

# Fact Sheet

## Winter Effects Algorithms — NATO Reference Mobility Model (NRMM II) —

### PROBLEM

To provide vehicle speed predictions over winter terrain.

### HISTORY

The NATO Reference Mobility Model (NRMM II) is a comprehensive computer model that predicts vehicle speed performance for operations on roads, trails, and cross-country in all weather conditions, including terrain conditions associated with winter. The model primarily calculates available traction and motion resistance caused by operation on soft surfaces. Traction versus slip, in conjunction with power-train capabilities, is used to generate an overall maximum traction-versus-speed prediction. The motion resistance is used in combination with other resisting forces (e.g., vegetation, slope) to determine the maximum possible force controlled by speed. Model outputs are velocities traveling up- and downslope, average velocity, and a code related to the speed controlling condition within a terrain unit.

### SOLUTION

The winter effects algorithms are a series of equations that predict traction and motion resistance on winter terrain. These terrain conditions include snow cover on unfrozen, frozen, and ice-covered surfaces; deep snow; thawing soils; and ice-covered surfaces with no snow cover. Deep snow is defined as snow conditions for which vehicle sinkage is greater than the minimum ground clearance of the vehicle. Winter terrain for mobility analysis is described as a layered system consisting of a surface cover of a given depth (snow), a surface condition (normal, slippery, ice-covered, etc.), a depth of freezing, and a depth of thawing. Terrain data requirements are snow depth and density, soil type, soil moisture content, frozen soil depth, and thawed layer depth. Data may be specified for a scenario or within a terrain unit. These data are also available as output from the Soil Moisture Strength Prediction model (SMSP II). The winter effects relations are derived from various studies involving combinations of vehicles and terrain conditions.



*HEMTT and HMMWV immobilized by winter conditions.*

### POINT OF CONTACT

Dr. Paul W. Richmond  
603-646-4461  
Fax: 603-646-4640  
E-mail: richmond@crrel.usace.army.mil

Richard Ahlvin  
601-634-3582  
Fax: 601-634-3068  
E-mail: ahlvinr@mail.wes.army.mil

January 1999



**US Army Corps  
of Engineers®**

Cold Regions Research &  
Engineering Laboratory