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A Hydrologic Modeling Study of Water Balance Relationships at the Area P Landfill in Los Alamos, New Mexico

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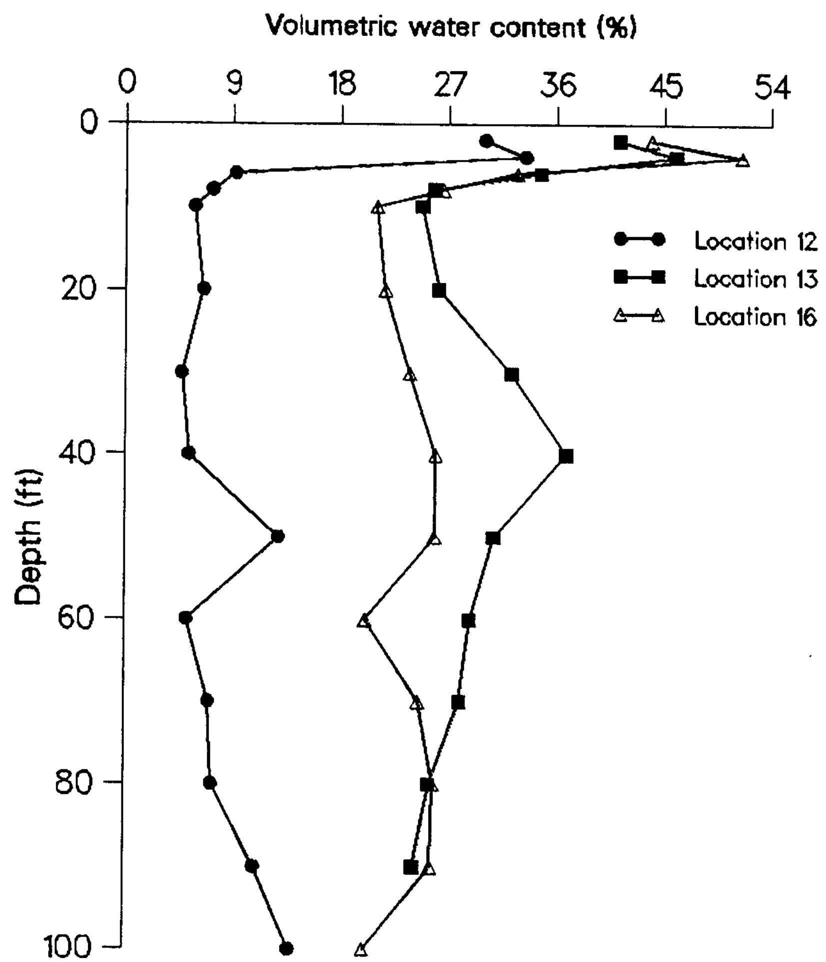

Fig. 14. Volumetric water content data for three sampling locations in March 1988.

water contents were not simulated in 10 yr until RC values closer to 0.003 in./hr were used (Figs. 15 and 16).

The second major conclusion reached was a verification that even a poor range-grass cover seemed to enhance simulated evapotranspiration, thus reducing volumetric water content (Fig. 16) predicted by CREAMS over that observed in the bare-backfill scenario (Fig. 15). Although CREAMS-predicted volumetric water content does gradually increase with time in the backfill, this occurs dramatically slower with time with a small amount of vegetation present.

These CREAMS simulations are summarized in Fig. 17 in terms of the volumetric water content predicted by the model in December 1987 and the average annual seepage as a function of the saturated hydraulic conductivity. Again, the point is made that as the saturated conductivity for the cover profile decreases, the volumetric water content increases and the average annual seepage through the fill cover decreases.

From the simulation results shown in Fig. 17, we decided to set the final RC factor at 0.003 in./hr and simulate seepage production over the 10 yr of precipitation observed at S Site (Figs. 18 and 19). CREAMS predicts annual seepage ranging from 0 in. to almost 7 in. from the 7-ft profile either with or without vegetation. Notice that there seems to be a lag period in maximum seepage production of about a year after a year with high-precipitation.

The simulation results presented in Figs. 17 to 19 are examples of what could be learned when a field-calibrated hydrologic model is developed for the Area P Landfill in the future. Current experience

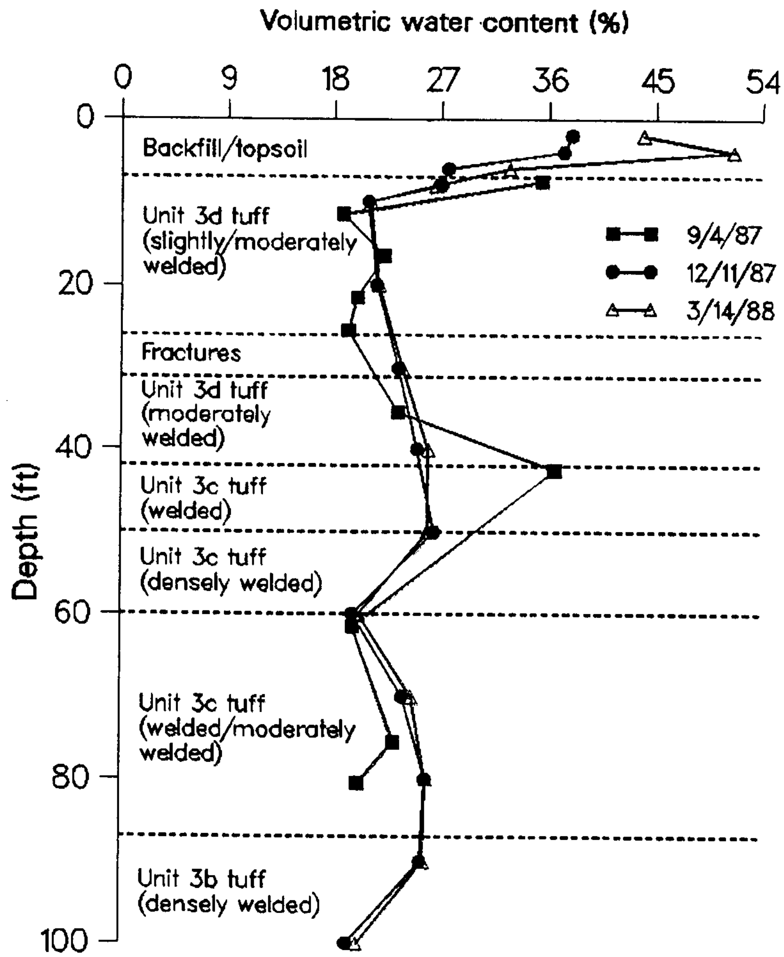

Fig. 13. Volumetric water content data for location P-16.

Because the only real site data for this time period consisted of volumetric water content data collected in December 1987, clearly, this was an attempt to extrapolate and estimate hydrologic variables to the maximum! However, after several CREAMS simulations, parameter optimization techniques lead to the estimation of volumetric water content with time while varying the saturated hydraulic conductivity (RC) in the model. The CREAMS RC parameter represents the slowest estimated hydraulic conductivity of either (1) any layer in the crushed tuff profile considered in the simulation at the Area P landfill, or (2) a layer immediately beneath the crushed tuff profile, such as a layer of either undisturbed tuff or fine-textured soil particles. The results are presented in Fig. 15 for the bare backfill scenario and in Fig. 16 for a cover with poor range-grass cover.

Two important conclusions resulted from these initial CREAMS simulations. First, as we discussed at the end of the last section, RC values as large a 0.070 in./hr and greater (which would be characteristic values for crushed tuff backfill alone) resulted in CREAMS-estimated volumetric water contents that were much lower (Figs. 15 and 16) than those observed in the field (Figs. 12 and 13). Thus, the rate-limiting saturated hydraulic conductivity that finally used in CREAMS simulations of the tuff backfill had to match the ra in RC factors known for the less-conductive underlying tuff (or a fine-textured soil layer immediately above the tuff), *i.e.*, 0.003 to 0.070 in./hr! Even within this range of conductivity values, field-observed

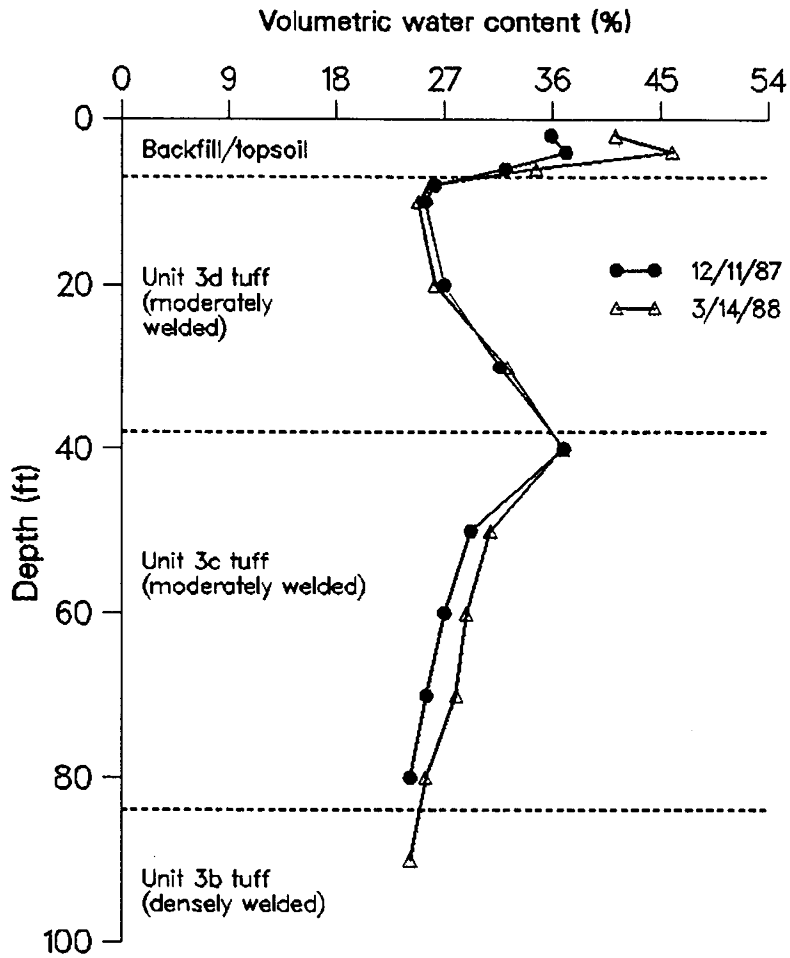

Fig. 12. Volumetric water content data for location P-13.

VI. HYDROLOGIC MODELING AT THE AREA P LANDFILL

The CREAMS modeling activities for the Area P landfill had two general objectives. The first objective was to estimate soil and plant modeling parameters to model the Area P landfill as it currently exists without implementation of a closure cover. The southeast and southwest portions of the landfill currently have no vegetation and sparse vegetation, respectively, so both of these scenarios had to be modeled. The second objective was to use a field-calibrated CREAMS model to help evaluate cover features, such as cover thickness, to help improve a final approved closure plan for this landfill.

A. Area P Landfill Scenario Without a Closure Cover

The CREAMS modeling scenarios in this subsection involved modeling the 7-ft-deep backfill at the landfill for the vegetated and nonvegetated portions of the site. Model parameter estimates were initially chosen using past experience (Nyhan 1989, Nyhan and Barnes 1989, Nyhan and Lane 1982) and other instructions on how to use CREAMS (Lane 1984). The daily precipitation input file used was the 1977-1987 data collected at S Site by Group HSE-8 personnel.