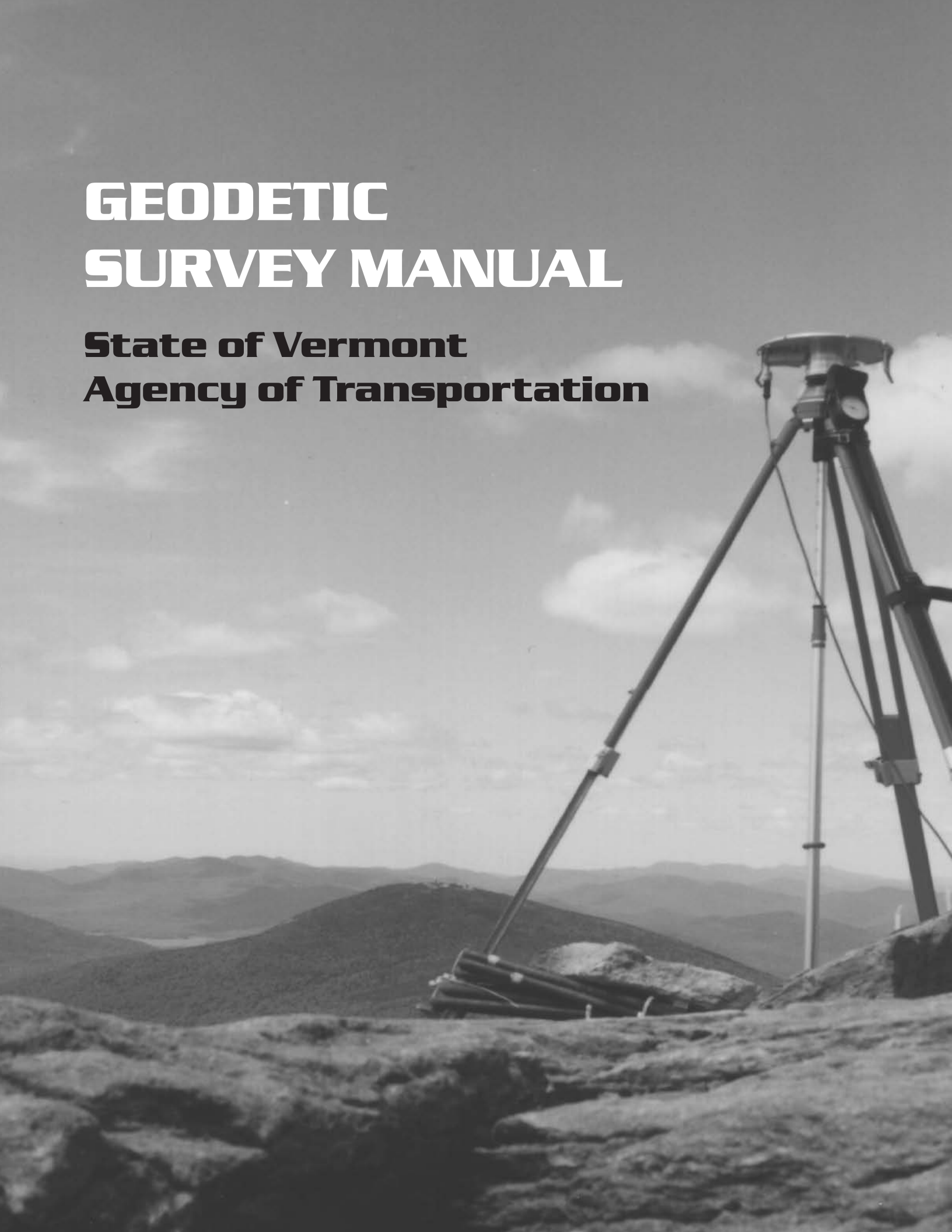
GEODETIC SURVEY MANUAL

State of Vermont
Agency of Transportation



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GEODETIC NETWORK

A geodetic reference network is a set of geodetic control points: physical monuments with known geodetic coordinates of latitude, longitude, and elevation. Maps and surveys that contain horizontal positions and vertical heights based on geodetic control points are related to one another, or coordinated. The VAOT uses the Vermont Coordinate System, a state plane coordinate system, to coordinate transportation projects. Access to the Vermont Coordinate System is limited by the number of geodetic control points in the geodetic reference network. Improved access will be achieved by densifying the geodetic reference network as described in the Geodetic Control Plan.

GEODETIC CONTROL PLAN

Objectives

The objective of the Geodetic Control Plan is to provide guidelines for establishing an adequate number of geodetic control points throughout the state, such that VAOT transportation projects can be referenced to the Vermont Coordinates System. An adequate geodetic reference network allows surveys to be coordinated and can reduce or eliminate duplicate surveys, better locate rights-of-way, unify mapping projects, rectify aerial photographs, and provide consistent and reliable spatial data for digital mapping and GIS applications.

Framework for Densification

Vermont's geodetic reference network is a subset of the National Geodetic Reference System (NGRS), established and maintained by the National Geodetic Survey (NGS). In 1992 the VAOT and the NGS worked cooperatively to upgrade the geodetic reference network in Vermont with a High Accuracy Reference Network (HARN), a network of A- and B-order horizontal coordinates. Second-order vertical coordinates for most of the HARN stations have since been determined using geodetic leveling techniques. The intent of the Vermont HARN is to upgrade, or to improve the quality of, the geodetic reference network to provide a framework for densifying geodetic control.

Long-Range Strategy

Requirements for geodetic control, and the way in which geodetic control is established, continue to change as advances occur in surveying and mapping technologies. The long-range strategy is to exploit advancing state-of-the-art technology to meet VAOT's geodetic control requirements as efficiently and cost effectively as possible.

Project Strategy

Geodetic control monuments are typically set with the intent of using them for many years. Regardless of the type of geodetic control project, monuments are usually permanent and set along the roadside so as to be easily accessible by vehicle. For densification projects, monuments are concentrated along major roads and are more widely spaced in remote areas. Geodetic control monuments set for individual transportation projects are set near the project but also with the intent of being part of Vermont's control network.

TYPES OF PROJECTS

GPS Densification

The primary purpose of this type of project is to establish horizontal control in a specific geographic area, such as greater Burlington. Typically the horizontal positions are established to first-order specifications while GPS-derived orthometric heights usually meet third-order specifications.

Level Lines

Using different leveling techniques, level lines are run along major corridors to densify the vertical control network. The primary purpose of these projects is to establish precise orthometric heights, typically first or second order.

Route Survey

Upon request from the Route Survey Unit, the Geodetic Survey Unit provides geodetic control to support VAOT transportation projects. Typically, these projects require both horizontal and vertical control. If there is no existing control within or near the project area, the Geodetic Survey Unit establishes control using GPS.

Orthophoto Agreement

Working cooperatively with the Vermont Mapping Program, the Geodetic Survey Unit uses GPS to establish first-order geodetic control to support digital orthophotography. The project area usually covers one or two counties. In addition to the monuments positioned to support the orthophotography, other monuments are added to the project area to create an evenly distributed and dense network.

Ground Control for Aerial Photogrammetry

On very rare occasions, the Geodetic Survey Unit is requested to establish control to support photogrammetry.

GEODETIC INFORMATION

Interactive Geodetic Information Management System

The Geodetic Survey Unit maintains a database that includes all control monument descriptions and coordinates it has established. The database also contains coordinates and descriptions for control monuments included in the National Geodetic Reference System (NGRS). The database resides on a GIS platform and can be accessed with a graphical interface. The Geodetic Survey Unit uses the Interactive Geodetic Information Management System to store and access information.

Continuously Operating Reference System

The Geodetic Survey Unit maintains a continuously operating GPS reference station (CORS) at 133 State Street in Montpelier. The data collected is available to the public through an electronic bulletin board or over the Internet. GPS users download data and typically use it to "correct" the GPS data that they have collected in the field in order to generate more accurate coordinates. The CORS is included in the federal CORS network.

Vermont Calibration Base Lines

In 1994 the Geodetic Survey Unit worked cooperatively with the National Geodetic Survey to establish five calibration base lines in Vermont. The base lines are located in South Hero, Berlin, Lyndonville, Springfield, and North Dorset and are used to calibrate electronic distance measuring instruments. The Geodetic Survey Unit maintains the base lines.

Technical Information

The Geodetic Survey Unit provides control information as requested. The information consists of monument descriptions, coordinates, and elevations; CORS data and instructions; and calibration base-line measurements and procedures. Requestors include surveyors, mappers, and engineers from the VAOT, other state and federal agencies, and the private sector.

FEDERAL INVOLVEMENT

The VAOT continues to support the NGS State Advisor Program. Through a cooperative agreement with the NGS, the State Advisor provides on-site expertise and training regarding geodetic surveying activities. The Advisor coordinates cooperative geodetic surveying projects between the VAOT and the NGS, other state and federal agencies, and the private sector. In addition, the Advisor works with the VAOT to submit geodetic control monument data to the NGS to be included in the National Geodetic Reference System.

PUBLIC RELATIONS

Gaining Access to Private Property

Before entering private land for survey work, it is the party chief's responsibility to attempt to contact each property owner and request permission for entry. Any special information, such as contacting property owners by phone before working, is given in the request for survey.

Be courteous at all times. If the property owner presses you for more information regarding future construction, provide the name and phone number of the contact shown on the request for survey. If you are refused entry, leave. Then notify your supervisor.

Requests for Technical Information

Always respond to requests made by the public in a courteous and timely manner but avoid giving out preliminary information. If you do not know the answer to a question, refer the request to another individual or agency.

Dealings with the Media

Follow the same conduct with the media as with a property owner. Never speculate about the possible location of future construction.

Respect for Private Property

Always treat private property in the way you want others to treat your property. To that end, use roads if they are available. If off-road travel is necessary, avoid driving through wet areas to prevent ruts.

Cut and trim as few trees as possible. Stack cut brush neatly but not in an area where livestock graze—cut brush can cause injury or death to livestock if consumed. Also, be sure to close gates behind you to prevent livestock from escaping.

Avoid cutting, trimming, or harming ornamental or shade trees, hedges, and other plants near a residence. Report the extent of any damage caused by the survey crew, in writing, to your supervisor.

To prevent damage to vehicle tires, countersink hubs and iron pins in and along roadways. And always check the area before leaving to be sure nothing is inadvertently left behind. Hubs, iron pins, nails, and the like can cause damage to vehicles and farm equipment and can cause injury or death to livestock.

Accessing Railroads and Airports

Always notify the appropriate railroad company or airport manager before arriving and when leaving. Make a list of the phone numbers of all railroad companies and airports and keep it up to date. Contact RAPT (Rail, Air, and Public Transportation) for more information.

VEHICLE RULES AND REGULATIONS

Refer to Administrative Bulletin No. 2.3 for rules and regulations concerning the use of state-owned and privately owned vehicles. The Agency's *Policies and Procedures Manual* and *Safety Manual* also contain important information regarding vehicle use.

The State may not be required to reimburse you for personal injury, property damage, and liability when you are involved in an accident while using a privately owned vehicle for State business.

SAFETY

All employees, and consultants working on State projects, should be familiar with the *Safety Manual*. In addition, there are a number of safety issues of particular interest to survey crews that are addressed here and referenced in other documents.

Personal and Protective Equipment

Always stow a fully stocked first-aid kit in the survey vehicle.

If working near a roadway, wear a safety vest or VAOT-approved brightly colored clothing. Always park the survey vehicle off the traveled way and use the vehicle's strobe lights. If a lane closure is required, contact the district maintenance office for assistance.

Dig Safe

Contact Dig Safe, 1-888-DIG-SAFE (344-7233), at least 48 hours before you need to drive any items longer than 300 millimeters into the ground. You may also have to contact utilities that are not part of Dig Safe.

If you are unsure of the presence of utilities, use wooden hubs or reinforcing bars less than 300 millimeters long.

Electrical Hazards

Always be aware of your surroundings. Power lines can be overhead, underground, and attached to buildings. Regard all power lines as dangerous and high-voltage lines as extremely dangerous. Electricity can arc from high-voltage lines at a ratio of 25 millimeters for every 1000 volts. Even using wooden rods is dangerous.

If you have to survey near power lines, keep all equipment at least three meters away from the nearest line. Never make direct measurements of the height of a power line. Use triangulation or a range finder.

If you get caught in an electrical storm, discontinue working and:

- Avoid touching metallic objects.
- Keep away from wire fences, telephone lines, metal tools, rivers, and lakes.
- Avoid tops of ridges, hilltops, wide-open spaces, ledges, and outcrops of rocks.

- Sit or lie down if you are in open country.
- Don't group together.
- Avoid large or isolated trees.
- Get away from horses and livestock.
- Get into the cab of a rubber-tired vehicle, if possible.
- Choose building shelters if available, but avoid small sheds in exposed locations.
- Seek shelter in dense woods, a cave, a depression in the ground, a deep valley, or the base of a steep cliff.

If you are outside on a humid day when a thunderstorm threatens and you notice a sensation that your hair is beginning to stand on end, lie down quickly in a ditch or depression; there is a high potential for a lightning strike.

Wooded Areas

There are a number of safety hazards in wooded areas: barbed wire fences; bee, hornet, and wasp nests; snakes; spiders; and poisonous plants. To avoid these hazards, expect the unexpected and avoid sitting on the ground or on logs. Additionally, avoid moving or disturbing rocks, stumps, and leaves. All of these can hide yellow jacket nests and poisonous snakes and spiders. You should also inspect your clothing and hair from time to time for chiggers and ticks. These are especially abundant in trees, grass, weeds, and pastures.

Avoid strange-acting animals because of the potential for rabies.

Railroads

Keep metallic objects away from railroad tracks because they may activate the signals.

Always be alert for oncoming trains. Never crawl under stopped cars and do not cross tracks between cars—they may move at any time.

Do not leave stakes protruding above ground within 3.5 meters of the track centerline, and do not park vehicles within 3.5 meters of the tracks.

Also keep in mind that different colors mean different things to different railroad companies. Orange, for example, may mean "remove rail." If you are unsure of the colors to use, discuss the matter with the company before you begin work.

Airports

Always notify the airport manager before arriving. Find out where you should and should not drive and whether to use the strobe lights on the vehicle. The procedures vary from one airport to another.

Accident and Injury Reporting

Refer to the *Safety Manual* for details concerning accident and injury reporting. All accidents and injuries must be reported within 72 hours.

Chapter Two
GPS Control

RELATIVE POSITIONING

Relative positioning with GPS is a technique used to establish precise horizontal coordinates. The position of a monument is determined "relative" to the position of a known monument.

For VAOT projects, position new monuments relative to the High Accuracy Reference Network (HARN) monuments, the continuously operating reference station (CORS), or other monuments previously referenced to the HARN.

STANDARDS AND SPECIFICATIONS

For projects to be submitted to the National Geodetic Survey (NGS), use the standards and specifications published by the Federal Geodetic Control Committee (FGCC). See the FGCC publication, "Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques." Accuracy specifications can be obtained through the NGS Information Branch or the Geodetic Survey Unit.

For route survey projects, meet first-order horizontal control accuracies and tie to a minimum of two first-order or higher horizontal control points. For vertical control, it is desirable to tie to a minimum of three benchmarks.

PROJECT DEVELOPMENT

Scope

The scope of a geodetic control project depends on the type of project. For route survey projects, the number of control points required depends on the size and nature of the route survey project. Typically, two to four control monuments are required to tie the route survey to the Vermont Coordinate System. Densification projects and control for orthophoto projects are usually done on a county-wide basis.

If the request for control is generated from outside the Geodetic Survey Unit—for example, the Route Survey Unit or the Vermont Mapping Program—the requestor usually provides one or more full-size USGS quadrangle sheets with the project area clearly identified on the maps.

Research

The objective of research is to determine whether any monuments exist in a particular geographic area. The monuments may have been set by NGS, USGS, VAOT, or various other agencies or organizations. The researcher extracts survey monument descriptions from various databases and files and gives the descriptions to the field crew to field check. See the section, “Retrieving Information,” in Chapter Five.

Reconnaissance

The field crew reviews the survey monument descriptions and searches for those monuments that appear to support the project. Some monuments identified during research are not fully investigated by the crew because of conditions found in the field—for example, if the monument appears to be buried under meters of fill or is clearly too far from the project to be useful.

The field crew revises the descriptions to reflect the current condition of the monument; for example, the crew reports the monument “not found,” or modifies ties or the “to reach” statement.

Setting Monuments

Based on the outcome of the reconnaissance, the survey crew may set monuments to support the project. The monuments are set as close to the project as possible but still within the Geodetic Control Plan guidelines. Monuments may be either permanent or temporary, depending on the location of the project. Temporary monuments are set in remote areas where there is little chance the monument will ever be used again. For each monument set, whether permanent or temporary, the person who sets the monument writes a survey monument description. Refer to “Writing Descriptions” in Chapter Four.

Network Design

Figure 2-1, on the next page, shows a sketch of a project network.

The objective of network design is to have good network geometry. Distribute control points around a project, rather than placing them all on one side of a project, for example.

Follow federal guidelines for network design on densification projects. On route survey projects, tie to a minimum of two first-order control points. If computing orthometric heights, tie to at least three benchmarks, preferably within 10 kilometers of the project and evenly distributed. The minimum base-line length is 400 meters. Each vector must be able to be checked in a closed loop consisting of independent vectors.

Observation Schedule

Figure 2-2 is an example observation schedule for the network shown in Figure 2-1. For an intervisible pair of monuments, each monument should be occupied twice, at least once simultaneously.

Figure 2-1

Project Network

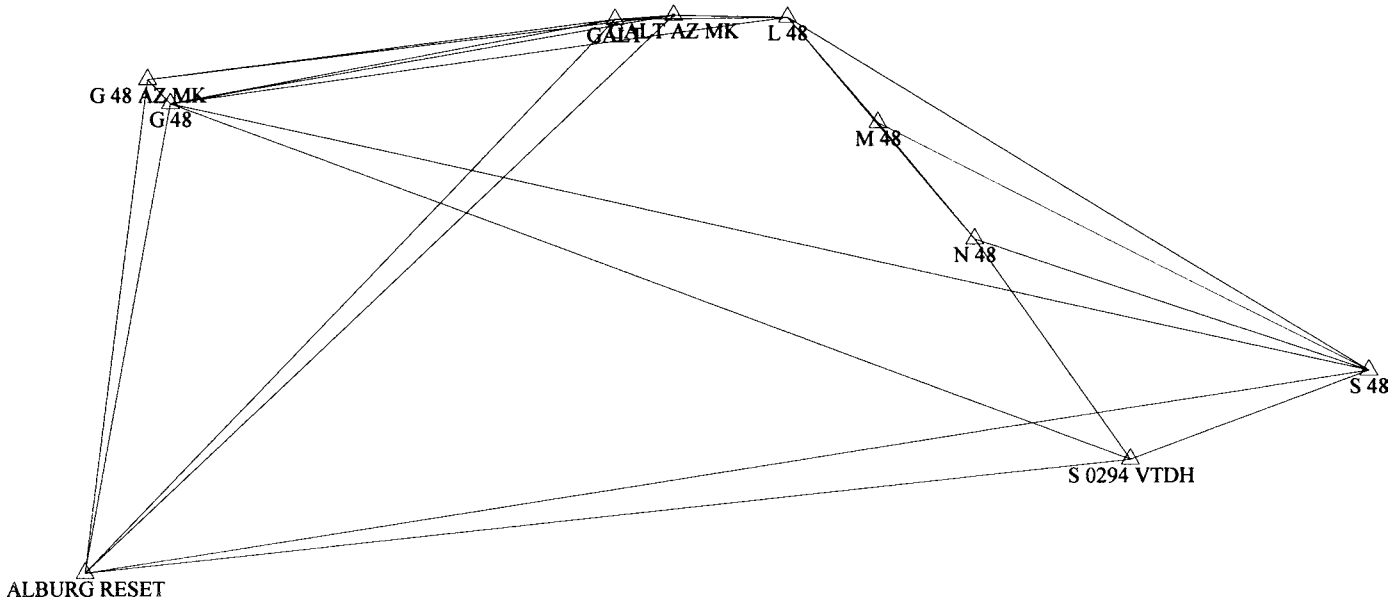


Figure 2-2

Observation Schedule

ALBURG STPG TSIG(3)SC 19 MARCH 1996
SWANTON NH036-1(9)SC

Station	Mark ID
ALBURG RESET	ALBU
G 48	G048
G 48 AZ MK	G48A
GALT	GALT
GALT AZ MK	GAAZ
L 48	L048
M 48	M048
N 48	N048
S 0294 VTDH	S029
S 48	S048

SESSION/TYPE	MLC	CHH	PCH	DJM	TIME
1 Static	N048	S029	----	----	8:30-9:15
2 Static	L048	N048	S048	M048	9:35-10:20
3 Static	G048	GAAZ	L048	GALT	10:40-11:25
4 Static	----	GALT	GAAZ	G48A	11:40-12:25
5 Fast Static	----	G48A	----	G048	12:45-1:05
6 Static	ALBU	G048	S048	S029	1:40-2:40

EQUIPMENT

Electronic Distance Measurement (EDM)

EDM equipment is occasionally used for short base lines as a check of GPS measurements. Refer to the EDM equipment manual for operating instructions.

GPS Receiver System

Figure 2-3 shows the components of a GPS receiver system.

The GPS receiver system is delicate and must be treated with care to ensure reliable measurements and long life. Use the following guidelines for handling and transporting the equipment:

- Be sure that each piece of equipment is secure in its carrying case and that the case is secure in the vehicle.
- Take care when loading and unloading equipment.
- During the winter, fixed-height pole legs have a tendency to freeze if they are transported in the back of a pickup truck. Dry off the legs before storing. Try to transport the pole in warm conditions.
- Roll cables for storage so that they are not crimped or twisted.

FIELD OPERATIONS

Preparation

Be sure that the following documents and equipment are on hand for field operations:

- Documents
  - Observation schedule
  - Station descriptions
  - Log sheets
  - GPS data collection procedure
- Equipment
  - Cellular phone
  - Receiver
  - Antenna and 10-meter cable (30-meter cable optional)
  - Four charged camcorder batteries (6-amp battery optional)
  - Fixed-height pole and adaptor
  - Receiver manual

  Use meteorological instruments if specified by the FGCC document. Follow the instructions provided with the instruments.

Figure 2-3

GPS Receiver System

Setup

Periodically check the fixed-height poles to make sure the pole points have not rounded and that the points are screwed tightly into the poles.

Before setting the fixed-height pole over the monument, check the stamping on the monument to make sure it is the correct one. For projects to be submitted to the NGS, make a rubbing or draw a sketch of the monument and attach it to the log sheet.

Level the pole over the datum point and secure the legs firmly in the ground. If your best efforts at leveling the pole leave one of the bull's-eye bubbles completely outside of the bull's-eye, report it and get the bubble adjusted.

Attach the antenna to the fixed-height pole and orient the antenna to north. Attach the antenna cable to the antenna and the receiver. Check to make sure that the adapter is screwed tightly into the antenna and set firmly onto the pole.

Under thawing conditions, consider placing wooden blocks under the legs. Under windy conditions consider adding weights to the legs. In precarious setups, consider tying the pole to a fixed object, such as a guardrail.

Operating Procedures

The GPS equipment can be operated in the static mode or the fast-static mode. See Figures 2-4 (static mode) and 2-5 (fast-static mode) for detailed procedures.

Log Sheet

For each session, all observers complete a log sheet. Figure 2-6 shows the front of a GPS log sheet. The log sheets are designed for up to two sessions. Use the back side of the log sheet to record any pertinent comments, such as strong wind gusts or unhealthy satellites.

BASE LINE PROCESSING

GPS observations are downloaded from the receivers to a laptop or office PC. The base line processing procedure is summarized below:

- Check height and start and end times.
- Enter complete station names and control point coordinates.
- Select files for processing.
- Choose vectors to process.
- Process vectors.
- Review results.
- Check loop closures.

ADJUSTMENT AND ANALYSIS

After the base lines have been processed, they are analyzed using the least-squares method. The usual process for horizontal control is to run a minimally constrained adjustment and a fully constrained adjustment.

A minimally constrained adjustment, holding one control station fixed in X (latitude), Y (longitude), and H (ellipsoid height), checks the internal consistency of the network vectors. A fully constrained adjustment, holding all control stations fixed in X, Y, H, fits the project network into the control network.

If computing orthometric heights, compute geoid heights and run a minimally constrained adjustment holding X, Y, h (orthometric height) fixed, followed by a fully constrained adjustment holding X, Y, h fixed.

Final coordinates are typically either geographic (latitude, longitude) or state plane. The coordinates can be automatically converted to another system.

PROJECT FINALIZATION

The final step for all projects is project archival and data management. See Figure 2-7 for a checklist of items to be completed.

PROJECT SUBMISSION

Projects that are submitted to the National Geodetic Survey (NGS) are included in the National Geodetic Reference System. NGS publishes the final coordinates and station descriptions and distributes the data. Refer to Annex L of the NGS Blue Book, “Guidelines for Submitting GPS Relative Positioning Data.”

Figure 2-4

Static Mode Procedures

BOLD = Receiver keys *Italics* = menu options

1. **POWER** on receiver

2. Select *QUICK-START NOW! (SINGLE SURVEY)*
(You can get back to this menu by pressing **LOG DATA**)

3. Press **LOG DATA**

4. Select *CHANGES*

a. *Select FILENAME* and enter it as shown below:

NEW: XXXX-DAY-S

XXXX = 4-character station name
Day = Julian Day number
S = session number
Example: GM211241

b. Select *ACCEPT*

c. Select *ANTENNA HEIGHT* and enter it as shown below:

ANT HEIGHT:	2.0625 METERS
MEAS TYPE:	TRUE VERTICAL
ANT TYPE:	COMPACT L1/L2 W GP
ANT SERIAL:	000XXX
	(XXX = last 3 digits of Antenna SN)

d. Select *ACCEPT*

5. Press **STATUS** key to make sure you are tracking SVs.

6. At end of survey, press **LOG DATA**
Select *END SURVEY*
Select *YES*

7. **POWER** off (hold down button).

Figure 2-5

Fast-Static Mode Procedures

BOLD = Receiver keys *Italics* = menu options

1. **POWER** on receiver

2. Select *START FAST STATIC OR KINEMATIC SURVEY*
Select *START FAST STATIC SURVEY*
Select *START*
(You can get back to this menu by pressing **LOG DATA**)

3. Input the *MARK-ID* (4 zeros followed by 4 character station ID)
Select *ACCEPT*

4. Press **LOG DATA**
Select *INPUT/CHNGS*
Select *CHANGES*

a. *Select FILENAME* and enter it as shown below:

NEW: XXXX-DAY-S

XXXX = 4-character station name
Day = Julian Day number
S   = session number
Example: GM211241

b. Select *ACCEPT*

c. Select *ANTENNA HEIGHT* and enter it as shown below:

ANT HEIGHT: 2.0625 METERS
MEAS TYPE: TRUE VERTICAL
ANT TYPE: COMPACT L1/L2 W GP
ANT SERIAL: 000XXX
(XXX = last 3 digits of Antenna SN)

d. Select *ACCEPT*

5. Press **STATUS** key to make sure you are tracking SVs.

6. At end of survey, press **LOG DATA**
Select *END SURVEY*
Select *YES*
Select *ACCEPT ANTENNA HEIGHT*

7. **POWER** off (hold down button).

Figure 2-6

Log Sheet

Project Name:				
Observing Agency: Vermont Agency of Transportation (VTAT)				
Date UTC	Day UTC	Start UTC	End UTC	Session
Station Name:		4-Char ID:	Station #:	
Tracking Euipment		Observer's Initials:		
Model: Trimble 4000SSE		Was fixed-height pole used? Y N		
Receiver S/N:		HI of fixed-height pole: 2.0625 m		
Antenna S/N:		Satellites Tracked Circle appropriate PRNs		
Tripod Type: Fixed Height		Block 1 SVs 3 6		
Ant. Model: L1/L2 Geodetic		Block 2 SVs 1 2 4 5 7 9 10 14 15 16 17 18 19 21 22 23 24 25 26 27 28 29 30 31		
Cable Length: m				
File Name:				
Agency Inscription:				
Mark is stamped:				

Project Name:				
Observing Agency: Vermont Agency of Transportation (VTAT)				
Date UTC	Day UTC	Start UTC	End UTC	Session
Station Name:		4-Char ID:	Station #:	
Tracking Euipment		Observer's Initials:		
Model: Trimble 4000SSE		Was fixed-height pole used? Y N		
Receiver S/N:		HI of fixed-height pole: 2.0625 m		
Antenna S/N:		Satellites Tracked Circle appropriate PRNs		
Tripod Type: Fixed Height		Block 1 SVs 3 6		
Ant. Model: L1/L2 Geodetic		Block 2 SVs 1 2 4 5 7 9 10 14 15 16 17 18 19 21 22 23 24 25 26 27 28 29 30 31		
Cable Length: m				
File Name:				
Agency Inscription:				
Mark is stamped:				

Figure 2-7

Data Management Checklist

GPS PROJECT CHECKLIST

PROJECT NAME_____ **DATE**___/___/____

PROCESSED BY_____ **PC USED 77 50 DELL**

FOLDER CONTENTS

- ○ SURVEY REQUEST
- ○ PROJECT MAP (USGS)
- ○ PROJECT NOTES
- ○ OBSERVATION SCHEDULE
- ○ DESCRIPTIONS OF NEW STATIONS
- ○ LOG SHEETS
- ○ PROJNAME.SPC
- ○ PROJNAME.GEO
- ○ PROJNAME.RTE
- ○ NETWORK MAP

TAPE BACKUP CONTENTS

VOLUME NAME SHOULD BE PROJNAME AND NUMBER

- ○ PROJNAME.A?
- ○ PROJNAME.HA
- ○ PROJNAME.SCH
- ○ PROJNAME.SPC
- ○ PROJNAME.GEO
- ○ PROJNAME.RTE

OTHER

- ○ ADD COORDINATES AND MARK INFO TO ACCESS DATABASE
- ○ DELETE PROJECT FROM PC
- ○ ADD DESC. TO APPROPRIATE DB .HA FILE
- ○ UPDATE VT98000.LST WITH PROJECT.LST
- ○ TRANSFERRED .RTE TO ROUTE SURVEY

Chapter Three
Differential Leveling

DESCRIPTION

The Geodetic Survey Unit uses differential leveling to determine the heights of geodetic control monuments. Monuments with known heights are called benchmarks. Differential leveling involves measuring the height differences between monuments. The heights of new monuments are determined relative to the heights of benchmarks. The height reference is NAVD88 (North American Vertical Datum of 1988).

The Geodetic Survey Unit provides the Route Survey Unit with benchmark descriptions and elevations for use in referencing route survey projects to NAVD88. If there are no existing benchmarks in or near the project area, the Geodetic Survey Unit establishes vertical control with GPS. The Geodetic Survey Unit does not typically do differential leveling for individual route survey projects, although route survey projects are sometimes located along corridors where benchmarks are established.

STANDARDS AND SPECIFICATIONS

For geodetic control projects to be submitted to the NGS, use the most current standards and specifications published by the Federal Geodetic Control Subcommittee (FGCS). Accuracy specifications can be obtained through the NGS Information Branch or the Geodetic Survey Unit.

PROJECT DEVELOPMENT

Scope

Differential leveling projects are usually large in scope and are performed in accordance with the Geodetic Control Plan. The Geodetic Survey Unit selects stretches of major transportation corridors that have sparse vertical control. For example, the Geodetic Survey Unit leveled from Bennington to Brattleboro along Vermont Route 9. Although the vertical control network was fairly dense at both ends of the project, few benchmarks existed in between.

Research

The objective of research is to determine whether any monuments exist in a particular geographic area or along a particular route. The monuments may have been set by NGS, USGS, VAOT, or other agencies or organizations. The researcher extracts survey monument descriptions from various databases and files and gives the descriptions to the field crew to check. See the section “Retrieving Information,” in Chapter Five.

Reconnaissance

The field crew reviews the survey monument descriptions and searches for those monuments that appear to support the project. Some monuments identified during research are not fully investigated by the crew because of conditions found in the field—for example, if the monument appears to be buried under meters of fill or is clearly too far from the project to be useful.

The field crew revises the description to reflect the current condition of the monument. For example, the crew reports whether the monument was found or not and modifies ties and the “to reach” statement, if necessary.

Setting Monuments

Based on the outcome of the reconnaissance, the survey crew usually sets monuments to support the project. The monuments are set within the guidelines established by the Geodetic Control Plan. For each monument set, the person who sets the monument writes a survey monument description. Refer to “Writing Descriptions” in Chapter Four for details on the automated description writing procedure.

EQUIPMENT

Electronic Digital/Bar-Code Leveling Instrument

Description

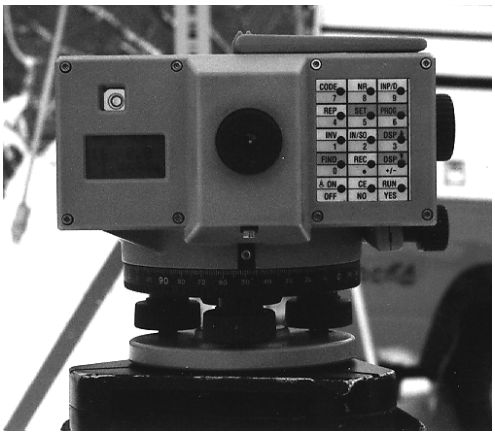
The Geodetic Survey Unit uses a digital/bar-code level. This instrument uses image technology to automatically “read” the height on the rod. See Figure 3-1.

Transportation

Normally, the instrument has to be upright in its case during transport; check the manufacturer’s instructions to be sure. Also, be sure that the instrument is secure in its carrying case and that the case is secure in the vehicle. When transporting the level between setups, keep the level on the tripod and the tripod near upright.

Figure 3-1

Digital/Bar-Code Level



Setup

Attach the instrument securely to the tripod. For each setup, level the instrument over the tripod. Be sure the tripod setup is stable.

Data Collection

Level data is stored on an electronic data card. Be sure the data card is secure in the instrument before beginning to collect data. Prior to beginning leveling, delete any old data from the data card. Before deleting any data, make sure the data has been downloaded and checked.

Downloading and Checking Data

Download data at the end of each day. See Figure 3-2 for downloading procedures.

Weather Package

The weather package is affixed to the tripod. There are upper and lower temperature probes. Be careful when taking the tripod in and out of the vehicle and carrying the tripod, not to damage the probes. Replace the batteries in the weather package as needed. Always measure the temperature in Celsius and turn the fans on prior to taking the measurements.

Bar-Code Leveling Rods

Description

Rods

The Invar level rods are three meters long. Metal struts are attached to a rod and are used to hold the rod vertical throughout the setup. See Figure 3-3.

Turning Pins and Plates

Turning pins and plates are used to ensure that the rod is set up over the same point. In general, turning pins are used on soft ground, while turning plates are used on hard surfaces. See Figure 3-4. It is critical that the pin or plate remains stable throughout the entire setup.

Spacers and Centering Shoes

Spacers are solid metal cylinders, either 2 cm or 10 cm long, used to set the rod over the monument under difficult circumstances—for example, if the monument is set just below the ground surface and the rod cannot set on the datum point.

Centering shoes or “flippers” are removable metal clips that are attached to the bottom of the rods. The flippers ensure that the rods are always centered over the turning pin or plate. Be sure to remove the flipper when setting the rod over a monument.

Calibration

The level rods are calibrated every three years or sooner as needed.

Transportation

The level rods are transported in wooden cases. The cases are usually carried on the roof of the state truck inside a metal box. However, if the truck is not available, the rods may be transported in their

Figure 3-2

Downloading and Checking Data

A. At the end of each day, download data as follows:

1. Download data from the REC module to the laptop computer using the GIF10 unit as follows:
   a. Turn GIF10 unit on
   b. Place REC-module in GIF10 unit
   c. At C:\PROJECTS\BB\VERTDATA\ type command GIF10.
   d. Select 1; Data from REC-module to computer
   e. Select 3; On disk
   f. Which REC-module file (1..14)? 1
   g. Start-block number? 1
   h. End-block number? 1000
   i. Enter disk-file name: BBmmdd.FLD (mmdd = month and day)

   Data should move across and down screen after a few seconds. Depending on the amount of data collected, it could take a few minutes for all the data to be downloaded.

2. Copy BBmmdd.FLD to BBmmdd.RAW. Edit BBmmdd.RAW to correct any errors made in the field, e.g., incorrect SPSN number, time, date. The .FLD file should remain a record of what was actually collected in the field.

3. Run NA3000 program
   Command: NASINGLE -i BBmmdd.RAW -l BBmmdd.LST -r BBmmdd.R4
   The following message should appear on the screen:
   OPENING BBmmdd.RAW
   OPENING BBmmdd.LST
   OPENING BBmmdd.R4

4. Check BBmmdd.LST to determine if all errors made in the field had been edited correctly and saved in the .RAW file. If additional errors are found, edit the .RAW file to correct errors and run NA3000 again. The existing .LST and .R4 files will be overwritten. The same message as above should appear on the screen.

5. Append (or create) BB_ALL.RAW with BBmmdd.RAW as follows:
   Command: COPY BB_ALL.RAW + BBmmdd.RAW BB_ALL.RAW
   The message "1 file(s) copied" should appear on the screen

   Append BB_ALL.R4 with BBmmdd.R4 similarly.

6. Copy BBmmdd.FLD, BB_ALL.RAW and BB_ALL.R4 to the Backup Disc.

7. Erase data from the REC module at the end of each day.

B. At the end of each week, drop-off the Backup Disc to the office, or copy files from the Backup Disc to C:\PROJECTS\BB\VERTDATA\ on the office PC.

Figure 3-3

Bar-Code Leveling Rod

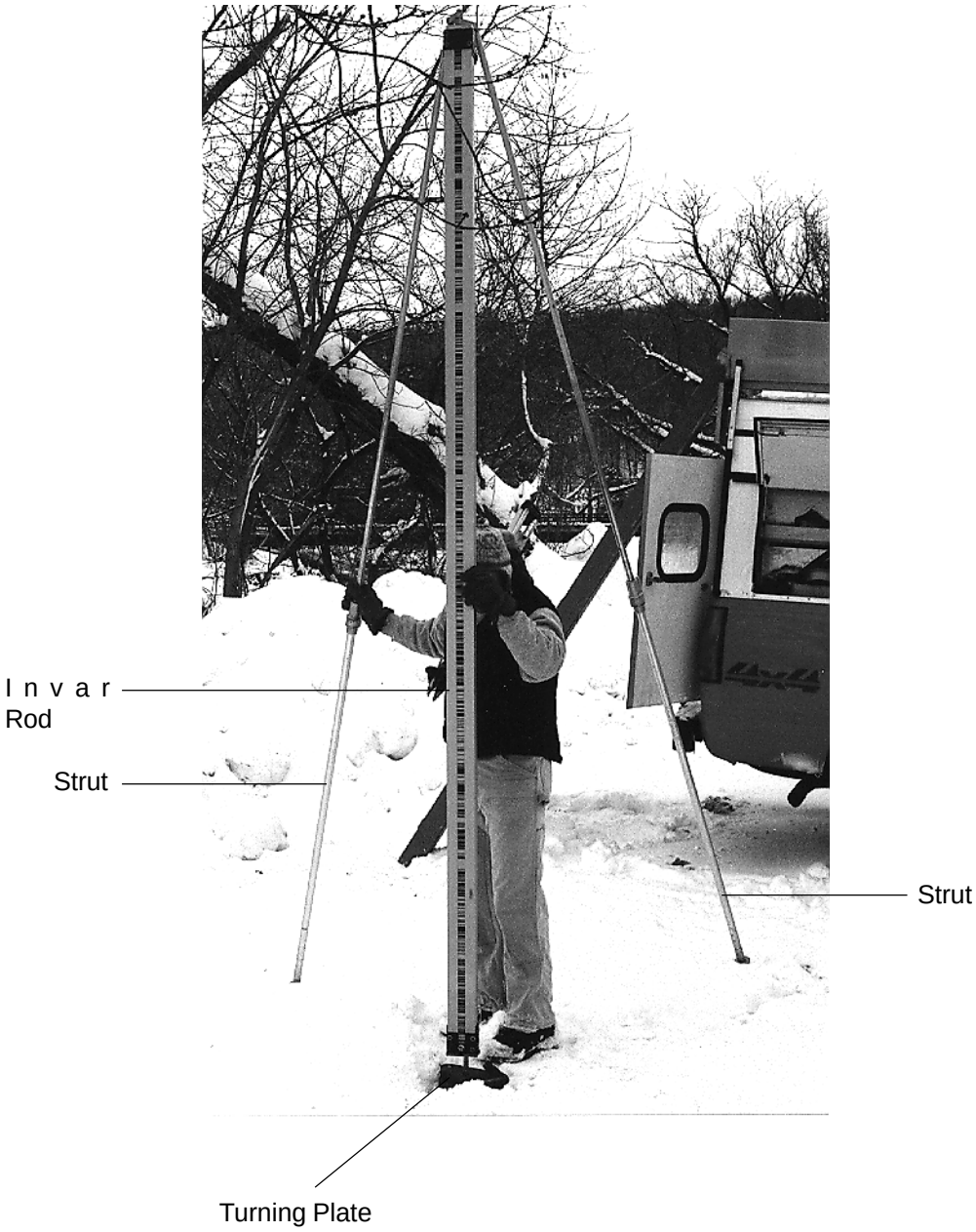
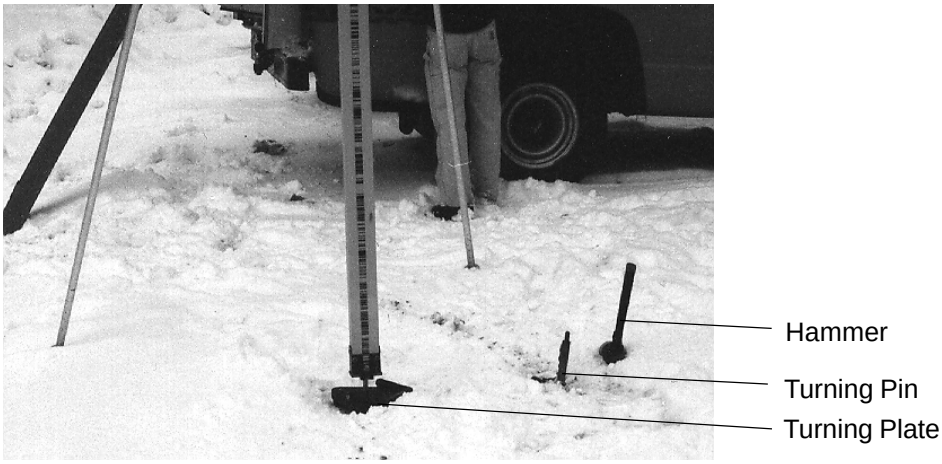


Figure 3-4

Turning Plate and Pin



cases in the back of a pickup truck or other large vehicle. In all cases, be sure the rod boxes are secure before traveling. The rods are very fragile and should be handled with care.

When carrying the rod, it is important to be aware of where the end of the rod is at all times. Make sure it does not stick out into traffic, and watch out for pedestrians or objects in your path. Be especially careful of overhead power lines. When handling the rod, do not touch the face of the rod and do not allow the foot plate of the rod to touch the ground. Do not set the rod down hard on the turning pins. When laying the rod down, be sure to do so with the Invar strip facing up.

Use

Be sure the centering shoe is attached to the base of the rod. Stand the rod up and center it over the turning pin or plate with the centering shoe. Secure the legs of the struts into the ground. Level the rod. Signal the instrument operator after the rod is level so that he or she can proceed with the observations. Stand by the rod to ensure that it does not fall.

FIELD OPERATIONS

Collimation Correction

At the beginning of the day, do a collimation error determination (peg test). See Figure 3-5.

Leveling Procedure

After satisfactorily completing the peg test, begin data collection. Follow the leveling procedure shown in Figure 3-6, and use the codes shown in Figure 3-7. Download data at the end of the day. If double-run sections are required, the forward and backward runs should be run under different atmospheric conditions, preferably on different days. If unsuitable weather or other conditions prohibit completing a section, abandon the section and run it again.

Do not level if it is raining or snowing steadily or if there is a threat of lightning striking the area.

Turning Points

Each rod is set up on a turning point. Be sure the turning pin or plate is firmly in the ground. It is critical that the rod is on the same point for the entire setup. If the turning point moves, i.e., the turning plate sinks into soft ground, then the sections must be started over.

ABSTRACTING AND ADJUSTMENT

After the data is downloaded, run the NGS abstract program and review the output file. This file shows the forward and backward measurements for each section and the resulting misclosure. Look for sections that do not close within the specified tolerances.

After the leveling data is collected for a project, adjust it using Cadastral Measurement Management (CMM) software. When satisfactory results are achieved, save the resultant output file for a record of the preliminary elevations.

PROJECT SUBMISSION

Leveling projects are submitted to the NGS to be included in the NGRS. NGS publishes the final coordinates and station descriptions and distributes the data. Follow NGS Blue-Booking procedures (Figure 3-8) for submitting data. Refer to Figure 3-9 for a level project checklist.

BENCHMARKS SET BY CONSTRUCTION

The VAOT Construction Division sets benchmarks on new or reconstructed bridges and determines the elevations of the benchmarks. The resident engineer completes a benchmark information form for each benchmark set and returns the form to the Geodetic Survey Unit. The form includes the location and elevation of the benchmark. See Figure 3-10.

Construction notifies Geodetic Survey if an existing benchmark on the bridge is in danger of being destroyed. If Geodetic Survey determines that the benchmark should be saved, Geodetic Survey transfers the benchmark.

Figure 3-5

Peg Test

Set rod A at 0 m, instrument at 15 m, and rod B at 45 m.

ENTRY	**DESCRIPTION**
PROG	Call Program Menu.
CHECK & ADJUST	Use DSP key to select program CHECK & ADJUST.
RUN	Confirms selection.
Measure A1	Observe at 15 m.
Measure B1	Observe at 30 m.
(Move instrument)	
YES	Confirms that you have moved instrument.
Measure B2	Observe at 15 m.
Measure A2	Observe at 30 m.
YES	Confirms that you want to compute Coll.
YES/NO	Use DSP key to check absColl. Store newColl if absColl is within allowable tolerance (≤10).

Figure 3-6

Leveling Procedure

ENTRY	DESCRIPTION
PROG	Call Program Menu.
Meas Only	Use DSP key to select program MEAS ONLY. This allows the first set of code blocks to be entered prior to starting the field work.
RUN	Confirms Selection.
CODE 1 RUN	Start of day/new observer.
Info 1-4;RUN	Enter info.
REC	Confirm entries.
CODE 2	Equipment used.
CODE 11	Start of leveling section.
PROG	Call Program Menu.
Start Leveling	Use DSP key to select program START LEVELING.
RUN	Confirms selection.
YES	Confirms start leveling.
spsn # RUN	Enter starting SPSN (Ind #).
0.0000 RUN	Enter starting ground hght.
For Each Set-up	
Meas. Backsight	Monitor std. dev.
Meas. Foresight	Check balance.
CODE 33	Enter temperature values.
End of Section	
CODE 99	
New Section	
CODE 1	Only if new observer.
CODE 11	Start of new leveling sect.
PROG	Call Program Menu.
Start Leveling	Same procedure as above.
End of Day	
CODE 9999	

Figure 3-7

Codes

NA3000

CODES
CODE 1—BEGINNING OF DAY OR CHANGE IN OBSERVER
1) DATE (MMDDYY)
2) TIME (24 LOCAL)
3) WEATHER CODE (SW)
4) OBSERVER'S CODE NUMBER

CODE 2—EQUIPMENT USED
1) INSTRUMENT NUMBER (90810)
2) COLLIMATION ERROR (NO DECIMAL)
3) ROD 1 NUMBER (25458)
4) ROD 2 NUMBER (25534)

CODE 3—START OF LEVELING SECTION
1) TIME
2) WEATHER CODE
3) STARTING SPSN
4) ROD NUMBER ON MARK (1 OR 2)

CODE 22—REJECT PREVIOUS SETUP
(NO ENTRIES—SELECT REC)

CODE 33—TEMPERATURE (END OF EACH SETUP)
1) LOWER TEMP PROBE (CELSIUS, NO DECIMAL)
2) UPPER TEMP PROBE (CELSIUS, NO DECIMAL)
(NO THIRD ENTRY—SELECT REC)

CODE 99—END OF SECTION
1) TIME
2) WEATHER CODE
3) ENDING SPSN
4) ROD NUMBER ON MARK (1 OR 2)

CODE 9999—END OF DAY
1) DATE
2) TIME
3) WEATHER CODE
4) OBSERVER'S CODE NUMBER

WEATHER CODES
SUN:
1—If less than 25% of the setups are performed under sunny conditions
2—If 25-75% of the setups are performed under sunny conditions
3—If more than 75% of the setups are performed under sunny conditions

WIND:
1—If the wind speed averaged less than 10 km/hr (6 mi/hr)
2—If the wind speed averaged 10-25 km/hr (6-15 mi/hr)
3—If the wind speed averaged greater than 25 km/hr (15 mi/hr)

OBSERVER CODES

10	Gilman	30	Reed	33	Barnard	40	Orvis	50	Robinson
11	Morse	31	Tabor	37	Meyers	41	Bullock	51	Carr
20	Moreau	32	Holman	38	Baker			52	Martin

Figure 3-8

Blue-Booking Procedures

- ☐ Review descriptions and clean-up xx.ha.
- ☐ Run NASINGLE program on xx_all.raw to create xx.r4.
- ☐ Compare xx.r4 with xx_all.r4; should be the same size and format.
- ☐ Copy level.hdr to xx.hdr and update to reflect current project, specs, date etc.
- ☐ Copy xx.r4 to xx.hdr to create xx.l. Add footer (*xx*).
- ☐ In xx.l, change operator ID numbers to operator initials. (Use search and replace in Norton Desktop Editor.)
- ☐ In xx.l, add time zone (Q=EDT) to 41 records. (Norton Desktop Editor and mouse.)
- ☐ In xx.l, add code O to 43 records to "office reject" sections as needed.
- ☐ Run MAKEFILE program on xx.l to create xx.hgz.
- ☐ Run ABSTRA program on xx.hgz and xx.ha to create xx.abs.
- ☐ Check errors listed at bottom of xx.abs for missing or extraneous descriptions in xx.ha.
- ☐ Check errors listed at bottom of xx.abs for missing/incorrect latitudes and longitudes in xx.ha.
- ☐ Modify xx.ha as needed to correct errors and run ABSTRA again.
- ☐ Run READFILE program on xx.hgz to re-create xx.l.

Note: programs do not run well on the F drive.

Figure 3-9

Project Checklist

PROJECT: _____ DATE: _____

☐ Project map on full size USGS quad sheets with red dots and station names. (File)

☐ Full size copy of maps. (NGS)

☐ Copy of project map cut into 8½ x 11 sheets. (File)

☐ Project report original. (NGS)

☐ Letter to NGS.

Digital files on office PC (f:\xx and c:\mc\gm9\level\xx) and copy on diskette:

☐ HA	☐ INX
☐ STT	☐ D
☐ RAW	☐ R4 (from RAW)
☐ LST	☐ L
☐ HGZ	☐ ABS

Digital files on office PC (c:\mc\gm9\level\xx)

☐ CMM project files	☐ Letter to NGS (.ltr)
☐ Project Report (.rpt)	☐ Closure.ch3 (HG chart)
☐ Cum_km.ch3 (HG chart)	☐ Stats.rpt

Digital files on office PC (c:\mc\gm9\level)

☐ R4_data.wk1/fmt (Lotus)	☐ Closure.wk1/fmt (Lotus)

Hardcopy for files:

☐ Station descriptions	☐ Abstract
☐ CMM adjustment output	☐ Project report
☐ Letter to NGS	☐ Closure.ch3 (HG chart)
☐ Cum_km.ch3 (HG chart)	☐ R4_data.wk1/fmt (Lotus)
☐ Closure.wk1/fmt (Lotus)	☐ Stats.rpt

Digital files on diskette for NGS.

☐ L	☐ D
☐ RAW	☐ LST
☐ HGZ	☐ ABS

☐ Project notes.

☐ Misc. correspondance.

☐ Procedures followed.

☐ Personnel related.

☐ Invoices.

Comments on reverse.

Figure 3-10

Benchmark Information

Date: _____

Town in which located: _____ Proj. No.: _____

Route or TH No.: _____

Approximate distance and direction from nearest road intersection:

_____

PLEASE CIRCLE THE CORRECT INFO AND FILL IN THE BLANKS BELOW

The bench mark is a brass disc/other _____.

The bench mark is set on a bridge/culvert/other _____.

The structure is over/under _____.

The bench mark is located on the N NE E SE S SW W NW end of the structure.

The bench mark is set in the abutment/wingwall/curb/headwall/sidewalk/ other _____

Please provide any additional info that you think might be helpful in finding the benchmark when it is buried under snow and ice.

_____

_____

TRANSFER INFO

Starting bench mark _____ elevation _____

Ending bench mark _____ elevation _____

Equipment used _____

ELEVATION: _____ feet/meters

DATUM: NGVD29/NAVD88/ASSUMED

Submitted by _____

Please return to Geodetic Survey Unit 11/18/96

Chapter Four
Monumentation and Descriptions

SELECTING MONUMENT SITES

Use the following guidance for either permanent or temporary monuments.

If practicable, select a monument site for GPS control or leveling so that the monument has these characteristics:

- Easily accessible, preferably by using a vehicle
- On public land
- Out of harm's way

If you must set a monument on private property, always obtain permission from the property owner prior to setting the monument. If possible, avoid setting monuments on railroad rights-of-way.

GPS

For GPS control, try to select a site so that the monument has the characteristics mentioned above, and:

- It provides an open window to the sky.
- It provides for easy setup of existing GPS and conventional equipment.

Leveling

For leveling, try to select a monument site so that the monument has sufficient clearance for the leveling rod (and rod struts), as well as the general characteristics mentioned earlier.

It's desirable that a monument site for leveling can also be used as a site for a GPS control point.

MONUMENT SPECIFICATIONS

Permanent Monuments

Construct permanent monuments as shown in Figure 4-1, on the next page. Preferably, set permanent monuments in ledge, massive structures, or concrete.

Temporary Monuments

For temporary monuments, use reinforcing bars in the ground or PK nails in pavement.

WRITING DESCRIPTIONS

Use the following guidelines so that descriptions entered into the Descriptive Data Processing System (DDPROC) software conform to a standard format. See Figures 4-3 through 4-6 for examples of DDPROC output. You can find additional help for writing descriptions in Annex N of the NGS Blue Book.

Fields

Fill in all fields that apply to the station that you're describing or recovering. If you cannot determine the information for a field, leave it blank. If the desired code is not listed under the **Choices** menu, select the command **Other—See Descriptive Text** and provide a full explanation in the descriptive-text portion of the form.

Generally, the form fields, with the aid of the **Choices** and **Help** menus, are self-explanatory. Guidance on selected fields is provided below.

Designation

If you're entering a station into the NGS database for the first time, don't include a date or elevation. This rule holds true even if there is a date or elevation stamped on the mark. For example, a station stamped "Peru 1994" would be designated "Peru." If you're recovering a station that resides in the NGS database and the designation contains a date or elevation, the designation remains unchanged.

Underground Mark Type

Don't use this field as if it applied to any station set below ground level. Use it only if you're recovering an old Coast and Geodetic triangulation station and information for the underground mark type already is included in the station's description. Some of the old Coast and Geodetic triangulation stations had a mark set directly beneath a primary station mark. The underground mark could be used if the primary station mark was destroyed.

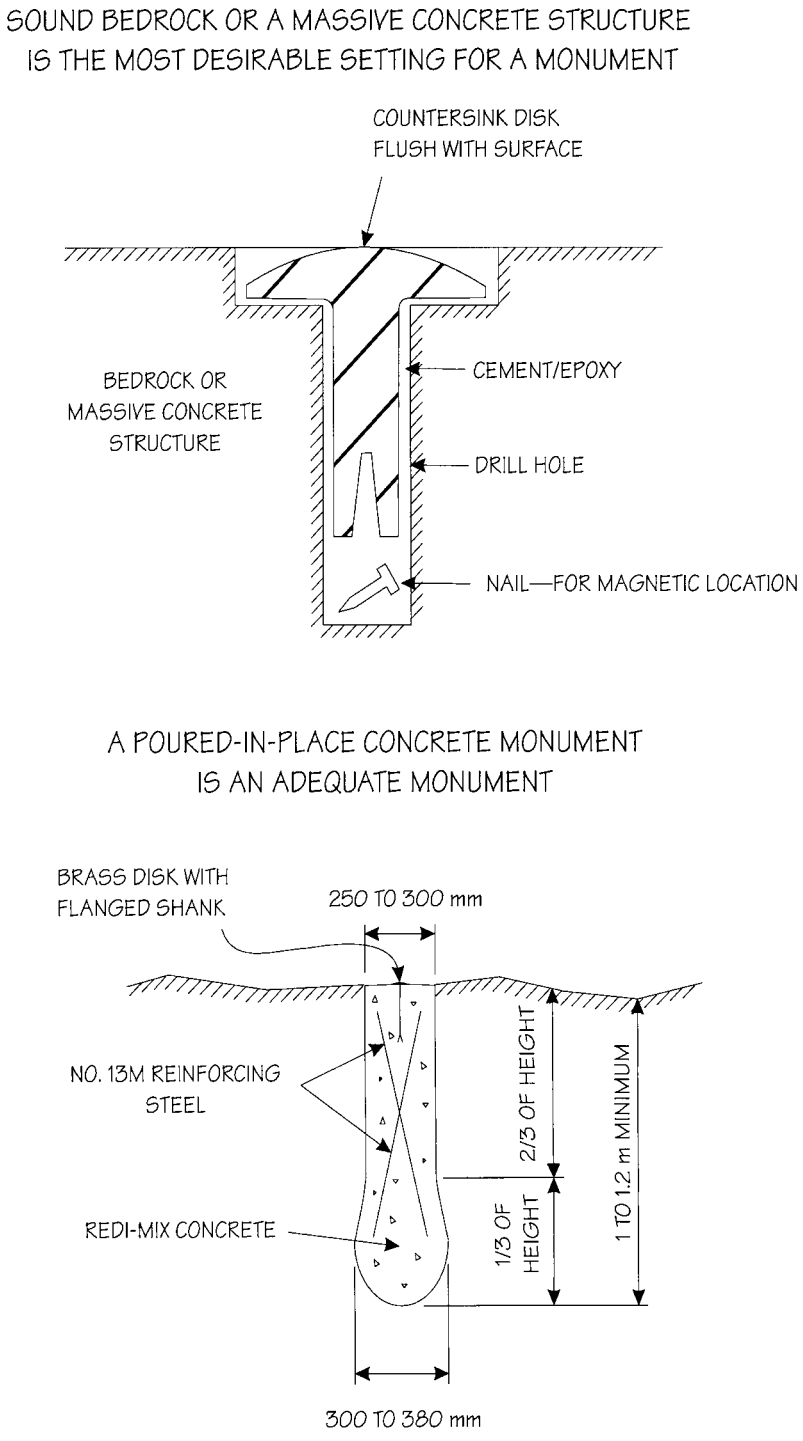
TR Code and Pack Time

If the pack time required to reach a station is less than 30 minutes by car, type "C" in the **TR Code** field and the pack time in the **Pack Time** field. Add a special note to the first paragraph of the descriptive text portion if the station can be directly accessed with a four-wheel drive vehicle.

If you must use a four-wheel drive vehicle to access the station directly and the pack time is more than 30 minutes if using a car, type "×" in the **TR Code** and "00:00" in the **Pack Time** field. Add a

Figure 4-1

Acceptable Monumentation



special note to the first paragraph of the descriptive text portion to indicate the pack time if a four-wheel drive vehicle is not used. A good guideline for pack time under normal conditions is two minutes per 0.1 kilometer.

If the distance from the end of vehicle travel is greater than 100 meters, type a minimum pack time of “00:01” to indicate that GPS observations cannot be directly made from the vehicle.

Agency Inscription

Take care to accurately report the agency inscription shown on the survey mark. In some cases, the inscription is the only factor that differentiates one mark from another.

Figure 4-2 is a list of agencies and inscriptions frequently found in Vermont. There is a complete list in Annex C of the NGS Blue Book.

If there is no agency inscription, report “UNK,” for “unknown.”

Stamping

Enter only that information on the mark that has been stamped by the surveyor. Don’t include information that has been cast into the mark. If the mark has no stamping, leave the **Stamping** field blank and add a special note to the fourth paragraph of the descriptive text indicating that the mark is unstamped.

Descriptive Text Format

Divide the information in the descriptive text portion into five distinct paragraphs:

- *Paragraph 1.* General location.
- *Paragraph 2.* Ownership.
- *Paragraph 3.* To reach.
- *Paragraph 4.* Special setting conditions.
- *Paragraph 5.* Ties.

First Paragraph—General Location

The “general location” is the town in which the station is located. In addition, include three airline distances and directions from major towns or cities, if the station is located in a remote area or a small town that is not easily identified on a state highway map. If the station is located within the boundaries of a town or city that is easily located on a state highway map, include one airline distance from the center of town. If three airline distances are used, locate the station from three different directions to create a good intersection.

Second Paragraph—Ownership

Show the ownership of the property on which the station is located, unless the station is within the highway right-of-way. Include the owner’s name (person, company, or agency), contact person, and phone number of the contact person. Get this information when consent is given to set the mark.

Figure 4-2

Common Agency Inscriptions

Agency	Inscription
National Geodetic Survey	NGS
US Coast and State Survey	CGS
United States Geological Survey	USGS
US Coast and State Survey	CGS AND STATE
US Forest Service	USFS
US Army Map Service	AMS
Defense Map Agency	DMA
Vermont Forest Service	VFS
Vermont Agency of Transportation	VTAT
Vermont Geodetic Survey	VTGS
Vermont Highway Department	VTDH
US Lake Survey	USLS
US Supreme Court	USSC
VT-NH Boundary Commission	VTNHBC
National Ocean Service	NOS
NH Department of Public Works and Highways	NHDPWH
NH Highway Department	NHHD
US Army Corps of Engineers	USE
Massachusetts Geodetic Survey	MAGS
Massachusetts Department of Public Works	MADPW
New York State Survey	NYSS
New York Geodetic Survey	NYGS
New York Department of Transportation	NYDT
New York Department of Highways	NYDH
Geodetic Survey of Canada	GSC
International Boundary Commission	IBC

Add “special notes concerning the station’s use,” if applicable. Include any information that dictates a special procedure or condition under which the mark is to be accessed or used. Examples are that a station cannot be accessed by vehicle during mud season or that the property owner must be notified prior to using the mark.

Third Paragraph—To Reach

Use “to reach” for describing how to find the station from a well-known or easily located landmark. In general, describe the station from a major highway intersection that is easily located on a highway map. If the station is located at a landmark, such as a major highway intersection or a municipal building that is easily located, describe the station as being located at the landmark.

A “to reach” description from two directions may be helpful for stations that commonly would be accessed from either direction. For example, a station located on U.S. Route 2 between Montpelier and East Montpelier would be described from the intersection of Routes 2 and 302 in Montpelier and from the most westerly intersection of Routes 2 and 14 in East Montpelier.

Fourth Paragraph—Special Setting Conditions

Use “special setting conditions” only if the information in the descriptive code fields is not adequate to describe the mark type, setting code, or setting conditions. For example, the mark may be set vertically or set below ground.

Fifth Paragraph—Ties

Use “ties” for all stations, including marks set on bridges. Try to include at least three good ties, as well as a highway centerline tie. For the centerline tie, try to include a distance and direction from the centerline, as well as a reference to the elevation difference between the centerline and the station. For example, a centerline tie might read, “17.5 m north of and 2 m higher than the centerline of U.S. Route 7.”

You can use more than three ties if they are necessary to locate the station under different conditions or if the station is in a remote location and no “good” ties are available. Examples are very old telephone poles that may be replaced soon or drop inlets that are covered in winter.

Take care to make ties properly. Make a tie from the tie object to the station, with a distance and a general compass direction (north, northeast, north-northeast, etc.). Spell out compass directions—don’t abbreviate. Tie all new stations to witness posts unless it wasn’t possible to set a witness post.

Figure 4-3

DDPROC Output—Example 1

```
--------------------------------------------------------------------------------

           ******* O R I G I N A L      D E S C R I P T I O N *******

              SSN: 0001
      Designation: EXAMPLE 1
              PID:
 Approx. Latitude: 444035N                          State: VT
Approx. Longitude: 0713537W                        County: ESSEX
Approx. Elevation: 268M                       Disk From: VTGS
         Stamping: EXAMPLE 1 1994

     Surface Mark-
             Type: Survey disk
    Magnetic code: T
          Setting: SET IN A DRILL HOLE IN BEDROCK
        Rod depth:                          Sleeve Depth:

****Mark is suitable for GPS

Set by VTAT in 1994, Chief of party DJM.

--------------------------------------------------------------------------------
GENERAL LOCATION - MAIDSTONE, 2.3 MI (3.7 KM) NORTH OF MAIDSTONE VILLAGE, 5.0
MI (8.0 KM) NORTHWEST OF GROVETON NEW HAMPSHIRE, AND 25.5 MI (41.0 KM)
NORTHEAST OF ST. JOHNSBURY.

OWNERSHIP - MAINE CENTRAL RAILROAD.  CONTACT JOHN DOE, CHIEF ENGINEER, (123)
456-7890.  ***ADVANCED PERMISSION MUST BE ATTAINED PRIOR TO USING THIS MARK***
***THIS STATION CAN BE REACHED DIRECTLY WITH A FOUR WHEEL DRIVE***

TO REACH FROM THE INTERSECTION OF VT ROUTES 105 AND 102 IN BLOOMFIELD GO SOUTH
ALONG VT ROUTE 102 FOR 8.1 MI (13.0 KM) TO A GRAVEL ROAD RIGHT.  TURN RIGHT
AND GO WEST ALONG GRAVEL ROAD FOR 0.6 MI (1.0 KM) TO ITS INTERSECTION WITH THE
MAINE CENTRAL RAILROAD AND END OF CAR TRAVEL.  TURN LEFT AND PACK SOUTH ALONG
THE MAINE CENTRAL RAILROAD FOR 0.5 MI (0.8 KM) TO A LEDGE CUT ON THE RIGHT AND
THE STATION SET NEAR THE SOUTH END.

THE STATION IS LOCATED 7.8 M (25.6 FT) WEST OF AND 1.2 M (3.9 FT) HIGHER THAN
THE CENTERLINE OF THE MAINE CENTRAL RAILROAD, 2.0 M (6.6 FT) EAST OF A
NORTH-SOUTH RIGHT OF WAY FENCE, AND 0.9 M (3.0 FT) NORTH OF THE SOUTH END OF
LEDGE CUT.
```

Figure 4-4

DDPROC Output—Example 2

```
--------------------------------------------------------------------------------

           ******* O R I G I N A L      D E S C R I P T I O N *******

              SSN: 0002
      Designation: EXAMPLE 2
              PID:
 Approx. Latitude: 444040N                          State: VT
Approx. Longitude: 0713540W                        County: WASHINGTON
Approx. Elevation: 268M                        Disk From: VTGS
         Stamping: EXAMPLE 2 1994

     Surface Mark-
             Type: Survey disk
    Magnetic code: N
          Setting: PIER
        Rod depth:                          Sleeve Depth:

****Mark is not suitable for GPS

Set by VTAT in 1994, Chief of party DJM.

--------------------------------------------------------------------------------
GENERAL LOCATION - MONTPELIER, 1.2 MI (1.9 KM) NORTHWEST OF THE CITY.

TO REACH - LOCATED AT THE NORTH-BOUND I89 OVERPASS OVER U.S. RTE 2.

THE STATION IS SET VERTICALLY IN THE EAST FACE OF THE MOST WESTERLY CONCRETE
PIER.

THE STATION IS LOCATED 9.8 M (32.2 FT) WEST OF AND ABOUT LEVEL WITH THE
CENTERLINE OF U.S. RTE 2, 1.8 M (5.9 FT) SOUTH OF THE NORTH END OF THE PIER,
1.1 M (3.6 FT) ABOVE GROUND LEVEL, AND 0.3 M (1.0 FT) NORTH OF A FIBERGLASS
WITNESS POST.
```

Figure 4-5

DDPROC Output—Example 3

```
--------------------------------------------------------------------------------

           ******* O R I G I N A L      D E S C R I P T I O N *******

              SSN: 0003
      Designation: EXAMPLE 3
              PID:
 Approx. Latitude: 444040N                          State: VT
Approx. Longitude: 0713540W                        County: ORANGE
Approx. Elevation: 268M                        Disk From: VTGS
         Stamping: EXAMPLE 3 1994

     Surface Mark-
             Type: Survey disk
    Magnetic code: T
          Setting: IN A BOULDER
        Rod depth:                          Sleeve Depth:

****Mark is suitable for GPS

Set by VTAT in 1994, Chief of party DJM.

--------------------------------------------------------------------------------
GENERAL LOCATION - WILLIAMSTOWN, 2 MI (3.2 KM) SOUTH OF VILLAGE.

OWNERSHIP - LOTUS LAKE CORPORATION, CONTACT PALMER MARTIN FOR KEY TO GATE (802)
433-5869 ***IF A FOUR WHEEL DRIVE VEHICLE IS NOT USED, PACK TIME IS 35
MINUTES.*** ***STATION MUST BE PACKED TO IN WINTER AS WINCHESTER HILL ROAD IS
NOT PLOWED***

TO REACH FROM THE INTERSECTION OF VT ROUTE 14 AND VT ROUTE 64 (INTERSTATE
ACCESS ROAD) IN WILLIAMSTOWN GO SOUTH ALONG VT ROUTE 14 FOR 2.3 MI (3.7 KM) TO
WINCHESTER HILL ROAD RIGHT.  TURN RIGHT AND GO EAST ALONG WINCHESTER HILL ROAD
FOR 1.1 MI (1.8 KM) TO A GATED WOODS ROAD LEFT.  TURN LEFT, PASS THROUGH GATE
AND GO NORTH ALONG WOODS ROAD FOR 0.6 MI (1.0 KM) TO AN OLD PASTURE AND THE
STATION SET IN THE WEST END.

THE STATION IS LOCATED 37.5 M (123.0 FT) NORTH OF A FENCE CORNER, 16.3 M
(53.5 FT) EAST-NORTHEAST OF A SMALL STREAM, 21.9 M (71.9 FT) WEST OF A 25 CM
MAPLE, AND 0.3 M (1.0 FT) SOUTH OF A FIBERGLASS WITNESS POST.
```

Figure 4-6

DDPROC Output—Example 4

```
--------------------------------------------------------------------------------

           ******* O R I G I N A L      D E S C R I P T I O N *******

              SSN: 0004
      Designation: EXAMPLE 4
              PID:
 Approx. Latitude: 422515N                          State: VT
Approx. Longitude: 0732415W                        County: LAMOILLE
Approx. Elevation: 152M                       Disk From: VTGS
         Stamping: EXAMPLE 4 1994

     Surface Mark-
             Type: Survey disk
    Magnetic code: T
          Setting: SET IN A DRILL HOLE IN BEDROCK
        Rod depth:                          Sleeve Depth:

****Mark is suitable for GPS

Set by VTAT in 1994, Chief of party DJM.

--------------------------------------------------------------------------------
GENERAL LOCATION, WATERBURY 7 MI (11.3 KM) NORTH OF VILLAGE.

OWNERSHIP - U.S. FOREST SERVICE, CONTACT I.S. FORESTER (802) 123-4567.

TO REACH FROM THE JUNCTION OF U.S. ROUTE 2 AND VT ROUTE 100 IN WATERBURY GO
NORTH ALONG VT ROUTE 100 FOR 7.2 MI (11.6 KM) TO JONES ROAD RIGHT.  TURN RIGHT
AND GO EAST ALONG JONES ROAD FOR 0.5 MI (0.8 KM) TO A LARGE ROCK OUTCROP ON
THE SOUTH SIDE OF JONES ROAD AND THE SITE OF THE MARK IN THE WEST END OF THE
OUTCROP.  THE STATION CAN ALSO BE REACHED ...FROM THE JUNCTION OF VT ROUTES
100 AND 108 IN STOWE GO SOUTH ALONG VT ROUTE 100 FOR 8.2 MI (13.2 KM) TO JONES
ROAD LEFT.

THE STATION IS LOCATED 9.9 M (32.5 FT) NORTH OF AND 2.4 M (7.9 FT) HIGHER THAN
THE CENTERLINE OF JONES ROAD, 37.5 M (123.0 FT) SOUTH OF POLE NO 1, 5.3 M
(17.4 FT) NORTH-NORTHEAST OF A 50 CM MAPLE, AND 0.4 M (1.3 FT) SOUTH OF A
FIBERGLASS WITNESS POST.
```

Chapter Five
Geodetic Information

OVERVIEW

One of the functions of the Geodetic Survey Unit is to manage, store, and retrieve geodetic information. In this context, geodetic information refers to the coordinates and descriptions of control monuments and related support information. Support information refers to the documentation, technical reports, and software necessary to work with geodetic information.

GEODETIC INFORMATION MANAGEMENT

Introduction

The Interactive Geodetic Information Management System facilitates the storage, management, and retrieval of geodetic control point information. The two major components are the Access database and the Arcview GIS. Access is used to compile, organize, and format geodetic information. Arcview is used to view and retrieve geodetic information.

Updating Information

Agency Data

Coordinate and description information that is collected from Agency projects (including preliminary information for projects submitted to NGS) is added to the Interactive Geodetic Information Management System after project finalization. See the following figures for the procedures:

- Leveling projects—Figure 5-1
- Horizontal projects—Figure 5-2
- Route survey projects—Figure 5-3

Figure 5-1

Adding Information to the Interactive Geodetic Information Management System

Leveling Projects

Procedures are being developed.

Figure 5-2

Adding Information to the Interactive Geodetic Information Management System
Horizontal Projects

1. Create .SPC and .GEO files from GPSurvey.
2. Import .SPC and .GEO files into Access database.
3. Add **pid**, **horz code**, **vert code**, and **fips** information to .SPC table.

   (See BB2DS documentation for explanation of these fields before proceeding.)
4. Add town to .GEO table
5. Run a table query to combine the .GEO and .SPC tables into a new table.
6. Export the new table in a dBase III format to the appropriate Arcview directory.
7. Export the new table as a fixed-width text file (.POS) to a project working directory.
8. Copy the .HA file to the project working directory and run **Readfile** to create a .LST file.
9. Add **pid**'s to .LST file.
10. Run BB2DS to create a .DAT file.
11. Copy the .DAT file to the DSData directory.
12. In Arcview

    a. Create the **Event Theme** from the new dBase III table.

    b. Modify the Arcview script to include the new theme and .DAT file.

Figure 5-3

Adding Information to the Interactive Geodetic Information Management System Route Survey Projects

1. Add **pid**, **horz code**, **vert code**, and **fips** information to .SPC table
2. Add town to .GEO table
3. Run the IGY query to create the IGY table.
4. Export the IGY table in dBase III format to the appropriate Arcview directory.
5. Export the IGY table as a fixed-width text file (.POS) to a project working directory.
6. Make a copy of the .POS file named BB2DS.POS.
7. Run **Readfile** on project .HA file to create project .LST file
8. Use Megaedit to join VT98000.LST and the project .LST
9. Add **pid**'s to .LST file.
10. Run BB2DS to create VT98000.DAT
11. Copy VT98000.DAT to the DSData directory.

NGS Data

As new control point information becomes available, it is added to Arcview. This is typically done once a year. The NGS program DSX is used to extract the necessary control point information. The information is imported into Access, where it is organized and combined with additional information, such as the **fips** code. The information is exported in dBase III format to Arcview. The description information is then loaded to the Arcview working directory.

Retrieving Information

Coordinate and description data for both AOT and NGS are retrieved through Arcview by town graphically or by a database query for a particular mark. Figures 5-4 and 5-5 are examples of the output.

CONTINUOUSLY OPERATING REFERENCE STATION

Introduction

The Geodetic Survey Unit maintains a continuously operating GPS reference station (CORS) at 133 State Street in Montpelier. The data collected is available to the public via an electronic bulletin board and also via FTP (file transfer protocol) through the Internet. GPS users download data and typically use it to "correct" the GPS data that they have collected in the field in order to generate more accurate coordinates.

In June 1996 the CORS was included in the federal CORS Network. It is officially designated "Vermont Capital CORS" or "VCAP."

Configuration

VCAP consists of a Trimble 4000SSE dual frequency receiver tracking at a 5-second epoch interval, with an elevation mask of 7 degrees. The data is logged in hourly files and is available in DAT, SSF, RINEX, and RAW formats. At the end of each hour, a file rollover occurs that formats, names, compresses, and stores the files in the appropriate file area. All data files are stored in a compressed format with the .ZIP extension.

File Naming

A file is named according to the date and time it was opened. The date and time is in Universal Coordinated Time (UTC). UTC = Eastern Daylight Savings Time (EDT) + 4 hours or Eastern Standard Time (EST) + 5 hours. For example, a file containing data for 12:00 PM to 1:00 PM EDT on May 10, 1996, would be named 96051016.ZIP (12 EDT + 4 hours = 16 UTC).

Data Storage

Data files are normally available on line for at least 30 days, after which they are deleted. *Data is not archived prior to deletion and is therefore unrecoverable.* Users are encouraged to download data as soon as practicable.

Figure 5-4

Arcview Output—Example 1

```
1        National Geodetic Survey,   Retrieval Date = JANUARY 22, 1996
 WA0066 ***********************************************************************
 WA0066  DESIGNATION -  LLC
 WA0066  VT PID      -  WA0066
 WA0066  STATE/COUNTY-  VTORANGE
 WA0066
 WA0066  HORZ DATUM  -  NAD 83(1992)
 WA0066  VERT DATUM  -  NAVD 88
 WA0066
 WA0066  POSITION    -  44 05 35.63495 (N)     072 32 55.06580 (W)
 WA0066  SPC VT (m)  -  177000.541 (N)         496105.873 (E)
 WA0066  E HEIGHT    -  250.829 (meters)
 WA0066  O HEIGHT    -  278.66 (meters)
 WA0066 ***********************************************************************
 WA0066
 WA0066  HISTORY     -  Year Condition            Recov. By / Chief
 WA0066  HISTORY     -  1992 STATION MONUMENTED   VTAT   /    DJM
 WA0066  HISTORY     -  1996 G                    VTAT   /    DJM
 WA0066 ***********************************************************************
 WA0066
 WA0066  TRANSP CODE  -  C     PACK TIME -  0000
 WA0066
 WA0066 ***********************************************************************
 WA0066
 WA0066  The horizontal coordinates were established by GPS observatons and
 WA0066  adjusted by the Vermont Geodetic Survey.
 WA0066  The orthometric height was established by GPS observations.
 WA0066
 WA0066
 WA0066  STATION MARK IS A SURVEY DISK
 WA0066  WITH SETTING: SET IN TOP OF CONCRETE MONUMENT (ROUND)
 WA0066  DISK FROM: VTAT
 WA0066  THE MARK IS STAMPED: LLC 1992
 WA0066  SATELLITE: THE SITE IS SUITABLE FOR GPS OBSERBVATIONS
 WA0066
 WA0066, GENERAL LOCATION - THE STATION IS LOCATED IN THE TOWN OF WILLIAMSTOWN,
 WA0066, 2.0 MI (3.2 KM) SOUTH OF WILLIAMSTOWN VILLAGE, 4.5 MI (7.2 KM) NORTH
 WA0066, NORTHEAST OF EAST BROOKFIELD, AND 6.5 MI (10.5 KM) WEST OF
 WA0066, WASHINGTON.  TO REACH FROM THE INTERSECTION OF VERMONT ROUTE 14 AND
 WA0066, VERMONT ROUTE 64 IN WILLIAMSTOWN, PROCEED SOUTH ALONG ROUTE 14 FOR
 WA0066, 2.15 MI (3.46 KM) TO A PRIVATE GRAVEL DRIVE EAST, THENCE EAST ALONG
 WA0066, PRIVATE DRIVE AND THROUGH GATE FOR 0.125 MI (0.201 KM) TO LOTUS LAKE
 WA0066, CAMP AND THE MARK ON THE NORTH SIDE OF THE PARKING AREA.  THE MARK IS
 WA0066, A STATE OF VERMONT SURVEY DISK SET IN THE TOP OF A CONCRETE MONUMENT
 WA0066, 30 CM IN DIAMETER, FLUSH WITH THE GROUND SURFACE.  IT IS LOCATED 113
 WA0066, FT (34.4 M) NORTH NORTHWEST OF MOST NORTHWESTERLY OF (5) 6X6 SUPPORT
 WA0066, COLUMNS FOR ROOF SUPPORT, 96 FT (29.3 M) NORTHEAST OF A 12 INCH
 WA0066, MAPLE, 63 FT (19.2 M) NORTH NORTHEAST OF THE GRAVEL DRIVE CENTERLINE,
 WA0066, AND 50.5 FT (15.4 M) EAST SOUTHEAST OF A 12 INCH PINE.  ****NOTE****
 WA0066, IN THE WINTER - MUST PACK FROM GATE - 3 TO 5 MINUTES.  CONTACT -
 WA0066, PALMER MARTIN, (802) 433-5869 OR HELEN MARTIN, (802) 433-5451.
 WA0066, OWNERSHIP IS LOTUS LAKE CORPORATION.
```

Figure 5-5

Arcview Output—Example 2

```
1        National Geodetic Survey,   Retrieval Date = JANUARY 22, 1996
 OD1255 ***********************************************************************
 OD1255  DESIGNATION -  W 62
 OD1255  PID         -  OD1255
 OD1255  STATE/COUNTY-  VT/RUTLAND
 OD1255  USGS QUAD   -  RUTLAND (1988)
 OD1255
 OD1255  HORZ DATUM  -  NAD 83 (1992)
 OD1255  VERT DATUM  -  NAVD 88
 OD1255
 OD1255  POSITION    -  43 35 08.55688(N)    072 58 03.97753(W)     ADJUSTED
 OD1255
 OD1255
 OD1255  HEIGHT      -       176.240  (meters)     578.21   (feet)  ADJUSTED
 OD1255  88 minus 29 -        -0.137  (+/- 2 cm)                    VERTCON
 OD1255  DY minus 88 -        -0.034                                 COMPUTED
 OD1255. (NOTE - For assistance in applying shifts see file readme.dat)
 OD1255 ***********************************************************************
 OD1255
 OD1255  LAPLACE CORR-          14.21                                DEFLEC93
 OD1255  GEOID HEIGHT-         -28.47                                GEOID93
 OD1255  ELLIP HEIGHT-         148.169
 OD1255  X           -   1,355,421.329
 OD1255  Y           -  -4,424,480.691
 OD1255  Z           -   4,374,966.530
 OD1255  MODELED GRAV-     980,423.6                                 NAVD88
 OD1255
 OD1255
 OD1255  HORZ ORDER  -  FIRST
 OD1255  VERT ORDER  -  FIRST     CLASS 2
 OD1255  ELLP ORDER  -  FOURTH    CLASS 1
 OD1255
 OD1255
 OD1255.The horizontal coordinates were established by GPS observations
 OD1255.and adjusted by the National Geodetic Survey in June 1995.
 OD1255
 OD1255.The orthometric height was determined by differential leveling
 OD1255.and adjusted by the National Geodetic Survey in June 1991.
 OD1255
 OD1255.The dynamic height is computed by dividing the NAVD 88
 OD1255.geopotential number by the normal gravity value computed on the
 OD1255.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 OD1255.degrees latitude (G = 980.6199 gals.).
 OD1255
 OD1255.The Laplace correction was computed from DEFLEC93 derived deflections.
 OD1255
 OD1255.The geoid height was determined by GEOID93.
 OD1255
 OD1255.The ellipsoidal height was determined by GPS observations
 OD1255.and referenced to NAD 83.
 OD1255
 OD1255.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 OD1255
 OD1255.The modeled gravity was interpolated from observed gravity values.
 OD1255
 OD1255;                    North         East        Scale          Converg.
 OD1255;SPC VT      -    120,717.442   462,223.078 0.99998183     -0 19 21.0  MT
 OD1255;UTM  18     -  4,827,866.681   664,063.309 0.99993109     +1 24 05.1  MT
 OD1255
 OD1255_STATION MARK IS A METAL ROD
 OD1255_WITH SETTING: STAINLESS STEEL ROD W/O SLEEVE (10 FT.+)
 OD1255_THE MARK IS STAMPED: W 62 1980
 OD1255_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
 OD1255_SATELLITE: THE SITE LOCATION WAS REPORTED AS NOT SUITABLE FOR
 OD1255+SATELLITE: SATELLITE OBSERVATIONS - July 07, 1994
 OD1255_ROD/PIPE-DEPTH: 7.3  meters
 OD1255
 OD1255  HISTORY     - Year Condition            Recov. By
 OD1255  HISTORY     - 1980 STATION MONUMENTED   NATIONAL GEODETIC SURVEY
 OD1255  HISTORY     - 1992 GOOD                 VT AGENCY OF TRANSP
```

Figure 5-5 (continued)

Arcview Output—Example 2

```
OD1255  HISTORY      - 1994 GOOD                 VT AGENCY OF TRANSP
OD1255  HISTORY      - 1994 GOOD                 VT AGENCY OF TRANSP
OD1255
OD1255                           STATION DESCRIPTION
OD1255
OD1255'DESCRIBED BY NATIONAL GEODETIC SURVEY 1980
OD1255'1.4 KM (0.9 MI) SOUTH FROM RUTLAND.
OD1255'1.4 KILOMETERS (0.9 MILE) SOUTH ALONG US HIGHWAY 7 FROM THE JUNCTION
OD1255'OF BUSINESS US HIGHWAY 4 IN RUTLAND, AT THE NORTHEAST CORNER OF THE
OD1255'JUNCTION OF SEWARD ROAD, NEAR THE FLAG POLE OF THE HOWARD BANK, 26.2
OD1255'METERS (89 FEET) NORTH OF THE CENTER OF SEWARD ROAD, 18.75 METERS
OD1255'(61.5 FEET) EAST OF THE EAST CURB OF US HIGHWAY 7, 12.65 METERS (41.5
OD1255'FEET) WEST-NORTHWEST OF THE SOUTHWEST CORNER OF THE BANK, 0.43 METER
OD1255'(1.4 FEET) WEST OF THE FLAG POLE.
OD1255
OD1255                           STATION RECOVERY (1992)
OD1255
OD1255'RECOVERY NOTE BY VERMONT AGENCY OF TRANSPORTATION 1992
OD1255'RECOVERED IN GOOD CONDITION.
OD1255
OD1255                           STATION RECOVERY (1994)
OD1255
OD1255'RECOVERY NOTE BY VERMONT AGENCY OF TRANSPORTATION 1994 (MC)
OD1255'RECOVERED AS DESCRIBED, EXCEPT BANK IS NOW NAMED CHITTENDEN AND FLAG
OD1255'POLE IS GONE.
OD1255
OD1255                           STATION RECOVERY (1994)
OD1255
OD1255'RECOVERY NOTE BY VERMONT AGENCY OF TRANSPORTATION 1994 (CHR)
OD1255'GENERAL LOCATION, RUTLAND. OWNERSHIP, BARBARA HOOD, CONTACT JIM
OD1255'PELL,FRANK PUNDERSON AGENCY, 19 WEST STREET, RUTLAND, VT. 05701. PHONE
OD1255'802-775-2552. TO REACH FROM THE INTERSECTION OF U.S. ROUTE 7 AND U.S.
OD1255'ROUTE 4 EAST (WOODSTOCK AVENUE) IN RUTLAND GO SOUTH ALONG U.S. ROUTE 7
OD1255'FOR 1.7 MI (2.7 KM) TO THE INTERSECTION OF SEWARD ROAD LEFT AND MARK
OD1255'IN THE NORTHEAST QUADRANT OF THE INTERSECTION NEAR THE FLAGPOLE OF THE
OD1255'CHITTENDEN BANK, 26.2 M (86.0 FT) NORTH OF THE CENTERLINE OF SEWARD
OD1255'ROAD, 18.75 M (61.52 FT) EAST OF THE EAST CURB OF U.S. ROUTE 7, 12.65
OD1255'M (41.50 FT) WEST-NORTHWEST OF THE SOUTHWEST CORNER OF THE BANK, 8.1 M
OD1255'(26.6 FT) NORTHEAST OF THE FLAG POLE.
```

Positional Information

Latitude: 44-15-43.10497 N

Longitude: 72-34-56.55651 W

Height above ellipsoid: 160.654 m

Elevation: 188.28 m

The latitude, longitude, and height above ellipsoid are expressed in terms of NAD83(92). The elevation (orthometric height) is expressed in terms of NAVD88.

The latitude, longitude, and height above ellipsoid were determined by a high accuracy GPS survey in 1994 that connected VCAP to surrounding High Accuracy Reference Network (HARN) stations.

The orthometric height was determined by trigonometric leveling in 1994.

Maintenance

On the 1st and 15th of every month, run program **Delfiles** to delete the oldest 15 days' data. For example, on October 15, 1996, the following command would be executed in each file area: **Delfiles** 96091423.ZIP. This would delete all files in that directory prior to and including 96091423. Running this program also removes the filename from FILES.BBS.

The Geodetic Survey Unit upgrades software and performs additional maintenance as needed.

External Access

The Geodetic Survey Unit monitors messages on the bulletin board and responds to any requests for personal log-ons. The bulletin board telephone number is 802-828-3785. If the request does not contain all the necessary information, contact the requestor by phone to get the needed information.

GPS correction files can also be downloaded via FTP over the Internet. Personal accounts are not necessary at this time. The FTP address is vcap.aot.state.vt.us. All users can log on as "anonymous," with no password. The only exception to this is a special FTP account that has been set up for NGS. NGS downloads data every hour and includes it with other federal CORS data on its web site at www.ngs.noaa.gov.

VERMONT CALIBRATION BASE LINES

In 1994 the Geodetic Survey Unit worked cooperatively with the NGS to establish five calibration base lines in Vermont. The base lines are located in South Hero, Berlin, Lyndonville, Springfield, and North Dorset and are used to calibrate electronic distance measuring instruments. The Geodetic Survey Unit maintains the base lines.

Refer to the publication, "Vermont Calibration Base Lines," for details on instrument calibration and base-line location. The publication is available through the Geodetic Survey Unit.

TECHNICAL INFORMATION

The Geodetic Survey Unit keeps on hand pertinent technical information relative to topics such as geodesy, coordinate systems, survey procedures, and survey equipment. Geodetic Survey Unit personnel and the NGS Advisor respond to requests for technical information from both the private sector and state organizations.