V. CONCLUSIONS

Experiments were conducted to determine the effectiveness with time of tillage for ameliorating compaction on reclaimed minelands caused by heavy equipment during the respreading operations. From the previous discussion, several conclusions may be drawn from the data:

1. Subsoil tillage prior to topsoil respreading did not have a significant effect on resultant bulk density following topsoil respreading with scrapers. Scraper and grader traffic during topsoil respreading compacted the tilled subsoil to bulk densities equal to areas left untilled.
2. Attempts to spread subsoil with scrapers and minimum traffic to reduce compaction were also not effective. Over half of the materials were compacted due to the scraper tires during the respreading operation. Most of the remaining subsoil material was compacted during levelling by graders and topsoil respreading.
3. Bulk densities increased significantly with time in the subsoil regardless of the tillage treatment applied due to reconsolidation of soil particles and depletion of soil water. The majority of change occurred within three to four years after reclamation.
4. Bulk densities near the surface generally decreased significantly with time due to vegetative growth, wetting/drying and freeze/thaw. However, adverse weather conditions during the final year of these experiments increased bulk density to values not significantly different from those of several years earlier at some

locations. Differences among topsoil tillage treatments generally decreased with time to where bulk density values were not significantly different after about 4 y.

5. Soil strength, as measured with a cone penetrometer, showed increasing values with time as bulk density increased. Bulk density was the major contributing variable for estimating soil strength during correlation/regression analyses.

6. Evidence of the areas disturbed by the shank of the deep rip implement were still present more than four years after the tillage treatment was applied. Soil materials in the shank tracks had not reconsolidated as much as between the shank tracks as measured by the cone penetrometer. This suggests that close spacing of shanks on this type of implement may be effective in maintaining lower soil strength with time for potentially greater rooting depth and water infiltration.

7. Low available soil water negatively affected vegetative growth and, as amounts decreased with time, bulk densities. Soil water amounts were not sufficient below the near-surface areas to significantly decrease bulk densities during freeze/thaw cycles.

8. Yields at all locations were adversely affected by low amounts of stored available soil water amounts, below normal growing-season rainfall, and generally hot summer temperatures. These factors also affected the initial germination of the planted forages resulting in either reseeding and/or plants entering the winter season under stress.

9. Rooting depth, root length density, and root mass values for the various forages measured have increased with time. However, few significant tillage effects were

found. Overall mean values for bulk density and soil strength at the sites by depth have not, as yet, reached values where root penetration (except in small areas) has been stopped completely. Growth to deeper depths may slow down because of small amounts of available soil water.

10. Wheat yields at the topsoil tillage/forage locations showed little effect from tillage. The only major difference occurred the first year of study at one location as a result of a heavy rain immediately following application of the tillage treatments. Soil water contents presumably increased markedly at depth in the subsoil tillage treatment, but not so in the chisel treatment. Resultant wheat yields from the subsoil treatment after a growing season of below normal rainfall, showed nearly a 400% increase over yields from the chisel treatment. This result was an isolated case not likely to be repeated with any regularity.

11. Wheat yields from prior-cropped strips were inconsistent. The prior-cropped strips affected yields at the two topsoil tillage/forage locations differently. However, yield differences among prior-crops were significant at both locations. No definite reasons for the observed results have been reached although some of the difference was attributed to available soil water at planting.

12. Bulk densities from long-term locations indicate that trends towards higher bulk densities in subsoils and lower bulk densities near the surface with time (up to 11 years) in reclaimed soils can be expected. Maximum subsoil bulk densities have most likely been reached at one location, and may be approaching a maximum at the other two locations. The outlook for other reclaimed minesoils is similar

given a return to more normal weather conditions within the current climatic pattern.