and the portion of the haul road or skid trail outside the buffer/filter strip.
Approach Area A or B–Inside the Buffer/Filter Strip	The road or trail to be monitored that is inside the State-designated buffer/filter strip width. The approach area inside the buffer/filter strip originates at the outer edge of the stream's bankfull width and extends inland perpendicular to the bank for a distance equal to the State-designated buffer/filter strip width.
Approach Area A or B–Outside the Buffer/Filter Strip	The road or trail to be monitored that is outside the State-designated buffer/filter strip width. The approach area outside the buffer/filter strip originates at the upland edge of the buffer/filter strip width as measured from the top of the stream bank. It extends inland perpendicular to the bank to a point where there is a minimum road or trail grade change of ±5 percent that extends for a minimum distance of 20 feet. In areas where the grade is less than 5 percent for a distance of 500 feet or more, limit the approach area outside the buffer/filter strip to three times the buffer/filter strip width.
bankfull elevation	The point of demarcation between the stream channel and the floodplain. The bankfull elevation is at the elevation of the lowest depositional flat immediately above the channel and is often identified by the deposition of fine sediments. These depositional flats are often discontinuous owing to the shape of the valley.
bankfull width	The width of the channel from the bankfull elevation on one side of the channel to the bankfull elevation on the other side of the channel.
Best Management Practices (BMPs)	Defined by the Clean Water Act as practices used to minimize adverse impacts to the Nation's waters from nonpoint source pollution. See also *BMP principles*.

BMP additions	Constructing additional BMPs on a given operation in response to problems developing after the initial suite of BMPs has been installed.
BMP maintenance	Reshaping or reinforcing installed BMPs to compensate for wear from use or erosion, or in anticipation of seasonal shutdown or extreme weather events. Examples include seeding, reshaping waterbars, and adding additional slash to reinforce skid trails or landing areas previously armored with slash.
BMP principles	The fundamental laws of nature underlying the workings of BMP practices such as planning the operation, controlling water flow, stabilizing disturbed soil, managing chemical pollutants, and minimizing biological impacts.
boulder	Rock fragments greater than 12 inches in diameter (300 mm).
bridge: closed top	A bridge with a continuous surface structure that prevents soil and related debris from falling through the surface structure into the water body below.
bridge: open planked top	A bridge with a discontinuous surface structure that permits soil and related debris to fall through the surface structure into the water body below.
buffer/filter strip	A State-designated width of land adjacent to surface water bodies where logging activities affecting shade, basal area, or erosion and sedimentation are regulated to protect the quality of water resources. In the absence of a State-designated width, the buffer/filter strip width will default to 50 feet for the purposes of this protocol.
canopy closure	The degree to which the sky directly over a plot is covered by tree and shrub canopy under leaf-on conditions. Measured with a spherical crown densiometer held at approximately breast height (4.5 feet) and recorded as the percentage of shade or canopy closure to the nearest 1 percent.
certification or stewardship programs	Various programs intended to encourage environmentally sound forest management on private lands. Examples include Forest Stewardship Program, Ch. 61 Program, Tree Farm, Sustainable Forest Initiative, Forestry Incentive Program, and forest taxation programs.
certified training programs	Various programs intended to encourage safe and environmentally sound logging practices. Examples include Master Logger, State licensing programs, and other recognized State, regional, or national programs.
channel	See *stream channel*.
chemical pollutants	Items used on logging operations that have the potential to pollute the site. Examples include motor oil, lubricating oil, hydraulic fluid, gasoline, diesel fuel, antifreeze, batteries, cleaning solvents, alcohol, lead, and petrochemicals.
cobbles	Rock fragments 3 to 12 inches in diameter (75 to 300 mm).

crossing structure	The term crossing structure refers to the structural components of a crossing device, such as culverts, timbers, poles, and manufactured portions of abutments. For the purposes of this protocol, crossing structures are defined as extending the bankfull width of the water body and include any fill material within the bankfull width but not beyond. Such structures include smaller culverts covered with fill material, and larger crossing structures composed of manufactured materials such as very large, bottomless culverts; timber, metal, or concrete spans; and timber, concrete, or laid up stone abutments. Fill material, stone, riprap, and manufactured portions of bridges and abutments outside the bankfull width of the water body are considered part of the approaches for the purposes of this protocol.
crossing structure: open bottom	A bottomless crossing structure, such as a bridge or an arch culvert, that leaves the natural stream bottom intact and available to the stream biota.
crossing structure: closed bottom	A crossing structure, such as a culvert of metal, concrete, wood, or other manufactured material, that covers the natural stream bottom and eliminates or renders it unacceptable to fish and macroinvertebrates.
culvert: embedded	A culvert installed with the bottom sufficiently below the natural stream bottom to allow the natural stream bottom material to become established continuously through the culvert.
culvert: suspended or perched	A culvert installed with the outlet end above the natural stream bottom.
ditch	A long, narrow drainage depression, usually at the side of a trail or roadway, either excavated or formed by erosion.
ditch: agricultural drainage systems	Common in the coastal plains of the Delmarva Peninsula, agricultural drainage ditch systems are constructed to lower the water table for forest or agricultural site improvements or for irrigation conveyance. Agricultural ditch systems are not normally sampled as water body crossings for the purposes of this protocol, but agricultural degrading outlet ditches may be sampled at the discretion of the individual States based on local requirements. Agricultural ditch systems do not include road drainage ditches.
ditch: outlet, aggrading	A field drainage ditch, often abandoned, in which the bed is aggrading or filling in owing to the slowing of water flow and the deposition of suspended materials. Aggrading outlet ditches, which often exhibit the characteristics of the forest floor, including the intrusion of fine roots, are generally not identified on USGS 7.5-minute topographic maps.
ditch: outlet, blue line	An outlet ditch that is identified as a blue line on USGS 7.5-minute topographic maps. These ditches are usually degrading outlet ditches.

ditch: outlet, degrading	A ditch in which the bed is degrading or lowering in elevation over time owing to the erosive action of water flow and that has an outlet to natural surface waters. Degrading outlet ditches are generally identified on USGS 7.5-minute topographic maps as blue line ditches.
dust: in water	Fine road-surfacing material thrown into the air as a result of heavy traffic on gravel or native material roads and deposited in streams as sediment. Dust in water usually occurs where heavily trafficked haul roads are constructed within buffer strips or in close proximity to streams.
first-order stream	See *stream order 1*.
gully	An erosion channel cut into the soil along a line of water flow with a minimum depth of 6 inches and a minimum length of 12 feet. The length requirement does not apply if the gully terminates in a water body before reaching 12 feet in length. Gully erosion produces channels larger than rills.
haul road	A road connecting a log landing to the public road system and used by wheeled trucks to haul wood products to destinations outside the timber harvesting area.
human activities	Any human activity unrelated to the timber harvesting operation. The term generally refers to recreational activities such as ATV use, mountain biking, or horseback riding, but also includes the use of roads for residential access or other nonharvest-related activities.
hydrologic soil type	A set of classes pertaining to the relative infiltration rate of soil under conditions of maximum yearly wetness. Generally expressed as Group A = gravel/sand, Group B/C = loams, Group D = silts/mucks.
K factor	Used in the Universal Soil Loss Equation to predict soil loss from erosion, the K factor is a relative index of susceptibility of bare soil to particle detachment and transport by rainfall.
lake	Any body of water with a surface area greater than 10 acres or designated by the State as a lake. See *pond*.
land: industrial forest	Land owned by individuals or businesses involved in processing logs and roundwood into primary forest products, such as lumber and paper. It does not include land owned by secondary wood processors—businesses purchasing materials from primary processors for further manufacture into item such as furniture or books.
land: nonindustrial private forest	Land owned by private individuals or by groups not directly associated with primary forest industries. Examples include investment groups, banks, sportsman's clubs, outdoor recreation clubs, and nonprofit organizations.
land: public forest	Land owned and managed by a town, county, State, or Federal government agency or entity.
large woody debris	Debris within the bankfull width of a channel that are greater than 4 inches in diameter at the small end and either longer than the stream width or anchored to the bank by roots or other means.

leaching	A form of sedimentation usually associated with a culvert or bridge abutment. Leeching usually occurs where water flows along the outside of a culvert or through gravel, large fill, or openings in bridge abutments, washing out fine fill and eventually larger material.
mechanical additions	Soil or fill material that is pushed into the water body by machinery while installing or removing crossing structures, or regrading crossings. It also includes material that is pushed into the water body or wetland ahead of wheels, tracks, or dragged logs.
natural events	Naturally occurring events or conditions unrelated to the timber harvesting operation or human activity. Examples include extreme weather events, natural debris dams, and wildlife usage of the area.
observation	A measurement or other answer recorded in response to an individual protocol question as part of a specific sample unit assessment.
other land use	Land uses unrelated to forestry, such as recreation, sports, residential, agriculture, or mining.
outside the buffer/filter strip	See *Approach Area A or B–Outside the Buffer/Filter Strip*.
pedestals	Columns formed below small stones or gravel by the erosion of the surrounding soil surface. The stones remaining are not embedded in, but sit entirely above, the supporting column and the surrounding area of soil.
percent shade	See *canopy closure*.
piping	The erosion of fill material, such as from a bridge abutment or around a culvert, as a result of water flowing through the abutment or outside the culvert and carrying entrained soil particles. This results in tunnels or "pipes" forming through the fill material, potentially resulting in the collapse and further erosion of the fill material.
pond	Any body of water with a surface area less than 10 acres or designated by the State as a pond. See *lake*.
quality control	Activities or data recorded for the purpose of ensuring accuracy and consistency of the monitoring process.
rill	An erosion channel cut into the soil along a line of water flow, often resembling a braided stream pattern, with a minimum depth of 1 inch, a minimum length of 12 feet, and a depth change of at least 25 percent over its length. The minimum length requirement does not apply if the rill terminates in a water body before reaching 12 feet in length. Rill erosion is the detachment and transport of soil by a concentrated flow of water and is the predominate form of erosion under most conditions. A rill becomes a gully when the depth exceeds 6 inches. See *gully*.

rut	Elongated depressions in a trail or roadway caused by dragged logs, or by wheels or tracks of harvesting machinery, and often exacerbated by erosion from uncontrolled runoff waters. Continuous ruts with lengths equal to or greater than the lesser of one wheel circumference or 12 feet should be recorded for this protocol. Ruts ending within the bankfull channel width of the stream should be recorded regardless of length.
sample site	A timber sale or forest harvest area within which sample units are randomly selected and measured.
sample unit	A discrete portion of a timber sale or forest harvest operation for which protocol data may be recorded. It is a unit of land delineated by cutting boundaries, ownership boundaries, or water bodies (figure 3.5 on p. 9).
second-order stream	See *stream order 2*.
sedimentation: deposit to a water body	For the purposes of this protocol, soil or fill material is defined as having entered the water body when it has been deposited within the bankfull width of the stream channel, below the normal high-water level of lakes, or within the boundaries of wetlands, whether or not water is present at the time of sampling.
sedimentation: measurable amounts	A soil or fill material deposit that is observable below the bankfull elevation of the channel at the time of sampling, is attributable to the logging operation, and, when measured, would round to 1 cubic foot or more. Examples include deposits associated with a terminating rill or gully, and mechanical additions.
sedimentation: trace amounts	A soil or fill material deposit that is observable below the bankfull elevation of the channel at the time of sampling and is attributable to the logging operation, but is insufficient in volume to be readily measured or, if measured, would round to less than 1 cubic foot. Examples include material in suspension, sediment film on vegetation, sediment traces, or film on stream substrate.
shade	See *canopy closure*.
sheet erosion	The more or less uniform removal of thin layers of soil from an area without the development of conspicuous water channels. Sheet erosion is often characterized by exceedingly numerous, tiny erosion channels or soil pedestals as the general soil layer is washed away. To ensure consistency in reporting, sheet erosion and associated sediment deposition must cover a minimum contiguous area of 2 square feet and be continuous for a minimum of 12 feet in length to be recorded. Sheet erosion terminating within the bankfull channel need not meet the length requirement. See also *pedestals*.
sheet flow	See *sheet erosion*.
skid trail	A cleared trail used by skidders or forwarders to drag or carry logs or other roundwood from the stump to the landing area, where they are transferred onto trucks for further transportation over haul roads.

skid trail: rutted, mineral soil	A skid trail that, through intense usage, has developed extensive mineral soil ruts that are devoid of organic matter, readily erodible, and likely to carry water and eroded soil material.
slash in the water body	Limbs, brush, treetops, or similar relatively small woody logging debris that is left in the channel below the bankfull elevation as a direct result of the current harvest. Slash resulting from windthrow or similar events is not considered a direct result of the harvest. Slash is smaller material that should not be confused with large woody debris. See *large woody debris*.
slope length	The slope distance measured in whole feet along the centerline of the haul road or skid trail between the beginning and ending points indicated in the various protocol questions.
sloughing	Downslope mass movement of soil usually associated with saturated soils and steep slopes, often forming a crescent-shaped depression. The minimum area of sloughing to be recorded is 1 square foot.
slumping	See *sloughing*.
soil movement	Displacement or redistribution of soil by machinery or erosion processes such as slumping, piping, sheet flow, and rill or gully erosion.
soil stabilization: acceptable	Soils stabilization is acceptable when exposed mineral soil is protected from rain impact, sloped equal to or less than the natural angle of repose, armored, or vegetated. It must show no evidence of rills, gullies, slumping, sheet flow, or other soil movement.
State-regulated water body	Water bodies receiving some degree of environmental protection as a result of State regulations. Federal regulations such as the Clean Water Act should not be considered when answering questions regarding State regulations.
stream: ephemeral	A stream generally lacking exposed mineral soil channels, exhibiting only a very poorly defined organic depression located above the water table, and flowing only for very short durations following rain or snow melt events. Ephemeral streams do not possess the hydrologic conditions that support true riparian vegetation. Ephemeral stream crossings are not normally sampled in this protocol but may be sampled at the discretion of the individual States based on local requirements.
stream: intermittent	A stream with a defined mineral soil channel and flowing water during times of the year when the water table is elevated or supplemented by precipitation, and which supports riparian vegetation. During dry years, intermittent streams may cease to flow entirely or may be reduced to a series of separate pools. Intermittent streams are often noted as a dashed blue line or thinner blue line on the most recent editions of USGS 7.5-minute series topographic maps.

stream: perennial	A stream with a well-defined flow-scoured channel with flowing water nearly year round during a typical year. The water table is located above the streambed for most of the year. Groundwater is the primary source of water for stream flow; runoff from rainfall is a supplemental source. Perennial streams are often noted as a solid blue or thicker blue line on the most recent editions of USGS 7.5-minute series topographic maps.
stream channel	A depression in the landscape formed and maintained by flowing water; sized to carry the normal water flow; characterized by lack of vegetation and exposure of mineral soil, gravel, and coarser materials or bedrock; and hydrologically connected to a higher order stream system. Stream channels do not include road ditch cross-drainage culverts.
stream channel: aggrading	A stream channel in which the streambed is rising in elevation owing to the deposition of sediment and other natural materials as a result of diminishing stream flow.
stream channel: degrading	A stream channel in which the streambed is being lowered in elevation by the erosive action of stream flow.
stream channel: overflow	An additional stream channel usually created by either an overflow or rerouting of the main channel during a period of high flow. These channels will typically be assessed along with the main stream channel as a single crossing. If only an overflow channel is crossed, then it will be considered an intermittent stream, unless knowledge or history of the stream offers evidence that the stream overflow channel should be classified as part of a perennial stream.
stream order 0 (zero-order stream)	Streams of a very temporary nature originating from precipitation or snow melt, often without channels or with very poorly defined channels seldom exposing mineral soil. Ephemeral streams are classified as zero-order streams for protocol purposes.
stream order 1 (first-order stream)	An unforked or unbranched perennial or intermittent stream often, but not always, shown as a solid blue line or dashed line on the most recent editions of USGS 7.5-minute series topographic maps.
stream order 2 (second-order stream)	A stream channel created by the confluence of two first-order streams.
stream order 3 (third-order stream)	A stream channel created by the confluence of two second-order streams.
third-order stream	See *stream order 3*.
water body	Any river, stream, drainage ditch, lake, pond, or wetland of Federal- or State-determined significance to be sampled using the BMP protocol.
water flow control: acceptable	A situation in which water flow does not create rill or gully erosion, undercutting of slope or head walls of the water control practices, or blockage or breach of water flow control practices, and in which water is directed onto a stabilized area to allow filtering and/or infiltration prior to reaching a water body.

weather: extreme events	Examples of extreme weather events include 100-year storms, hurricanes, multiple rain storms with above average rainfall in a 24-hour period or above average rainfall in a 24-hour period with high antecedent moisture content, rain on snow events, and drought.
weeping	See *leaching*.
wetland	Any area meeting the Federal or State definition of a wetland.
zero-order stream	See *stream order 0*.

Appendix D—Equipment Specifications

The BMP monitoring protocol can be used with any device that uses the Microsoft Windows Mobile 3, 4, or 5 operating system.

Pocket PCs

The first pocket PC (handheld) used with the BMP protocol was the Dell Axim X3/X3i. The X3/X3i and the following components purchased along with it were found useful and efficient for use in the field. Equivalent components are recommended for use with the other pocket PCs as well.

- Dell Axim X3/X3i Handheld 400MHz, 64MB Intel strata flash, 64MB SDRAM Wi-Fi $377.00
  Microsoft ActiveSync 3.5 or higher
  USB ActiveSync cradle or cable
  Microsoft Windows Mobile software version 3.0.1

- 256MB Secure Digital Card, Dell Part #311–2660 $67.46
  This memory device saves data in the event of battery failure and is highly recommended.

- Backup battery X3 950mAh, Dell Part #310–4268 $44.10

- Belkin USB Sync Charger Cable for Axim X3, Dell Part #A0178078 $22.49
  Combination battery charge cable and link to desktop computer

Prices shown are retail market prices from the Dell, Inc. Web site (www.dell.com) in 2004.

Additional pocket PC equipment used by various States during testing include the following:

- Hewlett Packard iPAC
- Toshiba Pocket PC
- Trimble Recon
- Trimble Ranger Handheld
- Trimble GeoXM

Other pocket PCs with Windows software will probably work as well.

GPS Receivers

Global Positioning System (GPS) receivers are necessary to record the GPS locations of the various portions of the sample units. The GPS information is used to navigate back to the sample units for quality control resampling and to permit analysis of the data by political or geographic boundary, such as county or watershed. Many States are already using GPS receivers for other purposes and have them on hand, while other States have chosen to acquire equipment that combines GPS and pocket PC functions into a single unit.

The Trimble GeoXM is one example of a unit that combines GPS and pocket PC functions. While significantly more costly than other units, it includes a powerful GPS receiver and is built to withstand difficult field conditions. The Windows Mobile software supplied with the GeoXM will run the current pocket PC version of the protocol. The TerraSync and Pathfinder Office software supplied with the GeoXM communicate with a desktop computer to install software on the GeoXM and upload data.

Emerging Technology

Technology is advancing rapidly, and more efficient equipment is constantly emerging. The Northeastern Area is working to keep abreast of developments and is available to assist you with equipment selection considerations. Contact Bill Frament at (603) 868-7707 or wframent@fs.fed.us if you have questions.

Appendix E—Identifying Bankfull

The photographic illustrations in this appendix were taken from a PowerPoint presentation by Elon S. Verry, USDA Forest Service Hydrologist (retired). A more comprehensive training tutorial is available as a four-CD set from the USDA Forest Service.[1] This appendix expands the discussion of identifying bankfull that was introduced in chapter 3 under Controlling Water Flow and Stabilizing Soil (page 8).

Water fills the bankfull channel an average of every 1.5 years. Soil enters the water body, in effect, when it is deposited below the bankfull elevation or on crossing structures within the bankfull width of the channel. Therefore, many protocol measurements are based on identification of the bankfull elevation and bankfull channel width.

Identifying bankfull is relatively easy when the stream channel is filled to the bankfull level because anything below the bankfull elevation is under water (figure E.1). Any crossing structures installed must have an opening large enough to accommodate flows of the bankfull magnitude. In many cases, a significant structure is necessary to completely span the bankfull channel width. Crossing structure openings that do not accommodate the bankfull flow often result in unacceptable levels of erosion within the channel or damage to the structure, or both.

Identifying the bankfull elevation at low flows from indicators in the channel and along the floodplain is necessary in order to answer the protocol questions. The bankfull indicators often provide clues as to the appropriate type and placement of crossing structures.

Figure E.1. Stream filled to bankfull. The shading in this photo depicts what a stream filled to bankfull in the spring or after a major storm might look like. Any material deposited below the bankfull elevation or on crossing structures within the bankfull width of the channel will eventually enter the water column as suspended sediment. Failure to accommodate a flow of this magnitude may result in the crossing structure being washed out or adverse impacts to the channel.

[1] U.S. Department of Agriculture, Forest Service. 2005. Guide to identification of bankfull stage in the Northeastern United States. RMRS–GTR–133–CD. Fort Collins, CO: Rocky Mountain Research Station. 4 CD–ROM set. [For more information, visit www.fs.fed.us/rm/pubs/rmrs_gtr133.html. To order, visit www.fs.fed.us/rm/publications/order.shtml or call 970-498-1392.]

Small headwater streams encountered during forest harvesting operations are often confined by the steep topography to narrow, relatively straight channels. Bankfull indicators in these channels tend to be discontinuous depositional flats formed when the stream fills with water and overflows its bankfull channel. As the overflow recedes, fine material is deposited in flat formations immediately above the bankfull channel. These depositional flats tend to be discontinuous in mountainous areas owing to fluctuations in terrain (figure E.2) and often show only small gravel bars (figure E.3).

Figure E.2. Bankfull indicators visible at low flow. The bankfull elevation is indicated by the first depositional flat above the channel. On very confined channels, the bankfull elevation may only be evident as the discontinuous flat depositional areas shaded on the photo.

Figure E.3. Bankfull indicators on confined channels. Even some confined channels, such as the one pictured here, have occasional small point bars with depositional flats (shaded areas on photo) to indicate the bankfull elevation.

Streams in gentler country are less confined by terrain. These streams tend to create meandering channels with gravel bars forming on the inside of the meander curves. These point bars, as they are called, slope upward from the bottom of the channel and form depositional flats at the top, identifying the bankfull elevation.

Current stream channels are often formed in the bottom of much larger historical stream channels and associated depositional flats. These historical depositional flats are higher in elevation than the depositional flats associated with the current bankfull channel and are generally referred to as terraces. It is, therefore, important to recognize that the current bankfull elevation is identified by the *first* depositional flat above the current channel (figure E.4).

Figure E.4. Bankfull indicators on less confined channels. On less confined streams with meander curves, the bankfull elevation is indicated by the flattened tops of point bars and, in this case, a flat created on the face of an old soil slump.