LONGWALL MINING UNDER A PUBLIC LAKE AND WILDLIFE REFUGE: PLANNING FOR SUBSIDENCE IMPACTS

by

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Abstract: Rend Lake is a man-made water body in south central Illinois completed by the Corps of Engineers in 1972. Approximately 18,900 acres of water and 20,000 acres of managed land encompass the project. The lake serves as a significant public water supply for the region and also provides outdoor recreation opportunities such as camping, swimming, boating, fishing and hunting. Over the past two decades, several coal companies have conducted both high extraction retreat and longwall mining operations under and adjacent to Rend Lake. The resulting surface subsidence has altered shoreline locations and increased water depths. Mitigation of subsidence impacts has been achieved by a combination of land acquisition to expand the project as well as site specific mitigation techniques to restore existing capabilities and uses. The last surviving company is currently conducting longwall operations under a State of Illinois managed wildlife refuge located on the Nason Point Peninsula. The longwall operations will inundate a portion of the peninsula's land surface and could potentially impact the existing habitats of the refuge. Issues at stake are potential impacts to shore birds and the migratory Canada goose. Several state and federal agencies have come together to work with the coal company to develop an acceptable mitigation plan. This paper provides an overview of the permitting process, public concerns raised and the efforts to arrive at an acceptable mitigation plan. Modeled changes in topography and potential impacts on the management of the refuge are examined.

Additional Keywords: Wildlife Habitat Evaluation Guide, mud flats

Introduction

Illinois is part of the Interior Coal Basin and rests over the largest bituminous coal reserve in the nation. Illinois has a rich history of coal mining dating back to the early 1800's. The first recorded commercial sale of coal occurred in 1810 when a drift mine along the banks of the Big Muddy River sent a flatboat down the Big Muddy to the Mississippi River to New Orleans. The height of the states production occurred in 1918 when slightly less than 90 million tons were produced by 966 mines employing 91,372 individuals. Although recently hit hard by both Clean Air Act provisions and a highly competitive coal market, Illinois continues to play a role in the national coal market. The annual production has however dipped to approximately 40 million tons produced out of 22 mines.

Modern coal mining must face many challenges in order to survive. Regulatory compliance as well as environmental stewardship can create difficult challenges. Co-existing with present land uses and being cognizant of the potential impacts on surrounding communities is a critical part of the success of today's coal mines. Jefferson County Illinois is home to both a long history of coal mining and, more recently, a large manmade water body designated as Rend Lake (Figure 1). This lake serves as a significant public water supply, a major silt trap for the surrounding prime farmland and an out door recreational area. Longwall mining and Rend Lake have coexisted since the late 1970's. The current challenge is subsidence of the Nason Point Wildlife Refuge, one component of the recreational management strategies of the lake project.

Area Mining History

Coal mining predates the existence of the lake by at least 63 years as the first recorded operation directly under the project boundaries dates back to 1907. Through time, 8 mines have operated under and adjacent to the area now home to Rend Lake (Figure 2). Room and pillar operations, both with and without secondary high extraction retreat techniques as well as longwall operations have mined the No. 6 Herrin Coal Seam.

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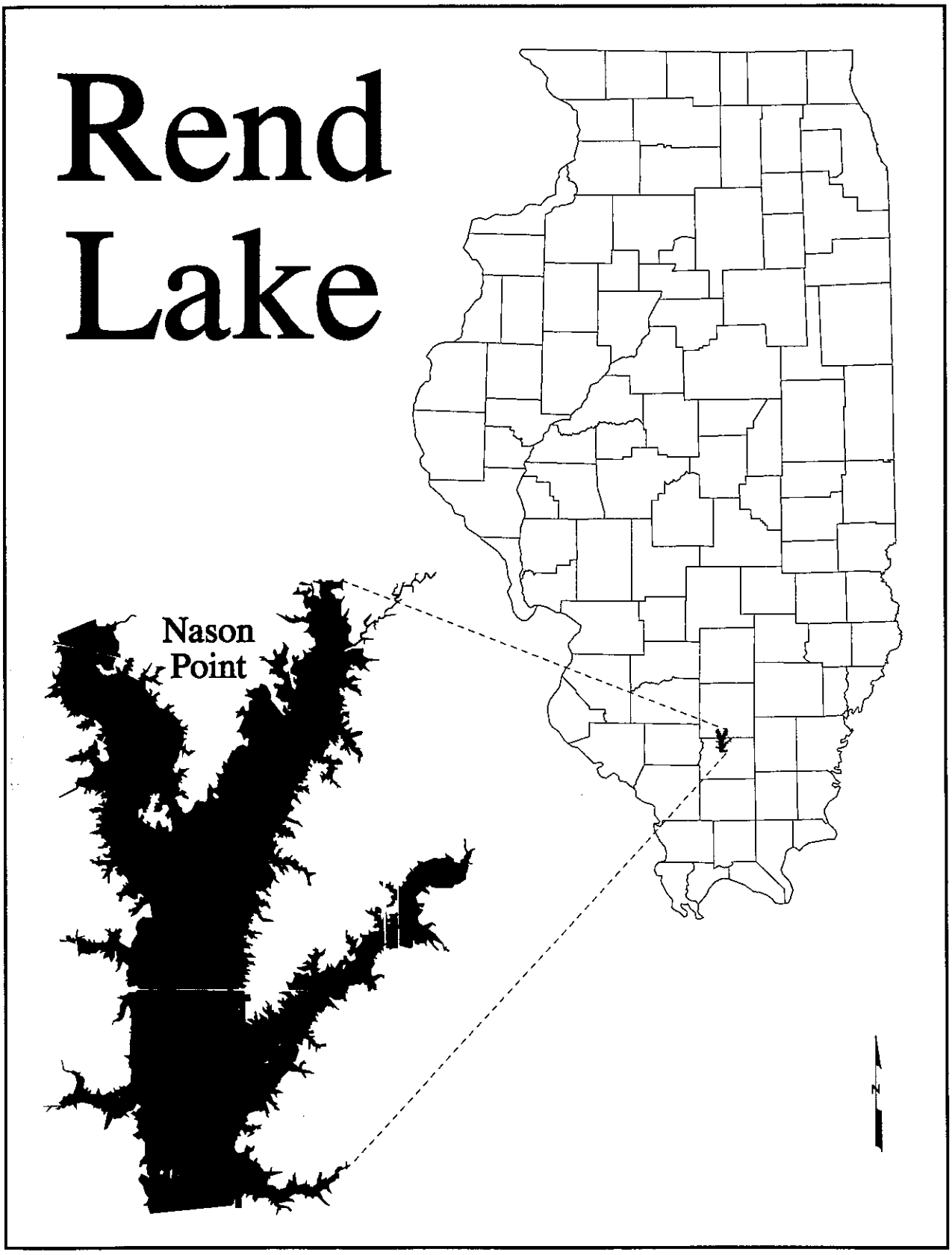

Figure 1: Rend Lake location map, Jefferson & Franklin counties.

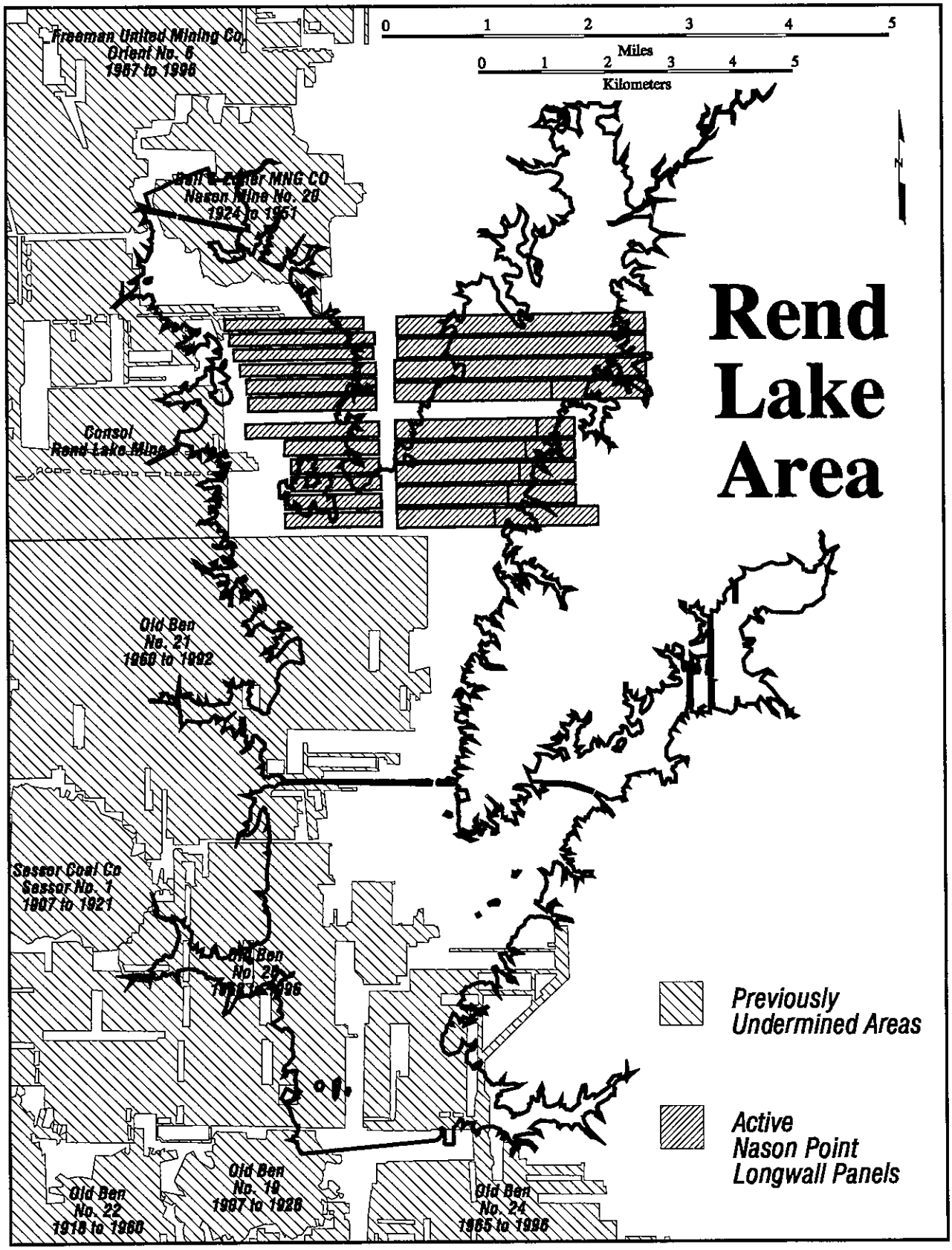

Figure 2: Historical underground mining in the Rend Lake area.

Over the entire area, the seam lies between 650 and 720 feet (198 to 219 meters) below the surface and averages 6 to 10.5 feet (1.8 to 3.2 meters) thick. The overburden consists primarily of shales and claystones with units of sandstone and limestone. Production out of this area has played a significant part in the mining industry of Illinois.

Lake Construction and Management

The construction of Rend Lake was authorized by the Flood Control Act of 1962. In accordance with the recommendations made by the U.S. Army Corps of Engineers (Corps), the ongoing purposes originally justified by Congress include:

A. downstream flood control
B. downstream water quality control
C. water supply
D. recreation
E. fish and wildlife conservation
F. area redevelopment

Rend Lake was constructed by the Corps with the intent of providing a public water supply and also serves as a sediment trap for the vast farmland that dominates the landscape in central Illinois. The Big Muddy River was captured to create 18,900 acres of water surface and a volume of 185,000 acre-feet. Approximately 20,000 acres surrounding the lake are controlled by the Corps. The project was completed in 1972.

An Environmental Impact Statement (EIS) was drafted to assess the impacts of the lake construction on the environment, local community and local economy. As part of the analysis, the presence of mining and the likelihood of future operations under and adjacent to the newly created water body were evaluated. Ongoing "planned" or intentional subsidence from high extraction retreat mining was recognized and fully expected to continue after lake construction. Both the positive and negative impacts of the surface subsidence were assessed. The EIS discussed the potential for infrastructure damage due to the coal mining rights and extraction practices in place. It was recognized that the approximate four (4) feet of subsidence would increase storage and silt volumes thus lengthening the life of the structure. The Corps made a conscious choice to not purchase the vast coal reserves remaining under the project, partly because of the enormous cost and partly because of the balance of both negative and positive impacts resulting from subsidence. The Corps did purchase coal rights under the dam itself to insure it's integrity.

The Corps developed areas of the lake into various boating, recreation and beach facilities. Wayne Fitzgerrell State Park was established on the eastern shoreline. The State of Illinois became a cooperative partner in lake management strategies through the Illinois Department of Conservation now known as the Illinois Department of Natural Resources (IDNR). The IDNR currently leases portions of the project for wildlife management and recreation.

Lake Subsidence, Past Impacts and Solutions

Longwall subsidence characteristics in the lake area varies due to changing coal thicknesses and extraction heights. In general, maximum vertical subsidence at the profile center varies between 5 and 7.3 feet (1.5 and 2.2 meters). The depth to the coal seam of 650 to 720 feet (198 to 219 meters) coupled with the regional geology (thick surficial clay units) allow the lake bottom to self heal and prevent loss of water to subsurface geologic units. In general, the only visible subsidence impact is a change in shoreline location as a panel retreats from under the water body to the surrounding land surface. The result of the longwall panel's subsidence trough on the surface is an increase in lake depth and surface area.

As stricter coal mining environmental regulation born by the Surface Mining Control and Reclamation Act (SMCRA) took it's place in the early 80's, Memorandum 's of Understandings (MOU's) were drafted and signed between the Corps, the Department of Conservation (now IDNR) and the coal companies conducting their operations under the project. The MOU's became part of the approved permit and defined how subsidence mitigation of impacts to both land and surface features are to be administered. Based on regulatory requirements holding coal companies responsible for all subsidence induced damages, the companies committed to mitigating any subsidence inundated areas by replacement acreage on a one to one basis. The companies also committed to baring the cost of any infrastructure damage repair, compensation or replacement. The sequential steps followed to assess material damage through final mitigation or compensation were itemized in the MOU's.

Through the MOU, the IDNR and Corps historically sought surrounding farmland acreage directly adjacent to the existing project boundary to replace shoreline acreage inundated by subsidence. This replacement land typically becomes managed farmland through a lease agreement to a tenant farmer with a portion unharvested and left as wildlife feed for species

such as the Canada goose. Some damaged infrastructure such as beaches and associated facilities were reestablished elsewhere on the lake. Compensation would also be accepted in certain cases to allow capital projects desired elsewhere around the project.

Mining Under the Nason Point Wildlife Refuge

The latest issue to address may in fact be the most challenging for all parties concerned. Nason Point is a former upland area that has been isolated by the water body to form a lake peninsula. Approximately 1,500 acres of land lying south of the town of Nason on the peninsula are leased by the IDNR and managed as a wildlife refuge. An additional 3,500 acres of water surrounding the peninsula managed for the goose population completes the main body of the refuge where public access is limited. The total refuge managed for fish and wildlife encompasses a much larger area extending north into two sub impoundment areas. The total size of the refuge is 12,690 acres (4000 acres of water and 8,690 acres of land). Wildlife has become abundant on the peninsula as the area is closed to the general public from November to May. Canada geese migrate south to avoid harsher winter weather to the north and have found the refuge provides a good place to feed and ride out the winter. Populations arriving at Rend Lake vary from year to year based on the severity and patterns of the winter weather. The attractiveness of the refuge to wintering geese has created an economic plus to the project by attracting hunters and creating hunting clubs on private lands adjacent to the refuge.

The man-made lake has also resulted in the creation of mud flats that benefit wildlife. The mud flats primarily are located along the east shoreline of the peninsula. Shorebirds, ducks and geese share the peninsula and benefit from the mud flats and associated wetlands. A major component of the management practices is the planting of crops, primarily corn, with selective harvesting to leave feed in the fields for the wildlife.

In addition to the land mass of the peninsula, an island comprised of approximately 80 acres jaunts out of the water approximately 1,000 feet (305 meters) to the west of the southern point of the peninsula. The island serves as a wind break allowing geese to loaf in the calmer waters down wind of the island. The island is also accessed by deer and other wildlife as a safe haven from predators due to the shallow waters separating the peninsula and island.

Mine planning

The Consolidation Coal Company (Consol), Rend Lake Mine, formerly Inland Steel Coal Company, has existed since 1966. Until recently, Consol operated two separate longwall units. The first unit mined primarily under private farmland to the west of the lake. This wall has recently ceased operations concentrating all production out of the second unit. The second wall has operated under the lake area since 1987. This wall has mined panels under the western portion of the water body traversing to the west and out from under the lake. The result was a change in shoreline location. Panels now average 1,000 feet (305 meters) in width and vary in length from 2,600 to 10,000 feet (793 to 3048 meters). Faulting throughout the reserves has impacted lengths of longwall panels and forced panel layout locations that avoid the faulted zones and more difficult mining conditions.

The mine plan under Nason Point was intentionally designed to give maximum protection to the peninsula by placing the main entry system down the spine of the peninsula (Figure 3). This plan would limit subsidence to the perimeter of the peninsula and leave the central portion of the peninsula supported by the main entry system and unaffected by subsidence. The resulting loss of land to the lake waters would therefore be as minimal as practical. Twelve (12) panels lay west of the main and 9 panels extend to the east.

Overburden specific to the Nason Point longwall area ranges between 650 and 680 feet (198 and 207 meters) while coal thickness varies between 6.0 and 7.5 feet (1.8 and 2.3 meters) (Figure 4). It is important to note that the extraction height does not always correspond to the coal seam height. It is often necessary to extract as much as an additional foot of material from the floor for proper longwall operation and adequate clearance. Therefore, subsidence profiles are modeled based on extraction height. A great deal of field surveying data has been collected concerning longwall subsidence profiles in the Rend Lake area and are now used to model subsidence. Maximum subsidence at the center of the profile averages 75% of the extraction height or 5.3 to 6.4 feet (1.6 to 2.0 meters) of subsidence.

Permitting process

The IDNR Office of Mines and Minerals is the regulatory authority that issues permits in compliance with SMCRA. The review process incorporates input from designated offices such as the Illinois Environmental Protection Agency, Historic Preservation

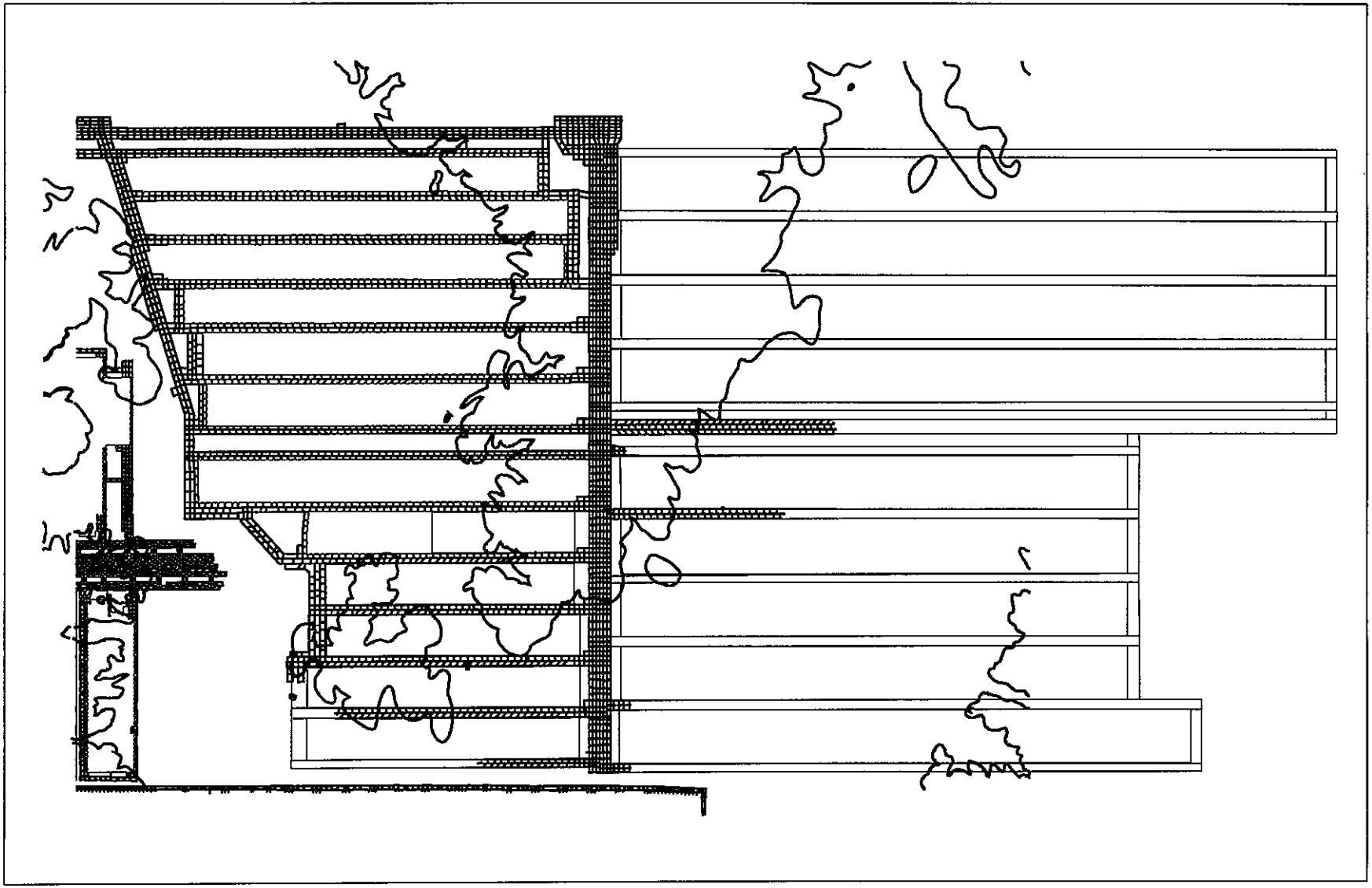

Figure 3: Mine plan layout under peninsula.

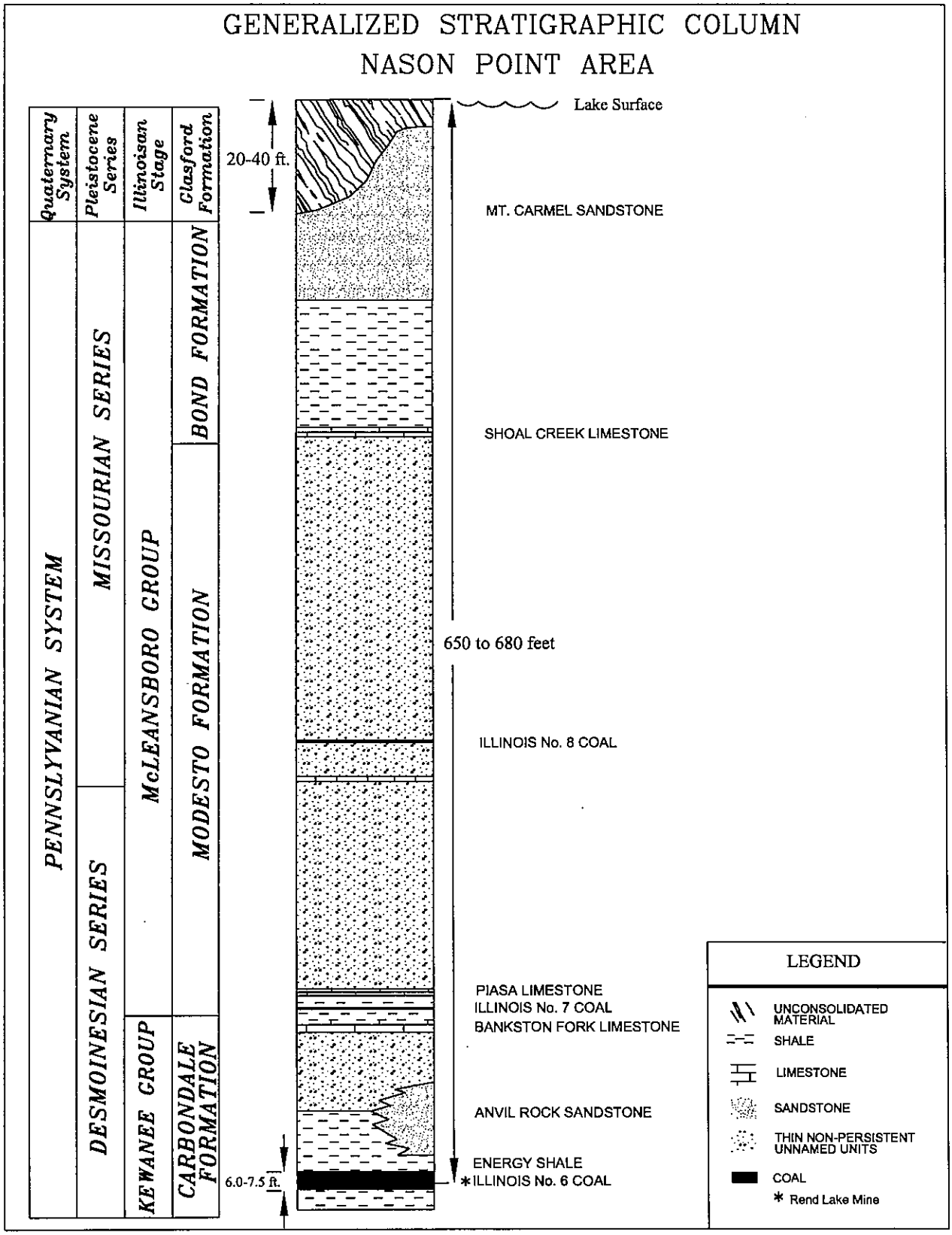

Figure 4: Nason Point area stratigraphy.

Agency, Department of Agriculture, Department of Transportation, IDNR Endangered Species and the National Resource Conservation Service. The general public is afforded an opportunity to comment on the applications and express how they may be impacted by the proposed mining operations. Opportunity for requesting informal conferences or public hearings are also provided.

The actual permitting of operations impacting the peninsula occurred under four separate permitting actions. Three separate "shadow area" or underground mining area expansion revisions occurred between April 1991 and January 1998. A satellite portal facility on the peninsula to provide ventilation and shorter travel time for the miners to access the working face was approved in January of 1994. This facility is constructed on private land north of the refuge.

All applications for longwall mining operations in Illinois are required to describe the potential impacts to surface lands, structures and facilities. The applications detail the steps taken to protect or repair surface features. As part of the analysis, pre and post subsidence contour projections are made. At Nason Point, the projections define the shoreline changes and acreage inundated at the mean lake elevation of 405 feet msl. Another important elevation is 410 msl which is generally the highest elevation the lake reaches throughout the year. It therefore defines the lowest elevation that crop land is managed for wildlife feed on the refuge.

The only revision to result in a public hearing occurred in August of 1993 during the second mining area expansion request. This hearing was well attended by a variety of private citizens and special interest groups. Comments were made by the U.S. Fish and Wildlife Services, U.S. Army Corps of Engineers, the Illinois Department of Conservation, and many private groups such as the Sierra Club and various hunting groups. The hearing resulted in discussions of the sensitive land uses that have developed over the 30 years the lake has existed and the need for additional attention to potential wildlife impacts. Out of these discussions evolved a team to evaluate potential impacts and to determine if the standard one acre for one acre replacement would preserve the refuge. Investigations of other mitigation techniques to preserve or enhance wildlife habits were also targeted.

Analysis of impacts

The team created out of concerns raised at the public hearing consisted of plant and wildlife specialists and mining specialists from Consol, the Corps, Fish and Wildlife Service, and the former Illinois Department of Mines and Minerals and the Illinois Department of Conservation (now housed collectively within the IDNR). The team referred to as the Resource Evaluation Team or RET Team undertook evaluating the potential loss of habitat and determining the most feasible way to preserve or replace the benefits of the refuge.

In the midst of the ongoing planning and analysis, the multi-faceted groups that utilize the area have been active in attracting media attention. Based on lack of information and the circulation of misinformation, individual groups fear the worst for their special interests. Therefore, media coverage, both newspaper and television, have focused on the negative impacts and played up a doom and gloom "sky is falling" approach to the issue. Planned subsidence is a difficult event to convey to those unfamiliar with coal mining effects. The fact that it is difficult to visualize combined with the drama of the media attention has inspired a strong opposition to the mining operations underway. Planning continues with the added weight of attention to all interested parties and education of what really is projected to occur.

The anticipated loss of peninsula and island surface to the lake waters was modeled by comparing pre and post mining elevations of 405 msl and resulted in inundation of 180 acres from the 21 longwall panels (Figure 5). The changes would potentially have a negative impact on certain species such as the Canada goose due to loss of calm water or loafing areas but could also potentially benefit fish habitat and shore bird habitat due to the creation of coves and more linear feet of shoreline. In order to quantify these changes the RET Team decided that a wildlife habitat modeling procedure would be appropriate. Although several models are available, the team selected the Wildlife Habitat Appraisal Guide (WHAG) as the evaluation tool contending it was more difficult to bias and therefore more objective than other available models.

The WHAG procedure involves responding to a series of questions by numerical answers to produce a habitat suitability index for a given area with respect to targeted wildlife species. Habit suitability indexes can then be used to compare current habitats with projected post subsidence habitats. The first step in this study is to select indicator species and define their preferred habitat on the peninsula. The Canada goose was the primary species selected due to it's important role in the management practices of the refuge. Canada geese

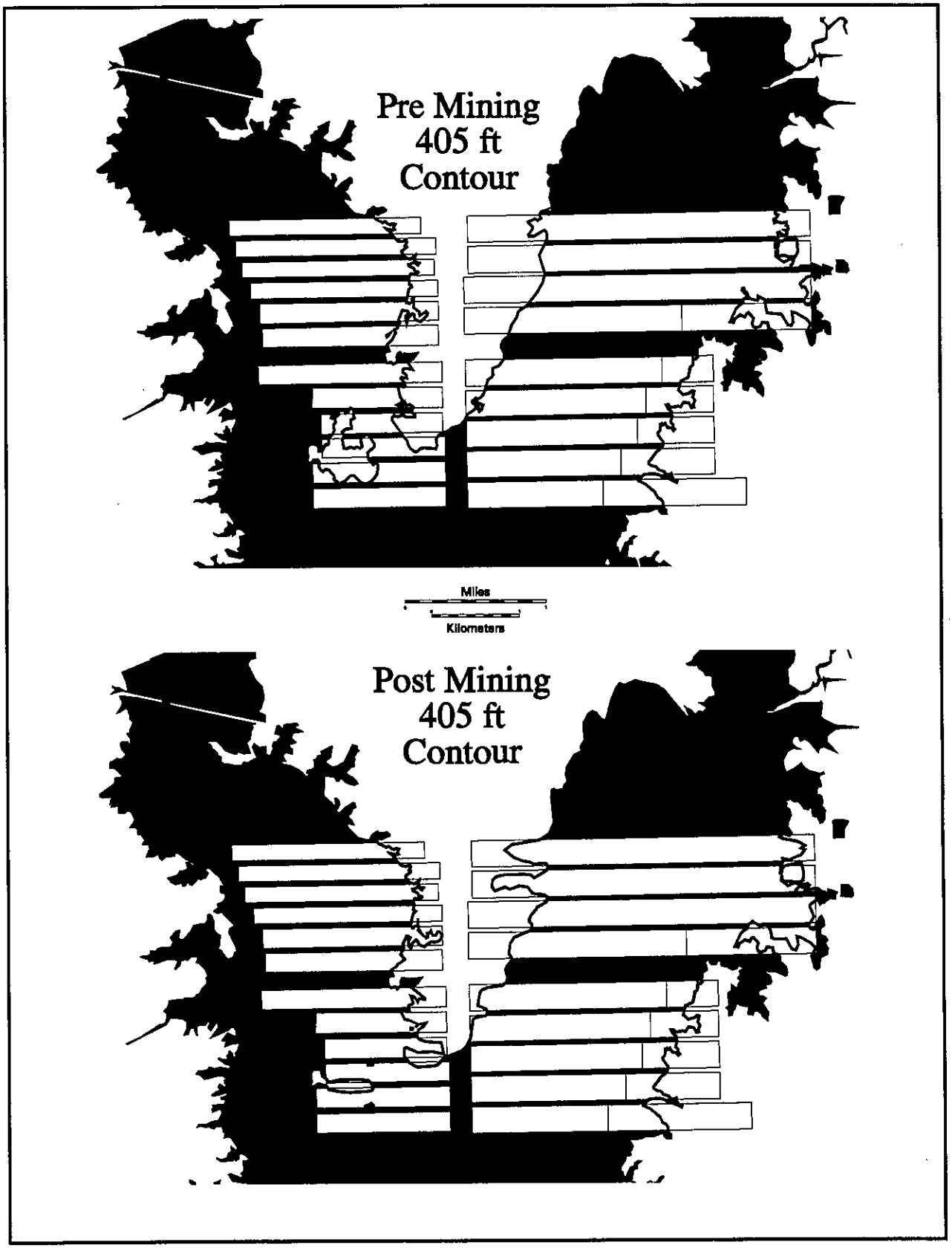

Figure 5: Projected shoreline changes from longwall subsidence.

primarily utilize the managed crop land feed above 410 msl and non-forested wetlands, generally found between 405 and 410 msl. The Bobwhite Quail habitat is defined as crop land as well as upland forest areas while the Green Back Heron habitat is limited to the non forested wetlands between 405 and 410 msl. The team then selected representative longwall sections to evaluate the existing habitats and plant communities. The importance of the habitats present is determined from scoring a series of questions relative to abundance and value. The process is then repeated after subsidence is complete with the changes in topography and shoreline taken into consideration. The pre and post mining indices determine the weighted net loss or gain and aid in determining the appropriate mitigation to maintain the overall habitat value.

The western shoreline longwall subsidence began in 1993 and will continue through the end of 2000. This side of the peninsula has greater topographic relief along the waters edge when compared to the eastern shoreline. The western shoreline will therefore experience less dramatic changes due to subsidence. Currently, the main focus of the western longwall panels is the importance of the island in serving as a windbreak and goose loafing area. Thus a new parameter, historically never a concern in the mitigation process, became the value of open water. The concern is the reduction in the island's landmass from what exists pre subsidence, to three smaller land masses remaining above water after subsidence. The fear is loss of adequate wind breaking ability, thereby forcing geese to the already crowded east peninsula shoreline. Fear of overcrowding and the potential of resulting disease on this east side has been raised. This challenge is being addressed by a research effort of the Southern Illinois University Cooperative Wildlife Research Lab. The study includes a detailed tracking of wind direction and speed which will be correlated to the densities of the goose population. It is hoped that the data will reveal the true importance of the island to the geese population and thereby aid in the analysis of post mining impacts.

The east shoreline subsidence will occur between 2001 and 2007. The RET team is now attempting to evaluate the potential subsidence impacts to habitats on much flatter topography. The team decided that shorebird habitat was of greater importance in this area and therefore changed the main indicator species to the Lesser Yellow Legs. The same process of assigning parameters is repeated for the new indicator species. Concerns of loss of mud flats on this shoreline are currently being evaluated. Mud flats and wetland zones along this shoreline will be modeled based on elevations and slopes pre and post mining. Shoreline vegetation will be temporarily affected but should reestablish in the revised elevation zones.

Mitigation alternatives

Once the actual impacts are quantified from the subsidence on the western shoreline, and projected impacts to the east shoreline are finalized, a combination of land acquisition and engineered water control structures will be quantified. Proposals under consideration are:

1. Creation of a berm to connect the peninsula tip to the post subsidence island pieces to preserve some of the islands wind breaking characteristics. This berm would be pursued only if the economics prove feasible and the benefits of the island determined to be critical enough to take on this rather large engineering project.

2. Creation of inland water control structures to allow periodic controlled flooding and wetland management. Two sites inland of the eastern shore are under consideration evaluating potential water control structures and the resulting quantity and quality of wetland habitats.

3. Enhancement of remaining mud flats on the eastern shore through construction of water control structures to enhance shorebird and Canada goose habitat. Structures under consideration include berms constructed across coves to contain and control water depths. Alternatively, cove points may be lengthened to increase shoreline and provide additional calm waters for loafing areas.

4. Private land acquisition on the peninsula adjacent to the existing refuge boundary to expand the managed area of the refuge.

Conclusion

Through cooperation of the coal company, federal and state agencies, and university research interests, a comprehensive evaluation to address impacts to the refuge is underway. The coal company's existing property right to extract the resource must be honored while working to preserve the existing environmental and recreational benefits that have developed after lake construction. The outcome of the efforts has yet to be

realized as the longwall subsidence and mitigation planning is ongoing. As with most issues, all parties will ultimately have to compromise to reach a mutually agreeable and economically feasible solution. Although strides have been made to obtain this goal, much work lies ahead to achieve a workable mitigation plan that balances the interests of all parties involved.

References:

1. Final Environmental Impact Statement, Rend Lake, Illinois (Operation and Maintenance); U. S. Army Corps of Engineer District, St. Louis, Missouri, December 1976

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