

## Line-of-Sight (LOS) Evaluation and Validation

**General:** The designer must ensure that all targets and firing positions are site-adapted. A graphical and/or numerical line-of-sight analysis is performed for all targets and corresponding firing positions. Long distances, natural terrain, and the large embankments associated with firing positions and targets all combine to block the soldiers' view downrange. The designer must account for this fact while locating range features and determining site grading. The RTLP MCX at the Huntsville Center utilizes a tool that analyzes the line-of-sight on the range, which is required to be evaluated at designated milestones during the design. However, this does not absolve the designer from the responsibility of considering line-of-sight when designing the range.

The location of targets and firing positions on the large movement ranges do not have to be as exacting with the standard range layout as is required by the small arms qualification ranges. The targets and firing positions are site-adapted to make the most of the natural terrain's characteristics, while achieving required training objectives. To assure required training can be accomplished on the range, a graphical and/or numerical LOS analysis must be performed for all targets and firing positions. The LOS is taken from the height of the gun barrel at the firing position to a point 350-mm (14in) above the front wall of the armor target emplacements and 200-mm (8in) above the front wall of the infantry target emplacements.

In order to verify any changes during design, a LOS analysis must be completed before or concurrent with the 35-percent design and at the final (95%) design stage. The LOS analysis must be based on a minimum 1/2-m (1ft) contour interval topographic survey of the site.

The designer must provide the RTLP MCX with fully modeled data concerning the project, to include survey data, proposed trails, proposed target berming, proposed downrange power centers, target engagement capability matrix, and proposed firing and target positions in the format defined below so that a complete line-of-sight evaluation can be performed. The data will then be processed through the LOS analysis tool to determine/verify that the proposed range meets training table requirements. The analysis will take place over a six-week period.

The installation's trainer or functional range training support personnel shall accompany the MCX technician during the LOS analysis process and should be prepared to coordinate any LOS generated adjustments to the layout with training requirements. The training specialist should expect to spend up to one week with the MCX technician for each evaluation.

LOS Data Requirements: The designer shall provide the following information:

Layer/Level Standards Document. The designer will provide the layer/level standards document utilized for range design. This document should include the following:

- a. Layer names/number and description of type of data contained
- b. Drawing naming convention
- c. Drawing units (English or metric)
- d. Target and firing point naming convention
- e. Firing/Target type designation
- f. Inventory of files contained within the submittal and a description of the data contained

Existing Digital Model. The designer will provide an existing surface digital terrain model utilizing one of the following formats:

- a. Preferred – dtm formatted Bentley InRoads version 8.4 surface
- b. Land XML Format
- c. Electronic **comma or space** delimited ASCII formatted files containing digital surface information. Each type of data should be in a separate file.

The file formats are as follows:

- 1) Random Points should have the following format:  
ID\*, Northing, Easting, Elevation, Feature\*
- 2) Breakline Information:
  - a) ID\*, Northing, Easting Elevation, Feature\*, Pencode
  - b) Pencode - This field defines for each linear feature a 0 or 1. A 1 identifies the first point of a linear component followed other points within the line having 0. The next new line will start with a 1.
- 3) For electronic **comma or space** delimited ASCII formatted files containing triangle point information (TIN), the file format is as follows:
  - a) Random Points should have the following format.
  - b) ID\*, Northing, Easting, Elevation, Feature\*

(NOTE: \* = Optional parameters)

Trail / Moving Target Emplacement Locations.

- a. Electronic file containing 3D graphic alignments shown at zero elevation at the centerline of trails and moving target emplacements.
- b. Profile of existing and proposed alignments and associated profile report in text format.

Stationary Target Emplacement. Electronic **comma or space** delimited ASCII formatted file with the following information:

- a. Name-Type, Northing, Easting, Elevation

Start / End Trail Firing Positions. In an electronic CAD file, the designer must locate and label starting and ending firing positions along the trails.

Proposed Range Digital Terrain. The designer must provide a proposed digital terrain model including all trails, firing positions, target locations and any other site grading required on the project. One of the following formats should be utilized:

- a. Preferred – dtm formatted Bentley InRoads version 8.4 surface
- b. Land XML Format
- b. 3D Electronic drawing containing 3D data defining proposed range: breakline features are preferred, but contours can be submitted

Target Engagement Capability Matrix.

- a. The functional range training support personnel shall develop the project's Target Engagement Capability Matrix based on training standards and the installation's training requirements in conjunction with the 15% design submittal. The Target Engagement Capability Matrix shall contain the critical engagements that the range must obtain in order for the project to meet Army training standards. The Target Engagement Capability Matrix will be delivered to the Army Training and Support Center (ATSC) for validation and will be included in the specification portion of the design submittal. The functional range training support personnel will also assist in the explanations, revisions, or corrections to the Target Engagement Capability Matrix in order to obtain ATSC approval.
- b. After the LOS validation (95% design) is complete, the functional range training support personnel shall review and revise the project's Target Engagement Capability Matrix based on any changes made since the 35% design submittal. The Target Engagement Capability Matrix must be resubmitted to the Army Training and Support Center (ATSC) for re-validation if changes have occurred since the 35% design submittal. The functional range training support personnel will assist in the explanations, revisions, or corrections to the Target Engagement Capability Matrix in order to obtain ATSC approval.
- c. The designer should coordinate with the Government on the application of the final Target Engagement Capability Matrix during construction. The construction contractor should normally be required to field verify all of the Target Engagement Capability Matrix engagements as early as possible in the construction progress. Any conflicts in engagement visibility should be brought

to the Government's attention as soon as possible in order to prevent wasted construction effort and for conflict resolution.