

A REPORT ON

**RECLAMATION RESEARCH IN NORTH DAKOTA:
AN INVENTORY OF PROJECTS, PUBLICATIONS, AND
FUTURE RESEARCH NEEDS**

Prepared by

**Reclamation Research Advisory Committee (RRAC)
&
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PREFACE

This report was first published in 1984 under the title "Reclamation Research In North Dakota: Inventory of Past and Ongoing Research, and Identification of Future Research Needs," for submission to the North Dakota Legislative Council, in compliance with the requirements of NDCC 38-14.1-04.2. Since then, each year, additional scientific material on reclamation research conducted in North Dakota was regularly reviewed, summarized, and inventoried by the Reclamation Research Advisory Committee with the assistance of the Public Service Commission staff. A revised edition of the report was prepared in 1986, followed by an addendum to the report in 1989. Now, after twelve years of initial compilation, the 1996 revised edition has been prepared to provide a broader, up-to-date perspective of the mined land reclamation questions and concerns that have been researched in North Dakota and those that remain to be addressed. The subtitle of the present edition has been slightly modified from the original, as there are no reclamation research projects ongoing or being funded at this time.

The 1996 revised edition consists of two parts. Part A contains an inventory, with brief descriptions, of research projects that have been conducted on coal mining and reclamation related problems in North Dakota, and two listings of the 'current and future' reclamation research needs. The first list identifies the research needs as perceived in 1996. The second list is included for the purpose of assessing the progress of research over the past 12 years, as it identifies the research needs envisioned in 1984. Part B contains an annotated bibliography of research reports, papers, presentations, etc. related to coal mining and reclamation in North Dakota. A brief description and analysis of conclusions was developed for each of these published or unpublished reports and papers. The resulting 'publication briefs' have been classified into various subject categories and arranged chronologically within each category. The report also includes an executive summary and introduction in the front, and author and subject indexes at the end, which are based exclusively on the contents of Part B.

In preparing this report immeasurable help was provided by the past and present staff of the Public Service Commission's Reclamation Division, Abandoned Mine Lands Division, and the Data Processing Section. The Reclamation Research Advisory Committee gratefully acknowledges their help and thanks each one of them for their valuable input. The assistance rendered by Paul Klebe in reformatting this report and in redeveloping the subject and author indexes is greatly appreciated. Thanks are also due to a number of state and out-of-state research organizations, North Dakota Universities, state and federal government agencies, and the North Dakota Lignite Energy Council for providing information on the reclamation research projects and future needs. A close interaction with and timely information provided by North Dakota State University's Land Reclamation Research Center, Mandan, and the University of North Dakota's Energy and Environmental Research Center, Grand Forks, made the task of compiling this report easier. Finally, the 1996 revised edition would not have been possible without the active support and interest of the North Dakota Public Service Commissioners.

December 1996

Nirander M. Safaya, Chairman
Reclamation Research Advisory Committee,
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EXECUTIVE SUMMARY

1. This is a revised, updated edition of a report that was prepared in 1984 pursuant to the amendments, NDCC 38-14.1-04.1, NDCC 38-14.1-04.2, and NDCC 38-14.1-04.3, made in the North Dakota surface mining and reclamation law in 1983.
2. As required by NDCC 38-14.1-04.1, a three-member Reclamation Research Advisory Committee (RRAC) was appointed by the North Dakota State Governor. The RRAC, with the administrative and staff assistance from the North Dakota Public Service Commission (NDPSC) was required (NDCC 38-14.1-04.2) to: 1) develop an inventory, with brief description and analysis of conclusions, of all past and ongoing reclamation research projects conducted in North Dakota; 2) identify all existing or future reclamation research needs, 3) establish priorities based on the criteria laid down in Section 38-14.1-04.3 of NDCC; 4) prevent duplication in reclamation research; and 5) prepare future reclamation research budgets administered by the Commission. It was in fulfillment of these requirements that the original report was prepared. This edition, however, does not include a research budget because the Commission is not currently administering any research projects.
3. The information presented in this report on reclamation research projects and current and future research needs in North Dakota was obtained from various research groups, state and federal agencies, and the lignite industry. Additionally, a comprehensive literature search was conducted, and all the available reports, papers, and other published and unpublished research material related to reclamation of North Dakota coal mine lands was reviewed and abstracted. These abstracts or "publication briefs" were developed to augment information on the reclamation research projects and to provide a consolidated reference source for all areas of reclamation research conducted in North Dakota.
4. Although there is a long history of reclamation research in North Dakota, a serious consideration to this end was given only after the enactment of the State's first reclamation law in 1969. The research efforts increased and diversified considerably during the 1970's and 80's, with much emphasis on geologic and hydrologic aspects of mining and reclamation, mine spoil characterization, restoration of agricultural productivity, and ecological rehabilitation of disturbed ecosystems. However, this trend has now reversed, as almost all active centers where reclamation research was vigorously pursued have either disengaged from this area of research or have been closed down.
5. Since the early 1970's, over 130 reclamation research projects have been conducted. Out of these, 50 projects have been devoted to geologic and hydrologic aspects, 50 projects to soil/spoil characterization and agricultural productivity of mined lands, and 30 projects to ecological aspects of mining and reclamation.
6. It was estimated that approximately \$23,600,000 have been spent for conducting mining and reclamation related research in North Dakota during the period of 1970 to 1996. Out of this amount, about \$10,000,000 were spent on geologic and hydrologic aspects, about \$11,000,000 on agricultural aspects, and about \$2,600,000 on ecological aspects of mine land reclamation. Ecological aspects of reclamation research received the least amount of funding, especially after 1984; the available information indicated that less than half a million was spent between 1984 to 1996.

7. There was not much redundancy detected in the research projects *per se*. However, some overlapping of goals and program objectives was evident in some cases. Also, some of the basic themes or questions seemed to have been researched over and over again, with no final answers. Limited interaction and collaboration, competition, inadequate or scattered funding, and short-term planning were, perhaps, some of the main reasons for overlapping of research objectives and repetitive field or laboratory studies. A marked tendency to publish the same results, findings, or ideas simultaneously in several reports and journals was quite evident. The redundancy in publication of results was due to the over-reporting requirements imposed by the funding agencies and, perhaps, also because of the 'publish or perish' ideology or the inflationary attitude prevalent in the scientific community.
8. Some of the research studies seemed to have had a significant influence on the surface mining and reclamation laws, rules, and practices in North Dakota. This includes the research on soil respreading requirements which led to the adoption of an alternative rule in 1985 that allows the soil respread thicknesses to be based on the characteristics of the underlying graded spoil. Also, enough data has been generated in many other subject areas (i.e., prime farmland restoration, soil productivity, management of reclaimed lands, erosion potential, water recharge, evaluation of revegetation success, etc.) that may be effectively used to bring about further changes in the mining and reclamation laws, rules and practices. Obviously, some of the research conducted thus far in North Dakota has and will continue to provide dividends in terms of reducing the cost of mining and reclamation, improving the quality of reclamation, and ensuring greater environmental safety. However, as several recently initiated studies remain incomplete, with no final conclusion drawn, their usefulness to the lignite industry will be slight.
9. The number of research needs perceived today are fewer and more well defined than those perceived in 1984. Some of the top priority research needs include: assessment and mitigation of mining effects on groundwater quality and quantity; suitability of mined areas for waste disposal; effectiveness of reclaimed wetlands for groundwater recharge; effects and alleviation of soil compaction in reclaimed mine lands; prime farmland restoration; stability of reclaimed grasslands; simple and reliable methods for evaluation of reclamation success, establishment, management and evaluation of tree and shrub communities; and use of microorganisms in reclamation. These and other research needs merit funding commitment.
10. A great deal of progress in reclamation research has been made in North Dakota since the enactment of its first reclamation law in 1969. This was possible mainly because several private and public entities in the state made a commitment to allow coal mining to occur at full scale while preserving the quality of environment and ensuring that the mined lands would be returned to their original or better use and productivity. This commitment was backed with proper funding and the interest of several dedicated scientists working at various universities and research organizations in the state. Since a large amount of money has already been spent in reclamation research, to reap its full benefit it is necessary that the outstanding questions and concerns are researched to their completion. The Lignite Energy Council is the most appropriate channel through which the lignite industry could seek funds from the Lignite Research Council for completing the remaining research.
11. This report will help the lignite industry, academia, and various public and private agencies to identify the tasks ahead, as it clearly defines what has been achieved and what remains to be addressed.