

# ACTIVITIES OF THE WYOMING RECLAMATION AND RESTORATION CENTER<sup>1</sup>

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**Abstract.** A half-day session at the 2009 ASMR/BLRS meetings showcased research activities, and some outreach/extension issues associated with the Wyoming Reclamation and Restoration Center (WRRC). Research activities associated with the WRRC are diverse and include plant and plant resources, soil issues, water and water quality, wildlife and wildlife habitat, economics of reclamation and others. Reclamation and Restoration related research and instruction have been on-going at the University of Wyoming since the 1960s. However, it was only in 2002 that a Center initiative was approved by UW's central administration. Early in 2007 activity of the Center increased with the selection of a new director and the creation of the School of Energy Resources (SER) at the University of Wyoming. The WRRC (<http://uwadmnweb.uwyo.edu/WRRC/>), administratively placed under the director of SER and the Dean of the College of Agriculture, has educational options offering of an undergraduate minor, as well as a graduate certificate both in Reclamation and Ecology. An outreach aspect of the school has will begin offering a regularly offered reclamation school for practitioners. Also, through Wyoming Cooperative Extension. The Sustainable Management of Rangeland Resources (SMRR), a fundamental Extension Initiative (composed of a team of nearly a dozen individuals from around the state) is involved with a diversity of issues regarding rangeland productivity including reclamation and restoration (see web site: <http://www.wyorange.net/>).

**Additional Key Words:** School of Energy Resources, College of Agriculture, outreach, cooperative extension, research.

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## **Introduction**

It is widely recognized that energy development provides a wide range of tangible positive products but at the expense of numerous of environmental impacts. Nowhere is this manifest more dramatically than in Wyoming and adjacent states. The Greater Yellowstone Area, largely in NW Wyoming, is among the most treasured and protected lands on the planet. However, and especially to the south, this abuts against some of the most intensively exploited zones of public lands. Here largely beneath the sagebrush steppe but extending into adjacent uplands and mountains are considerable deposits of natural gas, coal, uranium and petroleum. The surface is also is being developed for wind and solar resources, and trona, phosphates, and bentonite have been mined here for decades.

The rate of development is at the heart of this economic, environmental, political and social conundrum. The economic outputs for Wyoming's industries and citizens are significant corporate profits, opportunities for employment and tax derived benefits. Environmental impacts are associated with air, water and land perturbations. Although there is unabashed attenuation of physical and chemical characteristics of regional air-sheds, watersheds, and soils; biological communities are the ultimate concern. The environmental issues associated with such development are legion, but are exacerbated by complicated surface and subsurface ownership. Bifurcated ownership (split estate) is only one of several political issues that include a mixture of federal and state land management types, mismatch of governmental management philosophies, shared boundaries with diverse private landowners and users, and interfaces with municipalities.

The mission of the Wyoming Reclamation and Restoration Center is largely centered on management of extensively managed lands, making provision for education, providing a physical and economic environment where families can exist and prosper are certainly as much a component of stabilizing Wyoming's energy and extractive industries as is reclamation and restoration of air-sheds, watersheds and soils.

The main land management agency of publically owned lands in the energy development corridor of Wyoming is the Bureau of Land Management (BLM). They also manage the subsurface (split estate) under BLM lands as well as the subsurface under some other public lands (e.g. U.S. Forest Service) and under some private lands as well. BLM's articulated assumption is that disturbances resultant from development on lands under their control can and will be ameliorated to standards consistent with the pre-disturbance conditions. BLM has made

the case that this reclamation of disturbed lands is a component of the justification to the public for leasing of lands to developers. Thus, the Wyoming state BLM has embarked on developing a comprehensive State Reclamation Policy. Included in their policy is development of monitoring criteria to assure ultimate successful reclamation of sites and restoration of ecosystems.

The Forest Service, Fish and Wildlife Service, Bureau of Indian Affairs, National Park Service and other Federal entities along with State of Wyoming also have very significant surface holding. These lands range from being held in large, continuous tracks to marked as in a checkerboard arrangement, with every other section being private and those held in the public trust managed by various agencies. In general the aim of all land agencies and certainly private land owners too, is that post energy development, the land be returned to some near approximation of its former use be it wildlife habitat, domestic grazing, intensive agriculture or recreational usage.

The scale of disturbance across Wyoming is substantial. In the state there are about 100,000 existing oil and gas wells either plugged or abandoned or in production. There are tens of thousands more planned. To serve these wells there are over 40,000 kilometers of major pipeline (this does not include the capillary lines that serve each well). There is 100,000 hectares of surface coalmines (active and reclaimed), and smaller areas of other energy or mineral extraction (e.g. trona, bentonite) related disturbances. The energy Wyoming exports exceeds the energy usage of the state of California by 40% , provides more than 10% of the energy requirement of the United States (Surdam, 2008) and as such is the driver of most of Wyoming's economy. But too, there are land disturbances connected with natural catastrophic events such as wind and water erosion, fire, over use of plant cover by grazers, degradation of resources by off-road vehicles, abuse of wetlands and riparian areas, invasive species, insect outbreaks, drought.

All of these disturbances potentially come under a level of consideration by the WRRC. Clearly not all of these can be actively considered at one time. There have been, are and will continue to be pressure both scientific and cultural for WRRC to address disturbance issues in the State and region. Entities will see the WRRC in different lights and with a variety of mandates. Currently great focus is being made of the disturbances associated with oil and gas extraction. Part of the unwritten mandate is to stay ahead of expectations, anticipate needs, and to be proactive and nimble.

*Oh wad some power the giftie gie us  
To see oursels as ithers see us.*

Robert Burns, 1786

At the University of Wyoming, reclamation and restoration related research has been conducted arguably since before 1940, perhaps well before. It is clear now that much done early in the 20<sup>th</sup> Century was related to reclamation and restoration, although at the time it was not recognized. Now inventories of organisms, mapping of native vegetation communities, tallies of wildlife done sometimes as much as a hundred years ago, provide baseline, resource, and perspective that informs activities today. Projects that directly address energy and extractive related activities are more recent phenomena. These activities have waxed and waned over the past fifty years, but the last 30 years has seen a steady increase especially in research first related mostly to surface mining and now more focused on natural gas development related disturbances.

The objectives of this paper are to provide a general over-view of the activities of the Wyoming Reclamation and Restoration Center. This paper has been developed as an introduction to a symposium conducted at the Joint Meeting of the Billings Land Reclamation Symposium and the American Society of Mining and Reclamation (Billings, Montana, June 2009). The papers in the meeting will cover to a degree the depth and breadth of activities of the WRRC and have brief introduction herein. This paper, however, will address (1) history of reclamation at the University of Wyoming, (2) mission and vision, (3) administrative structure, (4) human resources, (5) interactions, (6) programmatic structures, and (7) funding of the WRRC.

### **History**

In many ways, the early botanical pioneer at the University, Dr. Aven Nelson, established rational, educational philosophy and resources that to this day underpin the art and science of reclamation and restoration ecology at this institution (Knobloch, 2005). An early graduate student in Botany at the University, A. A. Beetle (1938), studied plant taxonomy and then went on to earn a PhD elsewhere before returning to the University of Wyoming. Beetle is one of the Fathers of the Range Management discipline, although others here and elsewhere really initiated research in reclamation and restoration.

Early activity directly related to reclamation of mined lands was conducted in the Range Section of the Plant Science Department in the College of Agriculture. The Botany Department and the Zoology and Physiology Department also have been involved, but in Range (now under the degree program of Range Ecology and Watershed Management in the Department of Renewable Resources) is where emphasis was established and has been maintained and continues although several other academic units have been involved sometimes sporadically and sometimes intensively.

Dr. Mort May is credited with one of the earliest publications addressing from the University that addressed reclamation. His article, "Strip Mine Reclamation in the Western United States," was published in 1967. He, Robert Lang and later Oscar Barnes were a team that worked extensively in mine land reclamation related ecology. Frank Rauzi, a USDA Soil Scientist stationed at the University of Wyoming, also was heavily involved in mine land reclamation related research. Rauzi was closely associated with the USDA ARS High Plains Grassland Research Station in Cheyenne, Wyoming. Also from that station, having been hired in 1977 was Dr. Gerald Schuman, who worked closely with the University and ARS scientists mostly on reclamation related issues until his retirement in 2005. Among his colleagues at the University was Dr. Edward DePuit, hired in 1980, who taught the first structured course that exclusively addressed mine land reclamation. It was with DePuit and Schuman that many of educational and research initiatives involving reclamation at UW originated, however, DePuit left the University in 1995.

The work of E. DePuit and G. Schuman exemplifies the period of the late 1970s and into the later 1980s, but many others were involved too. M. Christensen (Department of Botany) did considerable work as well as J. Smith (Civil and Architectural Engineering). Much work was funded through the Wyoming Water Center and in the late 1970s and 1980s, the Industrial Fund out of the Rocky Mountain Institute of Energy and Environment. However, probably the most significant funding opportunity that developed during this period was the creation of the Abandoned Coal Mine Research Program, which was funded with Office of Surface Mining resources passed through the Wyoming Department of Environmental Quality's AML program. This program, continued for 20 years out of UW's Research Office, and provided considerable funds for a large number of applied and basic research programs and projects (University of Wyoming Research and Economic Development Office web page:

(<http://uwacadweb.uwyo.edu/research/technology%20transfer1.asp> ) The end of this program in 2005, as well as the demise earlier of the Wyoming Water Center, were serious blows to reclamation research enterprise on the University of Wyoming campus. These University programs funded research of various scientists at UW including A. L. Hild (who started at UW in 1996), L. C. Munn (who started in 1981), K. J. Reddy (started in 1986), P. D. Stahl (1995), G.F. Vance (1990), S. E. Williams (1976),

In 1998, G. Schuman and G. F. Vance conceived the idea of a center at the University devoted to amelioration of disturbed lands. Such a Center was established late in October of 2002 with G. F. Vance as the Director.. Although funding of the center remained problematic for some years, the basic structure of the center was established during this time (Vance, 2001 & 2003) as well as the undergraduate minor and the graduate certificate both in Reclamation and Restoration Ecology (Vance, 2002).

In 2006, the University received funding from the State of Wyoming to establish the School of Energy Resources (School for Energy Resources, 2009: <http://www.uwyo.edu/ser/>) . The research mission of this entity is to “Promote state-of-the-art research to maximize the value of our energy resources and minimize the impact on our environment.” Instructional and Outreach Missions are equally supported.

The Interim Director of the School, Dr. Carol Frost, was instrumental in providing funding for the WRRC to become more active. Resources were made available also from the College of Agriculture Dean, Frank Galey, to fund various aspects of the Center’s activity. The Department of Renewable Resources was able to provide a suite of offices for the Center, resources for physical infrastructure and temporary half-time support for an office manager.

In the summer of 2007, Dr. Mark Northam was appointed as Director of SER. Northam has been clear from early in his appointment that for Wyoming to have realistic and respected programs in energy development, reclamation and restoration of energy related disturbances had to be a part of the overall effort. This unambiguous support has placed the WRRC on a secure political footing with regard to the University.

In the Spring of 2009, the State of Wyoming Legislature appropriated funds to support the administrative, educational, research and outreach functions of the WRRC for three years. They also appropriated monies to initiate and endowment to support the center after temporary resources expired.

### **Vision**

The vision of the center is: To be a premier regional center for restoration, reclamation and rehabilitation of disturbed ecosystems based of sound ecological, agricultural and economic practices.

### **Mission**

The Mission Statement for the WRRC, approved by the University of Wyoming on October 31, 2002 is: To pursue and disseminate impartial, scientifically-based research information related to the reclamation, rehabilitation and restoration of disturbed ecosystems; To educate students so that they will be able to analyze, synthesize and integrate findings, results and related research for use in protecting and improving Wyoming and western U.S. ecosystems; and To serve as a resource for Wyoming citizens and communities, state and federal agencies, and private industries requiring assistance in reclamation science and ecological restoration endeavors (from the WRRC origination proposal approved by the University of Wyoming in October of 2002).

### **Administrative Structure**

The current WRRC director oversees a staff of one office manager, and one research associate involved especially with outreach publications. One graduate student (supported by an assistantship allocated from the UW-Agriculture Experiment Station) is also assigned to the Center.

### **Interactions**

During most of the past two years of activity of the WRRC, efforts have been made to establish professional alliances with various entities. These included university faculty and staff from various university organizations, state and federal agencies, private landowners, energy and mineral development companies, and consulting companies.

University units associated with the center include:

- Department of Renewable Resources (Entomology, Range Ecology, Soil Science, Watershed Management)
- Department of Botany
- Department of Agriculture and Applied Economics

- Department of Plant Science
- Department of Zoology & Physiology
- Civil and Architectural Engineering
- The College of Agriculture
- The School of Energy Resources
- The School of Environment and Natural Resources

Interactions with federal agencies have been dominated by the BLM, including the State Office in Cheyenne, and the Field Office in Rawlins. Interactions with state agencies include the Wyoming Oil and Gas Conservation Commission, the Wyoming Department of Environmental Quality, and the Wyoming Department of Game and Fish. The Wyoming Wildlife and Natural Resource Trust is a state entity where relationships are developing.

Private landowners where connections have developed mostly include various ranchers in the state. Energy companies where connections have developed are mostly represented in the Petroleum Association of Wyoming (PAW) and the Wyoming Mining Association (WMA). Consultants where connections have developed exist throughout Wyoming.

### **Programmatic Structure**

Overall programs of the WRRC are separated into instructional, extension/outreach and research.

#### **Instructional Programs**

The WRRC is responsible for maintaining and auditing two degree options, an undergraduate minor and a graduate certificate

**Undergraduate Minor in Reclamation & Restoration Ecology.** Reclamation and Restoration Ecology (RRE) involves the use of basic and applied ecological concepts to rehabilitate and restore processes and functions to disturbed ecosystems. Ecosystems of concern include: coal and bentonite mined lands, uranium mines, lands disturbed through drilling for and pipeline transport of natural gas and oil, altered wetlands, degraded rivers and streams, lands infested with exotic plants or noxious weeds, eroding range and forest watersheds, fragile arid and semi-arid rangelands, CBM product water disposal sites, lands contaminated by toxic chemicals (Pb, As, Cd, Hg, organic compounds, oils, tars, radioactive materials, etc.), and alkali/salt mudflats, etc. The RRE minor ensures students an education in the use of basic and applied ecological

concepts to rehabilitate and restore processes and functions to disturbed ecosystems.

Students take a variety of courses to secure a strong background in reclamation and restoration ecology but can take a variety of other courses to mould the minor to fit their interests. The core courses include General Ecology, Introduction to Soil Science, Reclamation of Drastically Disturbed Lands, Rangeland Restoration Ecology and a comprehensive seminar course. Elective courses are taken in planning and policy, above-ground processes and below-ground processes.

Table 1. Undergraduate Minor in Reclamation Ecology list of courses.

<p><b>Required Courses (five courses)</b></p> <ul style="list-style-type: none"> <li>• General Ecology</li> <li>• Introduction to Soil Science</li> <li>• Reclamation Drastically Disturbed Lands</li> <li>• Rangeland Restoration Ecology</li> <li>• RRE Seminar</li> </ul> <p><b>Planning and Policy (one course)</b></p> <ul style="list-style-type: none"> <li>• Natural Resource Law and Policy</li> <li>• Approaches to ENR Systems</li> <li>• Conservation of Natural Resources</li> <li>• Public Land Management</li> <li>• Environmental Politics</li> <li>• Federal Land Policy</li> <li>• Rangeland Management Planning</li> </ul> <p><b>Below-Ground Processes (one course)</b></p> <ul style="list-style-type: none"> <li>• Microbial Ecology</li> <li>• Hydrology</li> <li>• Groundwater and Drainage Engineering</li> <li>• Soil Physics</li> <li>• Genesis, Morphology and Classification of Soils</li> <li>• Soil Microbiology</li> <li>• Forest and Range Soils</li> <li>• Soil Fertility and Fertilizers</li> </ul>	<p><b>Above-Ground Processes (one course)</b></p> <ul style="list-style-type: none"> <li>• Remote Sensing &amp; Natural Resource Management</li> <li>• Vegetation Ecology</li> <li>• Weed Science and Technology</li> <li>• Aquatic Entomology</li> <li>• Insect-Plant Interactions</li> <li>• Geographic Information Sciences</li> <li>• Wildland Hydrology</li> <li>• Wildland Watershed Management</li> <li>• Rangeland Vegetation Management Techniques</li> <li>• Shrubland Ecology</li> <li>• Watershed Water Quality Management</li> <li>• Wildlife Habitat Restoration Ecology</li> <li>• Wetland Ecology</li> <li>• Remote Sensing (RS) of the Environment and</li> <li>• RS Lab: Applications for Vegetation or</li> <li>• RS Lab: Applications for Geology</li> </ul> <p><b>TOTAL REQUIRED: 22-25 hours</b></p>
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Graduate Certificate in Reclamation & Restoration Ecology. The graduate certificate prepares the student to use basic and applied reclamation concepts in preparation of their thesis or

dissertation as well as provide an overall philosophical basis to restore processes and functions to disturbed ecosystems.

The core courses for the graduate certificate are Reclamation of Drastically Disturbed Lands, Rangeland Restoration Ecology, and a course based on an individual's research topic or interest. Elective courses are in the areas of planning and policy, and reclamation processes.

Table 2. Graduate Certificate in Reclamation & Restoration Ecology Courses.

<p><b>Reclamation and Restoration Ecology (two courses)</b></p> <ul style="list-style-type: none"> <li>• Reclamation Drastically Disturbed Lands</li> <li>• Rangeland Restoration Ecology</li> </ul> <p><b>Reclamation Problems</b></p> <ul style="list-style-type: none"> <li>• Research in Soil Science</li> <li>• Investigation</li> </ul> <p><b>Planning/Policy (one course)</b></p> <ul style="list-style-type: none"> <li>• Environmental and Natural Resource Policy Practice</li> <li>• Environmental Assessment</li> <li>• Environmental Planning</li> <li>• Environmental Law</li> <li>• Environmental Politics</li> </ul> <p><b>MINIMUM REQUIRED: 16 hours</b></p>	<p><b>Reclamation Process (one course)</b></p> <ul style="list-style-type: none"> <li>• Geologic Environments of Coal-Bearing Deposits</li> <li>• Remote Sensing of the Environment</li> <li>• Vegetation Ecology</li> <li>• Analysis of Primary Production and Cycling in Terrestrial Ecosystems</li> <li>• Plant Physiology Ecology</li> <li>• Biogeochemistry</li> <li>• Weed Science and Technology</li> <li>• Seed Science and Technology</li> <li>• Geohydrology</li> <li>• Advanced Geohydrology</li> <li>• Stream Habitat Management</li> <li>• Watershed Water Quality Management</li> <li>• Wildlife Habitat Restoration Ecology</li> <li>• Shrubland Ecology</li> <li>• Soil Physics</li> <li>• Water and Chemical Transport</li> <li>• Genesis, Morphology and Classification of Soils</li> <li>• Chemistry of the Soil Environment</li> <li>• Soil Microbiology</li> <li>• Forest and Range Soils</li> <li>• Wetland Ecology</li> </ul>
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In addition to minor and certificate programs, students have the opportunity for internships with various organizations in the state and region. Internships sponsored by the BLM and administered by the WRRC are the Oil and Gas Surface Compliance Internships. The 2007 Program was spear-headed by Stephen Williams and Laura Gianakos (Department of Renewable Resources and The BLM Field Office, Rawlins, Wyoming) and the 2008 Program by S.

Williams and Gary McDonald (R. R. and The BLM Field office, Rawlins, Wyoming). These internships have been highly successful and there is a desire and need to expand this program.

### Research Programs

There are documented needs for research in various aspects of reclamation including topsoil handling, topography of spreading topsoil, seed quality and availability, use of livestock to enhance the initial reclamation effort, impacts of energy development on wildlife, off-site mitigation of on-site activities, down-stream effects of energy development, reclamation of abandoned mines on public lands, impacts of overland vehicles of ecosystems, fire, etc. Efforts have been made to address some of these issues through liaison with the oil and gas industry (e.g. through the Petroleum Association of Wyoming), through the Wyoming Mining Association, with various governmental agencies (e.g. federal BLM, USFS, NPS and others) as well as State Agencies (e.g. DEQ). Most research where WRRC is a partner is through the matching program sponsored by SER.

The research agenda for the WRRC is significant. Active research is evidence that this effort has attracted funding, but it is obvious that considerable on-going research was in place well before the activation of the WRRC in March of 2007.

The SER funded Matching Grant Program has, as a consequence, provided considerable resources for a diversity of Reclamation and Restoration related research. Some of the recently funded research projects are listed in These Grants are made in part based on capacity of any given project to attract matching resources from usually industrial sources. Such efforts are exceptionally attractive to industry where some of their immediate and applied concerns are addressed. Where more basic research is needed, UW researchers are often able to find resources from outside often federal sources (e.g. The Office of Surface Mining's grant program). However, national level funding is often difficult to attract especially for projects that are largely application oriented. None-the-less, there are opportunities at the national level, and many researchers have been able to take advantage of these.

Various potential research projects have been derived from a diversity of Wyoming meetings since the re-activation of the center in Spring of 2007. Several of these projects have been pursued by researchers here (for example the WYNDD is pursuing information on the Wyoming Pocket Gopher, and a project in Renewable Resources is addressing nitrogen fixation by range legumes). However many projects have not been pursued largely due to an absence of resources

to support this research. Potential projects were derived from conversations with government, industry, consultants and others during the last few years including the Wyoming Mining Association, the Wyoming Wildlife Heritage Summit, from individuals in the Governor's Office, the Rocky Mountain Elk Foundation, members of the Wyoming Legislature, the BLM, Wyoming Landscape Conservation Initiative (meeting in Laramie), the Wyoming Natural Diversity Data Base program, The American Society of Mining and Reclamation (Gillette and Richmond meetings), Oil & Gas Industry/Government Conference: Planning for Successful Surface Management & Reclamation (Rawlins). Some of the potential research ideas developed were:

- Invasive species, especially cheat grass and halogeton.
- Nutritional Diseases of Wildlife species control.
- Halogeton and Cheat Grass.
- Training of many people working in the field is inadequate.
- Fully understand species of concern.
- Aspen stand and sagebrush steppe deterioration.
- Much baseline information is needed.
- Cumulative effects (affects) analysis for water and soil.
- More soils data is needed in the WYNDD.
- More information is needed on seed sources and plant propagation in general.
- The Wyoming Pocket Gopher—Much general information needed especially on habitat.
- Sagebrush Dynamics: age of plants versus soil parameter.
- Information needed on standards of rangeland health.
- Outreach off continent: Provide travel scholarships for persons from the Republic of Mongolia to attend the next ASMR meeting.
- Need to evaluation mycorrhizal status of standard reclamation grasses, forbs and shrubs for competitive nature with cheat grass.
- Halogeton to be put on the noxious weed list. Will require state funding to combat this weed.
- Nitrogen dynamics—leguminous, non-leguminous, cryptogamic (microbiotic crusts) merits further investigation.
- Interactions between soil and wildlife are not delineated.

- Site adapted seed and seed germination research is needed.
- Because precipitation is so erratic and low, more investigation of supplementing rainfall is needed. This may include judicious irrigation and catchment of snow using snow fence technology.
- Because soil handling is awkward, storage is difficult, re-spreading is time consuming, and there is never enough soil, more research is needed to address these issues.
- Closure of access to lands because of Wildlife Stipulations needs further justification with research.

Activities of the Wyoming Reclamation and Restoration Center. S. E. Williams and R. E. Long.

Ecosystems Recovery on Reclaimed Surface Minelands. Peter D. Stahl

Effects of Natural Gas Well Development, Reclamation Activities , and Controlled Livestock Impact on Topsoil Properties. Jay D. Norton.

Native Plant Reestablishment. What is Inegrated Reclamation? Ann Hild.

Impacts of Oil and Natural Gas on Prairie Grouse: Current Knowledge and Research Needs. Jeff Beck

Coalbed Methane (CBM): Outfalls, and Disposal Ponds. K. J. Reddy.

Economic Issues and Policies that Affect Reclamation Decision Making. Matt Anderson

### Summary

Although the WRRC was officially created in October of 2002, substantive activity did not commence until March of 2007. The University of Wyoming's policy on Centers allows a period of five years of existence before a mandatory review determines continuation and direction of efforts. Review of the WRRC will, therefore, occur in 2012. However, the degree of support and the need for the educational, outreach and research functions provided through the Center suggest its continuance well into the future.

At present, the center is structured to support education, extension/outreach and research. This structure reflects the mission of the University in general and likely will not change in the future. The symposium of which this paper is a component will show-case some of the specific projects associated with the center.

There are several longer term, but general programs that will be developed through the center in the near future, these are:

- Develop a competitive grants program to address knowledge gaps in reclamation/restoration of Wyoming's disturbed lands.
- Develop a cooperative of governmental agencies, energy producers and the WRRC to mitigate disturbed land issues connected to energy extraction.

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