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AGENCY FOR NUCLEAR PROJECTS/ NUCLEAR WASTE PROJECT OFFICE

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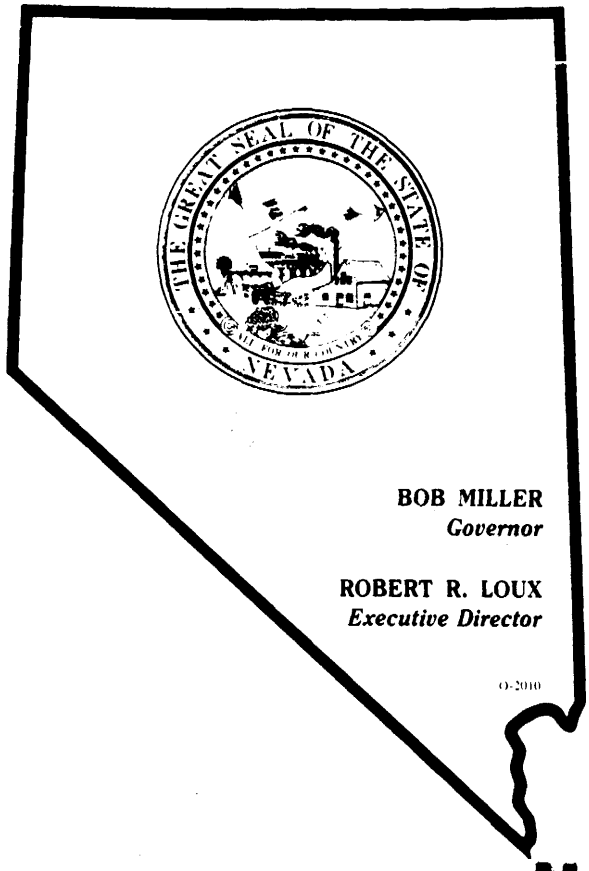
Yucca Mountain Socioeconomic Project An Interim Report on the State of Nevada Socioeconomic Studies

by

Mountain West Research
Las Vegas, Nevada

June, 1989



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The Nevada Agency for Nuclear Projects/Nuclear Waste Project Office was created by the Nevada Legislature to oversee federal high-level waste activities in the State. Since 1985, it has dealt largely with the U.S. Department of Energy's siting of a high-level nuclear waste repository at Yucca Mountain in southern Nevada. As part of its oversight role, NWPO has contracted for studies designed to assess the socioeconomic implications of a repository and of repository-related activities.

This study was funded by DOE grant number DE-FG08-85-NV10461.

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ACKNOWLEDGMENTS

This Interim Report is one product of a three-year research effort by a large and diverse social science research team. The Yucca Mountain Socioeconomic Studies have been initiated and are funded by the Nevada Nuclear Waste Project Office. The bibliography lists the numerous documents produced by the study team for the Yucca Mountain Socioeconomic Project (more than one hundred) as well as other documents consulted for the preparation of this report.

Planning Information Corporation (PIC) developed the project description used for this report and coordinated this work with the economic-demographic modeling effort. In addition, PIC conducted the background research and prepared materials on the community facilities and services at both the county and community level and developed the fiscal projections. These efforts were directed by Jim Williams with assistance from Steve Campbell and Lloyd Levy and are reported on primarily in Chapters 3 and 4.

The economic-demographic modeling effort was directed by Eric Anderson of Mountain West. The modeling output are summarized in Chapters 3 and 4. Ross Boyle of Growth Strategies Organization conducted the economic development potential research with assistance from Jack Tomasik of Mountain West. The results of this work were utilized in Chapter 2.

Analysis and preparation of the material on risk perception and assessment that was incorporated into Chapters 1 and 2 involved several study team members. Paul Slovic of Decision Research prepared sections of Chapter 2 dealing with the effects of imagery on tourism, migration, and business location decisions. Nancy Kraus and Mark Layman assisted Dr. Slovic in this effort. The image studies surveys were conducted by Michael O'Neil and coordinated by Gail Gesell of Mountain West during Phase III. Howard Kunreuther, with assistance of Doug Easterling and Paul Kleindorfer of the Wharton School, University of Pennsylvania, provided research findings on the potential impacts of the proposed repository on the Southern Nevada convention industry. Mike Greenwood, Bill Schulze, and Gary McClelland of the University of Colorado conducted research on the repository's potential impact on migration to the area.

The Center for Technology, Environment, and Development of Clark University conducted research on the repository program risk assessments. Roger Kasperson directed this effort with assistance from Jacque Emel, Robert Goble, Ortwin Renn, Jeanne Kasperson, Brian Cook, Seth Tuler, Samuel Ratick, and Dominic Golding. Decision Research and Clark University collaborated on the hazardous events case study research. David Pijawka of Arizona State University helped coordinate the risk studies work and assisted in the preparation of materials for Chapters 1 and 2.

Alvin Mushkatel and Eric Herzik of Arizona State University, Glen Atkinson of the University of Nevada, Reno, and James Toma of Mountain West conducted the research and prepared material for the report on potential impacts of the project on intergovernmental relations, political behavior, and on state agencies. Background research conducted during Phase II and III of this project by Dina Titus of the University

of Nevada, Las Vegas also was incorporated into the report. The results of this research can be found in Chapters 3 and 4.

Richard Krannich and Ronald Little of Utah State University and Rocky Mountain Social Science (RMSS) prepared sections of Chapter 3 and 4 that discuss the rural community social-cultural impacts. This material is based on both their research during the past three years as well as the ethnographic work conducted under their direction by Joanne Endter and Michael Trend during Phase III of the project.

The Native American research and sections of the report were prepared by Catherine Fowler of the University of Nevada at Reno. Dr. Fowler was assisted in these efforts by Mary Rusco, Elmer Rusco, and Maribeth Hamby.

Several study team members were involved in research on the social-cultural impacts on the Las Vegas urban area reported on in Chapter 3 and 4. Kathleen Stewart provided input based on her ethnographic work during the past year. Preliminary data from the urban risk survey conducted during Phase III by Alvin Mushkatel, Joanne Nigg, and David Pijawka also was incorporated into the report. This survey was implemented by James Frey at the University of Nevada, Las Vegas. Data from background reports prepared by Robert Rucker of the UNLV Sociology Department during Phase II and III were also utilized in the urban area sections.

Mountain West, as prime contractor, coordinated the research, report writing, and production efforts. James Chalmers is the project director and Jim Flynn is the project manager. James Toma and C.K. Mertz as senior consultants with Mountain West provided day-by-day coordination and assistance in the report preparation, including drafting and revising sections as necessary. LouAnn Ruller is the project administrator. Mountain West support staff included: Susan Wasserkrug, Ellen Harrington, Beverly Eagar, Bonnie Wilkins, Kay Fischer, and Jodi Conway.

The Yucca Mountain Socioeconomic Studies have been conducted under the direction of the State and Local Government Planning Group (SLGPG), which consists of representatives from the Nevada Agency for Nuclear Projects/Nuclear Waste Project Office, the Legislative Counsel Bureau, the Western Shoshone National Council, the Moapa Band of Paiutes, the counties of Clark, Nye, Lincoln and Esmeralda, and the cities of Las Vegas, North Las Vegas, Henderson, and Caliente. A list of the SLGPG representatives is on the following pages. John Gervers and William Freudenberg, as consultants to the SLGPG, also have made important contributions to this report and to the overall direction of the studies.

A Technical Review Committee was established early in the study process to provide expert advise and input into the design of the socioeconomic studies and to oversee the implementation, analyses, and reporting of the study team. The committee has reviewed and commented on earlier drafts of this report and their recommendations have been taken into account in this final report. The TRC members and their affiliations are listed on the following pages.

TECHNICAL REVIEW COMMITTEE

Gilbert F. White (Chairman)	Gustavson Professor Emeritus of Geography, University of Colorado
Michael S. Bronzini	Professor and Head, Department of Civil Engineering, Pennsylvania State University
E. William Colglazier	Director, Energy, Environment and Resources Center University of Tennessee
Bruce Dohrenwend	Professor of Social Science and Public Health, Columbia University
Kai Erikson	Professor of Sociology and American Studies, Yale University
Reed Hansen	President, Hansen Research Associates
Allen V. Kneese	Senior Fellow Resources for the Future, Inc.
Richard Moore	Independent Consultant/Former Director, Wyoming Industrial Siting Administration
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STATE AND LOCAL GOVERNMENT PLANNING GROUP

Mike Baughman	Lincoln County and City of Caliente
Donald Bayer	Legislative Counsel Bureau
Dennis Bechtel	Clark County
Steve Bradhurst	Nye County
Peter Cummings	City of Las Vegas
Jack Finney	City of Henderson
Jane Kinnee	City of North Las Vegas
Brad Mettam	Esmeralda County
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Bob Palm (alternate)	Clark County
Nancy Powers (alternate)	City of North Las Vegas
Joseph Strolin	Nevada Agency for Nuclear Projects/Nuclear Waste Project Office
Ian Zabarte	Western Shoshone National Council

EXECUTIVE SUMMARY

When the United States Congress passed the Nuclear Waste Policy Act of 1982 and the amendments to the Act of December, 1987, it recognized the potentially significant socioeconomic dimensions of siting, constructing, and operating facilities for the storage and disposal of high-level radioactive wastes. Specific provisions were written into the Act to enable prospective host states, tribes, and local governments to carefully and comprehensively assess socioeconomic impacts associated with waste disposal facilities and activities.

The State of Nevada formally initiated a study of the socioeconomic impacts of a proposed high-level nuclear waste repository at Yucca Mountain in southern Nevada in 1986 after the Nevada site had been chosen as a potential waste disposal site. The State and affected local governments that participated in the development of the study recognized that the effort would need to go well beyond what is traditionally considered adequate for socioeconomic impact assessment because of the unique nature of the repository project.

As a result of Congressional action in 1987, Yucca Mountain is now the only location being studied by the U.S. Department of Energy (DOE) as a site for the nation's first high-level waste repository. The site must be found suitable by DOE, the President, and the United States Congress, and licensed by the Nuclear Regulatory Commission, before it can be developed and operated as a repository.

This *Interim Report* is a report on work in progress and presents findings from the research to date on the potential consequences of a repository for the citizens of Nevada. The research and findings in the Report have been subjected to rigorous peer review as part of the state's effort to insure independent, objective analysis that meets the highest professional standards. The basic research effort will continue through June 1990 and will enable the state to refine and clarify the findings presented in this *Interim Report*.

HIGH-LEVEL NUCLEAR WASTE DISPOSAL

Disposal of high-level nuclear waste presents society with one of its most complex social and technological challenges. The search for an acceptable solution to this problem in the United States has been underway for several decades, with a history of shifting program directions, changing disposal preferences, frequent social conflict, intergovernmental tensions, and widespread media attention. To design and construct a repository that can contain the wastes for a minimum of 10,000 years, and to move the accumulated wastes from over a hundred waste generating sites across the country to a single national site will require a management system that integrates federal government agencies, state and local governments, waste generators, national laboratories, waste

shippers and carriers, equipment manufacturers, and many private contractors. These elements must be meshed into a reliable and smoothly functioning system that can accommodate the inevitable surprises and operate with a scant margin for error.

The issue is further complicated because nuclear power and radioactive waste are feared technological *hazards*. Experiments repeatedly show that people perceive these hazards as little understood and potentially uncontrollable threats that have the potential for catastrophic results. Wide-spread public concerns over the hazards of radioactive waste disposal create a special context for Nevadans, one which generates discussion, debate, and conflict. The intensity of the debate can be expected to fluctuate over time, but important concerns will continue to be expressed as long as the Yucca Mountain site remains a candidate for a repository.

Accompanying this condition will be a pervasive degree of *uncertainty*. Major scientific efforts to identify and assess the hazards associated with radioactive waste can be expected. However, the potential consequences of these hazards are not likely to be ever completely understood. The nature of future events and the types and magnitudes of the consequences will depend heavily upon future conditions that cannot be fully anticipated. The uncertainties associated with the repository stem from the number of variables affecting the repository, its mission, and the socioeconomic-environmental-institutional context in which it exists. These include: its extended time dimension (10,000 years); future national policies on retrieval, monitoring, and safety standards; transportation requirements to collect the waste from widely dispersed sites throughout the U.S.; the large number of ways by which human factors can alter the overall performance of the system; reactions of the public toward repository-related events; and public confidence in repository management.

In summary, the overall repository program must be visualized as having three dominant characteristics -- complexity, hazards, and uncertainty. Therein lie the principal challenges in anticipating the consequences of the repository for the citizens of Nevada.

RESEARCH APPROACH

The objective of the Yucca Mountain socioeconomic studies is to provide essential information so that affected governments can meet their obligations to protect the safety and welfare of their citizens. Given the complexity, hazards, and uncertainties of the high-level nuclear waste repository program, any study methodology that claims precision in the anticipation of repository consequences must be viewed with great skepticism. However, the goal ultimately must be to describe the repository impacts as clearly as possible, both in their qualitative and, where possible, quantitative dimensions. What *kinds* of effects can be anticipated? Are the effects likely to be *harmful or beneficial* and to *whom*? Under what *conditions* could these consequences be significant? To what extent can these effects be *quantified*?

At one level, this research proceeds as does any other socioeconomic assessment. An interdisciplinary group of social scientists works together to define the cause and effect relationships linking the proposed project to political, social, and economic

conditions in the study area. Impacts are defined as the difference between conditions that would exist with the project as compared to conditions in the absence of the project. Causation is traced from economic effects of the project on employment and income to implications for population and settlement patterns. This provides the basis for analyzing demands for community facilities and services. Service costs are then compared to incremental revenues to estimate the fiscal impacts of the project. Finally, all of these consequences are assessed in the context of community values.

This basic approach is appropriate to the assessment of most major developments; its results are referred to as "standard effects." But the repository program also includes a unique set of characteristics resulting from the hazards of high-level radioactive waste. This introduces an entirely different category of cause and effect relationships; these are referred to as the "special effects." This *Interim Report* presents findings for both the standard and special effects.

STANDARD EFFECTS

The project proposed for Yucca Mountain envisions a large and expensive undertaking of extraordinarily long duration. Ultimately, the national program will touch most parts of the United States as radioactive waste is collected and transported to the disposal site.

Direct DOE expenditures at the Yucca Mountain repository site are estimated to be $8.1 billion in 1987-1988 dollars over the approximately 70-year period of characterization, construction, operations, and decommissioning. At the construction peak, total employment impacts could amount to 15,000 jobs (combining direct, indirect, and induced employment), which could result in as many as 24,000 more people than would be the case without the project. With the exception of the construction peak, total annual employment impacts are estimated to be 3,000 to 4,000 jobs, with associated population impacts of 6,000 to 7,000 persons. Much of this economic/demographic impact will occur in the Las Vegas urban area, but the greatest relative effects undoubtedly will be felt in the smaller rural communities.

At both the state and local levels, Nevada's public expenditures are more responsive to population growth than are public revenues. This is because a significant portion of the revenues under current tax structures come from visitor spending while expenditures are driven by services provided to residents. This fiscal structure means that any growth that does not increase the contribution of revenues from visitors will not pay its own way. In recent years the growth of gaming and tourism has kept pace with other forms of development. However, it cannot be assumed that the structure of the economy or the tax structure will remain the same into the next century.

The net negative impact to the State General Fund resulting from repository-related population growth is estimated at $22 million during site characterization, $27 million during construction, and $41 million during the emplacement period. In addition, negative impacts for both county and municipal governments could amount to more than $500 million over the 70-year period of repository activities. It should be understood

that these negative fiscal balances would accompany growth from any source not accompanied by a commensurate increase in gaming revenues.

Besides these population-driven consequences, state agencies will face extraordinary demands for oversight, public safety, and new facilities. These costs could range from $85 million up to $156 million, based on preliminary estimates made to date.

The costs of transportation infrastructure development and improvements to assure safe shipment of high-level radioactive waste could cost additional millions of dollars. Particularly troublesome in this regard is the level of information available on waste transportation. Remaining to be defined are the form in which the waste will be transported, the mode (rail or truck) of transport, and the routes that will be selected. The lack of adequate description for the transportation program, combined with the fact that impact analysis in this area has only just begun, identifies a major gap in the current understanding of the project. These limitations will be overcome only when the disposal program is better defined and as the associated research progresses. It is not clear yet what part of the transportation costs might be properly attributed to the repository program.

The major uncertainties associated with transportation are reminders that important uncertainties also exist for the entire range of economic, demographic, and fiscal analyses. These areas of assessment are best presented in quantified form, but the outputs of these analyses are subject to the same uncertainties as the assumptions upon which the analyses are based.

Against this backdrop of potential employment, population, and fiscal impacts, social and political change can be anticipated in the communities of the study area. Survey data over the past several years have consistently shown that about 70 percent of the residents in the Las Vegas Valley oppose the project and feel that the proposed Yucca Mountain facility would diminish their satisfaction with living in the Las Vegas area. However, there also is organized support for the repository. These conditions imply that groups on both sides of the issue will increasingly organize and become active in advocating their views.

The rural communities are generally less opposed to the repository than is the urban area, but there is substantial variation between communities. In the western study area communities of Indian Springs (in Clark County), and Amargosa Valley, Beatty and Pahrump (in Nye County), opposition to the project ranges from 13 to 35 percent and there tends to be less apprehension about potential health and safety effects than in the Las Vegas urban area. The eastern study area communities of Alamo-Hiko, Caliente, Panaca, and Pioche (in Lincoln County) and the Moapa Valley (in northeast Clark County) are more negative than the western communities (42 to 51 percent opposed), due partly to the experience of this area with the downwind effects of atmospheric nuclear testing at the Nuclear Test Site.

The differences of opinion that have been recorded for these rural communities suggest that there is potential for conflict, a decrease in community satisfaction, and

divisive political issues in response to the repository program. To fully understand Nevada attitudes toward the repository, it is important to recognize that both the urban and rural residents, despite their opposition to the repository, assume a degree of fatalism about the likelihood of the repository being built.

Native American communities also may experience significant impacts from the repository program. These impacts likely would be sociocultural in character and derive directly from strongly-held beliefs among Native Americans that the repository and related nuclear waste transportation are contrary to a proper relationship between people and the land. The repository also poses yet another obstacle to Native American attempts to regain their traditional tribal lands.

The full implications of the repository cannot be considered, however, without looking more carefully at its "special" consequences.

SPECIAL EFFECTS

"Special" effects -- those resulting from the inherently hazardous characteristics of high-level radioactive waste -- have the potential to affect Nevada in two ways. First, these hazard-related effects of the repository could diminish the quality of life for Nevada residents. Second, special effects have the potential to negatively impact the economic base of the state which is dependent on the willingness of people outside Nevada to visit, invest in, and move to Nevada. Given the dominance of the visitor economy in Southern Nevada (at least one-third of total employment or 100,000 jobs), realization of these effects would have profound impacts on all dimensions of political, social, and economic life in Nevada.

The special effects have the potential to impact Nevada's economy because of the way people react to their perceptions of the repository program. Simply put, media reports about the performance of the repository program could stigmatize all or parts of Nevada. This stigmatization could then influence the behavior of people and diminish visitation, migration, and economic development. An analogous case in point would be the American tourists who stayed away from Europe during the terrorist scares of 1986. Significant reductions occurred in visitor spending in the affected European countries, based upon the perceived risk that attacks by terrorists might occur while tourists were on vacation. In Chapter 2 a number of cases involving stigmatization are evaluated. For people in Nevada, the numerous reports of cases where behavior of visitors or tourists have been significantly affected by their perception of places, raises some fundamental questions. Will adverse risk-induced effects accompany events associated with the repository? What will be their magnitude? What will be their frequency and duration?

These issues were addressed first by directly asking individuals both in Nevada and throughout the U.S. about how they would behave in the presence of a radioactive waste repository. When the repository was postulated to be 100 miles from a community, about 40 percent of the respondents said the community would be less desirable for conventions; 50 to 60 percent felt it would be less desirable to visit; and 60 to 70 percent felt it would be less desirable as a place to live and raise a family. Equally strong

responses were given in a subsequent survey when individuals were asked about Las Vegas as a place to attend a convention, visit as a tourist, raise a family, retire, etc. These respondents were asked about their potential behavior first without any reference to a repository and then a second time after being told a repository would be located 90 miles to the northwest. For all of the activities identified, the repository significantly reduced the numbers of people rating Las Vegas favorably for these activities and increased the numbers rating it unfavorably. Moreover, there was an increase in the number of people who said a repository within 90 miles would make Las Vegas totally unacceptable for any of these activities.

Interpretation of these results presents difficulties since the proposed repository is not yet well enough defined or understood to ensure that respondents could accurately predict how they would react to it. So while the issue of future behavior is necessarily unresolved, the surveys do record intense negative attitudes toward the repository at the current time. These attitudes may not predict future behavior but they indicate the direction that future actions may take. Given the inherent limitations of working with the answers to these hypothetical questions, it was critical to use other methods to better understand how risk-induced attitudes and perceptions might affect behavior.

One alternative approach to understanding the relationship between risk and behavior was to conduct "Image Studies" on the characteristics of Nevada, Las Vegas, and radioactive waste. This involved a research effort that dealt directly with perception and behavior. The approach was based on the hypothesis that people have images or stereotypes of places and that the positive or negative dimensions of these images influence behavior toward the places. To many people this will seem obvious since considerable effort in advertising products, services, and places is based upon just this premise.

The underlying hypothesis was tested in a pilot study of Phoenix households and demonstrated to be valid. People have images of places, and positive imagery is a very good predictor of their stated preference of a place to vacation, live, or start a business. People's imagery also predicts their actual, historical visitation behavior. This is not very startling. It just says that if you ask a group for spontaneous images they associate with cities A and B and then have them value the images, those with more positive images of A will indicate a preference for A if asked to choose a future vacation site and, in fact, will have visited A more frequently in the past.

The research program also explored the imagery of the repository and found it to be overwhelmingly negative. The most frequent associations were dangerousness and death and their synonyms, followed by pollution, radiation, and other negative concepts. It follows that if the repository were to become associated with Las Vegas or Nevada in the eyes of the general public, there exists real potential for a decrease in tourism, inmigration, and economic development.

Perhaps most relevant, Nevada is already associated with nuclear imagery. About 10 percent of the Phoenix sample used nuclear, radiation, bombs, etc. as one of the first six images they associate with Nevada. This group had a decidedly more negative image

of Nevada than the remainder of the sample, had visited Nevada less, and were less willing to visit Nevada in the future. Las Vegas, on the other hand, was conspicuously absent of nuclear imagery. This distinction on the part of people's perceptions and behavior is interesting and may imply either a fundamental separation of the image associations for Nevada and Las Vegas or some limitation in the current study methodology. Further research is indicated and is planned for the upcoming phases of the study.

The conclusion of the research to date is that Nevada faces considerable exposure with respect to risk-induced effects. Given the uncertainties associated with how the repository program and its consequences will be perceived, and about the way in which people will react to repository-related perceptions, Nevada must be alert to the possibility that these effects could be very negative and could be large.

The size of these potential negative effects has not been determined yet, and the subject remains under study. It should be noted, however, that each one-percent decline for Clark County in spending by visitors, retired people, and investors relative to the baseline levels assumed to occur in some future year (e.g., 2010) could produce an annual loss of 7,000 jobs and $200 million in income. It is not clear how large a percentage decline could be expected as a result of repository-related perceptions, nor how long it would last, but corresponding cases involving risk-related declines in tourist spending indicate that such decline could be well in excess of the conservative one-percent illustrated here. Further research into analogous cases is planned to test these assumptions.

Although the numbers generated by the one-percent scenario above are large in absolute terms, they should be seen in the context of expected growth in the Clark County economy. By 2010, the Clark County economy is expected to grow by 60 percent. Impacts of the magnitude represented in the scenario would be modest relative to the size of the overall economy. However, the magnitude of potential impacts could be greater in both relative and absolute terms if current growth projections for Clark County are not realized or if the special effects exceed those shown in the one-percent scenario.

The emphasis for continuing research will be on better understanding the relationship of the repository to perception and behavior. The imagery research will be expanded to include a representative national sample. The process of image formation will be studied to better understand the current place of things nuclear in the imagery associated with Nevada and to anticipate how that might change in the future. Attempts will be made to understand the duration of risk-induced effects. Under what conditions will stigmatization be lasting? Under what conditions will it be transitory?

OVERALL CONCLUSIONS BASED ON WORK COMPLETED TO DATE

The greatest potential socioeconomic difficulty of the proposed repository stems from the intense negative imagery associated by the public with a high-level radioactive waste repository, combined with the vulnerability of the Nevada economy to changes in its public image. Because of the high profile nature of the whole nuclear waste disposal

program, the potential exists for Nevada to become associated with this negative imagery to the detriment of its attempts to attract tourists, conventions, migrants, and diversified new industry to the state.

A portion of the research effort reported here has been devoted to measuring the intensity of people's current perceptions and to better understanding how imagery affects intended future behavior. The conclusions of the work to date are:

- the repository's image is very negative;
- the nuclear imagery of the repository could become associated with the State of Nevada; and
- a more negative image of the state could have substantial adverse effects on key Nevada industries.

Looking to the more conventional economic dimensions of the project, the proposed facility would provide an economic stimulus to the Nevada economy with total annual employment effects of about 3,000 to 4,000 jobs during the period the repository would be accepting waste. Associated population impacts would be 6,000 to 7,000 persons.

Economic growth and diversification are viewed positively in Nevada. However, one result of the current tax structure is that public services and facilities are already under stress. The additional repository-related population growth will generate substantial negative fiscal impacts for state and local jurisdictions. Although such negative fiscal impacts would result for any non-gaming industry economic development, there is a distinction between the state's willingness to subsidize desired economic diversification and its willingness to subsidize the fiscal effects of a repository. The goal of economic diversification programs in Nevada is to reduce the risk of economic losses in the event of a down turn in the state's all important tourism industry. A repository could enhance the risk to this very industry through the mechanism of risk perception and risk-related behavior. Thus the repository may not be considered attractive from an economic development standpoint because it has the potential to bring about precisely the opposite effects on the economy from other forms of development.

The issues and concerns expressed by many residents of Southern Nevada make it clear that there is wide-spread opposition to the repository based on health and safety concerns (especially in regard to transportation), the potential threats to the economy, the creation of divisive policy issues, and the fear of diminished quality of life. Native American residents consider the repository program as a threat to their cultural values and to their hopes to regain traditional lands.

Although the standard effects create challenges for monitoring and mitigation, they do not raise the same level of concern as the special effects. This is because the mechanisms by which the standard effects are transmitted are better understood and

there is a reasonable level of confidence that their negative impacts can be managed effectively.

The special effects create much greater concerns because less is known about how they work and there is no basis to argue conclusively that they could be reversed once set in motion. A primary conclusion of this research is that the State of Nevada cannot afford to ignore these risk-induced effects on its economy and society.

The results of the many different research efforts indicate that state and local governments must work under the assumption that the high-level radioactive waste repository proposed at Yucca Mountain has the potential to result in significant negative impacts for the state's economic base, revenues, public services, and community life. Such impacts could more than offset any expected benefits to be derived from employment and income generated by the project.

1.0 Overview

1.1 Background

1.1.1 Siting a Repository in an Environment of Hazard and Uncertainty

The siting of a high-level radioactive waste disposal facility is an extraordinary technological and social challenge. The search for an acceptable site in the United States has been underway for several decades, with a history of shifting program directions, changing disposal preferences, intense social conflict, inter-government tensions, and widespread media attention. With the accumulated wastes of decades of nuclear weapons production and over one hundred nuclear power plants, the implementation of an effective disposal system is essential for national security and the nation's energy future. To move these wastes from their present locations to a single national site will require the deployment of a technological management system of far-flung and extraordinarily diverse components, including federal government agencies, state and local governments, national laboratories, waste shippers and carriers, equipment manufacturers, and a host of private contractors. Somehow these varied elements must be integrated into a smoothly functioning system with shared objectives and meshed roles, one capable of isolating highly dangerous materials through an unknowable future extending over thousands of years. Despite the challenge, a social expectation exists that this mission will be accomplished with high reliability and a scant margin for error in the face of surprises that will inevitably occur. The success of the mission ultimately will be heavily influenced by the credibility, competence, and demonstrated good faith of the responsible parties.

Such a technological undertaking has the potential for substantial unanticipated effects, particularly for those who will bear the uncertain risks. This includes the communities that will host the development and operation of the facility, the state that must plan for the inevitable changes in its society and economy, the populations living astride the routes over which wastes will be transported, and the federal government that ultimately bears the burden for assuring the protection of public health and the fairness of the decision making process. These effects are not currently well understood because society lacks experience with this particular technological and managerial undertaking.

At first glance, it might be surprising that siting a nuclear waste repository has proved so controversial and difficult. Radiation hazards are generally better understood than the hazards of most chemicals and metals. Although a high-level waste repository is new, there is substantial accumulated experience with handling radioactive materials in governmental, industrial, and medical settings. A well-developed regulatory regime for protecting the public and workers from radiation hazards exists at both national and international levels. And, Congress, at last, has put its authority behind a disposal policy, authorized billions of dollars to implement the policy, and even selected a potential site.

Despite these attributes, a number of underlying factors contribute to the extraordinary complexity of high-level radioactive waste disposal. First, the nature of the hazards ensures continuing public concern. Not only are high-level radioactive wastes toxic, but they are dangerous for long time periods. The invisible nature of radiation exposure and its linkage with cancer add to this concern. Radioactive waste hazards have qualitative properties that heighten public concerns. Risk perception studies over the last decade have shown that lay people consistently judge radioactive wastes and nuclear hazards high on certain dimensions of hazards -- dread, unfamiliar, involuntary, uncontrollable, unknown to science -- that are strongly associated with public anxiety and concern over a technology (Slovic, Lichtenstein, and Fischhoff, 1979).

Related to the characteristics of the hazards is the fact that nuclear power, and by inference radioactive wastes, have been associated from the start with weapons of large-scale destruction. Accordingly, it is not surprising that nuclear energy as a technology has elicited fear over potentially catastrophic accidents. Risk perception studies reveal that many members of the public expect nuclear accidents to lead to vast catastrophes (Slovic, Lichtenstein, and Fischhoff, 1979), a perspective undoubtedly supported by the Chernobyl accident. Surveys conducted in association with Nevada's socioeconomic impact analysis (Chapters 3 and 4) reveal continuing high levels of public concern over radioactive waste accidents. Despite the fact that many experts see no risks of catastrophic releases from a geologic repository, it is apparent that many members of the public do not share such opinions.

Both the nature of radioactive waste hazards and the designation of a single disposal site contribute to value issues that are intermingled with the technical considerations in waste disposal. The longevity of the hazard inevitably requires definition of this generation's responsibility to future generations, both in regard to appropriate levels of protection, the potential export of management burdens, and the preservation of options for the future. Since no technical means of disposal can simultaneously achieve all desirable values, continuing debate over value tradeoffs is certain. In addition, the wide distribution of benefits across the nation and the concentration of risk-bearing along waste transportation routes and at the disposal site raises both substantive and procedural equity questions. What are the responsibilities of the beneficiaries of nuclear-generated electricity in the northeast, for example, to those who will bear the uncertain risks and burdens in Southern Nevada? And how may fairness be ensured in the way that decisions are made about risk acceptability, technical review, facility design, and social impact mitigation. In an insightful analysis of a broad spectrum of technological controversies, von Winterfeldt and Edwards (1984) suggested that the most difficult controversies for society to resolve were those in which issues oscillated between questions of fact and questions of value.

Then, too, apart from its distinctive nuclear mission, it must be appreciated that high-level radioactive waste disposal is a very significant technological undertaking. If the program is to satisfy the stated aims of Congress, a disposal system must be designed and constructed to be capable of ensuring the isolation of the waste from the biosphere over a 10,000 year period. All foreseeable events must be anticipated and taken into

account in the design of engineered systems and the repository itself. An entire waste facility and transportation system must be designed and implemented over the next decade, including the design and manufacture of a new generation of casks, development of interim storage facilities and their successful siting, choices of rail or truck transport, coordination of diverse public and private sector actors, and resolution of a host of institutional questions. Finally, the repository itself must be licensed by a government agency with no experience in licensing such a facility, and the entire transportation and disposal system will be regulated by a federal agency with only limited experience in radioactive materials transportation. All of these activities will be under the close scrutiny of a cadre of committed critics, an attentive mass media, and a concerned public.

To meet these challenges, the history of radioactive waste management affords relatively few successes upon which to draw. In the decade prior to the Nuclear Waste Policy Act, federal initiatives to design and implement a coherent waste management program foundered on shifting disposal strategies, federal-state conflicts, and evident public opposition. Commercial low-level waste disposal facilities built during the 1960s experienced leakages and waste migration, and a number had to be closed. The past several years have revealed widespread inadequacies in nuclear defense-related facilities, with a waste cleanup bill now estimated in the hundreds of billions of dollars. Recently, the opening of the Waste Isolation Pilot Plant (WIPP) repository proposed to store transuranic radioactive wastes in New Mexico was delayed because of unforeseen geologic and procedural problems.

In order to fully appreciate and anticipate the potential social impacts of a repository in Nevada, it is important to place present decisions and governmental activities in the historical context described above. No matter how technically safe the repository and attendant activities can be made, the technology may not be socially acceptable for many people and political jurisdictions in Nevada, and may also result in serious and long-lasting consequences to the economy of the state due to risk avoidance behavior on the part of people or groups important to Nevada's economic well-being. Since the passage of the 1987 Amendments to the NWPA, no other location is being examined as a possible site for a permanent high-level radioactive waste repository.

It is essential to recognize that, while these factors have some distinctive features in American experience, they have made the search for, and siting of radioactive waste disposal facilities, extraordinarily difficult in advanced industrial societies throughout Europe and North America (Parker, Kasperson, Andersson, and Parker, 1987). Although Sweden and France are both making progress in managing high-level radioactive wastes, they also have experienced intense siting conflicts. The United Kingdom has deferred the disposal of such wastes to the next century and has been forced repeatedly to alter its disposal plans for intermediate and low-level radioactive wastes. The Federal Republic of Germany has encountered substantial opposition from the Greens and local critics in its waste program as well as court challenges to most of its planned nuclear facilities. Switzerland has made extraordinary efforts in risk communication and public participation as a result of committed opposition in potential host cantons for a disposal facility. And all of these countries have adopted a central role for interim storage and more flexible schedules than those which characterize the U.S. program.

1.1.2 Historical Background for the Yucca Mountain Selection

The United States has been producing high-level radioactive waste in connection with defense activities and commercial electric power production for more than forty years. The United States Department of Energy (DOE) estimates that by the year 2036, the commercial spent fuel discharged from reactors will be about 87,000 metric tons of heavy metal (MTHM) (DOE, 1988c, p.11).

The total waste, including waste from defense facilities, identified by DOE for its Draft 1988 Mission Plan Amendment was 96,390 MTHM. A recent General Accounting Office report to Congress (GAO, 1988b, p. 16) estimates that existing nuclear plants and government defense activities are likely to result in "between 96,000 and 105,000 metric tons" or, at the upper level, about 50 percent more waste than the legal limit of 70,000 MTHM currently authorized for the first repository. These estimates are characterized by GAO as subject to a substantial degree of uncertainty. Under the terms of the Nuclear Waste Policy Act Amendments of 1987, DOE is required to report to Congress early in the next century on the necessity of a second repository. It is entirely possible that DOE will recommend an expansion of the first repository in order to accommodate future needs in excess of 70,000 MTHM.

The Nuclear Waste Policy Act of 1982

The Nuclear Waste Policy Act of 1982 (NWPA) was the product of years of debate stimulated by a long history of technical, political, and management difficulties in the federal government's attempts to solve the nation's nuclear waste disposal problem.

The Act, which was signed into law by President Ronald Reagan on January 7, 1983, was built on a series of finely crafted compromises designed to insure equity, scientific credibility, and public acceptance of the process by which the country proceeded to select, site, and subsequently build, two repositories for high-level radioactive waste disposal. The NWPA provided for:

- Oversight of federal (DOE) site selection and characterization activities by potential host states and Indian tribes;
- Regulation and licensing of the repositories and the Monitored Retrievable Storage (MRS) facility by the Nuclear Regulatory Commission;
- The ability of a state or tribe to veto the selection of a site for a repository or MRS within its borders, subject to override by a majority in both houses of Congress;
- Exemption of the site selection process for the repositories and MRS facility from certain provisions of the National Environmental Policy Act (NEPA);

- Establishment of a Nuclear Waste Fund to pay for all costs associated with the high-level waste disposal program and the assessment of a fee on generators of the waste (commercial power plants and defense facilities) to cover program expenses;

- Financial assistance to potential host states and tribes for participation in and oversight of DOE's high-level waste disposal program;

- Impact assistance for host states and tribes for mitigating repository/MRS-related socioeconomic, environmental, and other impacts;

- Grants to states, tribes and local governments in amounts such entities would have received were they able to tax federal repository/MRS activities in the same manner as they tax other industrial activities; and

- Other provisions addressing interim storage of high-level nuclear waste, judicial review of federal agency actions by affected parties, expedited procedures for authorizations sought by DOE from other federal agencies, and certain transportation issues associated with the repository/MRS programs.

Five years after the passage of the NWPA, many of the compromises which allowed the Act to become law had broken down, and the diverse constituency of environmental groups, states, tribes, local governments, nuclear utilities and others had begun to disintegrate. Major conflicts erupted over the site selection process employed by DOE for both repositories and for the MRS facility.

In an attempt to address the problems affecting the program and to get the waste disposal effort back on track, Congress passed the Nuclear Waste Policy Amendments Act of 1987 (NWPAA) in December 1987. The NWPAA eliminated the original provision for two repositories and directed that DOE characterize only one repository site -- the Yucca Mountain site in Nevada. If Yucca Mountain proved to be unsuitable, DOE was instructed to report back to Congress for further guidance. The NWPAA also:

- Cancelled DOE's plans for developing a MRS facility in Tennessee, and established a commission to examine the need for a MRS component in the waste disposal system;

- Provided participation rights and financial assistance to units of "affected local governments" that were similar to those originally afforded states and Indian tribes;

- Authorized the payment of benefits to potential host states, tribes, and local governments in amounts of $10 million per year during characterization and $20 million annually once waste began to be delivered to a repository. Jurisdictions hosting a MRS facility would be

eligible to receive $5 million during characterization and $10 million during operations. In exchange for these benefits, recipients would be required to surrender rights to veto the selection of the site, to receive impact mitigation assistance, and to cooperate with DOE in the siting process.

- Established a Nuclear Waste Negotiator to meet with interested states and tribes in an effort to find a volunteer to host a repository or a MRS facility;

- Established a Presidentially-appointed Nuclear Waste Technical Review Board to oversee and monitor DOE activities at Yucca Mountain and at any subsequent repository or MRS site;

- Required DOE to report to Congress on the potential socioeconomic, environmental, and public health and safety impacts of locating a repository at Yucca Mountain; and

- Imposed certain requirements on DOE for transporting waste to a repository or MRS and for studying alternative methods of waste disposal.

The extraordinary lengths to which the U.S. Congress has gone in debating, defining, establishing, and revising national nuclear waste disposal policy -- in both the NWPA and the NWPAA -- is reflective of the extreme complexities and uncertainties which characterize one of the most challenging public policy problems of our time. Congressional policy-making and the structures established to implement such policy have significant implications for the manner in which waste disposal initiatives, such as the proposed Yucca Mountain repository, will affect the socioeconomic environments within which they are attempted.

The Proposed Nevada Site: Yucca Mountain

The Yucca Mountain site is located in Nye County, Nevada about 93 air miles from the City of Las Vegas. Access to the site is from U.S. Highway 95 which runs north and northwest from Las Vegas toward Reno and the state capital at Carson City. The site is on three parcels of federal land, each controlled by a separate agency; portions are assigned to the U.S. Air Force, the Bureau of Land Management (BLM), and the DOE operations at the Nevada Nuclear Test Site (Figure 1-1). The DOE conducts major operations at the Nevada Test Site (NTS) and employs about 8,000 workers at the current time. The Department of Defense employment in Clark, Lincoln, and Nye counties numbered in excess of 15,000 employees in 1988. Altogether, the federal government owns about 87 percent of the total land area of the State of Nevada, a large portion of it administered by the BLM.

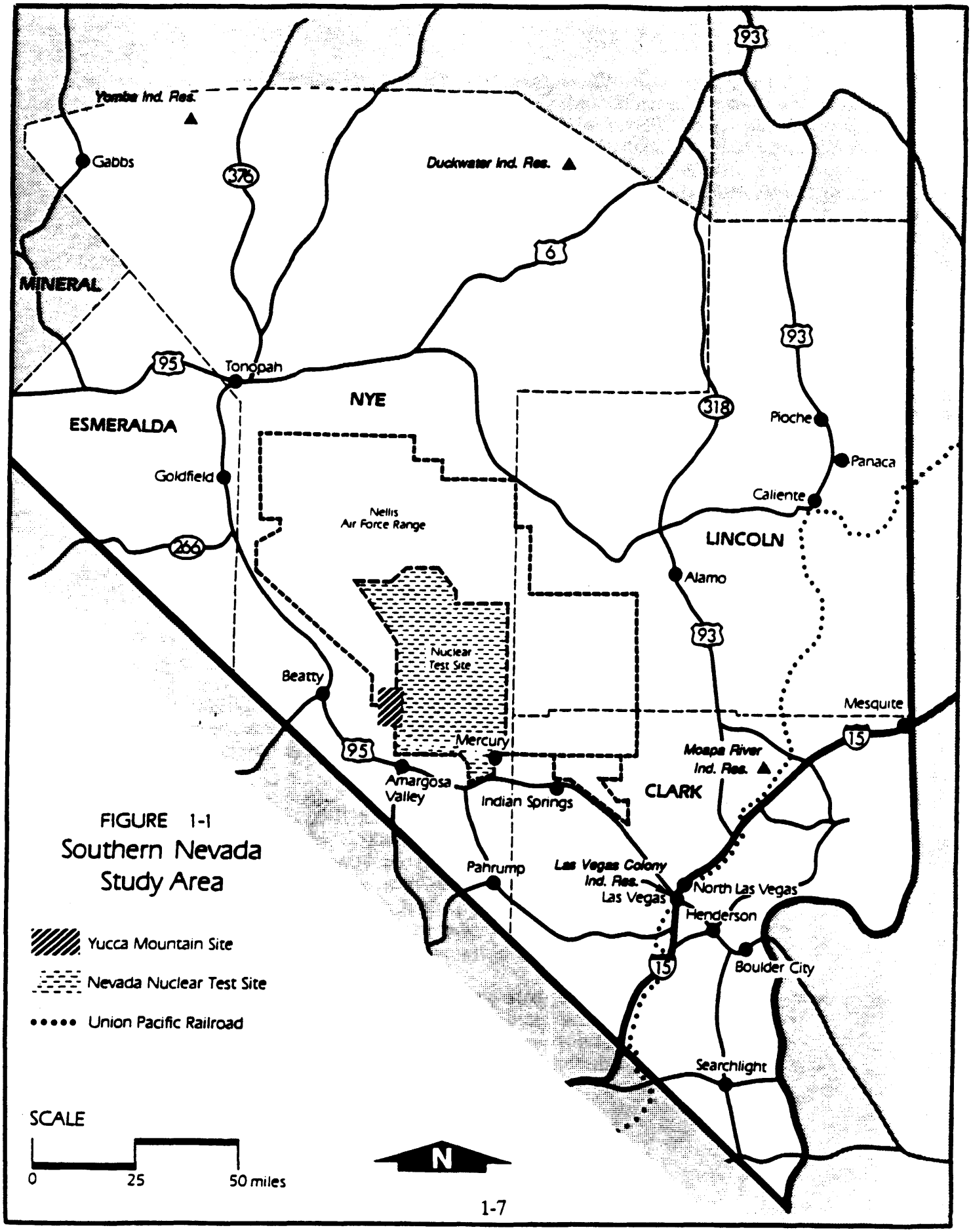


FIGURE 1-1
Southern Nevada
Study Area

The DOE describes Yucca Mountain as a suitable geologic formation of tertiary tufaceous volcanic material which occurs in this region to thicknesses of 6,500 feet and more (DOE, 1986c). The area of the southern part of the Great Basin experiences very low precipitation; at Yucca Mountain, the average annual rainfall is 5.91 inches. The proposed repository would be constructed in the unsaturated zone about 1,000 feet below the surface of the mountain and between 600 and 1,300 feet above the water table.

There are, however, a number of serious questions about the volcanic, tectonic, and hydrologic conditions of the site that may make the site unsuitable for a repository. The DOE plans to conduct extensive site characterization studies to determine if these conditions could disqualify the Yucca Mountain location from development as a permanent repository. In their review capacities, the U.S. Nuclear Regulatory Commission (NRC) and the State of Nevada have raised concerns about the adequacy and appropriateness of DOE's proposed site characterization activities for answering crucial site suitability questions.

1.2 Characteristics of the Project

In order to assess a proposed project, both the project and the context in which it takes place must be defined. The project itself must be described in terms of such key characteristics as design, employment, purchases, schedule, and other factors that directly influence the nature and magnitude of impacts. The context within which the project-related activities and events take place also must be well understood.

1.2.1 Areas of Uncertainty

Unfortunately, due to the unique character of the proposed repository, there are major areas of uncertainty that create special problems for the impact assessment process. The following areas are critical and illustrate the scope of uncertainty, but they are not by any means an exhaustive listing.

- Amount of waste. The current statutory limit is 70,000 MTHM, but the government estimates are that up to 105,000 MTHM may be produced for disposal (GAO, 1988b) and that modifications in the amount designated for Yucca Mountain may be sought by the DOE at some point in the future (DOE, 1988c, pp. 21-22). If the size of the repository expands, the level of impacts experienced by state government, tribes, localities, and citizens can also be expected to expand.

- Repository Design. Two basic design options have been considered: (1) vertical, or (2) horizontal emplacement of canisters. The labor, materials, purchases, and costs of the repository are significantly different with these two approaches. Further, important changes may result from the findings of the site characterization studies and from potential changes in policy

decisions on the respective roles of geological and/or engineered barriers to contain thermal and radioactive waste products.

- Risk Assessments. Risk assessments of the radioactive elements contained in high-level waste have never been accomplished for the variety of conditions to be experienced with the proposed repository at Yucca Mountain. The DOE conceptualization of the risk assessment problems is extremely limited, especially in the areas of human error, quality-assurance failures, human intrusion, and acts of sabotage and terrorism. In the area of potential retrieval of radioactive wastes (a capability that is required under the legislation and the regulations) almost no risk assessment work has been undertaken. The preliminary status of DOE risk assessment work is such that further research and study may actually expand the areas of uncertainty beyond the wide bounds that are currently indicated.

- Schedule. Variations in the scheduling of work on any phase of the project can have major effects on estimating impacts. The past schedules for even the earliest phases of the repository program have proven to be unreliable, with the implication that the current schedules very well may not be met or even approximated. Stop-and-go construction or operations activities are possible due to any number of causes. Ambiguity and uncertainty characterize everything from the likelihood that work will begin on the exploratory shaft construction in the Fall of 1989 at Yucca Mountain to questions regarding intermediate and longer-term schedules.

- System Components. Major components of the system are still in the design or even the pre-design phases. The need for a MRS is under review, and it is not clear how or where it would be sited and developed, even if it is recommended by the commission currently studying it. The role of at-reactor storage and the form of packaging by producers, utilities, and government agencies is subject to change. Cask designs are under development. Issues of waste consolidation, waste-acceptance rates, priorities of disposal (e.g., from defense plants or among power stations) incorporation of new technologies (e.g., robotics, phototransmutation), new regulatory requirements, or standards (e.g., cask integrity -- Sweden has developed containers that appear to have upward of one million years of integrity) could greatly impact the program. Serious consideration of the retrieval options could require significant changes in the design and schedule for the entire effort at Yucca Mountain.

- Transportation. Transportation is a critical component of the system, and the development of planning could best be described as in the pre-design rather than the design phase. In addition, precise definition of transportation elements does not appear to be a high priority with DOE at this time. Transportation routes, modal mix (rail or truck), timing, volumes, oversight and management, equipment, emergency response

capabilities, intergovernmental coordination, and special facilities all remain to be worked out. Almost every aspect of the transportation description is subject to revision, re-design, uncertainty, and ambiguity at the current stages of program development.

- Program Management and Administration. The potential for moderating and mitigating effects of the repository program could be very significant, but at the current time, neither an examination of potential management actions nor an organizational framework for implementing such types of mitigation have been outlined. Moreover, the capability of DOE to manage the program within the restrictions of regulation and oversight mandated by Congress remains to be demonstrated. There have been suggestions that DOE might not be the appropriate federal entity to develop a repository (Makhijani, 1989; Advisory Panel, 1984). Both these types of management questions could have significant effects on the timing, distribution, and eventually the nature and degree of impacts resulting from the Yucca Mountain project. Much uncertainty about the project will exist until these questions are resolved.

A great deal of uncertainty exists in all areas of project description, from project design to implementation schedule to the assessment of risks. Critical management decisions that could significantly affect the impacts of the program remain to be made and, in some cases, these decisions may be years in the future.

1.2.2 Description of Yucca Mountain Project Design and Functions

The function of the proposed repository is the permanent isolation of high-level radioactive waste. At this time, the design of the repository is not complete and will continue to evolve as more data is collected. The Site Characterization Plan (SCP) conceptual design, completed in 1987, was developed for the purposes of identifying design-related information that must be collected during site characterization. It is still an early conceptual design that is likely to change as more data is collected and more-detailed designs are developed (DOE, 1988b). Generally, the repository would consist of surface facilities, underground facilities, and shafts and ramps connecting the surface and the underground facilities. The characteristics of the repository design discussed here are based on the SCP conceptual design as presented in the Site Characterization Plan/Consultation Draft (DOE, 1988a).

The surface facilities would include areas for waste receipt and inspection, for waste operations necessary in preparing the waste for disposal, for access to and ventilation for the underground facilities, and for general support facilities. The repository would be developed in two phases and include two waste-handling buildings. The smaller waste-handling building would be developed first and used during the first phase. This building would be used for preparing waste that does not require consolidation, such as defense high-level waste, commercial high-level waste, spent fuel that cannot be consolidated, and spent fuel consolidated at the reactor site or another waste

management facility. Full operational capacity of the repository would be reached during Phase 2 when the larger waste-handling building is completed.

The second waste-handling building would contain the facilities for consolidating spent fuel into more compact arrays than those used in the spent fuel assemblies. In the waste-handling buildings, the spent fuel would be unloaded from the shipping cask it arrives in and transferred to a packaging station in a "hot" cell, which is a room provided with shielding against radiation and equipped with remotely controlled equipment. Here the spent-fuel rods would be consolidated into a more compact array and loaded into disposal containers. The loaded containers would be transferred to another station, where they would be sealed by welding and inspected for leaks. The sealed container would be moved into a surface vault for temporary storage before emplacement underground. Specially designed transfer casks and transporters would be utilized for transferring and emplacement operations.

DOE plans to undertake additional studies to further analyze the allocation of functions between the repository and the MRS facility. It may be that some of the functions currently anticipated for the repository may take place at the MRS facility.

Other surface facilities planned include: facilities used for testing the performance of the waste packages; a decontamination building for decontaminating any contaminated equipment or components; the waste-treatment building for preparing for disposal radioactive waste generated at the repository; and facilities for other support services, such as security, fire protection, administration, maintenance, and laboratories.

The current design includes six openings to the underground facilities, four vertical shafts and two ramps. The shafts would be used for intake ventilation air for the waste-emplacement area and mining area, exhausting air from the waste emplacement area, and for providing access to the mining area for people and equipment. One ramp would be used for transporting the waste containers from the surface to the underground facilities and for providing a fresh-air intake for the waste-emplacement area. The other ramp would be utilized for excavating and constructing the underground repository, for removing the excavated rock from underground, and for providing the primary exhaust airway for the underground-development area.

The underground repository would be constructed at a depth of about 1,000 feet below the eastern flank of Yucca Mountain. The primary area is in the welded tuff of the Topopah Spring Member. Preliminary data suggest that this site could accommodate the equivalent of 70,000 MTHM and that an area of 2,095 acres would be available underground for emplacement although current plans call for using 1,380 acres (DOE, 1988b).

The repository would consist of three parallel main entry drifts mined out of the volcanic tuff and a number of waste-emplacement panels, which are areas of solid rock in which the waste would be emplaced. Within each emplacement panel, boreholes would be drilled into the walls or floors of the emplacement drifts, depending on whether horizontal or vertical emplacement is used. Preliminary studies indicate that the

horizontal emplacement mode would permit the most efficient use of the site and would reduce mining requirements and costs.

1.2.3 Description of Project Phases

This section of the report provides an overview of the phases and schedule for the development of the proposed repository as these are presently envisioned by DOE (see Figure 1-2). As with other aspects of this project, uncertainty with schedules and even with specific tasks within various phases of activity poses unique challenges for estimating project effects.

Site Characterization

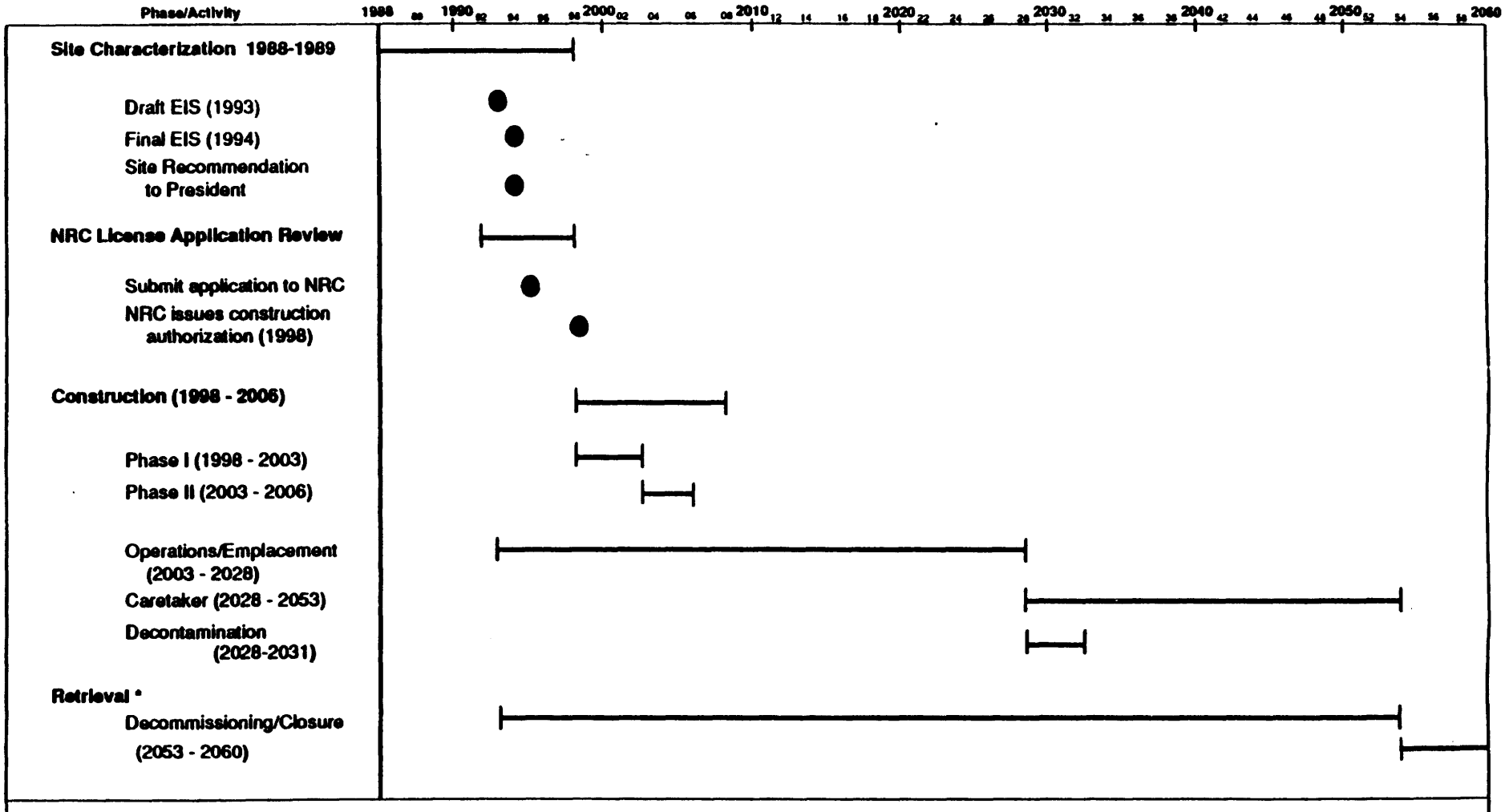
Before the Yucca Mountain site can be developed as a repository, it must be demonstrated that the site is suitable for such a purpose and can meet regulatory requirements. DOE will conduct site characterization activities to collect the detailed geologic and hydrologic data needed for determining whether the Yucca Mountain site is suitable for development as a high-level nuclear waste repository. Site characterization is required by the NWPA, the NWPAA, NRC regulations, and DOE siting guidelines. In addition to making a thorough examination of the suitability of the Yucca Mountain site, the DOE site characterization program must provide the technical data and evaluations necessary to meet all the licensing and permitting requirements which must precede construction and operation.

Activities planned for site characterization consist of surface-based tests, construction of an exploratory-shaft facility, and tests conducted in that exploratory-shaft facility (DOE, 1988b). Surface-based tests and field studies include: exploratory drilling; studies to monitor precipitation and stream flow; geophysical surveys; and geologic mapping.

Surface-based characterization studies have been in progress at Yucca Mountain since long before the site was selected for characterization in May, 1986. These studies have continued a surface-based testing program that began in 1977 when DOE first identified the NTS area as a potentially acceptable area for a mined geologic repository. The EA lists a number of ongoing field and laboratory activities that would be continued during site characterization: geodetic surveys; experimental horizontal core drilling; studies of past hydrologic conditions; studies of tectonics, seismicity and volcanism; studies of seismicity induced by weapons testing at NTS; field experiments in G-Tunnel facilities (at the NTS); and laboratory studies (DOE, 1986a). However, due to questions involving quality assurance and documentation, the results of this earlier work may have to be abandoned or replicated during site characterization.

The major undertaking during site characterization is the construction of an exploratory mine shaft to the area where nuclear wastes would be emplaced, and where tests would be conducted to collect information on the geologic, hydrologic, geoengineering, and geochemical suitability of the host rock for use as a nuclear waste

FIGURE 1-2 PROJECT SCHEDULE OF ACTIVITIES + MILESTONES



* Nuclear Waste Policy Act requires that the waste be retrievable for a period of up to 50 years after waste emplacement begins. If a decision to retrieve the waste were made during the caretaker phase, the lifetime of the project could be extended up to approximately 30 years during which actual waste retrieval would be accomplished.

MOUNTAIN WEST

repository. This facility would be located in Coyote Wash on the eastern side of Yucca Mountain and would consist of two exploratory shafts (one for exploratory testing and the second for egress, and ventilation), underground testing rooms and drifts; and surface facilities to support construction and testing.

If the Yucca Mountain site is found unsuitable for a high-level radioactive repository, the exploratory shaft facility will be decommissioned. Unless an alternative use for the exploratory shaft facility is identified, decommissioning will begin as soon as possible. Decommissioning activities include: removal of surface facilities and equipment; stabilization and rehabilitation of the land; backfilling the underground excavations and exploratory shafts with the rock removed during excavation; backfilling trenches; and sealing drillholes.

If DOE determines that the site is suitable for a repository, the Secretary of Energy will recommend to the President that Yucca Mountain be developed as a repository. This recommendation will be accompanied by an Environmental Impact Statement (EIS). The President then submits the recommendation to Congress. After this submission, the State of Nevada has 60 days in which to submit a notice of disapproval, which will prevent the site from use as a repository unless Congress passes a joint resolution overturning the state's disapproval. The joint resolution must be passed within the next 90 days of continuous session after the state's notice of disapproval.

If the designation of the repository site becomes effective, DOE must then apply to the NRC for authorization to construct the repository. According to the NWPA, this application must be submitted within 90 days after the effective date of site designation. This means that the compilation of all data, information and findings to support a construction authorization request must be completed during the site characterization period. Failure to collect adequate data that also meets NRC quality assurance standards could result in licensing delays or even in NRC's denial of a construction permit.

Construction

After NRC issues a construction authorization, the construction of the repository can begin. The activities involved in construction and operation of the repository are described in some detail in DOE's Environmental Assessment (EA) for Yucca Mountain (DOE, 1986a, pp. 5-12 to 5-20) and will only be briefly reviewed here.

Repository construction would proceed in two phases that would begin simultaneously. Phase I construction (1998-2003) consists of construction and start-up testing of the Stage 1 surface facility and underground facilities required to accept and emplace 2,100 metric tons (MTHM) per year. During Phase II construction, which ends in year 2006, all facilities, including the Stage 2 waste handling building, required to consolidate and accept 3,000 MTHM per year, will be completed. It should be noted that Phase II construction overlaps the operations period, which begins in 2003.

Underground excavation would begin in the construction period and continue throughout most of the operations period.

Surface construction away from the main surface facility complex would include roads (including a 16-mile, two-lane road to the site from the Lathrop Wells Gate Station at U.S. 95), rail connections, mine ventilation buildings, a bridge across Fortymile Wash, and other ancillary facilities. Conveyor systems and surface facilities for removing up to 22 million tons of mined rock also would be constructed.

The proposed subsurface facilities would encompass about 1,380 acres of tunnels and chambers beneath the ridge line of Yucca Mountain--approximately one mile west of the proposed surface facilities complex. The subsurface facilities would consist of main access drifts to the emplacement areas, the emplacement drifts, and service areas near the shafts and ramps. The layout of the facility would depend upon whether the waste is emplaced vertically or horizontally, a major uncertainty in project design that has yet to be resolved.

Operations

The operations period (2003-2053) would last 50 years and consist of two phases: a 25-year emplacement phase followed by a 25-year caretaker phase. Activities planned during the emplacement phase include: waste receipt, processing (inspection, unloading, packaging or disassembly, and consolidation of the radioactive waste of spent-fuel assemblies), transportation to the emplacement area, and emplacement; continued underground construction of waste-emplacement rooms and supporting services; and storage and management of mined rock for potential use as backfill.

The caretaker phase would begin after the last emplacement and continue until the start of decommissioning during which time the facilities as well as the surrounding environment would be monitored. In compliance with NWPA and NRC requirements, retrievability would be possible at any time up to 50 years after waste emplacement begins, or up to 25 years after receipt of the final shipment of waste. If a decision to retrieve the waste were made during the caretaker phase, the lifetime of the project would be extended approximately 30 years during which time actual waste retrieval would be accomplished.

Decommissioning and Closure

The decommissioning and closure of the repository would take place over a 7 to 9 year period. During this final phase, the underground emplacement area would be backfilled and sealed, all surface facilities would be dismantled, and radioactively-contaminated buildings and equipment would be decontaminated. Monuments (truncated granite pyramids) would be erected and records caches would be installed to warn and inform future generations of the boundaries and contents of the repository site.

1.2.4 Relation of the Repository to the Impact Analysis

The stimuli provided by a repository to the external socioeconomic environment are of two types. First, there are the basic characteristics of the repository program -- its design, safety precautions, number of waste shipments, methods and routes of transport, etc. Second, there will be a continuous stream of discrete events, some that appear to pose risk and some that do not, but all of which become part of the cumulative stimulus of the project. These events may reference program milestones, such as licensing and permitting decision-points, media stories about management events, incidents, events or accidents related to construction, operations or storage, or other news-worthy occurrences. It is this cumulative combination of repository program characteristics and associated events that drive the socioeconomic changes attributable to the program. Certain of these characteristics such as employment, purchases, taxes paid, or the impact on highways of overweight construction vehicles are common to most projects and provide the stimulus to what are referred to here as "standard effects" of the repository. These characteristics of the various phases of the repository program are detailed in Chapter 4 of this report where they become the basis for analysis of projected "standard effects" of the repository.

There is another set of effects, however, that stems from the inherently hazardous nature of high-level radioactive waste and the pervasive uncertainty surrounding the project itself. These are referred to as "special effects." They are driven by the risks associated with the repository in combination with the intended and unintended stream of events that accompanies the repository program.

These areas of risk imply uncertainties with regard to risk-related impacts, including impacts resulting from perceptions of risk. When added to the program uncertainties regarding design, risk assessments, schedule, transportation and program management, the dominant conclusion has to be that the stimuli driving both "standard" and "special" effects are subject to broad ranges of conjecture. Most sobering, perhaps, is the recognition that further scientific work may narrow, but is unlikely to resolve, these uncertainties surrounding the technology and risk of nuclear waste disposal.

Adding to these uncertainties about basic program characteristics that will drive both "standard" and "special" effects are more fundamental ambiguities about the waste disposal program itself and the direction of future national policy. As already noted, the history of the program in the United States, and in a number of other countries (e.g., the United Kingdom) as well, has been one of sudden redirection and continuing instability. Within five years, the carefully constructed series of compromises incorporated in the Nuclear Waste Policy Act of 1982 was abandoned, without benefit of searching congressional and technical reconsideration. Major questions remain as to (1) the appropriateness of the environmental standards and regulatory regime that has been constructed, (2) the possibility of removing major technical uncertainties and achieving "reasonable assurance" in the time schedules under which DOE (and necessarily the State of Nevada) is operating, and (3) whether DOE is institutionally capable of licensing the Yucca Mountain facility.

These issues create the distinct possibility that either a revised regulatory regime will be constructed, or that a revised set of schedules will be adopted, or even that responsibility for implementing the program could shift to another agency. Any of these will have far-reaching implications for Nevada because the motivations for such changes have never been entirely clear and the consequences of such alterations are not well defined. Other critical aspects of the program, such as the role of compensation, state and local participation safeguards, liability and insurance arrangements, premature closure or abandonment of the facility, shift to an entirely different disposal strategy (e.g., subseabed disposal, long-term monitored retrievable storage) will be subject to similar ambiguities.

The ambiguities will remain pervasive because the underlying factors that contribute to them continue to exist. With over 100 operating nuclear power plants and with nuclear energy a potential long-term energy source, substantial pressure exists to demonstrate progress in waste disposal. Similar pressures emanate from an embattled defense program that also generates high-level waste. Yet public concerns about radioactive waste continue unabated and the associated value issues remain difficult. With Congress increasingly assuming the role of "Board of Directors" for the waste disposal program, the requisite political insulation of the program that could assure greater technical stability is lacking.

1.3 Approach of This Report

This chapter has provided the context within which nuclear waste disposal at Yucca Mountain is being considered. It has provided specifics of the Yucca Mountain proposal and of the U.S. nuclear waste disposal program. More generally, it has looked at both the social/political and the technological environment within which nuclear waste disposal must take place. The conclusion is that every dimension of the program has important elements of ambiguity and uncertainty. Further, there is no reason to believe that the sources of ambiguity and uncertainty will diminish in the future. Uncertainty is a major factor influencing the whole constellation of variables that result in impacts of one form or another. To understand those impacts well enough to adequately define them and to plan for ameliorating their effects requires that uncertainty in its many manifestations be addressed and, to the extent possible, be reduced or bounded.

Within this context, the Yucca Mountain Socioeconomic studies are designed to anticipate the full range of social and economic consequences of the repository for the State of Nevada; the region of Southern Nevada; Clark, Lincoln, Nye, and Esmeralda counties; and the Native American, rural and urban communities in the defined study area.

In the case of the "standard effects," this work proceeds as in any other socioeconomic assessment. An interdisciplinary group of social scientists works together to define the cause and effect relationships linking the proposed project to political, social, and economic conditions in the study area. Impact is then defined as the

difference between conditions that would exist with the project compared to conditions in the absence of the project. In general, causation is traced from economic effects of the project on employment and income to implications for population and settlement patterns. This provides the basis for analyzing demands for community facilities and services. Cost of service provision is then compared to incremental revenues to estimate the fiscal impact of the project. Finally, all of these consequences of the project are fed into a community-based analysis of effects on community life and on the evaluation of these effects by community residents.

Each large-scale development project has significant and unique characteristics to it that distinguish it from others that are like it, even when numerous examples, such as an electric generating power station, have been completed. This means that the analyses of socioeconomic impacts almost always operate with some degree of uncertainty in making assessments. In the case of the Yucca Mountain repository, which is a first of its kind project, these areas of uncertainty are much greater and will require that the normal range of mitigation approaches be expanded in order to respond to the standard impacts that could result from the program.

The "special effects" or "risk-induced" effects of the repository stem from the hazardous nature of the nuclear waste disposal problem and have the potential to affect Nevada in two ways. First, they may diminish the quality of life within Nevada directly by creating a hazard or perception of hazard that could affect individual lives and community well-being. Second, they have the potential to diminish the economic base of the State which is dependent on the willingness of visitors, investors and migrants to visit, invest and move to Nevada.

The dominant challenges facing the study are of two types. The first requires that operational methods be found to project risk-induced impacts of the repository. The second requires that the analysis provide useful input to public policy makers despite the uncertainties and ambiguities that characterize the proposed nuclear waste disposal program.

The first challenge is taken up explicitly in Chapter 2 of this report. It begins by defining the mechanisms by which hazard characteristics of the repository could be translated into real, behavioral consequences for the State of Nevada and its citizens. The applicability of this model to the repository case is then illustrated by considering actual projects or events that have produced risk-induced effects. Attention is then turned to a multi-pronged approach to more formally test the central hypotheses and to begin to quantify the important relationships. This results in new insight into the nature of these effects, their relevance to the repository program, and the areas of future research that will be necessary to further refine understanding of them.

Chapters 3 and 4 proceed to examine existing conditions and projected future conditions, respectively. The emphasis in each is to isolate the consequences of the repository -- to date (in Chapter 3), and as they may occur in the future (in Chapter 4). The analysis in both chapters deals with "standard-effects" as well as "special effects." In

some cases these two dimensions of the project, and of the analysis, can be kept distinct, while in others they are intertwined.

Throughout these chapters, the uncertainties of the repository become key considerations. First, uncertainty itself is an important characteristic of both the "special effects" and the "standard effects." People by nature tend to resist conditions of uncertainty, especially when the consequences are potentially threatening to health, safety or economic security. Perceptions of the risks associated with the repository and the subsequent behaviors of visitors and residents are shaped by the uncertainty people associate with the repository program. Second, future characteristics of the repository and the study area are estimated by making a large number of assumptions. These assumptions refer to events or conditions both within and outside the study area. Some of the assumptions will be better defined with further work, but others are inherently unknowable given the time scale of the project, the evolution of future national policy, and the complexity associated with the potential effects of the repository.

Thus, while this report adopts the posture of trying to anticipate the implications of the repository based on assumptions grounded in the current state of knowledge and understanding, it must be recognized that the range of uncertainty is great and may expand with future research rather than diminish. It follows, that emphasis in subsequent work will have to concentrate on the management of risk and on the development of strategies by which populations can be protected from, and, if necessary, indemnified for adverse consequences in the face of great uncertainty. Elaboration of these policy strategies is not part of this report. These strategies, however, have to result from as clear an understanding as possible of the potential cause and effect relationships that can emanate from the proposed repository. As such, this Interim Report represents a preliminary attempt to characterize these effects and also to provide the basis from which strategies to manage them can be developed.

As an interim document, this report is not intended to represent final or complete findings in either the "standard" or "special" effects areas of inquiry. Rather, it should be viewed as reporting on work undertaken to date and findings that have been interpreted according to the current state of research and knowledge.

2.0 Risk-Induced Effects of a High-Level Nuclear Waste Repository

2.1 Introduction

In 1921, economic theorist Frank Knight argued that the distinction between risk and uncertainty is critical to the understanding of economic behavior (Knight, 1921). Risk (where events and their associated probabilities of occurrence can usefully be quantified) is more easily managed than uncertainty (where the multiplicity of unknown outcomes makes quantification inappropriate), which is why insurance companies are eager to insure automobiles against the risk of collision damages but are reluctant to insure chemical companies against the uncertain environmental consequences of a faulty waste disposal site.[1] Classic studies of decision making point out that states of uncertainty or ambiguity are much more difficult for people than states of risk (e.g. Ellsberg, 1961) and pose special challenges to our ability to construct criteria for rational choices (Luce and Raiffa, 1957). In the context of the nuclear waste repository and its socioeconomic impacts, uncertainty is a fact of life that will demand special assessment, monitoring, and management efforts.

Both risk and uncertainty are present in the siting of a nuclear waste repository. The overwhelming complexity of technology, time-span, and geographic spread is substantially complicated by the hazard dimension of nuclear waste which adds risk to all phases of the repository program. In addition, reflection on the scientific, social, and political challenges facing the waste disposal effort leads to the conclusion that the repository program is characterized by uncertainty and ambiguity. The problem can be visualized as being multi-layered -- a nucleus of complexity layered with risk and then surrounded by uncertainty.

Given the uncertainties and the risks of the program and the limited knowledge of individual-societal response to any particular chain of program characteristics and events that may occur, any methodology that claims precision in the anticipation of risk-induced consequences should be viewed with caution. The goal must ultimately be to describe these consequences as clearly as possible, but, at the outset, the emphasis is on their qualitative dimensions. What is the potential for risk-induced effects? What kinds of risk-related consequences could be expected from the siting and operation of a nuclear waste repository? Under what conditions could these consequences be significant?

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[1]Professional usage of these terms is quite inconsistent and does not always correspond to Knight's definition. The study team, nevertheless, finds the distinction useful and uses the terms in the sense intended by Knight.

Nuclear waste has several unique characteristics that strongly suggest the potential for risk-induced effects.

1. The technology of high-level nuclear waste disposal is complex and largely untried. There are extraordinary hazards associated with such a facility, and the nature of these hazards is only partly understood.

2. From the time that radioactivity was discovered shortly before 1900, nuclear energy has been unique in the power of the imagery and symbolism that has surrounded it. Weart (1988) traces the salience and persistence with which both positive and negative associations have become attached to things nuclear. His analysis demonstrates the strength of nuclear imagery and its broad penetration into our social and cultural consciousness over the past 90 years.

3. Contemporary evaluation of nuclear waste by the U.S. population could hardly be more negative (Kunreuther, Desvousges, and Slovic, 1988; Slovic, 1987; Slovic, Fischhoff, and Lichtenstein, 1985, 1986). People perceive risks from nuclear waste as "dread," "catastrophic," "unknown," "uncontrollable," and "inequitable" in the distribution of risks and benefits. This combination of characteristics leads to perceptions of risk that are on a par with those associated with nuclear reactor accidents and nuclear weapons.

These public perceptions have evoked sharp reactions from experts. One noted psychiatrist wrote that "the irrational fear of nuclear plants is based on a mistaken assessment of the risks" (Dupont, 1981; p. 8). A nuclear physicist and leading advocate of nuclear power contended that "...the public has been driven insane over fear of radiation [from nuclear power]. I use the word 'insane' purposefully since one of its definitions is loss of contact with reality. The public's understanding of radiation dangers has virtually lost all contact with the actual dangers as understood by scientists" (Cohen, 1983b).

Risk perception research paints a different picture, demonstrating that people's deep anxieties are linked to numerous realities, including the reality of radiation's unique and powerful qualities, the reality of nuclear power's links to nuclear weapons proliferation and war (despite the term "the peaceful atom"), the reality of many serious examples of mismanagement (e.g., the releases of radioactive material into the environment from military reactor sites), and the reality of extensive media coverage documenting major and minor problems and controversies involving nuclear technologies. Attempts to "educate" or reassure the public and bring their perceptions in line with those of industry experts appear unlikely to succeed because industry and government lack trust and credibility and because evidence of incompetence is much more persuasive than evidence of competence.

In sum, a high-level nuclear waste repository will be colored by the very powerful negative imagery historically associated with radioactivity. From this, it follows that the

repository site, the waste transport routes, and other locations linked to the repository may become affected by the negative perceptions and imagery associated with nuclear waste. If this occurs, these places could become less desirable in the eyes of both residents and nonresidents of Nevada.

The material presented in this chapter defines the mechanisms by which the hazard characteristics of the repository may be translated into real, behavioral consequences for the State of Nevada and its citizens. A theoretical framework is presented and then illustrated by looking at several case studies where risk-induced effects have occurred. Then, the research initiatives are reported, which test key hypotheses and begin to build the empirical foundation for quantification of the important relationships. Because of their potential economic significance to the state, the focus is on the potential for risk-induced effects that would be driven by the behavior of persons outside of Nevada. The impacts of concern include potential reduction in short-term visits to the region by vacationers, gamers, and convention-goers; effects on potential migrants to the state; and reduced ability to attract new businesses.

The work to date indicates that there is potential for risk-induced effects and that these effects could be significant. Anticipating the quantitative magnitude and duration of these effects is difficult because of the unique nature of the repository, and the uncertainties that surround it. However, given the critical role of tourism, conventions, migration and outside investments to the future economic development of the state, the State of Nevada cannot afford to ignore risk-induced effects that might stem from a high-level nuclear waste repository at Yucca Mountain.

All of the research completed to date indicates that the potential for risk-induced impacts cannot be prudently ignored, but must be carefully examined. It is imperative, therefore, that these potential impacts be understood to the fullest extent possible. The U.S. Department of Energy (DOE) has made no effort to address these effects to date so the work reported in this chapter is a first important step towards understanding risk-driven consequences of the repository.

2.2 A Conceptual Framework for Assessing Risk-Induced Effects

The conceptual model developed for analyzing risk-induced effects is shown in Figure 2-1. The stimuli provided by the project are of two types. First there are the basic characteristics of the repository program -- its design, safety precautions, number of waste shipments, methods and routes of transport, etc. Second, there will be a continuous stream of discrete events, some that appear to pose risk and some that do not, but all of which become part of the cumulative stimulus of the project. Events could range from an administrative controversy over emergency management procedures to a life-threatening transportation accident. Given the complexity of the nuclear waste disposal process, such "events" are certain to occur at intervals throughout the life of the project.

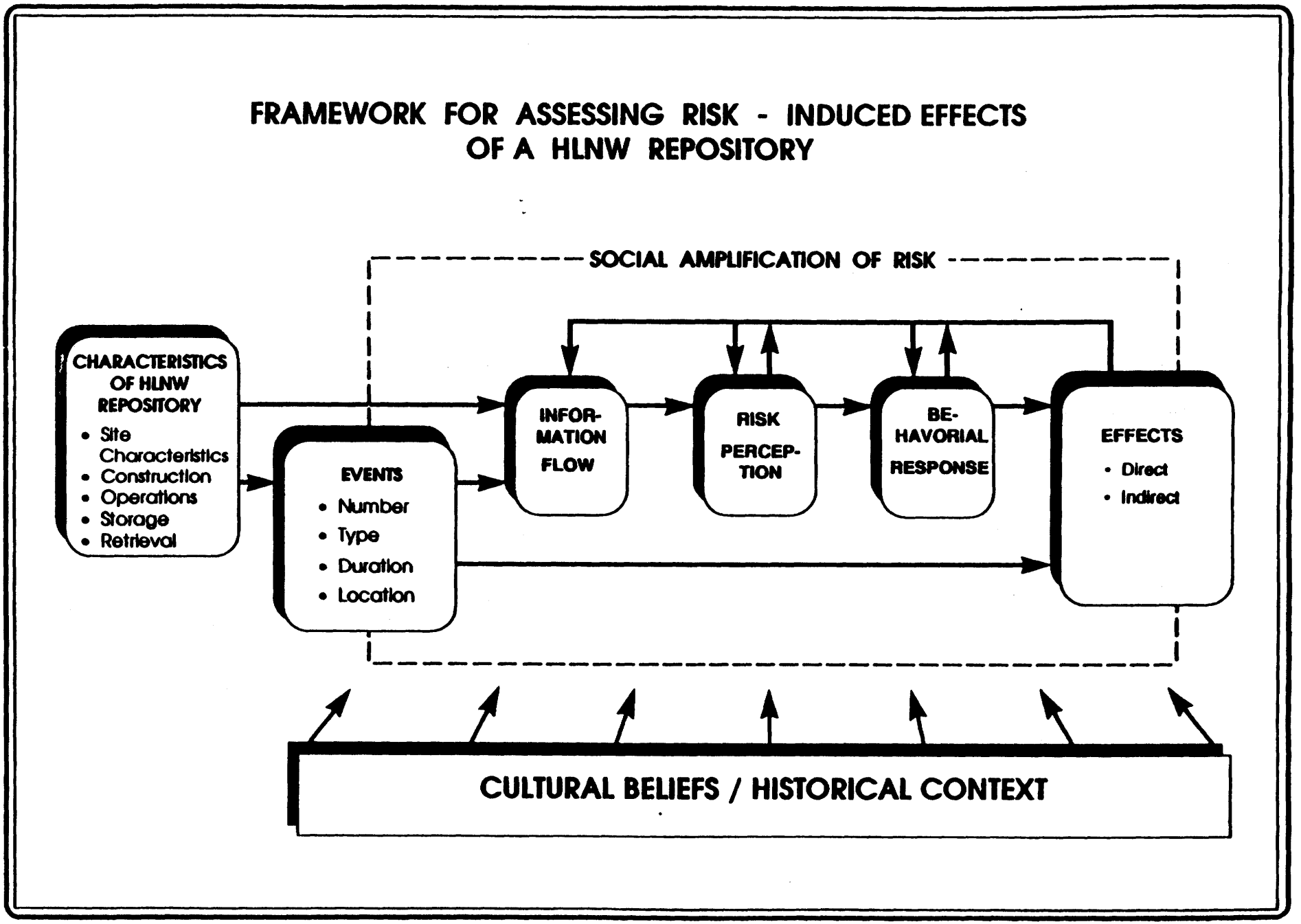

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FIGURE 2 - 1

Two interrelated processes mediate the responses to the repository-related stimuli. The first includes the set of cultural beliefs and historical context that characterize a given place and time. Beliefs and context can undergo large change over time or location and bring very different meaning to a given set of repository characteristics. The second includes all of the channels by which information about the repository is transmitted. This would include news media, various formal channels of regulatory or administrative communication as well as informal networks among social groups, friends and family.

Based on this combination of stimuli, context and information flow, individuals form perceptions about the repository and its associated events. Some may perceive great threat while others perceive economic opportunity. Individual perceptions are then the basis for individual behavioral reactions. If the repository were perceived to be threatening, it could stimulate avoidance behavior. If it were perceived as likely to contribute to an economic boon, it might stimulate political advocacy on its behalf. We must also recognize that some persons may feel less well-off because of perceived threat or better-off because of perceived benefit. We sometimes refer to these effects as "well-being" effects, and just because they may not be directly observable, they are no less real.

The model has one last element. As shown in the diagram, both perception and behavior have the potential of being communicated to others, setting off a new round of perception and behavior. Thus a chain of actions and reactions can be precipitated with the final consequences much more the result of the perception, behavior, and information flow dynamic than of the original repository stimuli. This layered set of reactions has been labeled the social amplification of risk. Behaviors can, of course, be either amplified or dampened. In either event, risk perceptions and behaviors can take on a life of their own quite independent of the objective stimuli that first trigger them, as can be seen in studies of actual cases where hazardous events have generated perceptions and behaviors with consequences that are both large and apparently out of proportion to the events or conditions generating them.

The underlying rationale for the process of social amplification is discussed in the next section.

2.2.1 Social Amplification

The investigation of risks is at once a scientific activity and an expression of culture. During the twentieth century, massive governmental programs and bureaucracies aimed at assessing and managing risk have emerged in advanced industrial societies. Despite the expenditure of billions of dollars and steady improvements in health, safety, and longevity of life, people view themselves as more rather than less vulnerable to the dangers posed by technology.

Particularly perplexing is the fact that even risk events with minor physical consequences can elicit strong public concern and produce extraordinarily severe social impacts, at levels unanticipated by conventional risk analysis. This is particularly the

case for radioactive waste management, and for nuclear power more generally, where public concerns are pronounced, high media attention accompanies even minor mishaps, and a committed cadre of critics exists to challenge industry and governmental authorities.

The technical approach to risk, such as that practiced by the DOE, focuses narrowly on the probability of events and the magnitude of specific consequences. Risk is usually defined by multiplication of the two terms, implying that society should be indifferent toward a low-consequence/high-probability risk and a high-consequence/low-probability risk with identical expected values. Studies of risk perception have revealed clearly, however, that most persons have a much more comprehensive conception of risk that includes voluntariness, personal ability to influence the risk, familiarity with the hazard, and the catastrophic potential of the consequences. As a result, whereas the technical assessment of risk is essential to decisions about competing designs or materials, it often fails to inform societal choices regarding technology or to anticipate the full range and depths of disruptions to society, communities, cultural groups, or the regional economy.

Accordingly, the socioeconomic analyses that follow adopt a broader approach to risk than that which has characterized risk analysis studies and traditional environmental impact analysis. This broader approach recognizes that the risks associated with the proposed Yucca Mountain facility interact with psychological, social, and cultural processes in ways that can heighten or attenuate public perceptions of risk and influence related risk behavior. Behavioral patterns, in turn, generate additional social or economic consequences but also may act to increase or decrease the physical risk itself. Secondary effects trigger demands for additional institutional responses and protective actions, or, conversely (in the case of risk attenuation), impede needed protective actions.

The social structures and processes of risk experience, the resulting repercussions on individual and group perceptions, and the effects of these responses on community, society, and economy compose a general phenomenon that is referred to here as the social amplification of risk.

The interaction between risk events and social processes makes clear that, as used in this framework, risk has meaning only to the extent that it describes how people think about the world and its relationships. Thus, there is no such thing as "true" (absolute) and "distorted" (socially determined) risk. Rather the information system and characteristics of public response that compose the social amplification of risk are the two key stages in determining the nature and magnitude of risk.

Like a stereo receiver, the information system may amplify risk events in two ways:

- by intensifying or weakening signals that are part of the information that individuals and social groups receive about the risks; or,

- by filtering the multitude of signals with respect to the attributes of the risk and their importance.

Signals arise through direct personal experience with a risk object or through the receipt of information about the risk object. These signals are processed by social, as well as individual, amplification "stations," which include (but are not limited to) the following:

- the scientist who conducts and communicates the technical assessment of risk;
- the risk-management institution;
- the news media;
- activist social organizations;
- opinion leaders within social groups;
- personal networks of peer and reference groups; and
- public agencies.

Social amplification stations generate and transmit information via communications channels (media, letters, telephones, direct conversations). In addition, each recipient group or individual also engages in amplification and attenuation processes, thereby acting as a "station" for risk-related information. In some cases, of course, particular groups or individuals actively seek out risks or risk events as part of their agenda of concern. Key amplification steps include the following:

- filtering of signals (e.g., only a fraction of all incoming information is actually processed);
- decoding of the signal;
- processing of risk information (e.g., the use of cognitive heuristics for drawing inferences);
- attaching social values to the information in order to draw implications for management and policy;
- interacting with one's cultural and peer groups to interpret and validate signals;
- formulating intentions to tolerate the risk or to take actions against the risk or risk manager; and,

- engaging in group or individual actions to accept, ignore, tolerate, or change the risk.

Several major societal mechanisms shape group and individual responses to the risks and risk events. Prominent among these are:

- Heuristics and values. Individuals cannot deal with the full complexity of risk and the multitude of risks involved in daily life. Thus, people use simplifying mechanisms to evaluate risk and to shape responses. These processes, while permitting individuals to cope with a risky world, may sometimes introduce shortcomings in the assessment. More importantly, the application of individual and group values will do much to determine which risks people consider important or minor, how these risks connect to other social considerations, and what actions, if any, should be taken.

- Social group relationships. Risk issues enter into the political agenda of social and political groups. The nature of these groups will influence member responses and the social orientations brought to risk issues. Social alignments tend to become anchors for interpretations of risk management and tend to resist new or conflicting information.

- Signal values. The seriousness that the public attaches to a risk event is determined, in part, by what that event signals or portends. The informativeness or "signal value" of an event appears to be related systematically to the characteristics of the event and what it suggests about the risk and the adequacy of the risk-management process. High-signal events suggest that a new risk has appeared, that the risk is different and more serious than thought previously, or that an adequate management process is not in place.

- Stigmatization. Stigma refers to the negative imagery associated with undesirable social groups, places, or individuals. Love Canal, Times Beach, and the Nevada Test Site evoke vivid images of danger, waste and pollution. Since the typical response to stigmatized persons or environments is avoidance, risk-induced stigma, may have significant social impacts and policy or decision-making consequences.

- Trust and credibility. Finally, the sources of the risk event and the ways in which managers respond to the event may either build or erode trust in the institutions responsible for risk management. If the public perceives that the risk managers failed to anticipate the risk or to respond in appropriate ways, confidence may be diminished and concern over the risk may grow accordingly. The presence of attributed blame seems to enlarge concern over the event. The degree of candor and openness also appear quite important, with the capacity either to enlarge or reduce the impacts of the event.

Social amplifications of risk can affect behavioral responses, thereby increasing or reducing secondary impacts. Secondary impacts can include such effects as the following:

- enduring mental perceptions, images, and attitudes (e.g., anti-technology attitudes, alienation from the physical environment, social apathy);
- local impacts on business sales, residential property values, and economic activity;
- political and social pressure (e.g., political demands, shifts in support for elected officials, changes in political climate and culture);
- changes in the physical nature of the risk (e.g., feedback mechanisms that enlarge or lower the risk);
- changes in the training, education, or required qualification of operating and emergency-response personnel;
- social disorder (e.g., protests, riots, sabotage, terrorism);
- changes in risk monitoring and regulation;
- increased or reduced liability and insurance costs;
- increased or reduced levels of trust in government and social institutions; and,
- repercussions on other technologies (e.g., higher or lower levels of public acceptance).

Secondary impacts are, in turn, perceived by social groups and individuals, so that another stage of amplification may produce third-order impacts. These impacts may spread, or "ripple," to other parties, distant locations, or future generations. Each order of impact will not only disseminate social and political impacts but may also trigger (in risk amplification) or hinder (in risk attenuation) positive changes for risk reduction. The concept of social amplification of risk is hence dynamic, taking account of the learning process and social interactions.

The analogy of dropping a stone into a pond provides an appropriate metaphor of the spread of the higher-order impacts associated with the social amplification of risk. The ripples spread outward, first encompassing the directly affected victims or the first group to be notified, then touching the next higher institutional level (a company or any agency), and, in more extreme cases, reaching other parts of the industry or other social arenas with similar problems. This rippling of impacts is an important element of risk amplification since it suggests that amplification can introduce substantial temporal and geographical extension of impacts.

2.2.2 Case Studies of Social Amplification and Stigmatization

The preceding section described the elements of a conceptual framework based on the social amplification of risk. This section describes several cases of social amplification resulting in substantial adverse socioeconomic consequences. These cases address specific radiological accident events, impacts of high-level nuclear waste repository developments, and the economic consequences of perceived risk regarding hazardous waste facilities. Cumulatively, they provide evidence that the consequences of risk perceptions, media exposure, and stigmatization are real and that social amplification processes must not be ignored in impact assessment.

The concept of social amplification, as described above, postulates that the social and economic impacts of an adverse event are determined not only by the direct physical consequences of the event, but by elements of perceived risk and information flow. This assertion was tested in a study that examined a wide range of hazards and events including radiological and chemical accidents, investigating the magnitude and kinds of socioeconomic impacts resulting from those events (Renn, Kasperson, Slovic, and Emani, 1989).

The data for the analysis were based on 128 hazard events identified principally by reports in the New York Times during the years 1977-1987. Selection of events was guided by a taxonomic analysis of hazards developed by Hohenemser, Kates, and Slovic (1983). Each of the news reports was evaluated on separate indices pertaining to social amplification. For example, four indices dealt with the magnitude of the physical consequences of the event, two focused on the level of socio-political attention and socioeconomic effects, and three measured the extent and intensity of media coverage. Each event was also rated on sixteen characteristics of perceived risk following the psychometric approach of Slovic, Fischhoff, and Lichtenstein (1985; 1986).

The results showed that four independent factors -- whether the event was perceived as a serious "industrial hazard" (like nuclear waste), whether the event involved an accident or explosion, the extent of media reporting, and the severity of human consequences -- were highly correlated with large impacts. The data thus showed that direct harm to persons or the environment are not the only factors contributing to economic and political impacts. In addition, events that are high on perceived risk and media coverage were found to contribute substantially to the prediction of large socioeconomic and political impacts -- consistent with the concept of social amplification of risk.

It is instructive to supplement this statistical analysis of many cases by taking an in-depth look at a few significant incidents. A study of the Goiania, Brazil radiological accident (Petterson, 1988a; 1988b) found stigmatization of the local area resulting in major economic impacts. On September 13, 1987, two scavengers entered an abandoned medical clinic in Goiania and dismantled a machine used to treat cancer patients with radiation. A platinum capsule containing 28 grams of Cesium was opened, and the

radioactive material was dispersed. According to Petterson, the actual health effects were limited to a few serious injuries and deaths.

The removal of the capsule and exposure to radioactive material received scant attention by the media until three weeks later, when a television broadcast reported the accident in a fashion that exaggerated the health risks. This "regional" news report resulted in heightened concerns and fears among the public over the potential for widespread exposure to the radioactive material and in behaviors that resulted in serious social and economic impacts. This media report and the fear it stimulated resulted in people evacuating Goiania and the establishment of a "hot-line" to report on possible contaminated sites and to provide medical information. In addition, political pressure to contain the spread of the contamination began to mount.

Petterson reported that within two weeks of the event the wholesale value of the area's agricultural products fell as much as 50 percent despite the fact that none of the products were shown to be contaminated. In addition, sales prices of manufactured goods dropped 40 percent. The stigmatization of food and other products was purposefully reinforced by the profits that could be gained by wholesalers and distributors located outside Goiania paying less to purchase "tainted goods." Five months following the accident, wholesale prices had still not reached pre-accident levels.

Adverse economic effects were also experienced in property values and service industry costs. During the first three months following the Goiania accident, both the number and price of houses sold fell dramatically. The greatest impacts occurred in the immediate vicinity of the accident area -- a geographical area that was viewed as contaminated, where economic impacts were most observable, and which fostered fear of exposure. Hotel occupancy rates dropped 60 percent for the six weeks following the media report. During that period all conventions that were originally scheduled for hotels in Goiania were cancelled or rescheduled for other communities.

When measured in terms of fatalities and injuries alone, the event was comparable to any number of accident cases and would seem to imply limited socioeconomic consequences. However, the secondary consequences were considerable, resulting in substantial long-term social and economic impacts.

Goiania showed that extensive media coverage with distorted or exaggerated reporting, enhances perceived risk and triggers social amplification of risk. Another mechanism of amplification occurs when a particular risk or risk event enters into the political agenda of special interest groups. This may occur either because a particular group has goals which include this risk issue or simply because political advantage is to be had by keeping it in the public eye.

A case in point is the "pilot mine" accident at Gorleben, Germany (Peters and Hennen, 1988). In May 1987, the walls of an exploratory mine shaft for a proposed nuclear waste repository collapsed killing one miner and severely injuring two others. The accident became a signal, a harbinger of safety problems that might surface later when the repository became operational. The opponents of the Gorleben repository

claimed that the accident was the result of mismanagement, that warnings not to sink shafts at selected locations were disregarded by the authorities, and that the government was deliberately discounting the importance of the accident. By May 1988, the accident was subject to expert hearings in government committees of both state and national governments where the questions of accountability had been raised regarding the repository program. The media reported widely on the accident and on the larger issues that the accident represents. As a result, the opponents of the nuclear waste program gained further recognition and legitimacy, the public became more concerned about the safety of nuclear waste management, the controversy became heightened at the national level, and questions were raised about the reliability and objectivity of the investigation of Gorleben's geology.

Although the accident had few direct impacts in terms of injuries and property damages, the secondary effects in terms of social amplification were large. The accident attracted the attention of the media which covered the issues heavily in the press. At the local level, the accident caused an increase in the salience of the controversy about the repository. At the national level, the accident lead to hearings regarding the repository and raised Gorleben as a national issue.

The research literature in recent years provides strong empirical support to the assertion that risk perception and stigmatization have important economic consequences in cases of contamination by chemicals or radiation. Relevant work includes:

(1) A study by Edelstein (1986) involving a case in which a dairy's cows became contaminated with PCB's for a short period of time. The reputation of the dairy was discredited and its products became undesirable, even though the levels of PCB were never sufficiently high to prohibit sale of the dairy's products.

(2) A study by Brookshire, Thayer, Tschirhart and Schulze (1985), which reported that homes in Los Angeles and San Francisco located near earthquake faults showed property value losses in response to an information program on earthquake risk;

(3) A study by Rowe and Schulze (1986) of property value losses along the Eagle River near Vail, Colorado, due to pollution with toxic heavy metals from a nearby mine; and

(4) A study by Smith and Desvousges (1986), which showed a substantial decrease in housing values with proximity to a hazardous waste site.

Thayer, Bernknopf, Brookshire, and Schulze (1987) measured the risk perceptions of the residents of Mammoth Lakes, California, a ski resort, in response to volcano and earthquake hazard alerts issued by the U.S. Geologic Survey. Risk perceptions were substantially increased by the hazard alerts issued and were partially reduced when the alerts were withdrawn. Property values fell in response to the alerts by as much as $10,000 and new construction was severely impacted. Interestingly, withdrawal of the

alerts did not cause a full recovery in property values. The risk beliefs measured in the local population were vast overestimates of the risk when compared to the USGS estimate which motivated the hazard alerts.

Schulze, McClelland, and Hurd (1987) examined property values among attractive homes surrounding a landfill containing hazardous wastes. This situation occurred because the landfill was expected to be closed and converted into a golf course. A serious odor problem combined with underground fires and detection of methane gas and vinyl chloride gas caused residents to be fearful in spite of careful epidemiological studies which showed no excess illness or death near the site. Risk perceptions of residents exhibited substantial bimodality (i.e., some believed the risk was serious and others did not). The geographic pattern of property value losses around the site closely followed the geographic pattern of perceived cancer risk. Further, although risk perceptions were not correlated with scientific estimates of the risk, they were explainable by a number of socio-demographic variables. Around the landfill, geographic areas became stigmatized as areas of cancer risk despite scientific risk estimations to the contrary. Homes became more difficult to sell and property values declined substantially in these stigmatized areas.

The concern over the potential stigmatization from the proposed siting of the Monitored Retrievable Storage Facility (MRS) for spent fuel in Tennessee was a principal factor in the state's opposition to the siting (Fitzgerald and McCabe, 1988). In response to the U.S. Department of Energy's siting plan, the Governor of Tennessee directed a comprehensive review of the federal agency's proposal. In January 1986, the state issued the findings of its evaluation of DOE's siting plan. As part of the findings, the state took the position that some direct economic benefits would be realized from the facility, but that the indirect costs would be excessive given the public perceptions about the danger of nuclear waste facilities.

A survey of 130 business executives in Tennessee showed that the MRS "would reduce the willingness" of a majority of these respondents to locate a business in the county where the MRS was located. About two-thirds of the respondents indicated that "business attractiveness" in the area would generally decline because of the facility. Respondents expressed the view that a nuclear waste facility would "stigmatize" an area as an "unfavorable business climate." A second survey also found that 47 percent of those persons that were most likely to visit Tennessee said they would alter their vacation plans if they became aware that the MRS was located near their vacation site. The report concluded:

> The economic costs of an MRS are likely to be related more to the perceptions than to the real risks associated with it. Business firms will make locational decisions and tourists will make travel plans based on the risks they think exist because of the MRS rather than actual risk ... The high degree of visibility of the MRS facility can magnify any consequences of perceptions. (Fitzgerald and McCabe, 1988)

The proposed WIPP project near Carlsbad, New Mexico, also a geologic repository for radioactive wastes, has experienced intensive opposition to its siting, primarily due to perceived threats to safety. Of particular importance is potential change in the area's image among retirees because of the proposed repository. The 1988 Consumer Guide, Best Rated Retirement Cities and Towns instructs its readers at the end of a positive summary of retirement opportunities in Carlsbad "CAUTION: Inquire About a Proposed Nuclear Waste Dump in the Area." This warning has caused consternation in the community which is attempting to attract retirees to the area.

Another relevant episode is documented by Fradkin (1989) in a report on the effects of radioactive fallout downwind from above-ground nuclear testing at the NTS. He reports on the preparation of the legal case for the fallout victims by Stewart Udall in 1978 and notes that not everyone was pleased with the way the case was proceeding.

> One segment of the local population lashed out publicly at Udall. The merchants of the St. George (Utah) area, which was receiving the brunt of the news coverage, were unhappy at the effect of the publicity on the tourist and retirement trade. The specters of radioactive fallout and cancer deaths were not good for business. A banker noted that home loans from southwestern Utah were beginning to be questioned, at least one major convention in St. George had been canceled, and tourists were staying away from the area. (Fradkin, 1989, p. 39)

Another relevant example is the large decline in U.S. tourism to Europe during the summer of 1986 in response to isolated acts of terrorism. Tourism losses ranged from 25 to 35 percent for different countries and resulted in massive ad campaigns to attract Americans back to European vacations. The perceived risk was apparently much larger than many would have thought given the nature of the events. In sum, analysis of prior experience establishes a link between environmental contamination, perceived risk, stigma, and adverse socioeconomic impacts. Perceptions of risk have been found to trigger substantial impacts even in circumstances where actual or anticipated damages are relatively minor.

2.3 Risk-Induced Effects: Potential Impacts of the Repository to the Visitor Economy, Migration, and Economic Development

A model has been presented above that summarizes the mechanisms by which a repository and/or repository-related events could affect socioeconomic conditions in Nevada. Case studies were then presented to demonstrate that hazard characteristics and risk events have, in fact, worked through a process of information flow and perception to ultimately influence behavior. The research described in this section establishes an empirical base for understanding how the hazard characteristics of the proposed repository might affect behaviors that are important to Nevada. Emphasis is placed first on behaviors that would be particularly important to the Nevada economy.

2.3.1 Overview: The Las Vegas and Nevada Economy

Three critical features of the state's economy were investigated:

- the visitor economy and its effects on the hospitality industry;
- the migration that will determine the state's population growth; and
- the potential to attract new businesses that will contribute to statewide economic development.

The current situation in each of these areas is reviewed below.

The Visitor Economy

The economy of Nevada is heavily dependent upon the hospitality industry. About one-half of the total economy of the Las Vegas metropolitan area is directly related to visitor spending. Visitors to Las Vegas are estimated to account for nearly 94 percent of the receipts in hotel and personal services, 71 percent of the receipts for businesses serving food, and 91 percent of the receipts for the amusements sector.

Annual visitor volume to Las Vegas increased 123.9 percent between 1970 and 1986, a compound average annual growth rate of 5.2 percent. Visitor volume has decreased only twice during that period -- during the recession years of 1981 and 1982. This decrease was due to a combination of several factors: a nationwide recession, the emergence of Atlantic City as a competitor for Eastern Seaboard gambling customers, and airline deregulation, which led to price changes and discontinuation of nonstop flights to Las Vegas from several major East Coast and Midwest cities (Planning Information Corporation, 1988a). Las Vegas adjusted to the impact of these changes and has recovered its growth momentum. The short-term outlook for growth in the gaming industry is excellent. More than 20,000 new resort hotel rooms are planned in Southern Nevada during the next few years, including 7,000 additional rooms for existing Las Vegas properties and 13,000 rooms at new properties (Laventhol and Horwath, 1987). In the early spring of 1989, a total of nearly 10,000 new rooms were under construction.

Although tourists accounted for over 90 percent of visitor volume in 1986, conventioneers are a fast-growing segment. Since the mid-1970s, Las Vegas has sought to establish itself as a premier site for conventions, trade shows, and business meetings. This strategy has proven successful: In 1970, convention attendance represented a 4 percent share of visitor volume; by 1986 convention attendance represented a 10 percent share. Convention attendance also grew 60.3 percent between 1980 and 1984, offsetting slower growth in tourism during the same period (Planning Information Corporation, 1988a). Generally, conventioneers gamble less than tourists, and therefore do not contribute as much to gaming receipts. However, conventioneers are economically important because they generate business during slow seasons, boost mid-week occupancy

rates, introduce new people to Las Vegas activities, and make a positive contribution to the Las Vegas image.

Migration

Nevada was the fastest growing state in the nation between 1970 and 1980. Since 1970 the state's population has grown at a rate almost three times faster than the U.S. average, and should double by the year 2010. The largest proportion of the growth in the state was in Clark County, which is home to over 60 percent of the state's residents. Las Vegas, the Clark County seat, was the second-fastest growing metropolitan area in the U.S. between 1970 and 1980, with a 69.5 percent increase in population.

The choice of migration destination may be driven by economic motivations -- employment-related circumstances or perceptions of relative job and earnings opportunities -- or, for those who have reached retirement age, by noneconomic motivations such as cost of living and quality of life. Clark County attracts large numbers of economically motivated movers because of rapid growth. Continued economic growth and the success of economic diversification efforts should make Clark County even more attractive to economically motivated movers. Noneconomically motivated movers are attracted to Clark County for its Sun Belt amenities, opportunities for recreation, and relatively low cost of living.

Migrants of or nearing retirement age (age 55 and over) accounted for approximately 15 percent of the total inmigrants to Clark County between 1975 and 1980. However, their importance to the economy is much greater than these figures suggest: people age 55 and over received almost 67 percent of the income derived from nonlocal sources (interest, dividends, rental income, as well as social security and other federal payments) in 1980, and recent inmigrants accounted for over 55 percent of the total (Planning Information Corporation, 1988h). Overall, nonlocal income accounted for approximately 10.7 percent of the total income in Clark County. Therefore, retirement-age migrants are a major source of new money for the local economy.

Retirement-age inmigration is projected to increase by at least 1.78 percent per year over the next 45 years, a growth rate twice as fast as that projected for total inmigration. Nonlocal income associated with this group is predicted to grow at the same rate (Planning Information Corporation, 1988h).

Economic Development

Las Vegas' economic base is dominated by the hospitality industry (hotel, convention, entertainment, gaming, etc.), which accounts for almost half of its jobs and more than a third of its personal income. Las Vegas contains six percent of the hotel rooms in the United States -- more than twenty times its share of population. Almost all of the area's business and professional services sectors serve businesses within the metropolitan area. There is a significant direct and indirect contribution from federal government investments in the Nellis Air Force Base in Clark County and the Nevada Test Site in Nye County. Together these federal installations generate local direct and

indirect payrolls that account for more than 10 percent of the total wages and salaries earned in the Las Vegas MSA. Beyond military installations, there is a modest but expanding manufacturing base, and a modest but growing information processing sector.

The local business climate has numerous characteristics that make it attractive as a business location, including low taxes, inexpensive electricity, abundant land, state-of-the-art telecommunications, and good transportation access (Growth Strategies Organization, 1988a). The lower operating costs in Las Vegas combined with excellent accessibility to the huge Los Angeles market add to its attractiveness as a business location and create the economic fundamentals that will support state and local diversification efforts.

Overall, the economic potential of Las Vegas and Nevada as a whole is promising. The outlook for the hospitality industry is bright; as gaming centers expand, new jobs will be created which in turn will attract more newcomers looking for a better economic future. The business climate of Las Vegas and the state of Nevada are favorable for growth and economic diversification. The area has the characteristics needed to attract and develop new businesses, some of which will be attracted by the opportunities presented by the expanding hospitality industry. The major barrier to economic development and diversification of the Las Vegas area at present appears to be the image created by the area's historical dependence on the gaming and hospitality industry. Part of the strategy outlined in the "Nevada State Plan for Economic Diversification and Development" (1985) involves a comprehensive marketing plan to overcome the image problems created by the state's dependence on gaming.

2.3.2 Risk Perception and Imagery Research Methods

The location of a high-level nuclear waste repository at Yucca Mountain raises questions about its potential impacts on the state and local economies. Image has been recognized as a crucial issue in the economic development of the area. Will the location of the high-level nuclear waste repository add to the image problems of Las Vegas and Nevada by creating additional negative imagery associated with nuclear energy and radioactivity? If so, what impact is this likely to have on the economic development of the City of Las Vegas and the State of Nevada?

To address these questions, Mountain West conducted a comprehensive research program to assess the public's perceptions of risk associated with a nuclear waste repository and to determine the potential impacts of the Yucca Mountain repository on tourism, migration, and business location decisions. The following sections describe the study methods and designs and summarize the findings of this research.

No single survey method is fully adequate to assess the complex behaviors and impacts of concern here. Therefore a variety of diverse, complementary approaches were employed ranging from standard survey questionnaires to imagery based methods. The studies included:

- A general risk perception survey conducted on both national and Nevada samples in 1987 to assess the risks people perceive to be associated with nuclear energy and nuclear wastes and their awareness of the proposed siting of a repository in Nevada (Kunreuther et al., 1987).

- A national survey conducted in 1988 to assess the attractiveness of Las Vegas as a residential and business location with and without the repository (Opinion Research Center, 1988). The survey also assessed awareness of issues surrounding the transportation and storage of nuclear wastes.

- Two telephone surveys conducted in 1988 to determine the most common images associated with Nevada and Las Vegas, measure the affective response associated with each image, and assess the implications of such imagery for economically important behaviors (Slovic et al., 1989).

- Special surveys and studies to assess the specific impacts of the repository on convention planning (Kunreuther, Easterling, and Kleindorfer, 1988), tourism (Planning Information Corporation, 1988a), migration (Greenwood, McClelland, and Schulze, 1988; Planning Information Corporation, 1988h), business location decisions and economic development potential (Growth Strategies Organization, 1988a, 1988b; Mountain West, forthcoming).

An overview of the components of the research program are described in the following sections. Detailed discussions of research methodology is contained in the technical reports that accompany each study.

2.3.2.1 National Perceptions of Nuclear Energy and Nevada (March 1988)

A telephone survey was conducted using a national probability sample of 1,012 people living in private households in the continental United States (Opinion Research Center, 1988). Because this survey assessed perceptions of Las Vegas, Nevada residents were not included in the sample. The survey was designed to measure the difference in perceived desirability of Las Vegas with and without the respondent's awareness of a high-level nuclear repository 90 miles north of the city. In addition, questions assessed the awareness of high-level nuclear waste issues and the legislation to explore a single repository site at Yucca Mountain, concern with environmental issues and trust in science and government, and respondent concerns about the transportation and handling of hazardous materials.

2.3.2.2 National and Nevada Imagery Surveys (May 1988)

Rationale and Method

These surveys assessed impacts based on the concept of environmental imagery. This approach was developed because of concerns that people may not really know how the repository will affect their preferences and behavior. Asking them to predict the repository's impacts on tourism and migration decisions to be made many years in the future may tell us more about current attitudes than about future behavior (see, e.g., Nisbett and Wilson, 1977).

The rationale for investigating imagery was stimulated in part by an assessment conducted for the DOE regarding the potential impact of Yucca Mountain on tourism in Las Vegas. This report concluded:

> Locating a repository at Yucca Mountain could damage the image or aesthetic appeal of the Las Vegas area. This could result from physical features of a repository (about 100 miles northwest of Las Vegas) or its associated transportation network (whose actual routes are presently unknown). Damage to the Las Vegas image could also be the result of events related to the repository, such as a highly visible debate in the national news media." (SAIC, 1985).

Studies of environmental imagery have the potential to provide a sound and defensible theoretical framework from which to understand and project possible impacts of a nuclear waste repository on tourism and other important behaviors. Studies were, therefore, designed to:

1. demonstrate the concept of environmental imagery and show how it can be measured;

2. assess the relationship between imagery and choice behavior; and

3. describe economic impacts that might occur as a result of altered images and choices.

The concept of imagery is not new to the study of environmental behavior and consumer choice. Geographers, environmental psychologists, and consumer theorists have written at length about the importance of images in our environmental consciousness and our behavior (Boulding, 1956; Kearsley, 1985; Saarinen and Sell, 1980; Weart, 1988).

The research design was predicated on four assumptions and a conclusion. The assumptions were:

1. There are consistent, often stereotypical images associated with environments.

2. These images have diverse positive and negative meanings which influence preferences for environments (e.g., in this case, preferences for places to vacation, retire, find a job, or start a new business).

3. A radioactive waste repository evokes a wide variety of strongly negative images, consistent with extreme perceptions of risk and stigmatization.

4. The repository at Yucca Mountain and the images it evokes will, over time, become increasingly salient in the images of Nevada and of Las Vegas.

If assumptions 1 through 4 hold true, it seems likely that, as the imagery of Las Vegas and of Nevada becomes increasingly associated with the repository and things nuclear, the attractiveness of these places to tourists, job seekers, retirees, and business developers will decrease, and their choices of Las Vegas and Nevada within sets of competing sites will decrease.

Support for these four hypotheses, therefore, would validate the mechanism whereby the repository could adversely affect tourism and migration to Nevada, and this validation would occur without having to ask people to make difficult, introspective judgments about their future behaviors.

Survey Design

In order to test the hypotheses described above, two surveys of residents of Phoenix, Arizona were conducted (Slovic et al., 1989). Metropolitan Phoenix was chosen as a pilot, target population for the surveys because its residents often visit Las Vegas and other parts of Nevada for vacation and business purposes.

The survey questions in Studies 1 and 2 were nearly identical. The "cities questionnaire" asked respondents to provide images for San Diego, Las Vegas, Denver, and Los Angeles. The "states questionnaire" elicited imagery for California, Nevada, Colorado, and New Mexico. These cities and states, in addition to Las Vegas and Nevada, were chosen for the study because they are important vacation destinations for residents of Phoenix.

The opening set of questions asked people for "the first six thoughts or images that come to mind when you hear the name of (city/state)." The order of the cities/states was rotated across respondents. Next, respondents were asked to rate each image they gave on a scale ranging from very positive (+2), somewhat positive (+1), neutral (0), somewhat negative (-1), or very negative (-2).

Respondents were then asked to rank the cities/states according to their preference for a vacation site (long weekend vacation for cities; week or longer vacation for states). Subsequent questions asked for a preference ranking among these cities or

states as retirement sites or places to move to assuming equally attractive job offers in each place, much in the same manner as vacation preferences were elicited.

Additional questions assessed the extent of previous visits or living experiences in each of the cities or states, and the existence of family or close friends in each of those places.

Next, up to six images were elicited to the stimulus "underground nuclear waste storage facility" and the stimulus "nuclear test site."

The survey also asked "in which state has the federal government proposed to build an underground facility for storing radioactive wastes?" and "in which state is the Nuclear Test Site located?"

Survey Samples

Phoenix adults 18 years of age and older were surveyed with the cities questionnaire during the period April 13 through May 4, 1988. The response rate was 73 percent of the households contacted by random digit dialing. The states telephone survey was conducted in metropolitan Phoenix between May 16 and June 8, 1988. The response rate was 71 percent. A modified KISH method of sample selection was used in both surveys. For this method, profiles of all members living in a household are requested and then one qualified member is randomly selected to be interviewed.

2.3.2.3 Special Surveys and Studies

In addition to the image surveys discussed above that asked questions about behaviors related to tourism, migration, and business location, special surveys were undertaken which looked explicitly at the convention industry, migration and economic development. The methods associated with these special studies are presented in separate reports (Greenwood, McClelland, and Schulze, 1988; Growth Strategies Organization, 1988a; 1988b; 1988c; Kunreuther, Easterling, and Kleindorfer, 1988; Mountain West, forthcoming; Slovic, 1988; Slovic et al., 1989) and are summarized in the following discussion, along with a description of the major findings to date. An earlier survey to estimate general risk perceptions was conducted in 1987 (Kunreuther et al., 1987). However, due to low response rates the analyses from this data were treated as "indicators of possible trends" and the survey was utilized primarily as input to subsequent research work.

2.3.3 Study Findings

The results of these studies will be reported separately for each of the economic issues of concern: impacts on the visitor economy, impacts on migration, and impacts on economic development potential and business site location decisions.

2.3.3.1 Potential for Risk-Induced Effects on the Visitor Economy

In the following discussion of potential repository effects on the visitor economy, we will focus first on the convention industry, and then focus on the potential effects on the tourist industry.

The Convention Industry

The vulnerability of the convention industry to the risk consequences of a repository located at Yucca Mountain depends upon two factors, each of which is addressed below: the willingness of the general public to attend a convention in Las Vegas, and the willingness of convention planners to schedule meetings in Las Vegas. To assess the first factor, samples of the U.S. population were questioned directly about their inclination to attend a convention near a high-level nuclear waste repository or a transportation route along which nuclear waste is being shipped (Kunreuther et al., 1987). The second factor was addressed through the investigation of attitudes and intended behaviors of professional convention planners. The results of each of these studies indicate potential vulnerability of the convention industry to a high-level nuclear waste repository.

The convention question in the 1987 risk perception surveys was phrased as follows:

> "Now I'd like you to think about a community that would be located about 50 miles from a high-level nuclear waste repository. Please tell me if you think being located about 50 miles from a repository would make that community a less desirable place for you to attend a convention."

For the national sample, 48 percent of the respondents indicated a repository would make the community a less desirable place to attend a convention while for the Nevada sample the corresponding percentage was 47 percent. When the distance in the question was changed to 100 miles, the national and Nevada percentages were 38 percent and 42 percent, respectively.

It should be reiterated that because of the respondent's unfamiliarity with the repository, these responses are not to be interpreted as predictions of future behavior, but as a reflection of current attitudes. Further, the limitations implied by low response rates (35 percent) must be kept in mind.

A second national telephone survey, conducted by the Opinion Research Corporation during 1988, found that attending a convention in Las Vegas would be less attractive if a high-level nuclear waste repository were located 90 miles away.

A decline in an area's popularity for tourists has been found to follow environmental events such as an oil spill, severe ocean pollution, or a volcanic eruption. However, with the exception of the Goiania incident, there has been little research to document the impact of such environmental events on decisions pertaining to

conventions. Therefore, a survey of convention planners was conducted to assess the impacts of the location of a high-level nuclear waste repository on the scheduling of conventions in Las Vegas (Kunreuther, Easterling, and Kleindorfer, 1988).

The first part of this study involved a focus group interview of nine convention planners from the Philadelphia area. The focus group interview was designed to provide more information concerning how planning decisions are made and what factors are important in choosing a city for a meeting. The information obtained was utilized to design the questionnaire used in the formal survey of planners.

In the second part of the study, convention planners who schedule meetings in Las Vegas were surveyed to determine whether their decisions to schedule such a meeting would be influenced by negative events associated with the location of a repository at Yucca Mountain. The survey was conducted with a telephone-mail-telephone format in which potential respondents were first contacted by phone to determine whether they fit the selection criteria for inclusion in the study. If they qualified they were asked to complete a questionnaire, which was then mailed to them. Each respondent was then re-contacted by telephone to obtain their responses to the questionnaire. Of the 241 identified planners eligible for participation, 160 (66 percent) completed the questionnaire. Seven participants served as a pre-test group, leaving 153 respondents in the final sample.

All regions of the country were represented, with a relatively high concentration (25 percent of the sample) from the Washington D.C. area. Almost 80 percent were trade or association planners, with the remainder split between corporate planners and independents. Respondents had a median of nine years of experience in the convention planning field.

To make the task as concrete as possible, each respondent was asked to focus on one particular target meeting for which he or she had actually selected Las Vegas as the meeting site. Respondents were then asked to reconsider their decision (i.e., to indicate whether they would still hold this meeting in Las Vegas) after being presented with different scenarios involving the transportation and storage of nuclear waste. Planners were instructed to focus, if possible, on a meeting that had been arranged but had not yet taken place in order to avoid bias that might occur as a result of having had a particularly good or bad experience with the target meeting. As of February, 1988, when the survey was conducted, 75 percent of the target meetings had not taken place.

Each planner indicated the relative attractiveness of Las Vegas under alternative repository scenarios. Each scenario was constructed by combining particular repository-related events with a series of amenities offered by Las Vegas hotels. As a Base Case situation, a repository 95 miles from Las Vegas had just begun to accept waste. Other repository scenarios were based either on a historical series of mishaps or on an isolated accident involving either the repository itself or the transportation of radioactive materials to it. For each repository scenario, media attention was specified as either amplified or dampened. The experimental design also involved systematic variation on factors such as price of hotel rooms, meal prices, availability of free gambling chips and free show

tickets, and price of coffee breaks. A total of 65 different scenarios were constructed in this way. Each planner responded to nine different scenarios.

The convention planning study indicated that the presence of a nuclear waste repository at Yucca Mountain (even under benign scenarios) reduced planners' preferences for Las Vegas. On the one hand, the vast majority of planners (82 percent) in the survey rated "environmental hazards" as either not at all important or only minimally important in the selection of a city; this result corresponds to most historical evidence on the impact of hazard events on convention business. However, the high-level nuclear waste repository appears to create special concerns among meeting planners, in part due to the safety of delegates attending a Las Vegas meeting, and in part due to the belief that the repository will diminish the image of Las Vegas as a safe and attractive convention site.

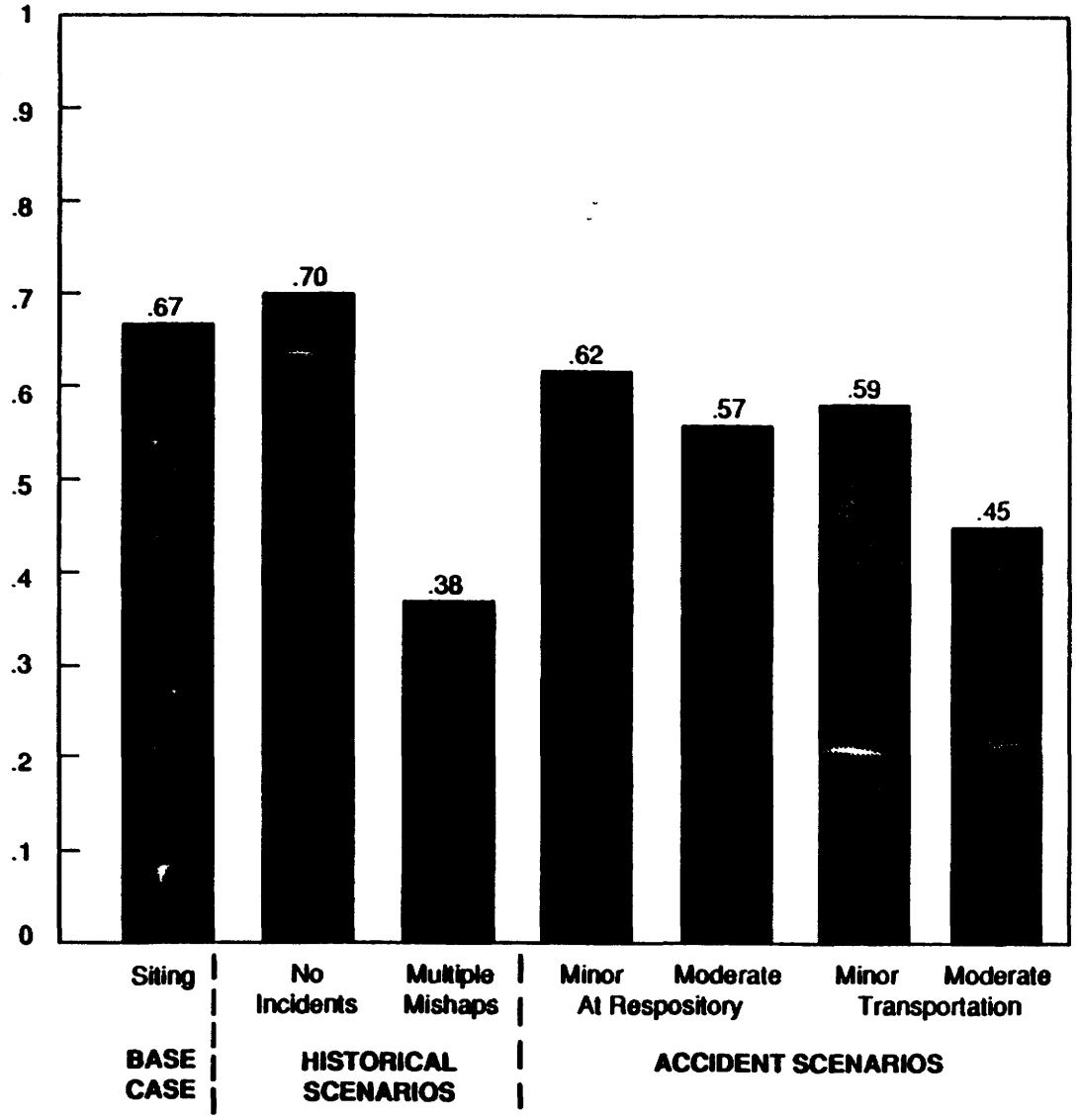
After being instructed to reconsider a specific convention they had scheduled for Las Vegas, planners rated the likelihood that Las Vegas would be chosen for that meeting in the event that the repository was located at Yucca Mountain. Mean ratings are shown in Figure 2-2 for the simple base-case scenario, as well as for a number of mild and severe "accident" scenarios. Ratings are especially low for the multiple-mishap scenario, in which repeated transportation accidents and evidence of poor facility management are documented in an investigative report.

A further decrease in the attractiveness of Las Vegas was observed if the repository event was accompanied by extensive media attention in the national press. Presumably because of concern regarding the stigma attached to Southern Nevada, mean ratings of the likelihood of going to Las Vegas dropped by about .10 across the various scenarios.

The reduced favorability of Las Vegas following repository events is unlikely to be recaptured through amenities offered by Las Vegas hotels. Even with a 20 percent discount in hotel room rates and meal rates, free gambling chips, free show tickets, and free coffee breaks, planners' ratings of Las Vegas showed only slight improvement (no more than .03 for each amenity).

Special sensitivity to the repository events was observed for planners from the Washington D.C. area and from the mid-west, with less effect on the preference of Nevada planners. Also, smaller meetings with fewer constraints were more likely to be taken from Las Vegas in reaction to severe scenarios.

While the responses observed are admittedly hypothetical in nature, the data may generalize to the actual location decisions made by planners. Planners generally have a number of cities from which they can choose, so they need not select a city for which they have serious reservations regarding safety and image. Thus, during a week in which a repository-related event is salient to planners, Las Vegas could lose meetings normally planned during that week. We are unsure for how long such an event would remain salient to planners; however, given the dynamic nature of the relationship between public



MEAN REPORTED PROBABILITY OF SELECTING LAS VEGAS (Pooled Across All Other Factors)

MOUNTAIN WEST

FIGURE 2 - 2

perceptions and media attention, it is possible that a given event could reduce bookings for weeks, months, or even permanently.

The Tourist Industry

Tourism has always represented most of the Las Vegas visitor volume. In 1986, for example, there were 13.7 million tourists out of a total of 15.2 million visitors. The purpose of this section is to examine the vulnerability of this major component of the visitor economy to the siting of a high-level nuclear waste repository north of Las Vegas. Once again, the key questions are addressed using two approaches. The first approach relies on direct questions to a national sample of adults, asking how their vacation preferences would be affected by a high-level nuclear waste repository. The second approach, focusing on imagery, is less direct, but may have more validity than the direct approach because of the difficulty people have in predicting how they would react to the hypothetical nuclear waste repository.

The first approach -- asking people to directly predict their vacation choices -- is pursued through the interviews conducted in 1987 and 1988. In the earlier survey, the question relative to tourism was phrased as follows:

> "Now I'd like you to think about a community that would be located about 50 miles from a high-level nuclear waste repository. Please tell me if you think being located about 50 miles from a repository would make that community a less desirable place to take a vacation."

For the national sample, 57 percent of the respondents indicated a repository would make the community less desirable to visit while for the Nevada sample, the corresponding percentage was 59 percent. When the distance in the question changed to 100 miles, 61 percent of the respondents in the national sample indicated a place would be less desirable and in the Nevada samples the percentage changed to 50 percent. It is interesting that the number of respondents finding a place less desirable because of a high-level nuclear waste repository averages at least 10 percentage points higher for purposes of taking a vacation than for attending a convention. This suggests that visitor behavior may be potentially more sensitive to the repository than convention behavior.

The 1988 national survey asked people to rate the desirability of Las Vegas as a vacation site. Later, the same question was posed with an addendum noting that a high-level nuclear waste repository was located 90 miles away. Mention of the repository dropped the percentage of "very desirable" or "somewhat desirable" responses from 64 percent to 48 percent. Again, vacation preferences were found to be somewhat more sensitive to the presence of a repository than were preferences for convention sites.

The two imagery surveys of Phoenix residents provide further evidence regarding the potential for the repository to damage the tourist industry in Southern Nevada. When respondents in the cities survey were asked to free-associate to the stimulus words "Las Vegas," images pertaining to gambling, casino-hotels, bright lights and entertainment

were dominant, followed by imagery pertaining to money and the climate and physical landscape. Prostitution and crime formed the seventh category of images (see Table 2-1). Imagery related to nuclear waste and the nuclear test site was very infrequent (only 2 images out of more than 1,500).

The hierarchy of images elicited by the stimulus phrase "underground nuclear waste storage facility" was overwhelmingly negative (Table 2-2). By far, the most frequent associations were dangerousness and death and their synonyms, followed by pollution, negative concepts, and radiation. Although people were not asked to score these images, it seems likely that most of them would be judged "very negative," a -2 on the scoring scale. Although some images pertaining to "necessity" came at the 12th position, they were very few in number. "Nevada" was weakly associated with the repository, which is not surprising, given the fact that only 19.6 percent of the respondents knew where the repository site is proposed to be located.

Images of the nuclear test site were similarly negative. Major images included radiation, death, danger, cancer, destruction, and Nevada. More people associated Nevada with the test site than with the repository (46.8 percent knew that the test site is in Nevada).

To predict preferences among cities from images, a scoring rule was developed, the summation model, which simply sums the ratings for all the images a respondent produced for each city. The image score for a city was then examined relative to an individual's stated preference to visit the city.

The summation model does quite well, correctly predicting 55 percent of the number-one-ranked vacation cities and 56 percent of the fourth-ranked cities, with somewhat less accuracy in predicting intermediate ranks (if the model lacked validity, a 25 percent hit rate would be expected by chance). The exact rank order of four cities generated by the summation model matched the exact rank order of the respondent 26.4 percent of the time (perfect matching of ranks would be expected by chance only 4.2 percent of the time).

A second set of tests was conducted with the summation model. Each of the four cities was paired with every other city -- making six pairs in all. For every respondent and every pair, the image score for city B was subtracted from the image score of city A. The resulting 2,346 A-B scores across all respondents were ordered from extreme negative to extreme positive and this distribution of difference scores was partitioned into five subsets, as equal in size as possible (range 419 to 511 comparisons in each subset). Finally, within each subset, the percentage of respondents who ranked city A more favorably than city B as a vacation site was calculated. The plot of the mean A-B difference within each subset against the proportion of people preferring city A is shown for all respondents and all pairs combined in Figure 2-3. Note the strong relationship between the mean image score difference (based on the summation model) in each subset and the proportion of respondents in that subset choosing city A over city B.

TABLE 2-1

HIERARCHY OF IMAGES ASSOCIATED WITH LAS VEGAS

Includes categories with frequencies > 10.

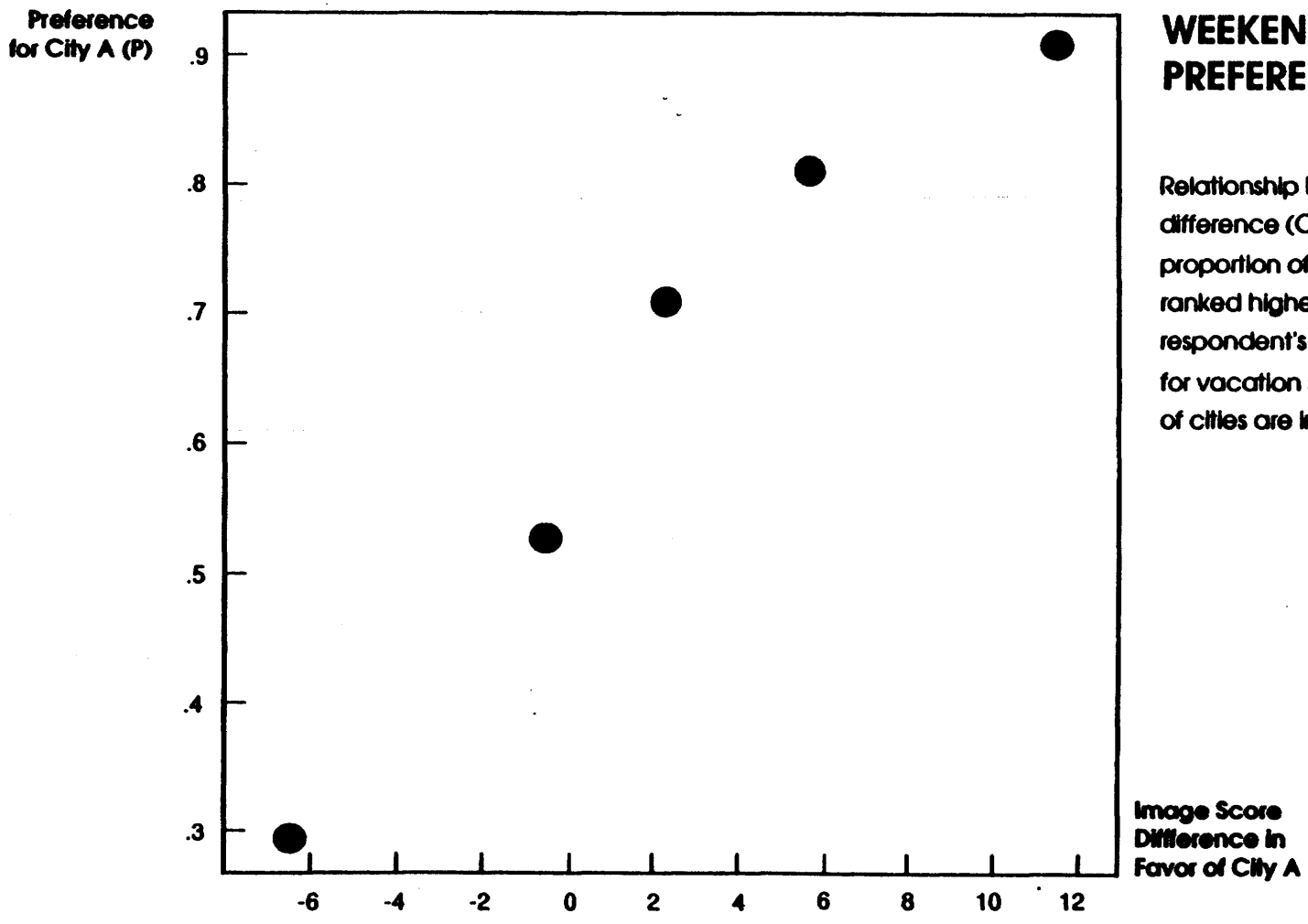
	Category	Image Frequency
1.	Gambling	365
2.	Casino-Hotels	200
3.	Lights	154
4.	Entertainment	154
5.	Climate/Natural Environment	108
6.	Money	101
7.	Crime and Immorality	99
8.	Fun and Good Times	60
9.	Celebrities	45
10.	Crowds - People Types/Watching	42
11.	Food and Drink	39
12.	Geographic Locations	35
13.	Unappealing	35
14.	Night	34
15.	For the Rich	28
16.	Hectic	28
17.	Appealing	28
18.	Friendly, Friends, Relatives	25
19.	Marriage and Divorce	19
20.	Travel to and Within	17
21.	Sports and Outdoor Activities	16
22.	Losing Money	15
23.	Inexpensive	14

Source: Slovic et al., forthcoming.

TABLE 2-2
HIERARCHY OF IMAGES ASSOCIATED WITH AN "UNDERGROUND NUCLEAR WASTE STORAGE FACILITY" CITIES SURVEY

	Image	Frequency	Synonyms Included in Category
1.	Dangerous	153	Danger, hazardous, toxic, unsafe, harmful disaster
2.	Death	78	Sickness, dying, destruction
3.	Pollution	66	Contamination, leakage, spills, Love Canal
4.	Negative	57	Wrong, bad, unpleasant, terrible, gross, undesirable, awful, dislike, ugly, horrible
5.	Radiation	46	Nuclear, radioactive
6.	Scary	41	Frightening, concern, worried, fear, horror
7.	War	29	Bombs
8.	Nevada	24	
9.	Desert	21	
10.	Safety	14	Security, protection
11.	Problems	12	
12.	Necessity	11	Necessary evil
13.	Palo Verde	11	
14.	Somewhere else	11	Wouldn't want to live near one
15.	Power	10	

Note: Only images elicited by two or more respondents are categorized in this table.
Source: Slovic et al., forthcoming.



WEEKEND VACATION PREFERENCE

Relationship between image score difference (City A - City B) and proportion of time (P) City A was ranked higher than City B in the respondent's preference rankings for vacation sites. All possible pairs of cities are included in this analysis.

MOUNTAIN WEST

FIGURE 2 - 3

Figure 2-3 illustrates the performance of the summation model across all pairs of cities. The data for specific pairs of cities (e.g., Las Vegas vs. Denver) look essentially like the combined plot in Figure 2-3 and are not shown here.

The quantitative implication of Figure 2-3 is noteworthy. If two cities such as Las Vegas and Denver are examined as competing destinations for a long weekend, and if the respondent was originally indifferent between the two (i.e., P=.5 for Las Vegas and P=.5 for Denver), a 2-point reduction in total image score for Las Vegas would change the choice probability to P=.41 for Las Vegas and P=.59 for Denver. If the summed image score were to fall by 4 points, the choice probabilities would be P=.32 for Las Vegas and P=.68 for Denver. If this were the case for 100 individuals who were originally equally disposed to Las Vegas (50 persons) and Denver (50 persons), the image changes would reduce Las Vegas to 41 or 32 persons -- decreases of 18 percent and 36 percent, respectively.

The summation model was equally accurate in predicting vacation preferences among states and predicting job and retirement preferences among both cities and states. Additional analyses showed that image scores for Las Vegas and for Nevada were linearly related to the probability that a person had visited those places during the past two years. The slope of the linear relationship between these variables was greater for visits to the state than for visits to Las Vegas. In general, a one-point change in image score was associated with a 1 percent change in Las Vegas visitations and a 2.5 percent change in visits to Nevada. This is important because it documents that people with less favorable images of Las Vegas and Nevada have, in fact, visited less frequently in the past.

Whereas few people expressed nuclear-related imagery in response to the stimulus words "Las Vegas," about 10 percent of respondents in the states survey produced nuclear imagery in response to the stimulus "Nevada" (see Table 2-3). Such images included the terms nuclear testing, nuclear bomb, nukes, explosions, and radiation. The mean image score for Nevada for these persons was 0.18. The mean image score for persons who did not associate Nevada with things nuclear was 2.56 (a statistically significant difference; $p < .001$). As expected, persons with nuclear imagery assigned much lower (poorer) preference rankings to Nevada than did persons without such images. This is a very significant finding because it suggests that Nevada has already undergone some stigmatization as a "nuclear" place.

Additional studies and analyses were done to validate the link between imagery and preference. For example, alternative ways of scoring a person's image set were evaluated. Different scoring rules (e.g., weighing image scores according to the order in which the images were produced, prior to summing them) produced results not much different from those reported above. A new study, conducted in Oregon, had one group of persons produce images for cities and a different group score the images. Predictive accuracy of the summation model was again high, indicating that the results from the Phoenix residents were not biased by the fact that respondents scored their own images.

TABLE 2-3

STATES STUDY SUMMARY

Hierarchy of Images Associated with
Nevada Includes Categories with Frequencies > 15

	Category	Image Frequency
1.	Gambling	359
2.	Cities in Nevada	354
3.	Geographic Features/Climate/Plants/Animals	309
4.	Casino-Hotels	117
5.	Entertainment	109
6.	Other Specific Geographic Locations	108
7.	Lights	53
8.	Money	44
9.	Sports and Outdoor Recreation	41
10.	Nuclear	39
11.	Crime and Immorality	35
12.	Unappealing	28
13.	Crowds/People Types	24
14.	Beautiful/Appealing	24
15.	Fun and Good Times	17

[a] Nuclear category includes nuclear testing, nuclear bomb, bombs, radiation.

Source: Slovic et al., forthcoming.

A challenge was devised to the summation model in the form of a hypothesis that people who like to gamble will not be influenced much by other attributes of Las Vegas. This hypothesis was tested using respondents in the cities survey who produced the term "gambling" as one of their images of Las Vegas. These individuals were separated into subgroups according to the value they assigned to the gambling image. Then a separate analysis of the relationship between image difference scores and preference probability for Las Vegas, analogous to the analysis in Figure 2-3, was performed within each subgroup.

The hypothesis predicts that those who see "gambling" as extremely positive (i.e., who rated it as a +2) would have vacation preferences for Las Vegas that are less sensitive to image differences compared to the preferences of people who are less favorable toward gambling (i.e., who rate "gambling" as intermediate or negative in value). The data showed no support for the hypothesis. The slopes of the best-fitting lines relating image score differences to preference probabilities for Las Vegas were not significantly different for groups of people who differed in their evaluation of gambling. In other words, people who viewed gambling as a very positive feature of Las Vegas were just as much influenced by other positive and negative images as were people who had less positive views of gambling.

The analysis of the potential for the proposed repository to affect the visitor economy is unsettling. Several independent research thrusts were made and each indicates a high level of sensitivity to the proposed facility. When individuals were questioned directly as to whether a repository would affect their tourist or convention behavior, many answered in the affirmative. When more detailed studies were conducted with convention planners, it was the strongly held opinion of many that both the existence of a repository and the occurrence of repository-related events would affect their willingness to schedule a convention in a nearby city.

A less direct, imagery-based approach was then used to try to better understand the mechanisms by which these effects might actually operate. It was shown that people have images of places and that the positiveness of their images of a place relative to other places will be a very good predictor of their choice among them as future vacation sites. Image also will correlate with their actual, historical visitation behavior to those places. Further, the imagery that the respondents associated with a nuclear waste repository was uniformly and intensely negative.

Most important, the kind of problem that might be generated by the repository may already be occurring, due to the Nuclear Test Site. In the pilot study sample of about 500 Phoenix households, 10 percent of the sample used "nuclear," "radioactive" or a synonym as one of the first six descriptors they free-associated with the State of Nevada. This stigmatization caused their overall image of Nevada and their preference for Nevada as a visitation site to be significantly more negative than the remainder of the sample.

There are many additional questions to answer and much work that needs to be done to generalize these results and to be more confident of their behavioral

implications. The conclusions of the work to date, nevertheless, give cause for concern. They demonstrate how risk effects could work to affect the visitor economy, and how "things nuclear" are already creating negative imagery which already may be affecting actual visitation behavior to Nevada. The possibility that the repository could accelerate this process of nuclear stigmatization cannot be dismissed based on the results reported to date.

2.3.3.2 Potential for Risk-Induced Effects on Migration

Inmigration tends to account for a large percentage of the population growth in Nevada. Between 1975 and 1980, for example, Clark County gained approximately 92,000 residents through inmigration -- over 80 percent of its total population growth (Nevada Office of Community Services, 1985; Clark County Department of Comprehensive Planning, 1988). People tend to migrate to Nevada for two reasons -- employment opportunities and retirement. Clark County attracts large numbers of employment-motivated movers because of the growth in the hospitality industry. The area attracts retirement motivated migrants because of its sunbelt amenities and relatively low cost of living.

The question of how the location of the high-level nuclear waste repository at Yucca Mountain will affect employment-related migration was approached from three directions. First, samples of the U.S. and Nevada populations were asked how much the presence of a repository would affect the attractiveness of Las Vegas as a place to raise a family or work. The second approach was experimental: the impact of an environmental hazard such as the repository was examined under controlled conditions to determine its effect on the psychological decision process. The third approach was the imagery studies, which related preferences for cities and states as places to work to images of those places.

The question of particular interest to employment-related migration in the 1987 risk perception surveys was phrased as follows:

> "Now I'd like you to think about a community that would be located about 50 miles from a high-level nuclear waste repository. Please tell me if you think being located about 50 miles from a repository would make that community a less desirable place for you to raise a family."

For the national sample, 80 percent of the respondents indicated that the presence of a high-level nuclear waste repository 50 miles away would make the area a less desirable place to raise a family. The corresponding percentage for the Nevada sample was 70 percent. When the repository was said to be located 100 miles away from the target community, 73 percent of the national sample and 61 percent of the Nevada sample indicated that it would be a less desirable place to raise a family. When these results were compared with the similar questions for tourism and convention attendance, it was found that the longer people think they would be in an area, the more likely they are to think that the repository would make the area less desirable.

In the 1988 national survey, respondents were asked to rate how desirable Las Vegas would be to raise a family or to work. They were then asked to reconsider the same question after being told that the repository would be located 90 miles to the north. The results showed that the desirability of Las Vegas as a place to raise a family or to work was significantly lower in the presence of a repository. Similar results were obtained with questions pertaining to the effects of a repository on the attractiveness of Las Vegas as a retirement location. Approximately 66 percent of the respondents in the national sample said that they would change their retirement plans if they found out that a repository was to be located 50 miles from their chosen destination. Most of these people said they would still change their plans even if it cost them $5,000 to do so.

An experimental study of the migration decision process was conducted at the University of Colorado at Boulder (Greenwood, McClelland, and Schulze, 1988). The study assessed the perceived effects of a nuclear waste repository on migration to the region in which the repository is located. The migration decision process was traced through the use of a computer program. In this program, individual subjects sifted through a large quantity of information about nine alternative areas to which they might migrate: Albuquerque, Denver, El Paso, Las Vegas, Los Angeles, Phoenix, Salt Lake City, San Diego, and Tucson. Information was available about five characteristics of the area: economic conditions; climate and terrain; recreation, culture and education; hazards, environment and safety; and people and friends in the area. Subjects were free to examine some or all of the available information about the alternative areas, but were not required to consider any given item. After considering the information they wished to view, the subjects chose a location to which to migrate. The computer program allowed the researchers to analyze the choice process as well as the choice itself. This choice process involves the order in which each subject considered the available information, what information each person chose to examine, and the amount of time spent on each item.

Subjects were recruited from among University of Colorado staff, graduate students and the general public. An effort was made to recruit subjects between 25 and 35 years of age as representative of potential employment-related migrants and subjects between 55 and 65 years of age as representative of potential retirement migrants. Of the 93 subjects, 85 percent were in the targeted age ranges, with 62 between the ages of 21 and 40 and 17 between the ages of 61 and 70.

The experimental study of the psychological processes underlying migration decisions found that the younger, job-choice age group tended to examine almost four times as much information about a community before making a location decision than did an older retirement-aged comparison group. The older group tended to focus on information about the presence of friends, cost of living and climate, while the younger, job-related group tended to focus on terrain, recreation, education, technological hazards and pollution in making their migration decision. Overall, the younger group gave much greater attention and weight to the technological hazards associated with each city.

In the experiments, the repository was located 100 miles from the city identified as most popular in a pre-test. Among all job-location subjects, 38 percent chose that city

when there was no repository located near any of the nine choice cities. The percentage choosing the target city dropped to 10 percent when the repository was located 100 miles from that community. This finding was highly significant ($p<.01$). Many of the subjects in this group did not examine any information about technological hazards. When only subjects who examined the technological hazards information were included, 43 percent chose the target city when the repository was absent, and only 11 percent chose it when the repository was said to be located 100 miles from that city. However, this difference was not statistically significant ($p<.19$).

The experimental study provided evidence that locating a nuclear waste repository near the most popular city drives people to choose another location, particularly when the people are considering employment-related migration. However, the study also indicated that employment opportunities are a very important consideration in the migration decisions of younger people. Although young, job-oriented migrants may be deterred from migrating to Las Vegas because of the presence of the repository at Yucca Mountain, potentially strong effects could also be exerted on them indirectly through employment opportunities.

The imagery studies reviewed earlier included questions asking the respondents to rank cities or states according to their preference for each as a site for employment (assuming that an equally attractive position was available in each one) and for retirement. The summation model, which simply sums the ratings for all images in the set, had excellent "hit rates" in predicting both sorts of preferences. Again, relationships between job and retirement preferences among pairs of cities/states and differences in image values were quite strong, indicating that a change in one or two images could imply a substantial shift in preference probability. The effects of such a shift in images appear slightly stronger on retirement-related migration decisions than on employment-related migration decisions. As suggested earlier, this may be due to the overwhelming influence of the economic climate and the importance of job opportunities on employment-related decisions.

The findings of the investigations of both employment-related and retirement-related migration were consistent. The presence of a high-level nuclear waste repository near Las Vegas reduces the stated attractiveness of the area as a place to raise a family, take a job, or retire. Individuals considering migrating to Nevada for employment were most likely to consider the presence of a high-level nuclear waste repository on their decision making process. People considering migrating to Nevada for retirement were highly affected by the scenario locating a repository nearby, and indicated that they would be willing to spend as much as $5,000 to change their plans. Images were good predictors of choice of job and retirement location preferences, indicating that increased association of Las Vegas and Nevada with the repository could have significant effects on these kinds of migration.

Overall, the longer a person expects to stay in the area, the more the repository influences their stated intentions; knowledge of the repository had stronger effects on the stated willingness of people to move to Nevada than it did on their willingness to visit.

2.3.3.3 Potential for Risk-Induced Effects on Economic Development

Several strategies were used to assess the impact of the high-level nuclear waste repository on the economic development potential of Las Vegas and the State of Nevada. The risk perception surveys incorporated questions about the respondent's preferences for Las Vegas as a place to locate a business. A special imagery survey was conducted using corporate site location decision makers as respondents. Finally, a target industry analysis was used to identify the types of businesses that would find Las Vegas attractive in today's business climate and to model the impacts that the repository might have on the future business location competitiveness of the area.

The key question in the 1987 risk perception survey asked whether the location of a high-level nuclear waste repository 50 or 100 miles away from a target community would make that community less attractive as a place to locate a business. In the national sample, 72 percent of the respondents indicated that they would find the community less desirable as a place to start a new business if it were 50 miles away from the repository; 68 percent of the national sample found the community less attractive if it was located 100 miles away. The Nevada sample had greater tolerance for a location near the repository. Only 63 percent indicated that the community located 50 miles away from the repository would be less desirable as a location for a new business, and 57 percent felt that way when the community was 100 miles away from the repository.

In the 1988 survey, a national sample of respondents were asked to rate how desirable they found Las Vegas to be as a location for a new business. Thirty-two percent of the respondents felt that Las Vegas would be a desirable location for a business without the repository, but only 20 percent rated it as desirable when they were aware of the repository, and 77 percent rated Las Vegas as an undesirable business location under these conditions.

Site location imagery. The survey of corporate decision makers was conducted in June and July of 1988. The sample was selected from the 1988 edition of Who's Who in Corporate Real Estate, published by the National Association of Corporate Real Estate Executives (NACORE). Five hundred and sixty-nine business people were contacted; 400 interviews were completed. Respondents were asked to report six images elicited by the names of four cities: Phoenix, Las Vegas, Denver, and Albuquerque. They were then asked to rate each image on a five-point scale, ranging from very positive to very negative. In addition, respondents were asked to respond to questions about the desirability of each site as a business location, the importance of each of five factors in selecting a business location (these factors included work force availability, image of the city, availability and cost of space, quality of life, and accessibility to markets), and what communities they have considered as sites in the past. Finally, respondents were asked to rate how influential a series of "LULU's" (locally unwanted land uses) would be in site selection decisions. These LULU's included factors such as proximity to a sanitary landfill, chemical manufacturing plant, or oil refinery and the presence of such environmental hazards as poor air quality, a flood plain, and earthquake tremors.

As in the imagery studies with Phoenix residents, respondents were asked to name up to six images evoked by the name of each city, to rate how positive or negative those images were, and to indicate their preferences for each location as an area in which to locate a business. Table 2-4 presents the hierarchy of images produced in response to the stimulus word "Las Vegas." As found in the previous imagery studies, the gambling image was dominant. However, images about the physical and business climates were more frequent among the corporate decision makers; positive aspects of the business climate and opportunities in Las Vegas were more dominant images than entertainment and casinos. Nuclear images were infrequent, appearing only twice within the negative attributes category.

As found in the other imagery studies, a simple summation model applied to the ratings of sets of images evoked by a city was a good predictor of the respondents' expressed preferences for places in which to site a business facility (see Figure 2-4). There is a strong correlation between the feelings about the images associated with a city and the city's ranking by site selectors as a place to do business.

The survey of corporate decision makers also examined the relative impact of various noxious environmental features on the selection of a business site. Respondents were asked to rate the influence that a set of "locally unwanted land uses" (LULU's) would have on their decisions to locate a business in a particular community. The following list ranks these LULU's on the percentage of respondents who ranked them as very influential in a location decision.

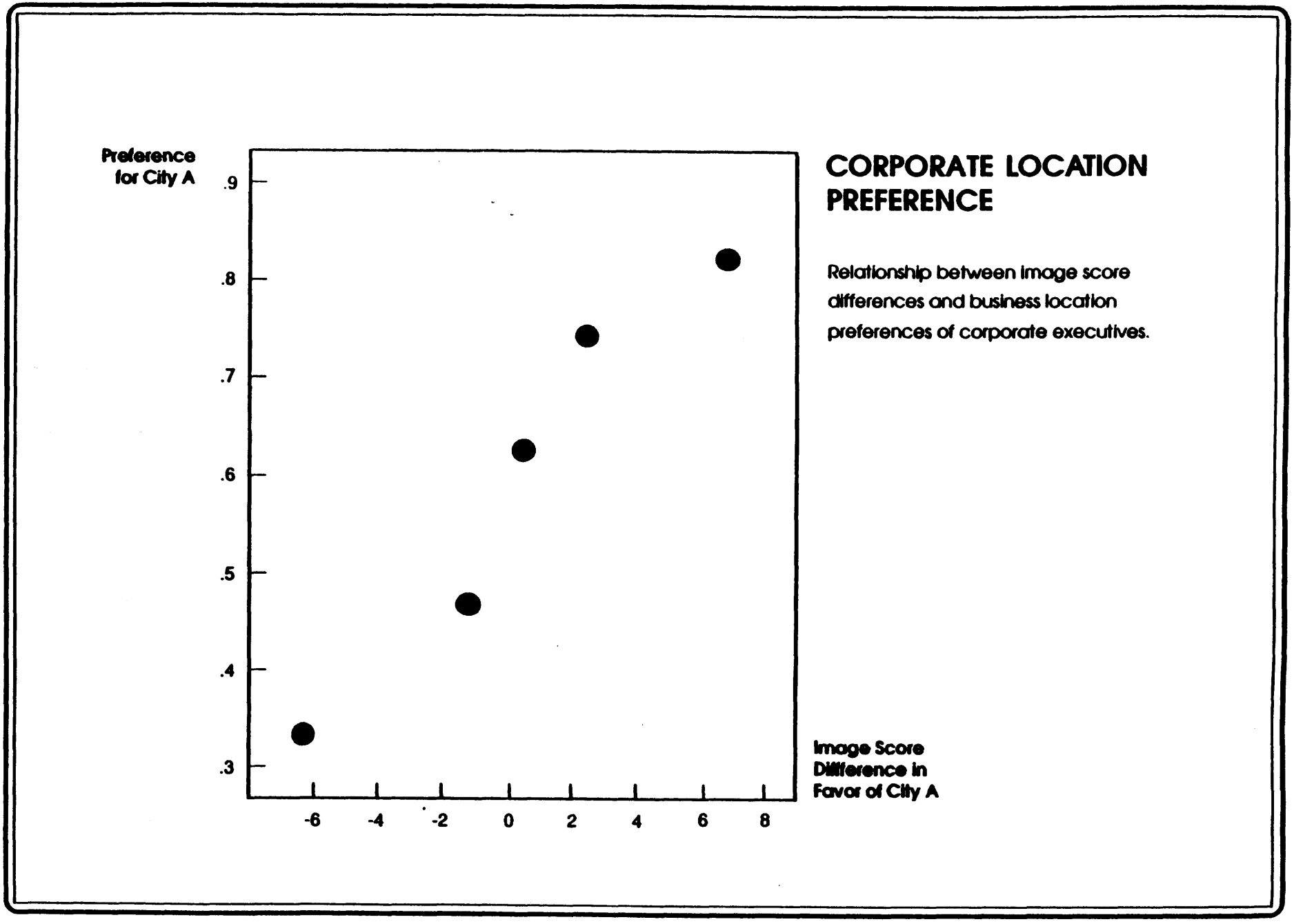
- A landfill for the disposal of chemical wastes (rated as very influential by 67 percent of the respondents);
- Air quality that does not meet federal ozone or carbon monoxide standards (54 percent);
- A sanitary landfill (52 percent);
- A site adjacent to a highway leading to an underground facility for disposing of radioactive wastes (52 percent);
- A chemical manufacturing plant in the vicinity (48 percent);
- A site located in a 100 year flood plain (45 percent);
- A site adjacent to a highway leading to a nuclear weapons testing site (38 percent);
- An oil refinery nearby (37 percent);
- A site adjacent to a highway leading to a nuclear power plant (26 percent); and

TABLE 2-4

IMAGES OF LAS VEGAS: CORPORATE DECISION MAKERS' SURVEY

	Category	Image Frequency
1.	Gambling	263
2.	Climate/Natural Environment	186
3.	Negative General Attributes/Attitudes/Images	154
4.	Good Business Opportunity	113
5.	Good Business Climate	75
6.	Entertainment	70
7.	Resort Hotels, Casinos	63
8.	Lights	63
9.	Positive General Attributes/Attitudes	56
10.	Fun and Good Times	55
11.	General Attributes Not Clearly Positive or Negative	54
12.	Nighttime	30
13.	Sports and Recreation	29
14.	Crime and Immorality	27
15.	Limited Business Opportunity	27
16.	Money and Wealth	23
17.	Tourist/Transient	21
18.	Poor Business Climate	20
19.	Geographic Features	19
20.	Types of People	16
21.	Busy/Active/Fast	14
22.	Types of Business	14
23.	Lack in Interest/Ignorance	13

Source: Mountain West, forthcoming.



CORPORATE LOCATION PREFERENCE

Relationship between image score differences and business location preferences of corporate executives.

MOUNTAIN WEST

FIGURE 2 - 4

- Earthquake tremors detected in the area over the past five years (19 percent).

The highest proportion of corporate decision-makers from every business sector chose either Denver or Phoenix as their preferred location for a new or expanded business facility. Las Vegas was first choice as a place to open or expand a business by corporate decision makers most often in wholesale trade (17 percent of respondents who chose it) and mining (17 percent), followed by retail trade (12 percent) and services (10 percent). Only 3 percent of the manufacturing sector respondents named Las Vegas as first choice for a new location.

Business climate and target industry analysis. Growth Strategies Organization (1988a) evaluated the Las Vegas area's business climate on forty factors grouped into eight broad categories: access to markets, access to the resources consumed in the production of goods or the provision of services, labor force characteristics, access to financing, space availability, public sector investments in the business climate, public sector costs imposed on businesses, and quality of life issues. This information was used to identify the strengths and weaknesses of the Las Vegas business climate and to model the business investment decision process. This model is based on two variables -- one measuring the relative importance of each factor within each business group and the other measuring a community's capacity to satisfy that requirement for each business group.

The "relative importance factor" used in the model is industry specific and does not vary from community to community. It reflects Growth Strategy Organization's understanding of how decisions are made within each of the business groups considered in the model. The "community response factor" is community specific and comes from the knowledge generated in preparing the area's business profile. The product of these two factors is the "location compatibility index" which measures the degree to which the community satisfies the needs of each type of business.

The impacts of the repository can then be examined for the business location factors to determine the magnitude and nature of the impact of the repository on the competitiveness of the Las Vegas area as a location for various types of businesses.

As a result of this analysis, strengths and weaknesses of the Las Vegas MSA's business climate were identified. Specifically, the strengths of the business climate include:

- Its location in the rapidly growing Southwest market for consumer goods;
- Excellent and competitively priced surface transportation services into the huge Southern California market;
- Good air access to regional and national markets;

- The area's role as the Western regional hub for the U.S. postal service overnight mail;
- Low taxes;
- An abundance of land;
- Cheap electrical energy;
- State of the art telecommunications services;
- Status as a right-to-work state;
- Good physical climate;
- Excellent recreational and entertainment opportunities.

Weaknesses in the business climate were identified as:

- Inadequate transportation access to national markets;
- Lack of a critical mass in manufacturing, which creates:
  - -- limited access to skilled blue collar workers in most industries
  - -- a shortage of suppliers of intermediate manufactured goods to the manufacturing sector
- Limited academic and technical support resources for high tech companies;
- Below average secondary education quality;
- Lack of local access to seed capital equity financing; and
- A negative image, centered on the area's image as a gaming and "sinful" center, as a center for organized crime, and a closely related perception of the city as a high crime area.

Growth Strategies Organization completed a target industry analysis to assess current economic development potential (Growth Strategies Organization, 1988b). The target industry analysis uses the business climate assessment to evaluate Las Vegas MSA's competitive posture in pursuing business investment in the "primary" sector of the economy -- businesses which sell their products or services outside the local marketplace and bring new money back into the area as well as businesses serving local customers who would otherwise import these products or services from suppliers outside the area.

The Las Vegas area's most competitive manufacturing attraction targets fall into five broad categories: (1) technology-driven industries -- electronics, computers and office machinery, aerospace parts, and instruments -- seeking a lower cost production environment; (2) building materials needed in a strong construction and infrastructure development market; (3) food products which are consumed in expanding markets and take advantage of the agricultural production in neighboring California; (4) nonferrous metals and chemicals industries that take advantage of the presence of raw materials in the region; and (5) printing, packaging, and promotional products consumed by business in expanding markets.

The proximity of the Las Vegas area to large and growing markets in Southern California, its high quality, cost competitive surface and air cargo service to this market, and its low operating cost environment make it an outstanding choice for distribution facilities. In addition, Las Vegas was identified as a competitive location for producer services businesses serving nearby metro and regional markets and for telecommunications firms who would be attracted by the state-of-the-art telecommunications systems available in the area.

The hospitality industry is the premier producer services activity in the Las Vegas area. However, continued success in attracting visitors will depend upon the projection of an image that treats gaming as just one element in a total visitor package. Las Vegas' business climate would normally make it a very competitive location for most types of business and professional services firms and administrative offices. However, except in the cases of equipment leasing and detective and protective services with strong markets in the gaming industry, the resultant images of crime and sin have effectively negated these advantages to date. Growth Strategies Organization concluded that the area could become fully competitive for administrative offices and all types of business services -- including personnel supply, legal, accounting, management consulting, public relations, financial services, and engineering firms -- if the area's image can be reshaped.

The competitiveness potential for the Las Vegas area is excellent. The region has attracted several new manufacturing and distribution facilities in the past five years. Las Vegas' proximity to the huge Southern California marketplace and its distinct operating cost advantages as a base from which to serve that market have driven this trend. There is every reason to expect this manufacturing and distribution trend to continue for at least the next decade, as long as Southern California, the Southwest United States, and the Pacific Rim economies continue to expand. As the presence of production facilities increases, more skilled manufacturing workers will be attracted to the area. When this trend is coupled with a strong image enhancement campaign, a commitment to improved educational opportunities, and other state and local improvements aimed at economic diversification, the Las Vegas area can expect to become a competitive location for at least a third and potentially as many as two-thirds of all types of business facilities that can be defined as primary contributors to the local economy. Thus, in the absence of the repository, it is very probable that the state's goal of economic diversification will take place.

The siting of an underground nuclear waste storage facility at Yucca Mountain and the related transportation of these materials through Clark County to the repository could, however, have major impacts on several of the factors that influence business location decisions. These would likely stem from effects the repository's location at Yucca Mountain has on the overall quality of life of the area. Three factors may be affected here: decision-makers' perceptions of the physical security of their employees, their perceptions of the environment, and the area's image. While these three factors by themselves may not be crucial for business location decisions in most regions of the country, they have special significance for the Las Vegas area, if it is to be competitive with other southwestern locations for new business development. Business executives were shown to hold images of nuclear energy and nuclear waste similar to those of the general public, who have repeatedly indicated that the repository would detract from their evaluations of the quality of the local environment and its effects on the long-term health and safety of people living within 100 miles. The impacts of the repository on business decision-makers' impressions of the quality of life in the Las Vegas area would be greatest on the location of administrative offices, business and professional services firms, and businesses that serve the hospitality industry.

2.4 Summary and Discussion

2.4.1 Findings

The research program described above was guided by a theoretical framework derived from the scientific literature on risk analysis and risk perception. The theory was first evaluated by examining "historical" evidence from actual hazard events, using both "broad-based" psychometric analyses of 128 newsworthy events and deeper study of a few particularly instructive incidents. In general, the analysis of past experience lent credence to the theory's assumptions that risk perception, media coverage, signal value, actions of interest groups, and the process of social amplification all played a role in producing significant economic impacts on industries, firms, and regions associated with a hazardous system or an adverse event.

This historical analysis was buttressed by a research program that commissioned six major surveys of over 3,000 members of the public, corporate decision makers, and convention planners. These individuals were interviewed extensively about topics relevant to the potential economic impacts of the repository. These surveys were supplemented by a laboratory study of migration decision processes in the face of risk and by an analysis of Las Vegas's economic potential performed by an experienced economic development consulting firm.

The surveys employed standard questions of the form "What would you do if ...?" In response to these questions, those interviewed consistently indicated that the presence of a nuclear waste repository would make a region much less attractive as a place in which to vacation, attend a convention, take a job, retire, or locate a new business. The experimental study showed that migration decision processes gave substantial weight to

considerations of hazards such as a nuclear waste repository. The economic development analysis examined the competitiveness of the Las Vegas area in attracting new industries and how the repository might affect the area's potential in this regard.

The surveys also employed analyses of imagery, designed to overcome concerns about the validity of direct questions regarding the influence of a repository upon one's behavior. The results supported the four assumptions that the imagery research aimed to test. People have images of places. The positiveness of the imagery will predict their stated choice of future places to visit. The imagery will also correlate with their actual, historical visitation behavior. Further, the imagery that the respondents associated with a nuclear waste repository was uniformly and intensely negative. Finally, the kind of problem that might be generated by the repository is already occurring, due to the Nuclear Test Site. In the pilot study sample of 500 Phoenix households, about 10 percent of the sample used "nuclear," "radioactive," "bombs" or a synonym as one of the first six descriptors they free-associated with the State of Nevada. This stigmatization caused their overall image of Nevada to be significantly more negative than the remainder of the sample.

The cumulative weight of the many studies conducted to date provides a clear answer to the questions that motivated the inquiry. The mechanisms of perceived risk, social amplification, and stigma are observable in the record of past experience. In the context of the Yucca Mountain repository, they appear to have the potential to cause substantial losses to each of the various economic sectors at risk. It would be unwise for development of the repository to proceed without taking these potential economic impacts into consideration. The state of Nevada can not afford to ignore the potential consequences of risk-induced effects of the repository.

2.4.2 Counter-Interpretation of the Evidence

The complexities of the processes reported on in this chapter leave much room for debate and counter-argument with respect to the implications of the findings. Several of these arguments are raised frequently enough that they deserve discussion here.

Will stated intent predict actual behavior? Much of the survey research carried out daily in this country asks hypothetical questions to gain insights about the likely course of future behavior (do you intend to vote for Bush or Dukakis?). Several of the studies reported on above have followed this approach and asked people how their future behavior might be affected by a repository. The answers to this question have been reported above. Many people answered that they would be less inclined to visit, vacation, live, work, raise a family, etc. in a community if a repository were to be located within 100 miles of the community. The question remains, how reliable are these responses as predictors of future behavior?

In a very general way, stated intentions will predict behavior to the extent that the respondent is familiar with the hypothetical situation asked about and to the extent that other variables do not intervene between the time that intentions are stated and the behavior occurs. For example, a question administered at 4:00 p.m. asking whether an

individual would choose chicken noodle soup or black bean soup as a first course before dinner should predict the actual choice at 6:00 p.m. very well. The individual presumably understands the alternatives and the opportunity for intervening variables to change his/her choice is limited. A high-level nuclear waste repository obviously fails to meet these criteria. None of us really know very much about how the repository would actually operate and how we might react to it. Further, even if we did, there are 20 years in which our circumstance, values, perceptions, etc. could change appreciably with the result that our behavior may be very different than our stated intention of 20 years previous.

What does this mean for the interpretation of the survey results reported above? Clearly, it implies that it would be naive to expect stated intent to precisely predict behavior two decades in the future. Nevertheless, it would be equally naive to suggest that because stated intent may be an imperfect predictor of future behavior there will in fact be no behavioral response to the risk and uncertainty characteristics of the repository. On the contrary, given the consistently high levels of sensitivity revealed in the surveys, some response appears very likely; its magnitude, however, remains in doubt. At the very minimum, there is absolutely nothing that can be inferred from this research to suggest that Nevada should not be concerned about potential risk-induced effects to critical elements of its economic base. The implication is the opposite -- it should be concerned precisely because future behavioral response is likely and its magnitude is highly uncertain.

How could the repository produce risk-induced effects when there have been no effects from NTS? Given the extremely rapid growth and prosperity of the Las Vegas Valley at the present time, many people find it counter-intuitive that the repository could adversely affect Nevada, based upon their perception that NTS has had no negative consequences on growth in Southern Nevada. Two points need to be made here. First, evidence to date suggests the premise of this question is incorrect. Although NTS has certainly produced significant positive economic effects, it appears to have also attached some stigma to the State. Based on pilot survey results of Phoenix households, a yet to be determined portion of the U.S. population may well have a significantly more negative image of Nevada because they associate it with things nuclear. It appears that this has affected past behavior and could affect future behavior. This does not conflict with the fact that Southern Nevada is prospering at the current time. It simply suggests that without the nuclear stigma dimensions of the NTS, certain sectors of the economy might be prospering even more.

Further, the repository may be perceived in a very different way from NTS. Nuclear waste transport, the operation of the repository, and any controversies over the safety of those activities will be open to much closer scrutiny by the public and the media than the operation of the test site, assuming no major accidents at the latter. In particular, tens of thousands of nuclear-waste shipments by truck or rail throughout the United States will be a highly visible reminder of the repository and its risks. Funneling of these shipments through or near Las Vegas may build nuclear associations with that city to a far greater extent than do the secret, contained underground explosions at the test site. People may also be more tolerant and positive in their reaction to a national

defense imperative than they will be to a "dump". After all, the attributes of patriotism, strength, and independence are all considerably more positive than the characteristics of a "dump" as the repository is commonly known.

It may also be the case that the synergy between the two facilities turns out to be important. Little is known about the dynamics of the process by which stereotypes are formed. It must be the case, however, that individuals have a large number of weakly associated images of a place. There would seem to be, therefore, some threshold of repetition that moves an image from the periphery into the core stereotype of a place. It follows, that Nevada's existing experience with the NTS may greatly increase its potential for stigmatization from the repository relative to a state with no existing base of nuclear imagery.

Occasional repository-related events may produce some behavioral response, but will the consequences be transitory or permanent? Experience with major risk events has shown the potential for large short-term response, but frequently, the response has been transitory. What is really known about the duration of response that would accompany a high-level nuclear waste repository?

It is important to acknowledge that to trace out the dynamics of behavioral response over time is an extraordinarily speculative task. It is useful, nevertheless, to distinguish the two basic kinds of stimuli emanating from the repository. First, there are the multitude of discrete events that are associated with the project. Second, there is the cumulative experience with the project at any given time which reflects the characteristics of the project plus the cumulative experience of all project-related events. It is reasonable to suppose that an isolated, once-and-for-all, event will generate a transitory response. It is also reasonable, however, to expect that the imagery of Nevada and Las Vegas held by the general population will reflect their cumulative experience with the repository program. Every one of the multitude of discrete events that might accompany the program, therefore, would have the potential for two kinds of consequences -- immediate response to the event itself, the duration of which would be related to the nature of the event; and response to the cumulative image of the repository to which this event makes a contribution on the margin. Just as this imagery will take time to develop, it will also be lasting. In fact, to the extent that strong nuclear imagery became associated with the repository, the host state or major communities along waste transportation routes, the stigmatization could be very long term, if not permanent.

2.4.3 Summary

Although this research has clarified the mechanisms by which adverse economic impacts can be generated, predicting the precise magnitude and duration of these impacts is impossible. The uncertainties involved in repository development make it inevitable that the actual impacts -- physical, biological, social, and economic -- will differ from the best of impact projections. There are at least four categories of uncertainty. First, the DOE plans are still largely unspecified on crucial matters; for example, it is impossible to know at this time whether waste shipments will be made by truck or rail, over which

routes, and with what frequency or safeguards. Second, the policies to be followed by state and local governments are largely unknown, and they could have a powerful influence on impacts. Third, there will continue to be external perturbations and surprises that may cause the repository development to differ from anything that can be foreseen at this time. Fourth, economically relevant decisions are always made in the context of alternatives; quantitative prediction requires currently unavailable knowledge of the alternatives individuals and society will have available in the future.

In sum, the analyses undertaken to date indicate that the development of the Yucca Mountain repository represents, in effect, a gamble for Nevada's future economy. The nature of that gamble cannot be specified precisely, but it appears to include credible possibilities (with unknown probabilities) of losses to the visitor economy, the migrant economy, and the business economy. These losses could be negligible or they could be large. The nature of the Nevada economic structure makes it uniquely vulnerable to these risk-related impacts. As pointed out at the beginning of this chapter, this situation can best be described as a state of uncertainty, rather than a state of risk. Risk situations are much more easily managed because they involve known probabilities and known consequences that can be addressed in mitigation programs. Uncertainty involves a lack of knowledge about both probabilities and consequences and consequently is less amenable to mitigation planning approaches.

Ongoing research will continue to probe the potential for risk-induced effects. Emphasis will be placed on better understanding the relationship of stated intention to actual behavior. The imagery work will be expanded to include a representative national sample. The process of image formation will be studied to try to better understand the current place of things nuclear in the imagery associated with Nevada and to anticipate how that might change in the future. Attempts will be made to understand the temporal dimension of risk-induced effects. Under what conditions will they be lasting? Under what conditions will they be transitory?

The households interviewed in the Phoenix image studies also will be recontacted to see if the imagery they held of cities and states was predictive of the actual behavior they demonstrated subsequent to the first interview.

Finally, a thorough search will be made of the marketing literature to see what empirical evidence has accumulated on the subject of the key relationship between image and consumer behavior.

As this work proceeds, however, uncertainty will continue to be a dominant theme. Therefore, the research also will work toward the development of risk management strategies that are generally perceived to be trustworthy, effective, and fair. Development of these strategies will require, nevertheless, as clear an understanding as possible of the important relationships between a repository, risk perception, and behavior.

3.0 Study Area Socioeconomic Conditions, Repository Program Responses, and Impacts to Date

3.1 Introduction

3.1.1 Purpose and Organization

Chapter 3 provides summary information on three topics that are essential to understanding the socioeconomic effects of the Yucca Mountain repository project. First, a description of the background and conditions of the communities, the Southern Nevada region, and the state is included. These descriptions define the contexts in which the repository-related effects and impacts have already taken place, and provide the basis for developing descriptions of future conditions. Second, this chapter summarizes the wide range of responses to the Yucca Mountain repository project that have taken place to date. These responses by officials, agencies, jurisdictions, and communities have attempted to change or modify the effects and impacts of the proposed repository program. Third, the chapter reports on data collected to date and on the current study team findings about the impacts that have occurred to date. This report provides a summary of the available information within the confines of a research program that is in progress.

More detailed descriptions of the research are available in the background reports already completed or forthcoming. Some of these forthcoming reports are scheduled as part of the basic research planned for the 1989 to 1990 fiscal year. Those reports and documentations that will be completed prior to June 30, 1989 are referenced in the text and cited in the bibliography. The background reports provide information on the conceptual design of the research, methods used, data collection procedures, analytic techniques, and findings.

The findings about employment, population, and fiscal conditions are contained in Section 3.2. The governmental responses and impacts are in Section 3.3, while Section 3.4 contains the community discussions and findings. Section 3.5 provides a brief summary of the chapter.

3.1.2 Nevada Overview

Geographically, Nevada is one of the largest states in the United States (ranked 7th of 50) and contains a wide variety of topographical and climatic conditions. On the whole, however, only relatively small areas are suitable for agriculture or the maintenance of dense populations. Large areas remain sparsely populated or uninhabited, and approximately 87 percent of the state's land area is controlled by the federal government. Native Americans, the Western Shoshone and the Southern Paiutes, have lived in the Nevada region for countless generations. In the nineteenth century, the first ranches and Mormon missions were established in the Las Vegas area, but development began in

earnest around 1905 with the construction of what is now the Union Pacific mainline between Salt Lake City and Los Angeles. When the mining booms came to Southern Nevada, Las Vegas was an economic center for those activities. However, that early boom was exhausted by 1918 and eventually the railroad between Las Vegas and Beatty was dismantled.

In 1926, the city became a refueling stop for Los Angeles-based flights of Western Air Express. Soon after, the highway (U.S. 91) was opened connecting Las Vegas to Salt Lake City. By 1930 when the Great Depression was well under way, the city had grown to over 5,000 people. Despite the depression, the 1930s brought continued growth to the Las Vegas area. The federal government began Hoover Dam, a massive project that employed thousands of workers during the period 1931-1936. Boulder City was established as a town owned and run by the federal government. Las Vegas benefited from both the materials shipments for the construction of the dam and the workers who were drawn to the area. Gambling, which was legalized again in 1931, and drinking in the speakeasies, as Prohibition was nearly ignored in the state, were attractions of Las Vegas.

Although the economy declined with the completion of Hoover Dam, other events soon brought development to the area again. In 1939, California began a major crackdown on gambling and Las Vegas benefited from the new market. By the 1940 Census, Las Vegas had grown to 8,422 people. Then in 1940, the federal government began what is now Nellis Air Force Base. By 1945, the base employed almost 13,000 people. In addition, defense-related plants were located in the area, such as Basic Magnesium which marked the beginning of the present town of Henderson.

Following World War II, there was increased development in the hotel/casino industry. The first hotels, motels, and casinos were located on the "Strip" outside the Las Vegas city limits in Clark County. The area's potential as a gaming and entertainment center was being established. By 1950, Las Vegas had achieved a population of over 24,000 and North Las Vegas, Henderson, and Boulder City accounted for 13,000 more people.

The government again turned to Nevada as a location for an important federal facility in the 1950s. The Nuclear Test Site was established and brought additional employment and purchases to the area. Nellis Air Force Base expanded during the Korean War.

The tourist and visitor sectors of the economy, however, continued as the dominant influence on growth. The 1960 Census recorded Clark County as having 127,000 people, almost 45 percent of the state's population, up from less than 15 percent in 1940. By the time of the 1970 Census, the county, with most of its population in the Las Vegas metropolitan area, was the state's major population center with more than 55 percent of the total state population (488,738) and was competing with the established northern interests and Carson City for influence in the state government. By 1988, Clark County had grown to about 660,000 people and contained almost two-thirds of the state population.

The Las Vegas metro area, currently Nevada's major center of population and employment, is significantly different from most other urban areas. The visitor economy dominates. Hotel, casinos, restaurants, shops, convention facilities, transportation, and development all cater to the tourist. Entertainment is available 24 hours a day, every day of the year. Downtown Las Vegas and the Strip are a blaze of light at all hours -- the desert sun during the day and flashing bulbs and neon after dark. The city skyline is dominated by the giant hotel/casinos. The Las Vegas Hilton is reported to be the world's largest at almost 3,300 rooms and new hotel-casinos are under construction that will be bigger yet.

Although there have been major efforts since the early 1980s by the State of Nevada and local jurisdictions, as well as by private groups, to diversify the economy, the visitor/tourist sectors are clearly dominant and seem to be increasing their share of jobs, contributions to income, and state and local revenues. This is especially the case for Clark County and the Las Vegas urban area. For the county as a whole, the employment base in 1988 was about 305,000 jobs, of which 95,000 were hotel and gaming employees and more than 17.2 million visitors spent about $9.9 billion dollars (Las Vegas Perspective, 1989). Las Vegas is dependent upon one economic sector, and this is one that is uniquely responsive to the image of the city as an exciting, entertaining, and attractive place to visit.

An economy dominated by the casino/hotel industry and in operation virtually 24 hours a day, seven days a week also produces jobs, work force hours, and resulting traffic patterns that are quite unlike other cities. Las Vegas exhibits high levels of in-and out-migration; 36 percent of the people have lived there less than 5 years (based on data from U.S. Census, 1980). There is an unusually high proportion of apartments and other forms of multi-family housing with about 40 percent of the metropolitan area's housing stock listed as multi-family. A considerable amount of the urban and suburban development has taken place in the county as well as within the boundaries of the cities, Las Vegas, Henderson, and North Las Vegas. Regional government is only partly supplied by the county and no formal association of local governments exists.

Rural communities in Southern Nevada vary considerably in character, differing from each other and also from the stereotypes that many people have based upon a typical Midwestern rural community. Most of these small Nevada towns are not agriculturally based and they exist at great distances from each other. Many of them have experienced a good deal of instability due to the boom and bust phenomenon of resource development. Beatty in Nye County is currently in a mining boom phase whereas Pahrump's growth is fueled by real estate sales and development. Located geographically between these two is Amargosa Valley, still shaking off the effects of the American Borax Company mine and mill operation shutdown which took place in 1986. Esmeralda County, also dependent upon mining, doubled its population over the period 1980 to 1984. The county seat of Goldfield once had as many as 30,000 residents (1908) compared to its present estimated population of about 400. Caliente in Lincoln County had a long decline due to the loss of railroad employment, but recently has experienced increases in population apparently due partly to retiree inmigration. Indian Springs in

Clark County near the Nye County border, experiences cyclical growth and stagnation due to adjustments in federal employment at the local Air Force facility.

3.2 Repository-Related Employment, Population, and Fiscal Impacts

The primary work done on the proposed high-level radioactive waste program in Nevada to date has been administrative, including engineering and scientific studies to address the many areas of project permitting and licensing. Some site studies have been conducted over the past ten years but these have been relatively modest efforts, and a significant portion of the technical analysis and evaluation has been done outside Nevada under contract to the national laboratories and other government agencies such as the U.S. Geological Survey. The Nevada-based staff of DOE and its contractors has been fairly small especially compared to the projected future jobs for the repository program and the regional employment/population bases.

The nuclear waste management budget for U.S. DOE/Nevada increased from $67 million in FY 1985 to $187 million in FY 1989, averaging $124 million over the five-year period (PIC, 1988e). About 53 percent of these amounts were allocated to Nevada contractors of DOE, while the remainder was allocated to national laboratories, program direction, and the purchase of equipment and construction (engineering) services. Costs of equipment and construction services increased from 2.5 percent in FY 1987 to 7.6 percent in FY 1989.

Some site studies have been conducted but these have required very limited on-site work efforts. In general, while the project has had significant effects on the political and governmental activities of the state and local jurisdictions, its "people effects" to date have been limited, especially in comparison with the projected work force associated with full site characterization, construction, and operation.

These potential effects could result in significant impacts for a number of Southern Nevada jurisdictions. In order to understand the nature and scope of these potential "standard" impacts, the following characteristics of the project have to be analyzed:

- Direct basic employment -- the number of jobs and personnel assigned to the project by DOE and its contractors;

- Indirect basic employment -- the number of jobs created by the purchases of materials, supplies, equipment, services, and other items (e.g., rent, utilities, employee training, travel, etc.) required to support the program effort in Nevada;

- Induced nonbasic employment -- the number of jobs that are created by the spending of basic employees in the local economy. These jobs are most likely to be in the areas of retail trade, personal, professional, and government services, etc.;

- The wages and salaries of the direct basic and the indirect basic employees;

- Factors which will influence the residential location of workers from each group (direct basic, indirect basic, and nonbasic);

- The household characteristics of each group, including the household size, and age composition (e.g., school age population);

- The per-unit cost of providing governmental services to the households and populations associated with the project, including appropriate service levels for each jurisdiction;

- The revenues contributed by the population associated with the project, and the distribution of those revenues to jurisdictions where the demand for services is required; and

- Project management policies that could affect any of the above factors.

The purpose of collecting these data is to provide a causal link between the effects of the project and the eventual cost/benefits in the community. The strength of the attribution of positive or negative impacts depends upon the ability to make these links with some degree of confidence.

Given the complex nature of the social and economic interactions involved in contemporary society, impact assessment processes must make a number of detailed assumptions about each of the areas of information listed above. In the case of the Yucca Mountain project, very little monitoring data are available to provide detailed information for making those assumptions. DOE has not provided separate data on repository employment and due to their past accounting procedures an "educated guess" may be the only approximation of these figures that is possible. Based upon an evaluation of available data and informal conversations with DOE personnel during the course of collecting data for the NTS study, the study team believes that average annual employment in the Las Vegas urban area was somewhat over 400 in 1986, about 500 in 1987, and over 700 in 1988. These jobs are mostly involved with planning, management, administration, and a limited amount of technical work; employees are DOE and other federal personnel (such as people from the national labs) and workers with DOE contractors. Detailed information on the wages, job location and residency, and household characteristics of the basic employees is not available. Nor is there any adequate description of purchases of materials, supplies, services, and other items needed to completely define the DOE efforts in Southern Nevada.

For these reasons, rough assumptions are needed to estimate the "standard" employment, demographic and fiscal impacts during the three-year period, 1986 through

1988, which covers the site characterization phase to the end of the most recent calendar year. The following essential assumptions have been made:

- Direct basic employment in Southern Nevada was (as indicated above) 400 in 1986, 500 in 1987, and 700 in 1988.
- DOE budgeted equipment/construction for materials purchases were analyzed to estimate a portion of the indirect basic employment.
- Other indirect basic costs were estimated at 15 percent of direct basic labor costs and half of these expenditures are for labor.
- Induced nonbasic employment is estimated at 1.0 per direct and indirect basic employee, which was the ratio in Clark County in 1988.
- Household size is estimated at 2.15 per employee, which again was the ratio for Clark County in 1988.
- School age population also is based upon the current share for Clark County, 15 percent of the total population.
- Due to demand for workers, the low unemployment rate, and high levels of inmigration, jobs added by the project (either directly or by replacement of positions) result in new residents and households.
- Most of the employment and population impacts have occurred in Clark County, due to the nature of the repository activities to date. (During future periods, a major work location will be at Yucca Mountain, in Nye County. See Chapter 4, below, for estimates of projected impacts during these future periods.)
- The costs of providing governmental services to repository-related populations and households are the same as the costs of other households in Clark County and the State of Nevada during this period.
- Public service costs represent the existing types, levels, and costs of service but for this preliminary assessment they do not include costs to upgrade existing capital facilities or to provide such facilities to new populations.
- Revenues contributed by the repository-related population are based upon the types and amounts of revenues contributed by existing residents, excluding revenues contributed by the visitor population.
- Based upon an evaluation of each major revenue source, it is assumed that about one-third of local government revenues and about

half of state revenues (e.g., gaming taxes, sales taxes, cigarette and liquor taxes, jet fuel taxes, etc.) are paid by visitors.

- The direct revenue payments by DOE are negligible since as a federal agency they are exempt from most state and local taxes, and the indirect revenues such as ad valorem taxes by owners of properties leased to DOE and revenues from DOE contractors are quite small during this phase of the program development.

The information shown in Table 3-1 shows the estimated employment and population impacts for the period 1986 through 1988. The combined employment effect was somewhat less than 1,000 in 1986, around 1,200 for 1987, and over 1,700 in 1988. The current estimates of the relationship between jobs and population were applied to determine the net population effects. These population impacts were calculated at about 2,000 in 1986, 2,600 in 1987, and over 3,600 in 1988. No attempt was made to further allocate these jobs or populations within the urban area since the basis of the data collection and evaluation was not adequate for such levels of precision.

In regard to income generated by repository employment, an estimate has been made using the population figures above and the per capita income for Nevada which was $15,445 in 1986, $15,958 in 1987, and $17,681 in 1988. This leads to the conclusion that the repository program has had an impact on the income for the urban area of approximately $137.6 million over the period 1986 through 1988.

Table 3-1 also shows the estimated costs for public services by major service area for the three-year period, 1986 through 1988. These figures are the result of multiplying the per capita expenditures for these periods by the number of repository-related people and households estimated according to the assumptions outlined above.

In a similar manner, revenues are estimated based upon the per capita averages for residents of Clark County for the three-year period. These revenues take into account all state and local revenue sources for each of the service areas included in this demonstration.

Finally, the expenditure estimates are compared to the revenues and a fiscal balance for the repository-related population is calculated. This assessment suggests that the fiscal impact of the repository program during the three-year period, 1986 through 1988, was a negative $5.5 million. The repository-related population required about $14.0 million in expenditures and provided about $8.5 million in revenues. These fiscal impacts do not include the capital costs of providing state and local facilities.

One of the major reasons for these significant negative fiscal impacts is that the repository program makes very little contribution to the visitor/tourist economy, which is one of the major sources of state and local revenues. The dependence of Nevada state and local jurisdictions on revenue contributions of visitors is unique and results from the fiscal structure of the state. Other economic developments, private or public, that do not expand the contributions of visitor spending also will have negative fiscal

TABLE 3-1
ECONOMIC, DEMOGRAPHIC AND FISCAL IMPACTS
1986 - 1988

Estimated Employment, Population, and Income Impacts

	1986	1987	1988
Employment:			
Direct Basic	400	500	700
Indirect Basic	68	108	157
Induced Nonbasic	468	608	857
TOTAL	936	1,216	1,714
Population	2,004	2,602	3,669
Income:			
Average Per Capita ($ 000)	15.5	16.0	17.7
TOTAL ($ Millions)	31.1	41.6	64.9

Estimated Fiscal Impacts: 1986-1988
State and Local Government Operations
(thousands of 1987-88 $)

	Expenditures	Revenues	Fiscal Impacts
Government Operations:			
Municipal	2,803	1,850	(953)
County	1,225	808	(417)
School	5,704	3,764	(1,940)
Local Subtotal	9,732	6,422	(3,310)
State	4,283	2,049	(2,234)
TOTAL	14,015	8,471	(5,544)

Source: Planning Information Corporation and Mountain West, 1989.

impacts. The result is that, under current tax laws, the repository-related population costs the state and local governments more for providing public services than they provide in revenues, and that difference is about $670 per person, per year. Since public expenditures per person were provided for repository-related population in excess of the revenues that these people provided, the level of services to the existing population was reduced by the amount of the negative impact. This means that in the absence of other direct or indirect revenue payments by DOE and its contractors, either in the form of taxes, payments in lieu of taxes, or other payments for mitigation or compensation, the repository program will consistently produce significant negative fiscal impacts. These impacts will, in turn, mean that a lower level of public services will be provided to other residents in order to cover the costs of repository-related households.

3.3 Governmental Context, Responses, and Impacts

The major public sector impacts to date have resulted from the Congressional mandates which established the repository program (NWPA, 1982) as amended by the NWPAA (1987) and the Congressional appropriations for FY 1989. The roles and responsibilities of the state and local governments, intergovernmental relations, and governmental structures have changed during this six-year period. These organizational changes, along with the political issues and the policy implications for all levels of state and local government, constitute one of the major areas of impact resulting from the repository program to date. New agencies have been formed, offices created and filled, working groups and committees have been established, and intergovernmental relations within the state have been affected.

There are two major sources for potential impacts to state and local governments, those resulting from legal mandates and those generated by service demands. The mandate causes of impacts are created through legislative, administrative, or judicial actions that require specified or implied responses by government agencies. Service demands can be traced to economic-demographic sources. Both sources for potential effects must be considered in the case of the Yucca Mountain program in order to adequately assess the full range of potential impacts (Mushkatel, Atkinson, and PIC, 1987).

3.3.1 Governmental Responses to the NWPA and NWPAA

Policies, positions, and other responses to the repository program by key governmental units within Nevada derive from the differing roles, responsibilities, stakes, and perceptions of each of the actors involved. Uncertainties in the repository program create a situation where many plausible outcomes can be constructed by the people required to plan for and respond to the program. Public officials in Nevada also must represent the citizens of the state and in some cases specific constituency groups. When, as is the case in Nevada, there is substantial citizen opposition to a program that Congress has mandated, this creates a conflict situation for public officials. The size, scope, and nature of the project, and the importance placed upon the repository by

actors within and outside of the state, have created a climate that engenders classical political conflict between those who see the potential for positive economic benefits and those who see the potential for adverse health effects and other economic costs. In addition, DOE has a strong and long-established position within Nevada. At the same time, the national nuclear industry has financed the Nevada Nuclear Waste Study Committee as an active repository-issue entity. The combination of all these factors contribute to the context in which the institutional responses and impacts to date have been produced.

3.3.1.1 The State of Nevada

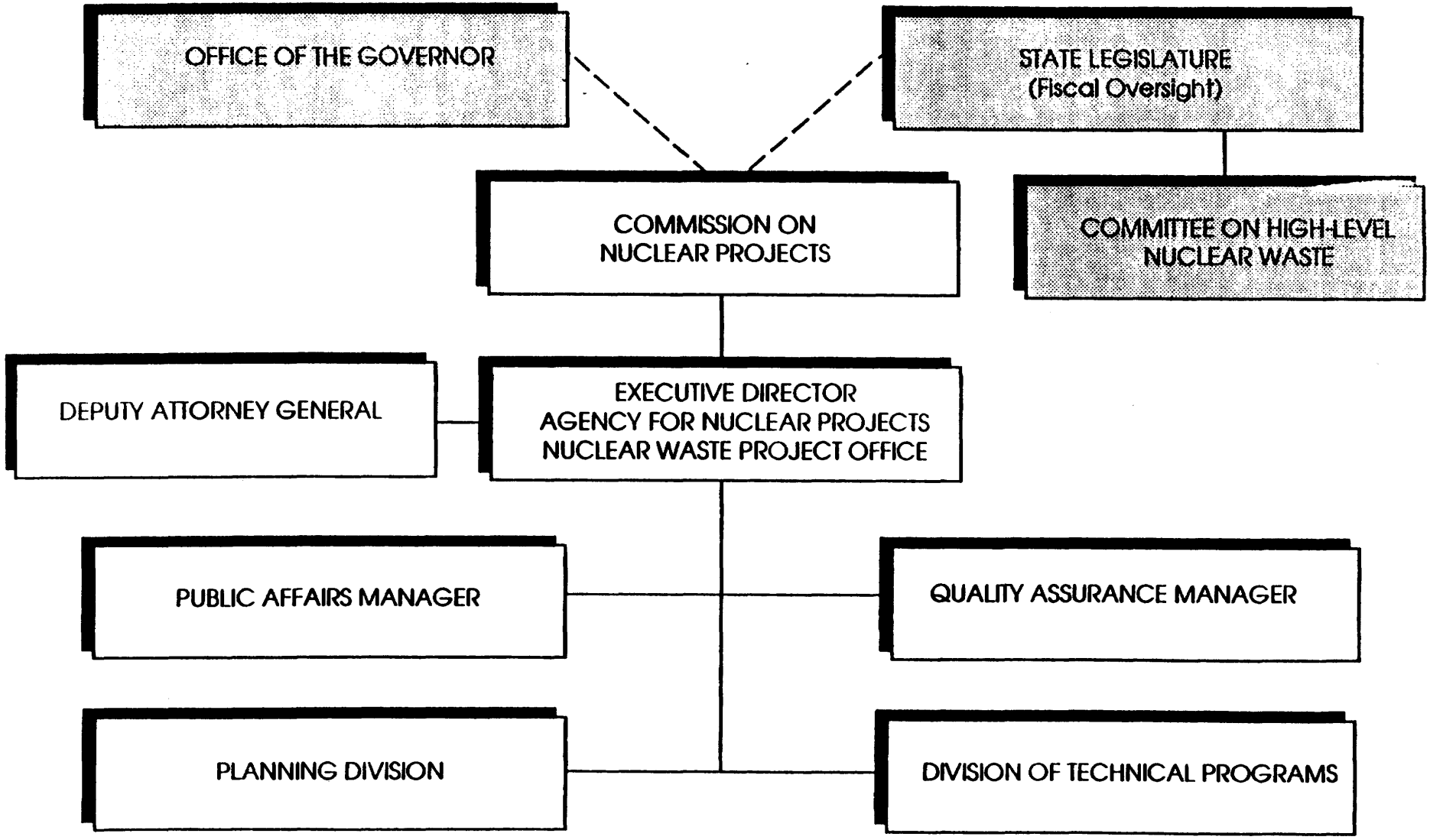
The unique characteristics of the high-level waste repository program required the implementation of new programs and the creation of new structures in order for the State of Nevada to carry out its responsibilities. The Nuclear Waste Project Office (NWPO) was formed in 1983 within the Office of the Governor under temporary authority of NRS 223.210. It was the governor's intention to establish the ability of the state to conduct oversight and research in response to the Nuclear Waste Policy Act of 1982 and the subsequent decision that Nevada would be a candidate site. The office also was charged with assisting officials in determining the state's policy on repository-related issues.

Another organization, the State and Local Government Planning Group (SLGPG) was created in order to coordinate the positions of both the state and local governments within Nevada. The SLGPG has come to include representatives of the NWPO; the counties of Nye, Clark, Lincoln, and Esmeralda; the local cities of Henderson, Las Vegas, North Las Vegas, and Caliente; the Western Shoshone and Moapa Indian Tribes; and the Legislative Counsel Bureau. The SLGPG has had a key advisory role in the NWPO research program which has focused on such subjects as socioeconomics, transportation, tectonics, hydrology, and seismology.

The Legislative Study Committee on High-Level Radioactive Waste, which was established as an interim study committee by the 1983 legislature, was made a permanent committee and expanded to seven members during the 1985 legislative session. This committee is responsible for legislative oversight of repository issues. Also during the 1985 session, the legislature established the Commission on Nuclear Projects and the Agency for Nuclear Projects. The Agency for Nuclear Projects incorporated the NWPO within a structure which provided the agency with its entire staff (see Figure 3-1).

The repository issue has been a major news item in the State of Nevada. Therefore the statements, decisions, and actions of public officials regarding this issue are given intense scrutiny. It was a major issue in the 1988 Senate contest in which the incumbent was defeated by the Governor of Nevada who had been a staunch and vocal opponent of the repository project. The State of Nevada's four-person Congressional delegation, which does not have the tenure or seniority of earlier years (the Representatives are beginning their second and fourth terms and both Senators are in their first terms), has had to contend with vocal criticism of their positions and efficacy from interest groups both for and against the repository proposal.

FIGURE 3 - 1
STATE OF NEVADA AGENCY FOR NUCLEAR PROJECTS
ORGANIZATIONAL CHART



Source: Nevada Nuclear Waste Project Office; Mountain West, 1988

The media visibility of repository issues, differing evaluations of repository effects by competing interest groups, and the political stakes involved, combined to prevent the Nevada Legislature from taking an official position on the repository for several sessions. In 1983, 1985, and 1987, resolutions opposing the repository died in committee without being voted upon by the state senate. Recently, in April, 1989, the state legislature established its position when two resolutions in opposition to the repository were passed.

The legislature also had to confront other ramifications of the proposed repository. For example, neither the legislature nor the local governments could reach agreement on the Grants Equal To Taxes (GETT) issue. Section 116(c)(3) of the NWPA authorizes the state and local government(s) within which a site for a repository has been identified for "characterization" (formal testing and evaluation as specified in the law) to receive grants through DOE as trustee of the Nuclear Waste Fund in the amount equal to that which these jurisdictions would have received if they were able to tax the repository project in the same manner as they would tax other industrial activities. The Nevada Assembly during the 1987 legislative session created Bullfrog County (S.B. 595) in an effort to capture the revenue generated by the proposed repository and to place the responsibility for its distribution in the hands of the state.

The Bullfrog County legislation was quite unusual. It carved out a 144 square-mile piece of land from Nye County encompassing the Yucca Mountain repository site. Bullfrog County had neither towns nor residents, so Carson City was designated as the county seat. The governor was authorized to appoint people from outside the county as the county commissioners and the other county officers. The bill allowed these appointed county commissioners to tax and regulate all industries, professions, and businesses in the county involved in high-level nuclear waste and its transportation. It further authorized a tax rate of up to $5 for every $100 of assessed value, the maximum allowed under the state's constitution and more than two and a half times higher than the current Nye County rate.

Although signed into law by the Governor, Bullfrog County was destined to be short-lived. The Nye County Board of Commissioners challenged the law as a piece of special interest legislation unlawful under the Nevada constitution. Bullfrog County was declared unconstitutional less than a year after it was created. This activity was directly related to the repository; it resulted in costs to both Nye County and the state (see Section 3.3.3 for fiscal impacts) and had effects on intergovernmental relations between Nye County and the state and between Nye County and other counties which might have received revenues from the repository through a state-taxing procedure.

The Nevada Attorney General's Office has significant responsibilities in response to the NWPA. First, the office must assure that the rights and responsibilities of the Nevada public are protected in regard to the repository program. Second, it must interpret and clarify the mandates from Congressional actions in relation to other federal laws and to other constitutional responsibilities for state and local officials. Third, the Attorney General's Office has found it necessary to initiate legal actions to determine if key DOE interpretations of their mandates are accurate and properly implemented.

By the end of 1987, the State of Nevada had initiated or joined in a number of lawsuits which were pending against the federal government over issues related to the proposed repository. The Nevada Attorney General is actively pursuing the following major cases (Swainston, 1989):

1. Nevada v. Herrington (No. 85-7308) challenges the validity of DOE's guidelines for siting and evaluating nuclear waste repositories. The State contends that the guidelines promulgated by DOE in 1984 do not conform to the NWPA.

2. Nevada et al. v. Herrington (No. 86-7308) asserts that, prior to characterizing the Yucca Mountain site, DOE must withdraw land for the site pursuant to the Federal Land Policy and Management Act and obtain appropriate cession of land from the Nevada Legislature.

3. Nevada v. Burford (CV-S-88-203PMP) challenges the legality of the "right-of-way reservation" awarded to DOE by the Bureau of Land Management (BLM) in order to allow DOE to begin site characterization studies at the site. This case was dismissed on January 27, 1989 and the State filed a notice of appeal. The State wanted to present a full trial record concerning impacts and potential damage to the economy and environment that a repository would cause.

4. Nevada et al. v. Herrington (No. 86-7309) challenges the conformance of DOE's Environmental Assessment to the provisions of the NWPA. DOE has filed a motion to dismiss and Nevada has filed a brief in opposition of dismissal.

In addition to the cases above, Nevada v. Herrington (No. 86-7307) challenging the procedures used by DOE in selecting sites for characterization was voluntarily withdrawn by the State. In Nevada ex rel. Loux v. Herrington, the Ninth Circuit Court of Appeals agreed with the State that DOE had arbitrarily limited funds for the State's oversight and monitoring functions. However, the Congress, through its FY 1989 Appropriations Act set the State's grant at a reduced level thereby limiting the effect of the court victory. The Ninth Circuit Court ruled against the State in Nevada v. Herrington, 1987 (827 F.2d 1394) holding that judicial review of DOE actions is not specified in the NWPA as an activity eligible for reimbursement using Nuclear Waste Funds. This strict interpretation of the statute meant that the State -- and affected local governments -- must bear the costs associated with necessary judicial action and litigation.

Recently, the Nevada Attorney General issued an opinion regarding possible effects of various actions on the part of the state and local units of government. It concluded that the litigation position of the State of Nevada may be compromised "by a level of consensual involvement in the repository siting program by the state or its

instrumentalities and an acceptance of benefits arising from the program which may be tantamount to an implied or tacit consent" (Swainston, 1988).

3.3.1.2 Tribal Government

Native American tribal governments, whether specifically established under the Indian Reorganization Act of 1934 or by other means, are independent governing bodies. They derive their rights to govern their people and reserved lands by aboriginal status, as well as by treaties, and a complex body of case law, agreements, and precedents (Cohen, 1982). Reservations and colonies are thus separate self-governing trust properties within larger non-federal jurisdictions. The Nuclear Waste Policy Act of 1982 recognizes the unique status of federally recognized tribes and gives them a voice in decision-making with respect to siting and construction of waste repositories parallel to that of states (NWPA, Sec. 118).

The NWPA gives the highest authority in responding to the planned repository to "affected Indian tribe(s)." By definition in the Act (Sec 2), an affected Indian tribe is:

> any Indian tribe (A) within whose reservation boundaries a monitored retrievable storage facility, test and evaluation facility, or a repository for high-level radioactive waste or spent fuel is proposed to be located; (B) whose federally defined possessory or usage rights to other lands outside of the reservation's boundaries arising out of congressionally ratified treaties may be substantially and adversely affected by the locating of such a facility.

The status of "affected Indian tribe" may be granted by the Secretary of Interior (DOI) upon review of the two criteria noted above. No tribes in Nevada have been so designated despite the proximity to the repository site of the Moapa Band of Paiutes, the Las Vegas Paiute Tribe, the Timbi-Sha Shoshone Tribe, the Yomba Shoshone Tribe, and the Duckwater Shoshone Tribe. At a greater distance are several groups whose broader cultural affiliations (Southern Paiute or Western Shoshone) might allow them to qualify, such as the several reservations and communities now federally recognized as the Paiute Tribe of Utah, the Kaibab Paiute Tribe of Arizona, and the Chemehuevi Tribe of California. Western Shoshone people in Owens Valley, California, as well as Owens Valley Paiute people on reservations in that area also might qualify. Although not specifically covered by the Act, the transportation of nuclear waste potentially affects many other tribes in Nevada, California, Utah, Arizona, etc. Potential impacts also might affect urban and rural Indian residents not now living on reserved lands or having federally recognized status: e.g., in Las Vegas, Pahrump, Beatty, Tonopah, and Caliente.

To date, two Nevada tribes, the Las Vegas Paiute Tribe and the Moapa Band of Paiutes have each sent letters requesting "affected Indian tribe" status to DOI. Based on an apparently strict interpretation of the NWPA criteria, these applications were denied. The proposed site is not technically on reservation lands, nor does DOI recognize a ratified treaty covering the site. In its 1986 EA, DOE seems to take the position that these tribes, as well as others, are too far from the site to be affected by worker

inmigration and other direct impacts. DOE further suggests that issues related to the transportation of waste over these and other tribal lands will be addressed later (DOE 1986c, 7-42).

Although the various Shoshone tribes in close proximity to Yucca Mountain have not filed for a reconsideration of the affected tribal status designation, owing in part to a complex set of issues related to tribal sovereignty, they do have a ratified treaty that covers the Yucca Mountain site. This is the Treaty of Ruby Valley, negotiated in 1863 and ratified in 1866 (Kappler, 1904). This treaty deals largely with matters of "peace and friendship," and does not relinquish to the U.S. government title to Western Shoshone lands. Through a complicated series of court cases in recent years, including a U.S. Supreme Court decision rendered on February 20, 1985 ((105) S.Ct. 1058-1065), some have argued that Western Shoshone claims to lands under the Treaty were nullified by the awarding of a judgement to the Western Shoshone by the Indian Claims Commission in 1979. Others (see for example, State of Nevada v. Nancy E. Heiner, Doc. 11-2855A -Trespass Cit. 96361A) have argued against this position.

The Western Shoshone National Council, a body that represents the three affiliate Shoshone tribes in the immediate Yucca Mountain area as well as others, also defends its treaty rights, and with its affiliate members has refused the Claims Case payment. The Council considers the takeover of Western Shoshone lands by the federal government after 1940 for military uses including the NTS, as well as the proposed use of Western Shoshone lands for siting the high-level waste repository as willful acts of trespass (Cultural Survival Quarterly, 1987). In the Council's view, until the larger issue of Western Shoshone title to the lands is settled, site characterization should not continue. Although DOE has not specifically addressed this issue in its 1986 EA, in recent actions related to the discovery of a Native American burial on the NTS (to which DOE responded based on the American Indian Religious Freedom Act), DOE seems to argue for the interpretation that the Ruby Valley treaty no longer applies (Reno Gazette-Journal, Oct. 22, 1988). Given the issues involved, all tribes will undoubtedly continue to push their positions, whether or not it is through the specific provisions of the NWPA or NWPAA. A number of other federal laws, including the National Environmental Protection Act, the National Historic Preservation Act, and the American Indian Religious Freedom Act do apply to the conduct of large, federal projects (see 3.4.3).

3.3.1.3 Local Government

The unique nature and characteristics of the repository program also have caused changes in the governmental structure and response in local areas. These repository responses have not been limited to the governments within the counties which DOE officially recognizes as "affected" (presently Nye, Clark, and Lincoln; although all 6 counties contiguous to Nye may be eligible) nor to our study area of Nye, Clark, Lincoln, and Esmeralda counties. Because of the elements of risk and uncertainty in the repository program and the far-reaching effects of transportation of high-level radioactive waste to the Yucca Mountain site, the repository program has the potential to produce state and local governmental responses nationwide.

This section provides a brief overview of governmental responses at the county level with reference to key activities by local cities and towns. In section 3.4, below, additional community level responses are discussed.

Clark County

Governmental response in Clark County closely paralleled that of the state. Formal resolutions of opposition to the repository were passed by Clark County and the City of Las Vegas. Henderson and Boulder City passed resolutions requesting guarantees of safety concerning any transport of nuclear materials through their communities. North Las Vegas passed a resolution opposing the transport of high-level radioactive waste through their jurisdiction. Formal public positions taken by elected officials in Clark County have been staunchly anti-repository.

Local government officials and residents of Clark County were appointed to the Nevada Commission on Nuclear Projects. The NWPO's State and Local Government Planning Group (SLGPG) has representation from Clark County and from the local cities of Las Vegas, North Las Vegas, and Henderson. Each of these governments has appointed staff to monitor work and represent them in issues concerning the repository. Funding for this participation was provided by the NWPO, however, in April, 1988, DOE approved Clark County's petition for status as an affected unit of local government. Therefore, beginning in July, 1988, Clark County obtained separate funding as an affected local government. The cities are still funded by the NWPO. Boulder City was invited to participate but is not currently doing so. Some residents of Mesquite (which became an incorporated city after the formation of the SLGPG) and Indian Springs in Clark County feel that they ought to have more direct representation in considering repository-related matters (Krannich and Little, 1987e; Endter, Little, and Krannich, 1988c).

Nye County

The local government response in Nye County differs in several respects from the position of the state and the response of Clark County in regard to the repository. Public officials in Nye County believe that their county will be impacted to a much greater degree than other jurisdictions in the state by virtue of being the "situs" county. However, the fiscal problems faced by the county as a whole, and the strong need for economic development in the surrounding small rural communities helps foster the perception that the repository project could be a much needed economic shot-in-the-arm. Job-related economic benefits and the potential for increased county tax revenues are emphasized, while the risks tend to be downplayed, particularly in light of the fact that these communities have existed for years in close proximity to the Nuclear Test Site (Krannich and Little, 1988).

Nye County has always been active in the state's repository oversight program and is represented on the NWPO's State and Local Government Planning Group. Nye County has adopted and maintained an independent, and pragmatic stance toward the repository. The county position has been to become as fully informed as possible and

to carefully weigh the pros and cons of the project before committing itself to either fully supporting or fully opposing the Yucca Mountain program. As a consequence, no resolutions either for or against the repository have been passed by any of its units of government. Instead the county has endeavored to keep good working relations with the state and DOE, and to maintain a strong presence in Congress. The county has a representative in Washington, D.C. and this office maintains contact with key Congressional staff as well as with federal agencies relative to the repository program.

There has been a history of tensions between Nye County and urban Clark County. Many rural residents think that the needs of the urban areas receive disproportionate attention from the state in comparison to the needs of rural areas. In Nye County, one example often cited is the Governor's allocation of the fees from the low-level waste repository at Beatty to fund statewide economic development. This is seen as benefiting Clark County with funds from a hazardous waste site in Nye. Many people in Nye County expect that urban interests in the state will attempt to distribute the potential economic or fiscal benefits from the high-level repository in a similar way (Little and Krannich, 1987a, 1987b, 1987c, 1987d; Trend, Little, and Krannich, 1988a, 1988b, 1988c).

The GETT issue has had, and will continue to have, important impacts on Nye County and intergovernmental relations. The maximization of GETT revenues and their subsequent distribution have become divisive issues between Nye County and other political jurisdictions and spilled over into the policy arena when the state legislature attempted to form Bullfrog County. The county's response to this legislation involved considerable expense in terms of technical and administrative personnel and other resources of which the legal costs alone exceeded $17,000 (personal communication from Nye County Assistant Attorney to Mountain West, 1988).

Prior to July 1, 1988, the Nye County repository program had been funded through the NWPO. These funds were used to support personnel and operating costs for the county's repository program, travel to various meetings, site visits, and limited research activities such as base mapping and the Nye County oral history project. With the passage of the NWPAA in 1987, Nye County as the situs county became an affected local government. Subsequently, Nye County applied for a grant through DOE as trustee of the Nuclear Waste Fund (approximately $1.0 million) for a work program that would continue county involvement in oversight of the project, analysis of the potential for economic development related to Yucca Mountain, and development of basic databases for economic and public service use. As of the writing of this report, about one-third of the grant amount has been approved and discussions are being held between Nye County and the DOE to resolve questions about the remaining portion.

Lincoln County

Lincoln County responses to repository issues have been strongly influenced by the location of major transportation routes through the county, in particular, the location of the Union Pacific mainline through the City of Caliente.

Lincoln County, like Nye County, is represented on the State and Local Government Planning Group by a consultant. The County conducts its repository program jointly with the City of Caliente under a memorandum of agreement which established the County/City Joint Impact Alleviation Committee. Membership on the committee includes individuals from throughout the county. In addition, three positions have been created to work on nuclear waste related issues.

The Joint City/County Impact Alleviation Committee drafted resolutions on the repository which were adopted by the Caliente City Council and the Lincoln County Commission on November 20, 1987 (Resolution No. 87/235 and 87-13, respectively). Without stating support or opposition to the repository, these resolutions note concerns about the potential impacts and admonish the federal and state governments to ensure that potential benefits from the repository accrue to the residents, businesses, and local units of government in the City of Caliente and Lincoln County. They also state the city's and county's intentions to achieve full participation in any negotiations over mitigation and compensation for the repository. Lincoln County was granted affected local government status by DOE in June of 1988 and began receiving direct funding through DOE in October, 1988. Prior to that time, the city and county received grant funds from the NWPO.

Esmeralda County

Esmeralda County responses to repository issues are partly dependent upon the existence of a potential high-level nuclear waste transportation route, U.S. 95, which passes through the county seat of Goldfield. This transportation route is essential to public and private activities within the county and represents the key to Goldfield's economic development and diversification.

Public officials, as well as many residents, are concerned with health, safety, and economic issues relating to the proposed repository program. These concerns center on the potential transportation impacts such as those that might result from a transportation accident.

The county is represented on the State and Local Government Planning Group and has applied to the DOE for "affected" local government status (August 19, 1988). This application was denied and the county requested a reconsideration which was also denied. Following these actions by DOE, the Esmeralda County Board of Commissioners requested the district attorney to file a petition for judicial review with the U.S. Ninth Circuit Court of Appeals. Despite DOE's denial of the application, the county has continued its participation in the SLGPG and data gathering for impact assessment in the coming year.

3.3.2 Organizational and Political Behavior and Intergovernmental Relations

The controversy surrounding the repository issue has constrained the positions taken by political parties. The Clark County Democratic party has adopted an anti-repository stand as part of its platform. However, the party left it to individual can-

didates to pursue the issue as they saw fit in their own campaigns (Titus, 1987). The Republican party has taken no formal position on the issue.

Other politically active organizations have responded to the repository issue as well. For example, some construction-related groups and labor unions have adopted positions in favor of the repository citing the potential employment benefits. Another organization favoring the repository proposal is the Nuclear Waste Study Committee which is partially funded by the nuclear power industry. This organization has an active public relations program and produces a newsletter, makes public presentations to interested groups, and generally attends public forums organized to discuss the repository issue (Titus, 1987).

Other economic interests have adopted cautious or non-committal positions regarding the repository. The tourism and gaming industry, clearly the dominant economic force in the state and Southern Nevada, has not taken a position on the repository issue. The Nevada Resorts Association, Convention Bureau, and Las Vegas Chamber of Commerce have been silent on the issue. No individual casino or hotel owner has formally announced a position. Besides the obvious controversy surrounding the repository issue, there may be other reasons for the silence of the tourist/gaming industry. If the images produced by the repository could negatively impact this sector of the economy, then publicizing such information might make the effects that much greater. The leaders of the tourist/gaming industry may feel that the most effective economic strategy, at least in the short term, is to generate as little controversy and publicity for the repository as possible (Titus, 1987).

There are several existing groups working in a coordinated effort to oppose the repository: Citizen Alert, Nevada Peace Test, Clergy and Laity Concerned, Nevada Desert Experience, and the Nevada Test Site Workers Association. Each of these groups has traditionally opposed DOE and nuclear materials operations of any kind in Nevada, in particular the NTS nuclear weapons programs. In a manner similar to the experience of Texas and Washington, a repository specific organization called Nevadans Against Nuclear Dumping has emerged and most recently was visible at the DOE Site Characterization hearings (Stewart, forthcoming).

In January 1988, the NWPO contracted with the Nevada Nuclear Waste Task Force (NNWTF), headquartered in Las Vegas, to provide information and promote public involvement in program decision-making at the state and federal level. The Task Force has been active in organizing educational workshops and forums and disseminating information. Its work represents one of the ways in which the NWPO is providing information to residents in the state.

Intergovernmental Relations Regarding the Repository

In the matter of Yucca Mountain, state/federal relations are complex with the DOE and Nevada state government fundamentally on opposite sides of the repository issue. The DOE's Yucca Mountain Project Office (YMPO), following its federal mandate, is moving to characterize the Yucca Mountain site. The state position on its

oversight responsibilities and its concerns about the technical and socioeconomic suitability of the Yucca Mountain program are quite different from the perspective taken by DOE in its program implementation to date and these divergences in state-federal positions have resulted in intergovernmental tension.

The state has less frequent interactions concerning the repository with the U.S. Department of Transportation, Nuclear Regulatory Commission (NRC), and the Environmental Protection Agency. Interactions with these federal agencies are geared solely to information exchange and data collection efforts. This current level of interaction also reflects the preliminary stage of the program. Additional interaction, especially with the U.S. Department of Transportation and the NRC would be expected if the Yucca Mountain site proceeded toward licensing, permitting, and operations.

A portion of the property designated for the Yucca Mountain repository is BLM land, and DOE needs BLM authorization in order to have access to the site. BLM agreed to an "administrative withdrawal" of Yucca Mountain lands which was accomplished without the consent of the Nevada legislature. As a consequence, the state has filed a lawsuit, seeking to nullify the "right-of-way reservation" granted to DOE to carry on site characterization activities (see Section 3.3.1.1 above).

Intergovernmental structures and regional authorities are underdeveloped in Nevada, which is especially noticeable in Clark County given the public sector demands on one of the nation's fastest growing urban areas. The history of governmental action in Southern Nevada is marked by considerable independence rather than intergovernmental cooperation (Herzik and Mushkatel, 1988). Regional decision-making and cooperation, when it does occur, is based more upon informal structures and lines of communication than formal ones.

Potential transportation impacts and risks from the repository program are primary concerns in Southern Nevada. There is a perception that the federal government may be willing to compensate the state with a substantial contribution to the Clark County infrastructure. Some of the current and projected traffic congestion could be alleviated by the construction of a beltway system around Las Vegas and there are people in Clark County (and elsewhere) who view such infrastructure improvements as appropriate compensation relative to the repository program, although such infrastructure contributions probably would be contrary to efforts to isolate transportation routes for high-level nuclear waste from the public (Herzik and Mushkatel, 1988). Others see acceptance of any such compensation as a form of implied consent for a project that has not been shown to be safe or without potentially significant negative economic impacts.

Major public sector actors with regard to highway transportation in Southern Nevada include the Nevada Department of Transportation (NDOT), the Clark County Regional Transportation Commission (RTC), the local governments that participate in the RTC, and the Department of Aviation which manages the county airport. NDOT works closely with the RTC because transportation plans must be coordinated through the RTC in order to be eligible for federal funds. The Nuclear Waste Transportation Research Center at the University of Nevada, Las Vegas College of Engineering has

been sponsored and is supported by the NWPO. These agencies and groups are in the early stages of evaluating potential repository-related transportation impacts of the repository.

Native American Political Behavior

As noted earlier, Native American tribal governments have a special status vis-a-vis the federal government, and also a special status under the NWPA. Given that tribes are independent governments, they have, from time to time, entered into certain contractual relationships with state and county governments for services (see Section 3.4.3). Since passage of the NWPA, two tribes have applied for and been denied "affected Indian tribe" status by the Department of Interior (the Las Vegas Paiute Tribe and the Moapa Band of Paiutes). Two entities also have contracted with the State of Nevada to conduct independent studies of potential repository impacts using monies allocated to the NWPO by the federal government (the Western Shoshone National Council and the Moapa Band of Paiutes). These two groups also are represented on the State and Local Government Planning Group. The Las Vegas Paiute tribe is considering applying for state assistance to participate in the program.

The Western Shoshone National Council passed a resolution in 1987 (87-WSNC-02) voicing strong opposition to the siting, as have the Duckwater Shoshone Tribe (88-D-22), and the Chemehuevi Tribe of California (CHEM. R. 88-16). The Moapa Band of Paiutes passed a resolution (88-M-4-19) regarding what the tribe considers to be appropriate mitigation considerations regarding cultural resources on these lands. As of November 1, 1988, resolutions were pending from the Las Vegas Paiute Tribe, the Timbi-Sha Shoshone Tribe, and the Paiute Tribe of Utah.

Native Americans from the Southern Paiute tribes (now in the states of Nevada, Utah, Arizona, and California) formed a Southern Paiute chair's association in the mid-1980s, which has devoted some time to discussing repository issues, including some proposed mitigation measures. Resolutions are pending from the chair's association.

Although avowedly anti-nuclear for several years, the Western Shoshone National Council, an organization that is the lineal descendant of several other Western Shoshone organizations that through the years have focused attention on tribal claims under the 1863 Treaty of Ruby Valley, has become increasingly vocal in opposing the high-level nuclear waste repository at Yucca Mountain, as well as federal activities at the NTS, the Nellis Air Force Range, and elsewhere on Shoshone lands.

On May 18-19, 1988 the Nevada Indian Commission and the National Congress of American Indians (NCAI, the largest single body representing Indian opinion in the nation), co-sponsored a workshop on nuclear energy and related repository issues in Tonopah, Nevada. It was attended by representatives from tribes in the study area, as well as others from greater distances. The NCAI suggested continued and active involvement of this body in the repository issue nationally as well as locally. In addition, nearly all tribes in the study area have designated one or more of their members (or council members) as advisors on cultural and other matters involving the site. This is

a conscious attempt to better manage and respond to the quantities of information that are beginning to come to the tribes from DOE and state sources, and also to develop well-reasoned opinions on the issues. These activities will undoubtedly continue.

3.3.3 State Agency Responses and Fiscal Impacts

In addition to the intergovernmental impacts discussed above, another type of impact stems from the planning, review, coordination, and other activities that agencies have undertaken in order to protect the health, safety, and welfare of Nevada residents in response to the Yucca Mountain repository. Such activities involve the personnel, time, and other resources of state agencies. Some of these expenditures have been reimbursed by the NWPO through DOE, the trustee of the Nuclear Waste Fund, but others are not reimbursed for a variety of reasons. Some costs are considered to be relatively small and the agency does not want to bother with documenting and applying for reimbursement, or the agency, either correctly or incorrectly, does not view these costs as reoccurring. In the research to date, an attempt has been made to identify the most important places where expenditures of state monies have taken place (Mushkatel, Atkinson, and PIC, 1987). However, since this report is on work in progress it should be noted that not all agencies and activities of the state have been examined nor have all agencies been able to locate and quantify all their costs.

Since mandate-driven impacts generally are not included in socioeconomic impact assessments, the data for estimating these fiscal costs are not readily available. The state currently does not track the time spent on repository activities separately from other state business so the real costs must be estimated. These estimations can be accomplished by careful review of agency budgets, procedures, responsibilities, and the expert judgment of agency personnel. In applying the mandate approach, an identification is made of state resources that are being applied to repository issues instead of being applied to other state issues. The mandate-generated effects are genuine costs which can and should be calculated as fiscal impacts (Mushkatel, Atkinson, and PIC, 1987).

The State Legislature

Although information to provide a comprehensive accounting of the unreimbursed, repository-related costs incurred by the legislature, its committees, and staff does not exist, the nature and extent of these costs can be demonstrated through example. A very conservative accounting of the personnel costs associated with the research and debate of the Bullfrog County Bill by the Legislative Counsel Bureau fiscal analysis staff, senate and assembly committees, and the legislature amounted to $34,685 (Personal communication from the Legislative Counsel Bureau to Mountain West, 1988).

Significant legislative and staff time was devoted to developing, debating, and enacting this legislation, and additional resources were required for the resolution of the ensuing litigation. Although the costs the state incurred in relation to the Bullfrog County law have not been determined, the legal expenses alone, if they were about the same as Nye County's costs, would exceed $17,000.

The repository program has generated both direct and indirect costs as the legislature attempts to deal with its implications. For example, the cost of background research reports and studies by committees and contractors on the subject of "grants equal to taxes" (GETT) is not included here. The GETT issue is still unresolved and it almost certainly will be revisited periodically and considered in great detail. Other state and local issues in such areas as transportation, emergency response, regulation, equity, intergovernmental relations, and compensation, are current issues and will require legislative attention.

State Agencies

In order to estimate the impacts to date on state agencies the first task was to identify which agencies needed to be examined. An examination of the state agency structure and interviews with state officials yielded the following 26 agencies:

Attorney General's Office
Commission on Economic Development
Controller's Office
Department of Administration
Department of Agriculture
Department of Commerce
Department of Conservation and Natural Resources
Department of Education
Department of Employment Security
Department of General Services
Department of Human Resources
Department of Industrial Relations
Department of Military
Department of Minerals
Department of Motor Vehicles and Public Safety
Department of Museums and History
Department of Personnel
Department of Taxation
Department of Transportation
Department of Wildlife
Governor's Office
Indian Commission
Nevada Agency for Nuclear Projects
Nevada University System
Public Service Commission
State Legislature

These are not all the possible impacted agencies since the project may change over time, as might the state's policy toward the project, DOE's project plans, and the missions of the various agencies. However, given the current organization of state agencies and the present status of the repository program, this list includes the most likely location of state fiscal impacts.

The study team prioritized these agencies according to the framework provided by the economic/demographic and mandate approaches (Mushkatel, Atkinson, and PIC, 1987). To date, nine agencies have been studied: the departments of Conservation and Natural Resources; Military; Human Resources; Motor Vehicles and Public Safety; Taxation; Transportation; Education; Employment Security; and the Public Service Commission.

For each agency, budgeting and organizational information was collected, key linkages to economic and demographic and mandate impacts were examined, and agency personnel interviewed. The focus of inquiry was on the involvement of agencies in repository-related activities, the costs incurred to date, and future demands. Due to the

early stage of the repository project, there are few economic and demographic impacts to date, although several agencies project significant future costs.

Not surprisingly, the major impacts to date have resulted from mandate demands such as planning in the context of the uncertainty which characterizes the repository program. The research has documented a total of over $73,000 in unreimbursed state agency costs. Some of these costs estimates were compiled as early as June, 1987, and updated costs could be much greater, since state agencies do not have tracking systems which identify these costs and such impacts can be easily overlooked. Significant additional costs could be demonstrated by including all the potentially impacted agencies and updating costs incurred by agencies that were examined as long ago as mid-1987. The fiscal costs presented here are by no means an accounting of all the state agencies' expenditures. An important point is that these mandate costs, which most often are not considered as impacts, are significant and can be identified and mitigated through a proper research and monitoring program.

3.3.4 Summary of Governmental Responses and Impacts

The major public sector impacts to date have resulted from the Congressional mandates which established the repository program (NWPA, 1982) as amended by the NWPAA (1987) and the Congressional appropriations for FY 1989. Significant changes within the state have taken place in response to these Congressional actions. Organizational changes, along with the political issues and the policy implications for all levels of state and local government, have resulted in major impacts as a consequence of the repository program. New agencies have been formed, offices created and filled, working groups and committees have been established, and intergovernmental relations within the state have been affected.

The mandate impacts have been significant in terms of costs to state and local governments and in terms of intergovernmental relationships at federal, state, and local levels. The State of Nevada implemented new programs in response to the NWPA and NWPAA including the creation of the NWPO, the Agency for Nuclear Projects, the Commission on Nuclear Projects, and the Committee on High-Level Radioactive Waste. Activities on the part of existing state and local entities resulted from the federal repository program. Changes in the roles, responsibilities, and intergovernmental relations also were produced. Public officials expect increased service demands from the economic-demographic impacts of the repository project and have begun planning for these impacts. The issues and concerns surrounding the project have put public officials in a difficult mediating position. Mandates at all levels -- federal, state, and local -- are often in conflict with positions adopted by important groups.

3.4 Community

This section describes study area economic/demographic, governmental, political, and social conditions at the community level. It defines responses and impacts to date

and includes data on attitudes and perceptions of community satisfaction and repository risk derived from the urban and rural surveys (Mushkatel, Nigg, and Pijawka, 1989b; Krannich and Little, forthcoming; Hamby and Rusco, 1988). Four distinct geographical populations are described: (1) the Las Vegas Valley urban area; (2) the rural communities of Indian Springs in Clark County; Amargosa Valley, Beatty, and Pahrump in Nye County; and Goldfield in Esmeralda County; (3) the rural communities of Mesquite in Clark County and the Alamo-Hiko area and Caliente in Lincoln County; and (4) the Native American rural and urban communities of the Southern Paiute and Western Shoshone tribes.

Several major research efforts were undertaken to determine the range and type of impacts that have taken place to date in the study area communities. For the rural communities, key informant interviews, ethnographic research, and community surveys were completed. In addition, a telephone survey of the state population was completed. The impacts to date in the Las Vegas urban area were examined from a number of perspectives. First, a detailed, two-phase survey which included both telephone and personal interviews was undertaken of the entire urban area. Data were collected on current and expected community well-being, concerns and risk perceptions regarding the proposed nuclear waste repository, and other impacts. Second, an urban ethnographic study was initiated to investigate the sociocultural context in which repository-related impacts can occur. Third, key informants, including representatives of public interest groups and local public officials, were interviewed.

3.4.1 Las Vegas Urban Area

The Las Vegas urban area covers that part of the Las Vegas Valley that includes the cities of Las Vegas, North Las Vegas, Henderson, and immediately adjacent unincorporated areas of development in Clark County. The estimated population of the Las Vegas urban area for 1988 exceeds 630,000 (over 90 percent of the county total) with the largest proportion of residents living in the City of Las Vegas (235,298) and unincorporated Clark County (297,000). This urban area contains approximately 95 percent of the Clark County population and nearly 60 percent of Nevada's total state population. Las Vegas is the state's largest city, with Henderson ranking third largest and North Las Vegas fourth. The Las Vegas urban area contains over 90 percent of the resident population and jobs in the Southern Nevada study area.

The distance between the Yucca Mountain repository site and the Las Vegas urban area ranges from 80 to just over 100 air miles. The closest jurisdiction is North Las Vegas, with Henderson (at 107 miles) the most distant. Downtown Las Vegas is approximately 93 miles from the repository site.

Economic-Demographic and Governmental

The major employment, population, and fiscal impacts to date were reported for all of Clark County in Section 3.2, above. An important portion of the impacts to date has resulted from the additional demands the repository places on the public sector. The rapid growth of the urban area has created serious tensions between those people in the

community whose economic, professional, and political fortunes are tied to expansion and development, and those public officials and community leaders who are concerned about the infrastructure capacities and fiscal resources for providing additional services. As the urban area infrastructure reaches and overruns its capacities, the costs of expansion may become so large that both individual and organized taxpayer groups could rise in opposition to the necessarily expensive plans to cover the service shortfalls. Because there are almost no public services within the urban area that have the capacity to provide for significant additional demands (PIC, 1988b), the additional demands upon services due to repository-related increases in population will only add to the infrastructure problems.

Political Behavior and Relationships

The governmental jurisdictions in the Las Vegas urban area provide the traditional urban services. Most services are provided separately by each government for citizens residing within their boundaries, although some sharing of service areas does exist. The most prominent example of shared service is the Metro Police Department serving Clark County and the City of Las Vegas. Rapid growth in the area has made communication and cooperation among local governments necessary, particularly on issues surrounding the provision of basic services to support increasing development. Relations between governments are generally acknowledged to be good and have improved from previous years. However, local officials all stress the independence of their cities in charting policy directions and in controlling key services.

Formal interaction among the local governments is limited. There is no overarching intergovernmental forum such as a council of governments or regional planning district. However, Metro Police links the county and City of Las Vegas. The County Airport Authority and the Convention and Visitors Authority coordinate key private sector activities that link all the area's governments. Several county-wide intergovernmental bodies and special districts exist covering distinct policy areas. The most significant regional entities are those dealing with water, sanitation, library, transportation, flood control, schools, health, and A-95 review. The binding decision-making and enforcement power of these bodies varies. The county takes the leading role in water, sanitation, library, health, and flood control. Indeed, the county is generally viewed as the most powerful governmental entity in the region because of its review and standard-setting powers granted from the state. However, direct enforcement ability in any area is quite limited, with ultimate enforcement power in most cases resting with the state.

Clark County and the City of Las Vegas both seek to avoid any negative effects to the hotel and gaming sector of the economy, which is the essential employment and revenue base of Southern Nevada. Hence, these two local governments have vigorously pursued policies geared to keeping the transport of hazardous waste away from established or planned centers of tourism and gaming. Interviews with local key informants and public officials indicate that officials in North Las Vegas and Henderson are concerned that such efforts may result in the transportation of high-level radioactive

waste through their jurisdictions, should a repository be located at Yucca Mountain. (Herzik and Mushkatel, 1988).

Responses and Concerns to the Repository Program

A general population survey of residents in the Las Vegas urban area was conducted over a three-month period in 1988. A representative sample of 755 adults was selected with a random digit dialing procedure; a modified Kish selection procedure was used to identify the appropriate respondent in each household. The selected respondents were interviewed first by telephone and subsequently more extensively in person, usually at their place of residence. A response rate of 73.5 percent was achieved. (Detailed information on the survey methods and implementation are contained in Mushkatel, Nigg, and Pijawka, 1989b).

The survey found that 89 percent of those interviewed had heard about the repository program, and over 75 percent of the respondents expressed interest in repository issues while only 17 percent said they had "not much" or "no interest at all." This level of awareness and interest is extremely high given the multitude of problems and issues that are part of urban life.

The survey found that 78 percent of the respondents had considerable concern about possible harmful effects of the repository on the Las Vegas urban area and 61 percent believed that they or their community in particular would be harmed if the facility is built. Forty-one percent of the population anticipate that they personally will experience some sort of harmful effects. The effects most frequently anticipated were from the contamination of air and water and transportation accidents. Significantly, ten percent of the harmful effects identified by respondents were expressed in terms related to loss or denigration of the community's reputation or image.

Almost half of the residents questioned (46 percent) thought that positive benefits would accrue to the urban area and 12 percent believed they would personally benefit. Yet, despite the perception that the repository would have both positive and negative effects, most respondents (53 percent) believed the negative effects would outweigh the positive effects; only 17 percent thought the positive effects would be greater than the negative effects.

Given the high levels of concern expressed by residents of the Las Vegas urban area about issues of health and safety, it is not surprising that about 70 percent of the respondents were opposed to building the repository. Of all the reasons given for not building the repository, 46 percent were technological in nature, most often related to the feasibility of making it safe. Forty-one percent of the urban population do not believe that the repository can be constructed and operated in an acceptably safe manner. Those who were in favor of the repository most often referred to the isolation of the site.

Potential harmful effects of shipping nuclear materials to the repository are of particular importance to people in the Las Vegas urban area. For urban area survey respondents, radioactive waste transportation presented a greater risk than the activities

at the repository site; 53 percent felt highly serious health risks were associated with transportation while only 44 percent felt equally concerned about on-site activities. In fact, 39 percent of the respondents do not believe high-level wastes can be transported in an acceptably safe manner. The distance of the urban area from Yucca Mountain perhaps explains why the residents view transportation as involving more serious risks than activities at the repository.

The urban survey respondents were asked how far from a highway they would be willing to live if high-level nuclear waste is transported on it. Over 80 percent of the population indicated that they are not willing to live within 5 miles of such waste transportation routes. It is ironic to note that 98 percent of the respondents lived within 5 miles of major urban highways which have the potential to be routes for high-level waste transportation (U.S. 93, U.S. 95, I-15, and I-515). These results strongly suggest why urban residents oppose transporting high-level radioactive waste on these urban routes.

Social and Cultural Developments

The local economy in the Las Vegas urban area produces a combination of stresses on individuals and families with a high proportion of working women and shift workers, long commutes to jobs (such as test site workers), and often the threat of defense-related or seasonal layoffs. Rapid growth compounds these effects. Approximately 20 percent of the schools have year-round sessions and others have double sessions until new schools can be built. Traffic congestion is worsening and the residents of the urban area see repeated media reports of problems with gangs, drugs, crime, and environmental degradation. The urban area survey found that crime and transportation were identified as the first and second most important problems within the urban area.

There is a steady stream of inmigrants, drawn by the promise of employment in the booming economy of Las Vegas. A number of these people have no financial margins to protect themselves from either periods of unemployment or high move-in costs. This puts an increased burden on the area's underdeveloped social services. There also is a steady and significant outmigration that contrasts with the inmigration. The large proportion of residents who are recent arrivals, or who are inclined to leave, reduces the level of people's commitment to their communities, either as taxpayers or as active supporters of charitable and civic causes.

Many city officials believe the image of the area is very important to economic development, tourism, gaming, convention, and other industries. Millions of dollars are spent annually to manipulate that image to proper advantage. Yet, there is still a prevalent perception that Las Vegas is a high crime area which was reinforced by published statistics that were unadjusted for the large number of visitors that are always present. Current crime-rate statistics indicate Las Vegas is one of the safer major cities.

The city's image is not only crucial to the economy but it is also important to the construction of the residents' pride in place. Las Vegas has a certain symbolic meaning for most people in the country -- often as "sin city" or "fun city." It is the subject of

continual comment in the national media. However, nearly three-quarters (74 percent) of the images of Nevada brought forth by respondents to the urban survey were "positive" or "very positive." When asked for images of their communities, 80 percent of the images provided by respondents were "positive" or very positive." Nearly half (49.4 percent) of the images provided by respondents were in the categories of "quiet," "new and clean," "accessible," "development and growth," "friendly," "suburban," and "safe." Such images contrast sharply with the stereotypes often associated with Las Vegas by non-residents. Residents of Las Vegas are acutely aware of the stereotypes people in other parts of the country hold regarding their city and they frequently find themselves defending their growing attachment to the local place against "outside" insults or threats (Stewart, forthcoming).

There are pockets of different kinds of residential areas scattered over the city ranging from the "old neighborhoods" which tend to have more stable populations and yards with large trees, to areas with many apartment complexes, mobile home parks, or the new "master planned communities." But much of the new housing is located within large planned developments and separated from adjacent streets, vacant desert, or other developments by surrounding walls, a distinctive name, or look. In general, the pattern and rapid growth of residential development has not produced traditional neighborhoods. Rather relations outside the family are formed in a proliferation of voluntary associations based upon everything from ethnicity, to place of origin before moving to Las Vegas, seniors groups, self-help groups, singles groups, homeowners associations, car clubs, outdoor recreation groups, and athletic clubs (Stewart, forthcoming).

"Community" can be constructed overnight, not as a natural outgrowth of "neighborhood" but in reaction to a perceived threat to shared interests such as property values, children's safety, school busing, or other specific issues. The recent PEPCON incident indicates how quickly and powerfully Las Vegas area residents can organize in response to a high-visibility event. Some residents of Green Valley were dissatisfied with the post-accident response, the compensation of victims, and the regulations of ongoing hazardous operations. The Governor organized a Blue Ribbon Commission in response to many of these concerns.

Las Vegan sociality has a distinctive quality of friendly informality, tolerance, and an ethic of privacy and independence. Often the same people who will willingly speak to strangers in public places and cooperate in voluntary associations may not have met or spoken to their neighbors. The recreational and entertainment resources of the city provide the opportunity to mix with other residents and also with visitors A "western" style of dress, music, dancing, trucks, outdoor recreation, and various kinds of "western" competition are commonly seen and further add to the city's distinctive quality. Many Las Vegas residents see themselves as living in a quintessentially American place that epitomizes prosperity, risk-taking, and a kind of "live and let live" egalitarianism (Stewart, forthcoming).

Impacts to Date on Well-being

On all dimensions of satisfaction and well-being, an overwhelmingly positive attitude was found among Las Vegas area residents. Almost three-quarters of those interviewed during the urban area survey felt that the community in which they currently live is their "real home" (that is, a place important to them). Also, when asked about the strongest images they had of their communities, respondents provided very positive ones. Regardless of the dimension of satisfaction raised -- with local government, economic opportunities, social life -- urban residents expressed high levels of satisfaction. These positive attitudes towards their communities obviously contributed to respondents' overwhelming satisfaction with their lives in general.

These positive feelings also were carried over into expectation for the future. Over 75 percent of the urban respondents felt their current community would become "more desirable" in the future or would retain the level of desirability it currently has. A majority (57 percent) of urban residents expressed high satisfaction with their community life and 95 percent expressed at least moderate satisfaction with life in their community.

The data currently available do not connect the repository with the urban area quality of life measures, although the repository program as an issue is very salient. There is no doubt that the majority of residents oppose the repository program and 64 percent say the selection process was unfair. In spite of this it is not perceived as having a direct negative impact upon the quality of life in the urban area communities up to the current time.

Repository Issues

Many long-term residents feel that there has been a special relationship between Nevada and the federal government. Traditionally there has been strong support for defense industries in the area. However, the repository has not enjoyed the same support. Some strong supporters of defense respond with a typical "not in my back yard" attitude when faced with the issue of nuclear waste and voice added resentment that the federal government would "dump" this on Nevada after local interests have been sacrificed to national interests through the nuclear testing program.

People in Las Vegas generally support economic development and some people see the repository as an opportunity for continued economic growth. For other people, the repository raises concerns with health and the environment and to them the possible economic benefits are not worth the risks.

The position against the repository is quite widespread in the urban area with approximately 70 percent of residents opposed to it (University of Nevada Poll, 1988; Mushkatel, Nigg, and Pijawka, 1989b). Also widespread is an assumption that the repository will be built despite Nevada's opposition, a belief held by over 70 percent of the respondents in the urban area survey. This is consistent with data from the urban area survey showing strong suspicion of and alienation from the federal government and

a sense of lack of local control over local events. Many people also object to the siting process, believing that it was a political move to "dump on" a state with one of the smallest Congressional delegations (Mushkatel, Nigg, and Pijawka, 1989b; Stewart, forthcoming). They also object to state and local governments and special interest groups "playing politics" with the issue. The bottom line is generally a demand for detailed public discussion with verifiable information on hazards, transportation, environmental impacts, and management (Mushkatel, Nigg, and Pijawka, 1989b; Stewart, forthcoming).

Although many public officials support the federal government operations at the NTS, the urban area survey respondents were doubtful that the dangers were properly reported. Only three percent of the respondents believe that the government has reported all the accidents at the NTS. The respondents said operations at NTS had caused more harm than benefits. Over half (54.9 percent) said it was likely that past above-ground testing had caused "harmful health problems for people that lived in the Las Vegas urban area." More than 25 percent (25.3 percent) judged these health problems to have been "extremely likely." In answer to another question, almost 40 percent (39.2 percent) thought that it was likely that underground testing will cause future health problems for Las Vegas residents. Downwinders and those who sympathize with them claim high rates of cancer resulted from these tests and are angered that these claims have gone unrecognized and uncompensated by the federal government (Titus, 1986). The two Nevada Senators are leading sponsors of a new Congressional bill to compensate these victims (Las Vegas Review-Journal, March 16, 1989). Only four percent of those interviewed believe that all of the accidents at a repository would be reported, 40 percent said that they would expect few if any accidents would be reported.

Another important underlying issue is with the fairness and equity of the repository program. The Yucca Mountain project has little claim to the sympathy or sense of public sacrifice that characterizes other federal projects in Southern Nevada, such as the NTS or the Nellis Air Force Base. Yucca Mountain involves waste, not national defense which carries patriotic overtones. It benefits large, mostly Eastern, utilities. The process for locating the repository is viewed by many people as blatantly political and involved a "ganging up on" Nevada. The urban survey found that about a third of the respondents felt the repository was being "forced" on Nevada, and 64 percent said the process was "unfair" or "very unfair." All of these facets of the program raise serious equity issues for local residents.

The Las Vegas area urban survey included a number of questions about how the respondents evaluate different federal, state, and local governments and officials. One question asked the respondents to say whether they trusted or did not trust each of ten specific agencies, institutions, or offices. For all ten agencies, the overall average was 50.3 percent of the respondents expressing some degree of trust; 26.3 percent expressing a lack of trust; and almost a quarter (23.3 percent) indicating no opinion. The highest trust score was the 63.7 percent of the respondents who expressed some degree of trust in the governor of Nevada who at the time of the interview was widely known for his stand in opposition to the Yucca Mountain repository program. He also recorded the lowest "no trust" score (16.4 percent). The highest "no trust" scores were recorded for

DOE (32.2 percent) and NRC (35.7 percent). These two agencies also gathered the lowest scores in terms of trust, 41.5 percent for NRC and 42.7 percent for DOE.

The potential risks of the repository and the sense people have that they have little control over federal actions, together with a feeling that the siting process was unfair and that the federal government will not be honest in reporting repository-related events has had an interesting social effect. In some cases, the repository has been directly associated with other issues or events. In other cases, it seems to serve as a bench mark for comparison with issues, or as a metaphor to describe the rationale for opposing current events. For example, some Green Valley residents in complaining about the response to the PEPCON explosion asked, rhetorically, what would happen in the case of a high-level radioactive waste transportation accident?

In another dispute between the City of Las Vegas and a group of over 1,000 residents over road boundaries, some residents contended that the issue came up only because the government is considering putting in a back road to the repository through their community (Las Vegas Sun, September 25, 1988). Regardless of whether this is true or not, the assumption was immediate and it influenced both the opposition to the city's efforts to resolve the dispute and prompted the demand that the city serve notice to every potentially impacted resident (Stewart, forthcoming).

Public sector transportation officials are concerned about future responses to highway construction. Given the realities of the current transportation infrastructure and the demands of the rapidly expanding population in Southern Nevada, the primary focus of transportation planning has to be on meeting immediate needs, something that may be contrary to efforts to isolate transportation routes for high-level radioactive waste from the population. In order to isolate the transportation of nuclear waste from the public, routes for these wastes must be located sufficiently far from the urban population to preclude their use in addressing the transportation congestion of the urban area. New freeways and major arterials that could address the transportation congestion of the urban area, if used for transporting high-level waste would pose the same dangers to urban populations as existing routes now under consideration by the DOE. For example, using the proposed outer loop as an alternate route for transporting nuclear waste in order to avoid the Las Vegas downtown area would simply send waste through the North Las Vegas urban area or through other areas which would develop rapidly in response to this new transportation link.

Between the opponents and the supporters there is another group of residents who do not seem to have a determination of the final desirability or undesirability of the repository. Some of these are focused on their immediate jobs and businesses and simply want to avoid any interference by the repository issues. Those people who serve the visitors and tourists, or those who work in community development, understand how important the area's image is. They tend to feel that questions about potential risks during the repository operations are premature and could have immediate adverse impacts. Therefore, they would like to downplay the repository issues and concentrate on building a positive image for Southern Nevada.

There also is a substantial minority who often exhibit a strong trust and faith in government, science, and the experts and a perception that the fear of things nuclear is an irrational product of ignorance and misinformation. Not surprisingly, solutions to repository problems and issues tend to be scientific and technical rather than social and ethical. The real risks, as defined from this perspective, have to do with economics -- the depletion of energy resources and the resultant loss of jobs.

Long-term NTS workers and employees of DOE and its contractors are likely to cite familiarity with things nuclear as first-hand knowledge that the risks are not, in fact, "cataclysmic" (Stewart, forthcoming). Some people make the argument that the test site is already contaminated and so it makes a good place for a repository. Other people claim that the testing has not caused damage to the area, either in terms of health or in terms of the hotel/casino industry, and they believe that the repository poses even less risk.

The repository issues are very salient ones; residents are both aware of and concerned about them. These issues have impacted planning and local government relations in the urban area and produced divided opinions on the issue. People feel both benefits and harm will be associated with the repository. However, in the urban area a majority of the people believe the harms will outweigh the benefits and a substantial majority oppose the repository. Trust in the federal agencies responsible for the repository program is lower than for other agencies and officials, as would be expected considering the publicity surrounding the management problems at the federal government's nuclear facilities. The survey documents that there is considerable doubt in the ability of the government to operate a repository in an acceptable manner and great doubt that the government would deal openly and honestly with any accidents. The issue of transportation of high-level nuclear waste is crucial for a number of reasons. One indication of the reasons for current attitudes is that a vast majority of people live closer to major highways than they say they would be willing to live if those highways were used as high-level waste transportation routes.

Summary

The standard impacts to date are relatively modest given the economic base of the urban area. Governmental fiscal impacts are negative as they are for any additional residents, given the state's revenue structure. The issues and concerns raised by the repository program center on transportation risks, equity questions, the potential to impact quality of life, and public trust in government. Transportation concerns express a wide range of complex perspectives and issues that involve difficulties with the current and future demands on highways and roads both with and without high-level radioactive waste shipments.

3.4.2 Rural Communities

The evaluation of repository impacts upon rural areas of Southern Nevada has focused on eight relatively small communities located in three counties. The communities include the unincorporated town of Indian Springs and the incorporated city of Mesquite

in Clark County, the unincorporated town of Alamo and the incorporated city of Caliente in Lincoln County, the unincorporated town of Goldfield in Esmeralda County, as well as the three unincorporated communities of southern Nye County: Amargosa Valley, Beatty, and Pahrump. All eight small communities could be impacted by the construction, operation, and eventual closure of the high-level nuclear waste repository proposed for Yucca Mountain. Their proximity to Yucca Mountain itself and/or likely transportation routes used to move nuclear wastes to the repository strongly suggest possible social impacts.

Baseline community social and cultural conditions, as well as residents' orientations toward the proposed Yucca Mountain repository, have been addressed in substantial detail in other reports (Krannich and Little, 1987a, 1987b, 1987c, 1987d, 1987e; Little and Krannich, 1987a, 1987b, 1987c, 1987d; Endter, Little and Krannich, 1988a, 1988b, 1988c; Trend, Little, and Krannich, 1988a, 198b, 1988c; Krannich and Little, 1988; Krannich and Little, 1989; Krannich and Little, forthcoming). The focus of the present section is to summarize the socioeconomic conditions, repository responses, and impacts to date in these rural communities.

Available ethnographic and survey data suggest that impacts and local orientations toward the repository program are likely to be similar in Caliente, Alamo, and Mesquite. All three are east of and relatively distant from the proposed Yucca Mountain site. Caliente is 127 air miles and 253 road miles from Yucca Mountain; Alamo 85 air miles and 197 highway miles distant; and Mesquite 142 air miles and 184 road miles from the Yucca Mountain. Throughout the remainder of this report these communities will be referred to collectively as the eastern study area.

As a result of the distance of the eastern study area communities from the proposed repository, it is unlikely that any of them would experience large-scale population growth effects from the construction or operation of the repository. Also, the potential for local residents to benefit from substantial numbers of repository-related jobs or economic advantages is likely to be limited. However, in spite of their distance from the proposed site, some Lincoln County residents are hopeful that the development of a "back road" access to Yucca Mountain across Nevada Test Site (NTS) lands would enhance local opportunities for repository employment.

Finally, the three eastern study area communities share two other important sociocultural characteristics. First, each community has a significant Latter-day Saints, i.e., Mormon, population which provides a degree of cultural homogeneity absent in the other five study communities. The presence of a substantial Mormon population implies not only the particular beliefs and values associated with the religion, but also unusual degrees of social organization and mobilization. Second, insofar as each community is downwind from NTS, they all experienced extensive radioactive fallout during the era of atmospheric nuclear weapons testing (Fradkin, 1989).

The five communities west and south of NTS also share some social and cultural features relevant to analyzing impacts of and local orientations toward the proposed repository program. For convenience they will be collectively referred to as the Western

study area communities. Amargosa Valley, Beatty, Pahrump, and Indian Springs are all in relatively close proximity to each other as well as to Yucca Mountain. Amargosa Valley is just 17 road miles from the site, Beatty is 45, and both Pahrump and Indian Springs are 61 road miles distant. Goldfield is 96 miles from the site. As a result of their proximity to Yucca Mountain, these western study area communities could be expected to experience economic and demographic changes as a result of repository development, operation and closure. In addition, all are located upwind of NTS and did not experience widespread nuclear fallout from atmospheric weapons testing during the 1950s and 1960s.

At the same time, most western study area communities have experienced substantial reliance on economic opportunities linked to NTS and other federal programs. There have been periods of rapid growth and/or decline, with all four communities experiencing demographic and economic instability. In recent years only Indian Springs and Pahrump have continued to provide residences for substantial numbers of NTS employees. Unlike the downwind communities, none of these communities exhibit high levels of cultural homogeneity, nor does any single religious orientation dominate the social landscape. The employment bases of the western communities is traditionally based upon mining, government employment and the inmigration of new residents, most dramatically in the case of Pahrump. The length of residence and the type of work are important factors in characterizing the social and cultural attributes of these communities.

Given the geographic clustering and the concomitant sociocultural clustering, the discussion which follows will address repository impacts to date at a fairly general level within each of the two areas. While this level of aggregation and generalization furthers the discourse and aids in the general understanding of the impacts generated by the proposed repository, it precludes the discussion of specific community-level conditions. However, community-specific impacts will be included in the discussion whenever they will illuminate the more general impacts experienced by the larger cultural area.

3.4.2.1 The Eastern Study Area: Impacts to Date

The incorporated City of Caliente is located in eastern Lincoln County and, with a current population of nearly 1,000 residents, is the largest community in this rural county. Despite several decades of economic and demographic decline, Caliente remains a commercial hub and in fact recently has seen some economic activity and population growth. It is closely linked to the nearby towns of Pioche, the county seat, and Panaca, home of eastern Lincoln County's high school. Taken together, the three towns form a functional community. Caliente is bisected by the main line of the Union Pacific Railroad, as well as U.S. Highway 93, both potential nuclear waste transportation routes.

The unincorporated town of Alamo is located in the Pahranagat Valley in southwestern Lincoln County. This section of Lincoln County also has experienced recent economic difficulties, due in large part to mine closures and declining agricultural profitability. Alamo, with a population of approximately 850, is the area's largest community and serves as the functional center of social and economic activities for other Pahranagat Valley settlements, i.e., Ash Springs and Hiko. All three of these small

communities lie adjacent to U.S. Highway 93, a potential nuclear waste transportation route.

The incorporated City of Mesquite is located in extreme northeastern Clark County, immediately adjacent to the Nevada-Arizona border. The city has grown rapidly in recent years as a result of hotel and casino developments. With a current population of over 1,500 it is the largest community in the Virgin Valley, which also includes Bunkerville. Mesquite is located immediately adjacent to Interstate 15, the major north-south interstate highway in the region and a potential nuclear waste transportation route.

Economic-Demographic Impacts

To date the repository program has had few identifiable effects; the modeling allocations estimate six repository-related jobs and 10 new residents. These jobs and subsequent income are certainly important to the individuals and may be relatively important to small rural communities.

Community Fiscal and Services Impacts

Impacts on local fiscal resources and public services are negligible for Alamo or Mesquite. In Caliente, some positive fiscal effects have resulted from repository program funds being made available to the Lincoln County/City of Caliente Joint Impact Alleviation Committee. That funding has been used to hire a non-local planning consultant to advise the county and city regarding repository issues and to represent the area in legislative and committee meetings and hearings. In addition, some of the funding has been used to support secretarial, clerical, and paralegal positions in Caliente and Pioche, the county seat; to pay for the attendance of local officials at nuclear waste meetings; and to acquire documents and other information pertinent to the nuclear waste program.

Political and Governmental Impacts

Impacts on local government have been negligible in both Alamo and Mesquite. The only meaningful effect on local governments has occurred in Caliente, where the city's involvement in the Joint Impact Alleviation Committee has required additional allocations of time and effort on the part of some local government officials. Participation in this committee has resulted in more cooperative city-county relations. Caliente has been designated as the locus of administration for Lincoln County's repository program activities, a role which will likely expand as a result of the recent designation of the county as an affected unit of local government.

As previously noted, several new administrative positions have been created in Caliente. These positions are funded through the repository program, with funds initially allocated by the Nuclear Waste Project Office. Recently the funds have come directly through DOE as trustee of the Nuclear Waste Fund.

Risks associated with the transportation of nuclear wastes through Caliente and Mesquite are an issue of major concern for local governmental officials and leaders alike. Both police and fire department personnel have expressed concerns about the potential inadequacy of equipment, personnel, and training programs available for successfully managing a nuclear waste transportation accident. They fear that they would be unable to provide an effective response. While local officials in both of these communities have targeted this issue as a potentially important focus of future mitigation efforts, to date no formal changes in safety service programs have been implemented.

Community Social Structures and Processes

The repository program has had very limited impact on either formal or informal social structures and processes in the eastern study area. Generally, effects on social structures and processes have been more or less benign, in spite of high levels of public concern about repository risks.

The nuclear waste repository program has not emerged as a focus for social or political action in any of the eastern study area communities. Consequently, there is no evidence of impacts to date on the array of nonpublic institutions and organizations that contribute to their social structures and processes. None of the community organizations has adopted a public stance on the repository issue, and there have apparently been no effects on interorganizational relationships. Similarly, informal linkages among networks of friends, acquaintances, and kin appear unaffected by repository-related events. In all three communities, the interests and activities of most residents appear to remain focused on the pursuit of normal day-to-day life.

Attitudes and Perceptions

Despite the absence of political or social activism focused on the repository program in any of the eastern study area communities, the repository is a focus of fairly widespread individual interest and concern. Survey data indicate that the majority of residents in both Caliente and Mesquite are aware of the repository program; ethnographic data collected in Alamo suggest a similarly high level of awareness there.

In all three communities, high levels of awareness about the repository program appear to have interacted with other proposals and events. The result is an increased concern over a variety of community hazards and risks. Many residents in these communities experienced and/or observed the adverse effects of earlier above-ground nuclear weapons testing at NTS. Although most residents seem to have accepted the presence of NTS and its current underground testing program, the proposed nuclear waste repository seems to have rekindled concerns and fears regarding the consequences of testing and using nuclear materials. High levels of concern about potential health and safety risks as a result of the repository program have been expressed by residents of these communities. Sixty percent of survey respondents in Caliente and Mesquite expressed concern about possible harmful effects on public health and safety from the repository and the ethnographic studies in Alamo suggest a similar level of concern there.

Available survey and ethnographic data suggest that these health and safety concerns are closely linked to residents' uncertainty regarding both the safety of waste transportation procedures and the ability of the repository itself to safely confine radioactive wastes. In Mesquite, about 50 percent of survey respondents expressed the belief that neither the operation of the repository itself nor waste transportation could be accomplished in ways that would be acceptably safe. About 45 percent of Caliente residents expressed similar concerns. In fact, it appears that focusing public attention on the nuclear waste program has increased local concerns about hazardous waste issues in general, and waste transportation in particular.

There appears to be an interactive effect between concerns associated with the repository program and concerns about other hazardous projects or events. This is especially evident in Caliente, where a recent controversy over a proposed hazardous waste incinerator and high levels of alarm over possible toxic contamination from the PEPCON explosion appear to be linked with worry about possible future repository risks.

Perceived health and safety issues are not the only concerns expressed by area residents. The federal government's decision to focus all repository site selection efforts on Yucca Mountain has exacerbated the tendency of many area citizens to express both feelings of powerlessness in the face of government and a sense of injustice. Most residents appear to be resigned to the fact that the repository ultimately will be built in Nevada, in spite of state opposition and widespread local perceptions of inequities in the attempt to force Nevada to accept the nation's nuclear waste. Only approximately 30 percent of survey respondents in both Caliente and Mesquite indicated that they believed that the process of selecting Yucca Mountain as a repository site had been fair.

These beliefs, along with long-standing distrust of the federal government and dissatisfaction with its responses to residents' concerns about the effects of nuclear weapons programs, contribute to high levels of dissatisfaction with the federal government in general. Survey data reveal that over 50 percent of Caliente residents and about 38 percent of Mesquite residents do not believe they can trust the federal government to "do what is right."

Data also indicate there is fairly widespread agreement among local residents that the federal government cannot be trusted to provide honest or accurate information about either the suitability of the Yucca Mountain repository site or any problems or accidents that might arise in the future. For example, in both Caliente and Mesquite, two-thirds of survey respondents specified that they were not confident that the federal government can be trusted to provide honest, accurate information about nuclear programs. Such distrust has been exacerbated by several repository-related events, including what residents perceive as the "screw Nevada" provisions of the 1987 amendments to the Nuclear Waste Policy Act and media reports in early 1988 of attempts by the DOE to suppress a report containing negative findings about the suitability of the Yucca Mountain site (see Endter, Little and Krannich, 1988a).

Given the relatively high levels of concern about repository risks and distrust of government management capabilities, it is not surprising to find that a majority of

residents in the eastern study area do not support construction of the repository. This conclusion is supported by ethnographic evidence collected in Alamo and Caliente, and by survey data collected in Caliente and Mesquite. The survey data show that about one-fourth of Mesquite residents and one-third of Caliente residents support the location of the repository at Yucca Mountain.

At the same time, however, residents of the eastern study area express high levels of support for economic development and enhanced employment opportunities. For example, in Caliente over 90 percent of survey respondents expressed a belief that it is important to increase local economic opportunities, with 56 percent stating that it was "extremely important." Levels of support for economic growth are nearly as high among survey respondents in Mesquite and are also quite evident from ethnographic observations in Alamo.

A great many area residents are hopeful the repository program will enhance local economic conditions, but fewer believe that there actually will be significant economic benefits. Moreover, many area residents express the belief that any such benefits would be substantially outweighed by negative, risk-related impacts. Only a small minority (under 30 percent) of survey respondents stated they expect the overall effects of the repository on their communities would be positive.

At present, residents express relatively high levels of satisfaction with the local social context. Survey data indicate that about 65 percent of Caliente residents and 75 percent of Mesquite residents currently exhibit high levels of satisfaction with their communities. Concerns about the adverse effects of the repository have not crystallized into any organized opposition in eastern study area communities, although the overall strength of local concerns and dissatisfaction suggests that there may be an important potential for these issues to eventually impact the residents' overall levels of well-being.

3.4.2.2 The Western Study Area: Impacts to Date

Adjacent to U.S. Highway 95, a potential waste transportation route, the unincorporated town of Amargosa Valley is approximately 17 miles from Yucca Mountain, making it the closest community to the proposed site. Although the population of the town substantially exceeded 1,000 in the early 1980s, extensive outmigration occurred after 1986 as a result of the closure of a local mining and milling facility, American Borate Company. With a current population of only 600 to 700 residents spread across a 500 square mile land area, Amargosa Valley has the smallest and least densely distributed population in the western study area.

The unincorporated town of Beatty lies about 35 miles northwest of Amargosa Valley and is bisected by U.S. Highway 95. Located just 18 air miles from Yucca Mountain, Beatty is a community which historically has experienced sharp economic and demographic fluctuations as a result of mining activities. During 1988, the population of the town increased from approximately 1,100 to over 1,600 as a result of extensive new mining activity. The Bond Gold/Bullfrog Inc. gold mining facility located in nearby Rhyolite has been the greatest contributor to the population influx.

Pahrump is an unincorporated town located in the extreme southern section of Nye County. Although not located on a major highway that would be a likely nuclear waste transportation route, one of the proposed railroad spur routes for waste transportation passes through sections of the town. The relocation of some NTS employees wishing to be closer to their work and some other Las Vegas residents wishing to live in a more rural area have also added to the population growth. At present Pahrump's population is approximately 7,000, making it the largest community in Nye County.

Located approximately 180 miles northwest of Las Vegas on U.S. 95 and 96 miles from the proposed repository entrance, Goldfield is the county seat of Esmeralda County. This unincorporated town has been almost totally dependent upon the mining industry and has been subject to its boom and bust forces since its founding in 1903. Goldfield's current population of about 400 reflects recent growth but remains only a shadow of its peak population of nearly 30,000 in 1908. The potential nuclear waste transportation route, U.S. 95, represents both a key to economic growth through visitors and a threat because a 90-degree turn at the edge of town would present an accident hazard in the event of nuclear waste shipments.

The unincorporated town of Indian Springs is located in northwestern Clark County, close to the Nye County line. The town lies immediately adjacent to U.S. Highway 95 and near one of the alternative railroad spur routes proposed for transportation of nuclear waste to Yucca Mountain. Since World War II, economic and demographic conditions in Indian Springs have been closely associated with government military programs, particularly the Indian Springs Air Force Base and nuclear weapons testing facilities at NTS. This geographically compact community (620 acres) had a population of approximately 1,200 in early 1988.

Economic-Demographic Impacts

The economy of southern Nye County is based primarily on the activities at the Nevada Test Site, the Tonopah Test Range, the mining industry, and the various hotels, motels, casinos, and other service establishments that serve tourism and travelers; the town of Pahrump also has a sizeable land development industry and retirement community as part of its economic base. The economy of the town of Indian Springs is based on the NTS, some tourism, and the Indian Springs Air Force facility.

Pahrump's sustained growth during the past decade is based largely on land development and inmigration of retirees. Beatty's recent rapid growth has been fueled by a mining boom, while Amargosa Valley has experienced both growth and decline as a result of fluctuations in mining and mining-related activities. Indian Springs also has experienced demographic instability, but its changing demographic structure has been dependent upon shifts in employment opportunities linked to NTS activities and various military programs. Goldfield's economy has been almost entirely dependent upon mining.

Economic impacts associated with the repository program to date have been modest in the western study area communities. The estimates for 1988 were for a total employment of 37 in Nye County with 5 in Amargosa Valley, 7 in Beatty, and 21 in Pahrump. Indian Springs in Clark County is estimated to have had employment impacts of 10 and population impacts of 21. The population impacts for 1988 for Nye County were 60 with 8 in Amargosa Valley, 11 in Beatty, and 35 in Pahrump. Impacts to Goldfield have not yet been modeled.

Community Fiscal and Services Impacts

To date, the modeling estimates of fiscal impacts for Nye County and its communities show positive, but modest effects with a combined net gain of $27,339 (see Table 4-13, below in Chapter 4). Modest amounts of program money allocated to Nye County by the state and DOE have been distributed to Amargosa Valley, Beatty, and Pahrump, primarily to support attendance by local officials at various waste management meetings and symposia. No such funding has been allocated to Indian Springs by Clark County.

Political and Governmental Impacts

One notable impact of the repository program on local units of government has been the formation of nuclear waste advisory committees in the three Nye County communities of Amargosa Valley, Beatty, and Pahrump. The committees were formed on the advice of Nye County's planning consultant to assist the county's efforts to remain informed about and responsive to repository program issues. The advisory committees address local issues related to the repository program and report to a town board (in Pahrump) or town advisory board (in Beatty and Amargosa Valley). The town boards or advisory boards in turn make recommendations to the Board of County Commissioners. In general, these committees do not appear to be very active, although individual members have attended both waste management meetings organized by DOE and NWPO as well as national waste management symposia. Typically, the local nuclear waste advisory committees attract very few local residents to their meetings.

An additional impact on local government activity has been the initiation of local planning and administrative actions in anticipation of potential social and economic impacts associated with the construction and operation of the proposed repository. Such responses have been most evident in Amargosa Valley, which at one time proposed to annex the area encompassing Yucca Mountain in order to expand the local tax base. Although that action was subsequently dropped, the town did act to develop plans for increased community park facilities. The planning was stimulated by the belief that the proposed repository would bring population growth to Amargosa Valley. In addition, local efforts to oppose proposals by the Nye County sheriff to eliminate local dispatchers and reduce the number of deputies assigned to Amargosa Valley were linked, in part, to concerns about future growth in law enforcement needs if the repository project should proceed.

There also have been a variety of political responses to repository issues and events by local communities. None of the town boards in the western study area has adopted a formal position either supporting or opposing the development of the repository at Yucca Mountain. However, in the Nye County communities there were both formal and informal responses to the State's attempt to create Bullfrog County. Although the responsibility for litigating the Bullfrog County issue rested with Nye County, the town boards also expressed strong opposition to the legislation creating the new county. Local officials regarded Bullfrog County as a blatant attempt by Clark County to siphon potential economic benefits of the repository away from Nye County.

One final dimension of political impact has involved strains on intergovernmental relations, especially between units of community and county government. In Indian Springs, the failure of Clark County to involve the town in its repository-related activities has reinforced local perceptions that the county government is unconcerned about the community. At the same time, the Nye County communities have complained that the county has failed to distribute adequate amounts of repository program funding for use in the local communities. In addition, the repository program has helped to fuel conflicts between Pahrump and the county administration centered in Tonopah. Proponents of an effort to divide Nye County, most of whom are Pahrump residents, argue that a new county (southern Nye County) could prosper, partially as a result of revenues from federal grants, mitigation payments, and other funding opportunities anticipated as a result of the repository program.

Community Social Structures and Processes

Despite the proximity of most western study area communities to Yucca Mountain and the presence of formally organized repository committees or boards in three of the five towns, in most ways the repository program has not emerged as a focus for social or political activism by western study area residents. One exception involves the response of local communities, especially those in Nye County, to the Bullfrog County legislation adopted by the Nevada legislature in 1987. In addition to the formal community opposition noted above, the responses of local residents to that action also were highly negative. Although Bullfrog County was ultimately declared unconstitutional, there have been effects in the western study area evidenced by expressions of distrust and hostility toward both state government and urban interests entered in Clark County.

With the exception of the controversies over splitting Nye County and the Bullfrog County situation, available evidence suggests that there have been no other incitements to social controversy or conflict. None of the voluntary organizations in these communities has adopted a public stance on repository issues, and there have been no apparent effects on interorganizational relations. Informal linkages among friends, kin, and other lines of association and affiliation appear largely unaffected.

Attitudes and Perceptions

In all the western study area communities, residents exhibit extremely high levels of awareness about the repository program. However, unlike the rural communities in

the eastern study area, the residents of the western study area communities tend, overall, to express low levels of concern about hazards and risks perceived as possible consequences of the repository program. This is especially true in Beatty and Amargosa Valley, where over 60 percent of the survey respondents indicated low levels of concern about the potential for adverse health and safety consequences of the repository. Residents in Indian Springs (53 percent) and Pahrump (36 percent) expressed lower levels of concern about health and safety impacts in contrast to the higher levels of concern evident in Alamo, Caliente, and Mesquite.

The lower levels of concern expressed by residents of these western study area communities appear to be linked to the fact that these communities did not previously experience the problems of radioactive contamination that occurred in "downwind" communities during the era of atmospheric nuclear testing (see Krannich and Little, 1989). In general, residents of four of these communities are substantially less likely than residents of Caliente or Mesquite to believe that negative health effects are associated with either previous atmospheric weapons tests or current underground testing at NTS.

In addition, the low levels of concern exhibited in Beatty and, especially, in Amargosa Valley appear to be positively related to the pro-development orientations expressed by the majority of residents of both communities. The pro-growth orientation would seem to follow from the fact that both communities have experienced sharp economic and demographic fluctuations as a result of their dependency on mining activities. Economic growth in the non-mining sector is generally seen by local residents as a desirable way to stabilize the local economy.

Although residents of Pahrump are also generally pro-growth, their somewhat higher expressions of concern regarding health and safety risks may be linked in part to community reliance on land development and a vision of retirement-oriented population growth. Such images of local development trends and potential appear to be perceived by some as incompatible with hazardous projects (see Edelstein, 1988b). Also, Pahrump is the home of numerous recently-arrived residents who may bring with them less positive orientations toward nuclear programs than those held by longer-term area residents. Many long-term residents have adapted their perceptions and attitudes as a result of association with NTS' nuclear activities.

Despite the lower levels of concern about health and safety risks exhibited in western study area communities, there are substantial proportions of residents in the western study area who express concerns about the potential for nuclear contamination. One focus of concern is on potential contamination of underground water resources. Data obtained from the rural community survey (Krannich and Little, forthcoming) indicate that in Beatty and Amargosa Valley, over 25 percent of respondents expressed concern about this issue. In Indian Springs and Pahrump the percentages exceeded 40 percent and 60 percent, respectively.

One additional focus of concern among some area residents involves the potential risks of accidents involving radioactive waste transportation. However, a majority of survey respondents in four of the communities indicated a belief that nuclear waste

transportation could be accomplished in an acceptably safe manner. Ethnographic research in Goldfield, however, revealed considerable concern about potential transportation risks.

Perceptions of the equity of siting the repository at Yucca Mountain are widely split in all four of the communities in the western study area. In general, there appears to be widespread agreement among local residents that the repository will ultimately be built in Nevada and that both the state and local communities are powerless to alter that situation. However, such resignation and perceptions of powerlessness do not appear to reflect widespread dismay about the potential development of the repository. Instead, the orientations of residents in these communities appear to reflect a willingness to accept what many perceive to be minor or moderate risks in return for anticipated economic benefits. In Pahrump, nearly two-thirds of survey respondents expressed beliefs that on balance the repository would have beneficial economic effects on the local community. The percentage of respondents expressing such expectations was greater in the other three western study area communities, reaching a high of over 75 percent in Amargosa Valley, but seems to be much lower in Goldfield according to ethnographic research.

The mixture of generally positive expectations about local economic benefits and relatively limited expression of concerns about repository risks results in a substantially more positive orientation toward construction of the repository in most of the western study area communities than in eastern ones. The proportion of survey respondents expressing opposition to repository development was under 15 percent in both Beatty and Amargosa Valley. In Indian Springs and Pahrump the percentage expressing opposition was higher, approximately 28 percent and 35 percent, respectively.

Residents of the western study area towns exhibit generally high levels of satisfaction with their communities, with the percentage of survey respondents indicating high satisfaction ranging from approximately 59 percent in Indian Springs to over 82 percent in Amargosa Valley. There is little evidence that the repository has had any adverse effect on community quality of life to date.

Summary

Overall, the impacts of the repository program to date on the rural study area communities in Southern Nevada have primarily involved effects on residents' levels of satisfaction and well-being, increased responsibilities for local units of government, and political tensions between the communities and various government entities. These impacts vary widely across the rural study areas. The most substantial negative impacts upon residents' perceptions of powerlessness, trust in the federal government, equity concerns, and risk perceptions appear to have occurred in the eastern study area communities. In contrast, impacts on these well-being dimensions appear to be substantially less negative in the western study area communities, and may, in fact, be positive overall. At the same time political conflict and controversy appear to be most evident in the Nye County communities where inter-community rivalries have involved

the potential for repository revenues and where state-county and inter-county relationships have been impacted.

In all of the study area communities, residents' concerns about the potential for future accidents involving repository operation or waste transportation appear to have stimulated a new awareness of and sensitivity to issues surrounding hazardous materials and activities. Although this sensitivity has not emerged as a major adverse impact on well-being thus far, it clearly suggests that the repository program has altered the ways in which local residents think about the risks associated with a variety of hazards, especially transportation of hazardous materials. Moreover, expressions of uncertainty about possible risks associated with the repository program reflect an alteration of the ways in which residents think about and anticipate the future. Additional analysis of current data and further research will be needed to determine the implications of these shifts in the perceptions and orientations of rural community residents for either current or future well-being. Nevertheless, it is clear that the impacts of the repository program to date have not been entirely benign in rural Southern Nevada, even in those communities most highly supportive of repository development.

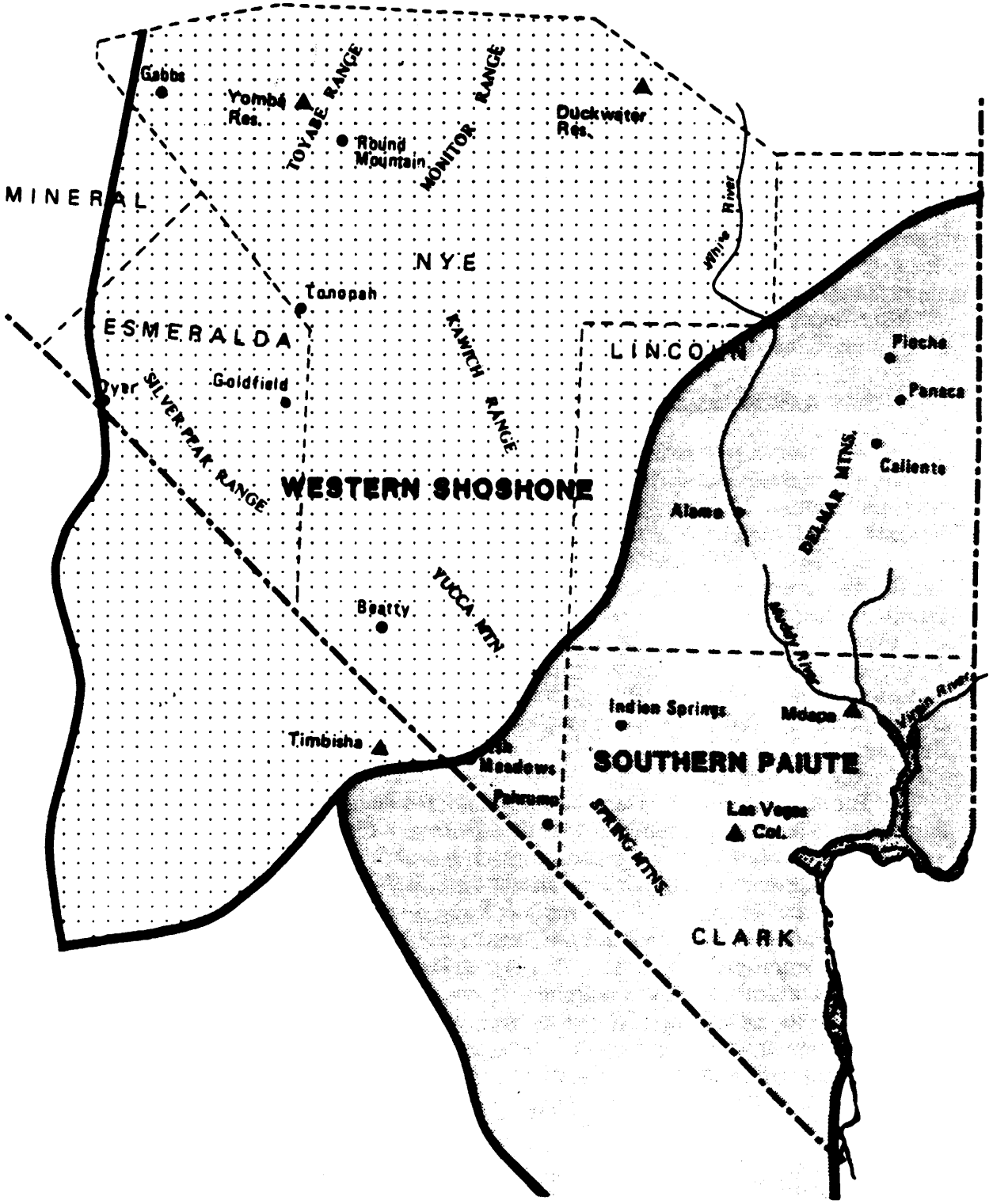
3.4.3 Native American Communities

The Native Americans of Southern Nevada belong to two major cultural divisions, the Southern Paiute and the Western Shoshone, and make up a small minority of the area population. Those groups in the immediate vicinity of the proposed Yucca Mountain site include the Las Vegas Paiute Tribe, the Moapa Band of Paiutes, the Timbi-Sha Shoshone Tribe, the Yomba Shoshone Tribe and the Duckwater Shoshone Tribe. There are in addition, a small number of people of Southern Paiute and Western Shoshone descent living in or near the towns of Pahrump, Beatty, Tonopah, and Caliente, and a much larger, but not well identified urban population in Las Vegas (Figure 3-2). At a greater distance, but only peripherally involved in studies reported here, are other Southern Paiute tribes in Utah, Arizona and California, other Western Shoshone communities in Nevada, Utah and California, and the Owens Valley Paiute people in California.

The data summarized are based on studies conducted over a period of two years (September 1986 to September 1988) that involved direct observations and extensive interviewing as well as library and archival research. Two field workers resided in or near each of the communities for extended periods (one month to three months each). During July and August, 1988, a modified (largely shortened) version of the rural risk survey questionnaire was also administered to 59 Native Americans in the study area. Although the sample is too small to be statistically valid, it serves as a preliminary indication of attitudes toward community, socioeconomic status, and concern perceived risks related to construction of the proposed Yucca Mountain repository. In addition, 20 Native Americans participated in three site visits to the Yucca Mountain area during 1987-88. The sections that follow utilize data from the survey and site visits as well as other directed interviews and the general field studies.

FIGURE 3-2

NATIVE AMERICAN GROUPS IN SOUTHERN NEVADA



3.4.3.1 Western Shoshone

The Western Shoshone people living in the study area are centered at three locations, Duckwater Shoshone Reservation, Yomba Shoshone Reservation, and the Timbi-Sha Shoshone Village. The two reservations are in Nye County, Nevada; the Timbi-Sha village is at Death Valley in Inyo County, California. All are small, isolated, rural groups; their total population is under 300 persons -- 130 at Duckwater, 90 at Yomba, and 50 at Death Valley. The groups have an inadequate land base for the support of their populations, and as a result of this and other difficulties all are economically disadvantaged.

Duckwater Reservation is located in northern Nye County, approximately 20 miles northwest of Highway 6, a potential waste shipment route. Duckwater is 144 air miles north-northeast of Yucca Mountain; the distance by road is about 290 miles to Mercury, at the Nevada Test Site. Yomba is also in northern Nye County, 45 miles south of Austin and 33 miles east of Gabbs. It is about 150 air miles north-northwest of Yucca Mountain and about 290 miles away by road. The Timbi-Sha village is located within the Death Valley National Monument, just south of the tourist facilities at Furnace Creek, California. The site is 42 miles south of Beatty, Nevada and approximately 30 air miles and 100 road miles southwest of Yucca Mountain.

The two Shoshone reservations, each just under 4,000 acres in size, are partially dependent on a rural ranching economy, supplemented by federally funded contracts, outside wage jobs, and government assistance programs. The Timbi-Sha, with no trust land of their own, depend on the Death Valley tourist industry, federal programs, and government assistance. All three groups, due to geographic isolation and a lack of economic resources, have few services available to them.

Economic-Demographic Impacts

The Yucca Mountain project has done little either positive or negative to change the economic situation of the Western Shoshone. None of the tribes have entered into negotiations or agreements directly with either the state or the federal government. The Western Shoshone National Council, a broader body that represents Western Shoshone interests on several reservations, has its headquarters at the Duckwater Tribal Office, and one tribal member has a full-time job with the Council, funded by NWPO. At all three places, individual tribal members have received money as consultants from the studies being done for the project, but the sums have been small and intermittent.

The nuclear waste repository program has had no discernable effect on the demographic situation of any of the Shoshone. There have been no increases in economic opportunity due to the project or otherwise that might cause inmigration. Although there is a widespread belief that the above-ground nuclear testing had a detrimental effect on their homeland, no one moved away during that time and the repository project to date has not prompted an observable outmigration.

Facilities and Services and Fiscal Impacts

The facilities and services available to the Western Shoshone people in the study area are all extremely limited by their geographic isolation and have not been affected by the proposed Yucca Mountain project to date. Nor has the repository project had any discernable impact upon the fiscal situation at any of the locations with the possible exception of Duckwater. The Western Shoshone National Council maintains an office at Duckwater and its funds are dispersed through Duckwater's bank accounts. A small amount of the Council's funds are derived from the repository project as a result of its contract with NWPO. The tribe receives no financial benefit from this arrangement, and may in fact have extra expenses as a result of it.

Intergovernmental and Political Behavior Impacts

The Yucca Mountain project has had some impact on the intergovernmental relations of the tribes by creating an additional basis for interaction between tribes and the state and federal government on the nuclear repository issue. Since the Shoshone view the Nevada Test Site and surrounding lands as their own, and the federal government's use of the land as an act of willful trespass, they have been attempting to influence the outcome of the repository site selection process. However, none of the Western Shoshone tribes have re-applied for affected-tribal status since being denied such status by the Secretary of Interior. The National Council feels that such a status might be in conflict with their tribal sovereignty, as indicated above.

The Council offers permits to individuals wishing to enter "that portion of its territory known as the NTS," which includes the Yucca Mountain site itself. It requests persons to apply for the permit "in recognition of the territorial sovereignty and land rights of the Western Shoshone Nation." The Council and individuals are also actively involved with Citizen Alert, which backs their claim under the Treaty, and both groups are opposed to the repository.

The Duckwater tribal administration has been actively involved in intergovernmental relations and political activities for the last ten years, with elected representatives traveling to Washington, D.C. to lobby for retention of tribal funding, to protest nuclear testing on their ancestral lands, and to attempt to increase their tribal trust land base. The tribe also is closely involved with the Western Shoshone National Council and with activist groups in Washington, D.C. and internationally. Through the Council, Duckwater is now involved with other tribes and with the federal and state government on the Yucca Mountain repository issue in addition to its prior concerns. It has passed a formal resolution of protest, as indicated in Section 3.3.2.

The nuclear waste repository issue is viewed by leaders of the Council and Tribe as an inseparable part of two larger issues: (1) the issue of nuclear activity in general, which they oppose; and (2) the issue of unauthorized and illegal use by the federal government of Western Shoshone lands, which they also oppose. Since the repository issue is such an integral part of the ongoing issues, it is difficult to separate out or measure the political impacts created solely by the repository.

Except for a very small number of political activists who regularly demonstrate at the Nevada Test Site, the level of political activity at Yomba and at the Timbi-Sha village has been limited on this issue. The repository issue is only one of many issues confronting these groups. Contact with field workers in repository studies has generated some awareness and discussion of nuclear issues among many who were born after the period of above-ground testing at the Test Site and previously had little awareness or concern for nuclear issues.

The Timbi-Sha tribal government has recently begun to be involved in intergovernmental issues, as a direct result of the Yucca Mountain project. Council members now hold strong opinions on Yucca Mountain issues and are cooperating with the Western Shoshone National Council in efforts to influence events regarding the proposed repository.

Yomba Shoshone tribal government has been the least active outside its own reservation. There is and has been little interaction with the Western Shoshone National Council or with state and federal government except on the part of individual residents. During the study period, there has been an increase in intergovernmental activities at Yomba directly related to the repository project, along with an increased awareness of nuclear issues on the part of Yomba residents.

Social/Cultural Impacts

The Western Shoshone people have a strong sense of cultural identity, viewing themselves as part of a wide family group closely related to their traditional lands. Their beliefs about the land and environment are central to their religious and cultural identity and the development of the repository is in direct opposition to those beliefs.

The Shoshone people are against siting the nuclear waste repository at Yucca Mountain. They are against the production, transportation, and the storage of nuclear waste anywhere at all. In addition, they feel a personal concern in that the proposed repository would be located on what they consider to be their land under the Ruby Valley Treaty of 1863. They do not believe that waste could be transported safely to the repository, nor do they believe that it could be stored safely when it arrived there. Accidents are inevitable, in their view, and any accident in transportation or storage would be harmful to them and their land. Further, as a result of their prior experiences with the government, they do not trust the government to tell them whether or not things are safe. The construction of the storage facility would also disturb burials and other sacred sites, and prevent even eventual use of their ancestral land due to radiation contamination.

The Timbi-Sha people express further concern that there is already radioactive contamination near them at the Test Site as well as the Beatty low-level site nearby. Older tribal members who are particularly concerned about the harm to tribal lands see these as further insults to the earth, as well as threats from radiation. Residents also feel that the proposed repository would damage their water, which according to both the

scientific and the traditional views comes from a large underground supply that extends under Yucca Mountain.

The Duckwater tribe sees itself as at risk from low-level nuclear waste and other hazardous materials due to their position as providers of the only medical and law-enforcement personnel within a large area. U.S. Highway 6 runs within 20 miles of the reservation and is included in their service area. They have had to acquire equipment and training to deal with accidents involving hazardous waste spills on this portion of the highway.

Studies done among Native Americans for the nuclear waste repository program have had some further integrative effects on the participants. NTS site visits took place on lands claimed by the Native Americans but long removed from public use, and engendered exchange of cultural and historical information among people who may not otherwise have had this opportunity (see Section 3.4.3.3). Tribal elders shared memories and sparked the interest of younger people. Other meetings with the DOE and NWPO as well as the communications and coordination efforts of workers concerned with the repository program have contributed to these social processes. Conversations in the Western Shoshone language, which is less often used these days because many young people do not know how to speak it, have revived an interest in the language and its preservation.

3.4.3.2 Southern Paiute

The Southern Paiute population of Clark and southern Nye counties totals approximately 321 and includes the Moapa reservation, the Las Vegas Colony, and private lands in the Pahrump and lower Amargosa Valleys. Their ancestors shared the region in which Yucca Mountain is located with other Southern Paiute and Western Shoshone groups.

The Moapa reservation is a 72,000-acre property located 55 miles northeast of Las Vegas. The residential community is in the northeast portion of the reservation near State Road 168, approximately four miles from its junction with I-15, a potential route for transporting high-level nuclear waste. Any waste transported to the repository along I-15 or on the Union Pacific Railroad would have to cross the reservation. The proposed Yucca Mountain repository site is approximately 106 air miles (165 highway miles) west-northwest of the tribal headquarters.

The Las Vegas Tribe of Paiute Indians has two tracts of federal trust land consisting of a 10-acre parcel northeast of downtown Las Vegas and a 3,840-acre tract 18 miles north of the city that spans both sides of U.S. Highway 95. U.S. Highway 95 is the only route from I-15 to the repository site and any waste traffic coming from the south through Las Vegas will pass through the rural tract. The tribe also could be affected by rail transportation. The Colony borders the present mainline of the Union Pacific and potential rail spurs to the site could also come within close proximity to the Las Vegas Tribe land. The proposed repository itself is approximately 91 highway miles northwest of an existing highway exit and intersection on the rural parcel.

The Pahrump Band consists of Indians descended from Southern Paiute and Western Shoshone families who occupied Ash Meadows and the lower Amargosa and Pahrump valleys in the Nineteenth Century and before. Some of the Pahrump people are on the Moapa or Las Vegas Paiute rolls, but the group has not been federally recognized as an independent tribe. The proposed repository site is approximately 59 air miles (80 highway miles) northwest of the intersection of State Road 19 and the Death Valley highway in Pahrump.

Economic-Demographic Impacts

The proposed high-level nuclear waste repository has had little or no direct economic impact on the three Southern Paiute communities to date. None were designated by the Secretary of Energy as affected tribes. A negligible source of economic impact has come from visits of study team field workers consulting with tribal elders and others. The Moapa Band has employed one person since September 1988 with monies from the repository program through an NWPO contract.

Impacts to date include the costs to tribal councils and staffs of attempts to estimate potential impacts of construction and operation of the facility, and to plan appropriate responses. In early 1988, the Las Vegas Tribal Council and its administrative staff initiated contact with the DOE staff in Las Vegas to discuss what kinds of employment might become available during construction of the proposed nuclear waste facility. As of August, 1988, the council did not believe that the DOE had provided sufficient information for the tribe to initiate special job-training programs targeted for employment on the repository program.

Although the Southern Paiute population has fluctuated somewhat during the 1980s, there is no indication that the repository program to date has initiated any of the demographic changes.

Facilities and Services and Fiscal Impacts

No evidence has been found thus far for impacts by the repository program on public services to colony or reservation residents. Most major health, social welfare, and other public services are provided to reservation and colony members as part of federal trust obligations. Programs administered by the tribes or by the Inter-Tribal Council are funded by a combination of federal grants or contracts, private foundations, and/or tribal funds.

Certain programs and services, for example, schools, fire protection, and assistance with police protection for the reservation and colony are partially or completely provided by the City of Las Vegas or by Clark or Nye counties. Repository effects on the local infrastructure, in general, will therefore be felt by residents of the reservation and colony, as well as by the Pahrump Indians.

Undoubtedly the greatest fiscal impact on tribal groups has been the burden placed on their councils and administrative staff members to attempt to evaluate and plan for the future impacts of the Yucca Mountain repository on their lands and economic bases. Their efforts are assisted, but also compounded by the need to participate in the various impact-related studies conducted for the DOE and NWPO. Fees paid by the study teams to individuals have helped off-set their expenses and even provided a small income supplement, but have not reimbursed the tribe for administrative and council-member time or other expenses. Moreover, council members serve in a largely or completely non-paid capacity. The major effort involved in housing and economic development leaves little time and energy to deal with issues imposed from outside. A review of council minutes and staff logs for the past two years might provide a general basis for the tribal staff to estimate impacts to date and project future costs. The recent employment by the Moapa Council of a tribal member to assess potential impacts and plan appropriate responses under a contract with NWPO will help alleviate the drain on administrative staff time. The Las Vegas Council has been negotiating with NWPO for a similar contract.

Intergovernmental and Political Behavior Impacts

Both the Moapa Band of Paiutes and the Las Vegas Paiute Tribe have formal governing councils made up of elected members. In 1983, both the Moapa Band of Paiute Indians and the Las Vegas Tribe of Paiutes wrote to the DOE formally requesting status as an affected tribe. Letters received the same year informed the tribes that affected-tribe status was denied, apparently based on a strict interpretation of the NWPA. Neither group was party to a treaty with the United States covering lands to be used for the repository; and neither wanted to have the repository located on reservation lands.

The informal Pahrump Band is not a federally recognized governmental unit and therefore does not have the standing to apply for affected tribal status. The Band does serve as a focus for the small dispersed groups, and its members have discussed the possibility of applying for recognition.

Representatives from both the reservation and colony, as well as members of the Pahrump Band, have consulted with DOE and NWPO study teams. The Southern Paiute Chairmen's Association (an informally organized association of chairs of all Southern Paiute tribal councils, which meets irregularly to discuss matters of mutual interest) held a meeting in Las Vegas, in April, 1988, to discuss impacts of the repository program on sacred lands. The meeting was attended by members of both the reservation and colony, as well as Utah and Arizona reservations. The Moapa Band of Paiutes passed a resolution (88-M-4-19) regarding what the tribe considers to be appropriate mitigation considerations regarding cultural resources on these lands (see Section 3.3.2).

Neither council has prepared a formal position paper on the proposed facility, but the Moapa Council has instructed its staff to prepare a draft for their consideration. The chair of the Las Vegas Council has indicated that they will also prepare a formal statement, probably with the assistance of a consulting attorney and a former council member who has served as a liaison with both the DOE and NWPO study teams.

Social/Cultural Impacts

In spite of a clear mandate for economic development, both reservation and colony residents want to protect their environment. They view the most serious threats from the proposed repository to be water contamination and a threat to personal and public health and safety. An example of their concern was the preliminary negotiation of the Moapa Business Council with the Henderson PEPCON plant after its explosion in 1988, which aroused considerable alarm among many tribal members not on the council. The most clearly perceived source of impact on the reservation and colony is actually from accidents occurring during the transportation of nuclear waste by rail or highway through reservation or colony lands. Some of the respondents, however, could see some economic benefits. Moapa tribal members discussed imposing a toll for passage of nuclear waste across the reservation or establishing a federally-funded monitoring program, and colony residents spoke of some possible direct benefits to tribal enterprises or from employment at the repository site. Although members of the same families expressed varying points of view on these issues regarding the Yucca Mountain repository program, no serious disruption within families or the communities has resulted to date over the repository program.

3.4.3.3 Native American Concerns Regarding Yucca Mountain

The primary way in which Native Americans have been affected by the repository project to date has been in terms of their religious beliefs and cultural values and identity, which are reflected in their concerns with siting the proposed nuclear waste facility within their aboriginal territories. Their concerns are three-fold: the effect on and loss of access to cultural properties including sacred sites in the project area; perceived danger to their health and to the environment from contamination by nuclear waste; and the Western Shoshone legal claim to the land on which the proposed facility is to be located. These and other concerns are related to traditional religious teachings and apply to both the Southern Paiutes and the Western Shoshone.

Religious Teachings and Sacred Sites

Given Native American concerns and existing federal legislation, a major consideration is the identification of sacred sites and other cultural properties within the project area that would be affected. To the traditional Southern Paiute and Western Shoshone people, who are the longest tenured residents of the project area, the determination of which sites are sacred is based on religious precepts concerning proper behavior in relationship to natural resources and the consequences of crossing negative forces or failing to keep them in balance (Fowler, Hamby, and Rusco, 1987).

Due to the closure of the area to public access in 1941 and due to cultural changes since the turn of the century, few Native Americans interviewed could discuss the Yucca Mountain area from continuous or intensive personal experience. Thus, as part of an overall plan to assess site-specific concerns for cultural properties in the area, and to comply with the spirit of the American Indian Religious Freedom Act (P.L.

95-341), Section 106 of the National Historic Preservation Act of 1966 (80 Stat 915; amended 1980), and the National Environmental Policy Act of 1969 (42 U.S.C. 4332), site visits were made to the area on three occasions in 1987 and 1988. On each visit, Native American consultants representing the cultural and tribal groups in the region toured representative archaeological sites on and near Yucca Mountain and gave their comments on the significance of these cultural properties. They commented generally on the area and provided observations on the proposed construction and operation of the repository at this location (Cultural Resources Consultants, Inc., 1988b).

Some of these visitors spoke of the sacredness to the Western Shoshone of Bare and Timber mountains, near Beatty, and of Fortymile Wash at the base of Yucca Mountain because of events related to them in The Time When Animals Were People. People were watchful for areas where the dead might be buried, noting some potential localities, although no one knew of specific burials at or near the sites visited. Some people expressed strong opinions as to the beauty of the area, especially the vistas from the top of Yucca Mountain. Two remarked that the area should be made into a state park, free in access to all. Some felt, however, that because of nuclear activities that had already taken place in the area, it appeared "burnt," "sick," and "destroyed." But they did not feel that this was justification for further destruction of the region with nuclear waste. All persons agreed that the repository should not be built there.

The present mood of the judicial system seems to allow little to qualify under AIRFA (Hopi Indian Tribe, et al., v. Block, et al. Navajo Medicinemen's Assn., et al., v. Block, et al., and Wilson, et al., v. Block, et al., Nos. 81-1912, 81-1905, 81-1956 D.C. Cir., May 10, 1983), or the religious wishes of a minority (Native Americans) to interfere with federal progress (Ling, et al., v. Northwest Cemetery Protective Assn., et al., No. 86-1013. Supreme Court, April 19, 1988), and it seems unlikely that concern over religious or sacred sites on Yucca Mountain or the general concern of Southern Paiute and Western Shoshone people for the sacredness of the land will be heeded for the purposes of this project. Now that the people have seen the area and its resources, however, they will be ever more watchful of DOE activities in the region. A major project impact to date with reference to site visits by DOE and NWPO study teams has been to heighten the people's awareness of cultural resources and their heritage in general, and to further suggest the danger both face. The fact that this and other areas have controlled access, and that they and their children and future generations will not be able to see these sites is particularly upsetting to a number of the people.

Native American Risk Perceptions

In addition to religious concerns for the effect of nuclear waste disposal on the earth, Native Americans are concerned for their health and the survival of all living organisms in the vicinity of the proposed repository. This has taken the form of widely-known stories about early days of testing, beliefs that pine nuts and other plant and animal resources have been affected as far from the test site as the Yomba and Duckwater reservations, and the perception that a high cancer death rate, attributable to continued nuclear testing, has already been experienced. The fear is commonly

expressed that the addition of radioactive waste disposal will exacerbate conditions already present.

In order to gather more data about Native American risk perceptions, a survey questionnaire asking about perceived risks related to placing the repository at Yucca Mountain was administered to 59 Native Americans in the study area. Several individuals also were interviewed separately about the risk posed, or merely asked to give opinions on the matter in general. This section will summarize the findings of the risk survey itself. Due to the small sample size, responses of both groups will be combined here.

All avenues of questioning found opinions regarding the perceived risks to be high, and attitudes strong against construction of the repository. Native American opinions are far more uniform in opposition to the repository, and the risks are perceived to be greater in degree than either their urban or rural non-Indian neighbors. The intensity of their feelings on this matter is consistent with their religious and cultural beliefs about the environment.

Seventy-one percent of the respondents felt that the nuclear waste repository could not be built and operated safely. This is in marked contrast to the general assessment of the majority of Nye County non-Indians that the repository can be built and operated safely. It is also a slightly higher percentage than elicited from urban Las Vegans. Nearly identical opinions were voiced on the issue of safe transportation of waste materials with 75 percent responding that it could definitely not be transported safely.

3.5 Summary of Responses and Impacts to Date

The purpose of Chapter 3 is to describe socioeconomic conditions, responses, and impacts to date resulting from the Yucca Mountain repository program. The approach was to describe the economic, demographic, social, and political characteristics of the study area including responses to both the potential standard project effects and the special risk characteristics.

This summary section classifies the impacts into three categories:

1. Significant impacts that can be classified into two major types: Special impacts that result from the unique characteristics of the Yucca Mountain High-Level Radioactive Waste Repository program, and Standard impacts that are somewhat analogous to the impacts of other major development projects;

2. Potential impacts that imply the possibility of significant impacts in the future but which have had less than significant occurrence to date;

3. Other impacts that are of importance to smaller areas or to specific economic sectors, jurisdictions, or communities and which can be managed within the existing response structure.

Significant Special Impacts. The source of the major impacts to date derive from unique characteristics of the high-level radioactive waste repository program especially the hazardous nature of the high-level radioactive waste which has been proposed for permanent storage at the Yucca Mountain site.

- The residents of Nevada oppose the siting and operation of the repository by a majority of between 70 to 80 percent as shown in numerous surveys conducted over the past five years. But as many as 89 percent of the residents believe it will probably end up being located in Nevada.

- The passage of the NWPA and the NWPAA mandated to the State of Nevada and to "affected" local governments the responsibility to oversee, plan for, and respond to the Yucca Mountain program as implemented by the DOE.

- The State of Nevada implemented new programs to exercise its responsibilities including creation of the Nuclear Waste Project Office, the Agency on Nuclear Projects, and the Commission on Nuclear Projects.

- Activities on the part of existing state and local governmental entities were initiated or were activated in response to the federal program for high-level radioactive waste disposal. Modifications and changes in intergovernmental relations in Nevada resulted.

- The issues involved with the repository at Yucca Mountain included personnel at all levels and branches of state and local government from the Governor's Office to volunteer town board members in Southern Nevada rural communities. Where different policy and strategy perspectives existed, intergovernmental tensions and conflicts resulted.

- Community-level groups have been active to either support or to oppose the Yucca Mountain repository program. This has raised the level of public concern with and interest in the issues posed by the Yucca Mountain project.

- The two federal agencies that have been given key responsibilities for the repository program, the DOE and the NRC, ranked lowest in terms of public trust of the ten offices and agencies rated, according to the Las Vegas urban area survey. Fifty-nine percent of the respondents do not feel that the DOE can accomplish its mission in

an acceptably safe manner, and seventy percent do not believe the government will make public reports if accidents occur.

- Intergovernmental relations between the State of Nevada and the DOE have experienced tension and conflict, including the filing of a number of legal suits by the State against the federal agency.

Significant Standard Impacts are mainly the result of the fact that the repository program generates fairly large employment, spending, and revenue/expenditure patterns. In these terms, the Yucca Mountain project is comparable to other major development efforts where significant impacts have been found to apply at the community, jurisdictional, regional, and state levels.

- During the period 1986 through 1988 the direct employment for the repository program in Nevada is estimated at an annual count of between 400 and 700.

- Additional employment created by the spending of direct wages and salaries, and purchases during the past three years is estimated at between 600 and 1000.

- The total population impacts resulting from both the direct basic employment, and the additional nonbasic employment is estimated at 2,000 in 1986 and increasing to over 3,600 in 1988.

- The revenue structure for the state and local governments in Nevada is designed to obtain significant taxes from visitors and tourists. For example, these visitors provide about one-third of the revenues for Clark County and about one-half of the state revenues. Residents of Clark County and the state are provided services at a greater level than they pay in costs since the funds provided through taxation of visitors are applied to public services for residents. Therefore, any enterprise that does not support the visitor economy will show a negative balance in a fiscal impact assessment.

- The increased demand for public services created a negative fiscal impact for state and local governments of about $5.5 million for the three-year period. This is the difference between the cost of services provided by the state and local governments and the revenues provided by the repository-related population and other Yucca Mountain repository-related tax payments. The per capita negative fiscal impact for the repository-related population is about $670 per year.

- The study of state agencies examined about one-third of those that could experience negative costs in responding to the Yucca Mountain program. In each case negative impacts were documented and major

areas where additional costs could have occurred but which are not documented have been identified.

- Somewhat different policy and strategy positions by state and local governments, and by public and private interests have resulted in tensions between various actors. Intergovernmental relations between the state and Southern Nevada jurisdictions have experienced strains during the past three years.

- Grant funds have been received from the Nuclear Waste Fund through the DOE by the state, the affected local governments, and by various subcounty jurisdictions and Native American groups. These funds have offset some of the costs of responding to the mandates of the NWPA, but have not included all costs.

- The repository program and activities of the major actors (e.g., DOE, NRC, NWPO, state and local officials, and interest groups) are major news/media items in both the urban and rural areas.

Potential Future Responses are produced by either the special or the standard effects of the project. These types of impacts suggest that there are future possibilities of impacts due to the Yucca Mountain program development and even while they may be small now, these impacts are seen as indications of the what might happen during the long time periods that are included in the Yucca Mountain project planning horizon.

- Due to the major contribution of visitors and tourists to the state revenues and the structure of the Nevada fiscal system, each additional person added as a resident results in a negative fiscal impact. This means that the Yucca Mountain repository program could result in significant negative fiscal impacts in the future, if future revenue and expenditure patterns remain basically the same as they currently are.

- NWPO serves as state agency to oversee the repository program, conduct necessary studies and reviews of DOE studies, supply public information, and to coordinate the state response and serve as a primary contact point for intergovernmental relations. NWPO and "affected" local governments make grant applications to fund implementation of mandated responsibilities. The state and local government response over the last six years implies that further changes in government structure and intergovernmental relations are likely for the future.

- Numerous state agencies have been involved in responding to the repository program but for a variety of reasons have not been funded or reimbursed for the time spent in their responses or in planning for future activities. The activities of the State Assembly in response to

the repository program are not covered by grant monies although some funds have been allocated to the Legislative Counsel Bureau and the Committee on High-Level Radioactive Waste. If the Yucca Mountain project proceeds, these costs could be expected to increase and more accurate accounting of actual costs could be achieved.

- The current low degree of trust in the NRC and DOE indicate that future cooperative agreements might be difficult to achieve. Litigation and other formal processes may become necessary for resolving some differences between the federal government and state and local jurisdictions rather than negotiated solutions.

- Legal action on the part of the State of Nevada undertaken by the Nevada Attorney General's Office has been necessary in a significant number of cases. These actions are not funded by grant funds. Future legal actions on behalf of the state and local governments, as well as by private parties, implies that future repository-related legal costs could continue to be a significant area of impacts.

- The Bullfrog County bill was a direct result of the Grants Equal to Taxes provisions of the NWPA. The process of legislation and litigation produced public sector costs, none of which were reimbursed to the state and local governments that were involved. Future actions in regard to the GETT, mitigation, and/or compensation programs could result in significant costs to the public sector including legal costs.

- The design, schedule, selection process, health and safety oversight, licensing and permitting, transportation routing and control, operations criteria, management, and administration of the repository program have all become important political issues. Further issues and political conflict can be expected as long as the Yucca Mountain project remains under development.

- Employment, income, and population impacts have occurred in the Clark County area and to a lesser degree in Nye County where the Yucca Mountain site is proposed. These impacts are only a small portion of what could be expected during the full development of the repository, perhaps only 10 percent of the peak impacts now scheduled for early in the next century. Much more of the future impacts could occur in the rural areas, especially in Nye County.

- Native American communities have become involved in the planning phases of the repository program and have evaluated it as an additional threat to the social and cultural integrity of their people. The Native Americans oppose the repository program, including the transportation of high-level radioactive wastes through and near their

communities and their tribal lands. Future opposition by the Native Americans could become more focused and include a greater degree of cooperation with state and local governments.

- The issues of rail and highway transportation of high-level radioactive waste have surfaced as ones of immediate and future concern both in the Las Vegas urban area and in the rural communities along potential transportation routes. In Lincoln County, the City of Caliente is located on both sides of the Union Pacific main line. In Clark County, in addition to the Las Vegas urban area, Mesquite is located along I-15 and Indian Springs is adjacent to U.S. 95. Goldfield in Esmeralda County, and Beatty and Amargosa Valley in Nye County are also located along U.S. 95 which is the only major highway route to the Yucca Mountain site. As potential transportation routes and their risk implications are better defined, greater concerns could be expressed by these communities. Also additional communities may become involved if alternative routes appear to become more likely (e.g., communities in Northern Nevada).

Other Impacts are those that apply to important but localized impacts, to specific jurisdictions, communities, or groups, or to levels of impacts that are manageable within the current day-to-day administrative structure.

- Small employment and population impacts have been estimated for Lincoln County in 1988. There were no discernable fiscal impacts.

- For Nye County in 1988 the estimated employment impacts were 37 with an associated population impact of about 60. There were no discernable fiscal impacts. As the "in situ" county, Nye County is expected to experience much larger impacts as soon as site characterization work is undertaken.

- Numerous local governmental jurisdictions have recorded or considered resolutions regarding the repository project. Many of the resolutions have been in opposition to the Yucca Mountain program or have expressed concerns about the safe operation and/or transportation of the program. Other resolutions have been passed in regard to various aspects of the program such as the amendments which define the process of achieving "affected" local government status.

- Local governments have established committees and boards to review the program. State and local agencies and governments have hired contractors and consultants to address specific issues related to the program, and state, county, and local jurisdictions have hired

personnel whose work is devoted all or in part to responding to repository-related matters.

4.0 Projected Impacts

4.1 Introduction

In order to estimate the impacts from the Yucca Mountain project, or any other proposed development, at least two major projections must be made. The first is a "baseline" case which estimates what the study area would be like without the project. The second case is a "with-project" estimation which can be compared to the baseline case to determine impacts.

For the baseline case, a projection is made of key study area characteristics for a specified period of time. Historical evidence is analyzed to define types of change that have taken place in the past and how these trends might continue into the future. Information on plans for future development are examined and the likelihood of their realization is determined. These planned-for activities are located both in terms of geography and schedule. Other forecasts are considered; for example, regional, national and international economic and trade projections that might affect the study area are related to projected local growth/decline rates. Specific constraints to change are considered. An example would be the existence or limitations on basic resources such as available land, water, air quality capacity, etc. Finally, theoretical models of economic and community change are employed to direct the modeling and forecasting efforts so that they represent a likely and useful scenario.

A second projection is then made using the same methodology as for the baseline case but with the inclusion of the variables for change that the project would generate. Since the modeling exercises are constructed to represent complex economic and fiscal systems, the potential impacts are not always obvious. A subtractive approach, which systematically compares the baseline to the with-project case, is used to isolate the potential impacts of the project. Although forecasts of baseline conditions are subject to uncertainty, project impacts are always considered in the context of the underlying social and economic structure of the study area.

In the case of both the Southern Nevada baseline and the Yucca Mountain project, a great deal of uncertainty exists. The Las Vegas urban area is one of the fastest growing in the nation with an economy that represents unique and specialized characteristics. The vulnerability of this economy to national, regional, or even international events is difficult to estimate accurately. For example, a U.S.-Soviet nuclear test ban might have important economic, population and fiscal effects for the region and the state. Cyclical changes in the national economy might have disproportionate effects on Southern Nevada by changing the base for visitor-tourist spending.

The uncertainty of making projections for the Yucca Mountain project has already been described in some detail above. In order to structure both the baseline and the with-project alternatives, it is necessary to make a number of assumptions that are subject

to these uncertainties but which provide the necessary descriptions on which to construct scenarios and make projections.

The purpose of this chapter is to use the information, methods, and data that have been produced by the study team to define, as accurately as possible, what the anticipated impacts from the Yucca Mountain project might be under a set of assumptions that might be called the "most useful" ones for the purposes of this demonstration. The term "most useful" does not mean that these descriptions of the project and the baseline conditions are necessarily the most likely ones for the future. Rather, it means that these assumptions are reasonable representations of the information currently available from the research of the study team, from DOE and its contractors, and from other sources that have been available for inclusion in our work.

What does this projection exercise hope to accomplish? First, the study team has created a flexible and state-of-the-art system for collecting, processing, and analyzing socioeconomic information. This chapter demonstrates something of the range and capabilities of the system. Second, this system has been calibrated to the study area and is capable of adequately demonstrating impacts. Third, the "most useful" assumptions and descriptions are probably within a reasonable range of accuracy (under the conditions described in this report) and therefore can be useful in identifying the potential geographical distribution of impacts, whether these impacts might be positive or negative, and whether it is likely that the impacts will be small or large. In the end, this exercise should alert public officials and other interested parties to possible impacts and, in this way, contribute to planning for various possible outcomes of the repository program.

In this report, the following questions also have been addressed:

- What areas and/or communities are likely to experience impacts and therefore need oversight attention?
- Who is likely to experience the impacts and why?
- What capabilities are needed to deal with the possible impacts and how are the communities/jurisdictions/agencies to obtain/apply the needed capabilities?

Not all parts of these questions will have been answered in every case. However, the process of addressing them will help define some of the answers and will identify items for further study and for policy and strategy consideration by public officials.

A final introductory point should be made. In Chapter 2, the findings of the research to date indicated a very real possibility of risk-induced effects from the Yucca Mountain repository. These risk-related effects are discussed in qualitative terms as a potential area of concern that cannot be overlooked at present but which needs more study in order to be included in a fully quantified socioeconomic impact assessment. The potential importance of these impacts is discussed, but the data base for more fully measuring and evaluating them is still under development.

The project characteristics that are most likely to serve as driving variables for change are described in Section 4.2, below. This section incorporates what has been presented by DOE as the description of the proposed project. The economic and demographic section (4.3) briefly summarizes the net employment and population impacts at both the county and the state level of aggregation; additional economic-demographic outputs are shown in the community section. Since so many of the individual and community concerns with the repository program are the result of the risk and hazard conditions, Section 4.3 ends with an illustration of the potential effects from these risk-related causes.

The government impact section (4.4) summarizes potential public services, facilities, and fiscal costs. These analyses use the economic-demographic findings as inputs and concentrate on presenting the fiscal impacts of the repository. Additional consideration is focused on the mandate-driven impacts at the state level. Projections are made for key agencies and institutions that must respond to either the mandate and/or the economic-demographic effects of the project. In addition to estimating fiscal costs from both these types of effects, an evaluation of political and intergovernmental issues resulting from the repository program is provided.

The community section (4.5) provides a description of how communities in Southern Nevada might respond to the impacts shown in the economic-demographic and public facilities, services, and fiscal sectors. The community-level impacts are estimated based upon the allocation of impacts to each community and an evaluation of how the specific characteristics of the community might respond to the combined impacts from all sources, including an illustration of risk effects as outlined in Section 4.3. A final section (4.6) provides a summary of the potential future impacts from the repository.

4.2 Project Description

The magnitude, timing, and distribution of repository impacts can be significantly effected by the characteristics of four major categories of the repository program: project costs, employment, revenues, and project management policies. Of course other characteristics of the project can be of critical importance, especially for those cases where there are questions of public health and safety, or those that raise important issues and concerns in regard to public policy. In terms of modeling the standard effects, however, these categories are widely recognized as essential inputs which are provided by a detailed project description.

Project costs include a number of variables, such as gross labor costs, employer contributions, materials, equipment and supply costs, indirect costs, and contingency costs. Wages and salaries from repository employment will be spent on housing, food, and commercial services producing "multiplier effects" in the local economy. The amount and place where purchases of materials, equipment, and supplies are made will have implications for indirect economic effects and for the generation and distribution of

various sales and use taxes. Other costs (e.g., telephone, office rent and utilities, contract fees, etc.) also will result in indirect economic effects. Moreover, any major project can anticipate contingency costs which cannot be specified at an early design stage.

Other factors that will affect the magnitude and distribution of impacts are the number and type of employees required to characterize, construct, operate, and decommission the repository both at the Nye County and at Clark County work sites, and the residential location of the workers and their household characteristics. Residency patterns will determine which communities will require additional housing, schools, and other local government services. Often the distribution of service requirements is not matched by the distribution of revenues, and the mismatches can strain local finances and/or reduce services to existing residents.

The characteristics of the local labor pool will affect the number of non-local workers needed. If the labor demand occurs in an area with a "tight" labor market, such as exists in Southern Nevada, or if the labor requirement is for specialized workers not locally available, then the proportion of inmigrants to fill jobs can be substantial. If, on the other hand, the local labor pool includes a significant number of unemployed or underemployed workers with the occupations and skills required at the repository, repository work force requirements may be met through increased labor force participation and/or absorption of existing underemployed (but suitably qualified) local labor rather than through inmigration.

The repository will generate revenues for both the state and local governments from a number of sources, such as sales and use taxes, property taxes, and grants. The State of Nevada levies sales taxes on taxable in-state purchases and it levies use taxes on certain goods purchased out of state (for "use" in state). These are collected at the place where purchases are made or where use takes place.

Currently, the state and local units of government are receiving grants from the Nuclear Waste Fund through DOE to oversee activities relating to the characterization of the site; these grants would be expected to be ongoing if the program proceeds. They also may be eligible in the future under Section 180 of the Nuclear Waste Policy Amendments Act (NWPAA) for grants for emergency management training. Other potential sources of revenues include Grants Equal to Taxes (GETT), and mitigation and compensation payments may be made to the state and local jurisdictions for needs or impacts created as a result of the project.

As this report has described, many aspects of the repository program and of the repository project design are at this point highly uncertain. The modeling exercise requires quantified input variables, many of which must be constructed by means of "assumptions." In assembling these variables, a detailed evaluation of the DOE project description was undertaken and original data were collected (PIC, 1988c, 1988j).

A study by Sandia National Laboratories (Gruer, Fowler, and Rocha, 1987) estimated the work force and total costs during the construction, emplacement, and

decommissioning phases. It did not, however, address the site characterization phase and, except for estimates for a 100-mile rail spur, it did not estimate the costs of improvements to Nevada highways and railroads used for nuclear waste transportation. The Sandia work force estimates identified workers at the Yucca Mountain (Nye County) work site, but excluded those at Clark County and other work sites. Its cost estimates reflected the several components of costs (labor costs, materials and equipment costs, indirect costs, and contingency) but did not identify the components individually.

As part of its response to the requirements of Section 175 of the NWPAA, DOE and SAIC developed estimates of the site characterization work force and estimates of the Clark County work force in other project phases. They also estimated materials and equipment costs during the several project phases. However, the DOE/SAIC estimates exclude all off-site improvements, including the rail spur. They also exclude indirect and contingency costs. In estimating labor costs, they include gross pay but not total labor costs (employer contributions), which at NTS range from 20 to 35 percent depending on the employee classification (DOE, 1988j).

A survey of NTS workers was conducted during 1988 to obtain data on worker residency, household characteristics, employee spending patterns, etc. In addition, Planning Information Corporation examined purchases and expenditures of 71 NTS contractors. While some differences between the NTS and the repository is expected, this data was felt to be useful in providing a better understanding of project characteristics (PIC, 1988j).

The following description includes activity at both the Nye County and Clark County work sites in all project phases, improvements to rail and highway facilities involved in nuclear waste transportation, nuclear waste transportation activities themselves, and the construction of casks for shipment of high-level nuclear wastes. It also includes an identification of labor, materials and equipment and indirect and contingency costs. All costs were identified by year, based on the schedule identified in materials prepared for DOE's "Section 175 Report" to Congress.

Finally, management policies can strongly influence the magnitude and distribution of impacts. Programs such as preferential local purchasing, policies influencing employee residence patterns, local hiring practices, etc. will be the result of future policies at the federal, state, and local levels but are difficult to predict at this time. Such alternatives for future actions have not been included in the present modeling exercise.

4.2.1 Project Costs

The DOE expenditures for the Yucca Mountain project are estimated at $8.1 billion in 1987-88 dollars, $111 million on an average annual basis. Of the total $8.1 billion, about $6.8 billion would be spent to construct and operate the surface and subsurface repository facilities, and $1.3 billion would be spent to manage the process. The $8.1 billion figure includes estimates for all project phases (including site characterization), for all labor costs (including overtime pay and employer contributions), for materials, equipment and supplies, and for indirect and contingency costs.

The present assessment exercise also includes a rough estimate of the cost of improving routes for the safe transportation of radioactive waste in Nevada. These costs add $1.06 billion, bringing the subtotal to $9.1 billion. Not included in the present estimates are the costs of the high-level radioactive waste transportation itself, an activity that is largely based outside Nevada. Also excluded are the costs of waste package fabrication which is assumed to occur at one of several existing facilities outside the State of Nevada. DOE estimates for these elements add $2.3 billion to system-wide project costs, bringing the total to $11.4 billion. With the exception of the off-site transportation improvements, all the cost estimates used in this assessment are consistent with those developed by DOE (e.g., Gruer, Fowler, and Rocha, 1987).

For the current assessment, the study team developed annual estimates of labor, materials and equipment, and contingency costs at the Nye and Clark County work sites. Labor costs distinguish base pay, gross pay (including overtime) and total labor costs (including employer contributions). Purchases are identified by type as well as by year.

Of the $8.1 billion figure, an estimated $2.9 billion (36 percent) would be spent on wages and salaries, with an additional estimated $748 million (9.3 percent) spent on employer contributions to labor costs. As Table 4-1 shows, an estimated $1.9 billion (22.9 percent) would be spent on purchases of materials, equipment, and supplies. In-state purchases indirectly generate local employment and income and will be discussed in Section 4.2.3, below. An estimated $2.6 billion (31.8 percent) would be spent on indirect and contingency costs, the impacts of which would be similar in nature to purchases of materials, equipment and supplies. Indirect costs include: telephone costs, office rent and utilities, contract fees (profits), equipment rental, employee training costs, travel, etc.

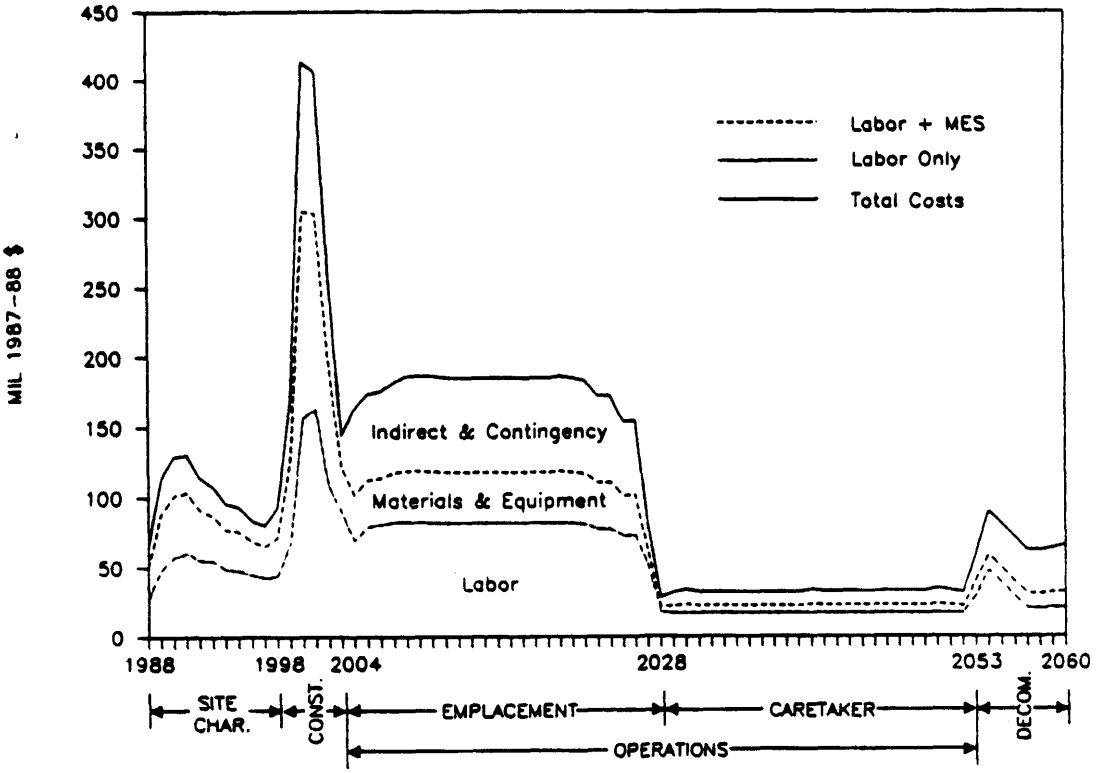
Repository spending could result in impacts for the Southern Nevada economy as a result of: (1) wages, salaries and other employment expenses; (2) the purchase of materials, equipment and supplies, (3) the indirect costs and contingency costs; and (4) major costs from building and upgrading key links in the transportation system, such as the proposed rail spur and highway route improvements. As monies are spent in the local economy for all these activities, additional jobs and spending results, especially in the service sectors.

Both the DOE cost estimates and those of the study team are subject to considerable uncertainty, as is discussed in the following section. The level of certainty is perhaps greatest regarding labor costs, but even here changes in project design, schedule and compensation rates could result in significant changes to estimates of spending in Southern Nevada. The current estimates for project purchases are highly uncertain, especially with regard to the purchase categories and the likely purchase patterns. These are matters of direct impact on spending in the local economy. The estimates of ancillary facility costs, in themselves fairly large construction projects, are very uncertain. For transportation-related work, neither the modes nor routes for radioactive waste transportation have been identified, and the schedule and funding for such improvements have not been determined. On the other hand, the estimates of how

TABLE 4-1
PROJECTED REPOSITORY COSTS: BY COST CATEOGRY
(MIL 1987-88 $)

	Site Character-ization	Construc-tion	Emplace-ment	Caretaker	Decommis-sioning	Total
Total						
Average Annual	101.4	246.9	169.5	33.9	70.8	110.6
Maximum Year	130.5	413.5	186.5	59.7	89.6	413.5
Sum						8,076.3
Total Labor						
Average Annual	48.7	104.9	76.3	17.5	27.9	50.1
Maximum Year	60.4	163.3	82.5	29.7	47.2	163.3
Sum						3,656.4
Materials, Equipment and Supplies						
Average Annual	32.2	81.7	32.7	5.7	11.0	25.3
Maximum Year	44.0	147.4	36.7	10.5	11.7	147.4
Sum						1,849.5
Indirect & Contingency						
Average Annual	20.4	60.4	60.5	10.7	32.0	35.2
Maximum Year	27.9	109.0	68.0	19.6	34.0	109.0
Sum						2,570.5

Source: Planning Information Corporation, 1989.



the local economy would respond to these sources of major additional spending, is reasonably well understood at this time, and can be modeled and analyzed with some confidence.

The local employment that results from spending in each of the cost categories, above, depends upon many factors, perhaps the most important being the amount of money actually going to local businesses and people. At the peak construction year (2001), about 3,400 employees could be working at the Yucca Mountain site, accounting for project spending of $163 million. Purchases of about $140 million in materials and equipment (much of it out of state) could result in about 1,100 jobs in Nevada. Spending of $103 million in indirect and contingency funds could create another 1,700 jobs, while construction of $100 million worth of transportation facilities could require as many as 1,750 workers. The total jobs directly and indirectly associated with the repository project could approach 8,000.

The response of the local economy to the spending of hundreds of millions of dollars in these categories, and to the 8,000 new jobs could be substantial, given the current and projected economy for Southern Nevada. These induced effects, especially in the service sectors, could bring the total employment effects--adding together the direct basic, the indirect basic and the induced nonbasic--to about 16,000 jobs. This would imply that about 1.03 induced nonbasic jobs would be added in response to each basic repository-related job.

The proposed repository for high-level nuclear waste is not only large and complex, it is also a first-of-its-kind facility, about which regulatory agencies and the public in general have special concerns. Even with the generous contingency factors included in some of DOE's preliminary estimates (Gruer, Fowler, and Rocha, 1987, pp. 4-9), the project provides many opportunities for cost estimates to be exceeded.

- The more detailed repository engineering design undertaken for the NRC License Application (or the NRC review of this engineering design) could identify additional cost elements of the project as currently proposed which have not been anticipated in studies to date.

- Changes in the project as currently proposed are possible, even likely. These range from major changes, such as the inclusion of a monitored retrievable storage facility, to lesser changes such as the "hardening" of surface facilities under Nellis AFB flight patterns, or the specific requirements associated with proposed transportation routes and modes.

- The project could experience NRC licensing or other regulatory delays. Delays are also possible due to labor problems, equipment breakdowns, weather conditions, unanticipated site conditions, etc.

- The repository could be required to accept additional high-level nuclear wastes or additional types of nuclear waste, or it could be required to retrieve wastes after

emplacement. These changes in basic mission could involve substantial additional costs.

4.2.2 Work Force, Earnings, and Residency

Work Force Hiring

Some portion of repository workers could be hired from the existing Southern Nevada work force, including those currently employed at NTS. The portion depends on the attractiveness of repository jobs in comparison to similar jobs elsewhere in Southern Nevada, and the available local pool of workers with the skills required.

Nevada's unemployment rate of 4.4 percent is below the national average (5.4 percent for November, 1988). Labor force participation rates in Nevada are particularly high (males were 81 percent in 1980 vs. 75 percent in the nation; females were 60 percent vs. 50 percent in the nation), and the indications are that labor force participation has continued to increase in the 1980s. A major question becomes, how many employees, particularly skilled workers, can be obtained from the Nevada labor supply.

These considerations suggest that repository workers would be either inmigrants, or if local hires, persons whose current jobs would then be filled by inmigrants. This applies to NTS as well as to the Southern Nevada labor market in general. Assuming that NTS activity remains at its current levels and that current NTS workers are fully employed, these workers cannot be hired for assignment to repository jobs without replacement by inmigrants to the tight current Southern Nevada labor market.

Work Force Residency

Residency patterns have important implications, not only for the distribution of economic and fiscal impacts among local jurisdictions, but also for the quality of life of workers and the character of affected communities. The residential choices of repository workers will depend in part on the worker's basic preferences, in part on the management policies of the lead agency, and in part on the character of the communities in the vicinity.

The study team has made a significant effort to learn more about the likely residential preferences and residential choices of repository workers--as revealed by the choices of a large group of existing workers employed by the same lead agency (DOE) and involved in similar activities at a close-by work site (NTS). With the cooperation of DOE and of its major contractors at NTS (REECo, EG&G, Holmes and Narver, Fenix & Scission, Wackenhut, etc.), a survey of 3,500 NTS workers was conducted, with a response rate of over 90 percent (PIC, 1988c; 1988e; 1988j). In addition to residency, the survey provides information on many work force characteristics which may help determine or explain residency--commuting time, household characteristics, occupation and employment type, hiring characteristics, work schedule, employment of other workers

in households, as well as the worker's satisfaction with various aspects of his community and his life in general.

The analysis of these data provides insights on how workers at the repository work sites might choose among residential options. These choices might be modified by various project management options, the evolution of dynamic Southern Nevada communities and community development investment targeted to the greatest enhancement of worker satisfaction.

Table 4-2 presents estimated employment by type (direct basic, indirect basic, and induced nonbasic), by place of residence (Clark, Nye and Lincoln Counties), for the year of peak employment, 2001. Total employment impacts are estimated at 15,570 for Southern Nevada and at 16,450 for the state as a whole.

The direct basic workers assigned to repository work at the Nye and Clark County work sites are estimated at about 3,400, or approximately 22 percent of the total basic work force. Twenty-nine percent of the total (about 4,550 workers) are indirect basic employees associated with materials purchases and offsite transportation improvements in Nevada. About 7,620 (49 percent) of the workers are estimated for the induced nonbasic impacts, jobs that would occur mostly in the service and trade sectors of the Southern Nevada economy.

Clark County is expected to receive about 14,669 employees in the peak year, including 2,906 direct basic (20 percent), 4,414 indirect basic (30 percent) and 7,349 (50 percent) induced nonbasic jobs.

Nye County could receive about 793 employees by place of residence in the peak year, including 447 direct basic (56 percent), 100 indirect basic (12.5 percent), and 246 (31 percent) induced nonbasic jobs.

The figures for Lincoln County show estimates of 108 employees by place of residence during peak year with 46 direct basic (43 percent), 37 indirect basic (34 percent) and 25 (23 percent) induced nonbasic jobs.

Repository workers whose jobs are based in Clark County would face residential options similar to those of other Las Vegas urban area residents. The current projection assumes that the Clark County work force will be distributed according to population growth in the urban area during the 5-year period since the recession of 1982. Thus, the City of Las Vegas' share of the Clark County work force is similar to its share of the 1982 Las Vegas urban area population (35 vs. 36 percent); Henderson's share is substantially greater (11.5 percent vs. 6 percent); the unincorporated area's share is slightly greater (52 percent vs. 49 percent), and the North Las Vegas share is significantly smaller (2 percent vs. 6 percent). These assumptions reflect recent growth patterns but do not reflect vacant land, transportation improvements, and other factors that could affect patterns of future growth. Nor do they reflect the specific locations of repository-related jobs within the Las Vegas urban area and their effects on residential choices.

TABLE 4-2
ESTIMATED REPOSITORY-RELATED WORKFORCE
BY CATEGORY AND BY PLACE OF RESIDENCE
PEAK YEAR (2001)

	Employment by Place of Residence				Percent Employment by Place of Residence			
	Total*	Clark	Nye	Lincoln	Total*	Clark	Nye	Lincoln
Direct Workforce:								
Nye Worksite	3,140	2,646	447	46	20.2%	18.0%	56.4%	42.7%
Clark Worksite	260	260	0	0	1.7%	1.8%	0.0%	0.0%
Sub-total	3,400	2,906	447	46	21.8%	19.8%	56.4%	42.7%
Indirect Workforce:								
Materials & Equipment Purchases	1,100	1,067	22	11	7.1%	7.3%	2.8%	10.2%
Other Indirect Costs, Contingencies	1,700	1,649	43	9	10.9%	11.2%	5.4%	7.9%
Offsite Transportation Improvements	1,750	1,698	35	18	11.2%	11.6%	4.4%	16.2%
Sub-total	4,550	4,414	100	37	29.2%	30.1%	12.5%	34.2%
Total Basic Workforce	7,950	7,320	547	83	51.1%	49.9%	69.0%	76.9%
Induced Workforce	7,620	7,349	246	25	48.9%	50.1%	31.0%	23.1%
Total Workforce*	15,570	14,669	793	108	100.0%	100.0%	100.0%	100.0%

*Total for Clark, Nye, and Lincoln counties.
Source: Planning Information Corporation and Mountain West, 1989.

Work Force Wages and Salaries

Average wages for direct basic workers (1987-88$, including overtime but excluding employer contributions) are estimated at $35,200 for all employees, $41,800 for exempt (professional and managerial) workers, $31,100 for technical and clerical workers and $33,700 for union workers in the various crafts. Indirect basic and induced nonbasic income vary by economic sector but range from minimum wages of less than $10,000 in the service and trade sector to over $40,000 in some of the professional and technical fields.

4.2.3 Project Revenues

Historically, much of the materials, equipment, and services required in the Southern Nevada economy has been purchased out of state and the "Nevada content"[1] of in-state purchases has been low. This has been true at Nellis, at NTS, in the mining industry, and even in the visitor/gaming industry.

An analysis of NTS purchases shows that only about 31 percent are made from Nevada firms and the "Nevada content" of purchases made from Nevada firms is very low, less than 10 percent (PIC, 1988j). The Nevada content was above the average in categories such as cement and concrete, mining, trucking and warehousing, and personal, miscellaneous business and medical services, but below the average in categories such as primary and fabricated metals, machinery, transportation equipment, and instruments. However, as the Nevada economy develops (particularly if development is combined with a targeted economic development strategy) the percent of repository purchases in Southern Nevada could increase over the NTS experience, as could the percent of the Nevada content. This is especially relevant in the case of the repository project, which could involve $4 to $5 billion in purchases over a 70-year period.

Sales and Use Tax Revenues

The State of Nevada levies sales taxes on taxable in-state purchases and use taxes on certain goods purchased out of state (for "use" in state). The taxes take several forms: a 2 percent state sales tax, a 0.5 percent Basic City/County Relief Tax (BCCRT), a 1.75 percent Supplemental City/County Relief Tax (SCCRT), and a 1.5 percent Local School Support Tax (LSST). For this report, the study team has assumed that federal contractors will continue to pay sales and use taxes on materials purchased for use at NTS, and that even if they were not required to pays at NTS, they would be required to do so at the repository, under provisions of the NWPA.

Taxable Purchases. The taxable portion of purchases of various types must at this point be based on rather crude assumptions, rather than on more refined assumptions based on scrutiny of past experience at NTS or other major projects with similar

[1]The Nevada "content" is the Nevada portion of the total cost in resources, manufacture, distribution, and sales and service required to create a good and deliver it to its place of use.

purchase requirements. The study team has analyzed DOE estimates (Gruer, Fowler, and Rocha, 1987) and made assumptions about the purchases of furniture and fixtures, motor vehicles and transportation equipment, apparel, eating and drinking, other retail trade and wholesale trade, paper and printing, mining, and construction categories. These assumptions indicate that about 32 percent of all repository purchases would generate sales and use taxes, though the percentage varies from phase to phase and from year to year.

Out-of-State Purchases. Based on analysis of the NTS experience, the study team estimated that about 64 percent of the repository-related purchases would be made out of state, although the percentage varies among purchase categories and from year to year. The distribution of in-state purchases was examined and a set of assumptions were made for each purchase category. The result was that a portion (10 percent or less) of the purchases would be made in Nye and Lincoln counties, but that most would be made in Clark County.

Sales and Use Tax Projections. Based on the above considerations, $787 million (1987-88 dollars) in taxable sales could be generated from $2.7 billion in repository-related purchases in all project phases. The information shown in Table 4-3 shows that on this taxable base, $45.3 million in sales and use taxes could be generated. Further analysis has shown that $15.7 million would come through the state sales tax, $13.8 million through the SCCRT, $3.9 million through the BCCRT, and $11.8 million through the LSST. Sixty-four percent of BCCRT revenues (the out-of-state portion) would be distributed among counties based on their shares of statewide population, and a similar portion of LSST revenues would be distributed directly to the State Distributive School Fund.

Grants Equal to Taxes (GETT)

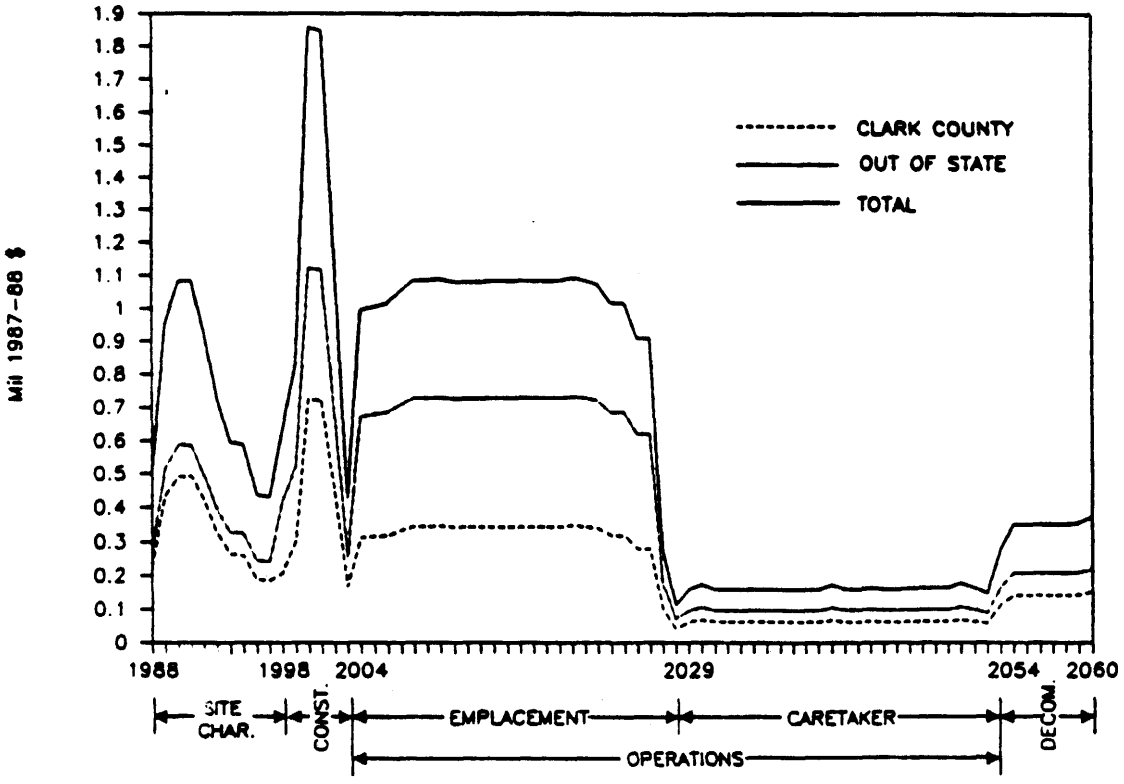
Section 116(c)(3) of the Nuclear Waste Policy Act of 1982 requires that DOE "grant to each state and unit of general local government in which a site for a repository is approved . . . an amount each fiscal year equal to the amount (each) would receive were they authorized to tax site characterization . . . development and operation . . . (as they would) other real property and industrial activities . . ." This grants (or payments) equal to taxes (GETT) provision has raised numerous issues regarding both its intention and application. The issues are likely to continue for years, with resolution emerging from a negotiation process involving high-level policy-makers at the federal, state, and local levels. Among the issues are: the basis for valuing a one-of-a-kind, high-level nuclear waste repository; the state and local tax rates that may be applied; the degree to which GETT is considered an ordinary tax or a special grant; the potential for distribution of the resulting revenues among state and local governments; the schedule and source from which GETT payments would be made; and the possibility of Congress eliminating the GETT provisions from the NWPA. Given these uncertainties, GETT revenues have not been incorporated into the fiscal analysis of repository impacts for this report.

TABLE 4-3
ESTIMATED REPOSITORY-RELATED SALES TAX REVENUES*
(000 1987-88 $)

	Site Characterization	Construction	Emplacement	Caretaker	Decommissioning	Total
Total						
Average Annual	733	1,122	982	167	355	620
Maximum Year	1,085	1,857	1,092	279	376	1,857
Sum						45.3 mil
Out of State						
Average Annual	400	686	661	101	209	392
Maximum Year	588	1,121	734	164	221	1,121
Sum						28.6 mil
Clark County						
Average Annual	330	429	312	65	144	223
Maximum Year	494	726	349	113	153	726
Sum						16.3 mil
Nye County						
Average Annual	2	5	6	1	1	3
Maximum Year	3	8	7	1	2	8
Sum						235
Lincoln County						
Average Annual	1	2	2	-	1	1
Maximum Year	1	3	3	-	1	3
Sum						89

* All sales and use tax resources (State 2%, SCCRT, BCCRT, LSST), by point of sale. PIC estimates of distribution of sales by category given current distribution patterns and policies.

Source: Planning Information Corporation, 1989.



4.2.4 Management Policies

Management policies of the lead agency are important factors that will affect the magnitude and distribution of many types of impacts. Such policies can strongly influence an employee's decision on where to live and even how to live while on the job. On-site housing can encourage employees to live away from their families during the workweek. Employee work schedules and employer busing policies are significant factors affecting transportation costs, traffic impacts, and the number of peak hour work trips. Management also could establish job training programs and policies could be established to increase the portion of the purchases made from Nevada firms.

4.3 Economic and Demographic Projections and Impacts

4.3.1 Overview

The purpose of this section is to describe the economic and demographic impact projections for the State of Nevada, and Clark, Nye, and Lincoln counties. These forecasts were produced through the application of the FS-53 model developed by Regional Economic Models Incorporated (REMI) for Nevada. Because data collection in Esmeralda County has not been completed, impacts have not yet been modeled but remain the subject of further study. An evaluation of this model was prepared in 1988 (Mountain West, 1988a).

The FS-53 model is a multi-regional model that is based on the theory that goods and services produced within a region for export to other regions are the basis for current and projected economic activity. Exports from the region depend on the level of activity within other regions, and at the national and international levels. Thus local activity is sensitive to variables such as national and international demand. In addition, interindustry linkages which represent the sales of intermediate goods or services from one industry to another within the region, are incorporated within the model. Demand stimulated in the hotel industry, for example, causes an increase in activity in those economic sectors which sell to the hotel industry. Households, government, and investment also are included as components of final demand within the model.

Factor costs which affect the competitiveness of the region are included in the model. Relative labor, energy, transportation, and capital costs are among these components. Importantly, the factor costs also affect the utilization of labor and capital in the production process. As labor costs rise, for example, capital is substituted for labor reducing the demand for labor which may attenuate rising labor costs.

The demographic module of the FS-53 model provides projections of population. Births and deaths are projected based on a cohort-survival model calibrated for each region. Migration is assumed to be a function of the relationship between the local population levels and the demand for labor or the attraction of the area to non-labor movers, such as retired people. The FS-53 model for Nevada is divided into five

regions: Clark County; Nye County; Lincoln County; Washoe County and Carson City; and the rest of Nevada.

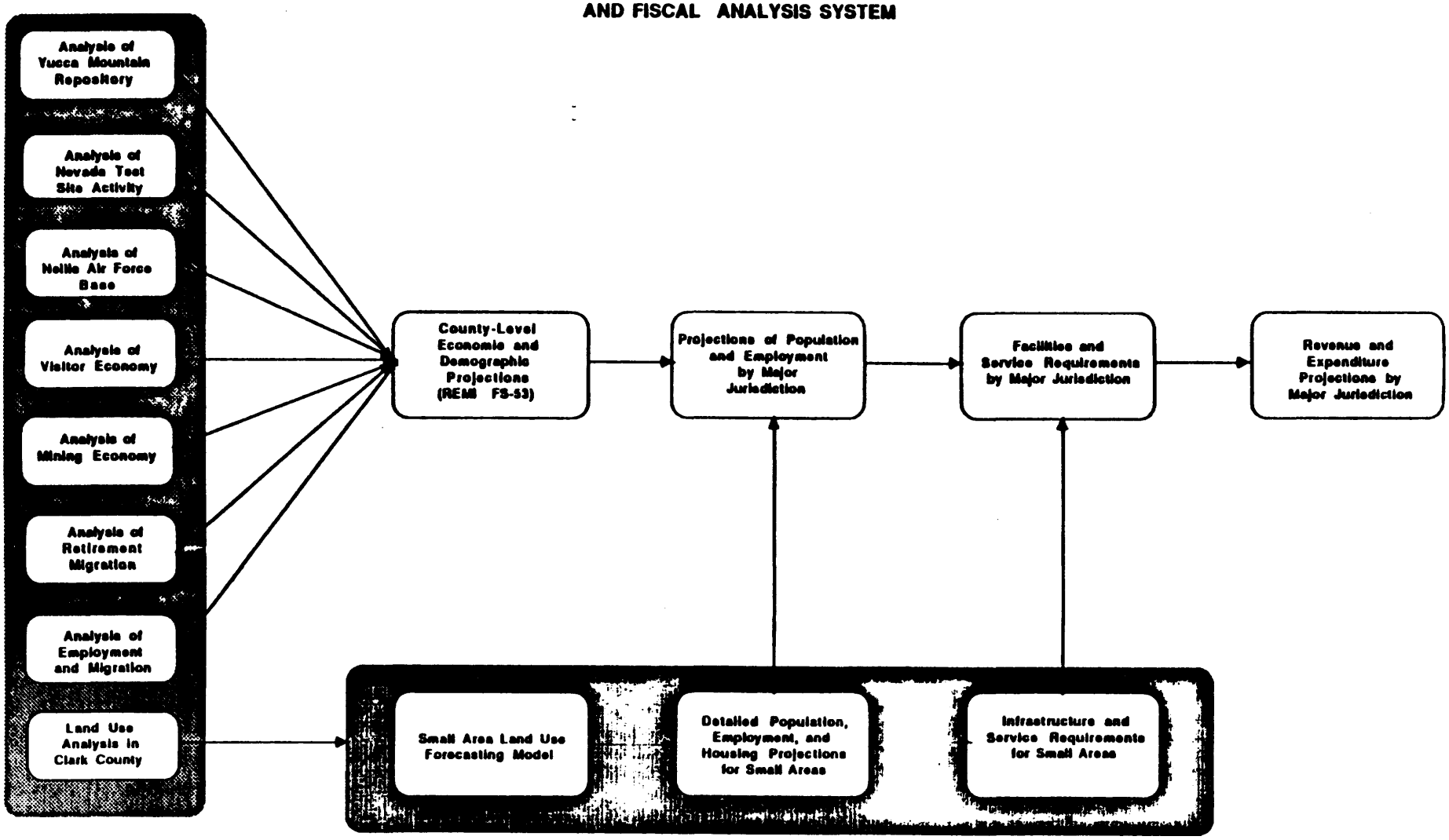
Projections of the economic and demographic effects of the repository were the result of a two-step process. First, a baseline projection was developed which assumes that no further repository-related activities occur within Nevada. The baseline forecast started with the default forecast from the FS-53 model which incorporates projections of national economic activity into the forecasts of activity within each region. These forecasts were then modified to incorporate the results of the various industry studies and research conducted by the project team. For example, the forecast for the visitor economy in Clark County was modified to reflect the anticipated development within the industry and the expected long-term trends, as were the current and projected new gold mining activities in Nye County.

The second step was to forecast economic and demographic activity assuming the repository would be sited at Yucca Mountain. The projection series makes the same assumptions that were incorporated in the baseline projections, but also includes the employment and income of the repository workers (based both in Nye and Clark counties), the purchase of materials and services, the construction of the rail spur to the site, and necessary improvements to the highway system to handle the waste shipments. Not included are the waste container fabrication facility, which is assumed to be located outside of Nevada, and the direct economic effects of those transportation-related activities which are assumed to be based outside of Nevada. Documentation of the runs made for this impact assessment exercise are in preparation (Anderson, forthcoming).

The REMI model produces estimates and projections at the county level. These are aggregated to show regional and state results and disaggregated to subcounty areas including cities, towns, and jurisdictions, or service areas. Subcounty allocations were made for cities, towns, and other jurisdictions. The results of these subcounty allocations are discussed in Section 4.5, below, where the community impacts are examined. Figure 4-1 presents an overview of the proposed economic and fiscal analysis system. As this figure notes some components of this system are under development, but are not at a point where they could be implemented to produce information for this Interim Report. Other components are mostly implemented although there are limitations when applied to some rural communities due to the need for further data collection, verification, and calibration.

The methodology used to conduct the subcounty analysis begins with the allocation of employment by place of work to the subcounty areas. This allocation was done for each major employment category and was based on a detailed analysis conducted for each county. The next step was to allocate the employment by place of work to places of residence on a sector by sector basis. The final step is to convert the employment by place of residence to population. This was accomplished by relating the relative distribution of the change in employment by place of residence in a county to the distribution of the county-wide population change.

FIGURE 4 - 1
OVERVIEW OF
ECONOMIC/DEMOGRAPHIC
AND FISCAL ANALYSIS SYSTEM



The projections are presented for selected years during the period 1988 through 2030. There are two levels of information displayed. First, the total employment and population which includes both the baseline and the with-project totals for these categories. Second, the impacts for employment and population are shown along with the percent of the total population and employment projections. The years shown were selected to present an overview of the possible impacts and to highlight information for certain key years. For example, the year 2001 is shown because the greatest total impacts resulting from project activities would be expected to occur during this year. The year 2003 was shown because it has been identified by DOE as the year in which operations are scheduled to begin.

4.3.2 State of Nevada

The State of Nevada and the southern region are projected to continue to grow rapidly through the turn of the century, and at declining rates thereafter according to the projections made for the baseline and other alternative scenarios. The changing composition of the state economy generally reflects the expansion of the business services, finance, and wholesale trade components which is related to the increasing importance of the links to the California economy. The service sector of the economy which includes visitor spending is projected to continue to dominate the economic base of the state. By the year 2010, this sector is projected to account for 46.4 percent of the total employment in the state. By 2030, its share rises to 48.1 percent. Within the service sector, however, the hotel and motel sector is projected to grow more slowly than the business and professional service component. The finance, insurance, and real estate sector also increases its share of total employment, rising from 7.4 percent in 1988 to 9.0 percent in 2010 and to 9.3 percent in 2030. Wholesale trade increases from 3.2 percent in 1988, to 4.1 percent in 2010, and 5.0 percent in 2030.

Total employment for the state is projected to increase at an annual rate of 2.4 percent between 1988 and 2010 rising from 642,941 to 1.1 million over this period (see Table 4-4). The rate of economic expansion slows considerably during the next twenty year period. By the year 2030, total employment in the state is projected to exceed 1.3 million, which represents an annual increase of about 1.0 percent.

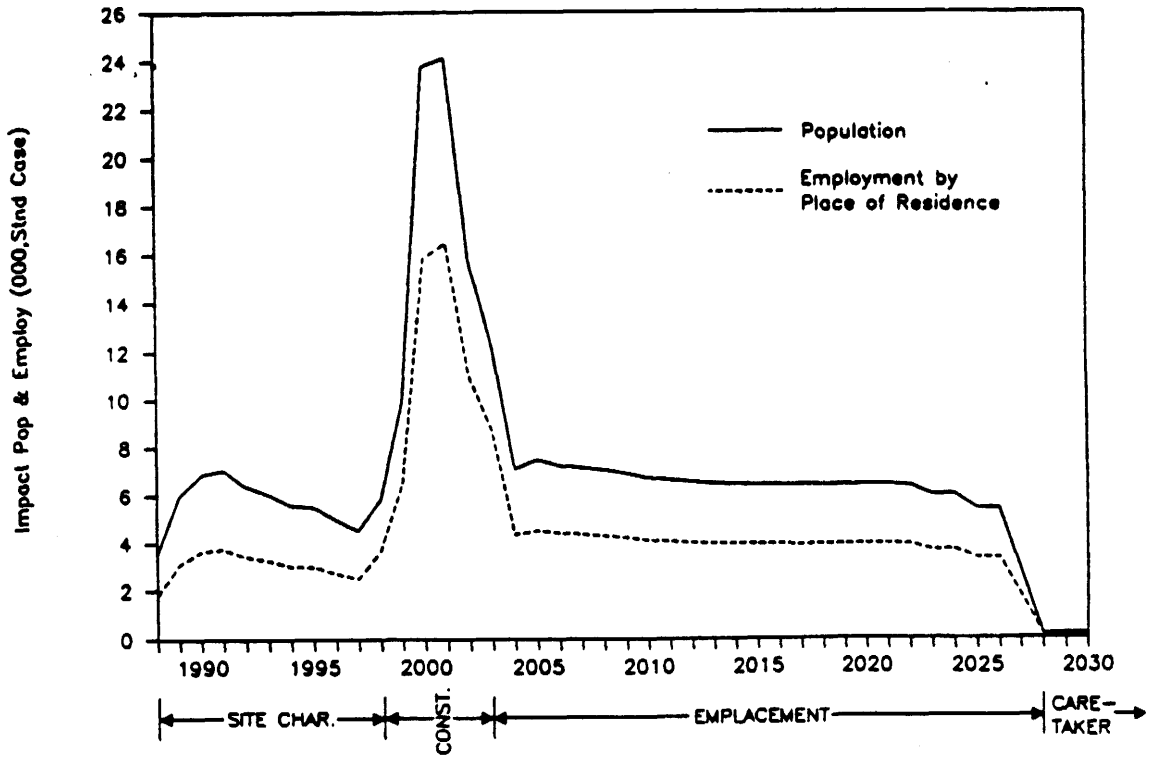
Population follows a similar trend. Between 1988 and 2010, the population grows at an annual rate of 1.9 percent reaching almost a level of 1.7 million. The fact that population grows more slowly than employment is because the projected ratio of employment to population, both nationally and within Nevada, is expected to increase over this period of time. After 2010, the employment to population ratio is projected to flatten out. By the year 2030, the population of the state is projected to be just over 2.0 million.

The repository-related employment and population impacts in Table 4-4 show that employment could vary on an annual basis between 3,000 and approximately 4,000 with a sharp rise at peak construction that could reach the 15,000 to 16,000 range. The repository-induced percentage of total state-level employment would generally be in the

TABLE 4-4
NEVADA STATE-LEVEL EMPLOYMENT AND POPULATION PROJECTIONS WITH REPOSITORY FOR SELECTED YEARS 1988-2030

	State-Level Projections[1]		State-Level Repository Impacts			
			Employment		Population	
Year	Employment	Population	Number	Percent[2]	Number	Percent[2]
1988	642,941	1,100,610	1,797	0.28%	3,514	0.32%
1989	663,024	1,137,124	3,128	0.47%	5,979	0.53%
1990	691,960	1,178,136	3,666	0.53%	6,884	0.58%
1995	794,545	1,334,388	2,993	0.38%	5,513	0.41%
2000	914,257	1,467,512	15,830	1.73%	23,756	1.62%
2001	935,852	1,486,963	16,450	1.76%	24,099	1.62%
2003	971,087	1,512,042	8,684	0.89%	12,221	0.81%
2005	1,010,552	1,541,903	4,519	0.45%	7,486	0.49%
2010	1,094,948	1,659,277	4,094	0.37%	6,712	0.40%
2020	1,233,683	1,868,452	3,956	0.32%	6,455	0.35%
2030	1,327,955	2,006,598	118	0.01%	200	0.01%

[1]Impact projection runs for the SIA models were made during the period November-December, 1988. The model outputs were calibrated to official state population estimates for 1987 (Nevada Department of Taxation), the most current figures then available. Some local jurisdictions feel that the Department of Taxation estimates while official for state revenue distributions do not accurately represent their current populations.
[2]Percent of estimated and projected direct and indirect population for the State.
Source: Mountain West, 1989.



range of a third to a half of one percent, excepting again the peak construction period where it could rise to as much as one and three quarters percent. This level of employment state-wide could result from the combination of the on-site workers (in Nye and Clark counties) and the expenditures for materials and services, rail spur construction and highway improvements. The additional input to the Nevada economy of these off-site activities could approach $1 billion; and thereby contributes a significant portion to the total employment and population impacts. Following emplacement, the impacts would drop to 118 jobs, and 200 people, less than .01 percent of the state total.

The graphic representation of the employment and population figures shows a sharp increase and decline that coincides with the construction period. It should be noted that these projections apply only to the standard effects and that if there were to be negative risk-related impacts these could combine with the results estimated here to produce a markedly different pattern for both jobs and population.

4.3.3 Clark County

The economy of Clark County is projected to diversify in the future. By 2010, the county should be somewhat less dependent on tourism with the emergence of the distribution industry and increased financial, business, and professional service activity. The hotel sector's share of total employment is projected to decline from 19.2 percent in 1988 to 17.0 percent by 2010 and to 14.5 percent by 2030. By 2010, business and professional services should account for about one in every five jobs compared to about one in six in 1988. By the year 2030, 25.1 percent of the employment in the county will be in the business and other services category. The wholesale trade sector, which is related to both local growth and the important distribution industry linkages to Southern California, is projected to increase from 3.1 percent to 5.4 percent over the projection period.

The employment projections indicate strong growth to the year 2010 as shown in Table 4-5. Over this period, just over 300,000 new jobs are expected in the county, an average annual growth of 2.8 percent. Employment growth is projected to slow over the next 20-year period to a rate of 1.3 percent. This slower growth primarily reflects a decline in the rate of growth within the hotel sector of the economy. By the year 2030, total employment in Clark County is projected to exceed 850,000.

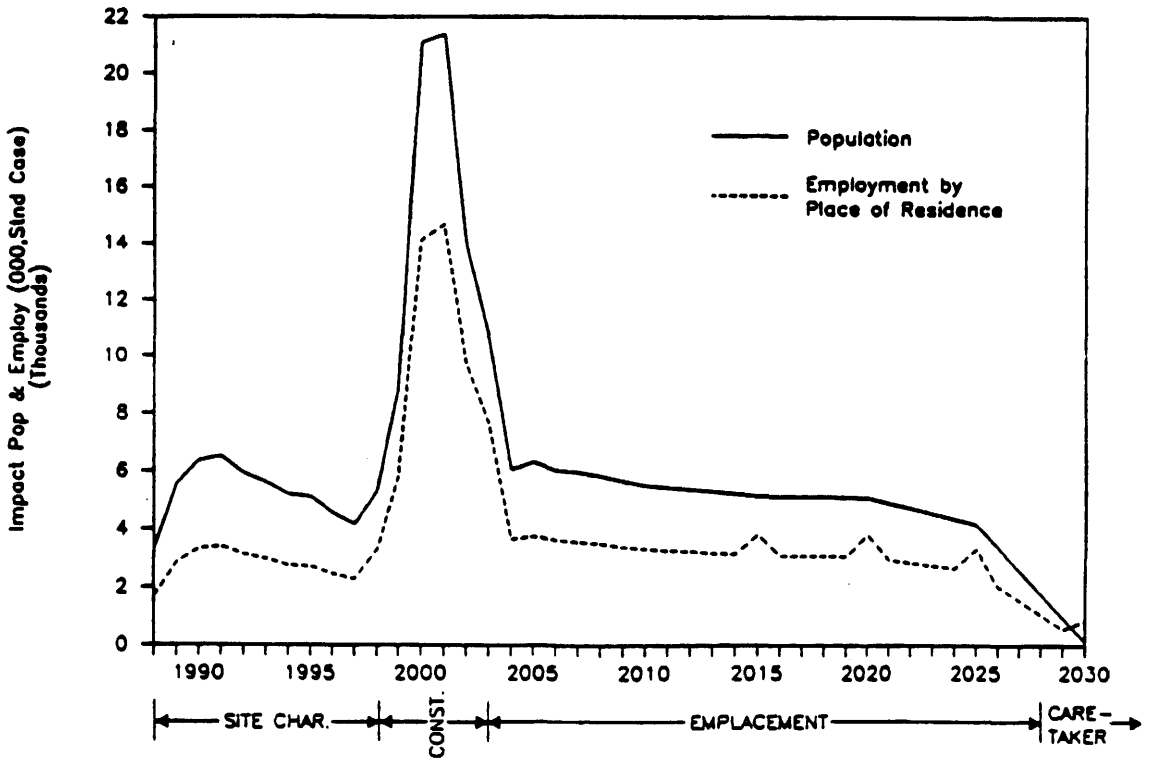
By the year 2010, the population of Clark County should be approaching 1.1 million. Between 1988 and 2010, the rate of population growth is projected to be 2.2 percent annually with a higher rate projected for the 1990s as planned additions to the supply of hotel rooms in the county are completed. After 2010, the rate of population growth slows to 1.2 percent annually.

The projections of the repository development show that for the most part the addition to the total county employment will be less than one percent with a peak during construction that could be more than 2.5 percent. The number of workers living in Clark County could be in the 3,000 to 4,000 range with up to 14,000 at the peak

TABLE 4-5
CLARK COUNTY EMPLOYMENT AND POPULATION
PROJECTIONS WITH REPOSITORY FOR SELECTED YEARS
1988-2030

	Clark County Projections[1]		Clark County Repository Impacts			
			Employment[2]		Population	
Year	Employment[2]	Population	Number	Percent[3]	Number	Percent[3]
1988	361,588	663,730	1,682	0.47%	3,324	0.50%
1989	374,142	688,335	2,862	0.76%	5,565	0.81%
1990	391,593	715,333	3,341	0.85%	6,383	0.89%
1995	455,477	821,383	2,741	0.60%	5,127	0.62%
2000	539,423	925,572	14,133	2.62%	21,132	2.28%
2001	554,344	940,909	14,669	2.65%	21,385	2.27%
2003	576,588	958,961	7,668	1.33%	10,678	1.11%
2005	602,344	981,506	3,782	0.63%	6,334	0.65%
2010	665,602	1,075,296	3,331	0.50%	5,515	0.51%
2020	774,875	1,247,425	3,093	0.40%	5,105	0.41%
2030	852,955	1,366,783	50	0.01%	123	0.01%

[1]Impact projection runs for the SIA models were made during the period November-December, 1988. The model outputs were calibrated to official state population estimates for 1987 (Nevada Department of Taxation), the most current figures then available. Some local jurisdictions feel that the Department of Taxation estimates while official for state revenue distributions do not accurately represent their current populations.
[2]By Place of Residence
[3]Percent of estimated and projected direct and indirect population for the jurisdiction.
Source: Mountain West, 1989.



of construction. During the emplacement period, employment impacts could be about 0.5 percent, with the absolute number of jobs averaging around 3,000. During the caretaker phase of the project, the employment impacts for Clark County could be very small, totalling about 50 jobs in the year 2030.

The population impacts follow a similar trend. Population increases would generally be in the range of 5,000 to 6,000 with peaks that could top 20,000 during the maximum construction period employment. To put these figures in perspective for the county, these peak period increases are equivalent to the impacts resulting from the operation of a mid- to large-size hotel/casino. During the emplacement phase of the project, the population impacts average around 5,000 persons or 0.4 percent of the population projected for the county. The caretaker phase of the project results in a gain of 123 persons in Clark County.

4.3.4 Nye County

Nye County is projected to grow at an annual rate of 1.1 percent between 1988 and 2010. During the 1990s, employment is expected to increase at a faster pace due to increased mining activity in the county. As this activity falls off after the year 2000, the rate of employment growth in the county declines. From its current share of 9.8 percent of total employment, the mining sector is projected to account for 5.6 percent by 2010 and 4.3 percent by 2030. The major growth sector is projected to be services which increases its share of employment from 67.5 percent to 71.3 percent by 2010 and to 73.0 percent by 2030. Total employment by place of work (which includes people residing in Clark and other counties) is projected to rise from 13,007 in 1988 to 16,595 by the year 2010. Over the next 20 years, the baseline projections indicate that an additional 2,690 jobs will be created in Nye County resulting in total employment of 19,279 in 2030.

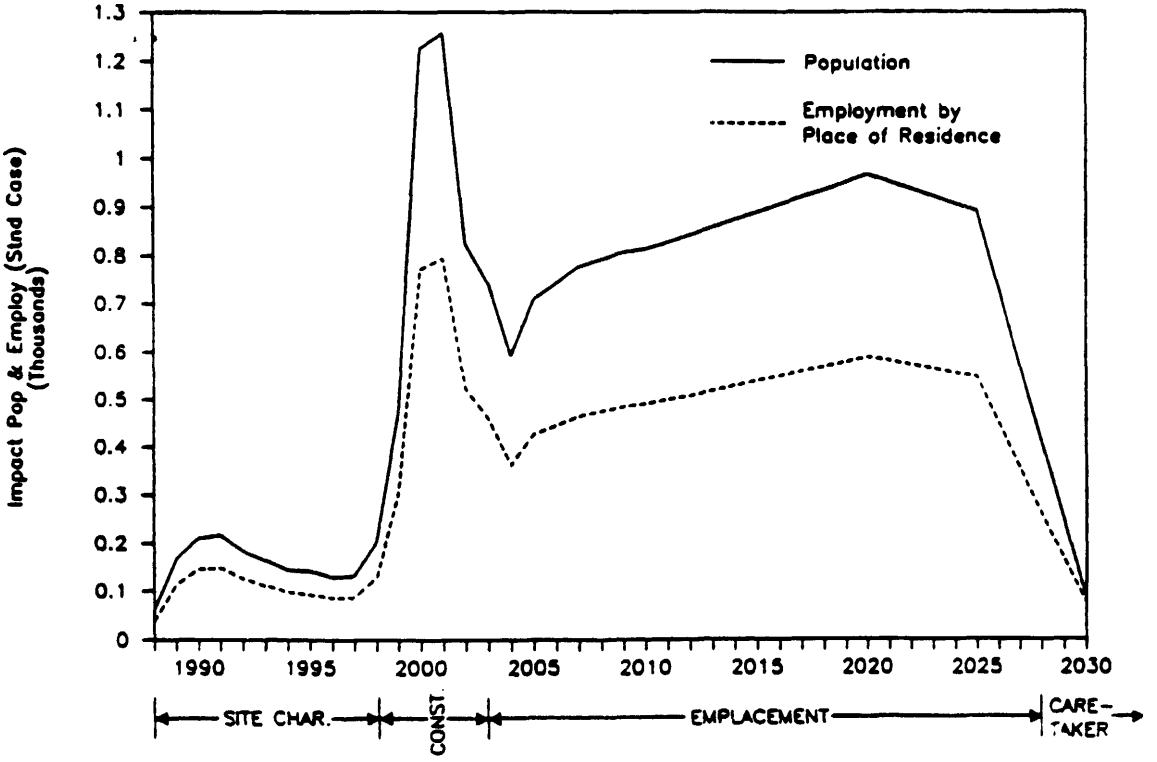
The population of Nye County is projected to grow by about 2.0 percent annually between 1988 and 2010. Unlike Clark County, the rate of population growth is projected to exceed that of employment for Nye County. This is a result of a gradual reduction in the number of persons commuting from other counties into Nye County to work. Thus the employment to population ratio for Nye County is projected to decline from 0.78 in 1988 to 0.635 in 2010 and 0.621 by 2030. By the year 2030, the population of Nye County is projected to exceed 30,000.

Table 4-6 presents the standard effects employment by place of residence and population projections for Nye County. Employment could be in the 400 to 500 range for most of the repository program with peaks around 700 at the height of construction. During the caretaker phase, the employment impacts could be reduced to about 74 jobs, less than one percent of county employment. In terms of the percent of the county labor force, the repository-related impacts could be in the five percent range with peaks during construction of over nine percent.

TABLE 4-6
NYE COUNTY EMPLOYMENT AND POPULATION PROJECTIONS WITH REPOSITORY FOR SELECTED YEARS 1988-2030

Year	Nye County Projections[1]		Nye County Repository Impacts			
			Employment[2]		Population	
	Employment[2]	Population	Number	Percent[3]	Number	Percent[3]
1988	6,890	16,781	37	0.54%	60	0.36%
1989	6,948	16,926	114	1.64%	169	1.00%
1990	7,277	17,744	146	2.01%	211	1.19%
1995	7,493	19,188	93	1.24%	142	0.74%
2000	8,251	22,496	771	9.34%	1,226	5.45%
2001	8,090	22,761	793	9.80%	1,257	5.52%
2003	7,854	23,545	460	5.86%	741	3.15%
2005	8,000	25,087	426	5.33%	709	2.83%
2010	8,296	26,945	489	5.89%	812	3.01%
2020	8,748	29,785	588	6.72%	966	3.24%
2030	8,492	31,149	74	0.87%	83	0.27%

[1]Impact projection runs for the SIA models were made during the period November-December, 1988. The model outputs were calibrated to official state population estimates for 1987 (Nevada Department of Taxation), the most current figures then available. Some local jurisdictions feel that the Department of Taxation estimates while official for state revenue distributions do not accurately represent their current populations.
[2]By Place of Residence
[3]Percent of estimated and projected direct and indirect population for the jurisdiction.
Source: Mountain West, 1989.



Population would be expected to follow the employment pattern but given the smaller family size of resident workers in Nye County the percentage of impacts on total county population would be less than the percentage of employment impacts on the county work force. Once operations were underway, population impacts could be about three percent, while during peak construction the estimates are that they could be over five percent. By the time of the caretaker phase an increase of 83 persons might be attributed to the repository, about 0.3 percent of the projected population.

4.3.5 Lincoln County

Having experienced a period of economic decline, Lincoln County is expected to have gradual but steady growth throughout the projection period. Trade and services will continue to be the dominant activities. Retail trade and services are projected to increase their share of total employment from 64.1 percent in 1988 to 69.2 percent in 2010 and to 71.0 percent by 2030. The government sector is the only other sector which is projected to grow significantly over the projection period although its share of total employment in the county is expected to remain around its current level of 19.0 percent.

The projections of employment and population under the standard effects scenario are depicted in Table 4-7. For construction and operations, the range of employment impacts could be in the two to four percent range with the higher level taking place during peak construction. The total number of jobs could be between 50 and 100. In 2030, which is during the caretaker phase, the Lincoln County employment impact is only 8 jobs or a 0.3 percent increase.

The percentage impact on population is almost the same as that estimated for employment. The increased population due to the repository could be in the range of 80 to 180 with smaller impacts prior to construction and after emplacement. During the caretaker phase the impacts could fall to 13 persons or 0.3 percent.

4.3.6 Special Effects

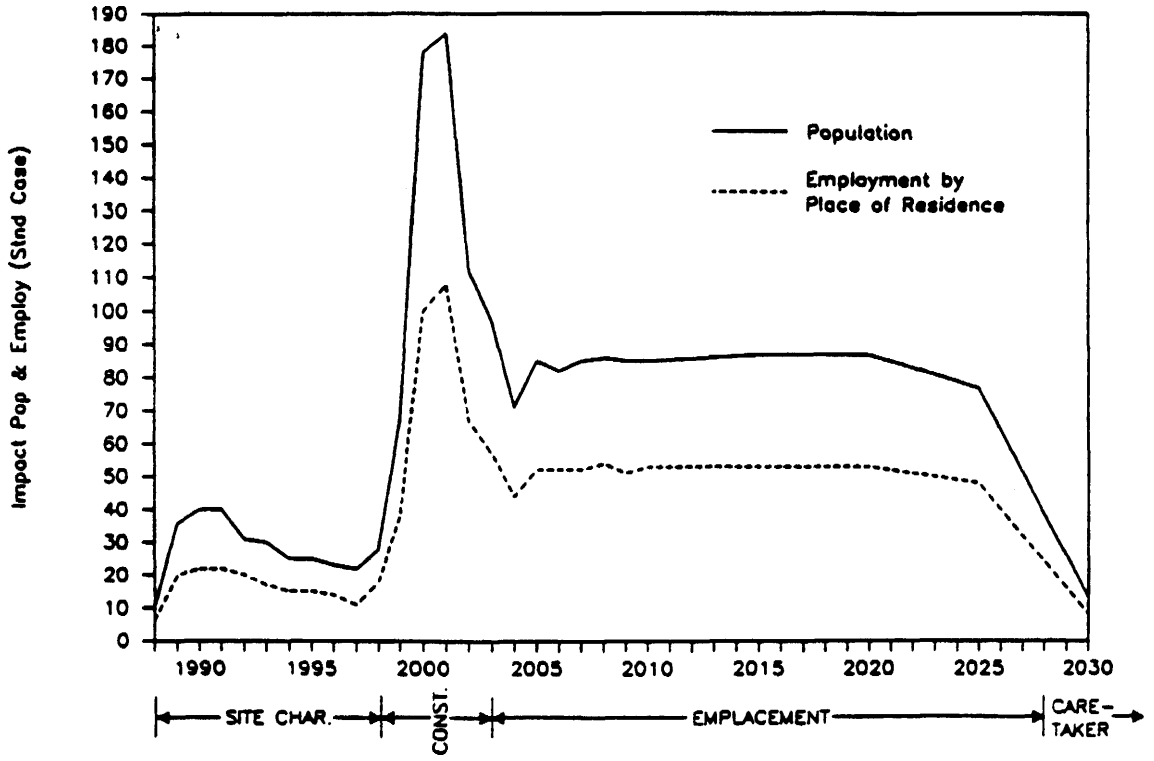
The analysis of standard effects associated with the repository project indicate that these could be important to the State of Nevada and Nye, Clark, Lincoln, and Esmeralda counties. A similar pattern of impacts might occur in the communities and subcounty jurisdictions, and these levels of analysis are discussed in Section 4.5, below.

There is, however, another and extremely important source of potential socioeconomic impacts. The analysis of Chapter 2 made it clear that the repository could have "special impacts" (i.e., those resulting from the hazardous characteristics of radioactive waste) on the Nevada economy. The research demonstrates that it is not possible at this time to dismiss the prospect that Nevada and the communities of Southern Nevada could be stigmatized by the repository program. Moreover, the studies carried out to date indicate that populations important to Nevada's economic well-being may be highly sensitive to the radioactive characteristics of the repository, and that the attractiveness of the state as a place to visit, move to, or invest in could be reduced.

TABLE 4-7
LINCOLN COUNTY EMPLOYMENT AND POPULATION
PROJECTIONS WITH REPOSITORY FOR SELECTED YEARS
1988-2030

	Lincoln County Projections[1]		Lincoln County Repository Impacts			
			Employment[2]		Population	
Year	Employment[2]	Population	Number	Percent[3]	Number	Percent[3]
1988	2,373	4,236	6	0.25%	10	0.24%
1989	2,408	4,307	20	0.83%	36	0.84%
1990	2,434	4,323	22	0.90%	40	0.93%
1995	2,541	4,452	15	0.59%	25	0.56%
2000	2,704	4,554	100	3.70%	178	3.91%
2001	2,726	4,544	108	3.96%	184	4.05%
2003	2,705	4,423	57	2.11%	97	2.19%
2005	2,732	4,374	52	1.90%	85	1.94%
2010	2,816	4,461	53	1.88%	85	1.91%
2020	2,989	4,695	53	1.77%	87	1.85%
2030	3,117	4,856	8	0.26%	13	0.27%

[1]Impact projection runs for the SIA models were made during the period November-December, 1988. The model outputs were calibrated to official state population estimates for 1987 (Nevada Department of Taxation), the most current figures then available. Some local jurisdictions feel that the Department of Taxation estimates while official for state revenue distributions do not accurately represent their current populations.
[2]By Place of Residence
[3]Percent of estimated and projected direct and indirect population for the jurisdiction.
Source: Mountain West, 1989.



A second major conclusion of the research was that the proposed repository represents a combination of complexity, risk, and uncertainty that makes anticipation of the magnitude of risk-related responses extremely difficult. Additional specificity in the definition of the project and better understanding of the behavioral mechanisms involved in response to the project may be able to reduce the uncertainty concerning the range of potential effects. It is clear, however, that this will continue to be an area of broad conjecture due to the complexity and unpredictability of many of the key assumptions and relationships.

It must be recognized, nonetheless, that the effects discussed in Chapter 2 are potentially of significant magnitude. If radioactive imagery became commonly associated with Nevada or Las Vegas, behavioral responses in terms of the visitor economy, inmigration, and economic development could result in substantial negative impacts. Estimates of 5, 10, and 20 percent or larger reductions in key economic sectors are not inconsistent with the preliminary empirical evidence gathered to date. It is useful, therefore, to understand the implications that even a small drop in visitation, retirement inmigration and economic development could have for the Southern Nevada economy.

As an illustration of the potential impacts from a decline in these areas of economic activity, a scenario was constructed that reduced by one percent the spending and employment that might otherwise occur (in the absence of the repository) for visitor spending, employment in new economic development enterprises, and spending by retired inmigrants. The area that this example applied to was limited to Clark County. The year 2010 was selected since it is a point in time when the risks from transportation, packaging, handling, and storage will all be present.

A one percent drop in visitors in the year 2010 would result in a decline of about $155 million of spending in the Las Vegas area; a five percent decline would mean a decline of more than $775 million; a ten percent decline would mean a decline of over $1.5 billion.

The contribution of the elderly to the Las Vegas economy is expected to grow over the next two decades as projects such as the Del Webb, Sun City - Summerlin are developed. If the spending by retired people were to decline by one percent for the year 2010, that loss would be almost $220,000 for the year; at the five and ten percent levels the loss would be over $1.1 million and $2.2 million respectively.

Major efforts have been undertaken to expand and diversify the economic base of the state and especially the Las Vegas area. If these efforts were to experience a one percent decline for the year 2010, it would mean that about 465 jobs would be lost in the areas of manufacturing; transportation, communications and public utilities; finance, insurance and real estate; and in the trade and services of the wholesale sector. For the five and ten percent cases, the losses would be 2,325 and 4,650 jobs, respectively.

Table 4-8 shows the impacts for employment, population, and state general fund revenues for the one percent decline in spending described above, and for the cases of a five and ten percent decline. The total loss of jobs, both direct and indirect, resulting from a one percent reduction in visitor spending, retired spending, and economic

TABLE 4-8
ILLUSTRATIONS OF RISK-INDUCED EFFECTS ON EMPLOYMENT, POPULATION AND STATE GENERAL FUND REVENUES, BY PERCENT OF LOST SPENDING, FOR THE YEAR 2010

Percent Lost	Employment	Population	Revenue
1 Percent	7,000	12,000	$7,000,000
5 Percent	35,000	60,000	35,000,000
10 Percent	70,000	120,000	70,000,000

Source: Mountain West, 1989.

development in the Las Vegas area would mean a total loss of about 7,000 jobs in the county economy. The loss of this number of jobs would mean that the economic support for about 12,000 residents would no longer exist and the reduction in revenues to the state general fund would be around $7 million from both residents and visitors. Local government revenues also would be reduced.

To put this in perspective, the Las Vegas area is an economy which for the past 40 years has been based upon visitors and tourists. The total 1988 employment base is about 305,000 jobs. Of this number, about 95,000 are hotel and gaming employees whose jobs exist because of the economic contribution of 17.2 million visitors and the $9.9 billion in visitor spending (Las Vegas Perspective, 1989). This level of spending and the jobs it directly creates also supports thousands of other nonbasic jobs. In addition, construction of new hotels, casinos, convention facilities, and visitor services has been undertaken in anticipation of future growth. Almost 12,000 new hotel rooms are under construction at the present time and another 30,000 are planned for the next few years.

In 1981 and 1982, Las Vegas experienced two years of downturn in the midst of a national recession. Total visitors in 1981 were 11.8 million, down about 120,000 from the 1980 figure of over 11.9 million. The drop continued in 1982 when the total visitors numbered about 11.6 million and the decline from the 1980 levels was more than 300,000 visitors. Since each visitor spends about $575, the total decline in visitor spending during 1982 was $17 million (PIC, 1988a). According to Bureau of Economic Analysis figures, employment in Clark County dropped by 3,000 between 1981 and 1982 (PIC, 1987d, p. 159). This would be a serious loss to any community but for a growth economy like Las Vegas the ripple effects were traumatic, even though the downturn represented only about one percent decline in 1981 and another 1.6 percent decline in 1982. The confidence of the area was shaken by the first downturn in decades. Suddenly, the Las Vegas economy did not look recession-proof anymore and business and

government leaders expressed concern about the narrow base of the economy. The major state, regional, and local initiatives for economic diversification came out of this period and included wide support for expanding existing economic activities and adding economic areas such as new sunbelt retirement communities.

This historical example of a somewhat modest downturn demonstrates the large-scale impacts that can result from a change of the direction of growth in a growth-oriented area. The direct economic impacts are certainly important and in this context they have major fiscal, social, and governmental ramifications. Larger declines, in the range of five, ten or even greater percentages, might be possible with final socioeconomic impacts that are so large they are difficult to estimate at the current time.

A number of questions about this line of study remain. The types of problems that could cause these adverse effects and some of the mechanisms by which they could come about have been established in Chapter 2. But it is unclear how long these negative impacts would last. They could be limited to a few days, or a week, or a year, or there could be permanent stigmatization, as at Love Canal and other sites of chemical contamination. It also is not clear how large these impacts could actually be. A one percent decline in spending is conservative when compared with other recent instances of economic losses resulting from image-based impacts.

Examples of such impacts abound in the past three years. In 1986, the decline in American tourist spending in a number of European countries was between 25 and 35 percent, due to perceived threats of danger to personal safety from terrorists. Also in 1986, a brief scare involving contamination of Italian wines resulted in a substantial decline in annual sales of Italian wines in the United States. In 1989, American consumer concerns over ALAR, a chemical spray for red apples, has resulted in a 20 percent decline in demand for apple products and a corresponding loss of income to growers. Also this year, the Chilean grape contamination incident, although short-lived, caused millions of dollars of lost income to growers and distributors when Americans took these Chilean products out of the nation's stores. Each of these examples provides supporting evidence for the potentially extensive economic costs associated with direct income losses attributable to risk-induced behavior. In each case the costs associated with direct income losses were compounded by the need to spend additional millions on advertising to reestablish the image of Europe as a safe tourist destination and of Italian wine, Chilean grapes, and American apples as safe products to consume. In all these cases, it was the response of the American public to socially amplified risk conditions that resulted in significant economic impacts.

The duration of risk-related negative impacts associated with nuclear incidents needs further study. In the cases of Three Mile Island, Chernobyl, Gorleben, Browns Ferry, and the Nevada Test Site, the indications are that the negative impacts can continue over very long time periods indeed. The NTS exposure to radioactive fallout of downwind communities in Nevada, Utah, and Arizona in the 1950s, although no further above-ground testing has occurred since 1962, is still responsible for a negative image of Nevada in almost ten percent of the respondents in the pilot image study of Phoenix households.

The possibility of both direct health and safety risks and of indirect negative impacts upon the Nevada economy and fiscal structure has long been recognized by a significant proportion of the public officials and residents of the state. This report provides substantiation for these concerns by demonstrating that the source of impacts from the radioactive hazards is not illusory. The fact that Nevada is especially dependent upon an economic base that is highly sensitive to externally-held images makes the state more vulnerable to risk-related economic loss than would be the case with more diversified economies.

4.4 Governmental Impacts

This section provides a summary of work in progress on the potential government and fiscal impacts of the Yucca Mountain repository at the state and local level. This section concentrates on the results of the fiscal study efforts undertaken to date; Section 4.5 describes the implications of the fiscal impacts on local communities. The focus is on describing the standard effects and the fiscal impacts that could result from both mandate-driven and economic-demographic-driven sources. Another major potential source of fiscal impacts would be the risk-related or "special effects" that originate in the hazardous nature of high-level radioactive waste. The studies reported on in Chapter 2 imply that serious fiscal impacts could result from the repository program under certain conditions.

The modeling system was prepared to focus on the standard effects of the repository program and to estimate fiscal impacts for different jurisdictions at the state and local levels. In structuring the variables for the modeling exercise, several potential inputs were not included. These were the possible risk-related effects and the possible revenues from: GETT (grants equal to taxes), any possible benefits package provided by Congress, mitigation funds, and special funds for program support such as those provided for in Section 180 of the NWPA to assist local emergency response capabilities.

4.4.1 Public Facilities, Services and Fiscal Projections

4.4.1.1 Fiscal Conditions

Facility and service costs are driven primarily by resident population, while revenues depend on economic conditions, and to a significant degree on the visitor/tourist economy. As a result, the costs associated with each additional resident are greater than their contribution to the revenue base (if visitor activity is held constant). Combined with these revenue conditions is the prevalent attitude in the region that development should be encouraged with minimal constraints. Therefore, mechanisms such as impact fees or development exactions are rare.

Recent voting patterns suggest a tendency toward improving local service standards for certain functions in Southern Nevada. For example, in November 1988, voters approved an expansion of the Las Vegas Metropolitan Police Department force by 50 officers annually over five years, to a level that would approximate national standards after the expansion process is completed. Also, in May 1988, Clark County voters (after several rejections of similar referenda) approved more than $600 million in capital improvements for the county's schools. Notwithstanding these recent expressions of approval for system enhancement, however, it appears that major changes in character of service-delivery systems (e.g., from volunteer to paid fire departments or from unincorporated town to incorporated city form of government) occur rarely and usually after long and persistent changes in conditions or in response to conditions of rapid, dramatic change. The more common practice among local governments historically has been to accommodate growth by a combination of ad hoc solutions (e.g., by installing modular classrooms until pay-as-you-go financing is available for permanent classrooms) and temporarily or permanently reduced service standards (e.g., by decreasing the maintenance or reconstruction budget for local streets).

Despite the apparent recent increase in voter approval of individual local government service improvements, the overall fiscal condition of local government remains tightly constrained by state-level restrictions on the types and levels of support available to finance local activities and facilities. The most restrictive of these constraints is the system which caps ad valorem tax revenues and (partially) replaces the foregone property taxes with sales taxes (the Supplemental City/County Relief Tax). This system, applied to all local governments having the ability to impose property taxes, has the effect of shifting the primary local tax burden away from resident capital stocks and toward consumption flows (and particularly transient or visitor-based consumption). While this system has been effective in maintaining very low property taxes, it is extremely sensitive to changes in economic conditions, and its revenue limits tightly circumscribe local determination of appropriate expenditure levels.

Local governments have attempted to respond to growth-related needs within the constraints of the state-controlled local revenue structure. The available techniques include special-purpose districts (with a combination of constrained and unconstrained revenue sources), enterprise funds to supplant previously tax-supported activities, and the introduction or expansion of user fees to augment otherwise tax-supported activities. But these adjustments are also subject to recognition by the State Tax Commission in equalizing revenues from property tax and SCCRT. Shifts toward local financing have been required due to diminishing federal participation and the additional pressures resulting from state-imposed revenue constraints. These pressures have combined to cause local government to decrease the scope of its functions, to reduce its service standards, or to increase the scope of functions considered proprietary.

Under the assumption that real per-capita income will continue to grow in the region, and the visitor and tourist economy flourishes (even at a lower proportion of total economic activity), public resources will continue to support the level of public services supplied at current standards. Even under these assumptions, however, state and local governments face fiscal strains. One reason is that, as the region increases in size

and complexity, new types or levels of services must be considered -- e.g., more support for higher education, more prison space, more extensive social services. Another reason is that current levels of expenditure involve deferred maintenance of some of the region's infrastructure (especially roads) which will require increased future expenditure. A third reason is that with the federal budget deficit, Nevada and other states can expect to receive additional mandates unaccompanied by federal financial assistance. A fourth reason is that, even if the major sales and gaming tax revenues keep abreast of population growth, other significant revenue sources will not. Liquor revenues, for example, are structured so that they are unlikely at current rates to keep pace with population, even if inflation remains at the low levels of recent years.

The fiscal and public service structure in Nevada is designed to collect a major portion of its revenues from visitors. The visitor economy and mining are the two significant basic sectors whose activities (gaming and net proceeds of mines) are taxed directly; because the state has no income tax, most other activities produce public revenues indirectly, e.g., through sales or property taxes, license fees, or payments in lieu of property taxes. The effect of this revenue structure is that, to a large extent, taxes paid by visitors subsidize many public services and facilities financed in most areas of the country by resident-paid taxes or impact fees. Thus, so long as visitor volume grows at least as quickly as the resident population, the visitor economy is the only sector that "pays its own way."

The Las Vegas urban area has grown rapidly since the establishment of this revenue system and, over most of this period, visitor volume has grown at least as quickly as resident population. However, in the early 1980s, the downturn in visitor volume (and therefore in per-resident revenues) caused a reappraisal of the revenue and expenditure structure of local government, resulting in substantially lower expenditure standards that have persisted to the present, with per capita spending declining in real terms in most jurisdictions. As a result, many infrastructure and service systems are now operating at or over capacity, and growth in resident population results in further declines in standards.

The repository would be developed just as the negative effects of the revenue and expenditure structures of state and local government are expected to become most apparent. The slower growth projected for visitor volume together with the needs associated with deferred maintenance and undersized infrastructure would combine to create significant fiscal strain during the 1990s. The results of the fiscal model show that the repository (as a further activity not directly taxed) would exacerbate this strain by contributing less in revenue base than in expenditure needs. The discussions in this section and in Section 4.5 (describing community impacts) illustrate some of the dimensions of this issue.

4.4.1.2 State Facilities and Services and Fiscal Projections

4.4.1.2.1 State General Fund

The General Fund supports most ongoing state public activities, including general government (the executive, legislative, and judicial branches); equalization support for public elementary and secondary education; higher education; health and social services; the state prison system; the state regulatory system; and other functions normally undertaken by state government. The other major functions of state government not supported by the General Fund include the Department of Motor Vehicles and Public Safety (including the Nevada Highway Patrol) and the Department of Transportation (both supported primarily by appropriations from the highway fund); most capital projects; and many independent boards and commissions.

The repository project, even if it were not accompanied by risk effects, would act as a net drain on the State General Fund. The positive revenue effects result chiefly through the two percent state sales and use tax. On the average, General Fund revenues under the standard effects future would increase by about $5 million annually during repository construction, about $1.5 million annually during emplacement, and about $1.8 million annually during site characterization. The additional General Fund expenditures required as a result of the repository-related population increases would be approximately $9.6 million during construction, about $3.1 million during emplacement and about $4 million during site characterization, with almost half of the additional expenditures made for educational purposes (primarily the Distributive School Fund).** The net projected fiscal shortfall is estimated at about $21.7 million during site characterization, $27.3 million during construction, and $40.5 million during emplacement. A summary of fiscal impacts for selected years is shown in Table 4-9.

The projected shortfalls reflect the fact that visitors and the visitor/gaming industry directly make contributions to gaming, sales, liquor, cigarette, and casino entertainment taxes which comprise between 85 percent and 90 percent of the State General Fund; as a result, visitors and the visitor/gaming industry directly contribute over half of State General Fund revenues. Nevada residents, who require State General Fund services (general government, higher education contributions, welfare and mental health services, regulatory services, etc.) directly contribute less than half of the revenues, mainly through sales and use taxes, and secondarily through licenses, fees, and charges and resident contributions to gaming, liquor, and cigarette taxes. The result is that new nonvisitor-related activity (such as the repository) produces net shortfalls in the State General Fund under the current fiscal structure. The shortfalls require the state to raise additional

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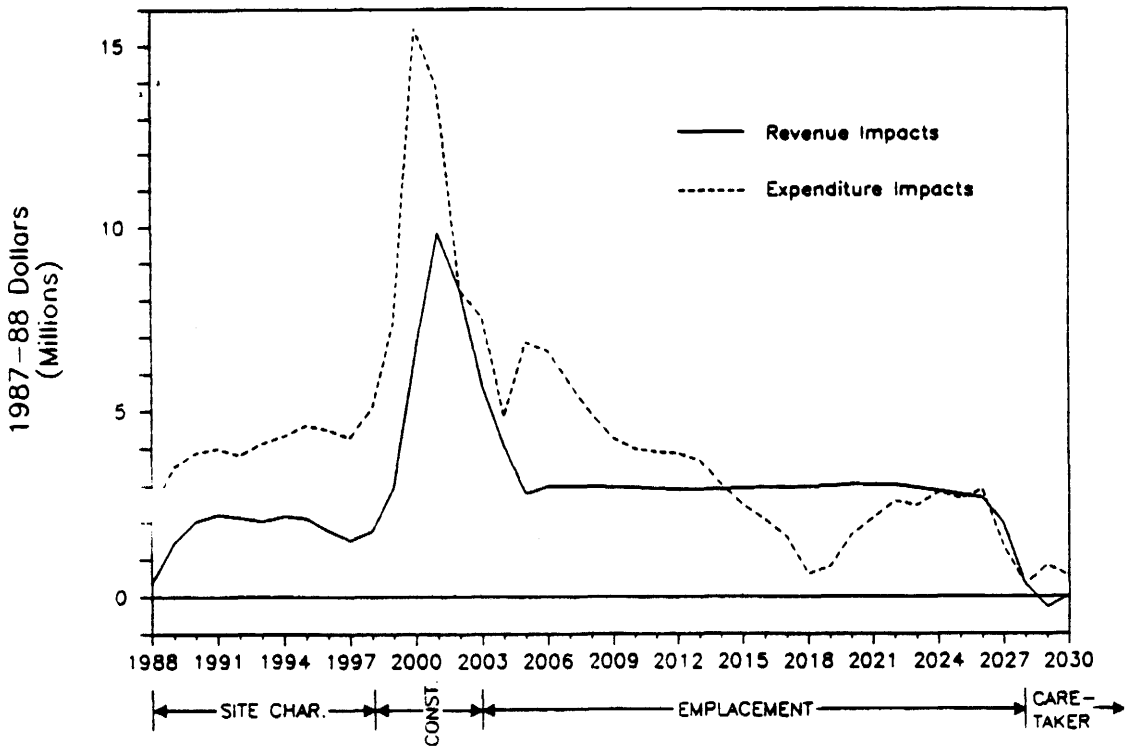
** The projections of State General Fund revenues and expenditures were produced at two levels of detail: a more complete analysis, based on detailed examination of revenue and expenditures and about 85 percent of the General Fund revenues; the balance of the fiscal analysis is based on per-capita multipliers derived from analysis of recent budget data and applied to population impacts over the projection period. Substantial analysis of State Highway Fund revenues and the Distributive School Fund has also been conducted, but comprehensive modeling of expenditures and revenues in the State General fund, the State Highway Fund and the Distributive School Fund is not yet complete.

TABLE 4-9
STATE GENERAL FUND
REVENUE, EXPENDITURE, AND FISCAL BALANCE IMPACTS
WITH PROJECT, SELECTED YEARS
1988-2030
(1987-88 $)

Year	Revenue Impacts	Expenditure Impacts	Fiscal Balance Impacts
1988	378,011	2,429,867	(2,051,856)
1989	1,457,132	3,521,876	(2,064,744)
1990	2,047,243	3,887,433	(1,840,190)
1995	2,120,979	4,620,896	(2,499,916)
2000	6,631,621	15,473,552	(8,841,931)
2001	9,832,401	13,861,499	(4,029,098)
2003	5,668,584	7,519,595	(1,851,011)
2005	2,788,982	6,844,479	(4,055,497)
2010	2,950,368	3,992,818	(1,042,450)
2020	3,038,409	1,670,764	1,367,645
2030	52,560	561,033	(508,473)

Source: Planning Information Corporation, 1989.



revenues if it intends to maintain or improve current service levels, or to reduce service levels. Such impacts, if they were to result from repository-related activity, could be subject to mitigation efforts.

4.4.1.2.2 State Agencies

The following projections were provided by state agency officials and personnel. Where appropriate, project descriptions were provided, although many agency personnel were already familiar with repository characteristics as a result of their planning and review responsibilities. These projections represent the current best estimate of each agency of intended future responses to the repository project, to the extent that these responses can be predicted.

It should be noted that potential revenue generated by the repository has not yet been allocated back to the state agencies for this interim report. Although there may be some off-setting revenues that have not been calculated in the projections which follow, this should not be a major factor because the state's tax system is not designed to take advantage of the taxing opportunities represented by repository activities. Moreover, many of the projections are based on mandated activities related to the hazardous nature of the repository rather than population-related impacts or other activities which might produce state revenues. Therefore, the projections appear to be reasonable estimates of impacts for the purposes of planning.

In estimating the fiscal costs of state agencies (see Table 4-10) it is necessary to make several observations. First, cost estimates are often presented as ranges reflecting the lack of certainty that agency personnel have about specific elements of the repository's construction and operation (e.g. transportation routes, modal mix, number of school children, timing, etc.). In such cases, low estimates assume the repository's siting, development, and operation proceeds according to DOE's plans and would require the minimum response. High estimates are based on the increased response which may be required by threats to the health, safety, environment, and welfare of the state's citizens. More detailed reports on each agency are referenced in the bibliography (Atkinson, 1988a, 1988b, 1988c; Mushkatel, 1988a, 1988b, 1988c, 1989; Mushkatel, Atkinson, and PIC, 1987; and Mountain West, 1989a, 1989b).

Not all agencies have been studied to date and those that will be investigated as part of the ongoing research will undoubtedly add to the state-level fiscal impacts. For the first stages of research, however, the study team has chosen to examine those agencies that are expected to experience impacts ahead of other agencies where the effects could be more modest (Mushkatel, Atkinson, and PIC, 1987). It should be noted, however, that the state and federal governments could increase the responsibilities for any of the agencies discussed below which, in turn, could increase the costs for that agency.

The departments of Conservation and Natural Resources and the Division of Health within the Department of Human Resources could be impacted mainly as a consequence of increased demand upon their existing health and environmental

TABLE 4-10
PROJECTED EXPENDITURE IMPACTS TO STATE AGENCIES
1989 - 2010
(million of dollars)

Agency	Impact through 2010	
	Low	High
Conservation and Natural Resources	$1.8	$3.2
Education	3.2	3.2
Employment Security	2.0	2.0
Human Resources	13.8	21.7
Military	22.9	23.4
Motor Vehicles and Public Safety	32.2	90.4
Public Service Commission	5.0	8.4
Taxation	4.3	4.5
Subtotal	$85.2	$156.8
Transportation	$200.0	$800.0

Source: Mountain West, 1989.

regulatory responsibilities. Environmental permitting required for site characterization and repository construction and environmental monitoring drive the projection of impacts for these agencies.

The economic and demographic effects of the repository could cause additional workload and expenses to maintain service levels within the departments of Education, Employment Security, and most of the Department of Human Resources. Projected impacts are associated not only with increased clientele but also with the delivery of program services to rural areas.

The departments of Military and Motor Vehicles and Public Safety could assume new responsibilities ensuing from the hazardous nature of the repository. Escorting the potential waste shipments, ports of entry, and radiological emergency response needs relating to the transportation of high-level nuclear waste drive the impact projections in these agencies.

The Department of Taxation could be impacted by increased auditing responsibilities associated with new tax accounts and by duties associated with the central assessment of the repository. Major impacts to the Public Service Commission depend

upon decisions involving utilization of rail transportation to the repository. Additional regulatory duties as a consequence of any rail spur construction or rail transfer of hazardous waste are reflected in the projections.

The magnitude of costs associated with bringing highway structures up to standards required for the safe transportation of high-level nuclear wastes are reported in the table above as an illustration of the type and range of possible transportation infrastructure impacts. These costs are separated from the other agency costs because it is not clear what portion should be attributable to the repository nor is it clear how these impacts might be distributed between the state and federal transportation agencies since a large portion of highway construction costs are funded through U.S. DOT.

Depending upon the DOE waste handling and packaging program and the mode of shipment, several highway routes in Nevada might have to be upgraded to adequate standards. Until DOE can better define some of the major high-level radioactive waste transportation system characteristics, estimates of potential costs to the Department of Transportation will be tentative. Additional issues of what proportion of infrastructure improvement costs should be attributed as impacts of the repository could be defined after these decisions are made.

Summary of State Agency Impacts

The estimated costs outlined for this sample of state agencies, excluding the Department of Transportation, total from about $85 million to over $156 million through the year 2010 of the repository time schedule. The costs to the Department of Transportation could reach $800 million when all necessary route segments are included. Other state agencies still need to be studied, the repository project description needs to be determined, agency responses need to be clarified, and management strategies need to be developed before a final impact assessment can be completed.

4.4.1.3 Local Government Agencies

This section presents a summary of the projected fiscal impacts among local jurisdictions in Southern Nevada. Presented here is a summary of the results of the study team's modeling of expenditures and revenues; further discussion of some of the implications of public facilities/services and fiscal impacts are included in Section 4.5, Community Impacts. The figures in Tables 4-11 show the total expenditures and revenues for repository-related standard effects. The increased spending is shown by county, by phase of the project and by category of public services; the increased revenues are shown by county, by phase of the project and by source. The expenditure and revenue projections are shown as aggregated totals for major governmental-type activities for all major jurisdictions within the county. The impacts shown here include general fund (current account) expenditures as the primary measure of fiscal conditions in the three counties. Over the projection period, the marginal capital expenditure impacts of the repository would be offset almost entirely by later baseline growth; therefore the capital expenditure impact issues related to the repository are primarily timing and capacity issues, rather than absolute difference issues (under the subtractive approach

TABLE 4-11
REPOSITORY-RELATED FISCAL IMPACTS, BY COUNTY (GENERAL FUND),
EXPENDITURES BY PERIOD AND BY FUNCTION, 1988-2028
REVENUES BY PERIOD AND BY SOURCE, 1988-2028
(Millions of 1987-88 $)

	Clark County		Nye County		Lincoln County		Total	
	Impact	Percent	Impact	Percent	Impact	Percent	Impact	Percent
I. REVENUE IMPACT								
Site Characterization	$ 49.2		$ 1.9		$0.4		$ 51.5	
Construction	91.6		5.4		1.4		98.4	
Emplacement	125.4		27.0		4.1		156.5	
By Source:								
Schools:								
Local Sources	$ 66.8	25.1%	$ 4.7	13.7%	$0.4	6.4%	$ 71.8	23.4%
State Sources	106.8	40.1%	22.7	66.3%	4.4	75.4%	134.0	43.7%
Other:								
Ad Valorem Prop Tax	29.2	11.0%	1.7	4.9%	0.2	4.1%	31.1	10.2%
Licenses & Permits	9.4	3.5%	0.2	0.7%	0.0	0.3%	9.6	3.1%
Intergovernmental Revenue	43.1	16.2%	3.3	9.5%	0.7	11.4%	47.0	15.4%
Charges for Service	5.1	1.9%	1.4	4.0%	0.0	0.7%	6.5	2.1%
Fines & Forfeits	2.9	1.1%	0.3	1.0%	0.0	1.2%	3.3	1.1%
Miscellaneous Revenue	3.0	1.1%	0.0	0.0%	0.0	0.6%	3.1	1.0%
TOTAL REVENUE IMPACT	$266.3	100.0%	$34.3	100.0%	$5.9	100.0%	$306.5	100.0%
II. EXPENDITURE IMPACT:								
Site Characterization	$101.9		$ 1.7		$0.6		$104.3	
Construction	149.6		6.3		1.8		157.7	
Emplacement	523.1		31.0		4.9		558.9	
By Function:								
Education	$176.1	22.7%	$23.9	61.4%	$5.2	70.4%	$205.2	25.0%
General Government	63.6	8.2%	5.2	13.4%	0.4	6.0%	69.3	8.4%
Judicial	39.8	5.1%	1.7	4.4%	0.3	3.6%	41.8	5.1%
Public Safety	330.2	42.6%	7.0	17.9%	1.3	18.0%	338.5	41.2%
Public Works	120.9	15.6%	0.2	0.4%	0.1	1.0%	121.1	14.8%
Recreation & Culture	6.0	0.8%	0.6	1.6%	0.0	0.1%	6.6	0.8%
Health & Welfare	8.7	1.1%	0.0	0.0%	0.0	0.1%	8.8	1.1%
Other	29.3	3.8%	0.3	0.9%	0.1	0.8%	29.7	3.6%
TOTAL	$774.6	100.0%	$39.0	100.0%	$7.3	100.0%	$820.9	100.0%
III. NET FISCAL BALANCE:								
Site Characterization	$(52.7)		$0.2		$(0.2)		$(52.8)	
Construction	(58.0)		(0.9)		(0.4)		(59.3)	
Emplacement	(397.7)		(4.0)		(0.8)		(402.4)	
TOTAL	$(508.4)		$(4.7)		$(1.4)		$ (514.5)	

Source: Planning Information Corporation, 1989.

described in the introduction to this section). Therefore, the fiscal impact projections do not include costs to upgrade existing capital facilities or to provide such facilities to new populations. Repository-related marginal capital needs in local communities often impose front-end financing impacts and thus may be amenable to mitigation assistance. Thespecific capital concerns of the three areas (including infrastructure and utility issues) are described in Section 4.5, Community Impacts.

Tables 4-12 through 4-14 show the fiscal effects projected for Clark, Nye, and Lincoln counties, respectively. Each table shows the repository's projected impacts on expenditures and revenues among the major jurisdictions providing governmental-type services in each of the counties. Each table illustrates the combined general fund effects among all major jurisdictions in each county -- cities, towns, and school districts -- as an overview of the modeling output and an indication of the level of severity of impact in each of the three counties. The particular effects that are expected to emerge in each area are discussed in Section 4.5.

The fiscal modeling approach used by the study team included detailed investigations of the expenditure and revenue systems used by local governments in Southern Nevada, and applied factors produced by these investigations to the economic and demographic projections described earlier.

The expenditure modeling approach included investigations of the historical relationship between population and service levels; between service levels and factors of production (staffing, supplies, facilities and equipment); and between factors of production and budgets. This research task included investigations of each major department of city, town, and county government and school districts in Clark, Lincoln, and Nye counties. The investigations included both proprietary funds (such as for providing utilities) as well as general funds, but only general fund projections are shown here to illustrate the effects of the repository on current accounts; the effects on proprietary funds relate more to capacity and management issues than to the fiscal impacts presented here under the subtractive method.

After creating a unique set of factors for each major department, the economic and demographic projections were applied to the expenditure models to produce expenditure projections over the period 1988 to 2030, based on existing standards of service, staffing, and budgeting.

The revenue projection method involved a very different approach due to Nevada's unique state and local revenue structure. Unlike the expenditure models, which were developed uniquely for each jurisdiction, the revenue models began with a statewide emphasis. Although the revenue models include local detail where appropriate (e.g., for service charges), most major revenue sources are either distributed by the state (such as motor vehicle privilege taxes and the School Distributive funds) or limited by state law (e.g., the combined SCCRT and property tax). In either case, the collections and distributions of revenues depend to a large degree on the statewide economic and demographic conditions, and to a lesser degree than for expenditures on local condition. The revenue models, therefore were created primarily at the statewide level and

TABLE 4-12
REPOSITORY IMPACT ON GENERAL FUND, CLARK COUNTY JURISDICTIONS (COMBINED) WITH PROJECT, SELECTED YEARS 1988-2030
(1987-88 $)

Year	Revenue Impacts	Percentage of Total Revenues	Expenditure Impacts	Percentage of Total Expenditures	Fiscal Balance
1988	1,436,050	0.23%	0	0.00%	1,436,050
1989	3,285,419	0.50%	4,019,616	0.59%	(734,197)
1990	4,692,955	0.68%	7,534,338	1.06%	(2,841,383)
1995	5,339,900	0.60%	14,189,560	1.51%	(8,849,660)
2000	16,298,905	1.50%	21,646,361	1.91%	(5,347,456)
2001	23,994,545	2.14%	32,646,596	2.78%	(8,652,051)
2003	13,673,042	1.18%	25,823,511	2.13%	(12,150,469)
2005	8,168,706	0.70%	21,370,357	1.78%	(13,201,651)
2010	6,224,775	0.49%	22,043,069	1.74%	(15,818,294)
2020	4,024,398	0.25%	18,678,502	1.22%	(14,654,104)
2030	197,243	0.01%	16,599,671	0.96%	(16,402,428)

Source: Planning Information Corporation, 1989.

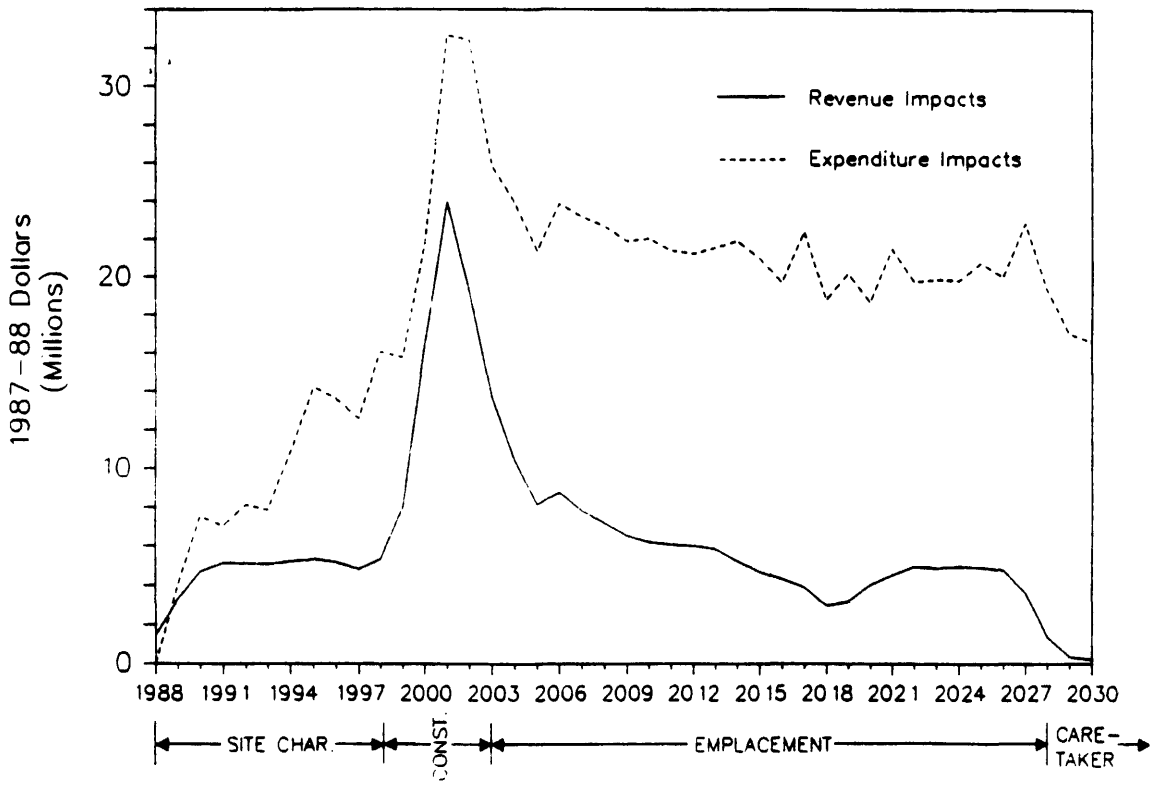


TABLE 4-13
REPOSITORY IMPACT ON GENERAL FUND, NYE COUNTY JURISDICTIONS (COMBINED) WITH PROJECT, SELECTED YEARS 1988-2030
(1987-88 $)

Year	Revenue Impacts	Percentage of Total Revenues	Expenditure Impacts	Percentage of Total Expenditures	Fiscal Balance
1988	27,339	0.13%	0	0.00%	27,339
1989	85,509	0.42%	92,384	0.50%	(6,875)
1990	166,790	0.77%	128,827	0.68%	37,963
1995	194,959	0.73%	156,902	0.63%	38,057
2000	1,010,010	3.09%	792,067	2.61%	217,943
2001	1,240,713	3.72%	1,470,533	4.61%	(229,820)
2003	899,879	2.62%	1,107,635	3.33%	(207,756)
2005	977,796	2.72%	976,811	2.80%	985
2010	1,089,936	2.86%	1,290,472	3.55%	(200,536)
2020	1,154,985	2.50%	1,301,613	3.01%	(146,628)
2030	319,128	0.63%	394,098	0.86%	(74,970)

Source: Planning Information Corporation, 1989.

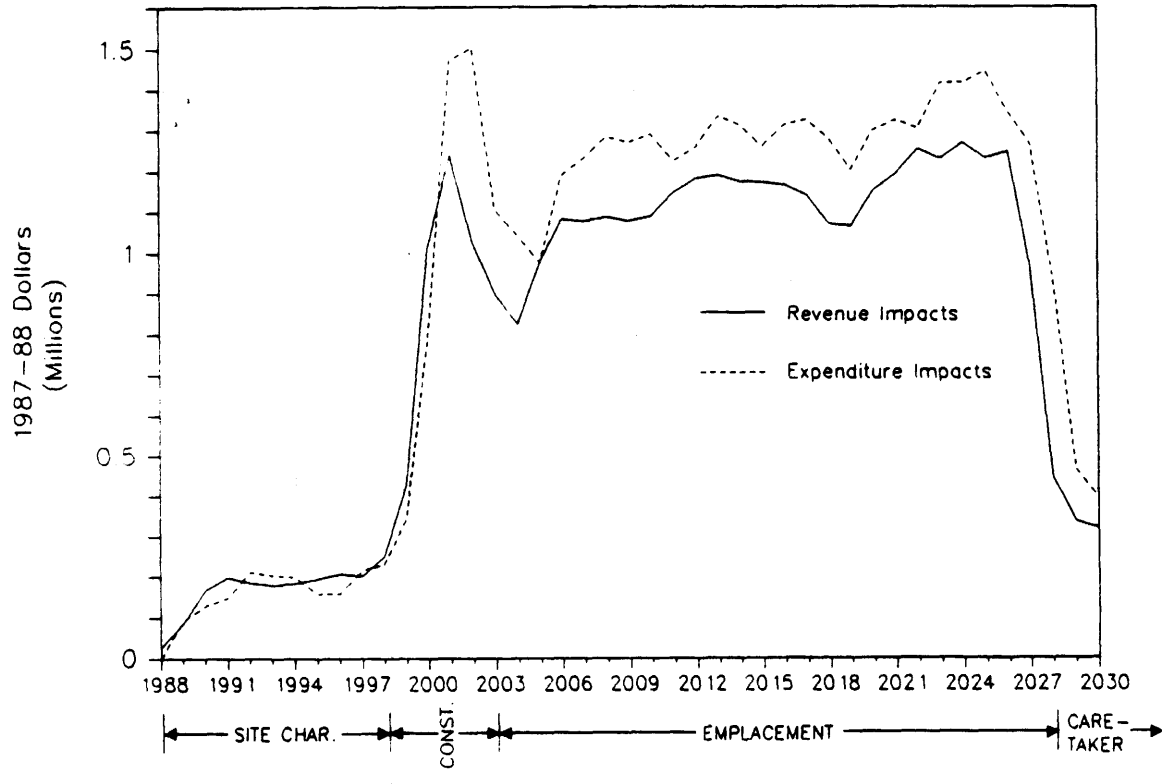
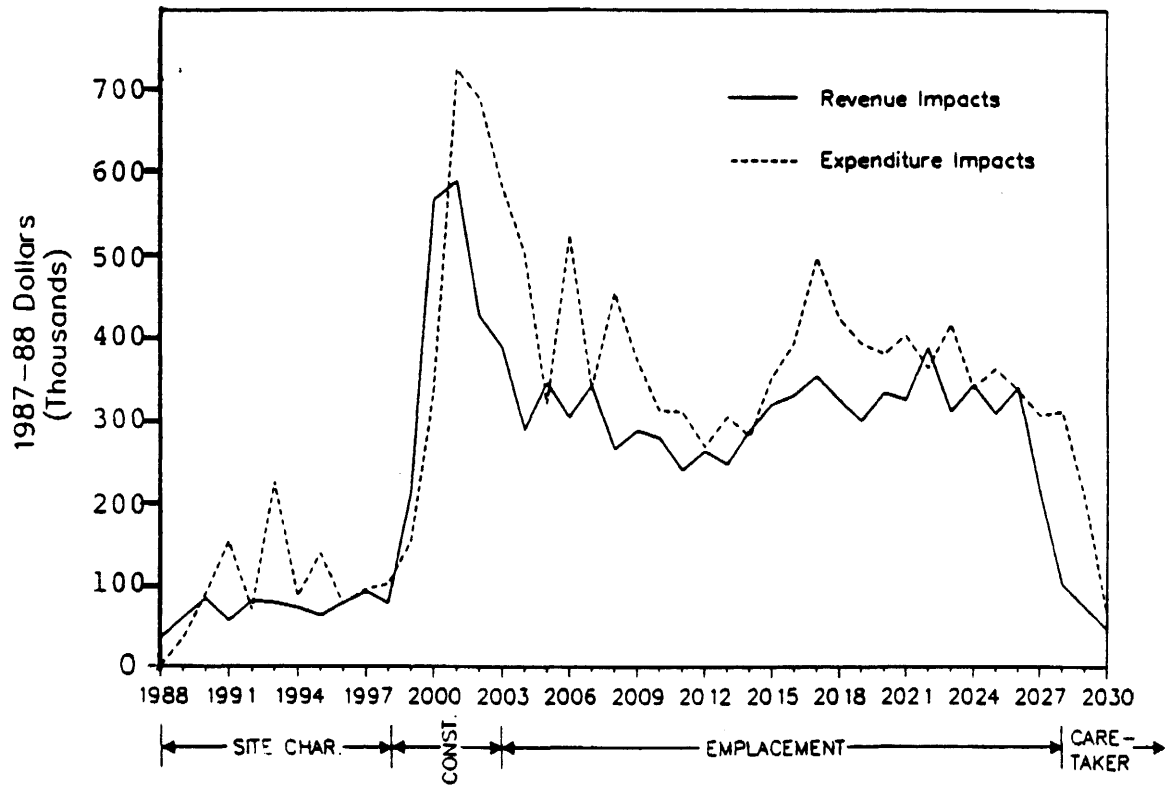


TABLE 4-14
REPOSITORY IMPACT ON GENERAL FUND, LINCOLN COUNTY JURISDICTIONS (COMBINED) WITH PROJECT, SELECTED YEARS 1988-2030
(1987-88 $)

Year	Revenue Impacts	Percentage of Total Revenues	Expenditure Impacts	Percentage of Total Expenditures	Fiscal Balance
1988	37,705	0.36%	0	0.00%	37,705
1989	63,889	0.61%	37,279	0.35%	26,610
1990	84,780	0.76%	92,475	0.87%	(7,695)
1995	63,405	0.43%	121,506	0.81%	(58,101)
2000	612,646	3.36%	334,935	1.84%	277,711
2001	615,103	3.29%	727,384	3.82%	(112,281)
2003	401,853	2.23%	532,823	2.72%	(130,970)
2005	364,916	2.19%	320,061	1.86%	44,855
2010	281,169	1.84%	307,346	2.06%	(26,177)
2020	339,839	1.70%	360,318	1.90%	(20,479)
2030	39,792	0.20%	68,063	0.35%	(28,271)

Source: Planning Information Corporation, 1989.



revenues were projected to be distributed among jurisdictions according to their relationship to the statewide conditions.

In the graphs included with Tables 4-12 through 4-14, expenditure impacts are shown to be generally more variable than revenue impacts. There are two reasons for this:

(1) expenditure projections are driven primarily by projections of the local service population while revenues are driven by many other economic and demographic variables -- including both local and state activity, as described above. Therefore, changes in local population affect expenditures much more than revenues, all other things equal; and

(2) because expenditures include various thresholds (particularly personnel hiring decisions), expenditure projections are generally much "lumpier" than revenue projections, which are more continuous functions of economic and demographic change. For example, the decision rule in a model might be to hire one additional full-time employee at a rate of $30,000 for each 10,000 residents. If the jurisdiction's population in year 1 is 19,990 and in year 2, it is 20,000, the model makes the hiring decision in year 2, and expenditures go up by $30,000 plus the other per capita costs associated with the additional 10 residents; however, revenues might go up by only several hundred dollars, the amount specifically attributed to the additional 10 residents.

Thus, the graphs accompanying Tables 4-12 through 4-14 show spikes for expenditure impacts where local population growth under the with-project scenario triggers higher levels of spending, followed by periods in which the baseline growth also triggers the higher level (and the impact is therefore shown to be much lower).

Clark County. As shown in Table 4-11, the greatest general fund expenditure impacts in terms of dollar amounts in Clark County would take place in the functional category of public safety, followed by education and public works. (However, as a relative proportion of total expenditures the impacts would be greatest in the public works function followed by public safety, and then general government.)

Because Clark County jurisdictions may receive the greatest number of inmigrants under the repository project assumptions discussed in Section 4.2, they also might receive the greatest absolute expenditure impacts. Both revenues and expenditures in Clark County are sensitive to repository-related employment and purchases. However, because the repository activity itself is not taxed and because the taxation of indirect activities, such as materials purchases and employment, is not sufficient to pay for growth, the net fiscal impact of the repository could be negative. The largest negative repository-related impacts among Clark County jurisdictions are projected to occur among public safety (42.6 percent of total expenditure impacts), education (22.7 percent), and public works (15.6 percent). The largest negative repository-related impacts to the general fund in Clark County are projected to occur about the time of peak repository activities during

site characterization ($4.7 million), construction ($24.0 million), and emplacement ($6.2 million), as shown in Table 4-12.

Nye County. The greatest general fund expenditure impacts in terms of dollar amounts in Nye County could take place in the functional category of education, followed by public safety and general government. (However, as a percentage of total expenditures in each general fund category the largest impacts could be in recreation and culture, followed by public works, and then public safety.)

As in Clark County, Nye County jurisdictions could expect to receive relatively large fiscal impacts due to the repository. However, the fiscal impacts pattern in Nye County is more closely parallel to the economic and demographic impacts on the area, as shown in Table 4-13. The absolute fiscal impact is projected to vary in direct proportion to the residential capture ratio. Because revenues generated by residents are less than expenditures, negative impacts result. These negative impacts are projected to be slight during site characterization and increase as the Nye County portion of work force residency increases. The largest negative impacts may accrue during peak construction activities, with expenditure impacts reaching nearly $1.5 million in 2001, a 4.6 percent increase. During the emplacement phase, fiscal impacts could decrease somewhat, but still range from $977 thousand to $1.3 million.

Lincoln County. Greatest impacts to the general fund expenditures in Lincoln County could occur in the category of education, followed by public safety, and then general government. However, as a percentage of total expenditures in each functional category the greatest impact could be in the category of public safety, followed by public works, and then education.

The projected patterns of repository-related fiscal impacts in Lincoln County are based on the fact that they represent comparatively large proportional changes in a small fiscal system. Even a small change in population can result in dramatic impacts to the general fund, as shown in Table 4-14. Because the revenues generated by residents are less than the level of per capita expenditures, negative impacts may accrue to the general fund. However, the negative impacts among Lincoln County jurisdictions might not be as severe as those in Clark and Nye counties, because the population impacts are not expected to be as great among the eastern rural areas as in the western rural and urban areas. These negative impacts are likely to be greatest about the times of peak repository activities, and could range up to $130,000.

Esmeralda County. Revenue and expenditure impacts for Esmeralda County have not yet been modeled but remain the subject of further study.

4.5 Community Impacts

4.5.1 Las Vegas Urban Area

The Las Vegas urban area represents a major portion of the state's economy and to a significant degree will influence the socioeconomic future of Nevada. In terms of population, employment, income, and most other measures of socioeconomic conditions, the urban area of Clark County accounts for more than half the state totals. Over the projection period, the dominance of this area is expected to continue and increase. The Las Vegas urban area share of the state population today is 57 percent and that is projected to increase to 62 percent by 2010; in fact, the area's population in the year 2010 is expected to be about the same as the total state population in 1988.

Economic-Demographic Impacts

The expected population growth described above would be based on increased economic diversification of the region, an expanding tourist/visitor sector, and the rapid development of Las Vegas as a regional trade and service center. REMI model projections of economic output dramatically illustrate these patterns. In constant dollar terms, output in the trade, TCU (transportation, communications, and utilities), and FIRE (finance, insurance, and real estate) sectors are expected to increase from about 50 percent of total economic output today to almost 60 percent by the year 2010. Services output, including both tourism and nontourism-related sectors, is expected to decline from about 36 percent to about 30 percent of the total output over the same period.

Largely as a result of these economic forces, population in the Las Vegas urban area is projected to increase to over 1 million in 2010. The City of Las Vegas is projected to increase its population by 82 percent reaching a level of almost 414,000 by 2010. Henderson and North Las Vegas are projected to increase by 88 percent and 66 percent, respectively. The population of Southern Nevada is expected to become increasingly concentrated in the Las Vegas urban area. The following table (4-15) illustrates this pattern of increasing centralization.

The population growth in the early years of the projection period is principally fueled by employment-related migration. In the later years, population growth will become more sensitive to other demographic characteristics, such as the birth rate and retirement-related migration. As a result, the age profile of the region will lose some of its "bulge" in the early working years (20-44), gain in school years (5-19) and in later working years, and remain relatively constant in the pre-school and post-retirement years. This pattern is consistent with a more "mature" urban area, one which has passed its peak growth period, but retains positive growth characteristics.

The age profile is also consistent with the increasing economic diversification of the region. As the economy matures and diversifies, more opportunities will become available for older workers in higher paying jobs such as those which exist in financial and business service sectors and in regional or national business headquarters. As a

TABLE 4-15
PROJECTED GROWTH PATTERNS FOR CLARK COUNTY
1988 and 2010

	1988	2010
Las Vegas as a Percentage of Incorporated Las Vegas Urban Area	64.7%	67.9%
Incorporated Cities as a Percentage of Las Vegas Urban Area	56.2%	59.7%
Las Vegas Urban Area as a Percentage of Clark County	94.7%	95.5%
Clark County as a Percentage of the State of Nevada	60.2%	64.7%

Source: PIC, 1989.

result, the average income measures such as per-capita income or earnings per employee are expected to rise in real terms over the projection period.

The net implication of these trends is that total income is expected to continue to rise faster than population growth in the region. This trend could include a higher standard of living and an enhanced revenue base for state and local government; the negative implications could include increased inflationary pressures in the urban area.

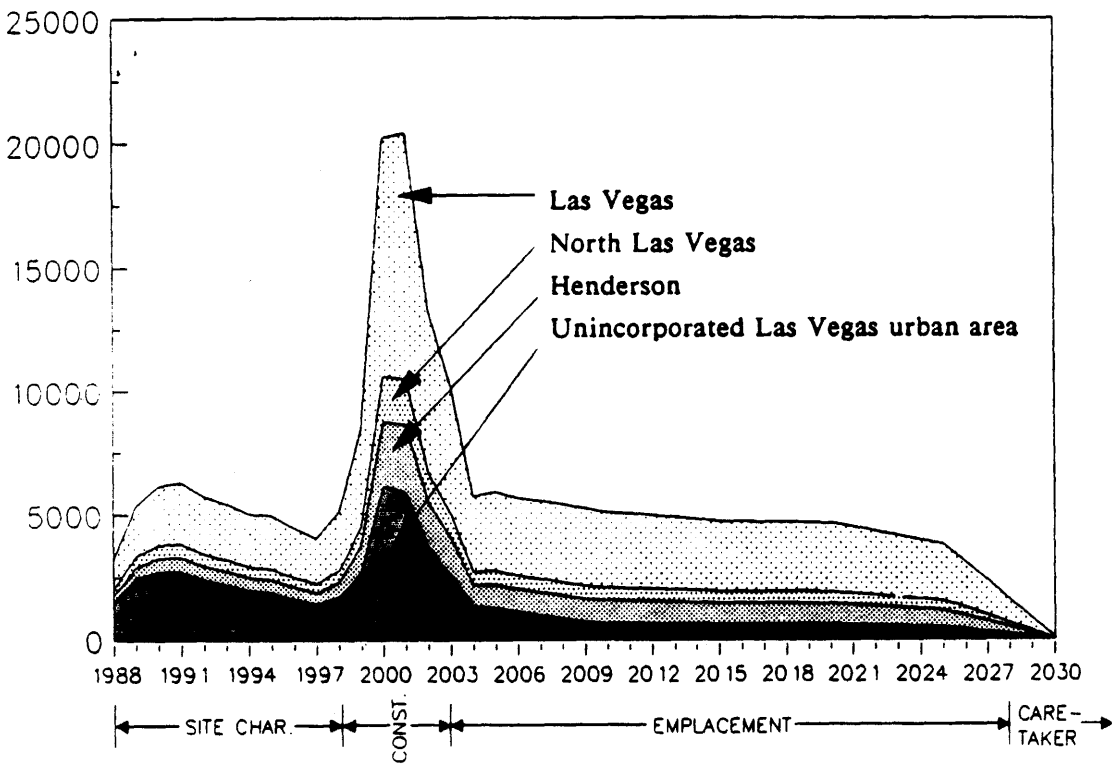
With the growing population and the greater opportunities for higher paid workers, the factor costs (labor, land, and other resources) in the Las Vegas urban area will rise faster than in the country as a whole. The socioeconomic projections assume that average factor costs in Clark County will rise from about 21 percent above the national average in 1988 to about 34 percent above the national average in 2010. This trend will reduce the region's comparative advantage relative to other areas in the Southwest and the country as a whole, and will impose market-based growth restraints on the region. These pressures are projected to result in the decline in population growth rates for the region from more than 4 percent in 1988 to less than 2 percent after the year 2000.

The effect of the repository on growth in the Las Vegas Valley would be relatively small compared to the total socioeconomic environment. As Table 4-16 illustrates, the peak population impact of the repository, including both direct and indirect

TABLE 4-16
LAS VEGAS URBAN AREA EMPLOYMENT AND POPULATION PROJECTIONS WITH REPOSITORY FOR SELECTED YEARS
1988-2030

	Urban Area Projections[1]		Urban Area Repository Impacts			
			Employment[2]		Population	
Year	Employment[2]	Population	Number	Percent[3]	Number	Percent[3]
1988	347,609	628,629	1,631	0.47%	3,223	0.51%
1989	359,672	652,250	2,756	0.77%	5,357	0.82%
1990	376,452	678,277	3,214	0.85%	6,141	0.91%
1995	438,066	780,701	2,649	0.60%	4,955	0.63%
2000	518,802	881,331	13,497	2.60%	20,181	2.29%
2001	533,159	896,188	13,993	2.62%	20,399	2.28%
2003	554,654	913,896	7,306	1.32%	10,174	1.11%
2005	579,446	935,773	3,528	0.61%	5,909	0.63%
2010	640,384	1,026,202	3,067	0.48%	5,078	0.49%
2020	745,681	1,192,102	3,805	0.51%	4,629	0.39%
2030	821,147	1,307,515	26	0.00%	64	0.00%

[1]Impact projection runs for the SIA models were made during the period November-December, 1988. The model outputs were calibrated to official state population estimates for 1987 (Nevada Department of Taxation), the most current figures then available. Some local jurisdictions feel that the Department of Taxation estimates while official for state revenue distributions do not accurately represent their current populations.
[2]By Place of Residence
[3]Percent of estimated and projected direct and indirect population for the jurisdiction.
Source: Mountain West, 1989.



components, would be about 2.3 percent of the total population and the peak employment would be about 2.6 percent of the Las Vegas urban area work force.

The population impacts for three Clark County cities, Las Vegas, North Las Vegas and Henderson and the unincorporated urban area are shown in Table 4-17. In all three cases, these impacts would be modest, generally under one percent of the total population for each city with the greatest effects during peak construction where there is a range of two to three percent of the total.

In terms of numbers, Las Vegas could get the largest impacts, generally in the range of 2,000 to 3,000 with a peak to nearly 10,000 during construction. A similar pattern applies to North Las Vegas and Henderson, although the ranges are smaller: generally 400 to 600 for North Las Vegas and 500 to 1,000 for Henderson. These cities also could experience three or four times the average impacts during peak construction.

Community Facilities and Service and Fiscal Impacts

The modeling exercise assumed a slowing rate of population growth for the urban area over the next 20 years. However, the need for public facilities and services will continue to grow in the Las Vegas urban area at a rate faster than for the state and the nation as a whole. The future costs to local governments in the Las Vegas urban area include the costs of meeting the additional needs of the inmigrant population, the catch-up costs associated with the lag in meeting needs of current residents, and the costs of replacing aging infrastructure.

Both general fund revenues and expenditures in the Las Vegas urban area are sensitive to repository-related employment and purchases. However, the revenues generated by additional residents are not sufficient to pay for growth because the repository contributes more to population growth than to growth in those economic sectors which generate the greatest revenues to local government. Table 4-12, above, displays the projected impacts on the general funds of Clark County and its jurisdictions.

The City of Las Vegas could receive the greatest number of inmigrants to the urban area and is projected to incur the largest negative fiscal impacts among the cities of the urban area. North Las Vegas, although it could receive fewer of the total projected population impacts, could receive generally the same pattern of fiscal impacts. Henderson, on the other hand, may receive positive impacts to its general fund balance during repository construction phase and relatively smaller negative impacts than the neighboring jurisdictions over the other project phases. This is primarily due to a somewhat lower per capita expenditure standard for public safety in Henderson. Therefore, the pattern of revenues and expenditures is similar to other jurisdictions in the urban area, but the expenditures produced as a result of increased population are closer in size to the revenues produced. However, Henderson has recently made significant increases in public safety personnel and equipment and as more increases are projected in the future, the city's per capita expenditures could increase and impacts may be greater than currently projected.

TABLE 4-17
REPOSITORY-RELATED POPULATION IMPACTS FOR
LAS VEGAS, NORTH LAS VEGAS, AND HENDERSON[1]
SELECTED YEARS: 1988 - 2030

	Las Vegas		North Las Vegas		Henderson		Unincorporated Las Vegas Urban Area	
Year	Impacts	Percent[2]	Impacts	Percent[2]	Impacts	Percent[2]	Impacts	Percent[2]
1988	1,178	0.52%	263	0.49%	250	0.44%	1,532	0.53%
1989	2,005	0.85%	442	0.80%	435	0.74%	2,475	0.82%
1990	2,364	0.96%	512	0.89%	531	0.87%	2,734	0.88%
1995	2,124	0.73%	426	0.64%	524	0.73%	1,881	0.53%
2000	9,614	2.86%	1,812	2.41%	2,599	3.11%	6,156	1.59%
2001	9,932	2.89%	1,850	2.41%	2,735	3.19%	5,882	1.51%
2003	5,183	1.47%	940	1.20%	1,471	1.66%	2,580	0.65%
2005	3,156	0.86%	556	0.69%	917	1.00%	1,280	0.32%
2010	2,989	0.72%	496	0.56%	913	0.85%	680	0.16%
2020	2,725	0.53%	452	0.43%	832	0.61%	620	0.14%
2030	38	0.01%	6	00.0%	12	0.01%	8	00.0%

[1]Impact projection runs for the SIA models were made during the period November-December, 1988. The model outputs were calibrated to official state population estimates for 1987 (Nevada Department of Taxation), the most current figures then available. Some local jurisdictions feel that the Department of Taxation estimates while official for state revenue distributions do not accurately represent their current populations.
[2]Percent of estimated and projected direct and indirect population for the jurisdiction.

Source: Mountain West, 1989.

The projections of general fund fiscal conditions in the Las Vegas urban area show large negative fiscal deficits; however, using a subtractive approach to measure capital impacts would show misleadingly small net negative impacts. This is because the baseline growth for the urban area is expected to be so great over the projection period that most additional capital costs would be incurred with or without the repository. Much more illustrative is the consideration of the timing of necessary capital additions and the ability of local government to withstand the combined effects of remedial and additional capital requirements, as well as the additional fiscal effects associated with the special risk characteristics of the repository.

Almost uniquely among the nation's major metropolitan areas, the Southern Nevada urban area is developing "all at once." Clark County's population increased by 146,000 during the 1960s, by 190,000 in the 1970s, and is expected to increase by 246,000 in the 1980s; the county's population in 1960 was only 16 percent of its projected population in 1990. As the Las Vegas urban area has developed all at once, it can expect to age all at once. Like other capital investments, most urban infrastructure has an expected useful life -- ranging from 20 to 40 years. Assuming that the annual rate of infrastructure repair, renovation, and replacement has been 5 percent since 1950, the proportion of the urban infrastructure which is over 30 years old will increase from about 10 percent in 1980 to 29 percent in 2020. The evidence, however, is that efforts to accommodate growth have resulted in significantly lower rates of infrastructure repair and replacement. The Las Vegas urban area has had to focus more on new development than on the repair and replacement of existing infrastructure resulting in a 2 to 3 percent annual rate of infrastructure repair and replacement. The proportion of the infrastructure that would be over 30 years old in 2020 would increase from 29 percent with a 5 percent maintenance and replacement rate to 42 percent with a 2 percent rate.

Political Behavior Impacts

The urban area's ability to absorb growth under standard impact projections depends on the ability of urban governments to cooperate in assessing, siting, and financing new facilities. However, past experiences indicate such cooperation cannot be readily assumed. As noted in Chapter 3, intergovernmental cooperation is not the norm for Las Vegas urban area governments. Any extended conflict over repository activities similar to that experienced between Clark County and the City of Las Vegas over waste water treatment earlier in the decade, could have deleterious effects on the economic growth and viability of the whole urban area. In such cases of conflict, repository-related growth could add to continuing costs and service overload levels with few off-setting positive benefits for local governments.

Intergovernmental relations could revolve around the credibility of the federal government's safe operation of the repository. Other areas of conflict between state/local and federal officials could be the selection and improvement of transportation routes, the needs of emergency management units, and adequate risk management and mitigation programs. Failure to deliver to the satisfaction of local governments could lead to continuing conflict with federal authorities. Failure to adequately inform local governments of operating procedures and safety records also could lead to conflict. In

the extreme case, legal action might be pursued to block waste shipments or to suspend operations, similar to actions taken in other areas against nuclear power plants and weapons facilities.

During the final caretaker, decommissioning, and closure phase of the repository, standard impacts could be minimal. The repository work force could decline gradually and become an insignificant percentage of the total population and economy of the Las Vegas area. Again, the key public issues could involve the credibility of the repository's ability to safely contain high-level radioactive waste. If a cooperative spirit existed between local, state, and federal governments, delivery of support services to assist in guaranteeing safety during this final phase could flow smoothly. However, if local government fears were unaddressed during the operations phase, there might be little reason for local officials to trust their federal counterparts in charge of monitoring the site. Demands for financial and legal liability coverage could be made upon the federal government. Potential legal avenues (with attendant costs) also might be explored.

The scenario of community services planning and development outlined above responds to the standard impacts of growth from the repository. However, if risk effects negatively impact tourism and migration, the local governments could be placed in an extremely vulnerable position. It is possible that large negative fiscal impacts could result for the state and local jurisdictions. If these revenue losses were due to an accident event, the impacts could occur very quickly since visitor spending and state/local revenues are interdependent. If the risk-related revenue losses were due to stigmatization of the urban area, long-term impacts could result. For example, given the lead times necessary for planning and construction of community services infrastructure, such facilities could require bond financing which might assume a rapidly expanding population base to make the bond payments. A population decline due to risk impacts could lead to excess capacity and increased costs to the individual users from fixed operating expenditures. Local governments could then be faced with the need to divert other resources to cover these losses.

These strains on intergovernmental relations could result in various types of political effects including a decline in public trust of government. Conflict between state and local governments over mitigation and equity issues, as well as conflict between the state and the federal government, could be given considerable media attention. As public dissatisfaction increases due to intergovernmental conflict and the inability of urban area governments to address regional problems, these issues could be raised to the level of citizen debate. This could result in increased political participation, turnover among officeholders, and public protests.

Intergovernmental conflict also could negatively affect the ability of the governments involved to find solutions to the regional problems. It is unlikely that the State of Nevada could mediate the negative impacts on urban area governments produced by risk effects because its own resource base could be diminished. Federal assistance could be necessary, but local government cooperation with the federal government could be undermined by the sense of distrust resulting from risk-related impacts and the discord among the local governments themselves.

Social and Cultural Impacts

As has been stated, the Las Vegas urban area has been undergoing extremely rapid growth and this growth is projected to continue in the future, although at somewhat slower rates (PIC, 1988a). The growth brings new and transient people seeking employment. It is a population self-selected to value and expect both economic and population growth and to expect further that growth will bring personal economic benefits in steady employment, high wages, and low taxes (Stewart, forthcoming).

These changes will bring with them increasing pressures to upgrade educational facilities, family recreation, city parks, and cultural resources such as museums, dance, and music. They may also bring increased social conflict between segments of the population and areas of the city -- particularly conflicts over tax rates, government spending, and service priorities. Also, with continued growth, the Las Vegas urban area will face added problems and expenses including more traffic, pollution, and crime, and consequently a greater need for public services and programs.

The process of siting the repository at Yucca Mountain and the possibility that nuclear wastes will be transported through the urban area adds another strain to the existing tensions within the urban area. As stated previously, nuclear waste carries a heavy load of fear associated with a risk that is invisible, beyond local control, and potentially irreversible (Douglas and Wildavsky, 1982; Slovic, 1988). In the United States in particular, nuclear issues have produced strong opposition and conflict because, as Downey (1986) has argued, they strike a nerve in basic American beliefs about government, progress, the environment, and the relationship between the individual and the community. Furthermore, these beliefs have become particularly cogent and volatile in the West as a result of their historical role in struggles over its development; they have become virtual symbols of a Western regional identity (Reisner, 1986; Worster, 1986; Steffen, 1979; Wiley and Gottlieb, 1982). The Las Vegas urban area is not only influenced by the images promoted by the tourist/gaming industry, but also by the beliefs, values, and perceptions of the inmigrants to the area (Stewart, forthcoming).

Particular segments of the population may come to be rigidly identified with extreme positions: some of the unions, military, DOE contractors, some retired military, and rural residents who live near the site are becoming associated with the pro-nuclear side while environmentalists, liberal professionals, downwinders, and national peace and religious groups are associated with the anti-nuclear position. Anthropological fieldwork in the urban area suggests there might be future differences on the repository issues based on class cultures. Depending on reactions to particular repository-related events in the future, and on the duration of the conflicts over the issues, the results could be alienation and bitterness or at the very least a loss of the current enthusiasm for the future of Las Vegas as a community (Stewart, forthcoming).

The well-being questions from the urban survey suggest potentially large impacts from the repository to Las Vegas area residents. While the responses of current residents to future conditions may not provide a completely accurate description of future behavior, it does give some evidence of the direction that future responses and behavior

could take. Even under a low-risk repository future, the respondents who indicated the highest satisfaction with their communities declined by 20 percent with the repository, indicating a potential lessening of satisfaction with the quality of life and with life in general in the Las Vegas area. Currently, 5 percent of Las Vegas area residents express low satisfaction with their communities; with the repository that could increase to 16 percent. Under any repository-risk future, at least 50 percent of the Las Vegas area respondents stated that their communities would have a less desirable future than they currently foresee their communities having without the repository. Such changes in community satisfaction could have significant impacts on residents sense of place, volunteerism, investment decisions, and political activities (Mushkatel, Nigg, and Pijawka, 1989b).

Additional evidence that investment decisions could be affected by the repository was uncovered by the urban survey. Respondents reported that they would be less likely to invest under any repository future than without the repository. The proportion reporting they would probably or definitely make investments decreased from 64 percent to 39 percent with the prospect of the repository. The proportion of people saying they definitely would not invest increased from 14 percent to 29 percent. Such changes in willingness to invest could have serious impacts upon growth and development in the urban area and exacerbate existing economic problems.

Outmigration also could be increased by the repository. People in the Las Vegas urban area could be more likely to move out of the State of Nevada if the repository were constructed. In the urban survey, the percentage of people reporting they definitely or probably would move increased from 29 percent to 46 percent when the repository was introduced to their future. The proportion of people saying they definitely would not move decreased from 28 percent to 14 percent. Of those reporting they might move, 75 percent said the move would be out of the state. Urban area growth and the stability of neighborhoods could be negatively impacted by such migration decisions.

Greater evidence that public participation in political activities may be affected by the repository is provided by more specific questions in the urban survey. Respondents were asked whether they had participated in seven types of political activities in the last four years. After a repository scenario was introduced, they were asked to indicate which of the same actions they would take in the future. Potential actions were: talking or writing to various officials, attending meetings, contributing money, volunteering, and demonstrating. In response to the repository future, people indicated they would increase the number of these activities in which they would take part from an average of two (in the past) to three (in the future).

Disagreement among experts and between elected officials on repository issues could lead to increased public uncertainty, increased doubt about what the hazards really are, decreased trust in official spokespersons, generally increased perceptions of risk, and feelings of powerlessness and lack of control. This might lead to resistance to the repository by some people and on the other hand, total support of the repository by other people. These conditions of social conflict could affect residents throughout the urban area.

The potential social impacts could have large negative effects on the morale of the urban area "communities." This is particularly important in booming southwestern cities like Las Vegas where the community process depends on spontaneous, voluntary community sentiment and action. Volunteer activities fill in for social services and where they are undermined, the quality of life suffers.

The site characterization and construction phases of the repository could be the time of greatest protest and social concern if this project were to follow the pattern of a number of nuclear power plants. Las Vegas already has a long standing base of national anti-nuclear organizations because of the Nevada Test Site. The repository, along with NTS, is the planned focus of future "actions" at the test site designed to draw national media attention. Already the proposed repository has drawn a national network of opposition, particularly in the other states previously under consideration as potential sites. A National Waste Transportation Task Force, formed by Citizen Alert in Nevada, plans to publicize nuclear waste transportation routes, both across the country and locally. Likely strategies include billboards that read "This is a nuclear waste transportation route" and parades of people pushing wheel barrows leaking "nuclear waste." A repository performance experience that resulted in significant public concerns about risk-related effects, on the other hand, could result in major protest actions at a later date in the program. In either case, it appears that the repository program could stimulate significant grassroots protests and national media attention.

4.5.2 Rural Community Impact Projections

The effort to project the possible economic, demographic, social and/or cultural impacts of repository construction, operation, and closure is constrained for two reasons. First, there is a high level of uncertainty about the basic characteristics of the proposed repository facilities, waste transportation routes, and any related waste management programs. Second, future growth and development trends for some of the area communities are highly volatile. There is the potential for both expected and unanticipated projects and events to dramatically alter baseline social conditions.

Despite these limitations, and using the best available information regarding the community allocation of repository standard effects, projections have been developed, focusing on the period from 1988 to 2030. In addition to projections linked to the standard effects, consideration also has been given to the hazard conditions of the repository program and the potential risk-related impacts where appropriate, although these discussions are necessarily confined to a more general and qualitative level of analysis.

As discussed in Chapter 3 (Section 3.4.2), the rural communities in Southern Nevada have been divided into two study areas on the basis of shared sociocultural characteristics. These two study areas were defined by proximity to the repository site, the attitudes and experiences relating to nuclear issues, and other relevant sociocultural characteristics (e.g., religion).

4.5.2.1 Eastern Study Area Impact Projections

The eastern study area is made up of several rural communities, the most salient being the City of Caliente and the Alamo-Hiko area, both in Lincoln County, and Mesquite with the surrounding Moapa Valley in Clark County. These communities share similar characteristics that are important in socioeconomic impact assessment. First, their distance from the repository makes it unlikely that any of them would experience large-scale population growth effects from construction and operation of the repository. Second, each community has a significant Latter-day Saints population which provides a degree of cultural homogeneity absent in the western study area communities. Finally, each community is downwind from NTS and experienced extensive radioactive fallout during the era of above-ground nuclear weapons testing.

Economic and Demographic Impacts

The first source of impacts to be considered are those that result from employment by place of residence and the wages and household characteristics that are directly attributable to the Yucca Mountain repository site development. In Section 4.2, above, the residency allocation of workers at Yucca Mountain was shown for the county level. The contribution of these residents to the local community businesses would have indirect effects, creating additional jobs and population.

Overall, it is likely that the repository program would have only modest population and employment effects on the eastern study area communities. Population and employment projections reported in Table 4-18 suggest that at the peak of employment, currently scheduled for the year 2001, employment increases by place of residence would be approximately 240 in the study area, approximately a three percent increase. Employment increases could be substantially lower before 1998 and after 2003, since the impact peak is correlated with construction employment.

Anticipated demographic impacts could be equally modest, paralleling the projected employment effects in the eastern study area. Population growth at the peak of the impacts could involve an estimated 60 additional residents in Alamo-Hiko, 99 in the Caliente, and 193 in the Moapa Valley (see Table 4-19). Except in Caliente and Alamo-Hiko, none of these population impacts exceeds 5 percent of the population and then only for a relatively short period during the peak impact years.

Given the distance of the eastern study area communities from Yucca Mountain, both employment and population growth are likely to be limited. Only if a new access route to Yucca Mountain is developed through NTS, or if activities to develop or upgrade waste transportation routes stimulate additional local employment opportunities, is it possible that population growth could be substantial. In all of the eastern study communities the population growth attributable to the repository program could be modest during the site characterization, construction, and operation phases.

TABLE 4-18
EASTERN STUDY AREA EMPLOYMENT AND POPULATION PROJECTIONS WITH REPOSITORY FOR SELECTED YEARS
1988-2030

	Eastern Study Area Projections[1]		Eastern Study Area Repository Impacts			
			Employment[2]		Population	
Year	Employment[2]	Population	Number	Percent[3]	Number	Percent[3]
1988	5,495	10,390	20	0.36%	38	0.37%
1989	5,648	10,693	44	0.78%	84	0.79%
1990	5,843	10,971	51	0.87%	95	0.87%
1995	6,560	12,116	37	0.56%	67	0.55%
2000	7,565	13,290	228	3.01%	369	2.78%
2001	7,740	13,448	240	3.10%	377	2.80%
2003	7,958	13,544	122	1.53%	188	1.39%
2005	8,265	13,763	83	1.00%	137	1.00%
2010	9,029	14,868	79	0.87%	128	0.86%
2020	10,433	17,047	77	0.74%	127	0.74%
2030	11,517	18,682	6	0.05%	8	0.04%

[1]Impact projection runs for the SIA models were made during the period November-December 1988. The model outputs were calibrated to official state population estimates for 1987 (Nevada Department of Taxation), the most current figures then available. Some local jurisdictions feel that the Department of Taxation estimates while official for state revenue distributions do not accurately represent their current populations.
[2]By Place of Residence
[3]Percent of estimated and projected direct and indirect employment or population for the eastern study area.
Source: Mountain West, 1989.

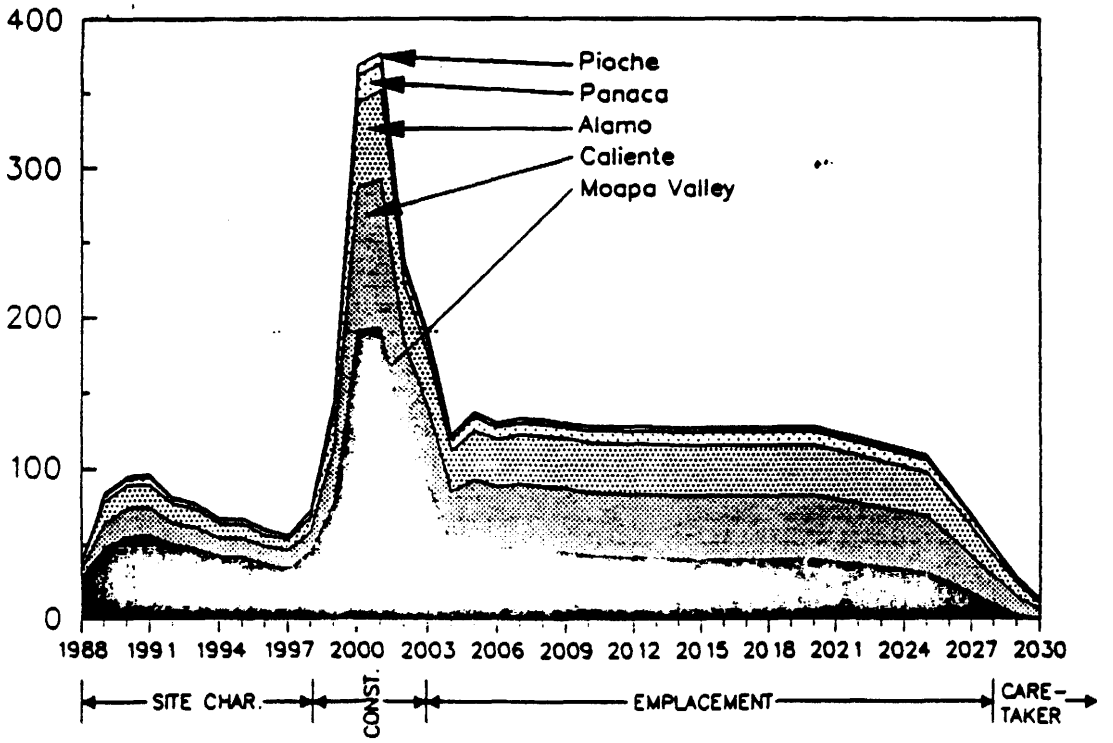


TABLE 4-19
REPOSITORY-RELATED POPULATION IMPACTS FOR EASTERN STUDY AREA JURISDICTIONS[1]
SELECTED YEARS: 1988 - 2030

	Alamo - Hiko		Caliente		Panaca		Pioche		Moapa Valley[2]	
Year	Impacts	Percent[3]	Impacts	Percent[3]	Impacts	Percent[3]	Impacts	Percent[3]	Impacts	Percent[3]
1988	5	0.48%	5	0.41%	0	0.00%	0	0.00%	28	0.45%
1989	14	1.34%	16	1.29%	4	0.32%	2	0.25%	48	0.75%
1990	15	1.45%	19	1.52%	4	0.32%	2	0.25%	55	0.83%
1995	9	0.88%	12	.94%	3	0.22%	1	0.13%	42	0.55%
2000	57	5.58%	96	7.14%	18	1.28%	7	0.90%	191	2.19%
2001	60	5.92%	99	7.37%	18	1.27%	7	0.90%	193	2.17%
2003	35	3.62%	49	3.82%	9	0.64%	4	0.53%	91	1.00%
2005	32	3.40%	41	3.24%	9	0.63%	3	0.40%	52	0.55%
2010	33	3.56%	41	3.18%	8	0.54%	3	0.40%	43	0.41%
2020	33	3.60%	42	3.10%	9	0.55%	3	0.38%	40	0.32%
2030	4	.45%	6	0.43%	2	0.11%	1	0.12%	(5)	(0.04)%

[1]Impact projection runs for the SIA models were made during the period November-December, 1988. The model outputs were calibrated to official state population estimates for 1987 (Nevada Department of Taxation), the most current figures then available. Some local jurisdictions feel that the Department of Taxation estimates while official for state revenue distributions do not accurately represent their current populations.
[2]Moapa Valley includes Mesquite, Bunkerville, and the Moapa Reservation.
[3]Percent of estimated and projected direct and indirect population for the jurisdiction.

Source: Mountain West, 1989.

Community Fiscal and Services Impacts

Largely as a result of the economic conditions in the recent past, the facility and service standards in Lincoln County are low relative to the rest of Nevada, and very low relative to comparable communities in the United States as a whole. The communities in the county are very vulnerable to small changes in population and tax base, and have relied on the state to supplement the county's budget during the past few years to meet even the currently prevailing local government services.

The projections of future fiscal conditions assume that the current standards could prevail over the indefinite future. No significant changes in staffing would be expected to occur in any areas; to respond to small population changes, it is assumed that fractional employment changes in public agencies would occur (i.e., a position could change from part-time to full-time status or vice versa). No significant changes in character of service are projected; e.g., no community is expected to change from a volunteer to a paid fire department. In Mesquite and Caliente, it is assumed that municipal services would continue to be provided at minimal levels over the projection period; in unincorporated Lincoln County, it is assumed that the county would continue to provide most public services. Table 4-14, above, displays the projected impacts on the general funds of Lincoln County and its communities.

Because of the state's fiscal structure the additional expenditure requirements due to the population increase in the eastern rural area would be uncompensated even with the increase in revenues. The specific fiscal effects would vary from community to community, with the county and the nearby communities of Alamo and Caliente experiencing a negative net impact.

In the cases of negative effects, the impacts are quite modest and could very easily be managed and mitigated. In the case of Caliente, the impacts are probably of a size that they would be compensated for by the positive benefits of the NWPO and DOE grant programs, if these were to continue in some form over the projection period. (These grant effects were not modeled for the Interim Report. See Section 4.1, above).

Political and Governmental Impacts

Given the projections for modest economic, demographic, and fiscal impacts, there is little reason to anticipate that the repository program would induce major shifts in governmental structure for the rural communities of the study area. In the Alamo-Hiko area, the minimal local government structure that is currently in place would likely persist, even if the additional population were to materialize. In all likelihood, the communities of the Pahranagat Valley would continue to rely on Lincoln County for provision of services for population growth, whether it was stimulated by the repository program or not.

In Mesquite, the projection of substantial population growth suggests there could be numerous new demands on the city government to expand existing services and provide new ones. The most likely changes could include adding new municipal

positions, departments and programs to manage various service provision activities. Modest population growth associated with the repository could exaggerate the total changes by adding to the existing demands for new services. The location of Mesquite along I-15 and the community's heavy reliance on visitors and tourists for its economic existence means that transportation of high-level radioactive waste through the community could be a major political and governmental concern.

Throughout the eastern study area, the repository program is also likely to induce changes in governmental and political conditions for reasons other than those associated with standard economic-demographic growth effects. Even in the absence of accidents or events that might contribute to heightened risk perceptions, the levels of concern currently present in eastern study area communities could give rise to local demands for expansion of public safety services and facilities, especially emergency response capabilities. This could place demands on local governments to obtain new or reallocate existing funding for public safety programs, and to focus attention on the implementation and administration of such programs.

In all of the eastern study area communities the high sensitivity of residents to repository risk issues suggests that new patterns of political participation, voting behavior, and collective action could develop in response to concerns about nuclear risks. Demands for governmental action could become much more extensive in the event of serious or recurrent accidents involving repository operation or waste transportation. Nuclear accidents could result in increased demands for local government efforts to oppose continued repository operation. Local political representation could change if voters shift their support to candidates viewed as anti-repository. The potential for and magnitude of such effects could be especially high if hazardous events were localized and perceived to be directly threatening to either community health and safety or local economic development.

Intergovernmental relations very easily could change as a result of the repository program. The potential availability of federal funds generated by the repository for both Lincoln and Clark counties could cause tensions between communities, and between communities and their county governments. The competition for federal funds could be particularly keen if local officials and residents perceive inequities in fund allocations. Also, perceived health and safety risks could generate local demands for increased county or state expenditures for health and safety services and for increased emergency response capabilities. Community demands for increased funding could set the stage for conflicts among and between various governmental units. Attempts to forge new political alliances with other units of government could occur, particularly if conflicts over funding allocations arise or if risk conditions contribute to local attempts to force improved safety procedures or other modifications on to the repository program.

Community Social Structures and Processes

Although the repository program has had minimal effects on social structures and processes in the eastern study communities to date, the potential for impacts to arise in

the future is substantial. It is most likely that structural changes, if any, could be the result of increased perceptions of risk.

Standard repository effects linked to economic and demographic change are expected to be relatively limited. Even in the case of Alamo and Caliente, where the effects are projected to be proportionately largest, the relatively small number of new inmigrants attributable to the repository would not be sufficient to trigger the types of social disruption which have been observed in many western boom towns (see Freudenburg, 1986; Krannich and Greider, 1984; Krannich, Greider and Little, 1985). To a limited extent the population influx could contribute to increased factionalism, particularly in relatively homogeneous communities like Alamo where new residents could find it difficult to become integrated into established community networks. The new residents would be so few in number, however, that their presence would be unlikely to alter the overall pattern of community social life. Further, the period of greatest population growth is projected to be relatively short, so significant structural changes would have little time to transpire.

Other aspects of the repository program could have substantial impacts on local social structures and processes. Eastern study area community residents have made long-term adaptations to nuclear testing programs, even while testing is widely viewed as undesirable. The emergence of risk conditions related to repository operation or waste transportation could, however, generate very substantial social change in the eastern study area communities if the residents perceived the risks as threatening themselves or their communities. Widespread dissatisfaction with the repository program would likely give rise to overt expressions of opposition and new patterns of collective action involving individuals and organizations within the local communities, and to political alliances involving linkages with extra local organizations (see Walsh and Warland, 1983; Williams and Payne, 1985).

Opposition to repository programs could in turn stimulate internal community conflict. Those local residents highly concerned about risks associated with the nuclear waste storage program who expressed opposition to it might find themselves in conflict with residents who place a high priority on economic development. The latter tend to downplay the seriousness of risks, fearing that repository-related economic benefits and/or the ability to attract new business and industry to their community could be jeopardized by overt expressions of concern and opposition. These contrasting views of the extent of the risks and the appropriate local responses to them could generate intracommunity tensions and conflicts in places like Caliente, where growth promotion interests and the anticipation of repository economic benefits appear to be highest.

Attitudes and Perceptions

In the Lincoln County segment of the eastern study area, the persistence of projected economic and demographic stagnation would be a source of concern and dissatisfaction for many local residents. Although there is little support for large-scale growth in these communities, most local residents express support for developments that would enhance local employment opportunities and stimulate modest population growth.

They further believe that employment and population increases would provide the foundation for expanding local businesses and services.

Consequently, the projected standard economic and demographic growth impacts of the repository program could be consistent with local preferences. If anything, locals could be disappointed that the projected levels of employment and other beneficial economic effects are so low and that the period of greatest economic and demographic effects so short. Disappointment could be particularly likely in Caliente, where expectations of significant repository-related economic benefits are relatively widespread. Nevertheless, the modest economic and population growth associated with standard impacts during both repository construction and operation periods could be viewed favorably by most residents, since the number of new residents would not threaten the overall stability of social conditions that contribute so importantly to overall high levels of community satisfaction and attachment.

Somewhat different attitudinal responses to standard economic and demographic effects could emerge in Mesquite, where residents express greater ambivalence about the potential for population growth. Even projected growth conditions without the repository could cause some current residents to become dissatisfied, perceiving that the changes could threaten existing lifestyles and community values. Standard repository impacts could exacerbate these local concerns regarding undesirable social change. Further, the stress and strain placed on community services and housing availability resulting from the standard impacts could heighten the level of dissatisfaction.

In all of the eastern study area communities, attitudes about the repository program could become more positive over time. If no major events that stimulate heightened risk perceptions occur, if repository-related fiscal effects contribute to economic well-being, and if associated social changes are not viewed negatively, the repository could come to be seen as a community advantage.

The potential for negative impacts, however, could be quite substantial. According to the rural communities' surveys and the fieldwork done in these communities, residents already express high levels of concern about risks related to waste transportation and repository operation. Local attitudes reflect stronger opposition to the repository than in the rural communities of the western study area. The very presence of the repository could contribute to increased community dissatisfaction, heightened perceptions of political powerlessness, and greater distrust of the federal government. Such responses could be especially intense if waste is transported through one or more of these communities (Krannich and Little, forthcoming).

The occurrence of even minor risk events associated with repository construction or operation could likely cause heightened concern about the program, as could transportation accidents involving nuclear waste. Increased distrust and dissatisfaction with the federal government's management of nuclear waste could result if serious risk events were to occur in proximity to any of the eastern study area communities. Attitudes toward and perceptions of the repository program could reflect significant deterioration in local residents' levels of community satisfaction and social well-being.

Evidence derived from the rural community survey suggests that such responses could contribute to a variety of related behavioral shifts, including possible increased rates of outmigration, altered investment behavior, and/or increased political activity.

4.5.2.2 Western Study Area Impact Projections

The communities in the western study area include the towns of Amargosa Valley, Beatty, and Pahrump in Nye County; Indian Springs in Clark County; and Goldfield and Silver Peak in Esmeralda County. These communities share some social and cultural features relevant to analyzing impacts of and local orientations toward the proposed repository program. They are the communities closest to the repository and most likely to experience significant impacts from development and operation of the proposed repository. In addition, all are located upwind of NTS and did not experience widespread nuclear fallout from atmospheric weapons testing during the 1950s and 1960s.

Economic and Demographic Impacts

The economic base of the western study area, focused on mining, government and other services, is expected to continue its growth through the year 2000. Although one of the major components of the economy, gold mining, historically has proved to be subject to boom and bust cycles, the projections assume uninterrupted gold mining growth until the year 2000, followed by a significant decline. This assumption, while quite vulnerable to attack as overly optimistic and unrealistically specific in duration, is among the conclusions reached in deriving a "most useful" scenario for analysis. The population of the region is projected to increase from about 10,400 in 1988 to about 14,600 in 2000 and to 16,700 in 2010.

In Section 4.2, above, the residency allocation of workers at Yucca Mountain was shown for the county level. Demographic impacts which would result from the worker allocation could be substantial in some of the western study area communities. At the point of peak impact, the number of new residents is projected to be over 1,400 persons in four of the study communities (see Table 4-20). As Table 4-21 shows projected population increases in individual communities range from 212 in Amargosa Valley to 742 in Pahrump. The proportionate population growth impacts range from a projected peak increase of 7.5 percent in Pahrump to an increase of over 13 percent in Indian Springs, over 14 percent in Beatty, and nearly 19 percent in Amargosa Valley. Although the magnitude of population growth effects would be greatest during the construction phase, growth effects during the emplacement period also could be substantial and could exceed 4 or 5 percent in Pahrump and nearly 10 percent in Amargosa Valley. The decline in employment and population following construction and again after emplacement could produce significant negative impacts, analogous to historical declines in these communities.

Community Fiscal and Services Impacts

The primary standard effects of the repository include additional demand for schools and school personnel, police and fire protection, recreation facilities and services,

TABLE 4-20
WESTERN STUDY AREA EMPLOYMENT AND POPULATION PROJECTIONS WITH REPOSITORY FOR SELECTED YEARS 1988-2030

Year	Western Study Area Projections[1]		Western Study Area Repository Impacts			
			Employment[2]		Population	
	Employment[2]	Population	Number	Percent[3]	Number	Percent[3]
1988	3,924	10,403	43	1.10%	75	0.72%
1989	4,014	10,571	134	3.34%	212	2.01%
1990	4,314	11,259	168	3.89%	259	2.30%
1995	4,527	12,194	105	2.32%	167	1.37%
2000	5,444	14,597	888	16.31%	1,397	9.57%
2001	5,325	14,551	926	17.39%	1,442	9.91%
2003	5,036	14,636	543	10.78%	849	5.80%
2005	5,150	15,489	498	9.67%	830	5.36%
2010	5,493	16,745	570	10.38%	946	5.65%
2020	6,045	18,725	679	11.23%	1,116	5.96%
2030	5,765	19,138	87	1.51%	119	0.62%

[1]Impact projection runs for the SIA models were made during the period November-December, 1988. The model outputs were calibrated to official state population estimates for 1987 (Nevada Department of Taxation), the most current figures then available. Some local jurisdictions feel that the Department of Taxation estimates while official for state revenue distributions do not accurately represent their current populations.
[2]By Place of Residence
[3]Percent of estimated and projected direct and indirect employment or population for the western study area.
Source: Mountain West, 1989.

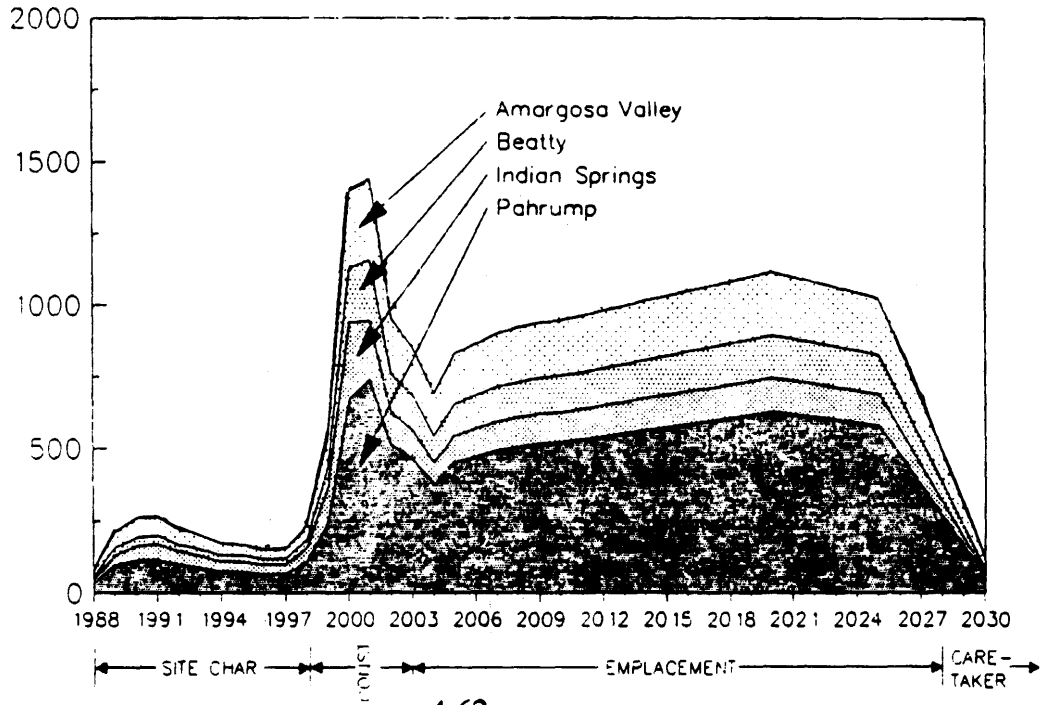


TABLE 4-21
REPOSITORY-RELATED POPULATION IMPACTS FOR WESTERN STUDY AREA JURISDICTIONS[1]
SELECTED YEARS: 1988 - 2030

Year	Amargosa Valley		Beatty		Pahrump		Indian Springs	
	Impacts	Percent[2]	Impacts	Percent[2]	Impacts	Percent[2]	Impacts	Percent[2]
1988	8	1.12%	11	0.69%	35	0.51%	21	1.70%
1989	26	3.52%	34	2.23%	96	1.37%	56	4.23%
1990	30	3.91%	49	2.50%	113	1.59%	67	4.78%
1995	22	2.68%	35	1.73%	71	0.92%	39	2.39%
2000	191	17.44%	266	13.31%	672	7.13%	268	12.89%
2001	212	18.61%	204	14.21%	742	7.54%	284	13.31%
2003	120	10.86%	99	7.63%	464	4.57%	166	7.95%
2005	112	9.64%	92	6.49%	450	4.19%	176	8.11%
2010	127	10.15%	105	6.95%	519	4.49%	195	8.08%
2020	149	10.74%	121	7.74%	625	4.83%	221	7.77%
2030	15	1.11%	9	0.65%	56	0.42%	39	1.32%

[1]Impact projection runs for the SIA models were made during the period November-December, 1988. The model outputs were calibrated to official state population estimates for 1987 (Nevada Department of Taxation), the most current figures then available. Some local jurisdictions feel that the Department of Taxation estimates while official for state revenue distributions do not accurately represent their current populations.
[2]Percent of estimated and projected direct and indirect population for the jurisdiction.

Source: Mountain West, 1989.

and utility infrastructure (water and sewer expansions). However, most communities in the vicinity of the repository site are actively pursuing additional population growth as a means to expand public and private amenities and to make the local communities more self-sufficient and attractive to current and future residents. The typical rural community model involves a tradeoff between the desire to expand (or even to avoid outmigration of high school graduates) and the desire to maintain a rural character. In part to make the rural community model more viable and in part to adapt the rural model to changing circumstances, the western study area communities seek certain additional amenities to reduce their reliance on the Las Vegas urban area.

For example, there is a constant effort to recruit and maintain medical personnel. The adaptation in rural areas of Nye County to the inability to recruit doctors is to establish and maintain clinics staffed by physicians' assistants under the guidance of doctors. Volunteer fire and EMT capabilities are similar examples, with the level of paid staff varying in proportion to the service demand and the financial ability of the community.

The levels of population increase projected in this analysis suggest only moderate additions to the public and private service base of the communities in the western rural area in the absence of significant changes in public standards or private entrepreneurial activity in the area. This is not to suggest that the growth desired by the rural communities is impossible, but only that the projections assume continuity of community character over the projection period.

The greatest expenditure impacts on the western rural communities would be for public elementary and secondary education and public safety (particularly the Nye County Sheriff's Department), which are the two functions that traditionally comprise most of the rural area's total local expenditure responsibilities. The general fund responsibilities could be accompanied by large capital responsibilities if the repository activities were to coincide with other major economic development activities in the area, especially gold mining. As Clark County provides many services for Indian Springs, increased demands for public facilities and services on the community could result in impacts to Clark County.

Model projections show that in the absence of significant revenues from grants, mitigation or compensation payments, the fiscal impacts could be negative. Table 4-13, above, displays the projected impacts on the general funds of Nye County and its communities. It also appears, however, that appropriate impact management in cooperation with federal allocations of funds could mitigate these levels of impact. Serious losses to the tax base from the potential risk-related effects might introduce negative impacts of considerably greater magnitude and could require mitigation strategies that would be considerably different than those that apply to the standard operations of public facilities and services.

Political and Governmental Impacts

Population growth anticipated for some of these western study area communities could generate demands for significant improvements and/or changes in community services. The demographic impacts could both increase the number of residents and the expectations of inmigrants for better community services and facilities. Additionally, transporting and handling the radioactive waste on-site almost certainly would require an expansion of public safety services and emergency response capabilities during the emplacement period. The demands for increased services, when combined with fiscal constraints which make the maintenance of even pre-existing service levels difficult, could provide an important stimulus for intracommunity conflict and thus changes in community government.

In the case of smaller western communities like Amargosa Valley, Beatty, and Goldfield, governmental changes probably would not involve major restructuring of the existing systems, insofar as town advisory boards and other voluntary boards and committees have little or no decision-making power. However, some expansion of local government structure in the form of new committees and boards could occur, as could shifts in political leadership. Some leadership changes could be voluntary as fiscal strains and social conflicts make leadership positions less attractive. Other changes in leadership could be involuntary. Experiences in other rapidly growing communities in the west have shown that leaders frequently are blamed for failure to resolve community service and fiscal problems. Further, newcomers, in the absence of established allegiances, tend to alter traditional local power bases (Gold, 1985).

Many of these same changes also could occur in Pahrump and Indian Springs where the potential for even more extensive changes in governmental structure appears to be high, due in part to the history of local efforts to incorporate the communities and the contentiousness of town-county relationships. Pahrump in particular would seem likely to exhibit increased pressures for incorporation and for expanded local governmental actions to address land use and service infrastructure issues. The pressures, however, are likely even in the absence of repository-induced growth. The substantial population growth projected to result from the repository program during both construction and emplacement phases could simply compound the effects of growth and contribute to the likelihood of community change.

Intergovernmental relations involving the five western study area communities and other units of government could change substantially as a result of repository construction and operation. Existing tensions between the communities and their respective county governments are particularly evident in Pahrump and Indian Springs. Intergovernmental relations could become more contentious as a result of increased pressures on service provision and land use issues projected to result from both growth conditions and repository construction and operation. In addition, the increased revenues which might become available as a result of GETT and other repository-related funding sources could become a source of increased intergovernmental tension, since the distribution of existing county funds is already a town-county issue.

Nuclear-related accidents or other serious problems involving repository operations or transportation also could contribute to high levels of political controversy and conflict in the western study area. The perception of increased risks could lead to changes in political leadership at both community and county levels and contribute to heightened intracommunity and intercommunity tensions, possible emergence of localized grassroots opposition groups, and changes in the political roles played by a variety of existing local organizations.

Community Social Structures and Processes

Unlike the eastern study areas where social changes could be limited, western study area communities could undergo significant changes in their social structures and processes. Except in the case of Beatty, it is not anticipated that growth is likely to overwhelm the communities' ability to function. Beatty's limited land base and the size of the projected population could make its success in coping with community change questionable, unless a downturn in the level of mining activity meshed almost perfectly with the repository-related demand and resulted in a fortuitous capacity increase.

As a result of population and economic growth, all five of the western study area communities could be expected to experience a deterioration of mechanisms of informal support and control, a process already underway in Pahrump and Indian Springs. With a larger and more heterogeneous population, the density of acquaintanceship could decrease, as could the extent of community integration (Freudenburg, 1986). In the process of such change, residents could find themselves increasingly dependent upon public and private formal organizations. For example, the reliance placed on friends and neighbors to provide help during times of financial need could shift to reliance on financial or welfare organizations. In a similar manner, social control exercised by residents toward misbehaving members of the community, especially juveniles, could increasingly be taken over by the sheriff's office or other agents of the justice system. Sanctions by residents either might not be sufficient or might not be forthcoming as more and more residents find themselves strangers to one another. Growth could bring increased difficulty in resolving community issues over the back fence, the hood of a car, or a cup of coffee. Formal community meetings could become more prevalent.

It should be pointed out that the shift from informal and rural to formal and urban is not necessarily symmetrical. Functions no longer maintained by an informal system are not immediately assumed by a formal network. Some functions, like the emotional support provided by neighbors in times of stress, may never become available locally. State and/or county governments may not opt to support local mental health facilities. Additionally, functions which are largely abandoned by the informal network may not be assimilated into a formal organization for some time. As a consequence of the lag, communities must survive with a less than satisfactory social structure while a new system is marshalled from the remnants of the old.

Even those structures typically considered to be strictly social would be subject to the forces of formalization. Friends who gather in local bars and restaurants for companionship could find such meeting places less desirable as inmigrants frequented the

same places. Needless to say, potential conflict exists when newcomers and oldtimers compete for the same social goods and/or services (Gold, 1985; Trend, Little, and Krannich, 1988a, 1988b, 1988c).

Conflict which can be damaging to the social structure is also possible when projected tax deficits are confronted by residents. It is almost certain that some residents would desire new or improved community facilities, while others will see tax reduction or stabilization as preferable. The lines of conflict in this instance would not be based entirely upon length of residence, although there is a tendency for newcomers to rural areas to have expectations for higher levels of community services than do rural residents. As a result of these conflicts some friendship networks could be fragmented, and others seriously stressed. The informal power structure might be one of the first networks to feel the strains as newcomers assert themselves in the political arena and oldtimers seek to maintain control by forming alliances with them. For communities like Beatty and Amargosa Valley, which have welcomed newcomers with open arms and have encouraged them to participate fully in the political process, any ensuing political conflict might be a particularly bitter pill to swallow. The battles over tax apportionment or other problems exacerbated by repository-related growth may lead to a perception of betrayal by governmental authorities and newcomers alike, the effect of which could exacerbate any ongoing community conflict.

Community Attitudes and Perceptions

Beatty, Amargosa Valley, and Indian Springs residents share social characteristics which tend to diminish or reduce the degree of perceived repository risks. First, none of these communities experienced long-term or frequent irradiation as a result of the atmospheric weapons testing of the 1950s and 1960s. Thus, a nuclear accident is not apt to recall the fears and anxieties so commonly expressed in the eastern study area communities. Second, the economic base of all three communities is likely to reflect continued or even increased dependence upon federal programs involving nuclear materials. Third, experience with things nuclear is commonplace in the three communities; data suggest that familiarity with nuclear materials leads to indifference, depreciation, or denial of the risks. These tendencies are consonant with the general attitudes of support for the construction of the repository at Yucca Mountain. Because Beatty, Amargosa Valley, and Indian Springs residents tend to downplay the magnitude of risks, they probably would require evidence of rather serious accidents prior to making major changes in their attitudes toward hazardous nuclear wastes (Krannich and Little, forthcoming).

Of course, not all residents in the western study area are so sanguine about the risks associated with nuclear storage. There are significant segments of all five communities that perceive nuclear risks to be serious, and these risks foster attitudes of hostility toward advocates of the repository. Moreover, a large proportion of area residents have expressed their fears regarding the transportation of wastes, even while they support the operation of the repository. Such perceptions are especially evident in Pahrump and Goldfield, where some segments view nuclear risk as a far more serious issue than do many residents of the other three western study area communities. This

results from the fact that these towns are relatively less dependent upon federal employment, being instead more dependent upon tourists and retirees. Pahrump is therefore more sensitive to the stigmatization which can be associated with nuclear waste. Many residents believe that repository or transportation accidents could seriously jeopardize the economic foundation of their communities. Heightened concern about risks could generate more political activity and conflict, both within these communities and between Pahrump and Goldfield and the other three western study area communities (i.e., if Pahrump and Goldfield residents sought to close or curtail the repository's operations when other communities supported the DOE project).

Overall, these observations suggest that, despite the generally favorable orientations toward the repository expressed by residents of the western study area, significant adverse effects on community social and cultural conditions could result from the construction and operation of the repository under certain circumstances. Standard effects of the repository could strain the capacity of local infrastructures throughout this study area, and could negatively affect local fiscal conditions. Such changes could in turn contribute to heightened political turmoil and conflict.

In addition, changes in social structures and processes could emerge, due to changes associated with both population growth and potential factionalization resulting from local responses to possible repository risk events. Finally, changes in attitudes and perceptions could arise, particularly in the event of accidents or events that could fuel increased concerns about repository risks. These changes suggest a potential for significant adverse effects on the social well-being of some residents in these communities.

4.5.3 Native American Communities

The following sections suggesting possible repository-related impacts on the Southern Paiute and Western Shoshone reservations and communities of Southern Nevada are based primarily on projections made from data gathered during studies in the communities from 1986 to 1988. This fieldwork and the associated secondary data collection was the basis for the summary of conditions, responses and impacts reported in Section 3.4.3, above, and in a number of background reports (Cultural Resources Consultants, 1988a, 1988b; Fowler, 1986; Fowler, Hamby and Rusco, 1987; Fowler, Rusco and Hamby, 1988; Hamby, 1988; Hamby and Rusco, 1988; Rusco, 1988; and Rusco and Hamby, 1988). The following discussion of future impacts is a continuation of the material contained in Chapter 3 with a focus on possible future conditions and impacts.

During the fieldwork, researchers discussed with tribal administrators and concerned community members their hopes and plans for future economic development, housing growth, population growth, educational development, and cultural maintenance. These data were then compared in a preliminary way with historical data on changes in these aspects for the groups over the past three to four decades. Although the historical data are far from complete, and more thorough analyses would doubtless better support trends, these materials are offered as our best approximation of likely impacts. A modified version of the rural risk questionnaire was administered to the Native American

study group; some of the longer scenarios were omitted due to their length and the lack of a large enough sample.

Several basic assumptions were made based on this review of fieldwork and historical data toward projecting impacts. These include: (1) that the trust relationship presently in operation between individual tribes and the federal government will remain roughly the same as at present (as it has for many decades); (2) following from this that the relationship of tribes to the governments of the State and counties will likely remain the same as well; i.e., one in which tribes are largely independent except for specific contractual relationships; (3) that tribes and tribal councils will take greater roles in the future in self-government and in supplying services to their constituencies; and (4) that pantribal and intertribal organizations will continue and become increasingly strengthened.

4.5.3.1 Western Shoshone

The majority of the Western Shoshone population of the study area is concentrated in three places, the Yomba and Duckwater reservations in Nye County and the Timbi-Sha Shoshone Indian Village at Furnace Creek, Inyo County, California, inside the Death Valley National Monument.

Standard Impacts

The "standard" impacts are expected to be small for the Western Shoshone. They tend to be located in somewhat remote rural areas, without easy access to the Yucca Mountain site, and they lack the background and training for specialized jobs so that direct employment and income benefits of the repository program are unlikely. Indirect impacts related to the tourist industry might affect the Timbi-Sha at Death Valley but these impacts probably would be small in the absence of significant risk-related impacts on the overall tourism to Nevada. Given the small likelihood that employment and income will be changed by the repository project, there is little reason to think that the standard effects would result in significant impacts on housing or land use for these Native Americans. The expansion of public services and facilities in towns near the Native American communities (e.g., Beatty for the Timbi-Sha) could provide new or expanded medical, educational, or other facilities. Additional revenues to Nye County that might be used to increase the level of public services for rural communities could have benefits for the Yomba and Duckwater residents. Both these possibilities, however, would have to be judged as minor potential impacts.

Special Impacts

The "special" impacts, those resulting from the hazardous nature of high-level radioactive waste, the risks, and the uncertainty associated with the repository program, could result in very significant impacts for the Western Shoshone. One case is the emergency response capability at the Duckwater reservation. An increase in traffic over U.S. Highway 6, a possible radioactive waste transportation route, could strain the Duckwater emergency medical and law enforcement services. The tribe has at least eight

certified Emergency Medical Technicians and a First Response Vehicle that respond to all medical emergencies from the Nye County line in the east to about Warm Springs in the west. In addition, the tribal police officer is cross-deputized with the county, and covers the same territory. If the increased traffic over U.S. Highway 6 includes any of the shipments of nuclear waste bound for Yucca Mountain, then new training and equipment to deal with potential nuclear accidents will be necessary in addition to increased personnel and regular equipment. Construction and improvement to upgrade the highway would in itself increase the responsibility of Duckwater's emergency teams.

The governmental response of the Western Shoshone to the repository overall and its various different components is another area of significant impacts. The basis for this category of impacts is the land itself. The Native American position is that some or all of the lands in the Nevada Test Site and the Tonopah Test Range are part of the Shoshone traditional lands and joint use areas with the Southern Paiute. The Western Shoshone National Council has contested the use of these lands for nuclear weapons testing and they view the Yucca Mountain project as another nuclear violation of their land, on the same order of those in the past. A related issue involves the Timbi-Sha who claim that the federal government through the National Park Service dispossessed them from the lands in Death Valley in order to create a National Monument.

Whether the next decades see even a partial resolution of any of these issues remains unclear. The key to the future direction of the Western Shoshone is land. The fact is that without more land for ranching, economic enterprise, or residential use, each of these groups will be facing progressively more serious economic difficulties. The history of relations between Shoshone people and the federal government, the current holder of the Shoshone lands, does not encourage belief in the government's good intentions toward Indian people. The effects of the repository project can only exacerbate these problems.

The repository not only permanently closes yet another area of land to Indian use, but it does so in a way that is viewed as a direct affront to deeply held values. There is consensus among the Native Americans that putting nuclear waste into the earth violates the traditional Shoshone teachings and will disturb the natural balance and bring harmful consequences. Should the repository be built against Shoshone wishes, the permanent violation of the land and Shoshone religious values would represent a major violation of the traditional environment with the result that the quality of life for the Shoshone might be significantly reduced. One possible adverse outcome of the repository is that more tribal funding may be necessary to deal with risk effects -- taking away funding for cultural maintenance programs.

The occurrence of a risk event, such as a transportation accident or the failure of storage safeguards that might directly contaminate the earth, air or water, could result in serious individual and community impacts. The Shoshone people are unanimous in their conviction that they were harmed in the past by above-ground weapons testing due to the radioactive fallout. Many stories are related about the birth defects, illnesses, and cancers that they attribute to the testing program. They anticipate further harm from present-day testing and from nuclear waste storage. The event of repository-related

accidents could serve as the catalyst for further reductions in community satisfaction and quality of life for the Western Shoshone.

The strong opposition of the Shoshone groups to the proposed repository is likely to further strain their relationship with their rural (e.g., Nye County) non-Indian neighbors, who tend to be more supportive of the repository. Any risk-related effects of the repository, such as declining economic conditions of the county and region would add further stress to these relationships.

4.5.3.2 Southern Paiutes

As described in Chapter 3, the three Southern Paiute tribal groups most directly affected by the Yucca Mountain repository program are the federally recognized Moapa Band of Paiute Indians, who occupy the Moapa Indian Reservation; the Las Vegas Tribe of Paiute Indians, on the Las Vegas Indian Colony; and a small, informally organized tribal group, the Pahrump Band, a mixed group of Southern Paiute and Western Shoshone people who live in the Pahrump and Lower Amargosa valleys. In 1988 their tribal population was estimated at 321. They are part of a larger Native American population in Clark County and southern Nye County estimated at slightly over 7,800 individuals. Over 98 percent of this larger population live in the urban Las Vegas Valley area.

Standard Impacts

The potential to experience standard impacts is greater for the Southern Paiutes than for the Western Shoshone. Both historically and currently the fortunes of the Southern Paiute communities are closely tied to the mainstream economy. Given their small numbers, limited infrastructure, ties to the surrounding area, and proximity to waste transportation routes, the Yucca Mountain repository program could have a number of significant standard socioeconomic impacts on these Native Americans and their communities. Standard impacts of the repository on the City of Las Vegas and on Clark and Nye counties will be felt by the reservation, colony, and the Pahrump Band.

The standard economic-demographic impacts of the repository are not expected to harm Native American economic developments, but may, in fact, facilitate their growth. Vocational or other training would still be necessary to take advantage of construction or operations employment at the repository. However, tribal efforts in 1988 to obtain information from DOE that would facilitate the planning of appropriate vocational training were unsuccessful. The Las Vegas Colony may realize some economic benefits if the Yucca Mountain work force patronizes their Smoke Shop on U.S. Highway 95. New business could benefit the Moapa Reservation only indirectly through population growth or increased tourism.

The success of tribal enterprises of the Moapa Reservation and the Las Vegas Colony are dependent in large degree upon a healthy local economy, primarily that of urban Clark County. Both Moapa and Las Vegas Colony anticipate the expansion of their highway businesses to attract motorists and truck drivers. Among proposed

additions to the existing Smoke Shops and fireworks outlet are service stations, restaurants, convenience stores or fast-food services, and possibly craft shops offering locally produced items. Currently, tourist purchases may account for as much as 20 percent of the Las Vegas Colony retail sales. Under projected growth, both tribal enterprises will become increasingly dependent on tourist trade. The Las Vegas Colony also would expect to attract more of the commuters between Las Vegas and the Nevada Test Site at businesses on their rural parcel and to gradually expand their graphite plant. However, improvement and additions to the tribal enterprises cannot take place without the accumulation of additional capital, which is presently not available without going outside the tribe.

The employment, income, and population impacts are likely to be more through these indirect effects of the repository than through any direct employment of Native Americans at the Yucca Mountain site or in the Las Vegas administrative headquarters. While these impacts have not been quantified, due to the small base of employment for the Southern Paiute, it can be expected that in as much as there are population and income growth from the repository they will benefit and if there are declines in population and income they will be negatively impacted.

The economic status of the small rural Pahrump Valley Indian population is related to their ability to find employment in the valley or within commuting distance. Projected population growth in Pahrump Valley with an attendant increase in the number of local jobs would probably result in some additional employment of Indians, but available jobs (largely in service positions) may not be secure or provide enough inducement for relatives of current Indian residents to return to Pahrump from various reservations where they now have better, lower-cost housing and other benefits, including employment. Therefore, while employment opportunities may increase somewhat due to the repository, this could have little impact on population growth of the Pahrump Band.

Special Impacts

Any significant decrease in population and employment associated with risk-related repository effects could have an adverse impact for the Southern Paiute. Even a modest decrease or slowing of the economic development or tourism in the valley will affect tribal enterprises adversely. Another more short-term economic effect could result from a serious accident in the transportation of nuclear waste in the local area. The resulting disruption of traffic flow between Pahrump and Las Vegas would have negative consequences for all the Southern Paiute communities. If an accident were to take place on or near the Paiute reservation at Moapa or at either location of the Las Vegas Paiutes, the results could threaten these Native Americans with immediate health and safety problems and adversely impact their business enterprises. This vulnerability is the result of the location of the Indians and their businesses along I-15 and U.S. Highway 95 both of which are likely waste transportation routes.

Tribal members express a high level of concern about the potential adverse impacts of the Yucca Mountain repository program, particularly with respect to its effect on their culture and on the health and safety of the people. Safe waste transportation

is of particular concern for those Native Americans close to potential transportation routes. Many members feel powerless to do anything about their perceived risk, but others, particularly council members, believe that some program of monitoring cargos that cross tribal land would help prevent accidents and that the assessment of a toll would help compensate the tribe for the risk. The risk effects associated with the repository could put pressure on the tribal government and administration to secure emergency training for tribal personnel, to establish toll stations and monitors, or to evaluate any such program they may already have in operation. Dealing with these issues could also give rise to increased intra-tribal conflict over how to handle these problems.

The Las Vegas Colony has already appointed council liaisons to interact with both the DOE and NWPO study teams and has requested their consulting attorney to reapply for affected tribe status. Acquiring affected local status would improve their negotiating position with DOE in terms of obtaining funds for planning for project impacts and for mitigation of those effects. They are also currently negotiating with NWPO for a tribal study, but have not yet entered into a contract. The Moapa Reservation has contracted with NWPO for a tribal study and has employed a tribal member to begin work on this. These intergovernmental relations would be expected to continue and expand if the repository program were to go ahead.

Potential adverse impacts associated with risk effects could further drain tribal resources. None of the existing public health or safety programs are adequate to cope with an actual emergency, such as could result from a transportation accident involving nuclear waste. In case of accidents, the colony would have the better equipped and staffed city health and safety programs available, but the Moapa Reservation would be required to rely on local volunteer units unless emergency services had been greatly improved over present levels. A nuclear waste transportation accident along I-15 on or near the Moapa Reservation, would cause serious confusion and probably greater damage than if such an accident were to take place in an area better-equipped to handle it.

It is possible that one or more of the tribal bodies may pursue some kind of litigation to challenge the repository's impact on cultural resources. Short of that, they may wish to negotiate some role in the management of cultural resources at Yucca Mountain, perhaps a continued involvement in the DOE archaeological studies or curation of archaeological remains. Many tribal members are concerned about the loss of this part of their cultural heritage. The DOE study which will continue throughout site characterization and early phase of construction could focus their attention on these concerns.

Project-related conditions could give rise to major impacts on the Southern Paiute communities and their social interaction with non-Indians. At present, these two populations differ in their attitudes towards the proposed waste facility; these differences are most pronounced in rural Nye County. Indian groups oppose the facility on traditional grounds that it would violate tribal values concerning the treatment of their traditional lands. In addition, a large number fear the eventual contamination of water or the environment in general. Non-Indians in rural areas of Southern Nevada share some of these fears, but others seem to believe that economic benefits or the greater

needs of the country offset the perceived threats, a belief shared by very few Indian people. These differences of opinion between the Indian and parts of the non-Indian populations may adversely affect social interactions and increase local prejudice against the Indian population.

4.6 Summary of Projected Impacts

The purpose of Chapter 4 is to: (1) identify areas and communities that are likely to experience impacts; (2) estimate the potential positive or negative direction of those impacts; and (3) estimate if these impacts might be large or small. A number of potentially significant impact areas were identified.

- According to the current plans of the DOE, the Yucca Mountain repository project would be a major development effort which, however, presents numerous uncertainties as to its final design, the requirements of ancillary facilities, transportation demands, schedule, ultimate costs, and demands on state and local governments. It is a one-of-a-kind project which could be subject to interruption from a number of causes. The level of uncertainty makes projected impact assessment difficult but even more importantly these conditions make extraordinary demands on state and local planning.

- The repository program is one that is highly visible to the citizens of the state and the Southern Nevada study area. According to several surveys, a large majority of the residents oppose the location of the repository in Nevada on the basis that it is an unwanted hazardous facility.

- At the state level and averaged over life of the project, the employment impacts could be less than one percent in employment (3,000 to 4,000 jobs) and less than one percent in population (6,000 to 8,000). At peak construction, the number of jobs and the population figures could increase to three or four times the overall average but in any case remain at less than two percent of the state total.

- The largest direct population impacts and most of the nonbasic responses to the repository project would be expected to be concentrated in the Las Vegas urban area. The largest relative impacts would be expected to occur in southern Nye County in those communities located nearest to the Yucca Mountain site.

- In Nye County, average annual employment in the 400 to 500 range during construction and emplacement, with populations about 700 to 900. This is about a five to six percent increase for employment and a two to three percent increase in population. Peak construction could exceed a nine percent increase in employment and five percent in population.

- In Clark County, employment and population patterns are similar to those of the state as a whole. Employment could be in the 3,000 person range with a larger number at peak construction, perhaps by a multiple of four. Population could average around 5,000 for the county which is less than one percent of the total population. The peak construction population could rise to over two percent of total county population.

- In Lincoln County, employment and population impacts between 2 and 4 percent over the construction and emplacement phases, representing 50 to 100 jobs, and 100 to 190 people.

The projections show the following positive employment and population increases could occur in the rural and urban communities over the construction and emplacement phases:

- In the Las Vegas urban area, 2,500 to 3,500 in employment and population in the 5,000 to 7,000 range, with three or four times that during peak construction; The cities of Las Vegas, North Las Vegas, and Henderson, population impacts of around 1 percent or 2,000 to 3,000 for Las Vegas, 400 to 600 for North Las Vegas, and 500 to 1,000 for Henderson. Peak construction impacts could reach 3 percent.

- In the western study area, Amargosa Valley, 25 to 100 jobs and over 100 in population; Beatty, about 60 jobs and 100 people; Pahrump, up to 300 jobs and 400 to 500 in population; and Indian Springs, over 100 jobs and up to 200 in population. All these communities could experience sharply higher impacts of two to three times these average figures during peak construction. These levels of impacts are very significant for basically rural communities in these size categories.

- In the eastern study area, Alamo-Hiko, around three percent and up to five percent during peak construction (about 20 jobs and 30 people); Caliente-Panaca-Pioche, from 30 to over 70 jobs at peak construction, and population of one to more than three percent; Moapa Valley, from 25 to over 100 jobs at peak construction, and 40 to almost 200 in population.

Public sector impacts as measured by the fiscal balance created for the repository-related population and households would tend to be negative. These balances might be changed significantly due to the Grants Equal to Taxes provisions of the NWPA, the potential for Congressionally mandated benefits to the state and local governments, or the distribution of mitigation funds from the Nuclear Waste Fund. However, none of these sources of public funding are currently available and the likelihood of their availability in the future is very uncertain.

- The net impact to the general fund balance of the state would be negative. This is because the expenditures required to provide public services for each resident is generally greater than the revenues they produce, a situation

normally compensated by visitor-generated revenues. Economic activities that do not expand the visitor economy do not produce the added revenues to pay for the added expenditures required by increased population and households.

- A negative fiscal impact was projected for the State General Fund of $21.7 million over site characterization, $27.3 million during construction, and $40.5 million through emplacement.

- The size and scope of the impacts within the State of Nevada also could result in significant responses by state agencies. These impacts would be the result of increased demands for public services by additional population within the state and by the intergovernmental demands that have been mandated by the U.S. Congress through the NWPA as amended. An analysis of about one-third of the targeted state agencies produced estimates by state officials that the repository project could cost the agencies more than $85 million, up to in excess of $156 million over the period 1989 to 2010.

- In addition, impacts resulting from the transportation of high-level radioactive waste could produce some of the major public sector impacts. The NDOT has estimated that it could cost between $200 and $800 million to bring the potential highway routes up to appropriate standards for repository waste shipments.

- Significant impacts could occur in the area of intergovernmental relations between the federal, state, and local governments. This is due to the different evaluations of the suitability of attempting to locate a waste repository at the Yucca Mountain site. The three major levels of government have all developed independent and incompatible positions on this project which is of great importance to them and has been established as an issue with high political visibility.

- At the county and local government levels of public service, the fiscal impacts will tend to be negative for the repository program. These impacts are due to the basic fiscal structure of the State of Nevada. For local jurisdictions the direction is similar to that expected for the state as a whole; for the year of peak impacts (2001), negative county and local impacts could approach $10 million.

Community political, social, and cultural impacts could occur due to the repository program. These impacts stem from the effect of the repository program on people's perceptions, feelings, and interactions resulting in the following:

- Survey information from the rural communities, the urban area, and the Native American communities indicates that the repository program would result in decreased quality of life for Southern Nevada residents under any of the alternative scenarios. Decreased community satisfaction could result in decreased investment and increased outmigration.

- Due to the hazardous nature of the repository program, any risk-related scenario would result in decreased trust in governmental institutions and officials, increased political participation (e.g., voting, volunteer work, organizing, and demonstrating), and increased political instability.

- The Native American communities could be impacted in ways both similar to the other communities and differently because of their different cultural context. The most important areas of impact could be social-cultural. The repository effects could be: increased intergovernmental participation for Native Americans, increased cultural stress due to conflict between the repository program and religious/cultural beliefs about and ownership claims to the land, and increased distrust of the federal government.

Potential Risk-related Impacts

One of the most significant findings of the research is that future risk-related impacts are very uncertain but could result in serious negative effects on the visitor/tourist sector of the economy, on the inmigration of retirees, and on economic development. These are all areas of economic development that are critical to the future of the State of Nevada and the Southern Nevada region. Significant reductions in the area of these activities could result in large reductions in employment, important losses in state and local revenues, slowed population growth or even population losses due to outmigration, reduced public services, intergovernmental and political conflict, and decreases in the community satisfaction and quality of life for residents. Even small reductions in visitor spending could result in losses of employment that would more than outweigh the added jobs provided by the repository program.

Bibliography

This bibliography contains references consulted during the preparation of this report. Of the documents listed below, 104 have been prepared as deliverables for NWPO's Yucca Mountain Socioeconomic Project; these documents are noted by an asterick.

Advisory Panel on Alternative Means of Financing and Managing Radioactive Waste Facilities. 1984. *Managing Nuclear Waste - A Better Idea.* Report prepared for the U.S. Secretary of Energy.

*Anderson, E. forthcoming. *Documentation of the REMI impact assessment runs for the Yucca Mountain socioeconomic project.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Atkinson, G. 1988a. *The Department of Taxation: State-level economic-demographic and fiscal costs, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Atkinson, G. 1988b. *Employment Security Department: State-level economic development and fiscal costs, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Atkinson, G. 1988c. *Department of Education: State-level economic-demographic and fiscal costs, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Baker, E. J., D. J. Moss, S. C. West, and J. K. Weyant. 1977. *Impact of offshore nuclear generating stations on recreational behavior at adjacent coastal sites.* (NUREG-0394). Washington, D.C.: U.S. Nuclear Regulatory Commission.

Barlett, D. and J. Steele. 1985. *Forevermore: Nuclear Waste in America.* New York: W.W. Norton & Company.

Battelle Columbus Laboratory. 1986a. *Analysis of safeguard needs for transport of high level waste.* NUREG/CR-4979. Washington, DC: Nuclear Regulatory Commission.

Battelle Columbus Laboratory. 1986b. *Evaluation of safeguard measures against sabotage of spent fuel and high level waste shipping casks.* NUREG/CR-4980. Washington, DC: Nuclear Regulatory Commission.

Battelle Pacific Northwest Laboratories. 1978. *An assessment of the risk of transporting spent nuclear fuel by truck.* PNL-2588, Richland. Washington, DC: Pacific Northwest Laboratories.

Bentley, Harold. 1987. Personal communication, 6 October.

Blumer, H. 1969. *Symbolic Interactionism: Perspective and Method.* Englewood Cliffs, NJ: Prentice Hall.

Boden, D.R. 1986. Eruptive history and structural development of the Toquina caldera complex, central Nevada. *Bulletin of the Geological Society of America* 97:61-74.

Bolt, B. 1988. *Earthquakes.* New York: Freeman and Company.

Booth, W. 1987. News and comment. Postmortem on Three Mile Island. *Science* 238:1342-1345.

Boulding, K.E. 1956. *The Image.* Ann Arbor, MI: University of Michigan Press.

Bredehoeft, J.D., A.W. England, D.B. Stewart, N.J. Trask, and I.J. Winograd. 1978. *Geologic disposal of high-level radioactive wastes: Earth science perspectives.* U.S. Geological Survey Circular 779.

Brookshire, D., M. Thayer, M. Tschirhart, and W. Schulze. 1985. A test of the expected utility hypothesis: Evidence from earthquake risks. *Journal of Political Economy.* April 1985.

Bryson, J. and W. Roering. 1987. Applying private-sector strategic planning in the public sector. *Journal of the American Planning Association.* Vol. 33 (Winter):9-22.

Carter, L. 1987. *Nuclear Imperatives and Public Trust.* Washington, DC: Resources for the Future.

Carpenter, D.W., and D.H. Chung. 1986. *Effects of earthquakes on underground facilities: Literature review and discussion.* NUREG/CR-4609 (UCID-20505). Lawrence Livermore National Laboratory, Livermore, CA.

Center for Philosophy and Public Policy. 1985. Faith in science. Report from the Center for Philosophy and Public Policy, 5:1-5.

Chang, Wallace Y. 1986. *Evaluation of regulatory guides potentially useful to geologic repository development.* Report prepared by Ebasco Services, Inc. for the Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Church, Albert M., and Roger D. Norton. 1981. Issues in emergency preparedness for radiological transportation accidents. *Natural Resources Journal* 21 (October):757-771.

Clark County Department of Comprehensive Planning. 1988. *Population Data 1988.*

Cohen, Bernard L. 1983a. Probabilistic risk assessment of wastes buried in the ground. *Risk Analysis* 3(4): 237-243.

Cohen, B.L. 1983b. *Before It's Too Late: A Scientist's Case for Nuclear Energy.* New York: Plenum.

Cohen, F. 1982. *Handbook of Federal Indian Law.* Charlottesville, WV: Michie Bobbs-Merrill.

Combs, B. and P. Slovic. 1979. Newspaper coverage of causes of death. *Journalism Quarterly* 56:837-843, 849.

Consumer Guide. 1988. *Best-rated retirement cities and towns: 100 of the most attractive retirement locations across America.* Lincolnwood, IL: Publications International Ltd.

*Cultural Resources Consultants. 1988a. *Socioeconomic profiles of Native American communities: Las Vegas Colony and Pahrump-Lower Amargosa valley, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Cultural Resources Consultants. 1988b. *Native American visit to Yucca Mountain: October 16-17, 1987, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Cultural Survival Quarterly, 1987. 11(4):7.

*Cummings, R. 1988. *New Mexico's Waste Isolation Pilot Project (WIPP): a historical overview, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson, City, Nevada.

Czarnecki, J.B. 1985. *Simulated effects of increased recharge on the groundwater flow system of Yucca Mountain and vicinity, Nevada-California.* U.S. Geological Survey Water-Resources Investigations Report 84-4344. Denver: USGS.

DeFleur, M. L. 1966. *Theories of Mass Communication.* New York: D. McKay.

Dennis, A.W., J.T. Foley, W.T. Hartman, and D.W. Larson. 1978. *Severities of transportation accidents involving large packages.* SAND 77-0001. Albuquerque, NM: Sandia National Laboratories.

Dennis, A.W. 1983. *Design considerations for occupational exposure for a potential repository at Yucca Mountain: High-level waste handling operations.* SAND83-0247C. Albuquerque, NM: Sandia National Laboratories.

Dennis, A.W., J.C. Frostenson, and K.J. Hong. 1984. *NNSWI repository worker radiation exposure. Volume 1: Spent fuel and high-level waste operations in a geologic repository in tuff.* SAND83-7436/1. Albuquerque, NM: Sandia National Laboratories.

Dennis, A.W., R. Mulkin, and J.C. Frostenson. 1984. *Operational procedures for receiving, packaging, emplacing, and retrieving high-level and transuranic waste.* SAND83-1982C. Albuquerque, NM: Sandia National Laboratories.

Dennis, A.W., P.D. O'Brian, R. Mulkin, and J.C. Frostenson. 1984. *NNSWI repository operational procedures for receiving, packaging emplacing, and retrieving high-level and transuranic waste.* SAND83-1166. Albuquerque, NM: Sandia National Laboratories.

*Desvousges, W., R. Dunford, J. Frey, H. Kunreuther, R. Kasperson, and P. Slovic. 1987. *High-level nuclear waste repository risks: focus group findings and implications for surveys, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson, City, Nevada.

DOE (U.S. Department of Energy). 1980a. *Assessment of the surveillance program of the high-level storage tanks at Hanford.* Washington, DC: U.S. Department of Energy, Office of Environmental Compliance and Review.

DOE (U.S. Department of Energy). 1980b. *Management of commercially generated radioactive wastes.* DOE/EIS-0046F. 3 Vols. Washington, DC: U.S. Department of Energy.

DOE (U.S. Department of Energy). 1985. *Mission plan for the civilian radioactive waste management program. Volume I.* Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

DOE (U.S. Department of Energy). 1986. *Generic Requirements for a mined geologic disposal system,* Appendix D, "Department of Energy position on retrievability and retrieval for a geologic repository". OGR/B-2, DOE/RW-0090. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management Program.

DOE (U.S. Department of Energy). 1986a. *Environmental assessment (EA), Yucca Mountain site, Nevada Research and Development Area, Nevada.* Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

DOE (U.S. Department of Energy). 1986b. *Quality assurance directive.* Washington, DC: U.S. Department of Energy.

DOE (U.S. Department of Energy). 1986c. *Environmental assessment overview, Yucca Mountain site, Nevada Research and Development Area, Nevada.* Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

DOE (U.S. Department of Energy). 1988a. *Site characterization plan: consultation draft, Yucca Mountain site.* Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

DOE (U.S. Department of Energy). 1988b. *Site characterization plan consultation draft, overview, Yucca Mountain site.* Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

DOE (U.S. Department of Energy). 1988c. *Draft 1988 mission plan amendment.* DOE/RW-0187. Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

DOE (U.S. Department of Energy). 1988d. *Section 175 report: Secretary of Energy's report to the Congress pursuant to Section 175 of the Nuclear Waste Policy Act, as amended.* Washington, DC: U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

DOE (U.S. Department of Energy). 1988e. *Draft Environmental Field Activity Plan for Cultural Resources: Native American Component.* Las Vegas, NV: U.S. Department of Energy, Nevada Operations Office.

DOE (U.S. Department of Energy). 1988f. *Draft Environmental Field Activity Plan for Cultural Resources: Archaeological Component.* Las Vegas, NV: U.S. Department of Energy, Nevada Operations Office.

DOE (U.S. Department of Energy). 1988g. *Projections of repository-related workforce requirements, wage and salary payments, and expenditures for materials, equipment, and supplies (Input for section 175 report).* Las Vegas, NV: U.S. Department of Energy, Nevada Operations Office.

DOE (U.S. Department of Energy) and USGS (U.S. Geological Survey). 1980. *Earth science technical plan for disposal of radioactive waste in a mined repository.*

Douglas, Mary T. 1985. *Risk Acceptability According to the Social Sciences.* New York: Russell Sage Foundation.

Douglas, M. and A. Wildavsky. 1982. *Risk and Culture.* Berkeley: University of California Press.

Downey, Gary. 1986. Risk in Culture: The American Conflict Over Nuclear Power. *Cultural Anthropology* 1:1.

Dupont, R.L. 1981. *Business Week,* 7 September, pp. 8-9.

Ebel, John. 1987. Personal communication, 17 December.

Edelstein, M. 1986. *Stigmatizing effects of toxic pollution.* Unpublished manuscript, Ramapo College, Department of Psychology, Ramapo, New Jersey.

Edelstein, M. 1988a. *Further thoughts on a theory of environmental stigma: radon gas exposure and the issue of boundedness.* Ramapo College, Department of Psychology, Ramapo, New Jersey.

Edelstein, M. 1988b. *Contaminated Communities: the Social and Psychological Impacts of Residential Toxic Exposure.* Boulder, CO: Westview Press, Inc.

Ellsberg, D. 1961. Risk, ambiguity, and the Savage axioms. *Quarterly Journal of Economics* 75:643-669.

*Emel, J., B. Cook, and R. Kasperson. 1988. *Risk management and organizational systems for high-level radioactive disposal: issues and priorities, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Emel, J., R. Kasperson, R. Goble, and O. Renn. 1988. *Post-closure risks at the proposed Yucca Mountain repository: a review of methodological and technical issues, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Endter, J., R. Little, and R. Krannich. 1988a. *Summary ethnographic report: Eastern Lincoln County.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Endter, J., R. Little, and R. Krannich. 1988b. *Summary ethnographic report: Pahranagat Valley.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Endter, J., R. Little, and R. Krannich. 1988c. *Summary ethnographic report: Indian Springs.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

EPA (U.S. Environmental Protection Agency). 1982. *Population risks from disposal of high-level radioactive wastes in geologic repositories.* EPA-520/3-80-006. Washington, DC: U.S. Environmental Protection Agency.

EPA (U.S. Environmental Protection Agency). 1983. *Potential individual doses from disposal of high-level radioactive wastes in geologic repositories.* EPA-520/1-82-026. Washington, DC: U.S. Environmental Protection Agency.

EPA (U.S. Environmental Protection Agency). 1985. *High-level and transuranic radioactive wastes: Background information document for final rule.* EPA-520/1-85-023. Washington, DC: U.S. Environmental Protection Agency.

ETS Pacific, Inc. 1986. *Pilot study and analysis of 46 mile rail corridor in Lincoln County,* Nevada. Report for Resource Concepts. Carson City, Nevada. Portland, Oregon: ETS Pacific.

Finley, N.C., et al. 1980. *Transportation of radionuclides in urban environs: draft environmental assessment.* NUREG/CR-0743; SAND79-0369. Albuquerque, NM: Sandia National Laboratories.

*Fitzgerald, M. and A. McCabe. 1988. *The U.S. Department of Energy's attempt to site the Monitored Retrievable Storage facility (MRS) in Tennessee: 1985-1987, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Flores, R.J. 1986. *Retrievability: strategy for compliance demonstration.* SAND83-2242. Albuquerque, NM: Sandia National Laboratories.

Fordham, John. 1987. Personal communication, 29 September.

Foreman and Quintiliani. 1988. *Transmittal of findings: valuation of Yucca Mountain repository.* Real Estate Research Corporation.

*Fowler, C. 1986. *Historic Indian names in the Yucca Mountain area, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada

*Fowler, C., M. Hamby, and M. Rusco. 1987. *Native American studies (first year socioeconomic progress report, appendix A.5.4), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Fowler, C., M. Rusco, and M. Hamby. 1988. *Native Americans and Yucca Mountain: ethnographic sketches, Las Vegas, Paranigat and Panaca, and Moapa Southern Paiute and Central Nevada Western Shoshone, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Fradkin, Philip L. 1989. *Fallout: An American Nuclear Tragedy.* Tucson, AZ: The University of Arizona Press.

Freeman, R. 1983. *Strategic Management: A Stakeholder Approach.* New York: Pitman.

Freudenburg, William R. 1986. The density of acquaintanceship: An overlooked variable in community research? *American Journal of Sociology* 92(July): 27-63.

Fritsch, Bruno. 1986. Wirtschaftswachstum und okologisches gleichgewicht: Modelle und Konzepte. In *Gewichts- und Ungleichgewichtskonzepte in der Wissenschaft,* ed. F. Stolz. Zuricher Hochschulforum, Vol. 7. Zurich: Verlag der Fachvereine.

Gale, J.E. 1982. Assessing the permeability characteristics of fractured rock. *Geological Society of America Special Paper* 189:163-182.

GAO (U.S. General Accounting Office). 1987. *Nuclear waste: status of DOE's nuclear waste site characterization activities.* GAO/RCED-87-103FS. Washington, DC: U.S. General Accounting Office.

GAO (U.S. General Accounting Office). 1988a. *Dealing with major problem areas in the nuclear defense complex expected to cost over $100 billion.* Statement of J. Dexter Peach, Assistant Comptroller General Resources, Community and Economic Development Division Before the Committee on Governmental Affairs, U.S. Senate. GAO/T-RCED-88-53, Washington, D.C., U.S. General Accounting Office.

GAO (U.S. General Accounting Office). 1988b. *Nuclear waste: fourth annual report on DOE's nuclear waste program.* GAO/RCED-88-131. Washington, D.C., U.S. General Accounting Office.

Gleick, J. 1987. *Chaos.* New York: Viking Press.

Glickman, T. 1987. *Summary of the RADTRAN III model, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Glickman, T., Resources for the Future, Inc. 1988. *Benchmark estimates of release accidents rates in hazardous materials transportation by rail and truck.* Presentation at the 67th Annual Meeting of the Transportation Research Board, Washington, D.C.

Goble, R., D. Golding, and R. Kasperson. 1988. *Potential retrieval of radioactive wastes at the proposed Yucca Mountain repository: a preliminary review of risk issues, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Goffman, E. 1963. *Stigma.* Englewood Cliffs, NJ: Prentice-Hall.

Gold, Raymond L. 1985. *Ranching, Mining, and the Human Impact of Natural Resource Development.* New Brunswick, NJ: Transaction Books.

*Greenwood, M., G. McClelland, and W. Schulze. 1988. *The effects of perceptions of hazardous waste on migration, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Growth Strategies Organization. 1988a. *Business profile of metropolitan Las Vegas, draft.* Mountain West Research for the Nevada Waste Project Office, Carson, Nevada.

*Growth Strategies Organization. 1988b. *Current target industry analysis, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Growth Strategies Organization. 1988c. *Assessment of the impact of a nuclear waste repository at Yucca Mountain on the economic development potential of Las Vegas, Clark County, and the surrounding area.* Mountain West Research for Nevada Nuclear Waste Project Office, Carson City, Nevada.

Gruer, E., M. Fowler, and G. Rocha. 1987. *Cost estimate of the Yucca Mountain repository based on the site characterization plan conceptual design.* Albuquerque, NM: Sandia National Laboratories.

Haken, H. 1983. *Advanced synergetics: Instability hierarchies of self-organizing systems and devices.* Berlin: Springer Verlag.

*Hamby, M. 1988. *Native Americans contemporary socioeconomic sketches, Esmeralda and Lincoln Counties and Death Valley, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Hamby, M. and M. Rusco. 1988. *Responses to risk perception questionnaire: Western Shoshone reservations and Southern Paiute reservations, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Hamilton, L., D. Hill, M. Rowe, and E. Stern. 1986. *Towards a risk assessment of the spent fuel and high-level nuclear waste disposal system.* BNL 51972. Upton, Long Island, NY: Brookhaven National Laboratory.

Harris, P.A., D.M. Ligon, and M.G. Stamatelatos. 1985. *High-level waste preclosure systems safety analysis. Phase 1, final report.* SAND 85-7192. Albuquerque, NM: Sandia National Laboratories.

*Herzik, E., and A. Mushkatel. 1988. *Urban area intergovernmental studies report, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Herzik, E. and A. Mushkatel. 1989. *Intergovernmental relations: a view from the federal agencies, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Hohenemser, C., R. Kates, and P. Slovic. 1983. The nature of technological hazard. *Science*. pp. 378-384.

Holling, C.S. (ed.). 1978. *Adaptive Environmental Assessment and Management.* Chichester: John Wiley and Sons.

Hoos, I.R. 1978. The credibility issue. Essays on issues relevant to the regulation of radioactive waste management. Washington, DC: U.S. Nuclear Regulatory Commission, pp. 20-30.

Hsieh, Paul. 1987. Personal communication, 3 October.

Hynes, M. and Van Marcke, E. 1976. *Reliability of embankment performance prediction.* Proceedings of the ASCE Engineering Mechanics Division Specialty Conference. Waterloo, Ontario: University of Waterloo Press.

ICMA (International City Managers Association). 1988. *The municipal year book.* Washington, DC: International City Managers Association.

Jackson, J.L., H.F. Gram, K.-J. Hong, H.S. Ng, and A.M. Pendergrass. 1984. *Preliminary safety assessment study of the conceptual design of a repository in tuff at Yucca Mountain.* SAND-83-1504. Albuquerque, NM: Sandia National Laboratories.

Jackson, J.L., H.F. Gram, H.S. Ng, A.M. Pendergrass, and M.C. Pope. 1985. Safety assessment of accidental radiological releases: A study performed for the conceptual design of a geological repository at Yucca Mountain, Nevada. *Nuclear Safety* 26 (July-August):477-488.

Janis, I.L. 1972. *Victims of GROUPTHINK.* Boston: Houghton Mifflin Co.

Janis, I.L. and L. Mann. 1977. *Decision Making: A Psychological Analysis of Conflict, Choice, and Commitment.* New York: The Free Press.

Jefferson, Robert M. 1982. *Shipping cask sabotage source term investigation.* NUREG/CR-2472. Washington, DC: U.S. Nuclear Regulatory Commission.

Jefferson, Robert M. 1985. *Considerations of the safety of transporting spent fuel.* SAND84-2128. Albuquerque, NM: Sandia National Laboratories.

Johnstone, K.J. and K. Wolfsberg, eds. 1980. *Evaluation of tuff as a medium for nuclear waste repository: Interim status report on the properties of tuff.* SAND 80-1464. Albuquerque, NM: Sandia National Laboratories.

Jones, E. E., et al. 1984. *Social Stigma: The Psychology of Marked Relationships.* New York: W. H. Freeman.

Kahneman, D., P. Slovic, and A. Tversky (eds.). 1982. *Judgment under Uncertainty: Heuristics and Biases.* New York: Cambridge University Press.

Kappler, C. 1904. *Indian Affairs: Laws and Treaties.* Washington, DC: U.S. Government Printing Office.

*Kasperson, R., J. Emel, R. Goble, J. Kasperson, and O. Renn. 1987a. *Nuclear waste system risks at the proposed Yucca Mountain repository (first year socioeconomic progress report, appendix A.2.1), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Kasperson, R., J. Emel, R. Goble, J. Kasperson, and O. Renn. 1987b. *Evaluation of site characterization risks (first year socioeconomic progress report, appendix A.2.2), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Kasperson, R., J. Emel, R. Goble, J. Kasperson, and O. Renn, 1987c. *Evaluation of preclosure risks (first year socioeconomic progress report, appendix A.2.3), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Kasperson, R., J. Emel, R. Goble, J. Kasperson, and O. Renn. 1987d. *Evaluation of transportation risks (first year socioeconomic progress report, appendix A.2.4), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Kasperson, R., J. Emel, R. Goble, J. Kasperson, and O. Renn. 1987e. *Summary and preliminary identification of risk assessment issues (first year socioeconomic progress report, appendix A.2.5), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Kasperson, R., S. Ratick, and S. Abdollahzadeh. 1988. *Distributional equity problems at the proposed Yucca Mountain repository, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Kasperson, R., S. Ratick, and O. Renn. 1988. *A framework for analyzing and responding to equity problems involved in high-level radioactive waste disposal, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Kasperson, R., O. Renn, and P. Slovic. 1988. *The social amplification of risk: a conceptual framework.* Mountain West Research for Nevada Nuclear Waste Project Office, Carson City, Nevada.

Kates, R.W. 1985. Success, strain, and surprises. *Issues in Science and Technology* 2:46-58.

Kates, Robert W., Christoph Hohenemser, and Jeanne X. Kasperson (eds). 1985. *Perilous Progress: Managing the hazards of technology.* Boulder, CO: Westview Press Inc.

Kearsley, G.W. 1985. Methodological change and the elicitation of images in human geography. *Journal of Mental Imagery* 9:71-82.

Kleindorfer, P.R. and H.C. Kunreuther. 1987. *Insuring and Managing Hazardous Risks: From Seveso to Bhopal and Beyond.* Berlin: Springer-Verlag.

*Kleindorfer, P., M. Knez, H. Kunreuther, D. MacLean. 1988. *Valuation and assessment of equity in the siting of a nuclear waste repository, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Knack, Martha C. 1986. Indian economics, 1950-1980. In *Handbook of North American Indian,* Vol. II (Great Basin). W.L. d'Acevedo (ed.) pp. 573-591. Washington, DC: Smithsonian Institute.

Knight, F.H. 1921. *Risk, Uncertainty, and Profit.* New York: Hart, Schaffner and Marx.

Krannich, R., and T. Greider. 1984. Personal well-being in rapid growth and stable communities: Multiple indicators and contrasting results. *Rural Sociology* 49 (Winter): 541-552.

Krannich, R., and T. Greider, and R. Little. 1985. Rapid growth and fear of crime: A four community comparison. *Rural Sociology* 50(Summer): 193-209.

*Krannich, R., and R. Little. 1987a. *Baseline community social structure for Alamo-Hiko area (first year socioeconomic progress report, Appendix a.5.2.5), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Krannich, R., and R. Little. 1987b. *Baseline community social structure for Caliente (first year socioeconomic progress report, Appendix a.5.2.6), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Krannich, R., and R. Little. 1987c. *Baseline community social structure for Pioche (first year socioeconomic progress report, Appendix a.5.2.7), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Krannich, R., and R. Little. 1987d. *Baseline community social structure for Indian Springs (first year socioeconomic progress report, Appendix a.5.2.11), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Krannich, R., and R. Little. 1987e. *Baseline community social structure for Mesquite (first year socioeconomic progress report, Appendix a.5.2.13), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Krannich, R. and R. Little. 1988. *Differential orientations of rural community residents toward nuclear waste repository siting in Nevada.* Paper Presented at the Annual Meetings of the Rural Sociological Society, Athens, GA.

Krannich, R. and R. Little. 1989. *Rural community residents' views toward nuclear waste repository siting in Nevada.* Paper Presented at the 1989 Annual Meetings of the American Association for the Advancement of Science, San Francisco, California.

*Krannich, R. and R. Little. forthcoming. *Rural Nevadans risk perceptions: survey findings.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Kunreuther, H., W.H. Desvousges, and P. Slovic. 1988. Nevada's predicament: Public perceptions of risk from the proposed nuclear waste repository. *Environment* 30(8):16-33.

*Kunreuther, H., D. Easterling, and P. Kleindorfer. 1988. *The convention planning process: potential impact of a repository in Nevada, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Kunreuther, H. and P. Slovic. 1989. *Forecasting the adverse economic consequences of a nuclear waste repository in Nevada.* Paper Presented at the Annual Meetings of the American Association for the Advancement of Science, San Francisco, California.

*Kunreuther, H., P. Slovic, J. Nigg, and W. Desvousges. 1987. *Risk perception telephone survey.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Landau, M. 1969. Redundancy, rationality, and the problem of duplication and overlap. *Public administration review* 29:346-358.

Las Vegas Review-Journal. 4 December 1988, p. B11.

Las Vegas Review-Journal, Nevada Development Authority, and First Interstate Bank of Nevada. 1989. *Las Vegas Perspective.* Prepared in cooperation with the University of Nevada, Las Vegas.

Las Vegas Sun. 25 September 1988, p. B1.

Laventhol and Horwath. 1987. *1987 Report on the U.S. Resort Lodging Industry.*

*Little, R., and R. Krannich. 1987a. *Baseline community social structure for Amargosa Valley (first year socioeconomic progress report, Appendix a.5.2.1), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Little, R., and R. Krannich. 1987b. *Baseline community social structure for Beatty (first year socioeconomic progress report, Appendix a.5.2.2), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Little, R., and R. Krannich. 1987c. *Baseline community social profile for Pahrump (first year socioeconomic progress report, Appendix a.5.2.3), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Little, R., and R. Krannich. 1987d. *Baseline community social structure for Tonopah (first year socioeconomic progress report, Appendix a.5.2.4), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Little, R. and Krannich, R. 1987e. *Baseline community social structure for Goldfield (first year socioeconomic progress report, Appendix a.5.2.8), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Little, R. and R. Krannich. 1988. *A model for assessing the social impacts of natural resource utilization of resource dependent communities.* Paper Presented at the Annual Meeting of the International Association of Impact Assessment, Brisbane, Australia.

Longino, C. F. and Steven G. Ullman. 1988. *The Economically Advantaged Retiree: State Statistical Profiles.* Center for Social Research on Aging, University of Miami, Coral Gables, Florida.

Luce, R.D. and H. Raiffa. 1957. *Games and Decisions.* New York: Wiley.

MacDougall, H. (compiled by). 1985. *Two-stage repository development at Yucca Mountain: an engineering feasibility study.* Albuquerque, NM: Sandia National Laboratories.

MacDougall, H.R., L.W. Scully, and J.R. Tillerson. 1987. *Site characterization plan conceptual design report.* Albquerque, NM: Sandia National Laboratories.

Madsen, Marcella M., Edwin L. Wilmot, and John M. Taylor. 1983. *RADTRAN II user guide.* SAND82-2681, TTC-0339. Albuquerque, NM: Sandia National Laboratories.

Maio, Domenic J. 1984. *Truck transportation of hazardous materials: A national overview.* Cambridge, MA.

Makhijani, A. 1989. *Reducing the Risks: A Reappraisal of the U.S. Policies for Long-Term Management of High-Level Waste.* Washington, DC: Institute for Energy and Environmental Research.

March, J.G. and Z. Shapira. 1987. Mangerial perspectives on risk and risk taking. *Management science* 33:1404-1418.

Marshall, E. 1987. News and comment. Hanford's radioactive tumbleweed. *Science* 236:1616-1620.

Mazur, A. 1981. *The Dynamics of Technical Controversy.* Washington D.C.: Communication Press.

Mazur, A. 1984. The journalist and technology: reporting about Love Canal and Three Mile Island. *Minerva* 22: 45-66.

McClure, J.D., and E. Emerson. 1980. *A review of U.S. accident/incident experience involving the transportation of radioactive material (RAM), 1970-1980.* SAND80-0899C, TTC-0100. Albuquerque, NM: Sandia National Laboratories.

McClure, J.D., and A. Tyron-Hopko. 1985. *Radioactive material transportation accident analysis.* SAND85-1016. Albuquerque, NM: Sandia National Laboratories.

McCracken, R. 1988. *Nye County Town history project.* Prepared for Nye County, Nevada.

Metlay, D.S. 1978. History and interpretation of radioactive waste management in the United States. *Essays on issues relevant to the regulation of radioactive waste management.* Washington, DC: U.S. Nuclear Regulatory Commission, pp. 1-19.

Michael, D.N. 1955. Civilian behavior under atomic bombardment. *Bulletin of the Atomic Scientists* 11:252-255.

Michael, D.N. 1962. Psychopathology of nuclear war. *Bulletin of the Atomic Scientists* 18:416-418.

Michael, D.N. 1978. *On Learning to Plan and Planning to Learn.* San Francisco: Jossey-Bass, Inc., Publishers.

Mileti, D., J. Hutton, and J. Sorensen. 1981. *Earthquake prediction response and options for public policy.* Boulder, CO: Institute for Behavioral Science, University of Colorado.

Milnor, J. 1954. Games against nature. In *Decision Processes.* R.M. Thrall, C.N. Coombs, and R.L. Davis (eds.). New York: Wiley.

Montazer, P., and W.E. Wilson. 1984. *Conceptual hydrologic model of flow in the unsaturated zone, Yucca Mountain, Nevada.* U.S. Geological Survey Water-Resources Investigations Report 84-4345.

Mosleh, A., V.M. Bier, and G. Apostolakis. forthcoming. *A critique of current practice for the use of expert opinions in probabilistic risk assessment.* Reliability Engineering and System Safety.

*Mountain West. 1986. *Summary draft: grants equal to taxes, Nevada site: Yucca Mountain high-level nuclear waste repository.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mountain West. 1987. *First year socioeconomic progress report: summary report,* draft. Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mountain West. 1988a. *County level comparison of the REMI/NV FS 53 model, preliminary baseline projections with other source projections, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mountain West. 1988b. *Preferred transportation system options: transportation needs assessment, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mountain West. 1988c. *Literature review: transportation needs assessment.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mountain West. 1988d. *Evaluation of the United States Department of Energy planned transportation system: transportation needs assessment.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mountain West. 1989a. *Nevada Department of Transportation: State agencies update.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mountain West. 1989b. *Nevada Department of Human Resources: State agencies update.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mountain West. forthcoming. *NACORE: imagery study survey results.* Prepared for Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mushkatel, A. 1988a. *Nevada Division of Emergency Management: NWPA and federal mandate demands and state costs, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mushkatel, A. 1988b. *The Department of Motor Vehicles and Public Safety: State level--cost analysis and intergovernmental relations, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mushkatel, A. 1988c. *The Nevada Public Service Commission: State level-cost analysis and intergovernmental relations, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mushkatel, A. 1989. *Nevada Department of Emergency Management: State agencies update.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mushkatel, A., G. Atkinson and Planning Information Corporation. 1987. *Intergovernmental relations and State-level cost analysis (first year socioeconomic progress report, appendix A.6.0), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mushkatel, A., E. Herzik, W. Freudenburg, and H. Molotch. 1987. *Urban study design.* Mountain West Research for Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Mushkatel, A., E. Herzik, and J. Toma. 1988. Interviews with Transportation Stakeholders. Conducted as part of the Nevada Nuclear Waste Project Office. Las Vegas, NV: Mountain West.

Mushkatel, A., J. Nigg, and D. Pijawka. 1989a. *Nevada urban residents' perceptions of a nuclear waste repository.* Paper Presented at the Annual Meetings of the American Association for the Advancement of Science, San Francisco, California.

*Mushkatel, A., J. Nigg, and D. Pijawka. 1989b. *Public response, risk perception, and intended behavior: analysis of a survey of the Las Vegas metropolitan area, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

NAS (National Academy of Science). 1983. *A study of the isolation system for geologic disposal of radioactive wastes.* Washington, DC: National Adademy Press.

National Research Council. 1957. *The disposal of radioactive wastes on land.* Publication no. 519. Washington, DC: National Academy of Sciences.

National Research Council. 1980. *Disasters and the mass media.* Washington D.C.: National Academy of Sciences Press.

National Research Council, Board on Radioactive Waste Management. 1985. Letter from Frank L. Parker to Ben Rusche, April 26.

Nebraska Energy Office. 1987. *A review of the effects of human error on the risks involved in spent fuel transportation.* Lincoln, Nebraska: Nebraska Energy Office.

Neuhauser, K.S., and P.C. Reardon. 1986. *A demonstration sensitivity analysis for RADTRAN III.* SAND85-1001, TTC-0057 UC-71. Albuquerque, NM: Sandia National Laboratories.

Nevada Commission on Economic Develpment. 1985. *Nevada State Plan for Economic Diversification and Development.*

Nevada Nuclear Waste Project Office. 1988a. Report of the State of Nevada Commission on Nuclear Projects. Draft. Prepared for Presentation to the Governor and the

65th Session of the Nevada Legislature. Carson City, NV: Nevada Nuclear Waste Project Office.

Nevada Nuclear Waste Project Office. 1988b. *Report of the Nevada Agency for Nuclear Projects to the Nevada Legislature on high-level nuclear waste transportation.* Carson City, NV: Nevada Nuclear Waste Project Office.

Nevada Office of Community Services. 1985. *Clark County, Nevada Profile.* Carson City, NV: Office of Community Services.

Nevada Office of Community Services. 1988. *Nevada Statistical Abstract.* Carson City, NV: Office of Community Services.

New York Times, 14 September 1988. p. 1.

Nielsen, D.R., M. Th. van Genuchten., and J. W. Biggar. 1986. Water flow and solute transport processes in the unsaturated zone. *Water Resources Research* 22(9):895-1085.

Nisbett, R., and T. D. Wilson. 1977. Telling more than we can know: Verbal reports on mental processes. *Psychological Review,* 84, 231-259.

NRC (Nuclear Regulatory Commission). 1977. *Final environmental statement on the transportation of radioactive material by air and other modes.* 2 vols. NUREG-0170. Washington, DC: Nuclear Regulatory Commission.

NRC (Nuclear Regulatory Commission). 1984. *Probabilistic risk assessment (PRA) reference document.* NUREG-1050. Washington, DC: Nuclear Regulatory Commission.

NRC (Nuclear Regulatory Commission). 1986. *Shipping container response to severe highway and railway accident conditions.* NUREG/CR-4829. Washington, DC: Nuclear Regulatory Commission.

NRC (Nuclear Regulatory Commission). 1988. *Peer review for high-level nuclear waste repositories.* NUREG-1297. Washington, DC: Nuclear Regulatory Commission.

Opinion Research Corporation. 1988. *Nuclear waste repository survey.* Prepared for the University of Nevada, Las Vegas.

Ostmeyer, Robert M. 1986. *A revised rail-stop exposure model for incident-free transport of nuclear waste.* SAND85-2149, TTC-0606 UC-71. Albuquerque, NM: Sandia National Laboratories.

OTA (Office of Technology Assessment). 1986. *Transportation of hazardous materials.* OTA-SET-304. Washington, DC: USGPO.

Pagels, H. 1988. *The Dreams of Reason: The Computer and the Rise of the Sciences of Complexity.* New York: Simon & Schuster.

Parker, F., R. Kasperson, T. Andersson, and S. Parker. 1987. *Technical and sociopolitical issues in radioactive waste disposal: 1986.* 2 Volumes. Stockholm, Sweden: The Beijer Institute.

Paschall, J.R. 1978. A railroad perspective on transporatation of spent fuel and high level waste and recent ICC decisions. In *Proceedings of the 5th International Symposium on Packaging and Transport of Radioactive material (PATRAM), May 7-12, 1978,* vol. 1: 173-185. Las Vegas, Nevada. Albuquerque, NM: Sandia National Laboratories.

Perelman, A.I. 1972. *Geochemistry of elements in the supergene zone* [translated from Russian, 1977]. Available from National Technical Information Service, Springfield, VA.

Perrow, C. 1983. The Organizational Context of Human Factors Engineering. *Administrative Science Quarterly* 28:521-541.

Perrow, C. 1984. *Normal Accidents.* New York: Basic Books.

Perrow, C. 1986. *Complex Organizations: A Critical Essay.* New York: Random House.

*Peters, H. and L. Hennen. 1988. *The accident at Gorleben: a case study of risk communication and risk amplification in the FRG, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Petterson, J. 1988a. *Report on follow-up study of Goiania incident, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Petterson, J.S. 1988b. Perception vs. reality of radiological impact: The Goiania model. *Nuclear News* 31(14):84-90.

*PIC (Planning Information Corporation), Clark University, and Mountain West, 1987. *Project description (first year socioeconomic progress report, appendix A.1.0), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1987a. *Reconnaissance of community facilities and service systems in Esmeralda County, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1987b. *Profile of local government facilities, services and fiscal conditions for southern Nye County, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation), 1987c. *Inventory of Lincoln County emergency management systems and schools, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1987d. *Linkages to project description and employment/local economy (first year socioeconomic progress report, appendices A.3.1 and A.3.2), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1987e. *Labor force and income (first year socioeconomic progress report, appendix A.3.3), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1987f. *Population/demographic characteristics (first year socioeconomic progress report, appendix A.3.4), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1987g. *Housing and land use (first year socioeconomic progress report, appendix A.3.5), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1987h. *Public infrastructure, community services and facilities, and fiscal (first year socioeconomic progress report, appendix A.4.0), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1988a. *Characteristics of the Las Vegas/Clark County visitor economy, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1988b. *Inventory of system characteristics (working draft).* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1988c. *NTS employee questionnaire: data coding and summary tabulation, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1988d. *Nellis AFB and its contribution to the southern Nevada economy, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1988e. *Contributions of DOE/NV and NTS to the southern Nevada economy, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1988f. *Nevada local government revenue analysis, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1988g. *Nevada State revenue analysis, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1988h. *Retirement migration and military retirement, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1988i. *Community development report, town of Beatty, Nevada.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1988j. *NTS project description (Phase IVA file memorandum, category 2).* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*PIC (Planning Information Corporation). 1989a. *Summary of background fiscal data and analysis for Yucca Mountain Socioeconomic Project Preliminary Impact Assessment Report.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

PIC (Planning Information Corporation). 1989b. *Potential GETT revenues: alternative revenue distributions.* For the Clark County Department of Comprehensive Planning, Las Vegas, Nevada.

Pollock, D.W. 1986. Simulation of fluid flow and energy transport processes associated with high-level radioactive waste disposal in unsaturated alluvium. *Water Resources Research* 23(5): 765-775.

Pahrump Valley Times, 2 September 1988.

Pahrump Valley Times, 28 October 1988.

*Radwan, A., and S. Kalevela. 1988. *Review of RADTRAN III documentation and assessment of theoretical background, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Radwan, A., and J. Zaniewski. 1987. *Special transportation infrastructure and potential impacts (first year socioeconomic progress report, appendix A.4.3), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Rasmussen, J. 1986. *Information Processing and Human-Machine Interaction: An Approach to Cognitive Engineering.* New York: North Holland.

Reisner, Marc. 1986. *Cadillac Desert: The American West and its Disappearing Water.* New York: Viking.

Renn, O. 1986. Risk perception: a systematic review of concepts and research results. In *Avoiding and Managing Environmental Damage from Major Industrial Accidents,* 377-408. Proceedings of the Air Pollution Control Association International Conference in Vancouver, Canada, November 1985. Pittsburg: The Association.

Renn, O., R. Kasperson, P. Slovic, and S. Emani. 1989. *The process of social amplification of risk: A comparative analysis of 128 hazard events.* Paper Presented at the 1989 Waste Management conference, Tucson, Arizona.

Reno Gazette-Journal, 22 October 1988.

Resnikoff, M. 1983. *The Next Nuclear Gamble.* New York: Council on Economic Priorities.

Rochlin, G.I. 1977. Two social criteria for nuclear waste disposal. *Science* 195:23-31.

Rogers, A.M., S.C. Harmsen, and M.E. Meremonte. 1987. *Evaluation of the seismicity of the Southern Great Basin and its relationship to the tectonic framework of the region.* U.S. Geological Survey Open-File Report 87-408. Denver: U.S. Geological Survey.

Roseboom, E.H., Jr. 1983. *Disposal of high-level nuclear waste above the water table in arid regions.* U.S. Geological Survey Circular 903. Washington, DC: USGS.

Rowe, R. and W. Schulze. 1986. *Economic assessment of damage related to Eagle Mine.* Prepared for Colorado Department of Law.

*Rucker, R. 1988a. *Report on the development of the transportation corridors in the Las Vegas Valley urban area, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Rucker, R. 1988b. *History, participation and sociocultural impact of gaming on the Las Vegas Valley urban area, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Rusco, E. 1988. *Establishment of the Yomba Reservation, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Rusco, M. and M. Hamby. 1988. *Socioeconomic profiles of Native American communities: Moapa, Yomba Shoshone, and Duckwater Shoshone Indian Reservations, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Saarinen, T.F. and J.L. Sell. 1980. Environmental perception. *Progress in Human Geography* 4:525-548.

Sandoval, R.P., et al. 1983. *An assessment of the safety of spent fuel transportation in urban environs.* SAND82-2365. Albuquerque, NM: Sandia National Laboratories.

Sandquist, G.M., et al. 1985. *Exposures and health effects from spent fuel transportation accidents.* RAE 8339/12-1. Rogers and Associates Engineering Corp.

Scanlon, R.D., and E.J. Cantilli. 1985. Assessing the risk and safety in the transportation of hazardous materials, *Transportation Research Record* 1020: 6-11.

Schmidt, E., B. Walters, J. Trott, and J. Gieseke. 1983. *Final report on shipping cask sabotage source term investigation,* NUREG/CR-2472. Washington, DC: Nuclear Regulatory Commission.

Schulze, W., G. McClelland, and B. Hurd. 1987. *A case study of a hazardous waste site: perspectives from economic and psychology.* Unpublished manuscript. University of Colorado, Boulder, Colorado.

SAIC (Science Applications International Corporation). 1985. *High-level nuclear waste transport and storage assessment of potential impacts on tourism in the Las Vegas area.* Prepared for U.S. Department of Energy, Nevada Operations Office, Las Vegas, Nevada.

Siv, O., and B.J. Garrick. 1981. *Analysis of severe transportation accident environment frequencies.* PLG-0207. Washington, DC: Pickard, Lowe, and Garrick, Inc.

*Slosky, L. et al. 1988. *Design of transportation impact studies: transportation needs assessment, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Slosky, L. et al. 1988. *Description of the U.S. DOE planned system for the transportation of nuclear waste to a repository at Yucca Mountain: transportation needs assessment, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office Carson City, Nevada.

Slovic, P. 1986. Informing and educating the public about risk. *Risk Analysis* 6: 403-415.

Slovic, P. 1987. Perception of risk. *Science* 236: 280-285.

*Slovic, P. 1988. *Preliminary findings: tourism and migration imagery survey, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Slovic, P., B. Fischhoff, and S. Lichtenstein. 1985. Characterizing perceived risk. In *Perilous Progress: Technology as Hazard*, R.W. Kates, C. Hohenemser, J. Kasperson (eds.). pp. 91-123. Boulder, CO: Westview Press, Inc..

Slovic, P., B. Fischhoff, and S. Lichtenstein. 1986. The psychometric study of risk perception. *In Risk Evaluation and Management*, V. T. Covello, J. Menkes, and J. Mumpower (eds.), pp. 3-24. New York: Plenum.

*Slovic, P., N. Kraus, W. Desvousges, H. Kunreuther, R. Kasperson, M. Greenwood, W. Schulze, and G. McClelland. 1987. *Risk perception, risk-induced behavior and potential adverse economic impacts from a repository at Yucca Mountain, Nevada, (first year socioeconomic progress report, appendix A.2.6), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Slovic, P., M. Layman, N. Kraus, J. Chalmers, G. Gesell, and J. Flynn. 1989. *Perceived risk, stigma, and potential economic impacts of a high-level nuclear waste repository in Nevada.* Mountain West Research for Nevada Nuclear Waste Project Office, Carson City, Nevada.

Slovic, P., S. Lichtenstein, and B. Fischhoff. 1979. Images of disaster: Perceptions and acceptance of risks from nuclear power. In *Energy Risk Management*, G. Goodman and W. Rowe (eds.). London: Academic Press, pp. 223-245.

Slovic, P., S. Lichtenstein, and B. Fischhoff. 1984. Modelling the societal impact of fatal accidents. *Management Science* 33:464-474.

Smith, D.R. n.d. *Analysis of alternative transportation methods for radioactive materials shipments including the use of special trains for spent fuel and wastes,* pp. 954-962.

Smith, R.F. 1980. *An organizational analysis of a nuclear waste management system.* Report prepared for the Office of Technology Assessment by Battelle Affairs Research Center.

Smith, V. and W. Desvousges. 1986. The value of avoiding a LULU: Hazardous waste disposal sites. *The Review of Economics and Statistics* 67(May).

SNL (Sandia National Laboratories). 1987. *Site characterization plan -- conceptual design report*, (SCP-CDR), SAND84-2641. Albuquerque, NM: Sandia National Laboratories.

Sorensen, J. et al. 1987. *Impacts of Hazardous Technology: The Psycho-Social Effects of Restarting TMI.* Albany, NY: State University of New York Press.

Starling, G. 1986. *Managing the Public Sector.* Chicago: Dorsey Press.

Steffen, Jerome. 1979. *The American West: New Perspectives, New Dimensions.* Norman: University of Oklahoma Press.

Stern, E. 1985. *The radiological consequences of a severe spent fuel transportation accident (draft).* Upton, NY: Biomedical 30 Environmental Assessment Division, Brookhaven National Laboratory.

*Stewart, Kathleen. forthcoming. *Ethnography of the urban area, Las Vegas Valley.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Stinebaugh, R.E., and J.C. Frostenson. 1986. *Disposal of radioactive waste packages in vertical boreholes -- a description of the operations and equipment for emplacment and retrieval.* SAND84-1010. Albuquerque, NM: Sandia National Laboratories.

Stinebaugh, R.E., and J.C. Frostenson. 1987. *Worker radiation doses during vertical emplacement and retrieval of spent fuel at the tuff repository.* SAND84-2275. Albuquerque, NM: Sandia National Laboratories.

Stoffle, R., M. Traugott, C. Harshbarger, F. Jensen, M. Evans, and P. Drury. 1988. *Perceptions of risk from radioactivity: the superconducting super collider in Michigan.* Ann Arbor, MI: Institute for Social Research, University of Michigan.

Swain, A.D., and H.E. Guttmann. *Handbook of human reliability analysis with emphasis on nuclear power plant applications.* NUREG/CR-1278. Washington, DC: Nuclear Regulatory Commission.

Swainston, H.W. 1988. Attorney General's Opinion to Robert R. Loux, Executive Director of Nevada Nuclear Waste Project Office, (September 22, 1988).

Swainston, H.W. (Nevada Office of Attorney General). 1989. Memorandum to file regarding status of nuclear waste lawsuits. Carson City, NV: Nevada Agency for Nuclear Projects.

Szymanski, J.S. 1987. *Conceptual considerations of the Death Valley groundwater system with special emphasis on the adequacy of this system to accomodate the high-level nuclear waste repository.* Unpublished report. Las Vegas, Nevada.

Taylor, John M., and Sharon L. Daniel. 1982. *RADTRAN III: Revised computer code to analyze transportation of radioactive material.* SAND80-1942, TTC-0239 UC-71. Albuquerque, NM: Sandia National Laboratories.

Thayer, M., R. Bernknopf, D. Brookshire, and W. Schulze. 1987. *Earthquake and volcanic alerts: An economic evaluation of risk perception changes.* Report submitted to the U.S. Geological Survey.

Thompson, J. 1967. *Organizations in Action: Social Science Bases of Administrative Theory.* New York: McGraw-Hill.

Thunvik, R. and C. Braester. 1982. Hydrothermal conditions around a radioactive waste repository. In *Scientific Basis for Radioactive Waste Management,* W. Lutze (ed.), pp. 587-595, vol. 5. New York: Plenum Press and North Holland Press.

Titus, A. 1986. *Bombs in the Backyard: Atomic Testing and American Politics.* Reno and Las Vegas, NV: University of Nevada Press.

*Titus, A. 1987. *Political organizational response (first year socioeconomic progress report, appendix A.5.3.), draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Titus, A. 1988. *NTS case study, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Travis, B.J., S.W. Hodson, H.E. Nuttall, T.L. Cook, and R.S. Rundberg. 1984. *Preliminary estimates of water flow and radionuclide transport in Yucca Mountain.* Report LA-UR-84-40. Los Alamos, NM: National Laboratory.

*Trend, M., R. Little, and R. Krannich. 1988a. *Ethnographic summary report: Amargosa Valley, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Trend, M., R. Little, and R. Krannich. 1988b. *Ethnographic summary report: Beatty, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

*Trend, M., R. Little, and R. Krannich. 1988c. *Ethnographic summary report: Pahrump, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

Tsang, Y.W. and K. Pruess. 1987. A study of thermally induced convection near a high-level nuclear waste repository in partially saturated fractured tuff. *Water Resources Research* 23(10):158-1966.

*Tuler, S., R. Kasperson, and S. Ratick. 1988. *The effects of human reliability on risk in the transportation of spent nuclear fuel, draft.* Mountain West Research for the Nevada Nuclear Waste Project Office, Carson City, Nevada.

University of Nevada Poll. 1988. *Public opinion in Nevada: the future (summary of survey results).* Prepared by University of Nevada-Reno (Senator Alan Bible Center for Applied Research) and the University of Nevada-Las Vegas (Center for Survey Research).

U.S. Bureau of the Census. 1988. *Government finances in 1986-87.* Washington, DC: U.S. Department of Commerce.

USGS (United States Geological Survey). 1984. *A summary of geologic studies through January 1, 1983, of a potential high-level radioactive waste reporitory site at Yucca Mountain, Southern Nye County, Nevada.* USGS-OFR-84-792, Open-File report. Menlo Park, California.

Urban Institute and Price Waterhouse. 1988. *Fiscal affairs of state and local governments in Nevada.* (4 vols.) Prepared for the State of Nevada, Carson City, Nevada.

von Winterfeldt, D. and W. Edwards. 1984. *Understanding public disputes about risky technologies.* New York: Social Science Research Council.

Waddell, R.K. 1982. *Two-dimensional, steady-state model of ground-water flow, Nevada Test Site and vicinity,* Nevada-California. U.S. Geological Survey Water-Resources Investigations 82-4085.

Waite, D.A., J.J. Mayberry, and J.M. Furr. 1986. *Preclosure radiological calculations to support salt site evaluations.* BMI/ONWI-541 (Rev. 1). Columbus: Office of Nuclear Waste Isolation.

Walsh, Edward J. and Rex H. Warland. 1983. Social movement involvement in the wake of a nuclear accident: Activists and free riders in the TMI area. *American Sociological Review* 48(December): 764-780.

Walters, C. 1986. *Adaptive Management of Renewable Resources.* New York: MacMillan and Co.

Weart, S.A. 1988. *Nuclear Fear: A History of Images.* Cambridge, Mass.: Harvard University Press.

Weinberg, A. 1977. Is nuclear energy acceptable? *Bulletin of the Atomic Scientists* 33(4):54-60.

West, S. G. and E. J. Baker. 1983. Public reaction to nuclear power: The case of offshore nuclear power plants. In *Advances in Applied Social Psychology,* R.F. Kidd and M.J. Saks (eds.) Vol. 2, pp. 101-129.

Weston, Roy F., Inc. 1985. *Preliminary repository underground design safety assessment report, Draft.* Columbus: Office of Nuclear Waste Isolation, U.S. Department of Energy.

Wildavsky, A. 1988. *Searching for Safety.* New Brunswick, New Jersey: Transaction Books.

Wiley, Peter and Robert Gottlieb. 1982. *Empires in the Sun: the Rise of the New American West.* New York: G.P. Putnam's Sons.

Wilkinson, K.P., J.G. Thompson, R.R. Reynolds, Jr., and L.M. Ostresh. 1982. Local disruption and western energy development: a critical review. *Pacific Sociological Review* 25:275-96.

Williams, Gary and Barbara Payne. 1985. *Emergence of collective action and environmental networking in relation to radioactive waste management.* Paper Presented at the Annual Meetings of the Rural Sociological Society, Blacksburg, Virginia, August.

Willrich, M. and R.K. Lester. 1977. *Radioactive Waste: Management and Regulation.* New York: MacMillan.

Wilmot, E.L. 1981. *Transportation accident scenarios for a commercial spent fuel.* SAND80-2124. Albuquerque, NM: Sandia National Laboratories, February.

Wilmot, Edwin L., Marcella M. Madsen, Jonathan W. Cashwell, and David S. Joy. 1983. *A preliminary analysis of cost and risk of transporting nuclear waste to potential candidate commercial repository sites.* SAND83-0867. Albuquerque, NM: Sandia National Laboratories.

Wilson, J.Q. 1978. *The Investigators.* New York: Basic Books.

Wilson, R. and E.A.C. Crouch. 1987. Risk assessment and comparisons: An introduction. *Science* 236:267-270.

Winograd, I.J. 1981. Radioactive waste disposal in thick unsaturated zones. *Science* 212 (4502): 1457-1464.

Winograd, I.J. and W. Thordarson. 1968. Structural control of groundwater movement in geosynclinal rocks of south-central Nevada. In *Studies of Geology and hydrology, Nevada Test Site,* E.B. Eckeled (ed.), pp. 35-48. Geological Society of America Memoir 110.

Winograd, I.J. 1987. Personal communication, 2 October.

Worster, Donald. 1986. *Rivers of Empire: Water, Aridity, and the Growth of the New American West.* New York: Pantheon.

Wynn, J.C. and Roseboom, E.H. 1987. Role of geophysics in identifying and characterizing sites for high-level nuclear waste repositories. *Journal of Geophysical Research* 92 (B8): 7787-7796.

Yeh, G.T. and D.S. Ward,. 1981. *FEMWASTE: A finite element model of waste transport through saturated-unsaturated porous media.* Report ORNL-5601. Oak Ridge, Tennessee: Oak Ridge National Laboratory.

Yook, H.R., J.G. Arbital, J.M. Keeton, J.E. Mosier, and B.S. Weaver. 1984. *Repository preclosure accident scenarios.* BMI-ONWI-551. Columbus: Office of Nuclear Waste Isolation, U.S. Department of Energy.

Yu, Jason C., and Charles A. Judd. 1985. Cost-effectiveness analysis of transportation strategies for nuclear waste repository sites. In *Improving Transportation of Hazardous Materials Through Risk Assessment and Routing,* pp. 23-30. Transportation Research Record 1020. Washington, DC: Transportation Research Board, National Research Council.