

## Appendix

# Survey SOP and Supporting Annexes

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The survey SOP is intended as a guide and source of information that may be the difference between an exemplary survey project and a very intensive learning experience for a survey crew. Not all eventualities have been addressed in the SOP and the annexes, nor can one SOP and set of annexes cover the diverse survey projects encountered worldwide. The intent of the SOP is to keep surveyors (and their supervisors) out of trouble survey-wise.

The following is an SOP designed for survey operations, which includes the following annexes:

<b>Annex A.</b> Initial Site Visitation Trip Report Format . . . . .	Appendix-11
<b>Annex B.</b> Technical Operations Order Format . . . . .	Appendix-15
<b>Annex C.</b> Fragmentary Order Format . . . . .	Appendix-16
<b>Annex D.</b> Percentage of Completion Guide . . . . .	Appendix-17
<b>Annex E.</b> End-of-Project Report Format . . . . .	Appendix-19

The SOP and the annexes are important for two reasons:

- 1 The formats area guide to ensure uniformity and completeness of survey orders and reports.
- 2 The examples of the orders and reports are from actual survey projects. A thorough reading of the annexes for content will provide insight into various types of surveys, the extent and depth of planning needed for surveys, and a means of learning from previous surveys.

(SOP Survey)

DEPARTMENT OF THE ARMY  
Engineer Company/Platoon/Squad/Detachment  
Engineer Battalion (Topo) (Army)

SUBJECT: Unit Survey Operations SOP

**1. INTRODUCTION:**

a. This SOP has been designed to clarify and expedite mission accomplishment, specifically survey projects, on time and meeting specifications at minimum cost.

b. The tasks identified herein must be accomplished. The format of this SOP is a flowchart with an explanation of activities, formats of reports, and information flow of reports. The SOP will be used as a check-list and management control document for all levels of operation: squad, platoon, and company.

**2. PROJECT REQUEST AND S3 TASKING:** No project will be undertaken unless directed by the Engineer Battalion Operations Officer. All projects must go through S3, regardless of the source of the request (Defense Mapping Agency, FORSCOM, Major Commands, Installation/Community Staff Elements, or Allied Nations).

**3. OPERATIONS SECTION PROJECT EVALUATION:** The company operations section must evaluate the project directive and advise the company commander in the following areas:

a. Resources — What are the required manpower and equipment available to complete the project as specified?

b. Appropriateness – Does the project require skills which emphasize military occupational specialty (MOS) skills required of 82D surveyors? Does the company currently have the expertise required by the project?

c. Scheduling – What is the project priority and duration? How will the current work schedule be affected? How will annual training requirements be affected? Can the work be done in any season?

d. Final Product – What does the customer really want and need? What does the company have to produce?

e. Funding – How will the project be funded? How much money is available and what may it be used to purchase (billeting, rations, marketing, materials, POL, repair parts, equipment rental).

**4. RESEARCH AND COORDINATION:** The operations will conduct an "Office Reconnaissance" for the project, including –

a. Customer contact to determine exact project requirements and the form of the final product.

b. Research for reference data, to include trigonometric station lists, maps, aerial photography, and climate data. Sources for data may be the Defense Mapping Agency, Corps of Engineers, US Geological Survey, National Geodetic Survey, National Oceanic and Atmospheric Administration, Engineer Topographic Laboratory, and the customer. Additional sources are state, county, and municipal records. When working in another nation, request information from the host nation.

**5. WARNING ORDER:** The company operations section will issue a warning order to the appropriate platoon based on project priority requirements, existing projects, available resources and training requirements. The warning order will identify project requirements and time of execution. The warning order will direct a reconnaissance mission and ISVT report in the format at Annex A. Upon receipt of the warning order, the platoon will begin reporting the project status weekly to company operations.

**6. PLATOON HEADQUARTERS ASSIGNS SQUAD:** Platoon headquarters will select a squad and/or personnel for the project based on availability, equipment, experience, familiarity with project area, and training time available.

**7. ON-SITE RECONNAISSANCE:** The platoon is responsible for their initial on-site reconnaissance, A squad representative will assist with the reconnaissance. An ISVT report in the format of Annex A will be rendered through the platoon leader to the company commander with an information copy provided to the Commander, Engineer Battalion (topographic), ATTN: S3. The report is normally due five working days after the completion of the reconnaissance, and will be prepared by the squad assigned and turned in to the platoon headquarters. The company commander will advise the battalion commander on the appropriateness of the project.

**NOTE:** If no further site reconnaissance occurs between the initial on-site reconnaissance and the arrival of the advance party, the most likely squad leader is a MUST to be with this reconnaissance. If this reconnaissance is for support, it must be firm and documented. If this reconnaissance is only to determine acceptance of the project, another reconnaissance WILL BE required to determine the survey plan and confirm the support.

**8. OPERATIONS ORDER:** The operations section will prepare and issue an operation order (OPORD) in standard military five-paragraph format of Annex B. The OPORD will direct the platoon to perform the survey mission. Company operations will issue all maps, trig lists, and overlays at this time if not previously issued to the platoon.

**9. FRAGMENTARY ORDER:** Platoon headquarters will issue a fragmentary order (FRAGO) to the assigned squad, instructing them to perform the survey mission. The FRAGO will contain all information required by the squad leader to complete the project. This format is at Annex C.

**10. RESEARCH, COORDINATION, RECONNAISSANCE:** The squad leader is responsible for detailed examination of applicable trig lists, past project reports in the area, maps, deeds, and any other pertinent source data. Platoon headquarters and the survey information center may be tasked to assist in assembling information. Using this information and any on-site reconnaissance information, the squad leader will design the project. Weekly progress reports will be submitted through platoon headquarters to company operations from this point until project completion. The format for this report is at Annex D. The squad leader will choose the method he will use to meet project specifications and time requirements and prepare a written survey plan, to include drawings/overlays of survey schemes as information permits. This plan should reflect the squad leader's best estimate of survey design, based on the information he has. If no comprehensive survey reconnaissance has been accomplished, the survey plan will not be final. The final plan will be designed on site as part of the advance party's tasking. Any changes from the original plan will be submitted to the platoon headquarters telephonically, and in writing if so instructed. The project plan will be written in the format of the project briefing.

**11. CREW AND EQUIPMENT PREPARATION:** The squad leader selects personnel based on job requirements, experience, expertise, training requirements, and equipment. The crew begins to train in specific skills needed for the project. The squad leader will identify specific items of equipment to be used on the job and will ensure their operational readiness, to include performing required maintenance. The squad leader will identify and order all required supplies for the project.

**12. PROJECT BRIEFING:** The squad leader will brief, in turn, the platoon leader and the company commander. The briefing will contain at a minimum –

- a. Mission: What will the final product be? Who is the customer?
- b. Concept of Operation: How will the squad complete the project?
  1. Design – What methods (triangulation, traverse, levels) will be used?
  2. Where will the lines of survey be run? Use a map to show existing control and proposed lines of survey.
  3. Time estimation – Show proposed work estimation. Indicate departure and return dates.
  4. Cost estimation – Break down cost categories (POL, billeting, per diem, contingency) and show total cost.
  5. Travel to site – What methods will be used and how long will it take?

- c. Personnel and Equipment Requirements:
  - 1. What personnel are required? Provide a by-name listing.
  - 2. What major items of equipment are necessary and how many?

- d. Service Support:
  - 1. Billeting
  - 2. Messing
  - 3. Medical
  - 4. Maintenance
  - 5. Materials and supplies
  - 6. POL
  - 7. Transportation

- e. Command and Signal: Reporting procedures

- f. Training:
  - 1. List specific MOS skills and ARTEP/AMTP tasks required and exercised by the project.
  - 2. What training is necessary to prepare the squad to execute the project?

**13. PREPARATION FOR TEMPORARY DUTY (TDY):** The squad will usually have 14 calendar days to prepare for a TDY project, The squad leader is responsible for scheduling and executing preparations in the following areas for his squad members. The platoon sergeant and first sergeant are responsible for assisting in these preparations.

- a. Request for TDY Orders:
  - 1. The squad leader will write a request for orders, to include –
    - a. Name
    - b. Rank
    - c. Social security number
    - d. Security clearance
    - e. Project directive number
    - f. Dates
    - g. Modes of transportation
    - h. Special considerations such as authorizations for telephone calls, rental vehicles, and extra baggage.
  - 2. This request will be forwarded to platoon headquarters.
  - 3. Platoon headquarters will review the request, add any necessary information, and forward to company operations.
  - 4. Company operations is responsible for obtaining the finalized orders and returning copies to the platoon.
- b. Barracks:
  - 1. Turn in sheets, pillow case, pillow, blankets, and bedspread.
  - 2. Store oversized and high value items.
  - 3. Inventory items in wall locker (three copies: individual, supply, and inside locker), by squad leader and officer.
  - 4. Have wall locker banded.
  - 5. Turn in room keys.
- c. Health Records:
  - 1. Pick up medical records and dental records.
  - 2. Reschedule any pending appointments.
  - 3. Update shot records.

d. Personal Gear:

1. Pack those items appropriate for the project area climate. (Consider, for example, that nighttime temperatures in a desert can be as much as 30 degrees LOWER than peak day temperatures).
2. Arrange for safeguarding of POV if left behind. Through prior coordination, it may be allowed to be stored in the motor pool. If it will need to be inspected, reregistered, or have insurance renewed before you return, make written notarized authorization for your proxy before leaving.

e. Mail:

1. Mail will not be forwarded unless requested differently.
2. A statement must be filed with the mail clerk in order for spouses to pick up mail in the event the soldier does not want it forwarded.
3. Have a squad member designated as mail handler.

f. Finances:

1. Only personnel with check to bank are authorized to perform TDY missions away from the installation.
2. After receipt of TDY orders, draw advance pay at finance if desired.
3. If flying to project site, use your TDY orders to obtain a transportation request and ticket at the Scheduled Airline Ticket Office (SATO).
4. Brief squad on travel voucher procedures (keeping copies of the original of all orders, travel requests, lodging receipts, official telephone receipts, contingency purchase receipts, and rental receipts).

g. Drivers' Licenses:

1. Get a license for all squad vehicles plus possible TMP vehicles (pickups, vans CJ-5s, and carryalls).
2. Take a copy of your *DA Form 348, Equipment Operator's Qualification Record*, to the project site.

h. Squad Equipment Inventories:

1. The equipment the squad leaves behind must be inventoried in writing and signed by the master hand receipt holder, or acting squad leader, as appropriate.
2. All equipment taken on the project will be inventoried in writing by the squad leader/team chief.
3. Copies of the above hand receipts will remain with the individuals concerned.

i. Military Vehicles:

1. Each vehicle will receive a thorough technical inspection prior to departure.
2. Each vehicle will have a complete set of organization vehicle maintenance (OVM).
3. Each vehicle will be dispatched for the length of the project.

j. Briefings:

1. Give a project briefing to the squad members.
2. Receive safety and personal conduct briefings from platoon and/or company headquarters.

k. Signing Out:

1. All personnel will sign out of the battalion at S1 or the SDNCO upon departure.
2. Meal card holders will turn in their meal cards.

l. Credit Card: Obtain a government credit card from S4 if required.

m. Instrument Calibration: Perform/obtain adjustments and calibrations for the surveying equipment to be used on the project.

n. Assemble Administrative Project File:

1. Copy of project directives
2. Copy of survey plan
3. Copy of reconnaissance report

4. Copies of all subsequent trip reports
  5. Copies of all TDY orders/advances related to project
  6. Emergency data on all personnel assigned to the project
  7. Company's officer and NCO rosters, especially telephony numbers
  8. File copies of all forms used (to be kept for reproducing additional copies)
  9. Copy of each driver's *DA Form 348*.
  10. Travel vouchers
  11. Copy of current battalion access roster
- o. General Support Equipment/Supplies:
1. Office supplies
  2. *DA Form 2404, Equipment Inspection and Maintenance Worksheet*, and other support forms
  3. Survey forms
  4. General first aid kit
  5. Drawing paper, chart paper
  6. Typewriter
  7. Calculators, paper, and batteries
  8. Counseling statements
  9. Official mailing envelopes
  10. Weekly report forms
- p. Reference Materials:
1. Maps and trig data
  2. SQT and common task test (CTT) manuals
  3. Job books
  4. Survey manuals
  5. Company survey project SOP
  6. Survey equipment manuals/manufacturer's manuals
- q. Complete/Reschedule Other Training:
1. Annual training requirements (mission)
    - a. Weapons qualification
    - b. Army physical readiness test (APRT)
  2. Annual training requirements (personal knowledge)
    - a. CTT Packet
    - b. Scheduled training for TDY period
  3. Weight control
  4. Vehicle (POV)
    - a. Registration current
    - b. License current
    - c. License plate current
  5. Defensive driver card
  6. Field 201 file update
  7. Off duty classes
- r. Married Personnel:
1. Power of attorney, if needed
  2. Arrangement for nonlicensed dependents
    - a. Commissary
    - b. Hospital
    - c. General shopping
    - d. PX

**14. ADVANCE PARTY:**

a. Generally, the squad leader and one or two squad members will depart approximately one week prior to the entire project crew. The assistant squad leader will do final administrative preparations with the remaining squad members.

b. The squad leader will inspect and sign for quarters and administrative space. Equipment will be secured and telephonic communications with the company will be established upon arrival. If calling after duty hours, call platoon headquarters personnel at home or the SDNCO as a last resort.

c. All POCs from the initial reconnaissance should be contacted. Additionally, the military police or local police should be informed of mission requirements, areas of operations, vehicle types, and bumper/license numbers.

d. Further detailed recon/station recovery and verification should begin and final project design be completed. Consideration should be given to access requirements (keys, escorts, range control operation times) and finding local personnel with intimate knowledge of the project area. Further local data maybe required (local surveyors, courthouse).

e. If the squad can begin work as soon as they arrive, the advance party has been successful.

**15. SQUAD MOVEMENT TO PROJECT:**

a. The squad leader/assistant squad leader will conduct the movement to the project. Both military vehicles and POVs will move as a group under the NCOIC's control. All posted speed limits will be obeyed. If the project is 450 miles or less away, the movement time will be one day. At distances greater than 450 miles, the movement rate will be approximately 300 miles per day. All overnight billeting arrangements will be at one location if possible. All equipment will be secured and each individual must obtain an individual receipt.

b. Fuel should be obtained at service stations that accept military credit cards for military vehicles, All POVs will be filled at the owner's expense. Use of military credit cards should be kept at a minimum. Use self-service pumps when possible.

c. The platoon headquarters or SDNCO will be notified daily of location and telephone number of overnight billeting area, and will be notified upon arrival at project site.

d. If movement is by commercial air, ensure that all baggage claim checks are safeguarded until all equipment is received at the final destination.

e. If movement is by military aircraft, make every attempt to move the equipment with the personnel. If equipment must be moved independently, the equipment will be submitted with a "Priority, No-Bump" statement. At least one person will observe the physical loading of the survey equipment onto the aircraft. Copies of all movement documents will be retained until the equipment is received after movement. At a minimum, the following information will be obtained and written:

1. Type (model) of aircraft.
2. Tail number of aircraft.
3. Mission number.
4. Transportation control management document (TCMD) number.
5. Date and time of departure.
6. Route of the aircraft, including all intermediate stops before the survey equipment is to be unloaded.

**16. PROJECT EXECUTION:**

a. All recordings and computations will be in black ink and will be double-checked and initialed to indicate the checks have been performed.

b. Maintenance – Perform daily maintenance on each vehicle and weekly PMCS on all survey equipment. Report immediately to platoon headquarters each time equipment readiness status changes. All accidents must be reported to the company commander within 24 hours. Accident reports and statements from all concerned parties will be prepared immediately and forwarded to the company commander.

c. Safety – Follow all guidelines set forth in the unit safety SOP.

d. Inventories – Inventory daily those items used in the field survey. Inventory daily all sensitive items of equipment (survey instruments, binoculars, compasses, and OVM). Inventory weekly all hand-receipted equipment. Report any damaged, lost, or inoperational equipment to the platoon headquarters within 24 hours of the incident.

e. Physical Training – Physical training will be conducted, Type and schedule will be determined by the squad leader. Generally, the training should be equivalent to the daily dozen and a two-mile run. Upper and lower body should be exercised and the cardiovascular system should be taxed.

f. Common tasks and SQT manuals should be taken to the project. During inclement weather, training in these skills can be conducted.

g. A weekly progress report will be submitted to platoon headquarters. The format is at Annex D and will include vehicle mileage, fuel used, man-hours expended, and percent completed.

h. The squad leader is responsible for daily checks of field work and computations.

i. The squad leader will keep a written daily log of the progress, activities and problems that relate directly to the mission. All other occurrences such as personnel insubordinate behavior will be recorded on *DA Form 4856, General Counseling Form*.

j. The squad leader will be prepared at all times to present an informal progress briefing to any visitors/inspectors.

**17. SURVEY HEADQUARTERS:** Survey headquarters section will be responsible for on-site edit, if possible, during the last phase of the project, Edit will include but not be limited to checking–

a. Computations – Math and procedures done correctly, to include all headings and signatures.

b. Field Sheets/Books – Verify checks and headings.

c. Station Descriptions – Completed sketch, reference features, proper grammar, sequence of paragraphs, and field checked.

d. Airfield Drawings – Complete, accurately plotted, and field checked.

e. Ensure project meets customer requirements.

f. All corrections/notations made by edit personnel will be in red ink.

g. All pages checked will include the editor's initials in red ink.

h. Notes/lists will be kept free of any glaring or repetitive errors.

**18. SQUAD MOVEMENT FROM PROJECT:**

a. After all field observations and computations are completed, the squad will clear the project site and return to its home installation. The squad leader will ensure that all borrowed equipment is turned in, billets are cleaned, equipment is inventoried, preoperational vehicle checks are conducted, all outstanding bills are

paid, and all vehicles are properly dispatched. The customer will not normally be provided a copy of the unedited project unless so directed by platoon/company headquarters, When required to leave a copy with the customer, ensure that a statement is attached indicating that the data provided is preliminary and unadjusted data.

b. Movement will be conducted under the same conditions as movement to the project. Platoon headquarters will be informed of your departure from the work site before you depart the job site.

**19. SQUAD RECOVERY:** Upon return to your home installation, the following will be accomplished:

- a. A platoon representative will meet the returning squad with main and any special instructions.
- b. Soldiers sign in at S1 or SDNCO.
- c. Soldiers sign for keys, linen, and inventory wall lockers.
- d. Vehicles are topped off, secured, cleaned, and technically inspected in the motor pool.
- e. The TOE equipment is cleaned, inventoried, inspected, and secured. Any required maintenance will be scheduled.
- f. Finance vouchers are completed, inspected at platoon headquarters, and filed for payment at the finance office. Unless otherwise instructed by the installation finance office, the voucher packets will include the following items:

<b>DOCUMENT</b>	<b>OFFICERS</b>	<b>ENLISTED</b>
DD Form 1610	Original + 4	Original + 5
DD Form 1351-2	Original + 4	Original + 5
DD Form 1351-3	Original + 2	Original + 2
DD Form 1351-5	Original + 2	Original + 2
Receipts	Original + 2	Original + 2

- g. Verbally brief platoon headquarters on project status.
- h. When final finance vouchers are received, a copy of each person's voucher will be forwarded through platoon headquarters to company operations.
- i. Ensure adequate time is scheduled for personal affairs and missed training.

**20. EDIT AT HEADQUARTERS:**

a. Upon return from the project, the squad leader will submit the completed survey packet to the survey's headquarters element. The headquarters element will check all final computations, drafting, and recovery card preparation. An after-action report, in the format shown at Annex E, will be submitted by the squad leader to platoon headquarters three working days after the survey packet is submitted, and will be included in the survey packet.

- b. The survey packet should contain the following items, in order:
  - 1. After-action report.
  - 2. Detailed narrative (packet introduction), explaining the contents of the packet.
  - 3. Sketch, or overlay of all work done.
  - 4. Index.
  - 5. Tabulated data/DA Form 1959 cards.
  - 6. Check angles, distances, levels, and starting inverse computations.
  - 7. All traverses and level lines in a logical sequence (main control extension, connecting control, side or loop extensions).

8. Level lines will contain the following items, in order:
  - a. Sketch of level line.
  - b. *DA Form 1942, Computation of Levels.*
  - c. Field notes.
9. Traverses will contain the following items, in order:
  - a. Sketch of traverse.
  - b. Final position computations (*DA Form 1923, Position Computation Order Triangulation For Calculating Machine Computation*, and *DA Form 1940, Traverse Computation on the Universal Traverse Mercator Grid*).
  - c. Final inverse position/astromic azimuth computations.
  - d. Elevation computations.
  - e. Abstracts.
  - f. Distance measurement/reduction field sheets.
  - g. Horizontal direction field notes.
  - h. Vertical angle/zenith distance field notes.
  - i. Astromic observation field notes.
  - j. Intersection/side-shot field notes.
10. Satellite receiver data will include the following items:
  - a. Sketch.
  - b. Printed tape of position computations and datum transformations.
  - c. Magnetic tapes containing all recorded data.

## 21. PLATOON REVIEW

- a. The platoon headquarters will review the final project and make a file of all pertinent records, vouchers, forms, reports, and a copy of the final project.
- b. Platoon headquarters will make appropriate award recommendations and ensure all soldiers' finance transactions (meal cards, separate rations, BAQ) are followed through to completion.
- c. Upon completion of the platoon review, a first endorsement to the after-action report will be prepared by platoon headquarters and forwarded with the report and final project packet to company operations. The endorsement will contain a report of any additional man-hours expended during the edit and review, inspection results, and any other pertinent data.

**22. COMPANY OPERATIONS FINAL REVIEW:** The company operations will review the final project for accuracy and completeness. A file copy will be made and pertinent data will be stored in the survey information center. The project will be forwarded with a letter of transmittal to battalion operations. Additionally, a second endorsement to the after-action report will be prepared and forwarded to battalion operations. This endorsement will contain a report of any additional man-hours expended during the edit and review, inspection results, and all final project data. Copies of the after-action report, with all endorsements and enclosures will be forwarded for information and filing, to the platoon and battalion operations. A file copy will also be kept in company operations.

**(ANNEX A: Initial Site Visitation Trip Report Format)**

EXAMPLE

EXAMPLE

EXAMPLE

EXAMPLE

EXAMPLE

**DEPARTMENT OF THE ARMY  
99th Engineer Company (Survey)  
99th Engineer Battalion (Topo) (Army)  
Fort Belvoir, Virginia 22060-5000**

AFFA-TA-S

03 February 1986

SUBJECT: Initial Site Visitation Trip Report Narrative  
(Ft. Bliss, Biggs AAF, TX, 28-31 Jan 86)

Commander  
99th Engineer Company (Survey)  
ATTN: Operations  
Fort Belvoir, Virginia 22060-5000

**1. Reference:** PD#85-2075, FAA Airfield Obstruction Survey

**2. Personnel:**

a. WO1 John Doe, Survey Technician, 99th Engineer Company (Survey), 99th Engineer Battalion (T) (A), Fort Belvoir, VA 22060 AVN: 555-1212 FTS: 544-XXXX

b. Mr. John Doe, DEH, Engineer Plans & Services Division, Master Planning, Bldg 1165, Fort Bliss, TX 79916 AVN: 555-1212 FTS: 478-XXXX

c. Ms. Jane Doe, Billeting Office, Bldg 504A, Fort Bliss, TX 79916 AVN: 555-1212 FTS: 478-XXXX

d. SGT Doe, HQ, USAADACENFB, DPT/G3, Bldg 2, Room 19, Fort Bliss, TX 79916 AVN: 555-1212 FTS: 478-XXXX

e. MSG Doe, Operations SGT, DIO, TMP, Bldg 1332, Fort Bliss, TX 79916 AVN: 555-1212 FTS: 478-XXXX

f. CPT Doe, Operations Officer, Biggs AAF, Bldg 11210, Fort Bliss, TX AVN: 555-1212 FTS: 478-XXXX

g. CW4 Doe, Asst Operations Officer, Biggs AAF, Bldg 11210  
Fort Bliss, TX AVN: 555-1212 FTS: 478-XXXX

h. SFC Doe, Operations NCOIC, Biggs AAF, Bldg 11210, Fort Bliss, TX 79916 AVN: 555-1212 FTS: 478-XXX

i. Mr. John Doe, Survey Division, US Army Corps of Engineers, Albuquerque District, Albuquerque, NM FTS: 555-1212

j. Jane Doe, Bogus Rental Car, 6012 Hollow Brook Road, El Paso, TX COMM: (915) 555-1212

**3. Objectives:**

- a. Determine the scope of work to be performed.
- b. Make a thorough reconnaissance of the areas to be surveyed, to include locating existing survey control.
- c. Complete liaison for all types of support requirements ranging from billeting to vehicle support.

**4. Mission:** The 1st Survey Platoon, 99th Engineer Company (Survey), will dispatch a survey team of eight soldiers to Fort Bliss, Texas, on or about 19 February 1986 after receipt of funding for the project. They will conduct a complete survey of all NAVAIDs and airfield obstructions IAW specifications established by the US Army Air Traffic Control Activity, Aeronautical Services Office, Cameron Station, Alexandria, VA 22304-5050. Additionally, if time and funding permit, the team will revalidate the aging compass rose located on Biggs AAF.

5. Discussion:

a. Location: Biggs Army Airfield is located adjacent to Fort Bliss, Texas on three sides and by El Paso International Airport on the fourth side.

b. Environmental Factors: The terrain is basically flat, with the airfield being located on a high desert plateau. The Franklin Mountains are located approximately four miles west of the airfield and the Hueco Mountains are approximately fifteen miles to the east, Vegetation is sparse and is limited to scrub brush. Normal daily temperatures for this time of year are 40 degrees to 50 degrees (F) during the day and 20 degrees to 30 degrees (F) at night. Precipitation is minimal throughout the year.

c. Medical Facilities: Emergency medical treatment is available 24 hours a day at the William Beaumont Army Medical Center. Routine sickcall may be accomplished at the consolidated troop medical clinic located in Bldg 2496. Dental care will be provided for emergencies only, at the dental clinic located at Bldg 2699.

d. Commissary/PX Facilities: Complete commissary and PX facilities are available on Fort Bliss. Additionally, small branch exchanges are located throughout the post and on Biggs AAF. Both accept checks as payment and the PX will cash personal checks for up to \$100.00 per day. Additionally, the main exchange will accept certain specified credit cards, as payment.

e. Vehicle Support: Fort Bliss TMP is unable to support our vehicle requirements. We will rent two sedans and one pick-up truck from the Bogus Rental Car Company, El Paso, Texas. Fuel will be procured through the TMP fuel point with DEH reimbursing the TMP for fuel we use.

f. Billieting/Office Space: As of this date, the only billeting available on Fort Bliss is through the BEQ. The billeting office is located in Bldg 504A on Fort Bliss. SGT Doe at DPT/G3 is currently working on finding free billeting space for the survey team. Office space and equipment storage space is available on Biggs Army Airfield. The POC is the airfield operations office.

g. Dining Facilities: The dining facilities on Fort Bliss are crowded and it would cause considerable delays daily if the survey team were to use them. It is strongly recommended that all personnel be placed on per diem. There are numerous restraints and fast food establishments in the Fort Bliss and El Paso area. Additionally, there is a food concession next to the main exchange on Fort Bliss.

h. Cost Parameters:

(1) Parameters for Cost Estimates –

- |                       |  |
|-----------------------|--|
| (a) Advance Party     | Depart 19 Feb 86 (survey technician and 2 soldiers)<br>Return 25 Feb 86 (survey technician to Belvoir)<br>Return 17 Mar 86 (2 soldiers to Belvoir) |
| (b) Remainder of crew | Depart 24 Feb 86 (6 soldiers)<br>Return 17 Mar 86 (to Belvoir)   |
| (c) Rental cars       | 2 rental cars for 27 days<br>2 rental pick-ups for 27 days<br>1 rental car for 3 days  |

(2) Actual Costs -		
(a) Air fare		
Advance party	3 persons x \$373.00 =	\$1,119.00
Crew	6 persons x \$373.00 =	2,238.00
Inspector	1 person x \$373.00 =	373.00
	<b>TOTAL</b>	<b>\$3,730.00</b>
(b) Lodging		
Advance party		
1 officer x 6 nights x \$12.00 =		\$ 72.00
2 enlisted x 26 nights x \$11.00 =		572.00
Crew		
6 enlisted x 21 tights x \$11.00 =		<b>\$ 1,386.00</b>
Inspector		
1 officer x 2 nights x \$12.00 =		24.00
	<b>TOTAL</b>	<b>\$ 2,054.00</b>
(c) Per diem		
Advance party		
1 person x 7 days x \$23.00 =		\$ 161.00
2 persons x 27 days x \$23.00 =		1,242.00
Crew		
6 persons x 22 days x \$23.00 =		3,036.00
Inspector		
1 person x 3 days x \$23.00 =		69.00
	<b>TOTAL</b>	<b>\$4508.00</b>
(d) Transportation on site		
Rental cars		
Crew 2 each x 27 days x \$14.00 =		\$ 756.00
Rental pick-up		
Crew 1 each x 27 days x \$18.00 =		486.00
Rental car		
Inspector 1 each x 3 days x \$26.00 =		78.00
	<b>TOTAL</b>	<b>\$ 1,320.00</b>
(e) Shipment of equipment – Bogus Shipping Company		
\$ 0.80/lb x 400 lb x 2 trips =		\$ 640.00
(f) Contingency fund		\$ 150.00
(g) Total estimated cost		<b>\$12,402.00</b>

**6. Technical Information:** (not included in this narrative)

**7. Recommendations and Conclusions:** The project should be accepted by this unit. It will provide training in the following SQT tasks:

- |                 |   |
|-----------------|---|
| a. 051-260-1101 | Observe Horizontal Directions (1" Theodolite) |
| b. 051-260-1102 | Observe Zenith Distances (1" Theodolite)      |
| c. 051-260-1105 | Operate Infrared EDM Instrument               |
| d. 051-260-1108 | Operate Semiprecise Level                     |
| e. 051-260-1109 | Determine Level Error C for Levels            |
| f. 051-260-1110 | Use Level Rod                                 |
| g. 051-260-1112 | Set Up a Wild T-2 Target                      |
| h. 051-260-120  | Record Horizontal Directions                  |
| i. 051-260-1202 | Record Zenith Distances                       |
| j. 051-260-1203 | Record Level Field Notes                      |
| k. 051-260-120  | Record Infrared EDM Field Notes               |
| l. 051-260-1301 | Recover Survey Control Station                |

n. 051-260-1401	Compute Grid Coordinates
o. 051-260-1402	Compute Geographic Coordinates
p. 051-260-1403	Compute Azimuth and Distances From Grid Coordinates
q. 051-260-1405	Compute Difference in Elevation From Reciprocal Observations
i. 051-260-1406	Compute Difference in Elevation From Nonreciprocal Observations
s. 051-260-1407	Compute Differential Level Line
t. 051-260-1408	Compute and Adjust Grid Traverse

2 Incl  
1 Ltr, AFFA-TA-S, dtd 31 Jan 86  
1 NAVAID Survey Specs.

JOHN DOE  
WO1, WU  
Survey Technician

CF: Cdr, 99th Engr Co.  
Party Chief  
Survey Opns  
Mr. Doe, DEH, Ft Bliss, TX

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(Annex A, Incl 1)

**DEPARTMENT OF THE ARMY**  
**99th Engineer Company (Survey)**  
**99th Engineer Battalion (Topo) (Army)**  
**Fort Belvoir, Virginia 22060-5000**

AFFA-TA-S

31 January 1986

SUBJECT; Biggs AAF Safety Survey Cost Estimate

Commander  
USAADACENFB  
ATTN: ATZC-DEH-P  
Fort Bliss, Texas 79916-6104

1. After performing a thorough reconnaissance for this project, I estimate the cost of the project at \$12i,000.00. This cost estimate reflects the fact that no vehicle or free billets support is available from Fort Bliss.
2. The cost estimate does not reflect the amount that DEH will need to reimburse the Fort Bliss TMP for 200 gallons of Mogas. This fuel will be needed for use by the three rental vehicles to be utilized on this project.
3. Request that a DA Form 2544, (Intra-Army Order for Reimbursable Services) be prepared for the amount of the estimate and forwarded to: Commander, 99th Engineer Battalion (Topo) (Army)  
ATTN: AFFA-TA-PCS (CW2 Doe) Fort Belvoir, Virginia 22060-5000.  
Request this action be expedited to allow the project to begin on 19 February 1986.

JOHN DOE  
WO1, WU  
Survey Technician

**(Annex B: Technical Operations Order Format)**

EXAMPLE

EXAMPLE

EXAMPLE

EXAMPLE

EXAMPLE

Copy # 4 OF 6 Copies

**99th Engineer Battalion(T) (A)**  
Fort Belvoir, (UT1387), VA

TECHOPORD

(Fort Bliss)

**References:**

- A. Letter, ASQ-AS-AI, dated 17 May 85. SUBJECT: Engineering Surveys of Army Airfields.
- B. Letter, AMCEN-F, dated 29 May 85, SUBJECT: Engineering Surveys of Army Airfields.
- C. Letter, AFFA-TA-PCS, dated 8 Nov 85, SUBJECT: Mission Capability of the 99th Engineer Company (Survey).

**Time zone used throughout the order: ROMEO****1. SITUATION**

- A. Enemy Forces: NA
- B. Friendly Forces: Directorate of Engineering and Housing, Fort Bliss, TX, 99th Engineer Battalion (T)(A) with subordinate units: HHC, 99th Engineer Company (Carto), and 99th Engineer Company (Survey).
- C. Attachments and Detachments: None.

**2. MISSION:** The 99th Engineer Company (Survey) will perform a NAVAID/obstruction survey of Biggs AAF at Fort Bliss, TX.

**3. EXECUTION:**

- A. Concept of Operation: 99th Engineer Company (Survey) coordinates, schedules, and performs survey operations to accomplish the above mission NLT 30 Apr 86. The S3 will monitor project progress and coordinate external requirements upon request.
- B. Coordinating Instructions: Direct coordination with the following point of contact is authorized:  
1LT Doe, Master Planners Office. AUTOVON 555-1212

**4. SERVICE SUPPORT:**

- A. Unit equipment and supplies will be used. If economically feasible, rental vehicles are authorized.
- B. Submit support request(s) to this Headquarters, ATTN: AFFA-TA-OP, as needed.

**5. COMMAND AND SIGNAL:**

- A. Command: Per Battalion SOP
- B. Reports. 99th Engineer Company (Survey) will:
  - 1. Submit to S3 a reconnaissance report within 30 days of receipt of this OPORD.
  - 2. Report project status weekly to S3 NLT 1200 hours each Friday.
- 3. Submit to S3 an end-of-project report within 15 days after completion of project.

JOHN DOE  
LTC, EN  
COMMANDING

**(Annex C: Fragmentary Order Format)**

EXAMPLE                  EXAMPLE                  EXAMPLE                  EXAMPLE                  EXAMPLE

FRAGO # 85-2009-1

**References:**

- A. Technical Operations Work Order # 85-2009
- B. TM 5-237, Surveying Computer's Manual, Chapter 5
- C. STP 5-82D14-SM-TG, Soldier's Manual, Task # 051-260-2421

Time zone used throughout the order: ROMEO

**1. SITUATION:**

- A. Friendly Forces: 99th Engineer Battalion (T) (A)
- B. Enemy Forces: None

C. Assumptions: This unit maybe tasked to perform high-order survey work in the near future. Personnel should become familiar with the computations associated with this type of work.

**2. MISSION:** Each squad within the 1st and 2d Survey Platoons, 99th Engineer Company has been tasked to compute geodetic azimuth from north and geodetic distance for each set of coordinates on the attached sheets.

**3. EXECUTION:**

## A. Concept of Operations:

- 1. Transcribe positions for each set to DA Form 1923.
- 2. Compute geodetic azimuth from north and geodetic distance for each set of coordinates.
- 3. Distance will be computed to 0.001 meter, and azimuth to 0.01 second.
- 4. All points are in northern Alabama.
- 5. This is a third-order Class I traverse project.
- 6. Maximize use of personnel unfamiliar with this computation.
- 7. Submit progress report, to include man-hours expended and a by-name list of personnel working

on

the computations by 1100 hours each Friday until completion of project.

- 8. Return completed data to Survey Platoon Technician (WO1 Doe) by COB 27 Feb 85.

## B. Coordinating Instructions:

- 1. Calculators and reference materials are available from WO1 Doe.
- 2. All technical questions/problems should be directed to WO1 Doe.

**4. ADMINISTRATION AND LOGISTICS:** The only available resources are those contained within the 1st and 2d Survey Platoons.

**5. COMMAND AND SIGNAL:**

A. Command: Squad leaders are responsible to ensure all required data and reports reach the Survey Technician by the required times.

- B. Signal: NA

DOE

**(Annex D: Percentage of Survey Project Completion Guide)**

EXAMPLE                      EXAMPLE                      EXAMPLE                      EXAMPLE                      EXAMPLE

FA-TA-S                      Survey Projects, Percentages of Completion

TO: SEE DISTRIBUTION

FROM: Commander  
99th Engr Co (Survey)  
Fort Belvoir, VA 22060

DATE: 26 Feb 86  
dr/1092

1. To standardize company operating procedures, projects will be reported using the percentages listed under your type of project.
2. This project status is due to company operations each Friday by 1000 hours. Request immediate attention be given to this suspense.
3. General breakdown for each project consists of eight key areas.

<b>Percentages of Area</b>	<b>Percentages</b>	<b>Percentages of Total Projects</b>
S3	0 - 2	2
Company Operations	3 - 6	4
Office Recon	7-10	4
Field Recon	11-20	10
Field Survey	21-75	55
Platoon Edit	76-90	15
Company Edit	91-97	7
S3	98-100	3

4. The field survey percentage of 55 is further broken down for each type of project, and reported as such.
  - a. Traverse for extension of control.

<b>Area</b>	<b>Percentages</b>	<b>Percentages of Total Projects</b>
Recover/Verify Control	21-30	10
Monument Stations	31-35	5
Horizontal/Vertical Angles	36-45	10
Distances	46-55	10
Computations	56-70	15
DA Form 1959 Cards	71-75	5

- b. Level line for control extension or cross sections/profiles.

<b>Area</b>	<b>% Control Ext</b>	<b>% X-Section Percentage</b>	<b>Total</b>
Recover/Verify Control	21-30	21-30	10
Monument BMs	31-35	31-35	10
Field Observations	36-55	36-50	20, 15
Computations	56-71	51-60	15, 20
DA Form 1958 Cards	71-75	61-65	5
Drafting Charts	0	66-75	0, 10
(Total of%)	(55)	(55)	(55)

c. Doppler point positioning.

Area	Percentages	Percentage of Total
Recover/verify control	21-30	10
Monument observation points	31-35	5
Doppler observations	36-55	20
Computations	56-70	15
Doppler station description cards	71-75	5
	55	55

d. APPS supporting projects.

Area	Percentages	Percentage of Total
APPS observations	21-60	40
Data reduction/transform	61-75	55
	55	55

e. Airfield obstruction surveys or NAVAIDs.

Area	Percentages	Percentage of Total
Recover/verify control	21-26	6
Monument stations	27-28	2
Horizontal/vertical angle observation	29-33	5
Distances observation	34-38	5
Side shot/intersection	39-43	5
Levels	44-48	5
Computations	49-63	15
DA Form 1959 Cards	64-65	2
Drafting	66-75	10
	55	55

f. INS surveys - reported as: traverse for extension of control.

5. Encl 1 (graphic breakdown for survey projects)

JOHN DOE  
 CPT, EN  
 Commanding

Distribution:

S3 (CWO2 Doe)  
 1st Survey Platoon  
 2d Survey Platoon  
 Cdr, 99th Engr Co

(Annex E: End-Of-Project Report Format)

EXAMPLE                      EXAMPLE                      EXAMPLE                      EXAMPLE                      EXAMPLE

**DEPARTMENT OF THE ARMY  
99th Engineer Company (Survey)  
99th Engineer Battalion (T) (A)  
Fort Belvoir, VA 22060-5000**

AFFA-TA-S

18 April 1984

SUBJECT: End-of-Project Report (New Cumberland Army Depot, PA, 19 Jan 84-2 Apr 84)

THRU: Commander  
99th Engineer Company (Survey)  
Fort Belvoir, VA 22060

TO: Commander  
99th Engineer Battalion (T) (A)  
Fort Belvoir VA 22060-5000

**1. References:**

- a. Letter, SDSNC-AF, dated 29 Sep 83, SUBJECT: Topographic Survey Requirements (Encl 1)
- b. Letter, AFOP-OCR, dated 10 Nov 83, SUBJECT: Topographic Support PD # 2-84 (Encl 2)
- c. OPORD, 99th Engineer Battalion (T)(A), dated 30 Nov 83, OPORD 83-148. (Encl 3)
- d. Letter, AFFA-TA-S, dated Oct 83, SUBJECT: Preliminary Reconnaissance Trip Report. (Encl 4)
- e. Letter, AFFA-TA-S, dated 22 Dec 83, SUBJECT: Reconnaissance Trip Report (Encl 5)
- f. Letter, AFFA-TA-S, dated 24 Feb 84, SUBJECT: Inspection Trip Report (Encl 6)
- g. Letter, AFFA-TA-S, dated 12 Mar 84, SUBJECT: Inspection Trip Report (Encl 7)

**2. Personnel:**

- a. Inspectors:
 

SFC John Doe	Platoon Sergeant	2 Feb 84
1SG John Doe	First Sergeant	16 Feb 84-17 Feb 84
2LT John Doe	Platoon Leader	16 Feb 84-17 Feb 84
CW2 John Doe	Survey Technician	1 Mar 84 - 2 Mar 84
		21 Mar 84
SFC John Doe	Battalion S3	14 Mar 84
- b. Field Crew:
 

SSG John Doe	Party Chief	19 Jan 84 - 2 Apr 84
SGT John Doe	Computer	19 Jan 84 - 2 Apr 84
PFC John Doe	Computer/Drafting	19 Jan 84 - 2 Apr 84
SP5 John Doe	Field Crew Chief	19 Jan 84 - 2 Apr 84
SP4 John Doe	Surveyor	19 Jan 84 - 2 Apr 84
PFC John Doe	Surveyor	19 Jan 84 - 2 Apr 84
PFC John Doe	Surveyor	19 Jan 84 - 2 Apr 84
PFC John Doe	Surveyor	2 Feb 84 - 2 Apr 84
PFC John Doe	Surveyor	19 Jan 84 - 5 Feb 84
PFC John Doe	Surveyor	19 Jan 84 - 2 Apr 84

**3. Requirements:**

- a. The original requirements for the project were –
  - (1) A verification of the entire boundary. The missing corners were to be monumented by Facilities Engineering Division.
  - (2) Third-order elevations were to be required on the boundary monuments.
  - (3) Topographic maps of the two areas where Buildings 87 and 92 would be relocated.
- b. After the final reconnaissance was made, the requirements had been changed to –
  - (1) A verification survey of the entire boundary. The missing corners were to be monumented by the survey crew with monuments premade by Facilities Engineering Division.
  - (2) Third-order elevations were required on the boundary monuments.
  - (3) The topographic maps were no longer needed.
  - (4) A drawing of the base boundary would be provided by the survey team, as well as station descriptions for each corner and bench mark.
- c. As the project neared its end, and the monuments for the boundary corners were still not made; the requirements for elevations on each boundary monument changed to establishing bench marks near the boundary corners (for example, nails in headwalls) and on as many boundary monuments as time would permit. All other requirements remained the same as stated in paragraph 3b of this report.

**4. Methods Used:** In order to accomplish the mission, it was broken down into five main areas:

- a. Reconnaissance: The reconnaissance was conducted approximately one month in advance of beginning the field work. It consisted mainly of a deed search at the courthouse, obtaining additional information from adjoining landowners (for example, CONRAIL, Pennsylvania Turnpike Authority), an on-ground search for existing boundary corners and starting control, and arranging logistical support. This phase of the operation resulted in a reciprocal request from the Pennsylvania Turnpike Authority for two copies of our final drawings (see Encl 8).

- b. Traversing: All traverse work was performed using third-order Class I procedures. In total, there were seven traverses, one of which was the main control traverse. It contained 25 stations and was run from station Shuey, a first-order horizontal control point, through boundary corners number 4, 5, and 6, stations T-4 and T-5, and closed on station Fishing, a second-order point. This established a common coordinate system for the existing boundary corners, and the other traverses we ran to place control near where the remaining boundary corners should have been. The azimuths were checked and verified by performing astronomic azimuth observations to third-order specifications at station Shuey and at station T-4 to T-5. The main control traverse had a position closure of 1:17,000 and the poorest closure obtained on any of the other six traverses was 1:5,000.

- c. Locating Corners/Placing Monuments: The lost/destroyed boundary corners were recovered and/or replaced by the following procedures:

- (1) Coordinates were computed for all boundary corners using the coordinates we established on boundary corners 4, 5, and 6, and the bearings and distances from the deeds.

- (2) Inverses were computed from our traverse stations nearest the desired corner to that boundary corner.

- (3) The traverse station was occupied, the computed angle was turned, and the distance was horizontally taped, thus locating the corner in question. This point was then temporarily marked by either a piece of rebar, a railroad spike, or a P-K nail depending on the type of ground encountered.

- (4) After the monuments had been made, we built plumbing benches over the temporary marks, removed the markers, dug the holes and placed the monuments in their proper positions. After the dirt was tamped down and the plumb was checked, concrete collars were poured around the monuments to ensure that they would not move.

- d. Leveling: The requirement for third-order elevations was met by running two third-order lines. The first line started on bench mark NC-2 and ran around the perimeter of the southern half of the depot to bench mark NC-1. This line established 13 bench marks, had an error of closure of 0.065 feet, and was 4.8 miles long. The second line started on bench mark NC-1 and ran around the perimeter of the northern half of the depot to station T-4. This line established elevation on seven points, had an error of closure of 0.003 feet, and was 1.7 miles long.

e. Computing/Drafting Computing for this project was an ongoing endeavor from the time of the final reconnaissance until two weeks after the end of the project. This was due largely to the vast number of deeds for the land surrounding and now comprising New Cumberland Army Depot and the fact that some of the final data was needed on site at the completion of the project. The drafting was accomplished in the last two weeks of the project and consisted of three drawings. Copies of all drawings were provided to Facilities Engineering Division prior to departing New Cumberland. Station descriptions were an ongoing effort throughout the project.

**5. Equipment Used:** The equipment used on this project falls into two categories – organizational and borrowed.

a. Organizational equipment: Three M892 vehicles, two wild T-2 theodolites, one Berger military level, one cubic DM-60 infrared EDM, two Philadelphia rods, two T-2 target sets, one 50-meter steel tape, one 100-foot steel tape, one tape tension handle, one taping pin set, and an HP-97 programmable calculator.

b. Borrowed equipment: The following was borrowed from FED, NCAD: three FM handie talkies, one posthole digger, one auger truck with operators, and on two or three occasions when our vehicles were down, a carryall from TMP.

**6. Achievements:** Excellent training was gained by all personnel in traverse, leveling, taping, and monument setting procedures. All personnel gained valuable experience at operating under extreme cold and wet conditions. SGT Doe and PFC Doe received valuable experience in all types of survey computations, to include curve layouts. SP5 Doe gained experience as a field crew chief. Facilities Engineering Division, NCAD gained much needed field data that should prove useful any time projects requiring survey data are undertaken by their office. In addition, all personnel assigned to the project, and the 99th Engineer Company (Survey), were each awarded a certificate of appreciation from the depot commander, Colonel John Doe.

**7. Technical Difficulties:** The majority of the technical problems encountered were a direct result of the vast number of deeds we were dealing with. Many of those deeds listed magnetic bearings, while others used true bearings. Ordinarily this would have been no problem, but the catch was that out of all the deeds we had, only two specified what type of bearings they were listing. This left us with a large jigsaw puzzle with many variables. It became a matter of trial and error until we were finally able to get the boundary to close on itself. Another problem encountered was that one of the reference drawings provided to us by Facilities Engineering Division had the numbers within a given distance scrambled; that is, 1307 feet was really 1370 feet. Additional problems were encountered when our only EDM went down and no replacement was available. The problems encountered in this area were due directly to a lack of training in taping procedures. After about two days of intensive on-site training, this problem was resolved.

**8. Administrative/Other Problem Areas:** The largest single problem encountered on this project was vehicles and vehicle maintenance support. The maintenance support that was promised **verbally** by the TMP at NCAD never developed. As a result, I would strongly recommend a written agreement be established during the recon phase of all future projects. As for the problems we encountered with our vehicles (for example, not starting, exhaust systems, tune-ups), I cannot understand how they could have gone through a complete **A** service prior to departing on the project and still be in such a poor state of repair. The only other real problem encountered was the adverse weather conditions that repeatedly plagued us. In total, we lost 13 work days to snow, ice, rain, or fog.

**9. Summary:** All in all, this was an excellent project. It fulfilled a vast amount of training requirements in a wide variety of skills. Once again, it became very obvious as to our weaknesses in the equipment department. These weaknesses include, but are not limited to, a need for rapid mobile communications equipment, medium or long range EDM, and four-wheel drive vehicles.

JOHN DOE  
SSG, USA  
Party Chief

8 Encl  
as