# NCDOT Photogrammetry Unit

## 2008 Construction Engineers Conference

copies: Rob
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STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

January 18, 2008

Asst. ___ Prod.Mgr. ___ Aute Mgr.
P.Lab ___ Admin Asst. ___ S.Engr.
All Supervisors
PHOTOGRAMMETRY UNIT
2-7-08 FEB 6 2008 2-6-08
Take appropriate action
For your information
File

MEMORANDUM TO: Division Engineers

FROM: W. S. Varnedoe, P.E.
Chief Engineer – Operations

SUBJECT: Aerial Photography for Earthwork Quantities

On many projects aerial photography is used to assist the divisions in the determination of earthwork quantities. In order to ensure the best possible interaction between our field forces and the Photogrammetry Unit we have established formal procedures when the use of aerial photography is necessary. Please implement these new procedures immediately for projects you intend to use aerial photography to measure earthwork.

After project letting and prior to any clearing work, an Earthwork Measurement Scoping meeting will be scheduled by the Resident Engineer to review the scheduled plan of construction. The meeting attendees shall be the Prime Contractor, Resident Engineer, Assistant Resident Engineer, Project Inspector, a representative from the Photogrammetry Unit, and a representative from the Locations and Surveys Unit. The purpose of this meeting is to discuss the details of the earthwork such that everyone has clear understanding of how the survey controls will be established, how the terrain data will be collected, and how earthwork quantities will be computed. The discussion shall also cover areas that will not be measured by aerial photography. The details will outline the Contractor's planned sequence of earthwork operations along with an estimated time frame for the work to be accomplished.

The attached form letter is to be used to make a formal request to the Photogrammetry Unit and the Location and Surveys Unit to initiate this process. This request is to be submitted by the Resident Engineer to the Photogrammetry Unit Head prior to the initial flight. The request shall be made well enough in advance so that all project earthwork details can be resolved and allow sufficient time for flight/control planning, panel setting, and control surveys. Subsequent flight requests on the same project can be arranged by contacting the Photogrammetric Project Engineer.

In addition to the procedures above a question has been added to the field inspection list of questions to discuss the use of aerial photography for each project. The intent of the question is to determine if aerial photography should be used to measure the earthwork. This question will

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1 SOUTH WILMINGTON STREET
RALEIGH NC

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***The Use of Photogrammetry for Excavation Quantities***

- *Memo to State Photogrammetric Engineer & State Location & Surveys Engineer with a date and location for the Earthwork Scoping Meeting*
- *Some Issues: Clearing, Phased Construction & Detours, Borrow Pits, Field Surveys, etc.*
- *Aerial Photography – A moment in time.*

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***Panel Plan and Ground Control***

***Panel Plan – will have panels in areas that should remain undisturbed through life of construction.***

***Ground control must be collected by licensed PLS – Very important!***

***Resident Engineer & Photogrammetric Engineer will coordinate on the required flights.***

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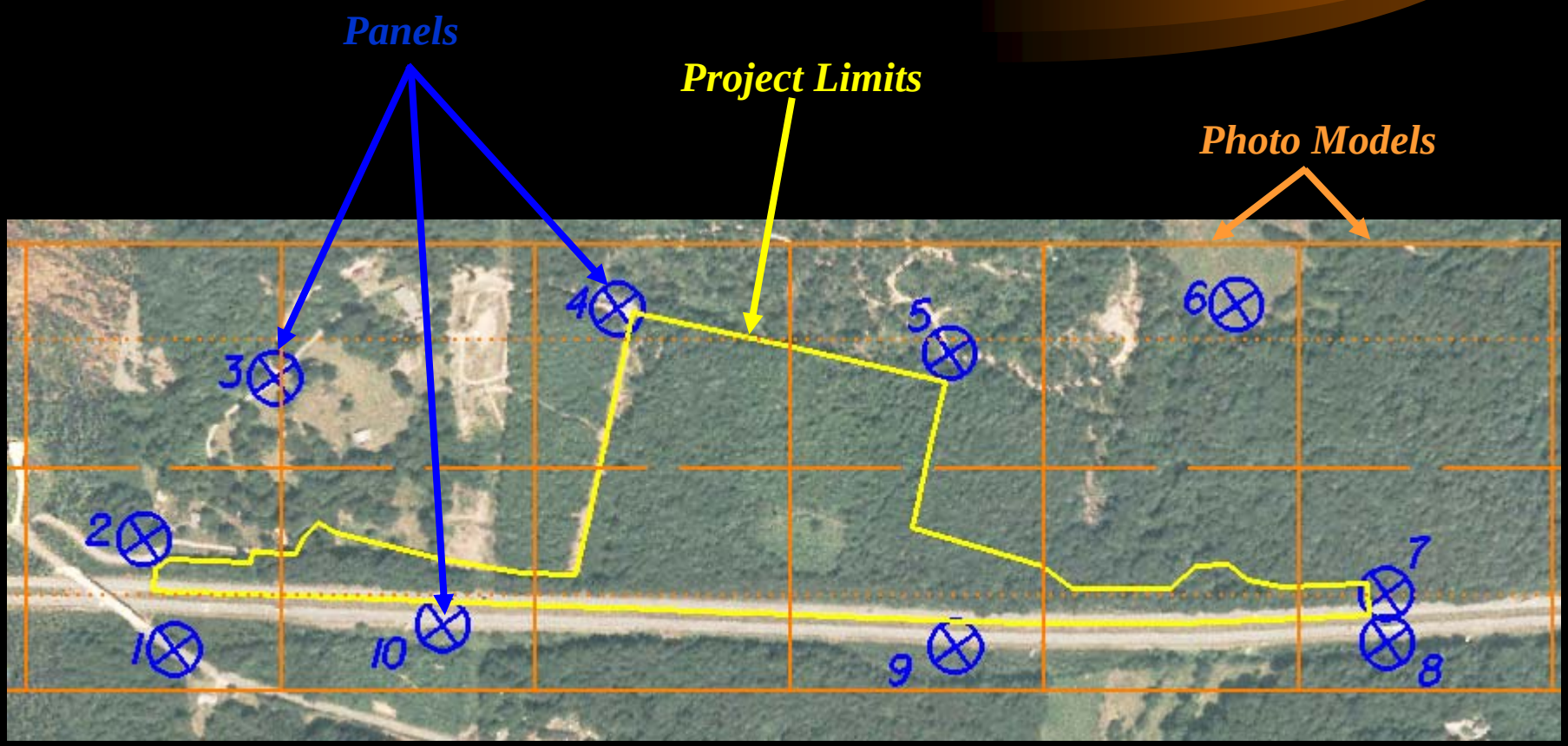

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## *Original DTM*

***Photogrammetry will compare the Original DTM against the Plan Sheet (PS) Design DTM – WHY?***

***THINGS***

***CHANGE***

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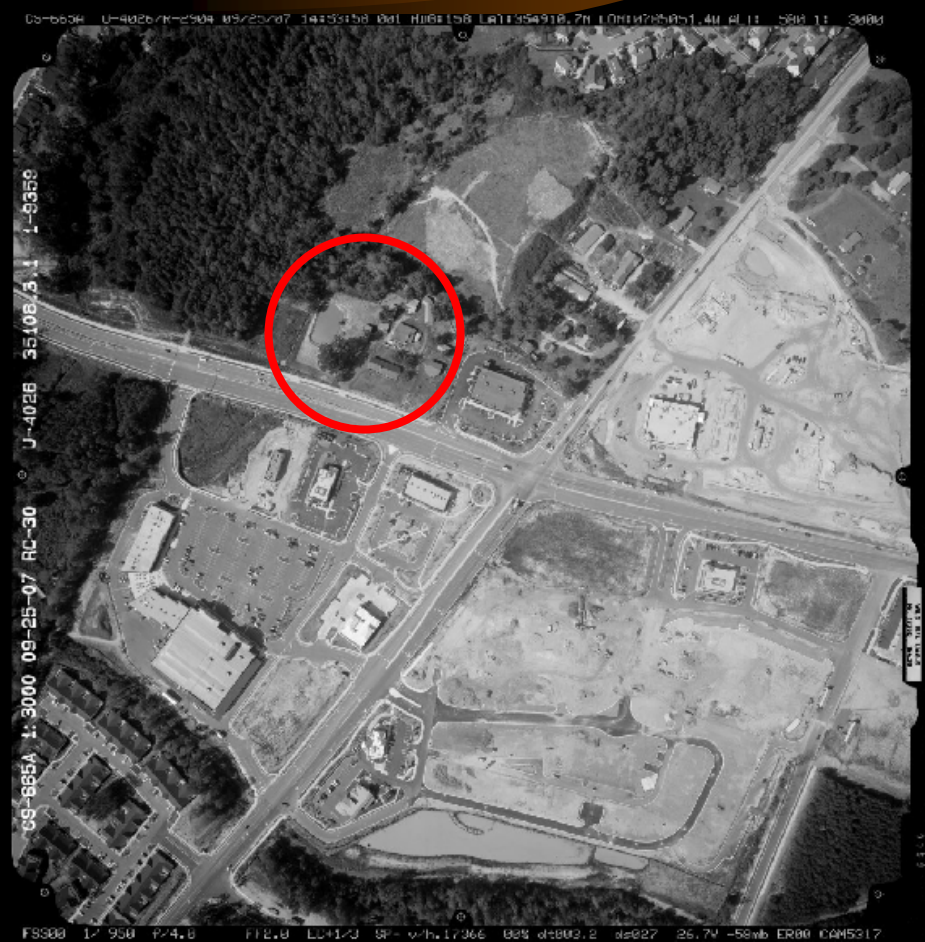
### Flown on 04-07-2000


### Flown on 09-25-2007



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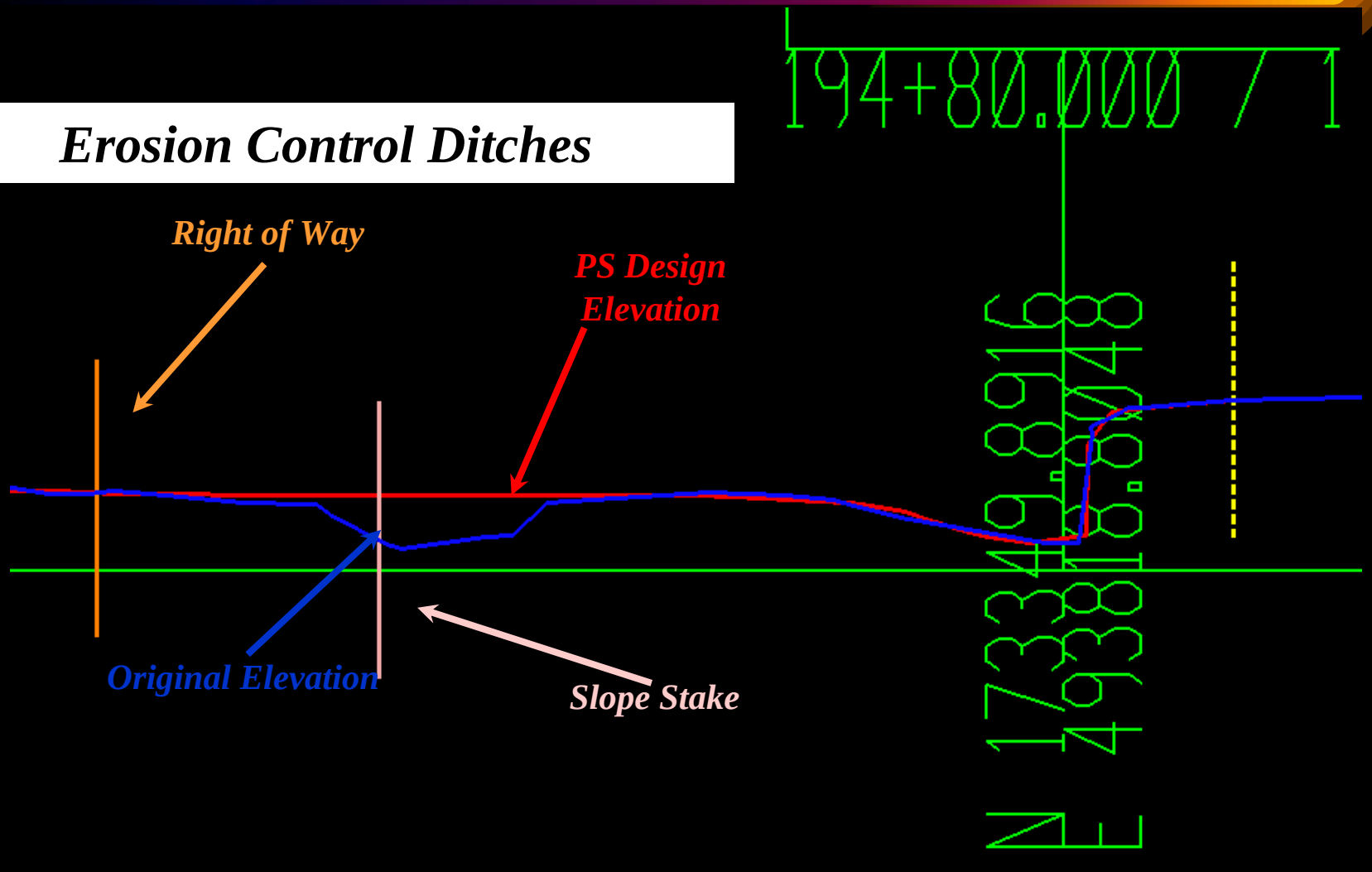
## Erosion Control Ditches



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### Earthwork Activities prior to Originals

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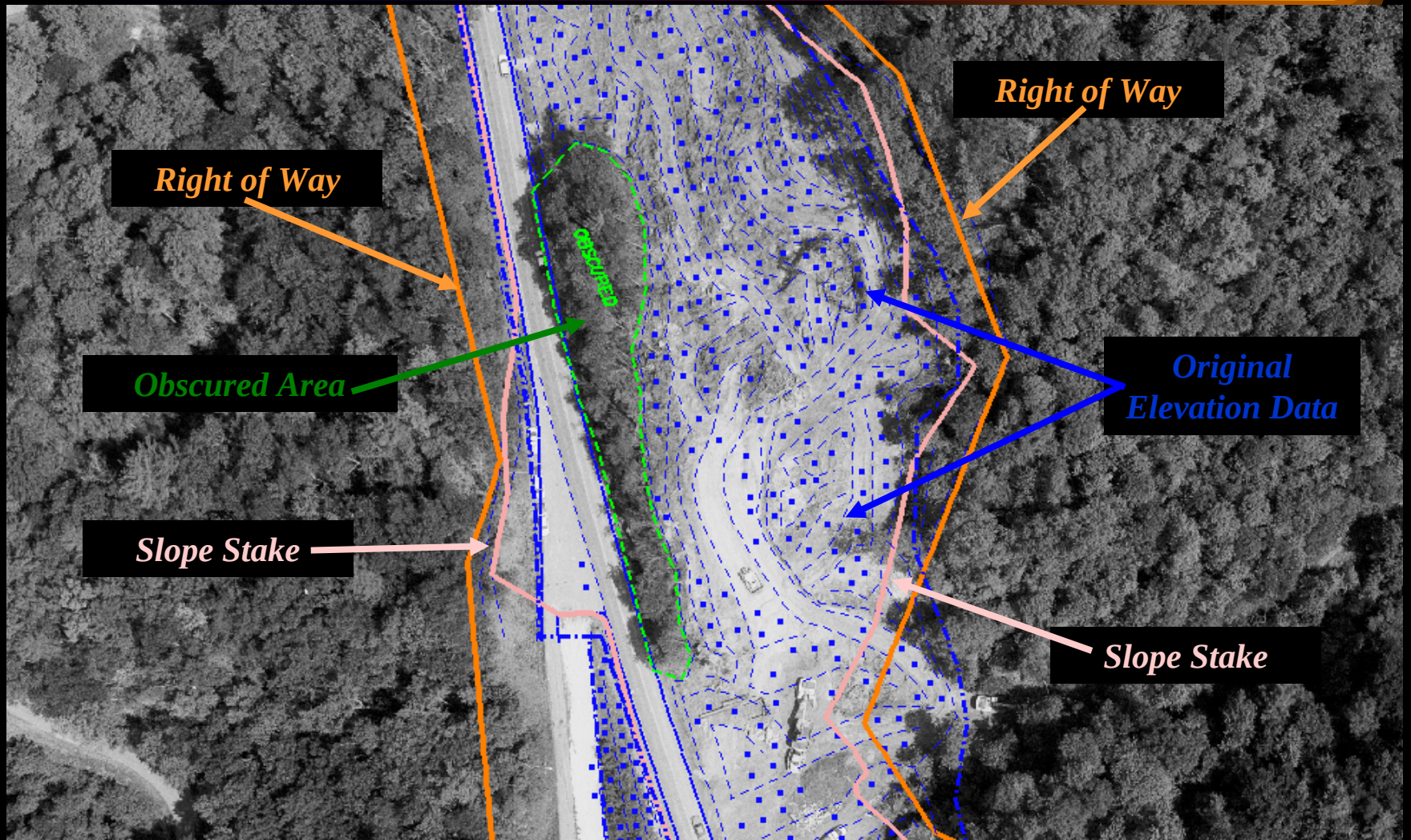

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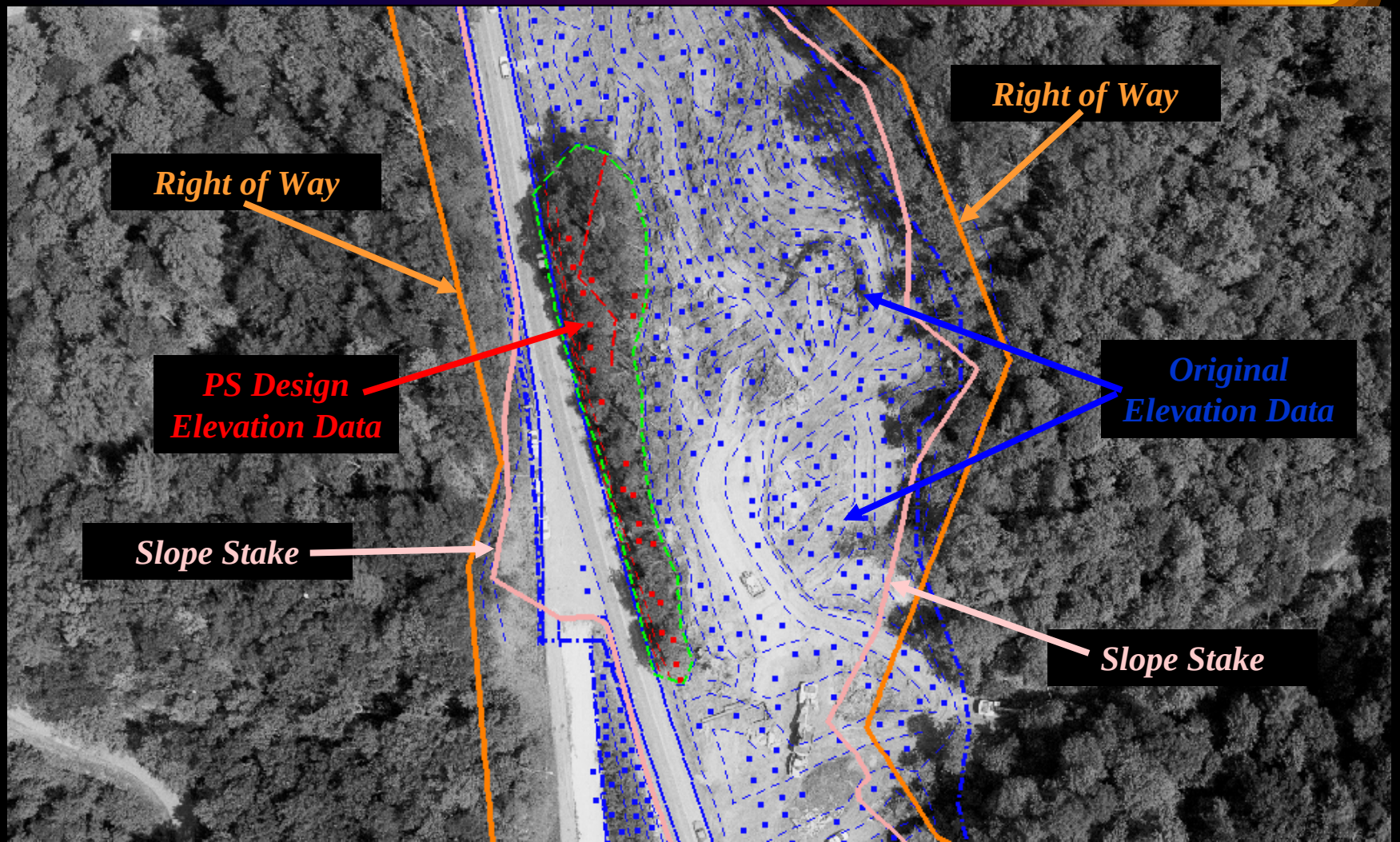

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## *Volume Calculations*

***Photogrammetry calculates volumes by the surface-to-surface method (the Prismoidal Method).***

***The key to this method is to define the shape of the area where volume calculations are needed.***

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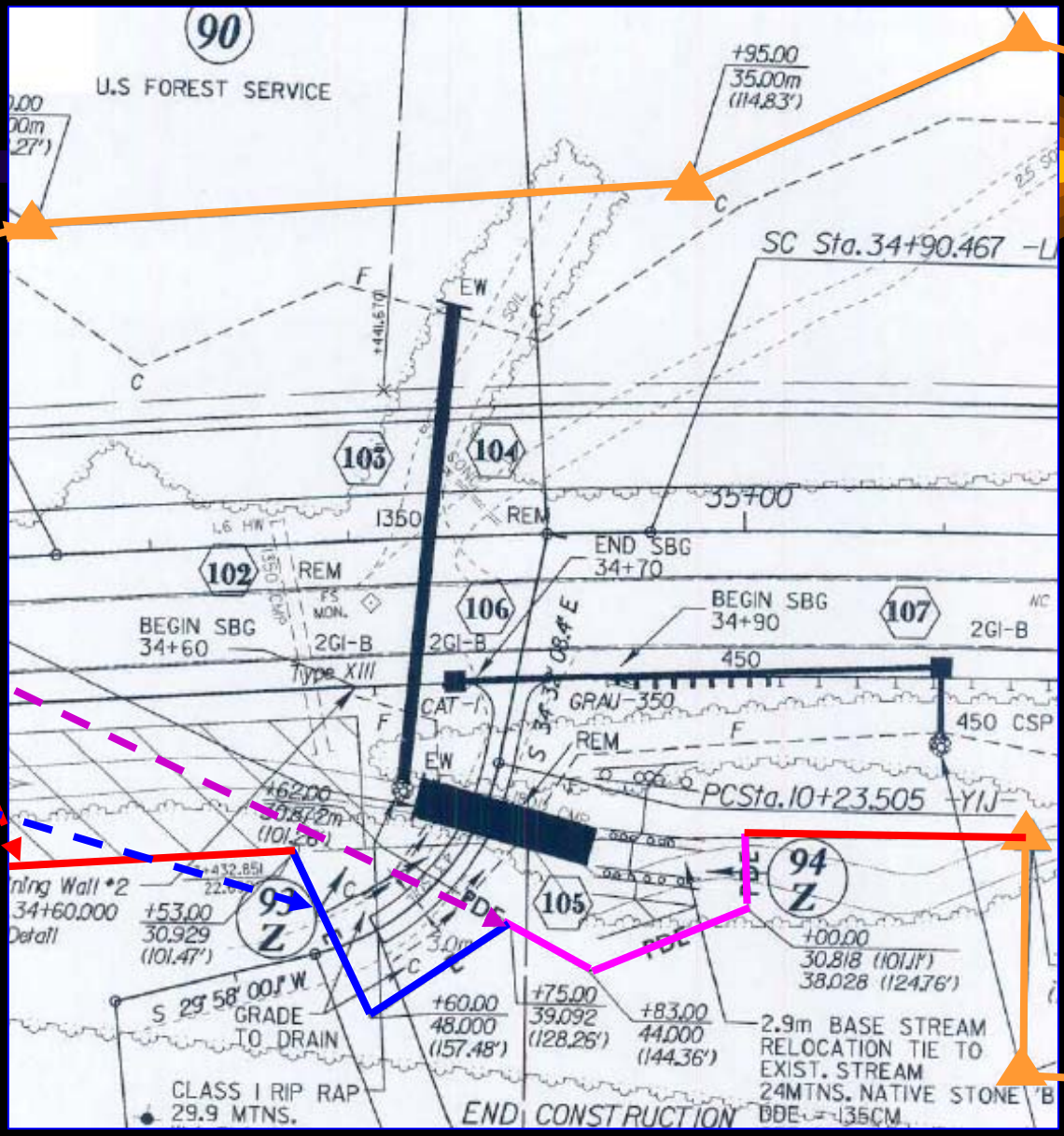
**Proposed Right Of Way**

**Existing Right Of Way**

**Proposed Drainage Easement**

**Easement**



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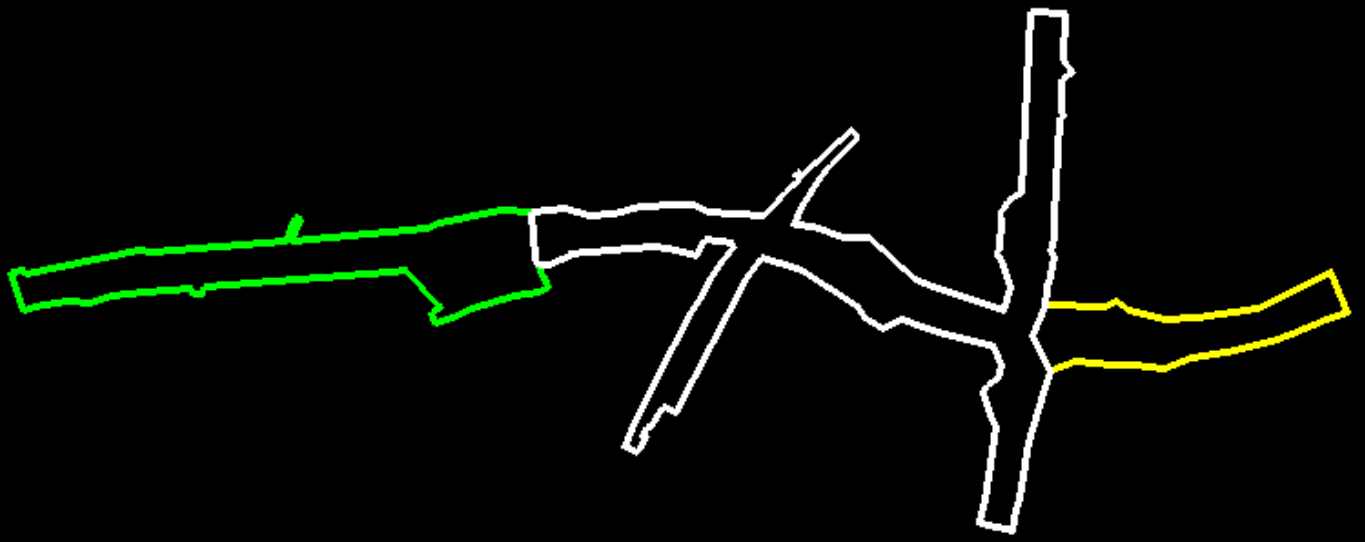
## Surface to Surface Shape Files



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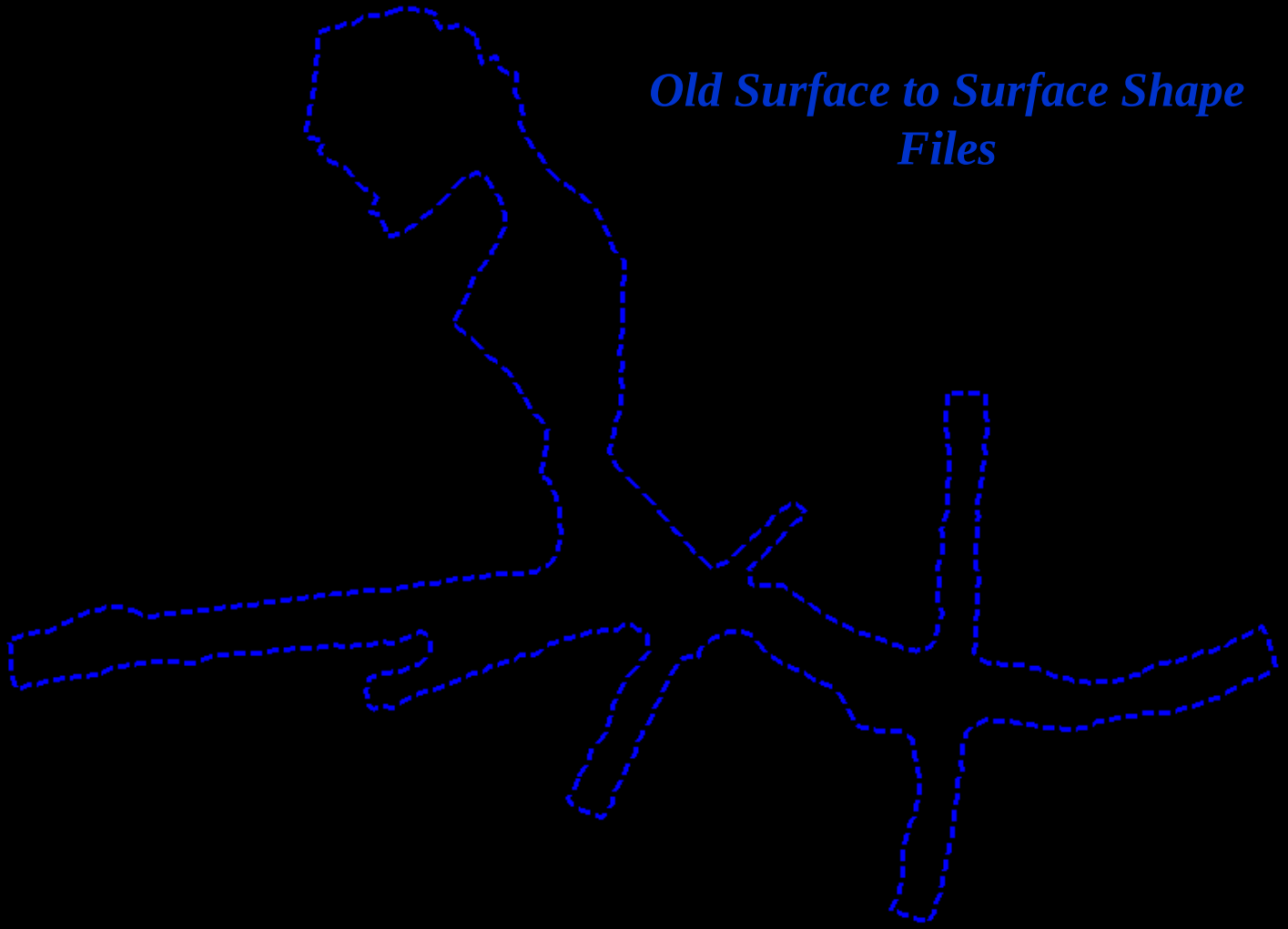
### Old Surface to Surface Shape Files



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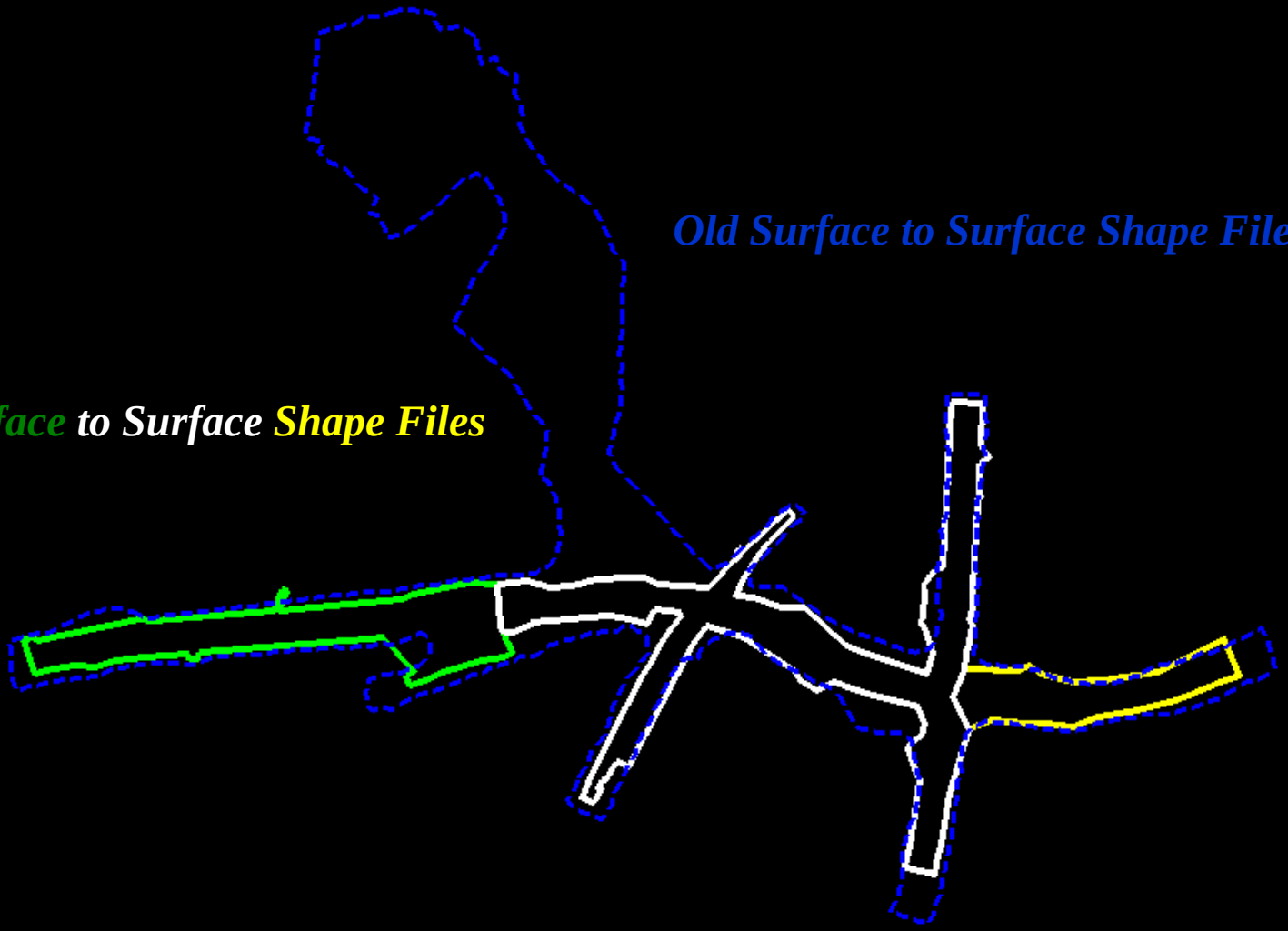
*Old Surface to Surface Shape Files*

*New Surface to Surface Shape Files*



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## *Intermediate Volume Calculations*

***Photogrammetry calculates volumes by the surface-to-surface method.***

***Use the shape file as defined by ROW and Easements.***

***Deliver an Earthwork Summary Sheet***

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**NCDOT / DIV OF HWYS**
**PHOTOGRAMMETRY UNIT**
**Earthwork Summary**

PROJECT 33333.3.3 R-0000 ORIG. PHOTO DATE 02-03-04
LOCATION SR 0000 5 Miles East of Intersection of Twin Bridges
RES. ENGR. Mr. Franklin County, PE INTERMEDIATE PHOTO DATE 05-06-07
PHOTO MISSION CS/FI-999

| Summary | Stations | Prelim. Est. CU.M | Final Quantity CU.M | Difference CU.M |
|---|---|---|---|---|
| SA 1 | L 7+60.000 to 17+60.000 | 23,699.00 | 0.00 | -23,699.00 |
| | Y1 10+00.00 to 11+20.000 | 6,271.00 | 0.00 | -6,271.00 |
| | Prismoidal Volumes | 0.00 | 27,135.39 | 27,135.39 |
| | **SubTotal SA 1** | **29,970.00** | **27,135.39** | **-2,834.61** |
| SA 2 | L 17+60.000 to 27+60.000 | 5,745.00 | 0.00 | -5,745.00 |
| | Y3 10+00.00 to 11+21.002 | 1,637.00 | 0.00 | -1,637.00 |
| | Prismoidal Volumes | 0.00 | 4,612.22 | 4,612.22 |
| | **SubTotal SA 2** | **7,382.00** | **4,612.22** | **-2,769.78** |
| SA 3 | L 27+60.000 to 29+40.000 | 133.00 | 0.00 | -133.00 |
| | Prismoidal Volumes | 0.00 | 31.88 | 31.88 |
| | **SubTotal SA 3** | **133.00** | **61.54** | **-71.46** |
| SA 4 | L 29+40.000 to 37+60.000 | 2,343.00 | 0.00 | -2,343.00 |
| | Y4 10+40.000 to 12+20.000 | 2,529.00 | 0.00 | -2,529.00 |
| | Prismoidal Volumes | 0.00 | 1,872.67 | 1,872.67 |
| | **SubTotal SA 4** | **4,872.00** | **1,872.67** | **-2,999.33** |
| | **Project Total** | **42,357.00** | **33,681.82** | **-8,675.18** |
| | | | | |

**Volumes were done by prismoidal method which includes drainage ditches and other cuts**

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## Final Volume Calculations

*Photogrammetry calculates volumes by the surface-to-surface method.*

**What is included**

*Ground as seen on photography (ditches, stream relocations, borrow pits)*

**What is not included**

*Stockpiles*
*Cut & fill between flights*
*Volume due to pavement*

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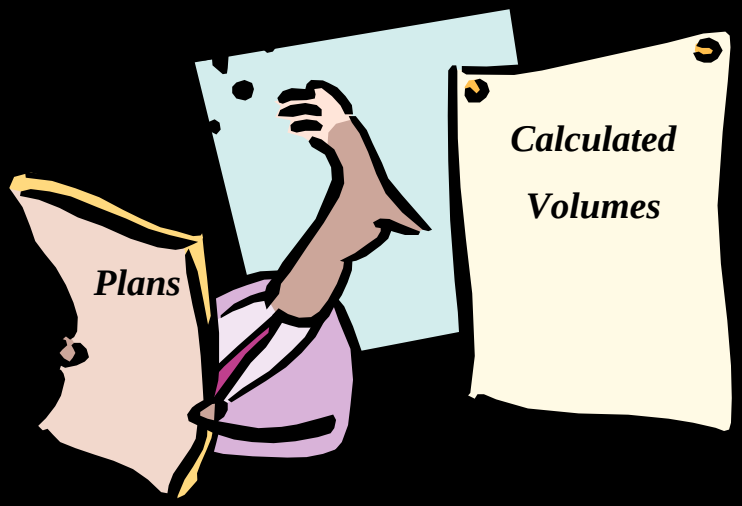
## Final Volume Calculations

*The calculated volumes do not match up with the plan volumes!*

*But Why?*



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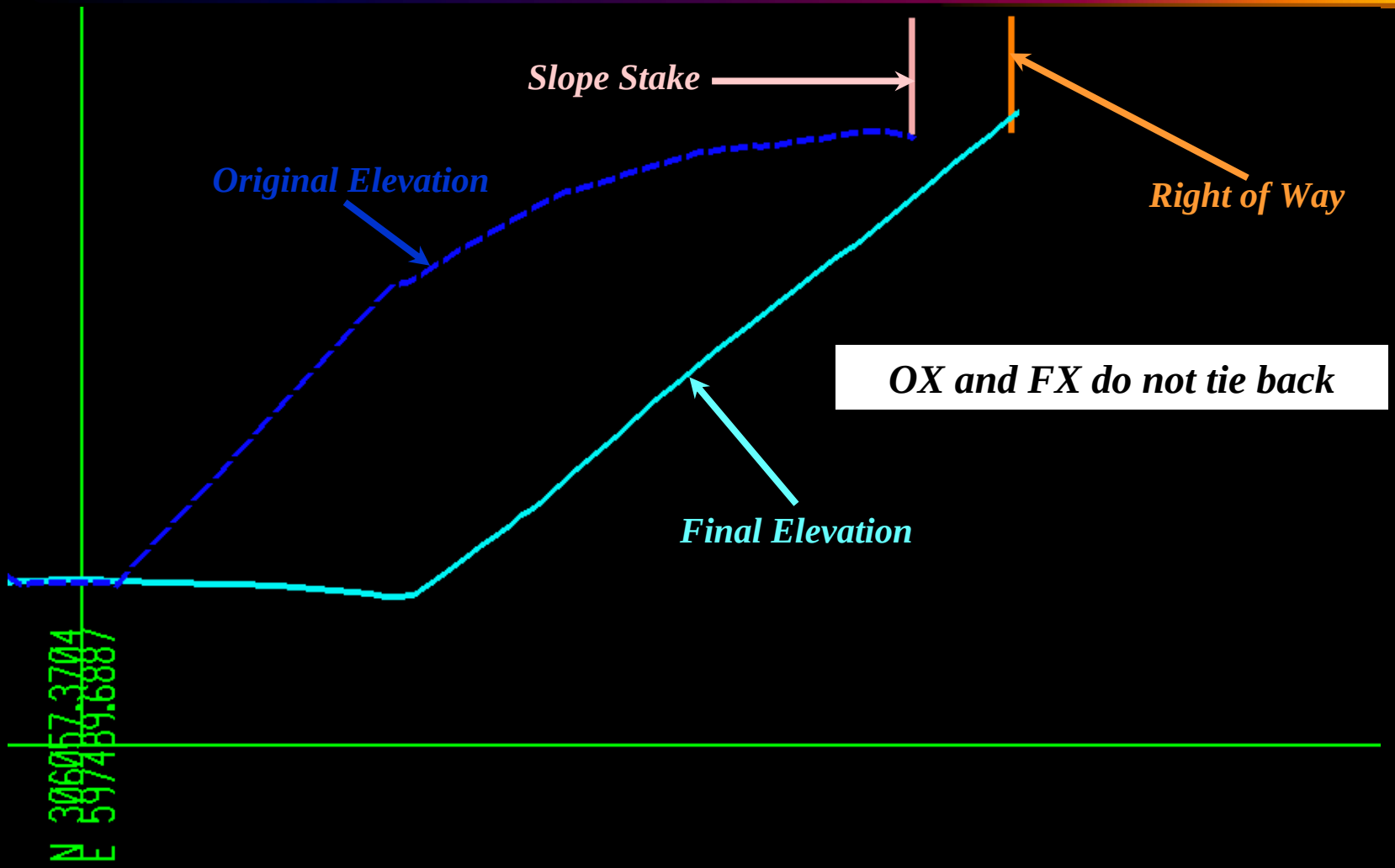

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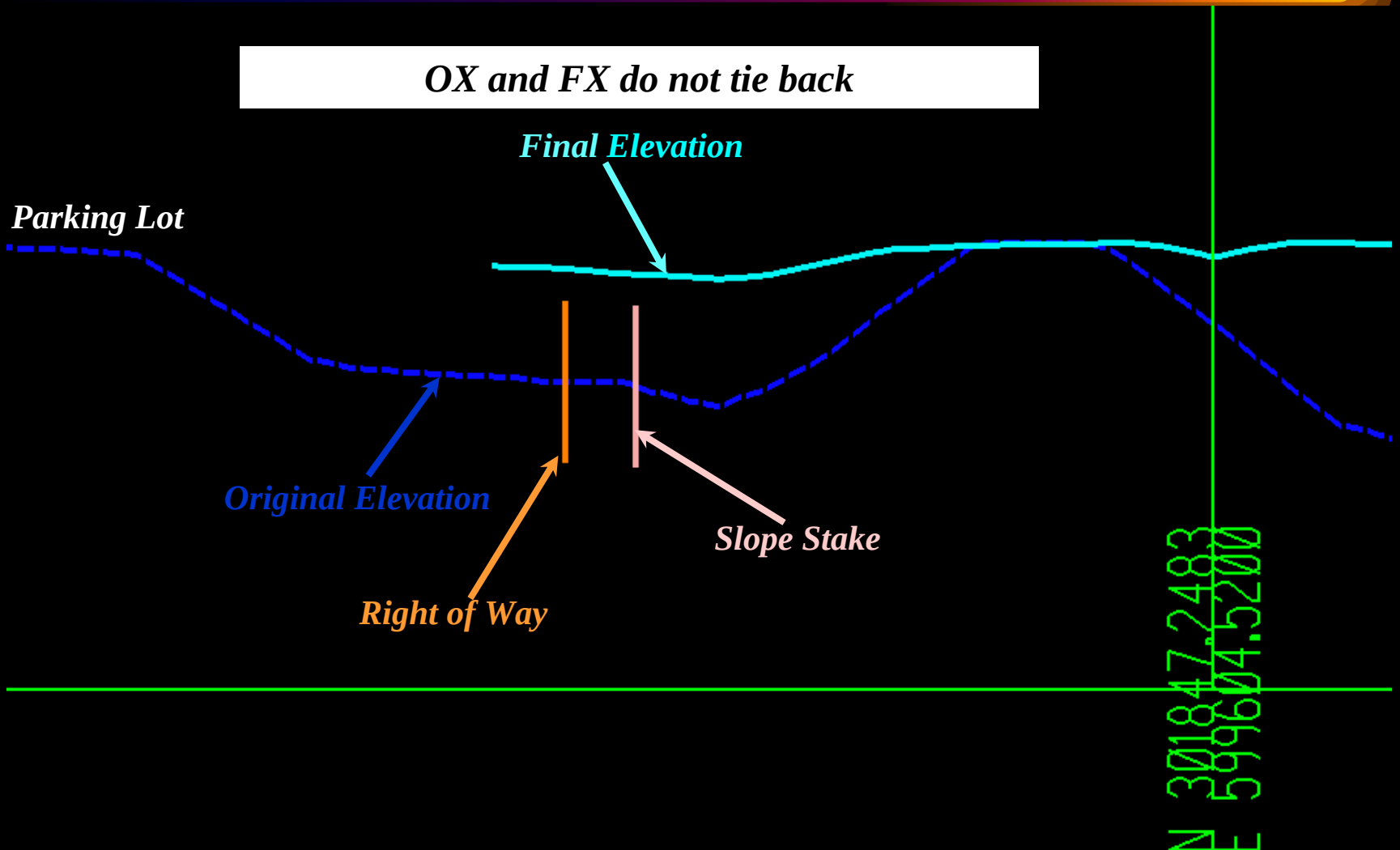
**OX and FX do not tie back**



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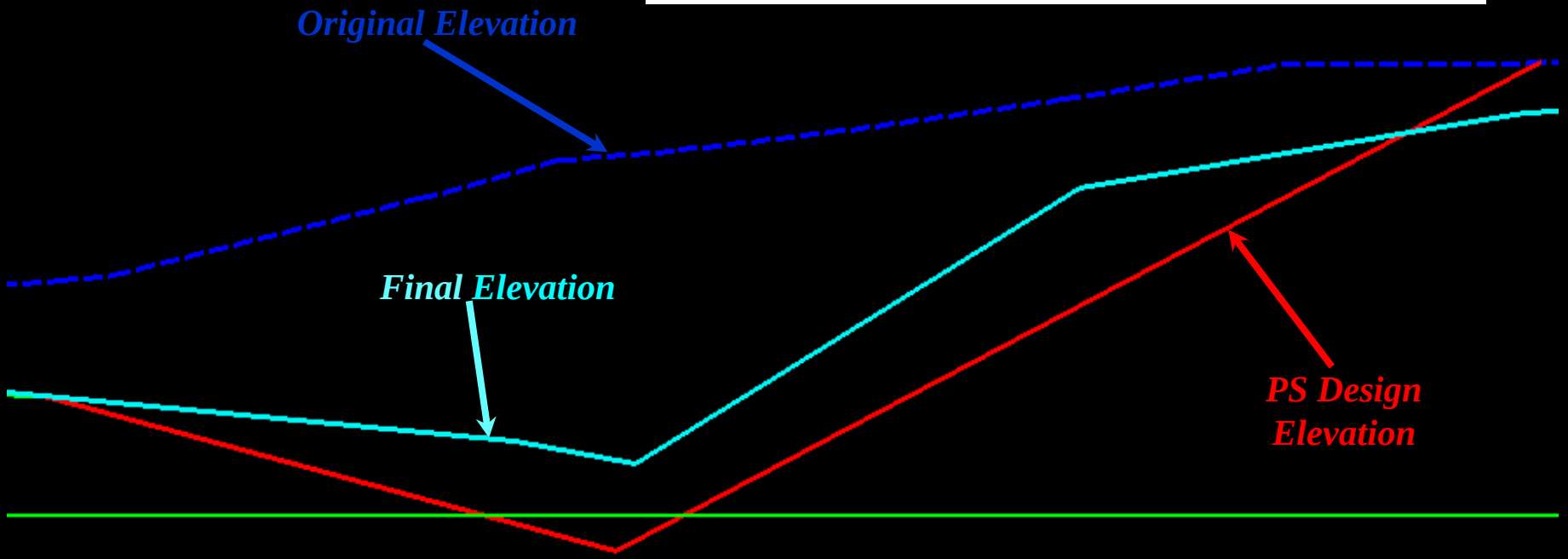
**Not Built as Design**



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## *Borrow Pits*

*Surface-to-surface method*

*Define limits of pit(s) for use as a shape file.*

*On site borrow pits – Calculate volume only once*

*Pits used for multiple projects*

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## *Average End Area*

*Photogrammetry will use Average End Area but…*

- *Work Load Capacity*
- *Template Volumes*
  - *Recommend using volume in plans if available*

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## *Digital Imagery available online*

*Photogrammetry has digital images since 2007 available over the intranet*

- *Requires a training class*
- *Can do in conjunction with the ½ day training session*

## *THANKS!*