

January 2012

**Proposed Uranium Mine and Mill,  
Coles Hill Virginia:  
An Assessment of Possible  
Socioeconomic Impacts**

**Final Report**

**Volume 2: Appendices**

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# **Appendix A: Qualitative Research into Community Characteristics, Aspirations, and Concerns**

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## **A.1 Introduction**

To better understand potential social and economic impacts from introducing uranium mining and milling in the Southside region of Virginia, RTI conducted qualitative research into people’s shared or collective notions of the region and its communities, as well as research into how residents of the region potentially see aspects of the community as changing or being affected as a result of the introduction of uranium mining in their community. This information is important to the overall analysis of social and economic impacts because it helps us understand more fully the history and context of the communities around the proposed mine and mill and how their features may influence change or be changed as result of the introduction of the mine and mill. In addition, through collecting information on people’s concerns and questions about the proposed mine, RTI is better able in its social and economic impact analysis and reporting to address those issues that are most important or meaningful from the perspective of residents living in the region, as well as suggest from a decision perspective critical areas for further discussion and discovery.

To help guide the qualitative social and cultural research, RTI’s team developed two main research questions, as shown in Table A-1.

**Table A-1. Values and Concerns of the Community**

<b>Question</b>	<b>Related Domains of Inquiry</b>
1. What do people currently value about their community?	History, resources, values, expectations for the future
2. What do communities around the mine see as potential impacts to their community as a result of the introduction of uranium mining and milling to the region?	Changes to social, economic, and environmental conditions

To answer our research questions, we used ethnographic and qualitative methods, including key stakeholder interviews (KSIs), focus group discussions, and structured ethnographic response data, to identify people’s knowledge, perceptions, and attitudes related to their communities and the proposed introduction of uranium mining and milling. Summarized in this section are the research design and methods used in conducting this research, our approach to analyzing the data, and a discussion of the findings.

## A.2 Research Design, Methods, and Analysis

The following section describes the overall design of the research and the methods used to collect the research data research, as well as our approach to its analysis.

### A.2.1 Research Design

In conducting this research, we used ethnographic and qualitative methods—including KSIs, focus group discussions, and structured response data—to identify people’s shared knowledge, perceptions, and attitudes related to the proposed introduction of mining.

The goal in conducting the KSIs was to develop an understanding of the range of perspective and concerns in the community related to the proposed mine and mill and set a goal of conducting 25 to 30 KSIs with community leaders and representatives in areas of business, community development, community advocacy, economic development, education, environment, health, religion, and government.

As a contrast to the more specialized information from the KSIs, we also planned eight focus groups with members of the general public in six communities geographically spread around the mine location (Chatham, Danville, Gretna, Lynchburg, Martinsville, and South Boston). Our goal in conducting focus groups was to develop a more nuanced understanding of the values and concerns of individuals in different communities in the region. We dropped the total number of focus groups to seven, however, when we could not find enough interested individuals to participate in the group discussion planned for Lynchburg.

In addition, we presented participants in both the interviews and focus groups with a structured ethnographic questionnaire that asked participants to rate the impact of the mine and mill on a range of economic, environmental, and community issues to better understand gauge levels of concern for key areas in each of those domains.

### A.2.2 Research Methods

#### A.2.2.1 Focus Groups

Focus groups are a common method in qualitative studies and offer the ability to rapidly produce data concerning participants’ knowledge, attitudes, perceptions, and opinions on a range of topics and are facilitated group discussions usually concerning a single topic of interest (Morgan, 1989).

The focus groups were conducted with convenience samples of citizens from five communities in the Southside region. Participants in the focus groups were recruited through a local recruitment firm that phoned households in the targeted areas. The recruitment firm used screening questions developed by RTI to determine eligibility and ensure proper representation in each group (Attachment A). The recruitment firm and RTI communicated daily during the process to ensure proper screening of participants and even representation across groups. A total of seven focus group discussions were conducted in Martinsville, Danville, South Boston, Gretna (2 groups), and Chatham (2 groups) with a total of 51 community members.

Before the discussion started, the moderator explained the purpose of the study and people's rights as participants. Participants had the opportunity to ask questions prior to consenting their participation or choose not to participate. Informed consent was obtained from each participant (Attachment B). Participants independently completed the Structured Ethnographic Questionnaire prior to the start of the discussion (Attachment C). Discussions were led by an experienced moderator who facilitated the discussion with a semistructured question guide framed by several key domains (Attachment D). A note taker was present and notes were systematically documented at each group and all groups were audio recorded with consent from participants. Notes taken during the focus groups were de-identified, and participant's names were not linked to responses. Discussions lasted approximately 2 hours. Following completion of the group, each participant received a \$50 honorarium.

#### **A.2.2.2 Key Stakeholder Interviews**

Key stakeholders are individuals who because of their knowledge, previous experience, or position in a community can potentially offer unique or specialized perspectives on an issue. Researchers select key stakeholder interview participants using some predefined criteria to ensure a balance of perspectives. In the current research, the research team identified, with help from RTI's Community Advisory Panel (CAP), community leaders, and representatives involved in different areas of civic life, including business, community development, community advocacy, economic development, education, environment, health, religion, and government.

Based on input from the CAP, the RTI team reviewed, vetted internally, and prioritized participation in the interviews based on a person's involvement in the community and area of representation. Two RTI project team members placed telephone calls to stakeholders, provided an explanation of the purpose of the study, and invited them to participate in a 60-minute interview. Interviews were scheduled according to the stakeholder's availability and took place at a convenient location. We conducted 29 interviews.

Prior to the interview, we explained again the purpose of the study and their rights as participants. Participants could ask questions or choose not to participate. Informed consent was obtained from each individual (Attachment E). An experienced moderator who used a semistructured interview guide with several key domains (Attachment F) led the interviews. A note taker attended most interviews and took thematic notes. These interviews were not recorded in an effort to keep participation and responses anonymous. Following the interview, stakeholders were asked to complete the structured questionnaire (the form completed by focus group participants). For various reasons, including time constraints and interview settings, not all stakeholders completed the Structured Ethnographic Questionnaire. Key stakeholders were not provided an honorarium or any other monetary compensation for their participation.

#### **A.2.2.3 Structured Ethnographic Questionnaire**

The Structured Ethnographic Questionnaire (Attachment C) asked participants to rate the impact of the mine and mill on specific qualities or features in the areas of economic, environmental, and community issues (see Table A-2). To rate the impact on these items, participants were asked to use an 11-point scale, where -5 indicates a highly negative impact and a +5 indicates a highly positive impact to

**Table A-2. Structured Questionnaire Rating Items**

<b>Economy</b>	<b>Environment</b>	<b>Community</b>
Employment	Land use and aesthetic (changes in landscape from new facilities and buildings for the mine)	Schools and/or educational system
Quality jobs	Air (dust, radiation, or particles in the air)	Crime and safety
Attract and retain businesses	Groundwater (use of water resource—quantity or quality)	Roads
Income and wages	Surface water (flow or temperature change in drinking water)	Transportation access (e.g., connectivity to highways, airports, rail)
Housing prices/rent	Human health (dust, radiation)	Access and quality of health care
Housing availability	Ecosystem (habitat)	Outdoor recreation (e.g., parks, hunting, fishing, hiking, golf courses)
Tourism	Agricultural (crops and livestock)	Indoor recreational activity (e.g., movies, street fairs, community events, museums)
		People moving to the community/region

the community. In addition, we asked participants to rank which was most important to them—economy, environment, and community—when considering the proposed mine and mill.

## **A.3 Data Analysis**

### **A.3.1 Theoretical Approach**

Two theoretical approaches informed our analysis of the qualitative interview/focus group data: grounded theory (Glaser & Strauss, 1967; Straus & Corbin, 1998) and schema analysis (Quinn, 2005; Ryan & Bernard, 2000). The former theory is concerned with identifying themes, as well as the categories and terms, used by interview participants in discussing their community and their concerns surrounding the proposed uranium mine or mill. We placed particular emphasis on understanding the constellation of ideas and experiences that potentially influence individuals' perception of the proposed activities. Schema analysis, while similar methodologically to grounded theory, treats talk as a window on how people interpret and reason about experiences with particular interest in the shared aspects of cognition. In schema analysis, the analyst often looks for the metaphors and symbols that people use to share ideas and concepts.

## **A.3.2 Key Stakeholder Interviews' (KSIs') and Focus Groups' Qualitative Data**

### **A.3.2.1 Data Collection**

Most of the KSIs and all of focus groups were conducted with a moderator and a note taker present. In some instances, it was not feasible because of schedules to have two people attend an interview. When a note taker was present, the note taker typed the discussion in a structured Word document that followed the moderator's guide, but there were no verbatim transcriptions.

### **A.3.2.2 Code Development and Nvivo Analysis**

The overarching code structure was adapted from the broad domains of interest touched on in the moderator's guide. Subcodes were also added based on probes or prompts from the guide. The team created a codebook containing the code structure, definitions of each code with general examples, and guidelines for all analysts to follow while coding. This codebook remained a living document throughout the coding process to be modified as determined by the team.

Two randomly selected "test" sources (one KSI and one focus group) were imported into a QSR Nvivo 9 database populated with the initial coding structure. Four analysts coded each of these test sources to get a feel for the structure of the data and codes. Once each analyst completed this first round of coding, the individual coding was merged into a master database for comparing coder reliability. Discrepancies were discussed as a team and resolved in the form of new codes or revision of existing codes that were then documented in the codebook. This review also provided an opportunity to discuss general understanding of the code definitions and highlighted any definitions that needed further refinement or elaboration.

Upon completion of the codebook revisions and Nvivo database updates, we then assigned each of the 27 sources (20 KSIs and seven focus groups) to one of three of the initial analysts for individual coding. Two of these analysts took the lead on coding, which improved consistency in applying the codes. Duplicate coding of each source by more than one analyst was not performed because of time constraints, so any questionable segments were coded into an "other" category for review and resolution by the team. This process led to the creation of roughly six new subcodes that were then applied to appropriate qualitative responses.

### **A.3.2.3 Thematic Review and Summary**

The identification of themes was an important final step to understand the most salient issues in our interviews. The team took an inductive approach to identify themes within and between different codes by reading through the coding summary and pulling out ideas that resonated with multiple participants (repetitions) (Ryan & Bernard, 2003).

## **A.3.3 Structured Questionnaire Data**

For the analysis of the structured questionnaire, for each rating item we calculated its mean and standard deviation.

## **A.4 Characteristics of the Participants in the Research and Research Settings**

### **A.4.1 Focus Group Participants**

A total of seven focus groups were conducted with community members in July 2011 living within the vicinity of the proposed mine and mill at Coles Hill. Focus group discussions were held and conducted with individuals living in Martinsville, Danville, South Boston, Gretna (2 groups), and Chatham (2 groups), Virginia. Between six and nine individuals participated in each focus group discussion. Discussions were held in locations that were convenient for participants to travel to in each city; locations included libraries and other meeting spaces that could facilitate a group discussion.

The genders of the people who participated were approximately balanced with 29 males and 22 female participants. The average age of the participants was 50. The majority (71%) of those who participated in the focus groups were white or Caucasian and 24% were African American. Twenty-seven participants reported having achieved a high school education or less. Most participants (41%) had attended some college or had received technical education or training. Thirty-nine percent of participants reported full-time employment followed by 27% who indicated they were presently retired. The remaining participants were students (12%) or unemployed (8%), and an equal number were homemakers or reported part-time employment (6%). Forty-one percent of focus group participants reported a household income of less than \$20,000 per year followed by 22% that reported earning between \$20,000 and \$30,000 and 25% that reported an annual household income between \$30,000 and \$40,000 per year. The majority (61%) were lifelong residents, while others had resided in the area for most or a large portion of their lives. Few had lived in the area for a short period of time relative to their age. De-identified screening and demographic data for each focus group participant can be found in Attachment G.

### **A.4.2 Key Stakeholders**

Between June and September 2011, twenty-nine interviews were conducted with a cross section of key stakeholders and engaged members of the community working/living in the vicinity of the proposed mine and mill. Stakeholders were representative of Danville, Chatham, Gretna, South Boston, Stuart, Roanoke, Rustburg, and Dry Fork, Virginia. The 50-mile radius also allowed for key stakeholder perspectives from Person, Rockingham, and Caswell Counties in North Carolina to be included in the analysis. Interviews were conducted at mutually agreed upon locations that were convenient for stakeholders. Many of the interviews were conducted at the stakeholder's work location or at another convenient location such as a nearby library. All interviews were conducted in person with the exception of one interview that was conducted via telephone.

Stakeholders represented a heterogeneous mix of leaders in business, community development, community advocacy, economic development, education, environment, health, religion, and government and were suggested by members of the CAP. See Table A-3 for an enumeration of interviews by categories of stakeholders. Demographic data were not obtained from stakeholders in an effort to keep their identity confidential.



**Table A-3. Stakeholder Representation**

<b>Stakeholder Category</b>	<b>N</b>
Business	4
Community development	1
Community leader/ advocacy	3
Economic development	9
Education	2
Environment	4
Health	1
Religion	2
Government	3
<b>Total</b>	<b>29</b>

#### **A.4.3 Settings for the Research**

The locations for the focus group were selected with any eye for balancing geographic diversity in the 50-mile radius from the mine site and focusing on those communities most likely to be directly affected by the potential mine and mill. Thus, we conducted two focus groups in each of the two towns closest to the mine site, Chatham and Gretna, while also conducting single focus groups in Danville (south of mine site), South Boston (east of mine site), and Martinsville (west of mine site). Our goal had been also to conduct a focus group in Lynchburg, north of the mine, but we had to cancel that group when we could not recruit a sufficient number of participants for a discussion of the mine, in part because many of the people that were approached about participating were not aware of the proposed mine.

Provided below is further description of the communities participating in the focus groups based on information shared in the focus groups and KSIs, as well as from observation while visiting the communities.

*Chatham:* Chatham is the county seat for Pittsylvania County. Its main geographic feature is a long main street that runs north to south, paralleling Highway 29. Along this road are numerous stately older homes that are well maintained. In the middle is a small shopping and business section that also features several of the county's administrative buildings. Other notable features are the town's two private secondary schools, Chatham Hall, a boarding school for girls, and Hargrave Military Academy for boys. The town has lost most of its industrial or manufacturing employers and relies on the county office and the two schools for most of its local employment. It is also currently where Virginia Uranium is headquartered. Given its proximity to the proposed mine and mill location, the people we talked to from the town were aware of the efforts to lift the moratorium on uranium mining and were more likely to have opinions about potential environmental impacts and people's safety.

*Gretna:* Gretna is also off Highway 29, a few miles north of the mine site. Its main street runs along a busy rail line. Like Chatham, it has lost many of its industrial and manufacturing jobs and is now mostly a residential community for people who work in other towns, including Danville and Lynchburg. It has its own elementary, middle, and high schools in town. It recently opened a new industrial park, which it hopes to use to attract new business, and it has a satellite branch of the regional community college. Its proximity to the mine also makes the mine and mill, jobs, and safety important topic of discussion among its citizens.

*Danville:* Danville is a small city located on the Virginia border and was once a large textile industry community. Most of the textile activity has ended, leaving empty riverfront buildings, some of which are currently being repurposed for new businesses. The city seems to be engaged in a number of ventures to help revitalize its economy, such as the Institute for Advanced Learning and Research. Interest in the proposed mine and mill ranges from interest in its economic benefits to concerns for larger environmental issues.

*Martinsville:* Martinsville is a medium-sized city of about 14,000 located in Henry County, Virginia, and west of the proposed Coles Hill site. Martinsville is most commonly known outside the region for the Martinsville Speedway, which has a capacity of 65,000 and hosts two NASCAR Sprint Cup Series every year. Like other cities in the area, Martinsville's economy has suffered because of waning manufacturing job demand as manufacturing has relocated outside the United States. The participants of Martinsville generally liked their quality of life, citing a low cost of living and small city atmosphere. With its location west and "upstream" from the proposed mine site, residents were typically less interested in the topic and felt unaffected by it compared with other study sites. This idea was reflected in the fact that we had difficulty recruiting participants for the research compared with the other sites.

*South Boston:* South Boston, a small town located to the east of the mine site, is geologically downstream from the watersheds that surround the mine location. Much like the other towns in southern Virginia, it has seen much of its manufacturing business move away, compounded by a decline in the former cash-crop of tobacco. In the place of these former industries, people are looking at tourism and organic or other specialized farming as possible new revenue generators. South Boston also has a high-speed Internet hub that is being used to attract potential Internet technology companies. Its local government (County of Halifax and South Boston) have been vocal in their opposition to the mine.

## **A.5 Results**

Provided in this section is a summary of the research findings for both of our main research questions. Section A.5.1 provides an overview of the communities involved in the data collections along with summaries of their valued aspects, challenges, and aspirations. Section A.5.2 presents participants' concerns and questions related to the proposed introduction of uranium mining and milling to the region.

### **A.5.1 Community Characteristics**

Participants were asked a series of questions that sought to assess what it is like to live in the Southside region. The questions were divided into three aspects: *valued aspects* (Section A.5.1.1),

*challenges* they face (Section A.5.1.2), and *aspirations* they have for the future of the community (Section A.5.1.3).

### **A.5.1.1 Valued Aspects**

We asked participants what they value about the region and what they considered the current strengths of their community, as well as the economy or businesses of the area.

#### **Community Values**

- *Sense of Community.* By and large, the values most frequently mentioned were that the people of their community stick together, care for one another in times of need, and are friendly. Equally as many participants voiced an appreciation for the peaceful, quiet “small town feel” made possible by the community’s rural location. A number of participants mentioned that they like that they are close to larger towns and are centrally located, but they don’t actually live in a large city, themselves. The character of the community members was also praised. Participants described them as being humble, having strong integrity, being hardworking, and having a strong will with passion and heart. A handful of participants discussed the value of having family living in the area.
- *Natural Beauty, Recreation, and Cultural Amenities.* The natural environment was another highly valued aspect of the community, whether it was for simply appreciating the natural beauty or enjoying the many recreational opportunities at nearby parks and lakes and the outdoor sports opportunities. Various cultural outlets were also important to a number of participants, including restaurants, entertainment, a growing art community, and the farmer’s market.
- *School System and Youth.* The quality of the schools in the area, both public and private, as well as the sports programs (football and baseball), was commonly praised as high-caliber education and outlets for youth. A handful of participants also went out of their way to praise the potential of the youth in the community.
- *Civic Benefits.* A small group of participants expressed an appreciation for law enforcement in the area and felt the community was safe with relatively little crime. The cost of living was reported as relatively low, including lower taxes than some other places. Reasonable real estate costs, good roads with little traffic, workforce development, and local foundations were other communal benefits discussed.
- *Community Resources and Growth.* A good portion of participants mentioned the importance of the religious community and churches in the area. Some participants also felt like the population was stable or even growing and relatively diverse. The health care system was praised by a few for the quality of the local hospital and nursing home. And lastly, the rich history of the area was embraced by a few as integral to the community.

#### **Economic or Business Values**

- *Current Local Staples and Corporate Employers.* Three areas of local business were praised by a good portion of participants: the health care system (including the hospital and nursing home), the agricultural industry, and small businesses such as restaurants and wineries. In addition to these local businesses, larger corporate employers or industries were highlighted as beneficial to the local economy. Goodyear was the most commonly mentioned corporation, followed by a vast array of other employers: the school system, the county

government, Nestle, Ikea, Ross, The Babcock and Wilcox Company (B & W), General Motors, Microsoft, Homeland Security, Columbia Forest Products, Enue Business Forms, Amthor International Truck Manufacturing, Capps Shoe Company, Corning Incorporated, the prison, and the Virginia International Raceway (VIR).

- *Resources to Grow the Economy.* The proximity to larger cities was mentioned a few times as a value that could help grow the economy. Other potential advantages briefly discussed were workforce development efforts; available space, including water and sewer capabilities in the Mega Park located in Pittsylvania County; the new fiberoptic infrastructure; lower taxes; local foundations to help bring in business; and opportunities for tourism.

### **A.5.1.2 Challenges**

We also sought to better understand from participants' perspective what communal or economic challenges or difficulties their region faces (not related to uranium mining).

#### **Community Challenges**

- *Lack of Appeal for Youth and Young Adults.* The most frequently mentioned community concern was a lack of fun and entertainment activities, especially for the youth of the area. Many participants explained that this gap also contributes to the migration of young adults away from the area and lack of desire to return as young adults.
- *Inadequate Leadership and Initiative.* A number of participants also voiced concern about the lack of a plan for the area's future and how this might affect the local children's future as well. The area's leadership was criticized for talking too much with nothing to show for it and a lack of fresh perspectives in leadership positions. A few went as far as saying it's a "good old boys club."
- *Psychological Barriers to Progress.* The sentiment that people in the area are resistant to change and don't like "rocking the boat" was repeated by a number of participants. Others felt the problem was more to do with a fear of change or simply a lack of awareness of the problems and/or potential of the area. Another psychologically influencing factor was the ongoing presence of the "mill mentality," which some believed is contributing to a collective low self-esteem or stagnant feeling in the area.
- *Psychosocial Concerns.* Although the number of participants that mentioned psychosocial concerns was relatively small, the issues voiced merit a brief discussion. Many were concerned about the growing crime rate and illicit drug use. Because they live in a dry county, illegal drinking was also an issue for a few participants had observed. A few commented on the aging population, wondering if the area was going to become a "retirement community," acknowledging a lack of resources for the elderly and noting a lack of employment opportunities for older adults. Other psychosocial concerns included unstable/single-parent families, teen pregnancy, racism, obesity, and poverty.
- *Low Priority for Education.* There was a general sense among a good number of participants that education is a low priority in the area, both for early childhood and adult education. Little funding was seen as a contributing factor to poor overall educational quality and inability to offer raises to teachers. A few participants also noted low literacy levels were a problem.

- *Communal Concerns.* A few environmental concerns were voiced concerning water levels and quality, increasing loss of trees, blight, decreasing land value, and “fracking” for natural gases.

### **Economic or Business Challenges**

- *Jobs and Unemployment.* Not surprisingly, the unemployment rate due to downsizing, the “death of the textile industry,” and outsourcing was the most common concern raised. Many mentioned struggling with the competition for what jobs are available and were discouraged by the selection of available positions because they offered little or no benefits or low pay or education requirements were too low. It was pointed out that these positions also do not help to draw young adults to the area.
- *Workforce Concerns.* A number of participants were worried that the local workforce is underqualified for the changing job market in that they are an aging community, untrained outside of factory work, not tech-savvy enough, and either too uneducated or overqualified for what jobs may become available. The necessity to commute to other towns was a challenge a few participants have noticed, contributing to the reputation of the area becoming a “bedroom community.” A small number of participants were concerned about the agricultural lifestyle of the area and feared that it will not prosper because of the changing demands and younger generations not wanting to continue the tradition.
- *Employers.* A good portion of participants felt that a lack of big industry and mill employers in the area is a major concern. They also acknowledged that the area’s small population, the down economy, and current tax rates do not draw or offer industry incentives to bring employers to the area.
- *General Political or Economic Issues.* Another frequent challenge discussed was the down economy and how residents do not have enough income to cover daily needs or to sustain the local economy and local businesses. Participants also expressed concern that the local leadership is not providing strong enough action and advocacy for change to counteract the economic downturn. Other economic concerns included the area being a low priority for state funding, tax increases and few incentives, and concerns with land and property values.

#### **A.5.1.3 Aspirations**

To complete our understanding of the communal and economic climate of the region, we asked participants to share their aspirations for their community, including valued aspects to be preserved and how they would like to see it grow in the future.

- *Business.* The hope for jobs and new businesses in the area was the most commonly mentioned aspiration for the future. Potential businesses discussed included the computer industry, automotive companies, green industries, and data gathering or data management industries. Some participants also expressed hope that the agriculture industry in the area will adapt to the changing demands and continue to provide for residents. A few commented on the hope that the Mega Park will grow and house new industries in the area, while others desire more diverse, small businesses that will take the place of large corporate employers. A good number of participants acknowledged a need for improving and diversifying adult education and training opportunities to accommodate changing work demands and make the workforce more competitive, adopting the attitude to work smarter, not necessarily harder.

Hopefully, with new businesses and new skill sets, salaries could be more than minimum wage and finally pay people “what they’re worth.”

- *Community Improvements.* Community improvements seemed equally important to participants as were business opportunities. The revitalization of the area with entertainment and recreation facilities for adults and youth alike was a common hope, including a desire for more restaurants, art galleries, music events, grocery stores, and farmers markets. Many hoped that increasing these community assets and opportunities would increase the likelihood of people (and hopefully the youth) living, working, and staying in the area. Preserving the area’s natural beauty, historic resources, and relaxing small town feel and increasing ecotourism were also common aspirations. Reinforcing a priority on early childhood education, including literacy, as well as incorporating technology into education, was desired for the community. In addition to the hope for a 4-year college affiliation sometime in the near future.
- *Leadership and Government.* A few participants expressed hope for stronger or more provocative leadership to help the area resolve its current challenges. Also a desire for more unified, communal decision making was echoed by a few individuals. Some believed that local foundations (e.g., Danville Regional Foundation) and schools (e.g., Averett University) might help bring improvements to the area.
- *Infrastructure and Economy.* Lastly, a few participants voiced the desire for improvements to the area’s infrastructure, including the roads, water, and sewer systems, and just more comprehensive planning policies in general. A few noted the need for more services for the aging community as well. Finally, there was an overall hope for a lower tax rate and a stimulated economy, freer spending, and an up-turn in the housing market to help turn the area round.

In addition to the many aspirations and hopes the participants expressed, a small group of individuals felt the need to express their concern for the future, either saying that things probably would not change or that if things did not change the area would be in serious trouble. For some, this depended on the uranium situation and whether employers would return to the area.

### **A.5.2 Concerns and Questions from Surrounding Communities**

Our second research question was “What do communities around the mine see as potential impacts to their community as a result of the introduction of uranium mining and milling to the region.” In conducting the focus groups and interviews, we asked participants to share both their concerns about the proposed mine and mill and the benefits they see to its potential opening. We started the conversation by asking about their concerns and discussing first those issues identified by the participants. If necessary, we further probed on issues related to the economy, environment, quality of life in the community, and health and safety. We then asked about potential benefits from the mine and mill. During these conversations, we also prompted them to share with us any questions they have about the mine and mill that would help them make decisions.

In the following section, we first present the set of concerns shared by participants in the interviews and focus groups, organized around the broad themes of environment, health and safety,

economy, government, and community, followed by a summary of the set of identified benefits. This is followed by a breakdown of the questions shared about the mine and mill.

#### **A.5.2.1 Environmental Concerns**

Concerns about the mine and mill's impact on the environment were both the most numerous, and most often brought up spontaneously by participants in the focus groups and interviews. Participants' comments included both general statements about concerns for potential pollution or damage to the environment and more detailed consideration of the mine and mill's potential impacts on the area's water contamination, air quality, and management of waste materials.

#### **Water Concerns**

Among environmental concerns, potential contamination of water was the most common concern mentioned by participants. Also implied in participants' statements about the threat of water contamination was the introduction of radioactive materials in water which would pose a greater threat to a larger number of people over a larger geographic area than other potential environmental exposures.

In particular, people cited concerns for the mine and mill contaminating local water used for drinking and agriculture. Several participants described scenarios where contamination would potentially come from seeping or leakage of materials from the mine and mill into subsurface water. A shallow water table in the area was thought to add to the risk of the mine contaminating local water. Also compounding this concern for some individuals was an understanding that other uranium mines in the United States are located in more arid climates, leading them to question whether it would be possible to mine uranium without contaminating the water system in an area, such as Southside, which contains river basins and watersheds.

The other water contamination scenario participants expressed concern about was a failure or breach of the containment basins used to store mine waste. A failure of this type was thought to be possible if the technology used to contain the water was to fail (e.g., crack in the lining) or if it were overwhelmed by a natural disaster, like a hurricane, flood, tornado, or earthquake. (To note, natural disasters were also frequently mentioned as an environmental concern independent of potential impacts to water, usually in general statements suggesting they are a threat to the environmental safety of the mine and mill.) Terrorism was also mentioned as a potential threat to the environmental safety of the mine. People saw the release of water from a containment area as being a greater threat to the region, because they saw it as having the potential to enter surrounding streams, rivers, and lakes, affecting more people and a larger geographic area.

Although participants in the focus groups tended to be less specific about the potential source for contamination to water, several of the interview participants were concerned specifically about the risks for water contamination from the tailings produced from the milling process and containment areas used to store them. For a few individuals, this concern was heightened by their knowledge of mining accidents in the states of West Virginia and Tennessee, where tailings from mines were accidentally released in water supplies causing extensive environmental damage. Some participants also reported reading or hearing that Virginian Uranium Incorporated (VUI) was planning to seal the tailings from the milling

process in concrete and then store them in either the mine or covered containment areas. Their understanding was that this process would reduce risk of potential release or contamination from the by-products of the milling.

Participants shared the following concerns related to the potential outcomes from introducing excess uranium into the local and regional water systems:

- poisoning of drinking water, both proximally (e.g., Chatham and Gretna) and distally (e.g., Virginia Beach), used by humans, farm animals, and wildlife;
- absorption by plants, including those grown on local farms;
- killing or contaminating of fish in local waterbodies; and
- contamination of local recreations areas, such as Smith Mountain Lake.

Unrelated to uranium, one person also shared a concern that water used in the mine and milling process would decrease the water levels in the area immediately surrounding the mine, which would be a concern for nearby homeowners that rely on well water.

The overall level of concern expressed for water contamination may reflect the importance several individuals placed on the region's watersheds. In the interviews, we learned of several different organizations in the region committed to water management and protection (e.g., Dan River Basin, Roanoke River Basin Association, Leesville Lake Association) and interviewed a representative from one of the organizations. Water was described as being historically important and integral to the economy of the region in terms of farming, manufacturing, and recreation and tourism.

Also somewhat implicit in participants' statements about the threat of water contamination is the idea that radioactive materials in water would pose a greater threat to a larger number of people over a larger geographic area than other environmental exposures.

### **Air Concerns**

Although quite a few participants in the research study mentioned air and air quality as an area of environmental concern, participants were less able to provide details about potential impacts. A few individuals described uranium from the mine as having the potential to be transported in the air by dust to surrounding areas. Although most concern was for the homes and communities immediately surrounding the mine, one participant suggested it would be possible for the dust to travel over a thousand miles from the mine site, while another likened its potential to spread to nuclear fallout. There was some recognition that the impact on air quality would depend somewhat on the process used in mining; impacts would be greater if VUI were to use open-pit type mining.

Radon gas was brought up by two participants as air-related environmental issue. However, it is primarily an already existing risk because of the higher levels of radioactive materials in the soil in the region. A few participants commented that people in the region were being exposed to some amount of radiation already just by living in the area.



### **Waste Material Concerns**

Management of waste materials from the mining process was previously mentioned in relation to the storage of waste materials, such as tailings, in water. However, people also expressed concerns about the dirt and other materials taken from the ground in mining and whether they would be contaminated or “toxic” and also need to be stored in some protective fashion.

### **Other Environmental Concerns**

A few individuals expressed concern about having the finished product from the milling process (one person mentioned yellowcake specifically) transported through their communities. Only a couple of participants mentioned potential visual impacts from the mine. One person raised the question of noise from the mine and mill. Another person wondered if the mining operation would disturb the habitats of local wildlife.

Participants also brought up concerns for the environment at a systematic level. A few individuals said they were interested in knowing more about how mining and milling would affect the environment in the long term, such as over the next 10 to 15 years. A few participants asked what would need to be done to reclaim and use the mined land after the end of mining. One person said that it could take up to 2,000 years for any environmental contamination from uranium to exit the local ecological system.

#### **A.5.2.2 Health and Safety Concerns**

Almost all of the participants in the research shared some concern about impacts to people’s health from the mine and mill. Many of these concerns were nonspecific statements about concerns (e.g., I am concerned that the mine will affect people’s health) or the importance of health in relation to the mine (e.g., protecting people’s health would be the most important thing about the mine). When more detail was provided about health exposures; aspects of the mine and mill that were linked directly to potential negative health impacts, included exposure to the tailings and water used to wash or store them, increased dust and other pollutants affecting air quality, and ingestion of uranium through food products. With this latter concern, a few individuals discussed information they had received from environmental groups concerning local livestock ingesting uranium or radioactive material from either plants or water, and it then being transmitted to humans through consumption of meat or milk products from those animals.

In describing health risks of the mine and mill, several people made analogies between the risk from the mine and science’s experience with asbestos and its dangers. In particular, they compared the previous lack of knowledge of the health risks from asbestos to the potential long-term effects of uranium exposure in the community. A few individuals also pointed to a lack of examples of uranium being mined in other similarly populated areas to be a sign that it could not be mined safely in Virginia.

Participants identified cancer as the illness most likely to occur from exposure to any pollutants from the mine and mill. Several participants expressed concern that the area around the mine would experience increased rates of cancer as a result of the mining. The immediacy of the threat of cancer varied. A few individuals expressed concern for people getting cancer from it in a matter of months.

Others said it could take many years, anywhere from 20 to 40, for the community to understand the impact on health and rates of cancer.

Participants, particularly in the focus groups, also discussed concerns for the health of future generations in the community. Some participants were worried that exposure of adults to increased radiation would result in increases in incidents of birth defects and deformities in children. Two individuals also cited a risk for people with asthma and other respiratory issues if the mine were to decrease the quality of air locally.

Only a few individuals expressed concern about the potential risks from working at the mine. One person mentioned the need for proper ventilation to protect those working in the actual mine. However, other participants pointed out that workers would likely have protective clothing and be checked regularly for any radioactive exposure. A few participants also suggested that the mine and mill could be at risk of being attacked by terrorists or others seeking materials for weapons.

One person was concerned that the presence of the mine in the area might affect the ability of people to get health insurance coverage. Another person felt that the current hospital system in the region was already facing challenges in meeting the needs of the community and that the system would not have the resources needed to address any new health issues that might arise because of the mine.

### **A.5.2.3 Job Concerns and the Economy**

Although participants seemed to have clear beliefs about impacts from the mine and mill to the environment and health, they were more uncertain about potential impacts to jobs and the local and regional economy. This was evident in both the focus groups and from responses made by individuals, because participants often argued back and forth about potential benefits and challenges to the economy.

Almost all of the participants recognized that the Southside region is in a period of economic challenge. With the collapse of the textile and furniture manufacturing industries in the region, as well as decreased tobacco farming, there are fewer well-paying jobs for its citizens. The area needs new industries and businesses to employ its citizens. Further, many people who are currently employed must regularly travel significant distances to other towns and cities within, as well as outside, the region to find work. The representatives from local governments that we interviewed expressed concern for decreasing populations in communities and the corresponding impact on local tax revenues. Participants in the focus groups were frustrated that young people in the community were moving away or not coming home after college because of the lack of job opportunities in the region, leaving an aging population and fewer college-educated citizens.

### **Jobs**

Given these challenges, the promise of new jobs, both from those related directly to the mine and milling operations, and from jobs created by other businesses supporting the mine, is appealing. Adding to these feelings are beliefs that mine jobs will be better paying and potentially also attract new, skilled, or educated workers to the region (e.g., engineers, managers, headquarters staff for VUI). Countering this

optimism, however, are concerns that the jobs for local people will be few and mostly low paying. Participants' estimates of the number new jobs that would be created ranged from 100 to 500.

Furthermore, participants believed that any benefit from new jobs from the uranium mine and mill would be offset by potential losses of jobs in other economic sectors that would be negatively affected by the mine and mill. In particular, participants in the research study shared that the agriculture industry, which includes several large dairy and produce farms located in close proximity to the mine site, is an important aspect of the local and regional economy. Participants were concerned that any level of contamination of agriculture products as a result of the mine or mill, or even the perception of contamination, could greatly damage these businesses. In particular, the threat of uranium to crops was seen as a challenge to the smaller, organic-oriented farming taking place in the region. Similarly, individuals we interviewed, particularly from the town of Chatham, were concerned that the two private secondary schools located in that town would become less competitive in recruiting students, leading to decreased enrollments and an increasing competitive market for private residential education.

### **Economic Growth**

Beyond jobs, there was some expectation that the mine, if opened, would increase tax revenues in local communities that could support needed infrastructure and educational improvements, as well as be used to support activities that foster long-term economic growth in areas immediate to the mine.

At the same time, many of the participants saw the presence of the mine and mill as putting the region at a disadvantage in attracting new business, potentially limiting the overall growth of the region. Participants questioned if new businesses would want to locate employees in an area with a uranium mine. They felt the area had many good things to offer in terms of attracting business—a workforce, nice communities, good schools, and affordable housing—but the negative of the mine would be enough to stop new business from locating to the area. Similarly, a few interview participants cited a growing heritage tourism and recreation industry in the region, which they felt would be adversely affected by having a uranium mine close by.

Other economic concerns included questions about how the mine would be affected by fluctuations in the market price for uranium; people wondered if the mine would have to close for a period if the price of uranium dropped too low. Others questioned what would happen to the local economy in 15 or 30 years (at least one participant in the interviews questioned VUI's estimates that it would take 30 years to mine the uranium at Coles Hill, suggesting that the period of time could be as short as 15 years) when the mine closed. Would the region experience another bust period as jobs ended? Also, if an environmental accident were to occur at the mine site, who would end up paying the costs of clean-up and would this ultimately fall on local governments? A few participants also wondered if mining would be limited to Coles Hill or would other companies open uranium mines in other locations in the region.

Individuals we interviewed living in Chatham and Gretna, the towns closest to the mine, were concerned about property values in those areas and whether they would decrease as a result of their

proximity to the mine. Some individuals felt that home values had already decreased in the area; fewer people were willing to buy homes in the areas surrounding the potential site.

#### **A.5.2.4 Economic Developers' Concerns**

Akin to themes of the economy and jobs are also issues related to the region's future economic development. To elaborate on these points that are often of importance across community sectors, RTI interviewed economic developers, directors of chambers of commerce, business owners, and representatives from industry and business associations to ask more pointed questions about economic development prospects in the region as they relate to the proposed mine and mill. In these key informant interviews, RTI did not seek to poll attitudes about the proposed mine and mill; instead analysts sought to identify topics of greatest interest to those working in economic development as a guide to help sharpen the focus of RTI's research. This information better enabled researchers to address areas of inquiry important to economic developers.

Although concerns in this section mirror the issues described in the previous section, this section reflects the perspectives of professionals and industry representatives whose jobs are to foster economic growth. Their input adds additional nuance to issues described above. It should be noted that, on the whole, relevant officials near and west of Chatham either declined or did not respond to interview requests. Representatives from the east, north, and south of the site, though, were responsive and ready to share their perspectives.

### **Overarching Regional Economic Development Findings**

Three more general economic development findings set the broader stage for more distinct insights gained about the proposed mine and mill. There was concern about the region's economic distress, a shared understanding that this study region is characterized by two different regional economies, and areas east and south of the proposed site voiced much more concern than those to the north.

All interviewees expressed concern about the economic downturn the region has experienced in the last 30 years. Similar concerns about prospects for renewed job growth in the future were also expressed. Declines in manufacturing, plant closings, job loss, population decline, and poor quality education continue to plague the region. Improving economic development through job creation, upgrades in workforce, small business support, and industry retention and attraction was a common priority among interviewees. There was also a shared respect and appreciation of the importance of the land to the area's economic history and culture, which is still evidenced by its use as farms and vineyards, and for outdoor recreation such as hunting and fishing.

In terms of the region's economic development, the 50-mile study area is divided into two separate economies—one in the north with Roanoke and Lynchburg as anchors and one in the south with Danville and Chatham as anchors. As one interviewee described, Smith Mountain Lake and associated tourism from the Lake are the only "big connectors" between the two areas.

A final overarching and related finding from the economic development interviews is that those south and east of the proposed site, or “downstream,” expressed much more concern about the impacts of the mine and mill than those north of the site or “upstream.” Further, those generally north and northeast described positive experiences working with the companies in the nuclear industry around Lynchburg. They cited dedicated commitment from leadership at these companies to the region as playing a role in this positive relationship. Others claimed that these industries have had positive experiences with the region for two main reasons. First, they came in as companies with employment opportunities, not as a nuclear industry. Second, they did not have mining and milling components, which are viewed as more threatening to the land and its residents.

### **Summary Findings about the Proposed Mine and Mill**

Interviews about economic development revealed five themes of importance to those working on these issues regularly:

- perception of uranium mining and milling;
- jobs, workforce, and business attraction;
- safety and the environment;
- community benefits; and
- lack of information to make informed decisions.

In this section we describe each theme of inquiry in more detail and then discuss RTI’s research and analysis to help inform the topic.

### **Perception**

By far the most pressing concern was the negative perception of being located in a region with uranium mining and milling—even people who viewed the mine and mill as a net positive to the region’s economic potential were worried about this perception. Economic development officials worried that regardless of the safety assured by the mining company and the government the perceptions about what could happen can easily overpower reality and affect location and investment choices.

Industries or employers most prone to experiencing negative impacts from issues of perception were those industries linked to the land and water:

- agriculture,
- tourism,
- food and beverage manufacturing, and
- chemical manufacturing.

One developer commented that one of the region's greatest assets was availability of water, which is key to manufacturers. (Manufacturers also tend to be large employers.) Several developers noted that if a food and beverage manufacturer left the region because its products were perceived to be contaminated with uranium or if a manufacturer did not locate in the region in the future, the benefits from the uranium mine and mill would not be worth it. Other specific employers that economic developers thought were at risk from negative perception were the private schools in Chatham—Hargrave Military Academy and Chatham Hall. These institutions are regarded as important anchors to Chatham's local economy because they employ educated workers and create spillover effects for the local service industry. Almost all of those interviewed stated that if the mine and mill do proceed a substantial public relations and marketing strategy should be undertaken to mitigate the issues of perception.

### **Jobs, Workforce, and Industry Attraction**

The ability to create jobs and upgrade the workforce is a second theme that is at the forefront of those working in economic development. Some see mining and milling as a means to create jobs in the short term whether through local jobs or relocation of workers to the Chatham/Danville area. Both were seen as generally positive to the region. Others speculated that a supply chain could be developed by attracting companies working in the uranium industry to collocate in the region. Spillovers to local service businesses would also be captured and bring an injection of dollars to local businesses. Specialty businesses mentioned that could benefit include mechanics, mining equipment, and safety equipment. Some thought the uranium company would likely locate offices or facilities nearby.

Others thought the job prospects were minimal, especially for locals. They also claimed it was hard enough to attract a well-educated workforce to the region. It would be even more difficult to promote the region's quality of life if there is a uranium mine and mill. In terms of industry recruitment, about half of those interviewed said that regional developers already struggle to recruit companies; the last thing they need is another barrier to overcome to sell the region to business. One person speculated about the criteria list that companies use when considering relocation decisions. The developer questioned, "Can you imagine seeing a company's response when it sees uranium mining and milling on that list?"

### **Safety and the Environment**

Even when probed about economic development, people raised topics related to safety and impacts on the environment regularly during the interviews. These were mostly split into two types of comments. First, mentioned regularly were general concerns for the safety of those living and working in the region, as well as speculation about accidents or noncompliance with environmental and safety protocols. Second, community developers were more focused on the issues of perception about safety and environmental impacts and how that would affect those vacationing in or relocating to the area.

### **Community Benefits**

Another theme that surfaced during interviews was what benefits would the uranium mine and mill offer to the community. Those voicing support, ambivalence, and opposition all commented that the community would see little reward from the uranium mine and mill. Instead, positive financial impacts would end up with a few landowners and the uranium company. There were questions about where the revenue from the mining would end up. Although some viewed this as a negative, saying "the community

takes all the risk and gets no reward,” others just saw this as a fact. This is a point that RTI cannot accurately report until more decisions about the mine and mill are made public. However, it is a question that economic development professionals can ask as more information is available.

### **Not Enough Information**

Several people added at the end of their comments that the lack of information was an obstacle to better understanding the implications, both positive and negative, of uranium mining and milling from economic development. As an interviewee noted, “there are just too many unknowns.” Reports from RTI and VUI should help address some of these unknowns or better inform additional questions for economic developers to ask.

#### ***A.5.2.5 Government-Related Concerns***

When discussing the place of government in relation to the proposed mine and mill, most people felt the state and federal government should protect the people through regulating and monitoring the activities at the mine and mill. Probably to no one’s surprise, participants also expressed some skepticism about the government’s ability to execute these tasks fully. A few participants suggested that the effectiveness of government’s oversight depends on knowing which regulations need to be in place and having the resources available to effectively monitor and enforce any regulations. A few participants cited incidents like the Gulf Coast oil spill, however, as evidence that the government does not always meet these conditions. Participants also voiced concern that government at the state and federal levels does not always have priorities and interests that align with the interests of the local communities.

In terms of the decision to allow uranium mining in Virginia, interview and focus groups participants expressed some doubt about the fairness of the process. Some people thought that people not from the region, but in Richmond, would be making the decision. A few participants also expressed concern that the amount of money at stake from mining the uranium would attract lobbyists and politicians to the issue and somehow corrupt the decision process.

Eminent domain was also brought up by one participant as a concern, fearing that land could potentially be taken from citizens to protect mining interests in the area or for future mining by the government.

#### ***A.5.2.6 Community-Related Concerns***

Participants in the research expressed some concerns for the effect of the mine on the organization and functioning of the local communities. Participants’ most significant concern was negative population growth if the mine were to open. Several participants said they had talked with or heard of people say they would move away from the area if the mine were to come, potentially leading to further decreases in home values in the areas near the mine. A couple of participants suggested that only the elderly and poor would remain in the areas around the mine, because they could not afford to move away.

Potentially countering this loss were suggestions that new workers would be coming into the community to support the mine. This influx could increase the number of educated and high income

families in the community. Others, however, questioned whether the more highly educated or skilled workers would want to live in the communities closest to the mine, such as Chatham or Gretna, preferring instead to live in larger communities like the cities of Danville and Lynchburg.

One participant voiced concern that the current infrastructure in the area, particularly for roads, would be insufficient to support the mines and roads would need to be widened to support increased trucking.

#### **A.5.2.7 Potential Benefits to Communities from the Mine and Mill**

Although we discussed some benefits of the mine and mill in relation to jobs and economic concerns, below is a more comprehensive list of the potential benefits of opening the mine as identified by participants:

- *Jobs and Economy.* Several individuals felt the mine and mill could provide much needed jobs to the community until other industries can take hold in the region. Also, the mine would promote growth in complementary industries such as construction, hauling, trucking, supplies, and support services. One person suggested the region could become a center for energy development.
- *Energy-Related Benefits.* A few people identified with the idea that the mine and mill would support U.S. energy independence goals, because increased nuclear energy in the United States can help reduce energy costs and provide safe and clean energy for the country.
- *Real Estate Values.* Another hope was that new jobs related to the mine would result in new home purchases that would help maintain or increase housing values.
- *Improvement to Infrastructure.* Improvement to roads, railroad lines, and airport, if needed to support mining business, would improve the region and support other growth.
- *Government.* Increased tax revenues would hopefully support local schools and services.
- *Communities.* Towns could grow from new workers and their families locating to the area.
- *Tourism.* People may be interested in the mine and may come to the area to see and study it.

#### **A.5.2.8 Questions about the Mine and Mill**

Throughout the discussion of concerns and benefits of the mine and mill, participants voiced a variety of explicit and implicit questions or uncertainties as well. Below is a comprehensive list of these questions in order of frequency discussed:

- *How do we get enough information to make an informed decision?* Far and away, the most common questions revolved around the lack of adequate information and participants not feeling educated enough to make a smart decision. They wondered where they could get well-rounded, unbiased information and what kind of information the various studies might produce. An important subtheme that emerged here is how they might determine if bringing the mine or mill to the area will be worth the benefits or risks. Participants wanted to know the pros and cons (or positives and negatives) to better understand the big picture of how the mine or mill would affect their community. Some participants wanted proof or a guarantee of



safety before they would feel confident. Participants also wondered what sources they can trust for information about this issue.

- *How does the mining or milling actually work?* Many participants have questions about the general workings of the mine or mill, including the following: why do they need to mine the uranium; how is mining done; how is the uranium stored, as well as transported, safely; what will happen to the displaced dirt, the waste, and the tailings; how will technology be updated to keep the operation safe; how deep will they mine; what will be the visual impact on the landscape; and why did they choose this area rather than a less populated area.
- *What are the health and safety risks of contamination?* General safety and health questions are a high priority for participants. Many questions center around the fear that the mining or milling might lead to contamination of the area (potentially due to radioactivity) and participants wonder if this could cause health concerns such as cancer or birth defects, health problems for local livestock/agriculture, and contamination fears from ingesting local produce. There is also uncertainty about if some people might be more vulnerable or susceptible to health problems than others and if this could result in an increase in health insurance or health-care costs. Participants want to know what protective gear workers would receive and safeguards at the plant that could contain health threats in case of a natural disaster.
- *What kind of jobs and staffing opportunities will it bring?* In addition to how many jobs the operation would create, participants wondered if the company would hire local workers for all those positions or if they would bring their own people. Worker qualifications, pay scales, and if positions would be full time or part time are also uncertainties.
- *What will be the environmental impact?* Participants questioned what the effect on water quality will be if the operation takes place and what effect it will have on the landscape. Many wondered if the uranium or by-products remain in the displaced dirt and how far potential contaminants could travel in the water, soil, or dust in the air.
- *What will be the economic impact?* Questions about both the positive and negative economic effects were raised. Fearing negative repercussions, some participants questioned if the property will be worth anything when the operation moves in, what will happen to farmers if their land is destroyed, and if industries will move to an area with uranium mining. To the more beneficial economic possibilities, some wonder what the net economic gain would be and how long the economic benefits would be projected to last. People also questioned whether this would be a viable operation 5 to 10 years from now.
- *How will the operation be regulated?* There is quite a bit of uncertainty around how the mine and milling operation will be regulated, by whom, and who will be responsible for “cleaning it up” safely and appropriately. One participant questioned if it will even be feasible to mine with all the regulations they will have to adhere to, while another person wondered if uranium mining has been banned anywhere. Who, if anyone, would help the community recover if it has negative repercussions on the land, the economy, or the environment is also unclear.
- *What will be the impact on our community?* Only a few participants posed questions specifically about the effect the mine and mill could have on the community. Some were unsure if people will stay in the area or if they will move away because of the negative stigma. Others wondered if this will be an issue for the area sooner or later, regardless of the outcome for this proposed operation. Other community-related questions include do citizens

have a right to vote on it, how will it affect Main St., and how will this affect the value of rental properties in the community.

- *Other questions.* A few other topics were discussed by a few participants and merit a brief discussion here. First, participants have questions about other mining operations, including where else has uranium been mined, are they populated areas, what safeguards were used, and what were the impacts there? The timeline is also a source of confusion; some participants were unsure of how long it will take or remain in the area, if mining has already begun, and when uranium was discovered in the area. A few participants expressed a lack of information about the company proposing the mining and milling operation, asking who are they, where are they located, and who are their funders or investors. Lastly, there were one or two questions asking if the community should be concerned about terrorism or the production of bombs resulting from uranium mining.

### A.5.3 Results from the Structured Questionnaire

The following are the results of the structured questionnaire completed by 63 individuals participating in the key stakeholder and focus group research, organized by economy, environment, and community. Note that we used an 11-point scale (–5 to +5), where negative numbers indicate a negative impact to a particular attribute of the community and positive numbers indicate a positive impact. Using this scale, the positive mean indicates a net perceived benefit to the community and a negative mean indicates a perceived negative benefit.

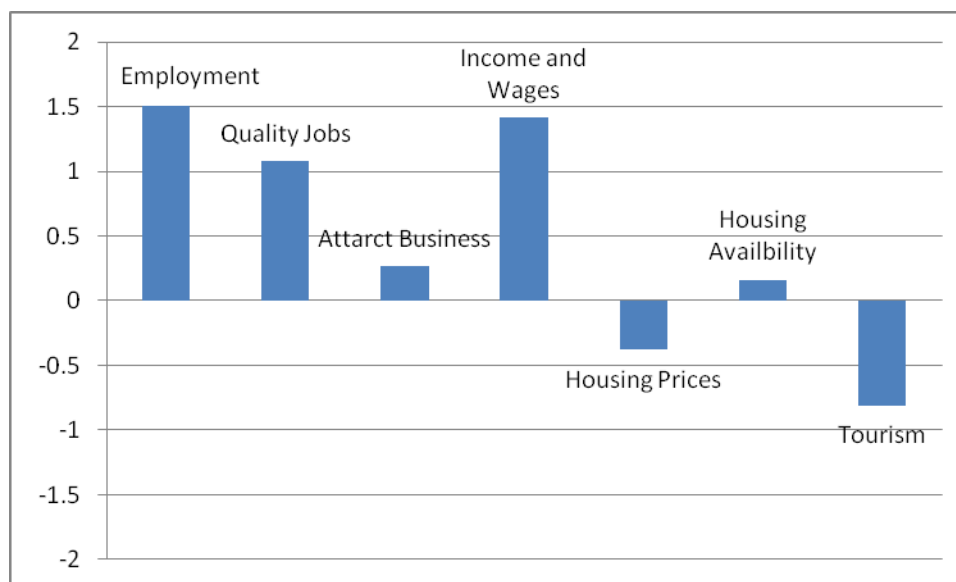
#### A.5.3.1 Ratings of Economic Impacts

Table A-4 shows the count, mean, and standard deviation for each item rated under the economy domain. Note that a count of less than 63 indicates that individuals failed to rank a specific item.

**Table A-4. Rating of Economic Impacts**

Economy	Count	Mean	Standard Deviation
Employment	63	1.51	3.35
Quality jobs	63	1.08	3.37
Attract and retain businesses	63	0.27	3.43
Income and wages	63	1.42	3.23
Housing prices/ rent	63	–0.38	3.21
Housing availability	62	0.16	2.60
Tourism	63	–0.81	3.05

The high standard deviation values suggest considerable variation in how individuals rated the items. Figure A-1 provides an alternative graphical display of the means rating of each item.

**Figure A-1. Economic Impacts Ratings**

Although most expectations are for positive economic benefits if the mine and mill are opened, particularly for employment and wages, people noted the negative expectations for both housing and tourism.

#### **A.5.3.2 Rating of Environmental Impacts**

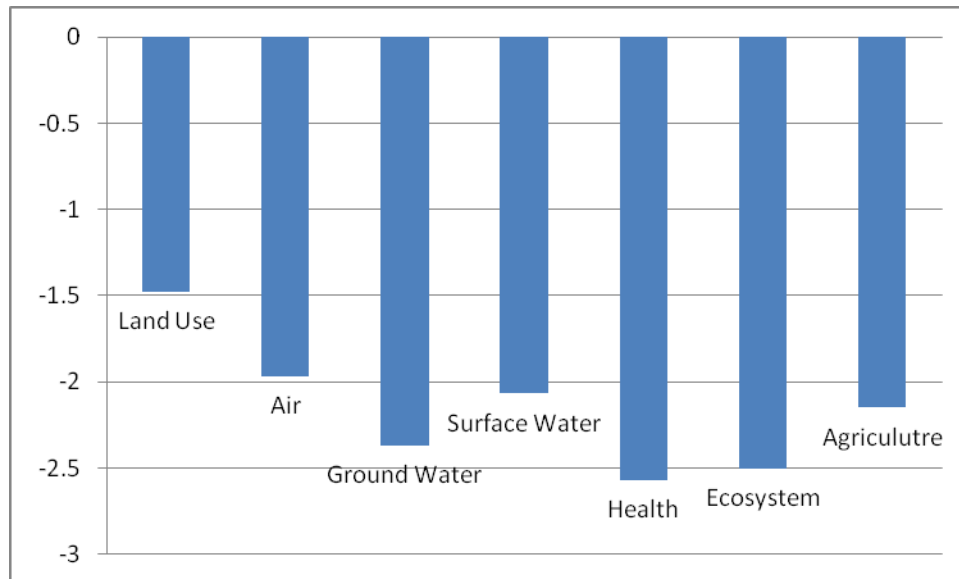
Table A-5 shows the count, mean, and standard deviation for each item rated under the environment domain.

**Table A-5. Rating of Environmental Impacts**

Environment	Count	Mean	Standard Deviation
Land use and aesthetic (changes in landscape from new facilities and buildings for the mine)	61	-1.48	3.00
Air (dust, radiation, or particles in the air)	61	-1.97	2.94
Groundwater (use of water resource—quantity or quality)	60	-2.37	2.87
Surface water (flow or temperature change in drinking water)	60	-2.07	2.82
Human health (dust, radiation)	60	-2.57	2.80
Ecosystem (habitat)	60	-2.50	2.72
Agricultural (crops and livestock)	61	-2.15	2.82

In contrast to the economic ratings, participants seemed to agree that the environmental impacts would be negative, as shown in Figure A-2. In particular, participants saw negative impacts for health, the ecosystem, and water.

**Figure A-2. Environmental Impacts Ratings Graph**



### A.5.3.3 Community Ratings

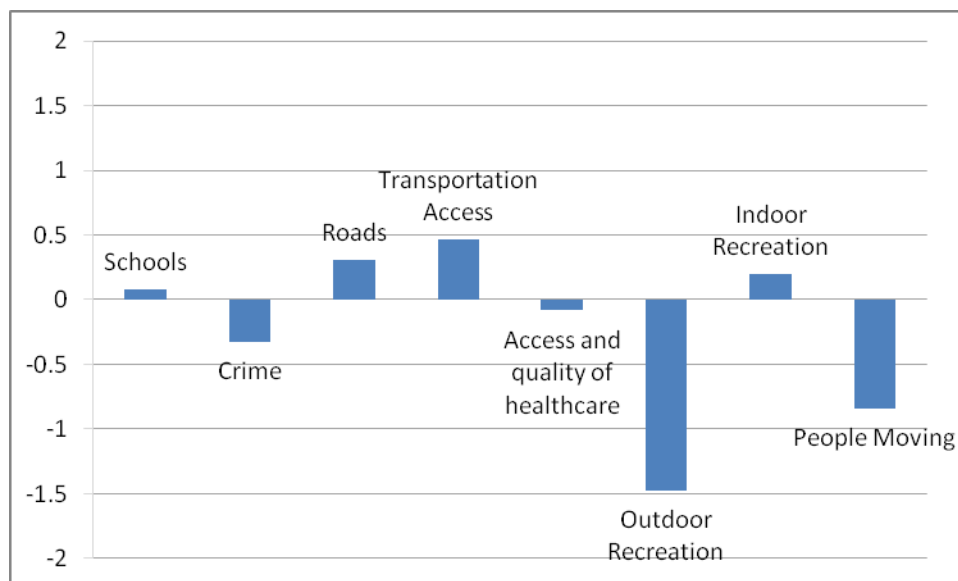
Table A-6 shows the count, mean, and standard deviation for each item rated under the community domain.

**Table A-6. Rating of Community Impacts**

Community	Count	Mean	Standard Deviation
Schools and/or educational system	63	0.08	3.11
Crime and safety	62	-0.32	2.13
Roads	62	0.31	2.47
Transportation access (connectivity to highways, airports, rail etc.)	62	0.47	2.51
Access and quality of health care	62	-0.08	2.89
Outdoor recreation (parks, hunting, fishing, hiking, golf courses etc.)	63	-1.48	3.02
Indoor recreational activity (movies, street fairs, community events, museums, etc.)	62	0.19	2.30
People moving to the community/region	63	-0.84	3.54

In terms of impact to the community, the positive impacts were seen as minimal, while there could be significant negative impacts to outdoor recreation and people moving to the region (see also Figure A-3).

**Figure A-3. Community Impacts Ratings Graph**



#### **A.5.3.4 Ranking of Importance of Economy, Environment, and Community**

Fifty-seven of the participants completed the ranking task where they were asked to rank the importance of the environment, economy, and community when considering the mine and mill. Environment was ranked the highest (mean = 1.6), followed by economy (mean = 2.1), and community (mean = 2.3).

## **A.6 Summary of Findings**

The research described in this report is qualitative in nature and presents the knowledge, views, and attitudes of a small convenience sample of individuals from the Southside area of Virginia. Thus, the findings from this report should not be seen as representative of all people within the region. What it does provide is a cross section of views and opinions that helps us better understand the set of issues shaping people's understanding and dialogue around the proposed Coles Hill uranium mine and mill.

For those involved in the interviews and focus groups conducted in the Southside region, the issues associated with potentially mining and milling uranium near their communities are varied and challenging and have fostered sincere introspection as to what is best and fair for their communities. For a subset of people we interviewed no risk from the mine or mill was acceptable in their minds.

Most participants shared some level of concern for the mine's potential impacts on human health; the environment, particularly in terms of quality and safety water; and the reputation of their communities as nice places that people would want to live (and potentially work). As to the questions that have arisen

out of this dialogue, at the base level, participants wanted to know and understand what they needed to be concerned about:

- How likely is it that contaminants from the mine or mill will get into the water they drink and recreate in?
- What are the potential effects on people's health?
- What are the chances of some kind of catastrophic event involving uranium from the mine or mill?

In other words, they want know the absolute risks to themselves and others from living in an area where uranium is mined and milled.

At the same time, they are trying to evaluate these risks, largely through asking whether mining of uranium has occurred in other locations with a similar population and climate, as well as looking at promises of new technology and regulation to see if they are credible, particularly given knowledge of other environmental disasters, such as the Gulf Coast oil spill.

By and large, most people we talked with would prefer that uranium mining not take place in or around their communities. Yet the collapse of one industry after another in the region—textile, furniture, tobacco—has caused some to become economic realists, questioning whether the things they value most about their communities can be sustained given a lack of jobs and incomes that are needed to support those communities. We observed in many of the discussions that people were weighing the potential immediate benefits, primarily in the form of steady employment over the next 30 years, with alternative visions for economic growth of the community—ones that merge, perhaps optimistically, new, clean industries with a stewardship of the region's aesthetic and cultural resources.

Unanswered in the question of economic benefit is what the cost to the area's reputation will be from the mine and mill. Will introducing uranium mining to the region be at the cost of any current businesses or, perhaps more importantly, any future business? This question is hard to answer but is clearly part of discussions people in the community are having while trying to balance the pros and cons of the mine.

## A.7 References

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# ***Attachment A: Focus Group Recruitment Screener***

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## **Socioeconomic Impacts of the Proposed Coles Hill Uranium Mill and Mine**

### **Focus Group Telephone Screener**

Hello, my name is \_\_\_\_\_ calling from RTI International. You may have heard that a there is a group interested in mining and milling uranium that is found in Pittsylvania county.

We are looking to talk with individuals that live near the possible mine and get their opinions on what they think about this possible mine. To do this, we are holding discussion group with 6 to 9 other community members.

If you choose to participate you will receive \$50 as a thank you. The discussion group will last approximately 2 hours. When you come to the discussion group, you are not expected to know anything about uranium or the mine. We just want to hear your general opinions.

Would this be something you would be interested in participating in?

**If No:** Thank you for your time.

**If Yes:** Great. As part of this process, there are a few questions that I would like to ask you. It will only take a few minutes, is now a good time to chat?

**If Not:** When may be a good time to call you back?

**If Yes:** Great

1. (Record gender): Confirm if unsure
  - a. Female\_\_\_\_
  - b. Male\_\_\_\_\_

*Quota: At least 3 males and 3 females in each group.*

2. Do you, or any one in your immediate household work for Virginia Uranium, or any other mining or nuclear energy company?

- Yes → TERMINATE
- No → CONTINUE
- Don't Know → TERMINATE

3. Do you or any members of your immediate household work for the Danville Regional Foundation?

- Yes → TERMINATE
- No → CONTINUE
- Don't Know → TERMINATE

4. What is your age?\_\_\_\_\_ [Thank and end if under 18]

*Quota:*

- Ages 18–35, at least 3
- Ages 36–45, at least 3

5. What city do you live in? \_\_\_\_\_  
[Only residents of: Chatham, Gretna, Danville, Martinsburg, Lynchburg]

6. Which of the following categories best describes your income (before taxes) from all sources?

- Less than \$20,000
- 20,000–29,999
- \$30,000–39,999
- 40,000–49,999
- 50,000–59,999
- 60,000–79,999
- 80,000–100,000
- 100,000+
- Don't know
- Refused

7. What is the highest grade or year of school you have attended?

- Less than high school
- High School graduate
- Some college or technical school
- Four year college degree
- Advanced degree

8. What is your current work status?

- Working full time for pay
- Working part time for pay
- Full-time homemaker or family caregiver
- Retired
- Unemployed
- Student
- Other, please specify: \_\_\_\_\_

10. Which best describes your race or ethnicity ?

- American Indian or Alaska Native
- Asian
- Black or African American
- Hispanic or Latino?
- Native Hawaiian or other Pacific Islander
- White or Caucasian
- Some other race

11. How many years have you lived in or near Pittsylvania county? \_\_\_\_\_

12. Is anyone else in your household participating in this focus group?

- Yes → TERMINATE
- No → CONTINUE
- Don't Know → TERMINATE

**NOTE TO SCREENER: Only one person per household can participate in the interview.**

That is actually all the questions that I have for you. The discussion groups will take place at X Location on the following dates/ times:

Date/ time

Date/ time

Date/ time

Date/ time

Date/time

Date/ time

Date/time

Date/time

Are you able to participate on any of these dates/ times? [Circle date/ time available]

Can I get your full name? [Record full name:] \_\_\_\_\_

As the group approaches, we would like to give you a reminder. Would you prefer a phone call or email reminder?

If phone, confirm number: \_\_\_\_\_

If email, ask email address: \_\_\_\_\_

Thank you very much. We will be in touch with you soon to confirm the date and time.

SCRIPT FOR TELEPHONE CONFIRMATION HERE:

LANGUAGE FOR EMAIL CONFIRMATION HERE:

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# ***Attachment B: Focus Group Informed Consent***

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## **Socioeconomic Impact Analysis of Proposed Coles Hill Uranium Mine and Mill**

Danville Regional Foundation (DRF) has contracted with RTI International to conduct a study of the social and economic impacts of the proposed Coles Hill Uranium Mine and Mill, located near the towns of Chatham and Gretna, in central Pittsylvania County, Virginia. The purpose of the study is to examine potential changes to the region as a result of the introduction of uranium mining, as well as to understand people’s concerns about the proposed mine and mill.

As part of this study, RTI will conduct eight focus group interviews with community members from the Southside region. Each focus group will last around two hours. An RTI moderator and note taker will conduct the focus groups, during which participants would discuss the community and people’s concerns and opinions about the proposed mine.

As someone living in the Southside region of VA, we would like to ask you to participate in a focus group. Participation is completely voluntary and you can stop participating at any time. For participating, you would receive \$50 dollars as compensation for your time.

We will keep the information shared in the focus group confidential to every extent possible and no personal identifying information would be passed on to the sponsors of this study. In reporting the information from the focus groups, we will share what we learned from everyone that participated in the groups and will not identify any individual participants.

There is no benefit to you for being a part of this study. However, the information collected as part of this study has the potential to inform people’s decision making around the introduction of uranium mining and milling. There is no physical risk to you for participating. While every effort will be taken to keep the information you share private, there is always the potential that someone else participating in the group would share what is said.

If you have questions about the focus groups, you can call or e-mail Jon Poehlman at 1-800-334-8571 extension 27068, [jpoehlman@rti.org](mailto:jpoehlman@rti.org). If you have any questions or concerns about your rights as a participant, you can call the Director of RTI’s Office of Research Protection toll-free at 1-866-214-2043.

Please sign below to acknowledge receipt of this information, and to indicate your willingness to participate in the focus group.

Name \_\_\_\_\_ Date \_\_\_\_\_



# Attachment C: Ethnographic Ranking Exercise

## Section 1. Economy

Please rate the overall impact you see the proposed uranium mine and mill as having on each of the areas listed in Column A. Circle the appropriate value in Column B, where -5 indicates a highly negative impact to the economy, 0 is neutral impact to the economy, and 5 is highly positive impact to the economy.

Once you have completed rating each item in column A, in Column C, please indicate with an "X" which item you see as most important in terms of potential economic impacts from the mine and mill

Column A	Column B	Column C
	Rate - 5 = a highly negative economic impact 0 = no economic impact + 5 = highly positive economic impact	Please check below the one item that you see as the most important economic consideration
Employment	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Quality jobs	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Attract and retain businesses	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Income and wages	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Housing prices/ rent	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Housing availability	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Tourism	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Other economic Impacts: _____	-5 -4 -3 -2 -1 0 1 2 3 4 5	

**Section 2. Environment**

Please rate the overall impact you see the proposed uranium mine and mill as having on each of the areas listed in Column A. Circle the appropriate value in Column B, where -5 indicates a highly negative impact to the environment, 0 is neutral impact to the environment, and 5 is highly positive impact to the environment.

Once you have completed rating each item in column A, in Column C, please indicate with an “X” which item you see as most important in terms of potential environmental impacts from the mine and mill

Column A	Column B	Column C
	Rate - 5 = a highly negative impact 0 = no impact + 5 = highly positive impact	Please check below the one item that you see as the most important environmental consideration
Land use and aesthetic (Changes in landscape from new facilities and buildings for the mine)	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Air (dust, radiation or particles in the air)	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Groundwater (use of water resource—quantity or quality)	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Surface water (Flow or temperature change in drinking water)	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Human health (dust, radiation)	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Ecosystem (habitat)	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Agricultural (crops and livestock)	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Other environmental impacts? _____	-5 -4 -3 -2 -1 0 1 2 3 4 5	



**Section 3. Community**

Please rate the overall impact you see the proposed uranium mine and mill as having on each of the areas listed in Column A. Circle the appropriate value in Column B, where -5 indicates a highly negative impact to the community, 0 is neutral impact to the community, and 5 is highly positive impact to the community.

Once you have completed rating each item in column A, in Column C, please indicate with an “X” which item you see as most important in terms of potential environmental impacts from the mine and mill

Column A	Column B	Column C
	Rate - 5 = a highly negative impact 0 = no impact + 5 = highly positive impact	Please check below the one item that you see as the most important community consideration
Schools and/or educational system	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Crime and safety	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Roads	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Transportation access (connectivity to highways, airports, rail etc.)	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Access and quality of healthcare	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Outdoor recreation (parks, hunting, fishing, hiking, golf courses etc)	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Indoor recreational activity (movies, street fairs, community events, museums, etc)	-5 -4 -3 -2 -1 0 1 2 3 4 5	
People moving to the community/region	-5 -4 -3 -2 -1 0 1 2 3 4 5	
Other community impacts? _____	-5 -4 -3 -2 -1 0 1 2 3 4 5	



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# Attachment D: Focus Group Moderator Guide

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## Socioeconomic Impacts of the Proposed Coles Hill Uranium Mine and Mill

### Focus Group Discussion Guide

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#### Research Questions:

1. What do people identify as or define as their community?
2. What things do people currently value about their community?
3. What do they see as the potential impacts to their community as a result of the introduction of uranium mining and milling in the region

#### Order of Events

Task	Time
<i>Consent and Ranking Questionnaire</i>	-10 to +10 Min
<i>Explanation of Study</i>	5 Min
<i>Introductions</i>	5 Min
<i>FG Discussion</i>	95 Min
<i>Closing</i>	5 Min
	120 Min

#### Explanation

##### A. Introduction

Good afternoon/evening! Thank you for taking the time to talk with us. My name is \_\_\_\_\_ and I work with RTI International. Assisting me is \_\_\_\_\_, also from RTI International.

##### B. Purpose

You are here today to take part in a discussion to find out your opinions and thoughts about proposed Uranium mining and milling to the Southside region. RTI has been commissioned by the **Danville Regional Foundation** to conduct a study to understand potential social and economic impacts from introducing Uranium mining and milling in the region. Our session will last about one and a half hours

### C. Procedural Details

Before we begin, we would also like to share some ground rules that will help make this discussion run smoothly.

- First, there are no right or wrong answers but rather differing points of view. Please feel free to share your thoughts and opinions even if they differ from what others have said. This also means that one of the main ground rules for our discussion is that all opinions are valued, no opinions are wrong and that everyone has a right to their own opinion. You may disagree with what someone has to say, but I ask that you let them have a chance to share their opinion.
- This leads us to our second principle, let's be sure to be polite to each other. That means we should make sure someone finishes talking before we make comments. This will help us make sure we get all your thoughts down. If several of you are talking at the same time, we'll miss some of your comments. So, please speak up, but only one person should talk at a time. Because we want everyone to have a chance to talk, at times we may ask someone to finish their comments, clarify something or share thoughts so that everyone can be heard and have chance to speak. We are very interested in what ALL of you have to say and want to be sure everyone has a chance to speak.
- Third, we would like to use everyone's first name, but we promise that no names will be attached to any comments in any reports we prepare. If you are more comfortable using a nickname, that is fine. Nevertheless, we cannot ensure that your comments will be completely confidential because they will be made in front of this group. Of course, only this group will know who said what in this group. We can assure you that we will NOT discuss your personal comments with anyone not involved in this project. We also ask everyone in the group, as part of participation, to keep what is said here in this room and not discuss others' comments outside of this group.
- We would also like to record our discussion. This will help us to be sure we don't miss anyone's ideas or comments. Of course, it is only for us and we won't share the recording with anyone outside of the research team and won't quote anyone in a way that will identify anyone. So we want to ask your permission to record. Is that okay with everyone?
- As a courtesy to everyone, **please turn off your beepers & cell phones** or place them on vibrate.
- If you need to go to the **restroom during the discussion, please feel free to leave**; however, I'd appreciate it if you would go one at a time.

Finally, before we begin I need to go over your rights as a participant on the discussion. You are free not to respond to any question, this applies to both the group discussion and the questionnaire. When you came in, each of you was asked to read and sign a form saying that you agree to take part in the study. Your signature means that you understand why you are here and agree to participate. Before we start, does anyone have any questions about any part of the study or is there anything about your participation that is unclear to you? (*Answer any questions that may be asked*). If you have any questions at any time during the study, please let us know. Your involvement in this study is completely voluntary and if at any time you are uncomfortable or do not wish to continue, you may stop.

Please put your name on the name cards in front of you to help us remember each other's names. Let's begin.

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## Discussion Guide

	Time (min)	Type	Question	Probes or Follow-Ups
	10	<b>Consent and Rating Questionnaire</b>		
	5	<b>Explanation of Study</b>		
1.	5	Introductions	Tell me your name and how long you have lived in the Southside region, and one thing you like about living in this area?	Do you picture yourself living in this area for the foreseeable future?
<b>Current state of the community- values, perceptions, strengths, challenges [no mine/mill]</b>				
2.	10	Key	What do you say is the most important thing that someone should know or understand about living in community/area [may define by research location or ask participants to clarify what they see as the community]? [Probe] The people, geography, history, culture, natural environment etc.?	3A. [Ask individually of participants] What things about this region are most important to you?
3.	2 ½	Transition	If someone asked you how things are in the community, would you say things are looking up for [name area], or things are looking down? <i>[If the proposed Uranium mine and mill, ask participants if they can hold their comments on the mine and mill, that you want to discuss it in detail at later point if that is okay]</i>	4A. Why do you say things are looking up/down?
4.	10	Key	What do you see as some of the challenge/ issues/ concerns you are facing in your community?	5A. [Probe:] Economy, quality of life, education, environment. 5B. Which of these do you think is most concerning? Why?
5.	5	Key	What do you see as some of the strengths of the community/region?	
6.	2 ½	Key	What do you think [area] will be like in 10 years? 20 years?	7A. What will be the main businesses or industries? 7B. What type of work will most people be doing? 7C. Where do you think most people will live? Rural/ urban? Towns? Cities?

7.	10	Transition	Now let's talk about the proposed Uranium mill and mine. What are people saying about the proposed mine and mill that is to be located in Cole Hill?			
8.	25	Key	What are your thoughts or concerns about the mine and mill?			
			ECONOMY	ENVIRONMENT	Quality of Life	Health and Safety
			<p><b>How do you think it will impact the local economy?</b></p> <p>1-A. Do you think jobs would be affected in any way?</p> <p>1-B. How do you think real estate/property values would change?</p> <p>1-C. What effects would it have on the agriculture industry in your community?</p> <p>1-D. How would business in the community be impacted?</p> <p>1-E. Do you think the proposed mill and mine would have an effect on new businesses moving to the area?</p>	<p><b>How do you think it will impact the environment?</b></p> <p>2-A. What concerns do you have about water quality?</p> <p>2-B. How do you think air quality would be affected?</p> <p>2-D. What effects, if any, do you see the proposed mine and mill as having on soil or crop lands?</p>	<p><b>How does it impact the quality of life in the region?</b></p> <p>3-A. Recreation/tourism? (e.g., fishing, hunting, sports, hiking), how would these change?</p> <p>3-B. Visual impacts? Do you think the community would look different? If so, what do you think it would look like?</p> <p>3-D. Would the proposed mill and mine detract from the look of your community? If so, in what way?</p> <p>3-F. Do you think having a mine in your community would change how people think about it? How so?</p>	<p><b>How do you think it will impact people's health?</b></p> <p>4-A. Do you think there would be any potential health effects? [If so,] what risks?</p> <p>4-B. Are there other risks that you associate with the mine?</p>

9.		Transition	Are there other issues or concerns that you have about the proposed mine and mill that we haven't discussed?	What are they? How do you think they would be impacted by the proposed mine and mill?
10.	5	Transition	If you could make sure one thing did not/or maybe did change in the community, if the mine and mill were to come, what would it be?	
11.	10	Key	Earlier we discussed what you liked about this area and that are important about it. How do you see these things changing if a mine and mill was to be located here?	
12.	5	Key	We also discussed what you saw as the future of this community (not including the proposed mine and mill). How does the proposed mine and mill affect that vision?	
13.	5	Key	Overall, do you think the mine and mill would help or hurt this community, or are you not sure?	
14.	5	Closing	Do you have any other points that you would like to add that did not come up in our discussion today?	
15.		Closing	Are there topics that we discussed here today that you have not personally thought about previously?	
<b>120</b>				





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# **Attachment E: Key Stakeholder Consent Form**

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## **Socioeconomic Impact Analysis of Proposed Coles Hill Uranium Mine and Mill**

Danville Regional Foundation (DRF) has contracted with RTI International to conduct a study of the social and economic impacts of the proposed Coles Hill Uranium Mine and Mill, located near the towns of Chatham and Gretna, in central Pittsylvania County, Virginia. The purpose of the study is to examine potential changes to the regions as a result of the introduction of uranium mining, as well as to understand people's concerns about the proposed mine and mill.

As part of this study, RTI will be conducting approximately 25 interviews with community members, business, and organizations in the Southside region. The interviews are to last 45 minutes to an hour. An RTI interviewer and note taker would conduct the interviews, during which participants would discuss the community and people's concerns and opinions about the proposed mine.

As someone living or working in the Southside region of VA, we would like to ask you to participate in an interview. Participating in an interview is completely voluntary and you can stop the interview at any time. The information you share in the interview will be kept confidential to every extent possible and no personal identify information will be passed on to the sponsors of this study. In reporting the information from the interviews, we will share what we learned from everyone that participated in the interviews and will not identify any individual participants.

There is no benefit to you for being part of this study. The information collected as part of this study has the potential to inform people's decision making around the introduction of uranium mining and milling. There is no physical risk to you for participating. While every effort will be taken to keep the information you share private, there is always the potential that someone from outside the study will view it.

If you have questions about the interview, you can call or e-mail Jon Poehlman at 1-800-334-8571 extension 27068, [jpoehlman@rti.org](mailto:jpoehlman@rti.org). If you have any questions or concerns about your rights as a participant, you can call the Director of RTI's Office of Research Protection toll-free at 1-866-214-2043.

Please sign below to acknowledge receipt of this information, and to indicate your willingness to participate in an interview.

Name \_\_\_\_\_ Date \_\_\_\_\_



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# Attachment F: Key Stakeholder Interview Guide

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## Key Stakeholder Interview Guide

Thank you for talking with me today. Your input is very important to us. Before we get started, I want to give you some background on what we're trying to accomplish. I'm/we are \_\_\_\_\_ from RTI, an independent non-profit organization that does social, health, economic, and environmental research. We have been commissioned by the **Danville Regional Foundation** to conduct a study to understand the social and economic impacts of potentially introducing Uranium mining and milling to the Southside region. We are conducting approximately twenty-five to thirty-five interviews with organizations and individuals in the community to learn about interests and concerns related to the proposed introduction of mining.

We would like to interview you as part of our study. Your participation in this interview would be completely voluntary and you are free not to answer any questions. We will ask you questions about:

- your organization and its role in the community;
- the community and region itself in terms of its strengths, weaknesses and its potential in the future; and
- your thoughts on how the proposed mine and mill might impact the region

We can also stop at any point. The interview would last approximately one hour.

There are no right or wrong answers to the questions we will be asking. Instead, we are interested in learning about your/your organization's perspective on the proposed mining. We will keep your direct responses confidential. Your name and other identifying information will not be used in any reports that result from our discussion today nor will we quote you. What we will do is report back themes from our interviews and focus groups in terms of findings and/or themes by type of organization/individual. Do you have any questions before we get started?

Okay, let's start.

Domain	Questions
<b>Organization and Role</b> Develop an understanding of the group, organization, or individual being interviewed and their role or position in the community.  ★ = Key Question	<b>1. ★Tell me about you/your [Name of the organization/business] and the type of work that it does?</b> <ul style="list-style-type: none"><li>• What is the organization's mission/business?</li><li>• How long has it been operating in this area?</li><li>• What does your organization provide to the community?</li></ul> <b>[If economic development professional]</b> <ul style="list-style-type: none"><li>• <i>What are the main roles and responsibilities of staff for supporting and</i></li></ul>

Domain	Questions
	<p style="text-align: center;"><i>growing the economy/Community Development?</i></p> <ul style="list-style-type: none"> <li>• <i>Who do you tend to work with in economic development related activities?</i></li> </ul> <p><b>2. What is your role in the organization?</b></p> <ul style="list-style-type: none"> <li>• How long have you been with [name or organization]?</li> <li>• What are your primary responsibilities?</li> <li>• Does your position require specific credentials or training?</li> </ul> <p><b>3. What is the geographic area that you serve?</b></p> <p><b>4. Who does your organization serve?</b></p>

Domain	Questions
<p><b>State of the Community</b></p> <p>Identify their view or understanding the community and what they see as some of its current strengths, weakness and issues or challenges.</p> <p><b>★ = Key Question</b></p>	<p><b>5. ★[ if applicable] What about this region is important to your organization/business and how its functioning?</b></p> <ul style="list-style-type: none"> <li>• Such as the people, the organizations, geography, history, culture, natural environment or other things that are important to your/your organization’s depends on to survive.</li> </ul> <p><b>6. What do you see as some of the strengths of the community/region in terms of living, working and raising a family here?</b></p> <p><b>7. ★What do you see as some of the current challenges for the community?</b></p> <p><i>[If the proposed Uranium mine and mill, ask the interviewee if they can hold their comments on the mine and mill, that you want to discuss it in detail at later point if that is okay]</i></p> <ul style="list-style-type: none"> <li>• Probe: Economy, quality of life, education, environment.</li> <li>• Which of these do you think is most important?</li> </ul>

Domain	Questions
	<ul style="list-style-type: none"> <li>• What are challenges that other members of the community would share?</li> </ul> <p><b>8. What do you say is the most important thing that someone should know or understand about this community/area?</b></p> <p><b>9. What do you think this community/area will be like in five years? 10 years?</b></p>

Domain	Questions
<p><b>Economic Interests</b></p> <p>Elucidate understanding of the economy its strengths and challenges for business development.</p> <p><b>★ = Key Question</b></p>	<p>Now I would like to ask you a few questions about the region’s economic development to get a better understanding of the current climate for creating jobs and starting businesses—aside from the potential mine.</p> <p><b>10. How would you describe your region’s/locality’s economy?</b></p> <ul style="list-style-type: none"> <li>• What are some of the most important industries?             <ul style="list-style-type: none"> <li>○ Which industries have done well?</li> <li>○ Which industries have not done well?</li> </ul> </li> <li>• Have you seen more jobs and opportunities coming to the region over the past 5 or 25 years? If so, what sectors have grown? Or do you think the region has tended to experience lower levels of job opportunities than before? If so, what sectors have experienced job losses?</li> <li>• How would you describe the region’s economy as compared to other similar regions nearby in Virginia and North Carolina?</li> <li>• When you talk to other businesses in the area, what are their views on the region’s economic situation?</li> </ul>

Domain	Questions
	<p><b>11. What are the region’s economic strengths for recruiting and retaining companies?</b></p> <ul style="list-style-type: none"> <li>• What are the region’s strengths for recruiting and retaining companies?</li> </ul> <p>Probe: Work force, labor costs, other costs of doing business, taxes, access to transportation routes etc, access to markets.  <i>What is the climate like for individuals starting their own businesses here?</i>  <i>Do you see many people doing this in the region?</i></p> <p><b>12. What are the challenges or weakness to growing this region economically?</b></p> <ul style="list-style-type: none"> <li>• What are the region’s biggest hurdles to creating more jobs and attracting/growing more companies?</li> </ul> <p><b>13. How do you think potential investors or workers outside the region considering doing business or relocating here perceive the area?</b></p>

Domain	Questions
<p><b>Position on the Mine</b></p> <p>Identify their organizations position and role in the proposed mine.</p> <p><b>★ = Key Question</b></p>	<p>Let’s discuss now the proposed Uranium mine and milling operation.</p> <p><b>14. Is your organization actively involved with discussions or decision-making about the proposed uranium mine and mill (“mine”)? If so, can you tell more about its role?</b></p> <p><b>15. ★ What is your/ your organization’s view of the proposed uranium mine and mill (“mine”)?</b></p> <ul style="list-style-type: none"> <li>• How was that position formulated? (e.g., via meetings, vote?)</li> <li>• Were there disagreements when formulating the organization’s position?             <ul style="list-style-type: none"> <li>○ [If yes] Can you share with us some of the issues that were part of the conversation.</li> </ul> </li> <li>• What were the majority’s reasons?</li> <li>• What were the dissenting views?</li> </ul>

Domain	Questions
	<p>16. Has you/your organization played an active role in supporting or opposing the mine? If so, what role? (e.g., passing out leaflets, writing editorials, making calls)</p>

Domain	Questions
<p><b>Community Response</b></p> <p>Determine the community response to the mine and key players so far in any debates?</p>	<p>17. So far, what do you think has been the community’s response to the proposed mine?</p> <p>18. What individuals/groups have been most vocal in discussing the mine?</p> <ul style="list-style-type: none"> <li>• What are their positions</li> </ul>

Domain	Questions
<p><b>View of Potential Impacts</b></p> <p>Develop a list of the potential impacts as understood by the organization and how they rank in terms of importance to the community.</p> <p>★ = Key Question</p>	<p>19. ★ In your/your organizations view, what are possible benefits of the proposed mine?</p> <ul style="list-style-type: none"> <li>• [If needed] Jobs, infrastructure, housing etc.</li> <li>• Do you have similar opinions, or do you personally think there are other potential benefits?</li> <li>• If you personally had to rank these potential benefits, what would you say are the top three, from 1 to 3 with 1 being highest?</li> <li>• Do you think your organization shares this view of potential benefits? Is it similar to what you are reading and hearing about from the wider community? Or is it different?</li> </ul> <p>20. ★ In your/your organizations view, what are the concerns about the proposed mine and mill?</p> <ul style="list-style-type: none"> <li>• [If needed] Environment, quality of life, etc.</li> <li>• In terms of concerns, how do your personal views match those of the organization?</li> </ul>

Domain	Questions
	<p><b>21. Earlier you told me what you valued about the area. How do you see these as changing if a mine was to be located here?</b></p> <p><b>22. Earlier you told me what you saw as strengths and/or challenges weaknesses about the region's economic climate. Do you think any of that would change if there was a mine and mill here?</b></p> <ul style="list-style-type: none"> <li>• <i>How would it change? (changes in employment growth, different sectors growing or declining?)</i></li> </ul> <p><b>23. ★Overall, do you think the mine will help or hurt the community? Why do you say that?</b></p> <ul style="list-style-type: none"> <li>• If you could make sure one thing did not/or maybe did change in the community, if the mine were to come, what would it be?</li> </ul> <p><b>24. Earlier I asked you about the future of the community. How does the proposed mine and mill affect that vision?</b></p> <ul style="list-style-type: none"> <li>• What are you expectations of what would happen with the mine?</li> </ul> <p><b>25. What role do you see as the mine's role in the long-term development of the region?</b></p> <ul style="list-style-type: none"> <li>• In 25 or so years, do you have any concerns about the community once the mine closes?</li> </ul>

Domain	Questions
Closing	<p><b>26. Do you have any other points that you think is important for RTI to understand as it performs this independent assessment to determine potential impacts for the mine?</b></p> <p><b>27. Are there others groups or individuals that you think are important for us to talk to?</b></p>



Domain	Questions
	<b>28. Is there anything that you would like to add that we did not get to touch on during this conversation?</b>

Thank you for talking with us today. If we had any follow-up questions at a later point, would you be willing to talk to us again.

Yes

No

Thanks.



## **Attachment G: Focus Group Participant Characteristics**

### **Martinsville, VA**

<b>Name</b>	<b>Gender</b>	<b>Age</b>	<b>City Live In</b>	<b>HH Income</b>	<b>Education</b>	<b>Employment</b>	<b>Race/Ethnicity</b>	<b>Yrs. Lived in Pittsylvania Co. Area</b>
Participant 1	F	27	Martinsville	<20K	Some Coll/Tech	Student	WH	27
Participant 2	M	49	Martinsville	<20K	Some Coll/Tech	UN	WH	49
Participant 3	F	24	Martinsville	30–40K	< HS	HM	WH	24
Participant 4	M	58	Martinsville	20–30K	Post Grad	Takes care of mother	WH	58
Participant 5	M	61	Martinsville	30–40K	Some Coll/Tech	Ret	AA	61
Participant 6	F	50	Martinsville	30–40K	College	FT	WH	40+
Participant 7	M	66	Martinsville	30–40K	College	Ret	WH	50+
Participant 8	M	20	Martinsville	<20K	Some Coll/Tech	Student	WH	20

### **Danville, VA**

<b>Name</b>	<b>Gender</b>	<b>Age</b>	<b>City Live In</b>	<b>HH Income</b>	<b>Education</b>	<b>Employment</b>	<b>Race/Ethnicity</b>	<b>Yrs. Lived in Pittsylvania Co. Area</b>
Participant 1	F	33	Danville	30–40K	College	FT	AA	33
Participant 2	F	53	Danville	<20K	Some Coll/Tech	FT—Student	AA	53
Participant 3	M	42	Danville	80–100K	College	FT	WH	18
Participant 4	F	57	Danville	<20K	HS	FT	AA	57
Participant 5	M	20	Danville	<20K	Some Coll/Tech	Student	WH	15
Participant 6	M	20	Danville	<20K	Some Coll/Tech	Student	WH	20
Participant 7	M	48	Danville	<20K	HS	PT	Native Am/ Alaskan	48

## South Boston, VA

Name	Gender	Age	City Live In	HH Income	Education	Employment	Race/ Ethnicity	Yrs. Lived in Pittsylvania Co. Area
Participant 1	M	40	South Boston	30–40K	College	FT	WH	25
Participant 2	F	58	South Boston	30–40K	PG	FT	WH	58
Participant 3	M	19	South Boston	<20K	Some Coll/Tech	FT student	WH	19
Participant 4	F	50	South Boston	40–50K	PG	FT	WH	40
Participant 5	F	36	South Boston	60–80K	PG	HM	WH	41
Participant 6	M	50	South Boston	<20K	HS	UN	AA	25

## Gretna, VA

Name	Gender	Age	City Live In	HH Income	Education	Employment	Race/ Ethnicity	Yrs. Lived in Pittsylvania Co. Area
Participant 1	F	40	Gretna	30–40K	Some Coll/Tech	FT	WH	40
Participant 2	F	38	Gretna	20–30K	HS	FT	AA	38
Participant 3	F	64	Gretna	<20K	Some Coll/Tech	Ret	WH	60
Participant 4	M	69	Gretna	20–30K	Some Coll/Tech	Ret	WH	69
Participant 5	M	68?	Gretna	20–30K	Some Coll/Tech	FT	AA	60
Participant 6	M	59	Gretna	30–40K	College	FT	WH	50+
Participant 7	M	67	Gretna	20–30K	Some Coll/Tech	Ret	WH	67

**Gretna, VA**

Name	Gender	Age	City Live In	HH Income	Education	Employment	Race/ Ethnicity	Yrs. Lived in Pittsylvania Co. Area
Participant 1	M	33	Gretna	<20K	College	PT	AA	22
Participant 2	M	29	Gretna	30–40K	Some Coll/Tech	FT	WH	29
Participant 3	M	73	Gretna	20–30K	HS	Ret	WH	60
Participant 4	F	67	Gretna	<20K	HS	Ret	WH	55
Participant 5	F	83	Gretna	<20K	HS	Ret	WH	83
Participant 6	M	60	Gretna	60–80K	HS	FT	WH	60

**Chatham, VA**

Name	Gender	Age	City Live In	HH Income	Education	Employment	Race/ Ethnicity	Yrs. Lived in Pittsylvania Co. Area
Participant 1	F	48	Chatham	<20K	Some Coll/Tech	FT	WH	48
Participant 2	F	82	Chatham	<20K	Some Coll/Tech	Ret	WH	60+
Participant 3	F	75	Chatham	<20K	College	Ret	AA	30+
Participant 4	M	64	Chatham	20–30K	Some Coll/Tech	Ret	AA	64
Participant 5	M	50	Chatham	<20K	HS	UN	WH	16
Participant 6	M	34	Chatham	30–40K	College	FT	WH	3.5
Participant 7	F	68	Chatham	20–30K	<HS	Ret	WH	5.5
Participant 8	F	40	Chatham	<20K	HS	UN	AA	40
Participant 9	M	70	Chatham	30–40K	Some Coll/Tech	PT	WH	12

## Chatham, VA

Name	Gender	Age	City Live In	HH Income	Education	Employment	Race/ Ethnicity	Yrs. Lived in Pittsylvania Co. Area
Participant 1	M	72	Chatham	20–30K	Some Coll/Tech	Ret	WH	72
Participant 2	M	64	Chatham	50–60K	College	FT	WH	64
Participant 3	M	33	Chatham	40–50K	College	FT	WH	11
Participant 4	M	72	Chatham	20–30K	HS	Ret	WH	72
Participant 5	F	62	Chatham	<20K	<HS	HM	AA	62
Participant 6	M	38	Chatham	30–40K	Some Coll/Tech	FT	WH	11
Participant 7	F	58	Chatham	20–30K	Some Coll/Tech	FT	AA	58
Participant 8	F	49	Chatham	<20K	Some Coll/Tech	FT	AA	49

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# ***Appendix C: Detailed Assumptions Used in the Water Balances Provided in Figures 3-8 and 3-9***

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## **C.1 Marline Water Balance Assumptions**

The following are key assumptions that were used in the Marline water balance:

- Values are given for the extraction and processing of 1,050,000 tons of ore per year.
- Net precipitation for runoff was calculated by assuming rainfall of 42 in/yr, evaporation of 9.5 in/yr, and zero percolation (pg. E.2-35, Marline Study).
- The settling ponds are designed to capture low or noncontaminated water that does not require radionuclide removal before discharge and was not explicitly included in the Marline preliminary water balance (Figure E.2-7) but is included here for completeness.
- The total for the site runoff value was not provided in the Marline study. The 775 gpm value used in this water balance was estimated by assuming that the site area was the “9T” area in the Marline topography map and 30-year average values for rainfall, evaporation, and percolation.
- The treatment pond is designed to hold all water with radionuclide levels that are too high for discharge (assumed to be an average of 100 pCi/L), for transport to the mill or the wastewater treatment plant.
- Water entering the mine site was estimated as follows:
  - Shallow Saprolite ground water indicates that radionuclide removal is not necessary (E.1.6.1 and Appendix IV in the Marline study), so the estimated 140 gpm are pumped and diverted to the settling pond.
  - The Chatham groundwater infiltration (92 gpm), which is contaminated due to its natural exposure to the ore body, is diverted to the treatment pond (pg. E.2-35, Marline study).
  - We assumed 20 gpm of mine water is to be used for dust suppression (Figure E.2-7, Marline study).
  - Mine runoff was calculated for an area of 110 acres.
- Runoff from tailings was estimated assuming an exposed area of 10 acres (Figure E.2-7, Marline study).

- Runoff from the mill area is assumed to be captured and returned to the mill for processing, and the milling site is designed to recycle water so that there is net demand of 115 gpm. The water lost to tailings is not included in the original overall Marline water balance but is shown in the mill process diagrams (see Figures E.2-5 and E.2-4 in Marline study), so it is included in Figure 3-8.
- Seepage through the tailings clay/soil liner is estimated to be 11 gpm (pg. B.2-23, Marline study).

## C.2 Revised Water Balance Assumptions

In addition to the rainfall modeling, the updated Coles Hill water balance was estimated using the following bounds and assumptions:

- Values are given for the extraction and processing of 1,050,000 tons of ore per year. Process flows are listed as average values, ignoring fluctuations.
- The wastewater treatment capacity of 300 gpm was used, based on the 2010 Virginia Uranium scoping study (pg. 16).
- Only the carbonate leaching water to tailings was included in this estimate, because the Virginia Uranium scoping study did a full estimate for only this case. This water balance assumes an under drain collection system is installed to collect all tailings drainage for treatment. Without this under drain, seepage/overflow from the tailings would constitute another discharge point.
- The value for makeup water to the mill (259 gpm) was obtained from the Virginia Uranium scoping study, which states a need of 270 gpm for 350 days/year (pg. 16). The 259 gpm is assumed to be constant and is reached from a combination of the two make-up streams as inputs to the mill.
- Water entering the mine is handled as follows:
  - Shallow saprolite ground water indicates that radionuclide removal is not necessary (E.1.6.1 and Appendix IV in the Marline study), which estimates a value of 140 gpm. A range of 0 to 140 gpm is given because infiltration is likely to slow significantly once initial dewatering occurs. This stream is assumed to be pumped and diverted to the settling pond as specified in the Marline study.
  - The Chatham groundwater infiltration (0 to 92 gpm), which is contaminated due to its natural exposure to the ore body, is diverted to the treatment pond (pg. E.2-35, Marline study).
  - Mine runoff was calculated for an area of 127 acres. No distinction is made between open pit and underground mining in the runoff calculation.
- Runoff area values for the tailings and mine were determined from the Marline site topography map, by importing the map into a geographic information system and georeferencing it to the appropriate location in Virginia. Each individual point source on the map was digitized and the area of each one was calculated in meters using the ArcGIS calculate geometry tool.



- The overall site runoff was assumed to be the same as in the Marline study, that is, the 9T area (381 acres).
- Two methods to estimate runoff were used in this water balance:
  - To be consistent with the methodology used in the Marline study, the conservative assumption (i.e., overestimation of water runoff) of zero percolation was used for the mine and tailings runoff. The ranges for net precipitation used in the water balance are bounded by the minimum (32 in/yr) and maximum (56 in/yr) annual rainfall data and an evaporation value of 28 in/yr.
  - For the overall site runoff (the 9T area), runoff values that do include percolation into the soil were used. The range given (232 to 2,173 gpm) in the figure are bounded by the low 3.2 in/yr and maximum 14.4 in/yr values for runoff. These values were determined from the 30-year average of historical values (1976 to 2006).

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## ***Appendix B: Socioeconomic Data on the Coles Hill Region***

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This section contains tables of data supporting Section 2 of the report.

Table B-1. Population 2000 and 2010 by County

Jurisdiction	2000 Population	2010 Population	2001–2010 Change	% Change
<b>United States</b>	281,421,906	308,745,538	27,323,632	9.7%
<b>Virginia</b>	7,078,515	8,001,024	922,509	13.0%
Caswell County, North Carolina	23,501	23,719	218	0.9%
Person County, North Carolina	35,623	39,464	3,841	10.8%
Rockingham County, North Carolina	91,932	93,643	1,711	1.9%
Amherst County, Virginia	31,894	32,353	459	1.4%
Appomattox County, Virginia	13,705	14,973	1,268	9.3%
Bedford County, Virginia	60,371	68,676	8,305	13.8%
Campbell County, Virginia	51,078	54,842	3,764	7.4%
Charlotte County, Virginia	12,471	12,586	115	0.9%
Franklin County, Virginia	47,280	56,159	8,879	18.8%
Halifax County, Virginia	37,350	36,241	-1,109	-3.0%
Henry County, Virginia	57,933	54,151	-3,782	-6.5%
Mecklenburg County, Virginia	32,380	32,727	347	1.1%
Patrick County, Virginia	19,407	18,490	-917	-4.7%
Pittsylvania County, Virginia	61,747	63,506	1,759	2.8%
Roanoke County, Virginia	85,776	92,376	6,600	7.7%
Bedford City, Virginia	6,299	6,222	-77	-1.2%
Danville City, Virginia	48,411	43,055	-5,356	-11.1%
Lynchburg City, Virginia	65,269	75,568	10,299	15.8%
Martinsville City, Virginia	15,416	13,821	-1,595	-10.3%
Roanoke City, Virginia	94,911	97,032	2,121	2.2%
Salem City, Virginia	24,747	24,802	55	0.2%
<b>Total</b>	<b>917,501</b>	<b>954,406</b>	<b>36,905</b>	<b>4.0%</b>

Source: 2010 Census <http://www.census.gov/popfinder/>

**Table B-2. Population Density**

	<b>Population Density (people/sq mi)</b>
United States	87.4
Virginia	202.6
Caswell County, North Carolina	55.9
Person County, North Carolina	100.6
Rockingham County, North Carolina	165.3
Amherst County, Virginia	68.1
Appomattox County, Virginia	44.9
Bedford County, Virginia	91.0
Campbell County, Virginia	108.7
Charlotte County, Virginia	26.5
Franklin County, Virginia	81.1
Halifax County, Virginia	44.2
Henry County, Virginia	141.6
Mecklenburg County, Virginia	52.5
Patrick County, Virginia	38.3
Pittsylvania County, Virginia	65.4
Roanoke County, Virginia	368.2
Bedford City, Virginia	903.0
Danville City, Virginia	1,001.3
Lynchburg City, Virginia	1,542.2
Martinsville City, Virginia	1,261.0
Roanoke City, Virginia	2,310.3
Salem City, Virginia	1,699.9

**Table B-3. Population Projections for Region**

County or City	2010	2020	2030
Caswell County, North Carolina	23,719	23,944	24,171
Person County, North Carolina	39,464	43,931	48,308
Rockingham County, North Carolina	93,643	98,664	103,563
Amherst County, Virginia	32,353	33,166	33,923
Appomattox County, Virginia	14,973	14,713	15,254
Bedford County, Virginia	68,676	76,731	84,858
Campbell County, Virginia	54,842	54,948	57,023
Charlotte County, Virginia	12,586	12,170	12,170
Franklin County, Virginia	56,159	57,347	62,443
Halifax County, Virginia	36,241	33,836	33,821
Henry County, Virginia	54,151	52,979	52,977
Mecklenburg County, Virginia	32,727	32,511	32,755
Patrick County, Virginia	18,490	18,895	18,885
Pittsylvania County, Virginia	63,506	63,057	63,901
Roanoke County, Virginia	92,376	99,048	105,889
Bedford City, Virginia	6,222	5,966	5,965
Danville City, Virginia	43,055	45,711	46,025
Lynchburg City, Virginia	75,568	72,615	76,499
Martinsville City, Virginia	13,821	13,952	13,954
Roanoke City, Virginia	97,032	88,503	88,495
Salem City, Virginia	24,802	24,145	24,143
Total	954,406	966,832	1,005,022

Source: Virginia State Data Center [http://www.vawc.virginia.gov/analyzer/populatchoice.asp?cat=HST\\_DEMOG\\_POP&session=populat&time=&geo=](http://www.vawc.virginia.gov/analyzer/populatchoice.asp?cat=HST_DEMOG_POP&session=populat&time=&geo=)

North Carolina Office of State Budget and Management.

**Table B-4. Racial and Ethnic Composition of the Population, 2005–2009**

	Total	White Alone	Black or African American Alone	American Indian and Alaska Native Alone	Asian Alone	Native Hawaiian and Other Pacific Islander Alone	Some Other Race Alone	Two or More Races	Minority (Nonwhite) Population	Minority Share
United States	301,461,533	224,469,780	37,264,679	2,423,294	13,201,056	447,591	16,986,453	6,668,680	76,991,753	25.5%
Virginia	7,721,730	5,458,832	1,510,139	22,932	371,788	5,804	192,534	159,701	2,262,898	29.3%
Caswell County, North Carolina	23,228	14,764	7,930	111	11	11	181	220	8,464	36.4%
Person County, North Carolina	37,301	25,782	10,181	209	127	8	462	532	11,519	30.9%
Rockingham County, North Carolina	92,007	70,115	17,487	300	325	27	2,675	1,078	21,892	23.8%
Amherst County, Virginia	32,185	24,899	6,134	244	107	0	270	531	7,286	22.6%
Appomattox County, Virginia	14,218	10,907	3,234	0	37	0	0	40	3,311	23.3%
Bedford County, Virginia	65,916	59,993	4,058	84	535	16	362	868	5,923	9.0%
Campbell County, Virginia	52,542	43,630	7,456	75	362	0	22	997	8,912	17.0%
Charlotte County, Virginia	12,222	8,073	4,006	63	0	0	39	41	4,149	33.9%
Franklin County, Virginia	51,023	45,612	4,727	19	124	0	205	336	5,411	10.6%
Halifax County, Virginia	35,460	21,488	13,094	45	107	17	410	299	13,972	39.4%
Henry County, Virginia	55,480	40,428	12,278	0	279	0	1,869	626	15,052	27.1%
Mecklenburg County, Virginia	31,987	19,113	11,949	37	186	18	320	364	12,874	40.2%

(continued)

**Table B-4. Racial and Ethnic Composition of the Population, 2005–2009 (continued)**

	Total	White Alone	Black or African American Alone	American Indian and Alaska Native Alone	Asian Alone	Native Hawaiian and Other Pacific Islander Alone	Some Other Race Alone	Two or More Races	Minority (Nonwhite) Population	Minority Share
Patrick County, Virginia	18,755	17,279	1,182	44	46	0	72	132	1,476	7.9%
Pittsylvania County, Virginia	61,156	45,549	14,029	11	187	30	975	375	15,607	25.5%
Roanoke County, Virginia	89,905	81,775	4,554	203	2,110	8	485	770	8,130	9.0%
Bedford City, Virginia	6,291	4,514	1,604	0	41	0	4	128	1,777	28.2%
Danville City, Virginia	44,978	23,085	20,407	90	372	11	735	278	21,893	48.7%
Lynchburg City, Virginia	71,357	48,082	20,190	101	1,381	13	491	1,099	23,275	32.6%
Martinsville City, Virginia	14,660	7,755	6,088	50	113	0	444	210	6,905	47.1%
Roanoke City, Virginia	93,271	64,342	24,610	335	1,189	0	1,103	1,692	28,929	31.0%
Salem City, Virginia	25,139	22,776	1,691	32	201	0	75	364	2,363	9.4%
Total	929,081	699,961	196,889	2,053	7,840	159	11,199	10,980	229,120	24.7%

Source: U.S. Census Bureau, 2005–2009 American Community Survey

**Table B-5. Percentage of the Population with Income Below the Poverty Level**

	<b>Total</b>	<b>Income in the Past 12 Months below Poverty Level</b>	<b>% of Population with Income below Poverty Level</b>
United States	293,507,923	39,537,240	13.5%
Virginia	7,467,511	752,446	10.1%
Caswell County, North Carolina	21,672	4,539	20.9%
Person County, North Carolina	36,367	5,596	15.4%
Rockingham County, North Carolina	90,682	13,574	15.0%
Amherst County, Virginia	29,878	4,032	13.5%
Appomattox County, Virginia	14,131	1,634	11.6%
Bedford County, Virginia	65,576	5,380	8.2%
Campbell County, Virginia	51,864	5,937	11.4%
Charlotte County, Virginia	12,090	1,932	16.0%
Franklin County, Virginia	49,731	6,320	12.7%
Halifax County, Virginia	34,885	6,442	18.5%
Henry County, Virginia	54,819	9,570	17.5%
Mecklenburg County, Virginia	30,641	5,233	17.1%
Patrick County, Virginia	18,370	2,494	13.6%
Pittsylvania County, Virginia	60,349	9,070	15.0%
Roanoke County, Virginia	87,452	4,605	5.3%
Bedford City, Virginia	6,256	1,334	21.3%
Danville City, Virginia	42,798	^	23.6%
Lynchburg City, Virginia	62,959	13,219	21.0%
Martinsville City, Virginia	13,870	2,881	20.8%
Roanoke City, Virginia	91,294	16,958	18.6%
Salem City, Virginia	23,367	1,825	7.8%
<b>Total</b>	<b>899,051</b>	<b>132,694</b>	<b>14.8%</b>

Source: U.S. Census Bureau. 2005–2009 American Community Survey 5-Year Estimates



**Table B-6. Educational Attainment**

	Total	8th Grade or Less	% 8th Grade or Less	HS, No Diploma	% HS, No Diploma	HS Diploma	%HS Diploma	Some College, no Degree	% Some College	Associates Degree	%Associate's Degree	Bachelors Degree	% Bachelors Degree	Graduate or Professional Degree	% Graduate or Professional Degree
United States	197,440,772	12,550,193	6.4	17,894,984	9.1	57,861,698	29.3	40,105,283	20.3	14,663,437	7.4	34,384,717	17.4	19,980,460	10.1
Virginia	5,092,358	282,123	5.5	442,628	8.7	1,339,669	26.3	987,934	19.4	337,026	6.6	1,010,306	19.8	692,672	13.6
Caswell County, North Carolina	16,386	1,256	7.7	2,839	17.3	6,158	37.6	3,217	19.6	1,082	6.6	1,307	8.0	527	3.2
Person County, North Carolina	25,544	,628	6.4	3,199	12.5	10,001	39.2	4,968	19.4	2,334	9.1	2,473	9.7	941	3.7
Rockingham County, North Carolina	64,016	6,048	9.4	9,600	15.0	22,984	35.9	12,863	20.1	4,522	7.1	6,054	9.5	1,945	3.0
Amherst County, Virginia	21,699	1,990	9.2	2,526	11.6	7,785	35.9	4,318	19.9	1,400	6.5	2,280	10.5	1,400	6.5
Appomattox County, Virginia	9,846	833	8.5	1,347	13.7	4,010	40.7	1,877	19.1	525	5.3	862	8.8	392	4.0
Bedford County, Virginia	46,145	1,926	4.2	5,018	10.9	14,991	32.5	10,172	22.0	3,218	7.0	6,984	15.1	3,836	8.3
Campbell County, Virginia	36,201	2,438	6.7	3,912	10.8	12,964	35.8	8,009	22.1	3,019	8.3	4,341	12.0	1,518	4.2
Charlotte County, Virginia	8,397	1,065	12.7	1,395	16.6	2,897	34.5	1,482	17.6	456	5.4	759	9.0	343	4.1
Franklin County, Virginia	35,793	3,278	9.2	4,214	11.8	13,157	36.8	7,432	20.8	2,576	7.2	3,264	9.1	1,872	5.2
Halifax County, Virginia	24,916	2,991	12.0	4,045	16.2	8,960	36.0	4,118	16.5	1,749	7.0	1,674	6.7	1,379	5.5
Henry County, Virginia	39,464	4,801	12.2	6,651	16.9	13,175	33.4	7,262	18.4	3,286	8.3	2,769	7.0	1,520	3.9

(continued)

Table B-6. Educational Attainment (continued)

	Total	8th Grade or Less	% 8th Grade or Less	HS, No Diploma	% HS, No Diploma	HS Diploma	%HS Diploma	Some College, no Degree	% Some College	Associates Degree	%Associate's Degree	Bachelors Degree	% Bachelors Degree	Graduate or Professional Degree	% Graduate or Professional Degree
Mecklenburg County, Virginia	23,197	2,153	9.3	3,712	16.0	8,806	38.0	4,203	18.1	1,349	5.8	1,945	8.4	1,029	4.4
Patrick County, Virginia	13,614	1,711	12.6	1,911	14.0	4,845	35.6	2,458	18.1	1,264	9.3	1,042	7.7	383	2.8
Pittsylvania County, Virginia	42,956	4,193	9.8	6,198	14.4	15,680	36.5	7,719	18.0	3,583	8.3	3,818	8.9	1,765	4.1
Roanoke County, Virginia	61,777	2,391	3.9	4,337	7.0	16,241	26.3	13,842	22.4	5,179	8.4	13,098	21.2	6,689	10.8
Bedford City, Virginia	4,075	240	5.9	407	10.0	1,254	30.8	1,041	25.5	298	7.3	622	15.3	213	5.2
Danville City, Virginia	31,339	2,963	9.5	5,018	16.0	9,431	30.1	6,467	20.6	2,545	8.1	3,077	9.8	1,838	5.9
Lynchburg City, Virginia	42,904	2,641	6.2	4,822	11.2	12,408	28.9	8,710	20.3	2,274	5.3	7,449	17.4	4,600	10.7
Martinsville City, Virginia	10,273	1,236	12.0	1,525	14.8	2,906	28.3	2,082	20.3	700	6.8	1,265	12.3	559	5.4
Roanoke City, Virginia	65,612	4,496	6.9	8,045	12.3	20,380	31.1	13,765	21.0	4,569	7.0	9,407	14.3	4,950	7.5
Salem City, Virginia	16,929	796	4.7	1,516	9.0	5,475	32.3	3,534	20.9	1,162	6.9	2,770	16.4	1,676	9.9
Total	641,083	51,074	8.0	82,237	12.8	214,508	33.5	129,539	20.2	47,090	7.3	77,260	12.1	39,375	6.1

Table B-7. Employment in 2001, 2005, 2009 by Sector

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
United States	10	Total	129,635,800	131,571,623	128,607,842	-1,027,958	-0.8%
	10	Public Sector Total	20,330,998	20,960,607	21,660,738	1,329,740	6.5%
	10	Private Sector Total	109,304,802	110,611,016	106,947,104	-2,357,698	-2.2%
	11	Agriculture, Forestry, Fishing and Hunting	1,170,570	1,163,629	1,142,192	-28,378	-2.4%
	21	Mining, Quarrying, and Oil and Gas Extraction	535,189	560,416	641,366	106,177	19.8%
	22	Utilities	599,899	550,593	560,713	-39,186	-6.5%
	23	Construction	6,773,512	7,269,317	5,948,837	-824,675	-12.2%
	31–33	Manufacturing	16,386,001	14,190,394	11,810,371	-4,575,630	-27.9%
	42	Wholesale Trade	5,730,294	5,752,802	5,561,787	-168,507	-2.9%
	44–45	Retail Trade	15,179,753	15,256,340	14,544,111	-635,642	-4.2%
	48–49	Transportation and Warehousing	4,138,146	4,098,553	3,985,037	-153,109	-3.7%
	51	Information	3,591,995	3,056,431	2,807,721	-784,274	-21.8%
	52	Finance and Insurance	5,642,689	5,912,592	5,618,477	-24,212	-0.4%
	53	Real Estate and Rental and Leasing	2,036,285	2,125,259	1,971,344	-64,941	-3.2%
	54	Professional, Scientific, and Technical Services	6,871,441	7,055,427	7,479,760	608,319	8.9%
	55	Management of Companies and Enterprises	1,716,130	1,743,214	1,855,139	139,009	8.1%
	56	Administrative and Support and Waste Management and Remediation Services	7,737,320	8,071,211	7,153,937	-583,383	-7.5%
	61	Educational Services	1,883,564	2,144,340	2,419,382	535,818	28.4%
	62	Health Care and Social Assistance	12,966,103	14,335,141	15,902,253	2,936,150	22.6%
	71	Arts, Entertainment, and Recreation	1,784,330	1,867,996	1,921,653	137,323	7.7%
72	Accommodation and Food Services	10,100,636	10,871,471	11,079,375	978,739	9.7%	
81	Other Services (except Public Administration)	4,206,345	4,324,015	4,369,780	163,435	3.9%	
99	Unclassified	254,603	261,876	173,872	-80,731	-31.7%	

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Study Area	10	Total	392,784	376,986	358,293	-34,491	-8.8%
	10	Public Sector Total	53,846	55,501	57,224	3,378	6.3%
	10	Private Sector Total	338,938	321,485	301,069	-37,869	-11.2%
	11	Agriculture, Forestry, Fishing and Hunting	1,012	670	640	-372	-36.8%
	21	Mining, Quarrying, and Oil and Gas Extraction	39	0	0	-39	-100.0%
	22	Utilities	511	666	573	62	12.1%
	23	Construction	16,312	14,121	11,464	-4,848	-29.7%
	31–33	Manufacturing	91,438	70,546	51,951	-39,487	-43.2%
	42	Wholesale Trade	7,708	10,219	10,226	2,518	32.7%
	44–45	Retail Trade	51,840	49,334	45,547	-6,293	-12.1%
	48–49	Transportation and Warehousing	10,667	10,053	9,174	-1,493	-14.0%
	51	Information	5,305	4,575	4,329	-976	-18.4%
	52	Finance and Insurance	12,979	12,867	11,464	-1,515	-11.7%
	53	Real Estate and Rental and Leasing	4,023	4,131	3,962	-61	-1.5%
	54	Professional, Scientific, and Technical Services	11,342	10,062	12,474	1,132	10.0%
	55	Management of Companies and Enterprises	6,381	6,082	6,784	403	6.3%
	56	Administrative and Support and Waste Management and Remediation Services	16,630	18,109	19,034	2,404	14.5%
	61	Educational Services	3,182	3,215	3,711	529	16.6%
	62	Health Care and Social Assistance	30,168	34,775	40,690	10,522	34.9%
	71	Arts, Entertainment, and Recreation	3,487	3,613	3,412	-75	-2.2%
72	Accommodation and Food Services	24,976	26,669	27,777	2,801	11.2%	
81	Other Services (except Public Administration)	10,399	10,540	10,264	-135	-1.3%	
99	Unclassified	0	81	62	62		

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Caswell County, NC	10	Total	3,520	3,069	3,108	-412	-11.7%
	10	Public Sector Total	1,457	1,437	1,427	-30	-2.1%
	10	Private Sector Total	2,063	1,632	1,681	-382	-18.5%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	216	233	201	-15	-6.9%
	31–33	Manufacturing	755	364	316	-439	-58.1%
	42	Wholesale Trade	N/A	34	65		
	44–45	Retail Trade	283	228	235	-48	-17.0%
	48–49	Transportation and Warehousing	N/A	7	16		
	51	Information	21	17	10	-11	-52.4%
	52	Finance and Insurance	50	57	62	12	24.0%
	53	Real Estate and Rental and Leasing	25	17	14	-11	-44.0%
	54	Professional, Scientific, and Technical Services	N/A	37	44		
	55	Management of Companies and Enterprises	N/A	N/A	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	54	N/A	50	-4	-7.4%
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	N/A	N/A	384		
	71	Arts, Entertainment, and Recreation	N/A	36	21		
72	Accommodation and Food Services	N/A	119	138			
81	Other Services (except Public Administration)	51	39	42	-9	-17.6%	
99	Unclassified	N/A	15	7			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Person County, NC	10	Total	11,916	11,623	9,817	-2,099	-17.6%
	10	Public Sector Total	2,181	2,212	2,103	-78	-3.6%
	10	Private Sector Total	9,735	9,411	7,714	-2,021	-20.8%
	11	Agriculture, Forestry, Fishing and Hunting	120	101	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	669	567	563	-106	-15.8%
	31–33	Manufacturing	3,500	2,450	1,309	-2,191	-62.6%
	42	Wholesale Trade	183	636	382	199	108.7%
	44–45	Retail Trade	1,511	1,586	1,528	17	1.1%
	48–49	Transportation and Warehousing	N/A	N/A	N/A		
	51	Information	132	109	77	-55	-41.7%
	52	Finance and Insurance	184	195	186	2	1.1%
	53	Real Estate and Rental and Leasing	92	69	58	-34	-37.0%
	54	Professional, Scientific, and Technical Services	131	134	158	27	20.6%
	55	Management of Companies and Enterprises	88	107	40	-48	-54.5%
	56	Administrative and Support and Waste Management and Remediation Services	497	509	277	-220	-44.3%
	61	Educational Services	65	93	163	98	150.8%
	62	Health Care and Social Assistance	1,033	1,320	1,198	165	16.0%
	71	Arts, Entertainment, and Recreation	40	110	101	61	152.5%
72	Accommodation and Food Services	785	793	923	138	17.6%	
81	Other Services (except Public Administration)	138	135	124	-14	-10.1%	
99	Unclassified	N/A	14	19			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Rockingham County, NC	10	Total	32,871	30,667	26,986	-5,885	-17.9%
	10	Public Sector Total	4,591	4,558	4,489	-102	-2.2%
	10	Private Sector Total	28,280	26,109	22,497	-5,783	-20.4%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	256	228	188	-68	-26.6%
	23	Construction	2,018	1,931	1,322	-696	-34.5%
	31–33	Manufacturing	11,808	8,712	6,236	-5,572	-47.2%
	42	Wholesale Trade	677	926	1,100	423	62.5%
	44–45	Retail Trade	3,771	3,539	3,584	-187	-5.0%
	48–49	Transportation and Warehousing	1,174	1,145	397	-777	-66.2%
	51	Information	258	176	211	-47	-18.2%
	52	Finance and Insurance	543	485	481	-62	-11.4%
	53	Real Estate and Rental and Leasing	150	194	158	8	5.3%
	54	Professional, Scientific, and Technical Services	380	N/A	N/A		
	55	Management of Companies and Enterprises	25	N/A	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	974	1,546	1,316	342	35.1%
	61	Educational Services	N/A	23	87		
	62	Health Care and Social Assistance	N/A	3,592	3,782		
	71	Arts, Entertainment, and Recreation	232	263	193	-39	-16.8%
72	Accommodation and Food Services	1,925	2,066	2,210	285	14.8%	
81	Other Services (except Public Administration)	652	643	614	-38	-5.8%	
99	Unclassified	N/A	52	31			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Amherst County, VA	10	Total	9,427	9,835	9,350	-77	-0.8%
	10	Public Sector Total	2,887	3,011	2,979	92	3.2%
	10	Private Sector Total	6,540	6,824	6,371	-169	-2.6%
	11	Agriculture, Forestry, Fishing and Hunting	59	74	58	-1	-1.7%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	755	797	569	-186	-24.6%
	31–33	Manufacturing	1,787	1,605	1,350	-437	-24.5%
	42	Wholesale Trade	288	N/A	N/A		
	44–45	Retail Trade	1,231	1,286	1,102	-129	-10.5%
	48–49	Transportation and Warehousing	N/A	353	303		
	51	Information	79	80	87	8	10.1%
	52	Finance and Insurance	119	131	135	16	13.4%
	53	Real Estate and Rental and Leasing	52	77	42	-10	-19.2%
	54	Professional, Scientific, and Technical Services	126	N/A	N/A		
	55	Management of Companies and Enterprises	69	N/A	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	101	166	163	62	61.4%
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	N/A	N/A	N/A		
	71	Arts, Entertainment, and Recreation	75	56	86	11	14.7%
72	Accommodation and Food Services	469	554	554	85	18.1%	
81	Other Services (except Public Administration)	177	181	147	-30	-16.9%	
99	Unclassified	N/A	N/A	N/A			

(continued)



Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Appomattox County	10	Total	3,599	3,504	3,214	-385	-10.7%
	10	Public Sector Total	843	851	922	79	9.4%
	10	Private Sector Total	2,756	2,653	2,292	-464	-16.8%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	410	391	325	-85	-20.7%
	31–33	Manufacturing	812	686	432	-380	-46.8%
	42	Wholesale Trade	N/A	N/A	83		
	44–45	Retail Trade	551	509	507	-44	-8.0%
	48–49	Transportation and Warehousing	87	84	N/A		
	51	Information	16	15	19	3	18.8%
	52	Finance and Insurance	42	51	48	6	14.3%
	53	Real Estate and Rental and Leasing	23	23	15	-8	-34.8%
	54	Professional, Scientific, and Technical Services	53	56	64	11	20.8%
	55	Management of Companies and Enterprises	N/A	68	68		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	53	23		
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	200	219	N/A		
	71	Arts, Entertainment, and Recreation	44	N/A	34	-10	-22.7%
72	Accommodation and Food Services	208	N/A	203	-5	-2.4%	
81	Other Services (except Public Administration)	67	72	61	-6	-9.0%	
99	Unclassified	N/A	N/A	N/A			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Bedford County, VA	10	Total	12,564	14,154	15,248	2,684	21.4%
	10	Public Sector Total	2,437	2,730	2,958	521	21.4%
	10	Private Sector Total	10,127	11,424	12,290	2,163	21.4%
	11	Agriculture, Forestry, Fishing and Hunting	114	117	128	14	12.3%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	3	5		
	23	Construction	1,796	1,912	1,547	-249	-13.9%
	31–33	Manufacturing	1,525	1,666	1,378	-147	-9.6%
	42	Wholesale Trade	563	902	1,102	539	95.7%
	44–45	Retail Trade	1,302	1,272	1,622	320	24.6%
	48–49	Transportation and Warehousing	331	392	198	-133	-40.2%
	51	Information	266	200	314	48	18.0%
	52	Finance and Insurance	173	219	289	116	67.1%
	53	Real Estate and Rental and Leasing	140	257	254	114	81.4%
	54	Professional, Scientific, and Technical Services	N/A	N/A	N/A		
	55	Management of Companies and Enterprises	N/A	N/A	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	1,126	1,045	1,479	353	31.3%
	61	Educational Services	14	18	30	16	114.3%
	62	Health Care and Social Assistance	715	796	1,085	370	51.7%
	71	Arts, Entertainment, and Recreation	332	307	257	-75	-22.6%
72	Accommodation and Food Services	518	718	884	366	70.7%	
81	Other Services (except Public Administration)	463	566	563	100	21.6%	
99	Unclassified	N/A	N/A	0			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Campbell County, VA	10	Total	16,187	15,574	14,595	-1,592	-9.8%
	10	Public Sector Total	2,243	2,263	2,418	175	7.8%
	10	Private Sector Total	13,944	13,311	12,177	-1,767	-12.7%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	74	73	63	-11	-14.9%
	23	Construction	1,879	2,185	2,048	169	9.0%
	31–33	Manufacturing	4,828	4,018	2,850	-1,978	-41.0%
	42	Wholesale Trade	714	575	629	-85	-11.9%
	44–45	Retail Trade	1,805	1,661	1,783	-22	-1.2%
	48–49	Transportation and Warehousing	685	717	526	-159	-23.2%
	51	Information	111	131	170	59	53.2%
	52	Finance and Insurance	277	341	371	94	33.9%
	53	Real Estate and Rental and Leasing	100	114	125	25	25.0%
	54	Professional, Scientific, and Technical Services	442	482	394	-48	-10.9%
	55	Management of Companies and Enterprises	81	87	58	-23	-28.4%
	56	Administrative and Support and Waste Management and Remediation Services	969	819	684	-285	-29.4%
	61	Educational Services	29	31	41	12	41.4%
	62	Health Care and Social Assistance	590	681	899	309	52.4%
	71	Arts, Entertainment, and Recreation	45	122	133	88	195.6%
72	Accommodation and Food Services	739	767	915	176	23.8%	
81	Other Services (except Public Administration)	453	384	346	-107	-23.6%	
99	Unclassified	N/A	N/A	N/A			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Charlotte County, VA	10	Total	3,399	2,973	2,744	-655	-19.3%
	10	Public Sector Total	803	879	991	188	23.4%
	10	Private Sector Total	2,596	2,094	1,753	-843	-32.5%
	11	Agriculture, Forestry, Fishing and Hunting	164	120	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	137	160	87	-50	-36.5%
	31–33	Manufacturing	1,202	674	408	-794	-66.1%
	42	Wholesale Trade	N/A	N/A	N/A		
	44–45	Retail Trade	243	277	244	1	0.4%
	48–49	Transportation and Warehousing	247	254	201	-46	-18.6%
	51	Information	N/A	N/A	N/A		
	52	Finance and Insurance	39	47	43	4	10.3%
	53	Real Estate and Rental and Leasing	N/A	11	N/A		
	54	Professional, Scientific, and Technical Services	26	46	45	19	73.1%
	55	Management of Companies and Enterprises	N/A	N/A	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	N/A	N/A		
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	N/A	N/A	N/A		
	71	Arts, Entertainment, and Recreation	17	21	14	-3	-17.6%
72	Accommodation and Food Services	97	87	78	-19	-19.6%	
81	Other Services (except Public Administration)	65	N/A	57	-8	-12.3%	
99	Unclassified	N/A	N/A	N/A			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Franklin County, VA	10	Total	13,100	14,517	12,963	-137	-1.0%
	10	Public Sector Total	1,812	2,021	2,138	326	18.0%
	10	Private Sector Total	11,288	12,496	10,825	-463	-4.1%
	11	Agriculture, Forestry, Fishing and Hunting	131	N/A	203	72	55.0%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	1,111	1,356	1,118	7	0.6%
	31–33	Manufacturing	3,554	3,304	2,315	-1,239	-34.9%
	42	Wholesale Trade	497	492	480	-17	-3.4%
	44–45	Retail Trade	1,671	1,959	1,877	206	12.3%
	48–49	Transportation and Warehousing	N/A	N/A	N/A		
	51	Information	73	105	135	62	84.9%
	52	Finance and Insurance	209	250	250	41	19.6%
	53	Real Estate and Rental and Leasing	135	187	155	20	14.8%
	54	Professional, Scientific, and Technical Services	193	N/A	308	115	59.6%
	55	Management of Companies and Enterprises	60	N/A	45	-15	-25.0%
	56	Administrative and Support and Waste Management and Remediation Services	865	994	531	-334	-38.6%
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	N/A	N/A	N/A		
	71	Arts, Entertainment, and Recreation	210	217	216	6	2.9%
72	Accommodation and Food Services	840	964	888	48	5.7%	
81	Other Services (except Public Administration)	377	452	425	48	12.7%	
99	Unclassified	N/A	N/A	N/A			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Halifax County, VA	10	Total	13,683	12,993	12,185	-1,498	-10.9%
	10	Public Sector Total	2,024	2,190	2,332	308	15.2%
	10	Private Sector Total	11,659	10,803	9,853	-1,806	-15.5%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	694	821	586	-108	-15.6%
	31–33	Manufacturing	3,986	2,508	2,045	-1,941	-48.7%
	42	Wholesale Trade	N/A	N/A	N/A		
	44–45	Retail Trade	1,596	1,500	1,295	-301	-18.9%
	48–49	Transportation and Warehousing	826	1,122	848	22	2.7%
	51	Information	135	105	101	-34	-25.2%
	52	Finance and Insurance	185	195	197	12	6.5%
	53	Real Estate and Rental and Leasing	233	133	143	-90	-38.6%
	54	Professional, Scientific, and Technical Services	138	151	142	4	2.9%
	55	Management of Companies and Enterprises	96	46	74	-22	-22.9%
	56	Administrative and Support and Waste Management and Remediation Services	369	342	349	-20	-5.4%
	61	Educational Services	3	N/A	N/A		
	62	Health Care and Social Assistance	1,472	N/A	N/A		
	71	Arts, Entertainment, and Recreation	218	258	292	74	33.9%
72	Accommodation and Food Services	808	1,005	922	114	14.1%	
81	Other Services (except Public Administration)	393	387	351	-42	-10.7%	
99	Unclassified	N/A	N/A	N/A			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Henry County, VA	10	Total	20,816	16,491	14,139	-6,677	-32.1%
	10	Public Sector Total	2,372	2,303	2,295	-77	-3.2%
	10	Private Sector Total	18,444	14,188	11,844	-6,600	-35.8%
	11	Agriculture, Forestry, Fishing and Hunting	78	75	70	-8	-10.3%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	109	N/A	N/A		
	23	Construction	812	691	593	-219	-27.0%
	31–33	Manufacturing	9,416	6,774	4,451	-4,965	-52.7%
	42	Wholesale Trade	324	N/A	N/A		
	44–45	Retail Trade	1,694	1,451	1,287	-407	-24.0%
	48–49	Transportation and Warehousing	2,301	1,154	891	-1,410	-61.3%
	51	Information	195	N/A	195	0	0.0%
	52	Finance and Insurance	257	280	302	45	17.5%
	53	Real Estate and Rental and Leasing	97	81	101	4	4.1%
	54	Professional, Scientific, and Technical Services	680	N/A	143	-537	-79.0%
	55	Management of Companies and Enterprises	N/A	N/A	116		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	572	448		
	61	Educational Services	102	N/A	N/A		
	62	Health Care and Social Assistance	329	N/A	N/A		
	71	Arts, Entertainment, and Recreation	222	222	203	-19	-8.6%
72	Accommodation and Food Services	1,002	927	975	-27	-2.7%	
81	Other Services (except Public Administration)	377	366	366	-11	-2.9%	
99	Unclassified	N/A	N/A	N/A			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Patrick County, VA	10	Total	5,449	4,835	4,944	–505	–9.3%
	10	Public Sector Total	815	826	861	46	5.6%
	10	Private Sector Total	4,634	4,009	4,083	–551	–11.9%
	11	Agriculture, Forestry, Fishing and Hunting	149	183	181	32	21.5%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	204	205	152	–52	–25.5%
	31–33	Manufacturing	2,416	1,756	1,578	–838	–34.7%
	42	Wholesale Trade	N/A	N/A	N/A		
	44–45	Retail Trade	402	425	544	142	35.3%
	48–49	Transportation and Warehousing	159	163	128	–31	–19.5%
	51	Information	115	122	97	–18	–15.7%
	52	Finance and Insurance	84	71	77	–7	–8.3%
	53	Real Estate and Rental and Leasing	30	17	7	–23	–76.7%
	54	Professional, Scientific, and Technical Services	67	55	306	239	356.7%
	55	Management of Companies and Enterprises	N/A	N/A	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	N/A	N/A		
	61	Educational Services	N/A	9	9		
	62	Health Care and Social Assistance	N/A	580	548		
	71	Arts, Entertainment, and Recreation	N/A	25	16		
72	Accommodation and Food Services	N/A	194	199			
81	Other Services (except Public Administration)	64	54	69	5	7.8%	
99	Unclassified	N/A	N/A	N/A			

(continued)



Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Pittsylvania County, VA	10	Total	16,650	13,247	11,131	-5,519	-33.1%
	10	Public Sector Total	2,205	2,405	2,681	476	21.6%
	10	Private Sector Total	14,445	10,842	8,450	-5,995	-41.5%
	11	Agriculture, Forestry, Fishing and Hunting	190	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	39	N/A	N/A		
	22	Utilities	72	65	72	0	0.0%
	23	Construction	1,644	1,340	1,144	-500	-30.4%
	31–33	Manufacturing	7,536	3,500	2,080	-5,456	-72.4%
	42	Wholesale Trade	243	698	735	492	202.5%
	44–45	Retail Trade	1,436	1,688	1,117	-319	-22.2%
	48–49	Transportation and Warehousing	332	293	191	-141	-42.5%
	51	Information	62	35	29	-33	-53.2%
	52	Finance and Insurance	155	174	136	-19	-12.3%
	53	Real Estate and Rental and Leasing	45	55	67	22	48.9%
	54	Professional, Scientific, and Technical Services	140	172	144	4	2.9%
	55	Management of Companies and Enterprises	200	108	76	-124	-62.0%
	56	Administrative and Support and Waste Management and Remediation Services	578	795	451	-127	-22.0%
	61	Educational Services	248	264	312	64	25.8%
	62	Health Care and Social Assistance	606	568	743	137	22.6%
	71	Arts, Entertainment, and Recreation	66	69	62	-4	-6.1%
72	Accommodation and Food Services	525	493	551	26	5.0%	
81	Other Services (except Public Administration)	329	314	300	-29	-8.8%	
99	Unclassified	N/A	N/A	N/A			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Roanoke County, VA	10	Total	31,875	32,898	34,670	2,795	8.8%
	10	Public Sector Total	4,176	4,325	4,499	323	7.7%
	10	Private Sector Total	27,699	28,573	30,171	2,472	8.9%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	225		
	23	Construction	1,569	1,532	1,209	-360	-22.9%
	31–33	Manufacturing	4,271	3,644	2,893	-1,378	-32.3%
	42	Wholesale Trade	1,193	N/A	1,393	200	16.8%
	44–45	Retail Trade	3,601	3,609	4,223	622	17.3%
	48–49	Transportation and Warehousing	N/A	N/A	848		
	51	Information	326	414	813	487	149.4%
	52	Finance and Insurance	2,603	2,594	2,458	-145	-5.6%
	53	Real Estate and Rental and Leasing	400	431	468	68	17.0%
	54	Professional, Scientific, and Technical Services	2,548	2,933	2,905	357	14.0%
	55	Management of Companies and Enterprises	613	533	984	371	60.5%
	56	Administrative and Support and Waste Management and Remediation Services	2,366	2,523	2,582	216	9.1%
	61	Educational Services	626	711	747	121	19.3%
	62	Health Care and Social Assistance	2,852	3,470	4,418	1,566	54.9%
	71	Arts, Entertainment, and Recreation	546	558	590	44	8.1%
72	Accommodation and Food Services	1,919	2,019	2,393	474	24.7%	
81	Other Services (except Public Administration)	987	983	993	6	0.6%	
99	Unclassified	N/A	N/A	N/A			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Bedford City, VA	10	Total	4,288	4,113	3,401	-887	-20.7%
	10	Public Sector Total	292	291	280	-12	-4.1%
	10	Private Sector Total	3,996	3,822	3,121	-875	-21.9%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	N/A	N/A	N/A		
	31–33	Manufacturing	1,489	1,127	813	-676	-45.4%
	42	Wholesale Trade	N/A	N/A	62		
	44–45	Retail Trade	725	725	395	-330	-45.5%
	48–49	Transportation and Warehousing	N/A	N/A	7		
	51	Information	76	61	47	-29	-38.2%
	52	Finance and Insurance	136	142	142	6	4.4%
	53	Real Estate and Rental and Leasing	33	34	26	-7	-21.2%
	54	Professional, Scientific, and Technical Services	88	91	81	-7	-8.0%
	55	Management of Companies and Enterprises	N/A	31	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	181	N/A		
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	652	780	856	204	31.3%
	71	Arts, Entertainment, and Recreation	N/A	8	N/A		
72	Accommodation and Food Services	N/A	215	N/A			
81	Other Services (except Public Administration)	254	245	259	5	2.0%	
99	Unclassified	N/A	N/A	N/A			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Danville City, VA	10	Total	27,610	28,480	26,810	–800	–2.9%
	10	Public Sector Total	3,916	3,990	4,142	226	5.8%
	10	Private Sector Total	23,694	24,490	22,668	–1,026	–4.3%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	20		
	23	Construction	726	N/A	N/A		
	31–33	Manufacturing	6,264	6,484	4,583	–1,681	–26.8%
	42	Wholesale Trade	640	655	645	5	0.8%
	44–45	Retail Trade	4,389	4,149	4,093	–296	–6.7%
	48–49	Transportation and Warehousing	N/A	N/A	331		
	51	Information	N/A	308	286		
	52	Finance and Insurance	902	908	817	–85	–9.4%
	53	Real Estate and Rental and Leasing	303	328	314	11	3.6%
	54	Professional, Scientific, and Technical Services	422	426	552	130	30.8%
	55	Management of Companies and Enterprises	203	242	228	25	12.3%
	56	Administrative and Support and Waste Management and Remediation Services	773	1,628	1,923	1,150	148.8%
	61	Educational Services	536	464	488	–48	–9.0%
	62	Health Care and Social Assistance	4,339	4,631	4,550	211	4.9%
	71	Arts, Entertainment, and Recreation	206	157	150	–56	–27.2%
72	Accommodation and Food Services	2,525	2,584	2,632	107	4.2%	
81	Other Services (except Public Administration)	N/A	725	604			
99	Unclassified	N/A	N/A	N/A			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Lynchburg City VA	10	Total	53,058	51,728	52,959	–99	–0.2%
	10	Public Sector Total	5,081	5,077	5,203	122	2.4%
	10	Private Sector Total	47,977	46,651	47,756	–221	–0.5%
	11	Agriculture, Forestry, Fishing and Hunting	7	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	1,672	N/A	N/A		
	31–33	Manufacturing	12,272	9,889	8,219	–4,053	–33.0%
	42	Wholesale Trade	1,141	1,463	1,617	476	41.7%
	44–45	Retail Trade	8,079	7,310	6,950	–1,129	–14.0%
	48–49	Transportation and Warehousing	N/A	N/A	N/A		
	51	Information	619	507	454	–165	–26.7%
	52	Finance and Insurance	2,671	2,493	2,141	–530	–19.8%
	53	Real Estate and Rental and Leasing	555	614	727	172	31.0%
	54	Professional, Scientific, and Technical Services	1,390	1,430	3,558	2,168	156.0%
	55	Management of Companies and Enterprises	1,244	1,486	1,676	432	34.7%
	56	Administrative and Support and Waste Management and Remediation Services	2,226	2,579	2,543	317	14.2%
	61	Educational Services	1,181	1,274	1,385	204	17.3%
	62	Health Care and Social Assistance	7,513	8,432	9,150	1,637	21.8%
	71	Arts, Entertainment, and Recreation	324	336	347	23	7.1%
72	Accommodation and Food Services	4,180	4,845	4,893	713	17.1%	
81	Other Services (except Public Administration)	1,780	1,473	1,501	–279	–15.7%	
99	Unclassified	N/A	N/A	5			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Martinsville City, VA	10	Total	12,760	12,515	11,081	-1,679	-13.2%
	10	Public Sector Total	1,464	1,588	1,592	128	8.7%
	10	Private Sector Total	11,296	10,927	9,489	-1,807	-16.0%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	N/A	N/A	N/A		
	31–33	Manufacturing	1,921	2,127	1,013	-908	-47.3%
	42	Wholesale Trade	220	N/A	115	-105	-47.7%
	44–45	Retail Trade	2,813	2,801	2,478	-335	-11.9%
	48–49	Transportation and Warehousing	N/A	106	N/A		
	51	Information	236	204	171	-65	-27.5%
	52	Finance and Insurance	314	313	266	-48	-15.3%
	53	Real Estate and Rental and Leasing	141	183	145	4	2.8%
	54	Professional, Scientific, and Technical Services	340	228	184	-156	-45.9%
	55	Management of Companies and Enterprises	72	N/A	100	28	38.9%
	56	Administrative and Support and Waste Management and Remediation Services	1,498	N/A	1,574	76	5.1%
	61	Educational Services	N/A	N/A	63		
	62	Health Care and Social Assistance	N/A	N/A	1,990		
	71	Arts, Entertainment, and Recreation	63	50	28	-35	-55.6%
72	Accommodation and Food Services	697	665	691	-6	-0.9%	
81	Other Services (except Public Administration)	365	383	396	31	8.5%	
99	Unclassified	N/A	N/A	N/A			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Roanoke City, VA	10	Total	74,377	70,866	66,467	-7,910	-10.6%
	10	Public Sector Total	8,004	8,742	8,581	577	7.2%
	10	Private Sector Total	66,373	62,124	57,886	-8,487	-12.8%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	297	N/A		
	23	Construction	N/A	N/A	N/A		
	31–33	Manufacturing	5,997	4,859	4,065	-1,932	-32.2%
	42	Wholesale Trade	N/A	2,639	N/A		
	44–45	Retail Trade	11,264	9,892	8,366	-2,898	-25.7%
	48–49	Transportation and Warehousing	3,890	3,572	3,737	-153	-3.9%
	51	Information	2,129	1,878	1,024	-1,105	-51.9%
	52	Finance and Insurance	3,725	3,497	2,546	-1,179	-31.7%
	53	Real Estate and Rental and Leasing	1,349	1,163	990	-359	-26.6%
	54	Professional, Scientific, and Technical Services	3,621	3,315	2,826	-795	-22.0%
	55	Management of Companies and Enterprises	3,365	3,089	3,006	-359	-10.7%
	56	Administrative and Support and Waste Management and Remediation Services	3,677	4,035	3,880	203	5.5%
	61	Educational Services	378	328	386	8	2.1%
	62	Health Care and Social Assistance	9,867	9,706	11,087	1,220	12.4%
	71	Arts, Entertainment, and Recreation	527	522	445	-82	-15.6%
72	Accommodation and Food Services	6,094	6,074	6,227	133	2.2%	
81	Other Services (except Public Administration)	2,600	2,597	2,447	-153	-5.9%	
99	Unclassified	N/A	N/A	N/A			

(continued)

Table B-7. Employment in 2001, 2005, 2009 by Sector (continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Salem City, VA	10	Total	25,635	22,904	22,481	-3,154	-12.3%
	10	Public Sector Total	4,243	3,802	4,333	90	2.1%
	10	Private Sector Total	21,392	19,102	18,148	-3,244	-15.2%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	N/A	N/A	N/A		
	31–33	Manufacturing	6,099	4,399	3,617	-2,482	-40.7%
	42	Wholesale Trade	1,025	1,199	1,818	793	77.4%
	44–45	Retail Trade	3,473	3,467	2,317	-1,156	-33.3%
	48–49	Transportation and Warehousing	635	691	552	-83	-13.1%
	51	Information	456	108	89	-367	-80.5%
	52	Finance and Insurance	311	424	517	206	66.2%
	53	Real Estate and Rental and Leasing	120	143	153	33	27.5%
	54	Professional, Scientific, and Technical Services	557	506	620	63	11.3%
	55	Management of Companies and Enterprises	265	285	313	48	18.1%
	56	Administrative and Support and Waste Management and Remediation Services	557	322	761	204	36.6%
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	N/A	N/A	N/A		
	71	Arts, Entertainment, and Recreation	320	276	224	-96	-30.0%
72	Accommodation and Food Services	1,645	1,580	1,501	-144	-8.8%	
81	Other Services (except Public Administration)	807	541	599	-208	-25.8%	
99	Unclassified	N/A	N/A	N/A			



**Table B-8. Projected Employment in Virginia, 2015 through 2035**

Sector	2015	2020	2025	2030	2035	Percent Change, 2015–2035
Total Nonfarm (Thous.)	4,010.72	4,249.70	4,500.00	4,789.58	5,141.82	28.2%
Non-Manufacturing (Thous.)	3,759.27	4,002.77	4,269.74	4,569.04	4,928.10	31.1%
Natural Resources & Mining (Thous.)	9.98	10.22	10.47	10.87	11.03	10.4%
Construction (Thous.)	220.11	227.97	247.88	243.59	251.31	14.2%
Manufacturing (Thous.)	251.44	246.92	230.27	220.55	213.73	-15.0%
Wholesale Trade (Thous.)	119.84	122.85	127.73	133.86	137.03	14.3%
Retail Trade (Thous.)	427.23	434.46	454.19	477.07	504.24	18.0%
Transportation and Warehousing (Thous.)	103.35	107.55	113.39	117.63	119.97	16.1%
Utilities (Thous.)	11.96	12.05	11.83	11.47	11.58	-3.2%
Information (Thous.)	84.65	91.02	99.01	113.81	129.94	53.5%
Financial Activities (Thous.)	191.40	193.81	203.08	218.72	239.52	25.1%
Professional & Business Svcs (Thous.)	806.05	945.07	1062.28	1202.93	1384.26	71.7%
Professional, Scientific, and Technical Services (Thous.)	460.57	540.49	626.13	733.22	862.98	87.4%
Management of Companies and Enterprises (Thous.)	79.53	87.44	95.65	105.11	115.76	45.6%
Administrative and Support and Waste Management and Remediation Services (Thous.)	265.95	317.14	340.51	364.60	405.52	52.5%
Educational Services (Thous.)	93.80	101.63	111.48	121.24	134.43	43.3%
Health Care and Social Assistance (Thous.)	405.04	446.04	483.93	528.33	576.69	42.4%
Leisure & Hospitality (Thous.)	362.28	375.01	386.88	404.63	429.50	18.6%
Arts, Entertainment, and Recreation (Thous.)	47.37	48.31	51.11	53.91	56.27	18.8%
Accommodation and Food Services (Thous.)	314.91	326.70	335.77	350.72	373.24	18.5%
Other Services (Thous.)	224.63	216.50	224.20	229.37	232.29	3.4%
Government (Thous.)	698.93	718.59	733.36	755.51	766.30	9.6%
Federal Government (Thous.)	164.39	165.03	158.65	161.62	156.34	-4.9%
State & Local Government (Thous.)	534.54	553.56	574.71	593.89	609.96	14.1%
Agriculture, Forestry, & Fishing (Thous.)	15.55	16.23	16.14	16.25	15.30	-1.6%
Military (Thous.)	163.25	163.78	164.35	164.92	165.49	1.4%

Source: I H S Global Insight—US Regional Service March 2010 Long Term Forecast

**Table B-9. Unemployment**

	<b>Total</b>	<b>Labor Force</b>	<b>Unemployed</b>	<b>% of Labor Force Unemployed</b>
United States	235,871,704	152,802,402	10,969,884	7.2%
Virginia	6,097,997	4,096,902	216,714	5.3%
Caswell County, North Carolina	18,766	10,478	1,297	12.4%
Person County, North Carolina	29,539	18,923	1,737	9.2%
Rockingham County, North Carolina	73,244	44,787	3,875	8.7%
Amherst County, Virginia	26,269	16,109	662	4.1%
Appomattox County, Virginia	11,462	7,180	616	8.6%
Bedford County, Virginia	52,880	34,994	1,184	3.4%
Campbell County, Virginia	42,435	27,506	1,481	5.4%
Charlotte County, Virginia	9,720	5,632	512	9.1%
Franklin County, Virginia	41,783	25,230	1,693	6.7%
Halifax County, Virginia	28,513	15,725	1,340	8.5%
Henry County, Virginia	45,459	27,000	2,296	8.5%
Mecklenburg County, Virginia	26,283	14,170	1,046	7.4%
Patrick County, Virginia	15,536	8,732	845	9.7%
Pittsylvania County, Virginia	49,481	30,525	2,481	8.1%
Roanoke County, Virginia	71,766	48,020	1,705	3.6%
Bedford City, Virginia	4,759	3,081	113	3.7%
Danville City, Virginia	36,673	20,322	2,567	12.6%
Lynchburg City, Virginia	58,440	34,120	2,981	8.7%
Martinsville City, Virginia	11,767	6,322	798	12.6%
Roanoke City, Virginia	75,488	46,013	3,099	6.7%
Salem City, Virginia	20,852	12,955	625	4.8%
Total	751,115	457,824	32,953	7.2%

Source: U.S. Census Bureau. 2005–2009 American Community Survey 5-Year Estimates

Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
United States	10	Total	7,984,529	8,571,144	9,003,197	1,018,668	12.8%
	10	Public Sector Total	259,565	276,482	294,082	34,517	13.3%
	10	Private Sector Total	7,724,965	8,294,662	8,709,115	984,150	12.7%
	11	Agriculture, Forestry, Fishing and Hunting	102,335	96,569	95,001	-7,334	-7.2%
	21	Mining, Quarrying, and Oil and Gas Extraction	25,786	26,313	31,140	5,354	20.8%
	22	Utilities	16,031	16,260	16,566	535	3.3%
	23	Construction	776,942	845,843	831,969	55,027	7.1%
	31–33	Manufacturing	397,552	365,351	351,307	-46,245	-11.6%
	42	Wholesale Trade	575,217	601,625	617,869	42,652	7.4%
	44–45	Retail Trade	1,046,730	1,038,585	1,034,198	-12,532	-1.2%
	48–49	Transportation and Warehousing	209,741	212,309	218,444	8,703	4.1%
	51	Information	152,227	141,871	145,685	-6,542	-4.3%
	52	Finance and Insurance	412,478	462,381	477,405	64,927	15.7%
	53	Real Estate and Rental and Leasing	309,170	351,329	358,929	49,759	16.1%
	54	Professional, Scientific, and Technical Services	827,793	902,710	1,007,720	179,927	21.7%
	55	Management of Companies and Enterprises	37,100	43,239	51,571	14,471	39.0%
	56	Administrative and Support and Waste Management and Remediation Services	392,672	426,681	463,843	71,171	18.1%
	61	Educational Services	66,416	78,410	90,997	24,581	37.0%
	62	Health Care and Social Assistance	620,427	689,010	775,749	155,322	25.0%
	71	Arts, Entertainment, and Recreation	105,423	118,614	124,950	19,527	18.5%
72	Accommodation and Food Services	529,108	572,791	612,716	83,608	15.8%	
81	Other Services (except Public Administration)	975,813	1,102,054	1,227,133	251,320	25.8%	
99	Unclassified	146,006	202,720	175,923	29,917	20.5%	

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Study Area	10	Total	21,651	22,307	23,210	1,559	7.2%
	10	Public Sector Total	958	991	1,064	106	11.1%
	10	Private Sector Total	20,693	21,316	22,146	1,453	7.0%
	11	Agriculture, Forestry, Fishing and Hunting	203	290	286	83	40.9%
	21	Mining, Quarrying, and Oil and Gas Extraction	4	13	13	9	225.0%
	22	Utilities	26	63	57	31	119.2%
	23	Construction	2,419	3,017	2,907	488	20.2%
	31–33	Manufacturing	1,203	1,163	1,107	–96	–8.0%
	42	Wholesale Trade	766	1,166	1,147	381	49.7%
	44–45	Retail Trade	3,734	3,603	3,357	–377	–10.1%
	48–49	Transportation and Warehousing	481	717	660	179	37.2%
	51	Information	270	287	313	43	15.9%
	52	Finance and Insurance	1,286	1,371	1,326	40	3.1%
	53	Real Estate and Rental and Leasing	749	873	959	210	28.0%
	54	Professional, Scientific, and Technical Services	1,371	1,632	1,786	415	30.3%
	55	Management of Companies and Enterprises	128	155	169	41	32.0%
	56	Administrative and Support and Waste Management and Remediation Services	912	1,062	1,103	191	20.9%
	61	Educational Services	110	162	178	68	61.8%
	62	Health Care and Social Assistance	1,140	1,698	2,794	1,654	145.1%
	71	Arts, Entertainment, and Recreation	253	281	280	27	10.7%
72	Accommodation and Food Services	1,316	1,496	1,553	237	18.0%	
81	Other Services (except Public Administration)	2,238	2,240	2,078	–160	–7.1%	
99	Unclassified	0	69	101	101		

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Caswell County, NC	10	Total	296	271	279	-17	-5.7%
	10	Public Sector Total	48	37	39	-9	-18.8%
	10	Private Sector Total	248	234	240	-8	-3.2%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	8	10		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	1	1		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	43	33	33	-10	-23.3%
	31–33	Manufacturing	19	14	14	-5	-26.3%
	42	Wholesale Trade	N/A	4	8		
	44–45	Retail Trade	43	42	39	-4	-9.3%
	48–49	Transportation and Warehousing	N/A	7	6		
	51	Information	6	4	3	-3	-50.0%
	52	Finance and Insurance	12	11	12	0	0.0%
	53	Real Estate and Rental and Leasing	10	9	6	-4	-40.0%
	54	Professional, Scientific, and Technical Services	N/A	14	17		
	55	Management of Companies and Enterprises	N/A	1	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	13	11	13	0	0.0%
	61	Educational Services	N/A	1	N/A		
	62	Health Care and Social Assistance	N/A	28	31		
	71	Arts, Entertainment, and Recreation	N/A	5	4		
72	Accommodation and Food Services	N/A	14	13			
81	Other Services (except Public Administration)	25	19	17	-8	-32.0%	
99	Unclassified	N/A	11	14			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Person County, NC	10	Total	796	781	782	-14	-1.8%
	10	Public Sector Total	60	59	50	-10	-16.7%
	10	Private Sector Total	736	722	732	-4	-0.5%
	11	Agriculture, Forestry, Fishing and Hunting	23	20	20	-3	-13.0%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	1		
	22	Utilities	N/A	5	5		
	23	Construction	138	113	119	-19	-13.8%
	31–33	Manufacturing	35	38	35	0	0.0%
	42	Wholesale Trade	27	35	34	7	25.9%
	44–45	Retail Trade	152	127	123	-29	-19.1%
	48–49	Transportation and Warehousing	N/A	20	18		
	51	Information	9	10	7	-2	-22.2%
	52	Finance and Insurance	33	34	33	0	0.0%
	53	Real Estate and Rental and Leasing	18	22	21	3	16.7%
	54	Professional, Scientific, and Technical Services	36	40	42	6	16.7%
	55	Management of Companies and Enterprises	4	5	4	0	0.0%
	56	Administrative and Support and Waste Management and Remediation Services	54	52	42	-12	-22.2%
	61	Educational Services	5	6	10	5	100.0%
	62	Health Care and Social Assistance	62	69	73	11	17.7%
	71	Arts, Entertainment, and Recreation	6	11	13	7	116.7%
72	Accommodation and Food Services	45	47	56	11	24.4%	
81	Other Services (except Public Administration)	61	54	46	-15	-24.6%	
99	Unclassified	N/A	16	31			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Rockingham County, NC	10	Total	1,800	1,790	1,796	-4	-0.2%
	10	Public Sector Total	76	70	71	-5	-6.6%
	10	Private Sector Total	1,724	1,720	1,725	1	0.1%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	18	20		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	1	1		
	22	Utilities	12	12	12	0	0.0%
	23	Construction	255	251	233	-22	-8.6%
	31–33	Manufacturing	136	115	98	-38	-27.9%
	42	Wholesale Trade	63	70	69	6	9.5%
	44–45	Retail Trade	364	327	299	-65	-17.9%
	48–49	Transportation and Warehousing	56	54	48	-8	-14.3%
	51	Information	23	17	21	-2	-8.7%
	52	Finance and Insurance	93	97	91	-2	-2.2%
	53	Real Estate and Rental and Leasing	46	54	59	13	28.3%
	54	Professional, Scientific, and Technical Services	98	91	113	15	15.3%
	55	Management of Companies and Enterprises	3	3	3	0	0.0%
	56	Administrative and Support and Waste Management and Remediation Services	84	87	100	16	19.0%
	61	Educational Services	N/A	8	11		
	62	Health Care and Social Assistance	N/A	155	166		
	71	Arts, Entertainment, and Recreation	23	29	23	0	0.0%
72	Accommodation and Food Services	122	130	149	27	22.1%	
81	Other Services (except Public Administration)	166	162	157	-9	-5.4%	
99	Unclassified	N/A	42	56			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Amherst County, VA	10	Total	612	640	689	77	12.6%
	10	Public Sector Total	36	38	39	3	8.3%
	10	Private Sector Total	576	602	650	74	12.8%
	11	Agriculture, Forestry, Fishing and Hunting	17	13	11	-6	-35.3%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	2	2		
	23	Construction	115	131	133	18	15.7%
	31–33	Manufacturing	44	45	46	2	4.5%
	42	Wholesale Trade	19	16	22	3	15.8%
	44–45	Retail Trade	98	93	84	-14	-14.3%
	48–49	Transportation and Warehousing	N/A	30	16		
	51	Information	12	14	16	4	33.3%
	52	Finance and Insurance	26	29	35	9	34.6%
	53	Real Estate and Rental and Leasing	22	22	18	-4	-18.2%
	54	Professional, Scientific, and Technical Services	28	34	31	3	10.7%
	55	Management of Companies and Enterprises	3	2	3	0	0.0%
	56	Administrative and Support and Waste Management and Remediation Services	23	24	28	5	21.7%
	61	Educational Services	N/A	4	3		
	62	Health Care and Social Assistance	N/A	40	102		
	71	Arts, Entertainment, and Recreation	8	9	10	2	25.0%
72	Accommodation and Food Services	36	40	38	2	5.6%	
81	Other Services (except Public Administration)	62	57	54	-8	-12.9%	
99	Unclassified	N/A	N/A	N/A			

(continued)



**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Appomattox County	10	Total	293	299	348	55	18.8%
	10	Public Sector Total	30	23	26	-4	-13.3%
	10	Private Sector Total	263	276	322	59	22.4%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	14	15		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	1	1		
	22	Utilities	N/A	2	2		
	23	Construction	51	55	55	4	7.8%
	31–33	Manufacturing	17	16	17	0	0.0%
	42	Wholesale Trade	N/A	11	12		
	44–45	Retail Trade	55	55	51	-4	-7.3%
	48–49	Transportation and Warehousing	12	12	12	0	0.0%
	51	Information	3	4	8	5	166.7%
	52	Finance and Insurance	9	11	10	1	11.1%
	53	Real Estate and Rental and Leasing	7	8	10	3	42.9%
	54	Professional, Scientific, and Technical Services	11	12	20	9	81.8%
	55	Management of Companies and Enterprises	N/A	3	4		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	13	12		
	61	Educational Services	N/A	N/A	1		
	62	Health Care and Social Assistance	17	16	55	38	223.5%
	71	Arts, Entertainment, and Recreation	4	3	4	0	0.0%
72	Accommodation and Food Services	15	16	15	0	0.0%	
81	Other Services (except Public Administration)	27	27	20	-7	-25.9%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Bedford County, VA	10	Total	1,209	1,426	1,625	416	34.4%
	10	Public Sector Total	39	54	64	25	64.1%
	10	Private Sector Total	1,170	1,372	1,561	391	33.4%
	11	Agriculture, Forestry, Fishing and Hunting	23	22	25	2	8.7%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	4	4		
	23	Construction	333	382	394	61	18.3%
	31–33	Manufacturing	77	77	68	–9	–11.7%
	42	Wholesale Trade	62	82	89	27	43.5%
	44–45	Retail Trade	136	146	147	11	8.1%
	48–49	Transportation and Warehousing	42	42	38	–4	–9.5%
	51	Information	18	12	19	1	5.6%
	52	Finance and Insurance	46	64	70	24	52.2%
	53	Real Estate and Rental and Leasing	35	60	87	52	148.6%
	54	Professional, Scientific, and Technical Services	N/A	135	151		
	55	Management of Companies and Enterprises	N/A	4	5		
	56	Administrative and Support and Waste Management and Remediation Services	77	87	93	16	20.8%
	61	Educational Services	5	6	7	2	40.0%
	62	Health Care and Social Assistance	51	57	165	114	223.5%
	71	Arts, Entertainment, and Recreation	21	19	20	–1	–4.8%
72	Accommodation and Food Services	33	52	68	35	106.1%	
81	Other Services (except Public Administration)	106	124	114	8	7.5%	
99	Unclassified	N/A	N/A	0			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Campbell County, VA	10	Total	1,076	1,127	1,257	181	16.8%
	10	Public Sector Total	43	38	46	3	7.0%
	10	Private Sector Total	1,033	1,089	1,211	178	17.2%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	18	21		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	2	2		
	22	Utilities	4	5	4	0	0.0%
	23	Construction	212	237	226	14	6.6%
	31–33	Manufacturing	68	65	68	0	0.0%
	42	Wholesale Trade	48	45	44	-4	-8.3%
	44–45	Retail Trade	186	180	175	-11	-5.9%
	48–49	Transportation and Warehousing	53	53	46	-7	-13.2%
	51	Information	9	13	16	7	77.8%
	52	Finance and Insurance	52	51	55	3	5.8%
	53	Real Estate and Rental and Leasing	43	51	55	12	27.9%
	54	Professional, Scientific, and Technical Services	77	88	84	7	9.1%
	55	Management of Companies and Enterprises	4	6	4	0	0.0%
	56	Administrative and Support and Waste Management and Remediation Services	56	64	68	12	21.4%
	61	Educational Services	7	3	5	-2	-28.6%
	62	Health Care and Social Assistance	47	57	179	132	280.9%
	71	Arts, Entertainment, and Recreation	12	11	13	1	8.3%
72	Accommodation and Food Services	56	53	59	3	5.4%	
81	Other Services (except Public Administration)	84	88	88	4	4.8%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Charlotte County, VA	10	Total	268	252	278	10	3.7%
	10	Public Sector Total	25	24	29	4	16.0%
	10	Private Sector Total	243	228	249	6	2.5%
	11	Agriculture, Forestry, Fishing and Hunting	29	29	23	-6	-20.7%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	1		
	22	Utilities	N/A	1	1		
	23	Construction	28	32	31	3	10.7%
	31–33	Manufacturing	18	16	15	-3	-16.7%
	42	Wholesale Trade	N/A	8	12		
	44–45	Retail Trade	43	37	32	-11	-25.6%
	48–49	Transportation and Warehousing	23	21	24	1	4.3%
	51	Information	N/A	2	1		
	52	Finance and Insurance	9	9	9	0	0.0%
	53	Real Estate and Rental and Leasing	N/A	8	7		
	54	Professional, Scientific, and Technical Services	11	13	14	3	27.3%
	55	Management of Companies and Enterprises	N/A	1	2		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	4	5		
	61	Educational Services	N/A	2	1		
	62	Health Care and Social Assistance	N/A	15	36		
	71	Arts, Entertainment, and Recreation	4	3	3	-1	-25.0%
72	Accommodation and Food Services	9	8	8	-1	-11.1%	
81	Other Services (except Public Administration)	30	20	25	-5	-16.7%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Franklin County, VA	10	Total	1,060	1,237	1,302	242	22.8%
	10	Public Sector Total	42	41	52	10	23.8%
	10	Private Sector Total	1,018	1,196	1,250	232	22.8%
	11	Agriculture, Forestry, Fishing and Hunting	22	32	41	19	86.4%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	1	N/A		
	22	Utilities	N/A	3	2		
	23	Construction	247	299	278	31	12.6%
	31–33	Manufacturing	69	60	52	-17	-24.6%
	42	Wholesale Trade	47	60	62	15	31.9%
	44–45	Retail Trade	164	181	174	10	6.1%
	48–49	Transportation and Warehousing	N/A	37	37		
	51	Information	10	13	17	7	70.0%
	52	Finance and Insurance	43	54	53	10	23.3%
	53	Real Estate and Rental and Leasing	32	55	57	25	78.1%
	54	Professional, Scientific, and Technical Services	58	81	92	34	58.6%
	55	Management of Companies and Enterprises	3	2	6	3	100.0%
	56	Administrative and Support and Waste Management and Remediation Services	45	59	54	9	20.0%
	61	Educational Services	N/A	7	11		
	62	Health Care and Social Assistance	N/A	48	119		
	71	Arts, Entertainment, and Recreation	19	21	19	0	0.0%
72	Accommodation and Food Services	56	72	71	15	26.8%	
81	Other Services (except Public Administration)	113	114	105	-8	-7.1%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Halifax County, VA	10	Total	837	855	876	39	4.7%
	10	Public Sector Total	60	60	61	1	1.7%
	10	Private Sector Total	777	795	815	38	4.9%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	22	18		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	1	1		
	22	Utilities	N/A	2	2		
	23	Construction	86	95	93	7	8.1%
	31–33	Manufacturing	42	43	42	0	0.0%
	42	Wholesale Trade	N/A	31	31		
	44–45	Retail Trade	153	146	130	-23	-15.0%
	48–49	Transportation and Warehousing	46	45	36	-10	-21.7%
	51	Information	12	10	8	-4	-33.3%
	52	Finance and Insurance	34	40	40	6	17.6%
	53	Real Estate and Rental and Leasing	33	29	26	-7	-21.2%
	54	Professional, Scientific, and Technical Services	33	35	40	7	21.2%
	55	Management of Companies and Enterprises	6	7	6	0	0.0%
	56	Administrative and Support and Waste Management and Remediation Services	32	29	34	2	6.3%
	61	Educational Services	3	4	4	1	33.3%
	62	Health Care and Social Assistance	75	84	147	72	96.0%
	71	Arts, Entertainment, and Recreation	8	10	10	2	25.0%
72	Accommodation and Food Services	52	72	62	10	19.2%	
81	Other Services (except Public Administration)	107	92	84	-23	-21.5%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Henry County, VA	10	Total	931	958	1,013	82	8.8%
	10	Public Sector Total	35	34	46	11	31.4%
	10	Private Sector Total	896	924	967	71	7.9%
	11	Agriculture, Forestry, Fishing and Hunting	13	14	5	-8	-61.5%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	4	5	2	-2	-50.0%
	23	Construction	130	134	135	5	3.8%
	31–33	Manufacturing	86	84	90	4	4.7%
	42	Wholesale Trade	49	58	59	10	20.4%
	44–45	Retail Trade	194	180	165	-29	-14.9%
	48–49	Transportation and Warehousing	46	49	48	2	4.3%
	51	Information	3	8	9	6	200.0%
	52	Finance and Insurance	48	52	50	2	4.2%
	53	Real Estate and Rental and Leasing	25	31	33	8	32.0%
	54	Professional, Scientific, and Technical Services	38	33	37	-1	-2.6%
	55	Management of Companies and Enterprises	N/A	1	4		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	48	46		
	61	Educational Services	5	4	4	-1	-20.0%
	62	Health Care and Social Assistance	31	42	109	78	251.6%
	71	Arts, Entertainment, and Recreation	15	17	14	-1	-6.7%
72	Accommodation and Food Services	66	63	68	2	3.0%	
81	Other Services (except Public Administration)	98	103	91	-7	-7.1%	
99	Unclassified	N/A	0	N/A			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Patrick County, VA	10	Total	353	360	375	22	6.2%
	10	Public Sector Total	24	22	24	0	0.0%
	10	Private Sector Total	329	338	351	22	6.7%
	11	Agriculture, Forestry, Fishing and Hunting	26	25	20	-6	-23.1%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	1	1		
	23	Construction	49	47	49	0	0.0%
	31–33	Manufacturing	38	40	37	-1	-2.6%
	42	Wholesale Trade	N/A	17	15		
	44–45	Retail Trade	50	51	45	-5	-10.0%
	48–49	Transportation and Warehousing	29	31	26	-3	-10.3%
	51	Information	5	6	5	0	0.0%
	52	Finance and Insurance	17	16	18	1	5.9%
	53	Real Estate and Rental and Leasing	8	10	7	-1	-12.5%
	54	Professional, Scientific, and Technical Services	17	14	23	6	35.3%
	55	Management of Companies and Enterprises	N/A	1	1		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	11	12		
	61	Educational Services	N/A	3	3		
	62	Health Care and Social Assistance	N/A	19	40		
	71	Arts, Entertainment, and Recreation	N/A	5	3		
72	Accommodation and Food Services	N/A	20	19			
81	Other Services (except Public Administration)	22	22	26	4	18.2%	
99	Unclassified	N/A	N/A	N/A			

(continued)



**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Pittsylvania County, VA	10	Total	959	978	1,013	54	5.6%
	10	Public Sector Total	45	50	62	17	37.8%
	10	Private Sector Total	914	928	951	37	4.0%
	11	Agriculture, Forestry, Fishing and Hunting	45	40	41	-4	-8.9%
	21	Mining, Quarrying, and Oil and Gas Extraction	4	2	2	-2	-50.0%
	22	Utilities	6	6	5	-1	-16.7%
	23	Construction	210	207	179	-31	-14.8%
	31–33	Manufacturing	70	64	57	-13	-18.6%
	42	Wholesale Trade	29	40	40	11	37.9%
	44–45	Retail Trade	158	153	129	-29	-18.4%
	48–49	Transportation and Warehousing	42	43	46	4	9.5%
	51	Information	11	8	7	-4	-36.4%
	52	Finance and Insurance	36	40	37	1	2.8%
	53	Real Estate and Rental and Leasing	18	18	21	3	16.7%
	54	Professional, Scientific, and Technical Services	46	57	54	8	17.4%
	55	Management of Companies and Enterprises	6	7	5	-1	-16.7%
	56	Administrative and Support and Waste Management and Remediation Services	45	48	50	5	11.1%
	61	Educational Services	7	7	9	2	28.6%
	62	Health Care and Social Assistance	32	42	125	93	290.6%
	71	Arts, Entertainment, and Recreation	8	10	13	5	62.5%
72	Accommodation and Food Services	39	43	44	5	12.8%	
81	Other Services (except Public Administration)	103	97	90	-13	-12.6%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Roanoke County, VA	10	Total	1,806	2,085	2,227	421	23.3%
	10	Public Sector Total	56	56	60	4	7.1%
	10	Private Sector Total	1,750	2,029	2,167	417	23.8%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	4	7		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	2	2		
	22	Utilities	N/A	4	4		
	23	Construction	238	272	263	25	10.5%
	31–33	Manufacturing	72	86	89	17	23.6%
	42	Wholesale Trade	137	165	160	23	16.8%
	44–45	Retail Trade	242	277	265	23	9.5%
	48–49	Transportation and Warehousing	N/A	46	44		
	51	Information	15	20	28	13	86.7%
	52	Finance and Insurance	151	198	184	33	21.9%
	53	Real Estate and Rental and Leasing	70	86	108	38	54.3%
	54	Professional, Scientific, and Technical Services	167	189	225	58	34.7%
	55	Management of Companies and Enterprises	13	18	23	10	76.9%
	56	Administrative and Support and Waste Management and Remediation Services	110	119	133	23	20.9%
	61	Educational Services	12	25	26	14	116.7%
	62	Health Care and Social Assistance	154	185	246	92	59.7%
	71	Arts, Entertainment, and Recreation	32	26	36	4	12.5%
72	Accommodation and Food Services	95	111	120	25	26.3%	
81	Other Services (except Public Administration)	193	200	207	14	7.3%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Bedford City, VA	10	Total	292	318	318	26	8.9%
	10	Public Sector Total	33	35	35	2	6.1%
	10	Private Sector Total	259	283	283	24	9.3%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	1	1		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	1	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	N/A	28	22		
	31–33	Manufacturing	18	20	22	4	22.2%
	42	Wholesale Trade	N/A	5	5		
	44–45	Retail Trade	46	52	44	-2	-4.3%
	48–49	Transportation and Warehousing	N/A	3	3		
	51	Information	5	5	4	-1	-20.0%
	52	Finance and Insurance	22	27	31	9	40.9%
	53	Real Estate and Rental and Leasing	10	13	7	-3	-30.0%
	54	Professional, Scientific, and Technical Services	29	30	30	1	3.4%
	55	Management of Companies and Enterprises	N/A	3	2		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	11	6		
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	29	36	58	29	100.0%
	71	Arts, Entertainment, and Recreation	N/A	3	1		
72	Accommodation and Food Services	N/A	15	21			
81	Other Services (except Public Administration)	38	32	27	-11	-28.9%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Danville City, VA	10	Total	1,472	1,445	1,464	-8	-0.5%
	10	Public Sector Total	53	54	57	4	7.5%
	10	Private Sector Total	1,419	1,391	1,407	-12	-0.8%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	2	4		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	2	4		
	23	Construction	110	94	89	-21	-19.1%
	31–33	Manufacturing	45	44	44	-1	-2.2%
	42	Wholesale Trade	67	74	72	5	7.5%
	44–45	Retail Trade	328	309	294	-34	-10.4%
	48–49	Transportation and Warehousing	N/A	28	27		
	51	Information	N/A	18	19		
	52	Finance and Insurance	115	108	102	-13	-11.3%
	53	Real Estate and Rental and Leasing	61	68	70	9	14.8%
	54	Professional, Scientific, and Technical Services	74	83	88	14	18.9%
	55	Management of Companies and Enterprises	9	10	10	1	11.1%
	56	Administrative and Support and Waste Management and Remediation Services	59	61	63	4	6.8%
	61	Educational Services	16	17	16	0	0.0%
	62	Health Care and Social Assistance	155	163	212	57	36.8%
	71	Arts, Entertainment, and Recreation	20	20	18	-2	-10.0%
72	Accommodation and Food Services	114	129	130	16	14.0%	
81	Other Services (except Public Administration)	N/A	162	149			
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Lynchburg City VA	10	Total	2,338	2,359	2,496	158	6.8%
	10	Public Sector Total	72	75	78	6	8.3%
	10	Private Sector Total	2,266	2,284	2,418	152	6.7%
	11	Agriculture, Forestry, Fishing and Hunting	5	3	1	-4	-80.0%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	4	3		
	23	Construction	174	182	187	13	7.5%
	31–33	Manufacturing	121	110	106	-15	-12.4%
	42	Wholesale Trade	107	108	104	-3	-2.8%
	44–45	Retail Trade	417	409	384	-33	-7.9%
	48–49	Transportation and Warehousing	N/A	51	56		
	51	Information	40	35	41	1	2.5%
	52	Finance and Insurance	163	177	168	5	3.1%
	53	Real Estate and Rental and Leasing	92	104	119	27	29.3%
	54	Professional, Scientific, and Technical Services	186	204	224	38	20.4%
	55	Management of Companies and Enterprises	15	21	21	6	40.0%
	56	Administrative and Support and Waste Management and Remediation Services	110	112	112	2	1.8%
	61	Educational Services	23	30	33	10	43.5%
	62	Health Care and Social Assistance	213	226	378	165	77.5%
	71	Arts, Entertainment, and Recreation	27	24	25	-2	-7.4%
72	Accommodation and Food Services	167	208	204	37	22.2%	
81	Other Services (except Public Administration)	347	277	253	-94	-27.1%	
99	Unclassified	N/A	N/A	0			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Martinsville City, VA	10	Total	748	719	719	-29	-3.9%
	10	Public Sector Total	46	52	48	2	4.3%
	10	Private Sector Total	702	667	671	-31	-4.4%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	1	1		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	1	1		
	22	Utilities	N/A	1	1		
	23	Construction	N/A	27	24		
	31–33	Manufacturing	21	29	25	4	19.0%
	42	Wholesale Trade	35	27	27	-8	-22.9%
	44–45	Retail Trade	140	131	121	-19	-13.6%
	48–49	Transportation and Warehousing	N/A	13	13		
	51	Information	13	14	14	1	7.7%
	52	Finance and Insurance	48	50	45	-3	-6.3%
	53	Real Estate and Rental and Leasing	33	33	37	4	12.1%
	54	Professional, Scientific, and Technical Services	54	49	52	-2	-3.7%
	55	Management of Companies and Enterprises	8	8	8	0	0.0%
	56	Administrative and Support and Waste Management and Remediation Services	35	38	33	-2	-5.7%
	61	Educational Services	N/A	3	3		
	62	Health Care and Social Assistance	N/A	92	128		
	71	Arts, Entertainment, and Recreation	6	7	8	2	33.3%
72	Accommodation and Food Services	41	44	42	1	2.4%	
81	Other Services (except Public Administration)	122	101	89	-33	-27.0%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Roanoke City, VA	10	Total	3,552	3,404	3,317	-235	-6.6%
	10	Public Sector Total	91	115	122	31	34.1%
	10	Private Sector Total	3,461	3,289	3,195	-266	-7.7%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	3	1		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	4	3		
	23	Construction	N/A	289	271		
	31–33	Manufacturing	136	128	117	-19	-14.0%
	42	Wholesale Trade	N/A	224	199		
	44–45	Retail Trade	616	572	522	-94	-15.3%
	48–49	Transportation and Warehousing	109	102	85	-24	-22.0%
	51	Information	62	64	58	-4	-6.5%
	52	Finance and Insurance	268	235	210	-58	-21.6%
	53	Real Estate and Rental and Leasing	163	164	176	13	8.0%
	54	Professional, Scientific, and Technical Services	326	347	354	28	8.6%
	55	Management of Companies and Enterprises	46	47	53	7	15.2%
	56	Administrative and Support and Waste Management and Remediation Services	144	149	157	13	9.0%
	61	Educational Services	27	25	22	-5	-18.5%
	62	Health Care and Social Assistance	274	251	326	52	19.0%
	71	Arts, Entertainment, and Recreation	32	38	34	2	6.3%
72	Accommodation and Food Services	286	276	283	-3	-1.0%	
81	Other Services (except Public Administration)	419	373	323	-96	-22.9%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-10. Number of Establishments by Sector in 2001, 2005, and 2009  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Salem City, VA	10	Total	953	1,003	1,036	83	8.7%
	10	Public Sector Total	44	54	55	11	25.0%
	10	Private Sector Total	909	949	981	72	7.9%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	1	1		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	N/A	109	93		
	31–33	Manufacturing	71	69	65	–6	–8.5%
	42	Wholesale Trade	76	86	83	7	9.2%
	44–45	Retail Trade	149	135	134	–15	–10.1%
	48–49	Transportation and Warehousing	23	30	31	8	34.8%
	51	Information	14	10	12	–2	–14.3%
	52	Finance and Insurance	61	68	73	12	19.7%
	53	Real Estate and Rental and Leasing	23	28	35	12	52.2%
	54	Professional, Scientific, and Technical Services	82	83	95	13	15.9%
	55	Management of Companies and Enterprises	8	5	5	–3	–37.5%
	56	Administrative and Support and Waste Management and Remediation Services	25	35	42	17	68.0%
	61	Educational Services	N/A	7	9		
	62	Health Care and Social Assistance	N/A	73	99		
	71	Arts, Entertainment, and Recreation	8	10	9	1	12.5%
72	Accommodation and Food Services	84	83	83	–1	–1.2%	
81	Other Services (except Public Administration)	115	116	113	–2	–1.7%	
99	Unclassified	N/A	N/A	N/A			



**Table B-11. Employers in the Core Study Region with 1,000 or More Employees in 2010**

Area	Employer	NAICS Code	Industry Sector
Bedford County, VA	Bedford County School Board	611	Educational Services
Campbell County, VA	Campbell County Schools	611	Educational Services
Campbell County, VA	Babcock & Wilcox Nuclear	332	Fabricated Metal Product Manufacturing
Danville City, VA	Danville City Public Schools	611	Educational Services
Danville City, VA	City of Danville	921	Executive, Legislative, and Other General Government Support
Danville City, VA	Danville Regional Medical	622	Hospitals
Danville City, VA	Goodyear Tire & Rubber Company	326	Tire Manufacturing
Franklin County, VA	Franklin County School Board	611	Educational Services
Halifax County, VA	Halifax County School Board	611	Educational Services
Henry County, VA	Henry County School Board	611	Educational Services
Lynchburg City, VA	Lynchburg City Schools	611	Educational Services
Lynchburg City, VA	City of Lynchburg	921	Executive, Legislative, and Other General Government Support
Lynchburg City, VA	Centra Health	622	Hospitals
Lynchburg City, VA	GNA Corporation	524	Insurance Carriers and Related Activities
Lynchburg City, VA	J. Crew Outfitters	454	Nonstore Retailers
Lynchburg City, VA	Framatome	541	Professional, Scientific, and Technical Services
Pittsylvania County, VA	Pittsylvania County School Board	611	Educational Services
Roanoke City, VA	Carilion Roanoke Memorial Hosp	622	Hospitals
Roanoke City, VA	Anthem Blue Cross Blue Shield	524	Insurance Carriers and Related Activities
Roanoke County, VA	Allstate Insurance Cstmr Svc	524	Insurance Carriers and Related Activities
Rockingham County, NC	Rockingham County Schools	611	Educational Services
Salem City, VA	VA Medical Ctr-Salem	622	Hospitals
Salem City, VA	GE Controls & Power Elctrncs	334	Industrial controls manufacturing
Salem City, VA	Yokohama Tire Corp	326	Tire Manufacturing

Table B-12. Location Quotient

			Location Quotient			2001–2005	2005–2009	2001–2009
			2001	2005	2009			
Study Area	10	Total	1.00	1.00	1.00	0.00	0.00	0.00
	10	Public Sector Total	0.96	1.01	1.04	0.05	0.03	0.08
	10	Private Sector Total	1.01	1.00	0.99	-0.01	-0.01	-0.01
	11	Agriculture, Forestry, Fishing and Hunting	0.27	0.20	0.17	-0.07	-0.03	-0.10
	21	Mining, Quarrying, and Oil and Gas Extraction	0.10	0.05	0.00	-0.05	-0.05	-0.10
	22	Utilities	0.32	0.44	0.39	0.13	-0.06	0.07
	23	Construction	0.82	0.72	0.74	-0.10	0.02	-0.08
	31–33	Manufacturing	1.78	1.68	1.55	-0.10	-0.13	-0.23
	42	Wholesale Trade	0.45	0.62	0.64	0.17	0.02	0.20
	44–45	Retail Trade	1.12	1.12	1.12	0.00	0.00	0.00
	48–49	Transportation and Warehousing	0.81	0.84	0.76	0.03	-0.08	-0.05
	51	Information	0.49	0.51	0.54	0.02	0.03	0.06
	52	Finance and Insurance	0.70	0.71	0.68	0.00	-0.03	-0.03
	53	Real Estate and Rental and Leasing	0.66	0.69	0.74	0.03	0.05	0.07
	54	Professional, Scientific, and Technical Services	0.56	0.52	0.60	-0.04	0.08	0.04
	55	Management of Companies and Enterprises	1.24	1.18	1.19	-0.06	0.01	-0.05
	56	Administrative and Support and Waste Management and Remediation Services	0.71	0.78	0.93	0.07	0.15	0.22
	61	Educational Services	0.51	0.49	0.52	-0.01	0.03	0.02
	62	Health Care and Social Assistance	0.74	0.82	0.87	0.08	0.06	0.13
	71	Arts, Entertainment, and Recreation	0.64	0.66	0.62	0.02	-0.05	-0.02
72	Accommodation and Food Services	0.87	0.89	0.94	0.02	0.05	0.07	
81	Other Services (except Public Administration)	0.82	0.84	0.83	0.02	-0.01	0.01	
99	Unclassified	0.00	0.09	0.11	0.09	0.02	0.11	

**Table B-13. Number of Small Business Establishments by Size for Study Area 2002–2007**

Study Area (n = 21)	Establishments	Net Opened	Net Expanded	Net Moved In
	Total	10,679	1,287	650
	Noncommercial	-271	417	38
	Nonresident	-340	-56	69
	Resident	11,290	926	543
	Self-employed (1)	5,862	2,147	144
	Stage 1 (2–9)	5,729	-997	321
	Stage 2 (10–99)	-286	-191	72
	Stage 3 (100–499)	-8	-22	4
	Stage 4 (500+)	-7	-11	2
<b>By County</b>				
<b>Caswell County, NC</b>	Total	243	1	8
	Noncommercial	6	0	1
	Nonresident	-3	1	1
	Resident	240	0	6
	Self-employed (1)	132	29	2
	Stage 1 (2–9)	113	-23	3
	Stage 2 (10–99)	-5	-6	1
	Stage 3 (100–499)	0	0	0
	Stage 4 (500+)	0	0	0
<b>Person County, NC</b>	Total	495	34	5
	Noncommercial	-7	16	2
	Nonresident	-12	1	1
	Resident	514	17	2
	Self-employed (1)	294	96	2
	Stage 1 (2–9)	226	-74	1
	Stage 2 (10–99)	-7	-4	-1
	Stage 3 (100–499)	0	0	0
	Stage 4 (500+)	1	-1	0

(continued)

**Table B-13. Number of Small Business Establishments by Size for Study Area 2002–2007 (continued)**

<b>Study Area (n = 21)</b>	<b>Establishments</b>	<b>Net Opened</b>	<b>Net Expanded</b>	<b>Net Moved In</b>
<b>Rockingham County, NC</b>	Total	909	36	-31
	Noncommercial	-27	42	-1
	Nonresident	-40	-4	-1
	Resident	976	-2	-29
	Self-employed (1)	512	204	-19
	Stage 1 (2–9)	494	-158	-8
	Stage 2 (10–99)	-25	-47	-1
	Stage 3 (100–499)	-5	1	-1
	Stage 4 (500+)	0	-2	0
<b>Amherst County, VA</b>	Total	289	88	11
	Noncommercial	2	19	2
	Nonresident	-2	-1	-2
	Resident	289	70	11
	Self-employed (1)	146	71	0
	Stage 1 (2–9)	150	8	10
	Stage 2 (10–99)	-8	-10	1
	Stage 3 (100–499)	1	1	0
	Stage 4 (500+)	0	0	0
<b>Bedford City and County, VA</b>	Total	1200	236	63
	Noncommercial	-49	20	6
	Nonresident	-11	2	-2
	Resident	1260	214	59
	Self-employed (1)	636	196	13
	Stage 1 (2–9)	637	7	43
	Stage 2 (10–99)	-12	14	2
	Stage 3 (100–499)	0	-3	1
	Stage 4 (500+)	-1	0	0

(continued)

**Table B-13. Number of Small Business Establishments by Size for Study Area 2002–2007 (continued)**

<b>Study Area (n = 21)</b>	<b>Establishments</b>	<b>Net Opened</b>	<b>Net Expanded</b>	<b>Net Moved In</b>
<b>Campbell County, VA</b>	Total	375	65	2
	Noncommercial	-2	24	2
	Nonresident	-2	-2	2
	Resident	379	43	-2
	Self-employed (1)	228	85	-2
	Stage 1 (2–9)	157	-32	2
	Stage 2 (10–99)	-7	-11	-2
	Stage 3 (100–499)	1	1	0
	Stage 4 (500+)	0	0	0
<b>Charlotte County, VA</b>	Total	165	20	2
	Noncommercial	9	3	-1
	Nonresident	-5	-4	0
	Resident	161	21	3
	Self-employed (1)	108	29	3
	Stage 1 (2–9)	58	-6	-2
	Stage 2 (10–99)	-5	-2	2
	Stage 3 (100–499)	0	0	0
	Stage 4 (500+)	0	0	0
<b>Franklin County, VA</b>	Total	701	122	54
	Noncommercial	-2	26	-4
	Nonresident	-6	-4	4
	Resident	709	100	54
	Self-employed (1)	342	141	19
	Stage 1 (2–9)	380	-32	32
	Stage 2 (10–99)	-12	-3	2
	Stage 3 (100–499)	0	-5	1
	Stage 4 (500+)	-1	-1	0

(continued)

**Table B-13. Number of Small Business Establishments by Size for Study Area 2002–2007 (continued)**

<b>Study Area (n = 21)</b>	<b>Establishments</b>	<b>Net Opened</b>	<b>Net Expanded</b>	<b>Net Moved In</b>
<b>Halifax County, VA</b>	Total	249	52	10
	Noncommercial	-21	17	-1
	Nonresident	-11	4	-1
	Resident	281	31	12
	Self-employed (1)	175	73	6
	Stage 1 (2–9)	118	-56	6
	Stage 2 (10–99)	-11	13	-1
	Stage 3 (100–499)	-1	1	1
	Stage 4 (500+)	0	0	0
<b>Henry County, VA</b>	Total	306	-28	3
	Noncommercial	-21	6	5
	Nonresident	-14	5	0
	Resident	341	-39	-2
	Self-employed (1)	198	74	0
	Stage 1 (2–9)	155	-93	0
	Stage 2 (10–99)	-9	-15	-1
	Stage 3 (100–499)	-1	-2	-1
	Stage 4 (500+)	-2	-3	0
<b>Mecklenburg County, VA</b>				
	Total	373	35	22
	Noncommercial	-11	26	1
	Nonresident	-22	-8	0
	Resident	406	17	21
	Self-employed (1)	241	83	0
	Stage 1 (2–9)	173	-48	15
	Stage 2 (10–99)	-8	-20	6
	Stage 3 (100–499)	0	2	0
	Stage 4 (500+)	0	0	0

(continued)

**Table B-13. Number of Small Business Establishments by Size for Study Area 2002–2007 (continued)**

<b>Study Area (n = 21)</b>	<b>Establishments</b>	<b>Net Opened</b>	<b>Net Expanded</b>	<b>Net Moved In</b>
<b>Patrick County, VA</b>	Total	202	44	8
	Noncommercial	3	13	0
	Nonresident	-4	1	0
	Resident	203	30	8
	Self-employed (1)	99	35	7
	Stage 1 (2–9)	110	-4	0
	Stage 2 (10–99)	-6	0	0
	Stage 3 (100–499)	0	-1	1
	Stage 4 (500+)	0	0	0
<b>Pittsylvania County, VA</b>	Total	410	-21	15
	Noncommercial	-6	-1	-2
	Nonresident	-10	-4	0
	Resident	426	-16	17
	Self-employed (1)	249	78	10
	Stage 1 (2–9)	184	-91	10
	Stage 2 (10–99)	-7	-3	-3
	Stage 3 (100–499)	0	0	0
	Stage 4 (500+)	0	0	0
<b>Roanoke County, VA</b>	Total	1104	91	469
	Noncommercial	-45	35	29
	Nonresident	-42	-13	72
	Resident	1191	69	368
	Self-employed (1)	585	180	73
	Stage 1 (2–9)	628	-113	229
	Stage 2 (10–99)	-20	7	63
	Stage 3 (100–499)	-1	-4	2
	Stage 4 (500+)	-1	-1	1

(continued)

**Table B-13. Number of Small Business Establishments by Size for Study Area 2002–2007 (continued)**

<b>Study Area (n = 21)</b>	<b>Establishments</b>	<b>Net Opened</b>	<b>Net Expanded</b>	<b>Net Moved In</b>
<b>Danville City, VA</b>	Total	559	91	-2
	Noncommercial	-26	15	3
	Nonresident	-24	2	-2
	Resident	609	74	-3
	Self-employed (1)	295	117	-4
	Stage 1 (2–9)	337	-31	2
	Stage 2 (10–99)	-24	-13	-1
	Stage 3 (100–499)	1	3	0
	Stage 4 (500+)	0	-2	0
<b>Lynchburg City, VA</b>	Total	965	201	-9
	Noncommercial	-24	71	-3
	Nonresident	-69	8	-4
	Resident	1058	122	-2
	Self-employed (1)	527	233	9
	Stage 1 (2–9)	589	-77	-13
	Stage 2 (10–99)	-54	-16	3
	Stage 3 (100–499)	-2	-15	-1
	Stage 4 (500+)	-2	-3	0
<b>Martinsville City, VA</b>	Total	302	46	-13
	Noncommercial	-6	21	-3
	Nonresident	-25	1	0
	Resident	333	24	-10
	Self-employed (1)	151	81	-4
	Stage 1 (2–9)	196	-47	-8
	Stage 2 (10–99)	-13	-13	0
	Stage 3 (100–499)	-1	2	2
	Stage 4 (500+)	0	1	0

(continued)



**Table B-13. Number of Small Business Establishments by Size for Study Area 2002–2007 (continued)**

<b>Study Area (n = 21)</b>	<b>Establishments</b>	<b>Net Opened</b>	<b>Net Expanded</b>	<b>Net Moved In</b>
Salem City, VA	Total	418	17	-14
	Noncommercial	-6	9	-2
	Nonresident	-16	-10	-1
	Resident	440	18	-11
	Self-employed (1)	230	92	-2
	Stage 1 (2–9)	214	-73	-12
	Stage 2 (10–99)	-2	-6	2
	Stage 3 (100–499)	-1	5	0
	Stage 4 (500+)	-1	0	1

**Table B-14. Jobs Created by Small Businesses by Stage (Size)**

<b>Study Area</b>				
<b>Jobs</b>	<b>2002</b>	<b>2007</b>	<b>Change</b>	<b>%</b>
Total	468,441	465,646	-2,795	-0.006
Noncommercial	94,404	97,085	2,681	0.027615
Nonresident	117,797	103,591	-14,206	-0.13714
Resident	256,240	264,970	8,730	0.032947
Self-employed (1)	10,520	16,199	5,679	0.350577
Stage 1 (2-9)	73,002	84,224	11,222	0.13324
Stage 2 (10-99)	93,892	96,154	2,262	0.023525
Stage 3 (100-499)	40,812	40,670	-142	-0.00349
Stage 4 (500+)	38,014	27,723	-10,291	-0.37121
<b>Caswell, NC</b>				
Total	3,601	4,124	523	0.145
Noncommercial	1,204	1,243	39	0.032
Nonresident	220	288	68	0.309
Resident	2,177	2,593	416	0.191
Self-employed (1)	190	324	134	0.705
Stage 1 (2-9)	961	1,181	220	0.229
Stage 2 (10-99)	776	838	62	0.08
Stage 3 (100-499)	250	250	0	0
Stage 4 (500+)	0	0	0	0
<b>Person County</b>				
Total	14,896	14,334	-562	-0.038
Noncommercial	2,133	1,974	-159	-0.075
Nonresident	5,082	3,954	-1,128	-0.222
Resident	7,681	8,406	725	0.094
Self-employed (1)	453	754	301	0.664
Stage 1 (2-9)	2,873	3,222	349	0.121
Stage 2 (10-99)	3,178	3,321	143	0.045
Stage 3 (100-499)	1,177	1,109	-68	-0.058
Stage 4 (500+)	0	0	0	0

(continued)

Table B-14. Jobs Created by Small Businesses by Stage (Size) (continued)

Study Area				
Jobs	2002	2007	Change	%
<b>Amherst County</b>				
Total	9,005	9,705	700	0.078
Noncommercial	1,839	2,091	252	0.137
Nonresident	2,224	1,870	-354	-0.159
Resident	4,942	5,744	802	0.162
Self-employed (1)	319	443	124	0.389
Stage 1 (2-9)	2,016	2,416	400	0.198
Stage 2 (10-99)	2,217	2,025	-192	-0.087
Stage 3 (100-499)	390	860	470	1.205
Stage 4 (500+)	0	0	0	0
<b>Appomattox County</b>				
Total	4,804	4,397	-407	-0.085
Noncommercial	759	780	21	0.028
Nonresident	1,278	586	-692	-0.541
Resident	2,767	3,031	264	0.095
Self-employed (1)	128	234	106	0.828
Stage 1 (2-9)	931	1,009	78	0.084
Stage 2 (10-99)	1,208	1,288	80	0.066
Stage 3 (100-499)	0	0	0	0
Stage 4 (500+)	500	500	0	0
<b>Bedford City and County, VA</b>				
Total	24,922	27,516	2,594	0.104
Noncommercial	6,744	6,720	-24	-0.004
Nonresident	2,712	2,421	-291	-0.107
Resident	15,466	18,375	2,909	0.188
Self-employed (1)	824	1,404	580	0.704
Stage 1 (2-9)	4,878	6,614	1,736	0.356
Stage 2 (10-99)	5,628	6,146	518	0.092
Stage 3 (100-499)	3,236	4,211	975	0.301
Stage 4 (500+)	900	0	-900	-1

(continued)

Table B-14. Jobs Created by Small Businesses by Stage (Size) (continued)

Study Area				
Jobs	2002	2007	Change	%
<b>Campbell County, VA</b>				
Total	15,957	17,144	1,187	0.074
Noncommercial	4,524	4,580	56	0.012
Nonresident	4,428	4,313	-115	-0.026
Resident	7,005	8,251	1,246	0.178
Self-employed (1)	343	547	204	0.595
Stage 1 (2-9)	2,387	2,842	455	0.191
Stage 2 (10-99)	3,000	2,687	-313	-0.104
Stage 3 (100-499)	1,275	2,175	900	0.706
Stage 4 (500+)	0	0	0	0
<b>Charlotte County, VA</b>				
Total	4,166	3,895	-271	-0.065
Noncommercial	1,326	896	-430	-0.324
Nonresident	466	355	-111	-0.238
Resident	2,374	2,644	270	0.114
Self-employed (1)	158	268	110	0.696
Stage 1 (2-9)	938	1,044	106	0.113
Stage 2 (10-99)	1,108	1,062	-46	-0.042
Stage 3 (100-499)	170	270	100	0.588
Stage 4 (500+)	0	0	0	0
<b>Franklin County, VA</b>				
Total	16,310	16,808	498	0.031
Noncommercial	2,887	2,791	-96	-0.033
Nonresident	3,100	2,937	-163	-0.053
Resident	10,323	11,080	757	0.073
Self-employed (1)	621	939	318	0.512
Stage 1 (2-9)	3,886	4,916	1,030	0.265
Stage 2 (10-99)	3,490	3,608	118	0.034
Stage 3 (100-499)	1,804	1,617	-187	-0.104
Stage 4 (500+)	522	0	-522	-1

(continued)

Table B-14. Jobs Created by Small Businesses by Stage (Size) (continued)

Study Area				
Jobs	2002	2007	Change	%
<b>Halifax County</b>				
Total	16,665	14,533	-2,132	-0.128
Noncommercial	2,962	2,715	-247	-0.083
Nonresident	5,765	3,791	-1,974	-0.342
Resident	7,938	8,027	89	0.011
Self-employed (1)	456	657	201	0.441
Stage 1 (2-9)	2,902	2,976	74	0.025
Stage 2 (10-99)	3,025	3,234	209	0.069
Stage 3 (100-499)	965	570	-395	-0.409
Stage 4 (500+)	590	590	0	0
<b>Henry County</b>				
Total	21,672	15,173	-6,499	-0.3
Noncommercial	2,267	2,442	175	0.077
Nonresident	4,622	2,914	-1,708	-0.37
Resident	14,783	9,817	-4,966	-0.336
Self-employed (1)	460	692	232	0.504
Stage 1 (2-9)	2,352	2,564	212	0.09
Stage 2 (10-99)	3,016	2,781	-235	-0.078
Stage 3 (100-499)	2,179	1,480	-699	-0.321
Stage 4 (500+)	6,776	2,300	-4,476	-0.661
<b>Mecklenburg County, VA</b>				
Total	16,117	14,790	-1,327	-0.082
Noncommercial	2,665	2,604	-61	-0.023
Nonresident	5,104	2,838	-2,266	-0.444
Resident	8,348	9,348	1,000	0.12
Self-employed (1)	451	690	239	0.53
Stage 1 (2-9)	3,280	3,678	398	0.121
Stage 2 (10-99)	3,309	3,370	61	0.018
Stage 3 (100-499)	558	860	302	0.541
Stage 4 (500+)	750	750	0	0

(continued)

Table B-14. Jobs Created by Small Businesses by Stage (Size) (continued)

Study Area				
Jobs	2002	2007	Change	%
<b>Montgomery County, VA</b>				
Total	49,556	59,167	9,611	0.194
Noncommercial	20,143	25,906	5,763	0.286
Nonresident	7,952	8,740	788	0.099
Resident	21,461	24,521	3,060	0.143
Self-employed (1)	821	1,242	421	0.513
Stage 1 (2–9)	6,602	7,475	873	0.132
Stage 2 (10–99)	10,621	10,449	–172	–0.016
Stage 3 (100–499)	2,817	2,506	–311	–0.11
Stage 4 (500+)	600	2,849	2,249	3.748
<b>Patrick County, VA</b>				
Total	5,704	6,170	466	0.082
Noncommercial	796	850	54	0.068
Nonresident	1,380	1,106	–274	–0.199
Resident	3,528	4,214	686	0.194
Self-employed (1)	222	323	101	0.455
Stage 1 (2–9)	1,265	1,481	216	0.171
Stage 2 (10–99)	1,496	1,480	–16	–0.011
Stage 3 (100–499)	545	930	385	0.706
Stage 4 (500+)	0	0	0	0
<b>Pittsylvania County, VA</b>				
Total	11,937	10,772	–1,165	–0.098
Noncommercial	2,578	2,739	161	0.062
Nonresident	3,997	2,037	–1,960	–0.49
Resident	5,362	5,996	634	0.118
Self-employed (1)	466	729	263	0.564
Stage 1 (2–9)	2,419	2,761	342	0.141
Stage 2 (10–99)	2,029	1,923	–106	–0.052
Stage 3 (100–499)	448	583	135	0.301
Stage 4 (500+)	0	0	0	0

(continued)

Table B-14. Jobs Created by Small Businesses by Stage (Size) (continued)

Study Area				
Jobs	2002	2007	Change	%
<b>Roanoke County, VA</b>				
Total	39,491	41,712	2,221	0.056
Noncommercial	7,999	8,159	160	0.02
Nonresident	10,353	9,194	-1,159	-0.112
Resident	21,139	24,359	3,220	0.152
Self-employed (1)	952	1,617	665	0.699
Stage 1 (2-9)	6,439	8,325	1,886	0.293
Stage 2 (10-99)	8,926	10,380	1,454	0.163
Stage 3 (100-499)	3,972	4,037	65	0.016
Stage 4 (500+)	850	0	-850	-1
<b>Danville, VA</b>				
Total	36,820	43,511	6,691	0.182
Noncommercial	4,568	4,196	-372	-0.081
Nonresident	10,267	11,764	1,497	0.146
Resident	21,985	27,551	5,566	0.253
Self-employed (1)	648	958	310	0.478
Stage 1 (2-9)	5,546	6,095	549	0.099
Stage 2 (10-99)	7,976	8,051	75	0.009
Stage 3 (100-499)	3,615	3,547	-68	-0.019
Stage 4 (500+)	4,200	8,900	4,700	1.119
<b>Lynchburg, VA</b>				
Total	79,730	68,187	-11,543	-0.145
Noncommercial	12,954	10,641	-2,313	-0.179
Nonresident	24,617	20,203	-4,414	-0.179
Resident	42,159	37,343	-4,816	-0.114
Self-employed (1)	1,040	1,515	475	0.457
Stage 1 (2-9)	8,886	10,000	1,114	0.125
Stage 2 (10-99)	14,653	14,828	175	0.012
Stage 3 (100-499)	6,664	5,316	-1,348	-0.202
Stage 4 (500+)	10,916	5,684	-5,232	-0.479

(continued)

Table B-14. Jobs Created by Small Businesses by Stage (Size) (continued)

Study Area				
Jobs	2002	2007	Change	%
<b>Martinsville, VA</b>				
Total	25,620	25,691	71	0.003
Noncommercial	2,939	2,981	42	0.014
Nonresident	9,367	9,550	183	0.02
Resident	13,314	13,160	-154	-0.012
Self-employed (1)	460	616	156	0.339
Stage 1 (2-9)	3,435	3,661	226	0.066
Stage 2 (10-99)	4,399	4,713	314	0.071
Stage 3 (100-499)	1,970	2,670	700	0.355
Stage 4 (500+)	3,050	1,500	-1,550	-0.508
<b>Salem, VA</b>				
Total	30,078	31,363	1,285	0.043
Noncommercial	6,534	6,393	-141	-0.022
Nonresident	5,903	8,719	2,816	0.477
Resident	17,641	16,251	-1,390	-0.079
Self-employed (1)	434	677	243	0.56
Stage 1 (2-9)	3,680	3,943	263	0.071
Stage 2 (10-99)	6,058	6,159	101	0.017
Stage 3 (100-499)	3,669	3,172	-497	-0.135
Stage 4 (500+)	3,800	2,300	-1,500	-0.395



Table B-15. Employer Revenues by Sector, 2002 and 2007 (\$1,000)

Geographic Area Name	NAICS Code	Meaning of 2002 NAICS Code	2007 Employer Receipts (\$1,000)	2002 Employer Receipts (\$1,000)	Percentage Change, 2002–2007
United States	21	Mining, quarrying, and oil and gas extraction	413,524,731	N/A	N/A
	22	Utilities	584,192,658	398,907,044	46.4%
	23	Construction	1,731,841,830	N/A	N/A
	31–33	Manufacturing	5,319,456,312	3,918,851,117	35.7%
	44–45	Retail trade	3,917,663,456	3,056,421,997	28.2%
	48–49	Transportation and warehousing	639,916,407	382,152,040	67.5%
	51	Information	1,072,342,856	891,845,956	20.2%
	52	Finance and insurance	3,669,302,691	2,803,854,868	30.9%
	53	Real estate and rental and leasing	485,058,597	335,587,706	44.5%
	54	Professional, scientific, and technical services	1,251,003,504	886,801,038	41.1%
	55	Management of companies and enterprises	104,442,966	107,064,264	–2.4%
	56	Administrative and Support and Waste Mang and Remediation Srvs	630,771,091	432,577,580	45.8%
	61	Educational services	44,980,656	30,690,707	46.6%
	62	Health care and social assistance	1,668,276,808	1,207,299,734	38.2%
	71	Arts, entertainment, and recreation	189,416,942	141,904,109	33.5%
	72	Accommodation and food services	613,795,732	449,498,718	36.6%
	81	Other services (except public administration)	405,284,048	307,049,461	32.0%
Virginia	21	Mining, quarrying, and oil and gas extraction	4,480,783	2,277,885	96.7%
	22	Utilities	N/A	N/A	N/A
	23	Construction	51,968,222	33,667,129	54.4%
	31–33	Manufacturing	92,417,797	83,952,547	10.1%
	42	Wholesale trade	94,658,929	69,267,796	36.7%
	44–45	Retail trade	105,663,299	80,509,062	31.2%
	48–49	Transportation and warehousing	10,993,371	7,137,609	54.0%
	51	Information	N/A	N/A	N/A
	52	Finance and insurance	N/A	N/A	N/A
	53	Real estate and rental and leasing	12,636,795	8,038,543	57.2%
	54	Professional, scientific, and technical services	68,693,490	40,683,149	68.8%
	55	Management of companies and enterprises	13,303,763	1,239,245	973.5%
	56	Administrative and Support and Waste Mang and Remediation Srvs	18,239,660	11,730,310	55.5%
	61	Educational services	1,499,952	989,795	51.5%
	62	Health care and social assistance	37,522,004	28,199,263	33.1%
	71	Arts, entertainment, and recreation	3,803,476	2,781,488	36.7%
	72	Accommodation and food services	15,340,483	10,929,429	40.4%
81	Other services (except public administration)	16,498,183	11,910,043	38.5%	

(continued)

Table B-15. Employer Revenues by Sector, 2002 and 2007 (\$1,000) (continued)

Geographic Area Name	NAICS Code	Meaning of 2002 NAICS Code	2007 Employer Receipts (\$1,000)	2002 Employer Receipts (\$1,000)	Percentage Change, 2002–2007
Study Area	31–33	Manufacturing	16,818,417	16,387,447	2.6%
	44–45	Retail trade	11,178,308	9,531,452	17.3%
	51	Information	0	0	N/A
	53	Real estate & rental & leasing	584,632	472,771	23.7%
	54	Professional, scientific, & technical services	764,873	948,833	–19.4%
	56	Administrative & support & waste management & remediation service	910,679	657,986	38.4%
	61	Educational services	0	12,277	N/A
	62	Health care & social assistance	4,434,977	2,905,131	52.7%
	71	Arts, entertainment, & recreation	165,545	102,207	62.0%
	72	Accommodation & food services	1,189,232	883,937	34.5%
	81	Other services (except public administration)	681,620	476,440	43.1%
Caswell County, NC	31–33	Manufacturing	N/A	N/A	N/A
	44–45	Retail trade	52,986	40,359	31.3%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	733	D	N/A
	54	Professional, scientific, and technical services	4,292	2,222	93.2%
	56	Administrative and Support and Waste Mang and Remediation Srvs	1,366	2,078	–34.3%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	18,066	15,315	18.0%
	71	Arts, entertainment, and recreation	765	D	N/A
	72	Accommodation and food services	5,410	2,517	114.9%
	81	Other services (except public administration)	4,013	3,053	31.4%
Person County, NC	31–33	Manufacturing	D	1,443,870	N/A
	44–45	Retail trade	384,238	305,362	25.8%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	8,823	6,409	37.7%
	54	Professional, scientific, and technical services	D	10,469	N/A
	56	Administrative and Support and Waste Mang and Remediation Srvs	12,272	11,512	6.6%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	89,973	69,370	29.7%
	71	Arts, entertainment, and recreation	5,294	5,528	–4.2%
	72	Accommodation and food services	37,380	25,319	47.6%
	81	Other services (except public administration)	15,059	14,191	6.1%

(continued)

Table B-15. Employer Revenues by Sector, 2002 and 2007 (\$1,000) (continued)

Geographic Area Name	NAICS Code	Meaning of 2002 NAICS Code	2007 Employer Receipts (\$1,000)	2002 Employer Receipts (\$1,000)	Percentage Change, 2002–2007
Rockingham County, NC	31–33	Manufacturing	3,118,411	3,176,085	–1.8%
	44–45	Retail trade	839,555	748,225	12.2%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	15,732	15,089	4.3%
	54	Professional, scientific, and technical services	D	D	N/A
	56	Administrative and Support and Waste Mang and Remediation Srvs	90,714	57,270	58.4%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	291,215	227,864	27.8%
	71	Arts, entertainment, and recreation	14,321	14,201	0.8%
	72	Accommodation and food services	84,590	65,426	29.3%
	81	Other services (except public administration)	36,301	29,504	23.0%
Amherst County, VA	31–33	Manufacturing	554,193	478,009	15.9%
	44–45	Retail trade	311,758	226,771	37.5%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	5,236	4,082	28.3%
	54	Professional, scientific, and technical services	11,126	7,389	50.6%
	56	Administrative and Support and Waste Mang and Remediation Srvs	8,479	4,732	79.2%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	D	20,590	N/A
	71	Arts, entertainment, and recreation	D	1,928	N/A
	72	Accommodation and food services	23,765	20,089	18.3%
	81	Other services (except public administration)	12,358	13,142	–6.0%
Appomattox County, VA	31–33	Manufacturing	D	64,153	N/A
	44–45	Retail trade	107,167	76,416	40.2%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	5,742	852	573.9%
	54	Professional, scientific, and technical services	D	3,903	N/A
	56	Administrative and Support and Waste Mang and Remediation Srvs	2,250	2,130	5.6%
	61	Educational services	D	N/A	N/A
	62	Health care and social assistance	D	7,654	N/A
	71	Arts, entertainment, and recreation	D	D	N/A
	72	Accommodation and food services	7,267	5,745	26.5%
	81	Other services (except public administration)	4,216	3,725	13.2%

(continued)

Table B-15. Employer Revenues by Sector, 2002 and 2007 (\$1,000) (continued)

Geographic Area Name	NAICS Code	Meaning of 2002 NAICS Code	2007 Employer Receipts (\$1,000)	2002 Employer Receipts (\$1,000)	Percentage Change, 2002–2007
Bedford County, VA	31–33	Manufacturing	785,359	485,632	61.7%
	44–45	Retail trade	466,545	297,077	57.0%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	20,764	20,537	1.1%
	54	Professional, scientific, and technical services	82,653	79,827	3.5%
	56	Administrative and Support and Waste Mang and Remediation Srvs	61,933	36,634	69.1%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	D	34,197	N/A
	71	Arts, entertainment, and recreation	13,812	10,838	27.4%
	72	Accommodation and food services	27,892	13,434	107.6%
	81	Other services (except public administration)	22,941	27,993	–18.0%
Campbell County, VA	31–33	Manufacturing	1,527,558	922,542	65.6%
	44–45	Retail trade	511,759	367,924	39.1%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	19,218	11,637	65.1%
	54	Professional, scientific, and technical services	79,066	46,042	71.7%
	56	Administrative and Support and Waste Mang and Remediation Srvs	48,677	37,318	30.4%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	40,833	23,576	73.2%
	71	Arts, entertainment, and recreation	1,441	1,205	19.6%
	72	Accommodation and food services	32,679	24,229	34.9%
	81	Other services (except public administration)	34,300	25,344	35.3%
Charlotte County, VA	31–33	Manufacturing	91,908	138,832	–33.8%
	44–45	Retail trade	62,090	58,327	6.5%
	51	Information	N	N/A	N/A
	53	Real estate and rental and leasing	548	D	N/A
	54	Professional, scientific, and technical services	D	2,409	N/A
	56	Administrative and Support and Waste Mang and Remediation Srvs	884	1,842	–52.0%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	13,898	8,149	70.5%
	71	Arts, entertainment, and recreation	1,023	D	N/A
	72	Accommodation and food services	2,729	D	N/A
	81	Other services (except public administration)	3,156	D	N/A

(continued)

Table B-15. Employer Revenues by Sector, 2002 and 2007 (\$1,000) (continued)

Geographic Area Name	NAICS Code	Meaning of 2002 NAICS Code	2007 Employer Receipts (\$1,000)	2002 Employer Receipts (\$1,000)	Percentage Change, 2002–2007
Franklin County, VA	31–33	Manufacturing	D	427,304	N/A
	44–45	Retail trade	444,514	313,940	41.6%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	27,157	9,580	183.5%
	54	Professional, scientific, and technical services	21,368	13,899	53.7%
	56	Administrative and Support and Waste Mang and Remediation Srvs	D	48,942	N/A
	61	Educational services	D	D	N/A
	62	Health care and social assistance	D	52,710	N/A
	71	Arts, entertainment, and recreation	D	3,576	N/A
	72	Accommodation and food services	40,310	D	N/A
	81	Other services (except public administration)	22,803	16,457	38.6%
Halifax County, VA	31–33	Manufacturing	620,067	570,302	8.7%
	44–45	Retail trade	324,090	269,357	20.3%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	11,843	13,487	-12.2%
	54	Professional, scientific, and technical services	D	9,366	N/A
	56	Administrative and Support and Waste Mang and Remediation Srvs	16,357	12,183	34.3%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	140,382	113,685	23.5%
	71	Arts, entertainment, and recreation	10,524	11,046	-4.7%
	72	Accommodation and food services	31,245	31,851	-1.9%
	81	Other services (except public administration)	24,767	15,763	57.1%
Henry County, VA	31–33	Manufacturing	1,097,915	1,017,410	7.9%
	44–45	Retail trade	436,996	428,619	2.0%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	13,335	6,285	112.2%
	54	Professional, scientific, and technical services	D	10,057	N/A
	56	Administrative and Support and Waste Mang and Remediation Srvs	45,659	16,038	184.7%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	41,849	25,627	63.3%
	71	Arts, entertainment, and recreation	10,429	D	N/A
	72	Accommodation and food services	38,392	31,555	21.7%
	81	Other services (except public administration)	24,032	D	N/A

(continued)

Table B-15. Employer Revenues by Sector, 2002 and 2007 (\$1,000) (continued)

Geographic Area Name	NAICS Code	Meaning of 2002 NAICS Code	2007 Employer Receipts (\$1,000)	2002 Employer Receipts (\$1,000)	Percentage Change, 2002–2007
Mecklenburg County, VA	31–33	Manufacturing	281,033	348,808	–19.4%
	44–45	Retail trade	406,322	348,098	16.7%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	15,852	10,666	48.6%
	54	Professional, scientific, and technical services	21,688	13,803	57.1%
	56	Administrative and Support and Waste Mang and Remediation Srvs	9,262	30,251	–69.4%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	149,447	93,315	60.2%
	71	Arts, entertainment, and recreation	3,322	2,517	32.0%
	72	Accommodation and food services	43,485	33,868	28.4%
81	Other services (except public administration)	21,090	12,649	66.7%	
Patrick County, VA	31–33	Manufacturing	248,454	149,344	66.4%
	44–45	Retail trade	148,590	82,365	80.4%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	2,244	1,552	44.6%
	54	Professional, scientific, and technical services	D	3,032	N/A
	56	Administrative and Support and Waste Mang and Remediation Srvs	2,661	1,386	92.0%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	29,230	24,096	21.3%
	71	Arts, entertainment, and recreation	D	D	N/A
	72	Accommodation and food services	6,647	5,225	27.2%
81	Other services (except public administration)	4,060	3,547	14.5%	
Pittsylvania County, VA	31–33	Manufacturing	752,137	673,496	11.7%
	44–45	Retail trade	269,316	307,166	–12.3%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	5,706	5,512	3.5%
	54	Professional, scientific, and technical services	D	14,950	N/A
	56	Administrative and Support and Waste Mang and Remediation Srvs	34,195	21,832	56.6%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	30,733	29,993	2.5%
	71	Arts, entertainment, and recreation	4,306	D	N/A
	72	Accommodation and food services	15,256	12,970	17.6%
81	Other services (except public administration)	19,002	D	N/A	

(continued)

Table B-15. Employer Revenues by Sector, 2002 and 2007 (\$1,000) (continued)

Geographic Area Name	NAICS Code	Meaning of 2002 NAICS Code	2007 Employer Receipts (\$1,000)	2002 Employer Receipts (\$1,000)	Percentage Change, 2002–2007
Roanoke County, VA	31–33	Manufacturing	896,071	568,537	57.6%
	44–45	Retail trade	835,653	835,274	0.0%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	69,955	54,749	27.8%
	54	Professional, scientific, and technical services	D	D	N/A
	56	Administrative and Support and Waste Mang and Remediation Srvs	92,831	63,081	47.2%
	61	Educational services	D	8,716	N/A
	62	Health care and social assistance	340,949	188,891	80.5%
	71	Arts, entertainment, and recreation	D	D	N/A
	72	Accommodation and food services	112,694	86,200	30.7%
	81	Other services (except public administration)	68,377	55,691	22.8%
Bedford City, VA	31–33	Manufacturing	D	164,655	N/A
	44–45	Retail trade	124,881	108,730	14.9%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	5,069	2,925	73.3%
	54	Professional, scientific, and technical services	D	6,935	N/A
	56	Administrative and Support and Waste Mang and Remediation Srvs	11,783	7,688	53.3%
	61	Educational services	D	N/A	N/A
	62	Health care and social assistance	D	24,234	N/A
	71	Arts, entertainment, and recreation	D	D	N/A
	72	Accommodation and food services	15,426	15,597	-1.1%
	81	Other services (except public administration)	21,312	17,144	24.3%
Danville City, VA	31–33	Manufacturing	1,275,937	1,389,804	-8.2%
	44–45	Retail trade	892,207	672,723	32.6%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	41,377	37,226	11.2%
	54	Professional, scientific, and technical services	D	25,953	N/A
	56	Administrative and Support and Waste Mang and Remediation Srvs	56,089	25,456	120.3%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	407,145	320,446	27.1%
	71	Arts, entertainment, and recreation	5,965	D	N/A
	72	Accommodation and food services	110,262	88,898	24.0%
	81	Other services (except public administration)	52,970	D	N/A

(continued)

Table B-15. Employer Revenues by Sector, 2002 and 2007 (\$1,000) (continued)

Geographic Area Name	NAICS Code	Meaning of 2002 NAICS Code	2007 Employer Receipts (\$1,000)	2002 Employer Receipts (\$1,000)	Percentage Change, 2002–2007
Lynchburg City, VA	31–33	Manufacturing	2,801,602	1,758,135	59.4%
	44–45	Retail trade	1,665,130	1,420,834	17.2%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	72,369	56,387	28.3%
	54	Professional, scientific, and technical services	528,155	396,540	33.2%
	56	Administrative and Support and Waste Mang and Remediation Srvs	100,389	69,702	44.0%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	828,141	552,515	49.9%
	71	Arts, entertainment, and recreation	26,120	18,103	44.3%
	72	Accommodation and food services	189,961	130,883	45.1%
81	Other services (except public administration)	80,331	73,962	8.6%	
Martinsville City, VA	31–33	Manufacturing	201,385	415,735	-51.6%
	44–45	Retail trade	316,916	218,572	45.0%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	22,494	14,349	56.8%
	54	Professional, scientific, and technical services	16,525	20,421	-19.1%
	56	Administrative and Support and Waste Mang and Remediation Srvs	44,844	47,440	-5.5%
	61	Educational services	D	D	N/A
	62	Health care and social assistance	115,790	173,432	-33.2%
	71	Arts, entertainment, and recreation	23,491	D	N/A
	72	Accommodation and food services	28,727	27,745	3.5%
81	Other services (except public administration)	16,914	D	N/A	
Roanoke City, VA	31–33	Manufacturing	1,582,354	1,026,999	54.1%
	44–45	Retail trade	2,039,763	1,712,312	19.1%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	188,558	174,745	7.9%
	54	Professional, scientific, and technical services	D	281,616	N/A
	56	Administrative and Support and Waste Mang and Remediation Srvs	270,034	103,544	160.8%
	61	Educational services	D	3,561	N/A
	62	Health care and social assistance	1,301,188	899,472	44.7%
	71	Arts, entertainment, and recreation	44,732	26,655	67.8%
	72	Accommodation and food services	267,171	214,221	24.7%
81	Other services (except public administration)	155,724	134,087	16.1%	

(continued)



Table B-15. Employer Revenues by Sector, 2002 and 2007 (\$1,000) (continued)

Geographic Area Name	NAICS Code	Meaning of 2002 NAICS Code	2007 Employer Receipts (\$1,000)	2002 Employer Receipts (\$1,000)	Percentage Change, 2002–2007
Salem City, VA	31–33	Manufacturing	984,033	1,167,795	–15.7%
	44–45	Retail trade	537,832	693,001	–22.4%
	51	Information	N	N	N/A
	53	Real estate and rental and leasing	31,877	26,702	19.4%
	54	Professional, scientific, and technical services	D	D	N/A
	56	Administrative and Support and Waste Mang and Remediation Srvs	D	56,927	N/A
	61	Educational services	D	D	N/A
	62	Health care and social assistance	596,138	D	N/A
	71	Arts, entertainment, and recreation	D	6,610	N/A
	72	Accommodation and food services	67,944	48,165	41.1%
	81	Other services (except public administration)	37,894	30,188	25.5%

Note: To maintain confidentiality, the Census Bureau suppresses data to protect the identity of any business or individual.

Source: U.S. Census Bureau, 2007 Economic Census, 2002 Economic Census

**Table B-16. Per Capita Income during the Past 12 Months**

Location	Per Capita Income
United States	27,041
Virginia	31,606
Caswell County, North Carolina	17,443
Person County, North Carolina	22,016
Rockingham County, North Carolina	20,284
Amherst County, Virginia	21,463
Appomattox County, Virginia	22,268
Bedford County, Virginia	27,630
Campbell County, Virginia	22,629
Charlotte County, Virginia	17,818
Franklin County, Virginia	23,425
Halifax County, Virginia	19,960
Henry County, Virginia	18,945
Mecklenburg County, Virginia	19,727
Patrick County, Virginia	18,694
Pittsylvania County, Virginia	20,668
Roanoke County, Virginia	30,338
Bedford City, Virginia	19,056
Danville City, Virginia	19,074
Lynchburg City, Virginia	21,548
Martinsville City, Virginia	17,797
Roanoke City, Virginia	22,883
Salem City, Virginia	26,182
Average, core study region	21,421

Source: U.S. Census Bureau, 2005–2009 American Community Survey

Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
United States	10	Total	697	782	876	179	25.7%
	10	Public Sector Total	703	800	914	211	30.0%
	10	Private Sector Total	695	779	868	173	24.9%
	11	Agriculture, Forestry, Fishing and Hunting	388	445	501	113	29.1%
	21	Mining, Quarrying, and Oil and Gas Extraction	1,148	1,389	1,645	497	43.3%
	22	Utilities	1,261	1,446	1,632	371	29.4%
	23	Construction	739	810	948	209	28.3%
	31–33	Manufacturing	826	948	1,055	229	27.7%
	42	Wholesale Trade	938	1,063	1,185	247	26.3%
	44–45	Retail Trade	436	479	503	67	15.4%
	48–49	Transportation and Warehousing	696	760	824	128	18.4%
	51	Information	1,102	1,209	1,369	267	24.2%
	52	Finance and Insurance	1,225	1,411	1,534	309	25.2%
	53	Real Estate and Rental and Leasing	632	758	813	181	28.6%
	54	Professional, Scientific, and Technical Services	1,130	1,255	1,438	308	27.3%
	55	Management of Companies and Enterprises	1,326	1,640	1,758	432	32.6%
	56	Administrative and Support and Waste Management and Remediation Services	470	541	627	157	33.4%
	61	Educational Services	617	701	808	191	31.0%
	62	Health Care and Social Assistance	631	728	831	200	31.7%
	71	Arts, Entertainment, and Recreation	487	541	608	121	24.8%
72	Accommodation and Food Services	263	292	321	58	22.1%	
81	Other Services (except Public Administration)	447	498	554	107	23.9%	
99	Unclassified	710	732	892	182	25.6%	

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Study Area	10	Total	500	553	608	108	21.6%
	10	Public Sector Total	501	544	609	108	21.6%
	10	Private Sector Total	492	544	594	102	20.7%
	11	Agriculture, Forestry, Fishing and Hunting	415	479	573	158	38.2%
	21	Mining, Quarrying, and Oil and Gas Extraction	643	n/a	n/a	n/a	n/a
	22	Utilities	957	1,030	1,091	135	14.1%
	23	Construction	484	514	597	113	23.4%
	31–33	Manufacturing	621	715	773	152	24.5%
	42	Wholesale Trade	631	756	795	164	26.0%
	44–45	Retail Trade	335	377	407	72	21.6%
	48–49	Transportation and Warehousing	536	573	636	100	18.7%
	51	Information	596	646	758	162	27.2%
	52	Finance and Insurance	615	666	753	138	22.4%
	53	Real Estate and Rental and Leasing	383	405	469	86	22.6%
	54	Professional, Scientific, and Technical Services	587	690	776	189	32.1%
	55	Management of Companies and Enterprises	812	906	1,013	200	24.6%
	56	Administrative and Support and Waste Management and Remediation Services	338	346	411	73	21.7%
	61	Educational Services	441	453	489	48	10.9%
	62	Health Care and Social Assistance	494	547	637	143	28.8%
	71	Arts, Entertainment, and Recreation	244	253	295	51	20.8%
72	Accommodation and Food Services	192	207	235	43	22.3%	
81	Other Services (except Public Administration)	337	378	414	77	22.8%	
99	Unclassified	n/a	402	550			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)**  
(continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Caswell County, NC	10	Total	460	499	560	100	21.7%
	10	Public Sector Total	544	577	626	82	15.2%
	10	Private Sector Total	401	430	504	103	25.7%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	432	374	496	64	14.8%
	31–33	Manufacturing	427	516	492	65	15.2%
	42	Wholesale Trade	N/A	559	862		
	44–45	Retail Trade	290	341	367	77	26.6%
	48–49	Transportation and Warehousing	N/A	252	463		
	51	Information	420	241	389	–31	–7.4%
	52	Finance and Insurance	624	668	686	62	9.9%
	53	Real Estate and Rental and Leasing	355	387	475	120	33.8%
	54	Professional, Scientific, and Technical Services	N/A	856	832		
	55	Management of Companies and Enterprises	N/A	N/A	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	374	N/A	578	204	54.5%
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	N/A	N/A	606		
	71	Arts, Entertainment, and Recreation	N/A	245	263		
72	Accommodation and Food Services	N/A	168	188			
81	Other Services (except Public Administration)	281	317	259	–22	–7.8%	
99	Unclassified	N/A	345	645			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Person County, NC	10	Total	517	597	618	101	19.5%
	10	Public Sector Total	521	554	644	122	23.4%
	10	Private Sector Total	516	607	611	95	18.4%
	11	Agriculture, Forestry, Fishing and Hunting	441	378	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	405	515	708	303	74.8%
	31–33	Manufacturing	602	813	862	260	43.2%
	42	Wholesale Trade	570	978	701	131	23.0%
	44–45	Retail Trade	376	383	406	30	8.0%
	48–49	Transportation and Warehousing	N/A	N/A	N/A		
	51	Information	539	576	724	185	34.3%
	52	Finance and Insurance	628	633	669	41	6.5%
	53	Real Estate and Rental and Leasing	290	404	419	129	44.5%
	54	Professional, Scientific, and Technical Services	474	485	492	18	3.8%
	55	Management of Companies and Enterprises	1,494	1,170	947	-547	-36.6%
	56	Administrative and Support and Waste Management and Remediation Services	415	471	618	203	48.9%
	61	Educational Services	341	373	461	120	35.2%
	62	Health Care and Social Assistance	470	440	553	83	17.7%
	71	Arts, Entertainment, and Recreation	178	180	201	23	12.9%
72	Accommodation and Food Services	175	227	221	46	26.3%	
81	Other Services (except Public Administration)	366	422	524	158	43.2%	
99	Unclassified	N/A	406	564			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)**  
(continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Rockingham County, NC	10	Total	510	560	604	94	18.4%
	10	Public Sector Total	565	594	674	109	19.2%
	10	Private Sector Total	501	554	590	89	17.8%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	931	1,105	1,270	339	36.4%
	23	Construction	547	591	617	70	12.8%
	31–33	Manufacturing	608	728	855	247	40.6%
	42	Wholesale Trade	558	609	696	138	24.7%
	44–45	Retail Trade	349	406	397	48	13.8%
	48–49	Transportation and Warehousing	504	633	610	106	21.0%
	51	Information	643	748	813	170	26.4%
	52	Finance and Insurance	585	685	685	100	17.1%
	53	Real Estate and Rental and Leasing	372	353	403	31	8.3%
	54	Professional, Scientific, and Technical Services	515	N/A	N/A		
	55	Management of Companies and Enterprises	306	N/A	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	287	301	362	75	26.1%
	61	Educational Services	N/A	437	323		
	62	Health Care and Social Assistance	N/A	551	595		
	71	Arts, Entertainment, and Recreation	254	251	255	1	0.4%
72	Accommodation and Food Services	192	193	231	39	20.3%	
81	Other Services (except Public Administration)	306	332	369	63	20.6%	
99	Unclassified	N/A	455	755			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Amherst County, VA	10	Total	516	553	624	108	20.9%
	10	Public Sector Total	516	551	624	108	20.9%
	10	Private Sector Total	516	554	624	108	20.9%
	11	Agriculture, Forestry, Fishing and Hunting	527	560	656	129	24.5%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	570	612	699	129	22.6%
	31–33	Manufacturing	759	832	971	212	27.9%
	42	Wholesale Trade	487	N/A	N/A		
	44–45	Retail Trade	313	362	391	78	24.9%
	48–49	Transportation and Warehousing	N/A	659	713		
	51	Information	677	851	1,290	613	90.5%
	52	Finance and Insurance	489	528	586	97	19.8%
	53	Real Estate and Rental and Leasing	256	288	376	120	46.9%
	54	Professional, Scientific, and Technical Services	603	N/A	N/A		
	55	Management of Companies and Enterprises	828	N/A	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	254	326	362	108	42.5%
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	N/A	N/A	N/A		
	71	Arts, Entertainment, and Recreation	199	232	256	57	28.6%
72	Accommodation and Food Services	190	214	241	51	26.8%	
81	Other Services (except Public Administration)	308	349	402	94	30.5%	
99	Unclassified	N/A	N/A	N/A			

(continued)



**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Appomattox County	10	Total	448	480	538	90	20.1%
	10	Public Sector Total	500	533	610	110	21.9%
	10	Private Sector Total	432	463	509	77	17.8%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	500	532	580	80	16.0%
	31–33	Manufacturing	513	566	597	84	16.4%
	42	Wholesale Trade	N/A	N/A	728		
	44–45	Retail Trade	325	322	369	44	13.5%
	48–49	Transportation and Warehousing	734	816	N/A		
	51	Information	643	561	882	239	37.2%
	52	Finance and Insurance	502	497	570	68	13.5%
	53	Real Estate and Rental and Leasing	371	357	399	28	7.5%
	54	Professional, Scientific, and Technical Services	381	516	623	242	63.5%
	55	Management of Companies and Enterprises	N/A	612	744		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	242	381		
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	350	398	N/A		
	71	Arts, Entertainment, and Recreation	158	N/A	229	71	44.9%
72	Accommodation and Food Services	159	N/A	216	57	35.8%	
81	Other Services (except Public Administration)	326	392	466	140	42.9%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)**  
(continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Bedford County, VA	10	Total	489	556	595	106	21.7%
	10	Public Sector Total	485	539	583	98	20.1%
	10	Private Sector Total	490	560	598	108	22.0%
	11	Agriculture, Forestry, Fishing and Hunting	471	454	422	-49	-10.4%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	419	285		
	23	Construction	501	560	640	139	27.7%
	31–33	Manufacturing	852	962	1,035	183	21.5%
	42	Wholesale Trade	717	893	1,036	319	44.5%
	44–45	Retail Trade	289	329	394	105	36.3%
	48–49	Transportation and Warehousing	448	497	609	161	35.9%
	51	Information	525	579	640	115	21.9%
	52	Finance and Insurance	724	745	830	106	14.6%
	53	Real Estate and Rental and Leasing	401	410	465	64	16.0%
	54	Professional, Scientific, and Technical Services	N/A	N/A	N/A		
	55	Management of Companies and Enterprises	N/A	N/A	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	265	309	314	49	18.5%
	61	Educational Services	547	463	698	151	27.6%
	62	Health Care and Social Assistance	466	433	545	79	17.0%
	71	Arts, Entertainment, and Recreation	293	311	373	80	27.3%
72	Accommodation and Food Services	203	208	218	15	7.4%	
81	Other Services (except Public Administration)	344	392	437	93	27.0%	
99	Unclassified	N/A	N/A	0			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Campbell County, VA	10	Total	503	572	602	99	19.7%
	10	Public Sector Total	478	537	587	109	22.7%
	10	Private Sector Total	507	578	605	98	19.3%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	939	1,222	1,391	452	48.1%
	23	Construction	540	580	660	120	22.2%
	31–33	Manufacturing	646	758	815	169	26.2%
	42	Wholesale Trade	595	679	784	189	31.8%
	44–45	Retail Trade	343	411	407	64	18.7%
	48–49	Transportation and Warehousing	505	625	657	152	30.1%
	51	Information	341	525	654	313	91.8%
	52	Finance and Insurance	546	585	641	95	17.4%
	53	Real Estate and Rental and Leasing	333	455	465	132	39.6%
	54	Professional, Scientific, and Technical Services	697	863	1,114	417	59.8%
	55	Management of Companies and Enterprises	1,186	912	1,050	-136	-11.5%
	56	Administrative and Support and Waste Management and Remediation Services	265	285	381	116	43.8%
	61	Educational Services	203	211	144	-59	-29.1%
	62	Health Care and Social Assistance	381	469	449	68	17.8%
	71	Arts, Entertainment, and Recreation	136	183	189	53	39.0%
72	Accommodation and Food Services	200	220	237	37	18.5%	
81	Other Services (except Public Administration)	313	353	394	81	25.9%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Charlotte County, VA	10	Total	436	477	518	82	18.8%
	10	Public Sector Total	426	496	545	118	27.7%
	10	Private Sector Total	439	469	503	64	14.6%
	11	Agriculture, Forestry, Fishing and Hunting	411	489	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	367	416	490	123	33.5%
	31–33	Manufacturing	504	518	526	22	4.4%
	42	Wholesale Trade	N/A	N/A	N/A		
	44–45	Retail Trade	298	320	410	112	37.6%
	48–49	Transportation and Warehousing	555	610	583	28	5.0%
	51	Information	N/A	N/A	N/A		
	52	Finance and Insurance	535	596	826	291	54.4%
	53	Real Estate and Rental and Leasing	N/A	256	N/A		
	54	Professional, Scientific, and Technical Services	352	439	580	228	64.8%
	55	Management of Companies and Enterprises	N/A	N/A	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	N/A	N/A		
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	N/A	N/A	N/A		
	71	Arts, Entertainment, and Recreation	304	296	325	21	6.9%
72	Accommodation and Food Services	210	213	228	18	8.6%	
81	Other Services (except Public Administration)	228	N/A	271	43	18.9%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Franklin County, VA	10	Total	451	515	558	107	23.7%
	10	Public Sector Total	532	583	669	137	25.8%
	10	Private Sector Total	438	504	536	98	22.4%
	11	Agriculture, Forestry, Fishing and Hunting	471	N/A	539	68	14.4%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	419	485	542	123	29.4%
	31–33	Manufacturing	532	622	648	116	21.8%
	42	Wholesale Trade	627	799	880	253	40.4%
	44–45	Retail Trade	332	406	411	79	23.8%
	48–49	Transportation and Warehousing	N/A	N/A	N/A		
	51	Information	492	584	544	52	10.6%
	52	Finance and Insurance	575	645	721	146	25.4%
	53	Real Estate and Rental and Leasing	398	436	515	117	29.4%
	54	Professional, Scientific, and Technical Services	498	N/A	592	94	18.9%
	55	Management of Companies and Enterprises	384	N/A	817	433	112.8%
	56	Administrative and Support and Waste Management and Remediation Services	353	373	458	105	29.7%
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	N/A	N/A	N/A		
	71	Arts, Entertainment, and Recreation	276	296	315	39	14.1%
72	Accommodation and Food Services	181	203	223	42	23.2%	
81	Other Services (except Public Administration)	314	336	395	81	25.8%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Halifax County, VA	10	Total	480	526	598	118	24.6%
	10	Public Sector Total	509	556	598	89	17.5%
	10	Private Sector Total	475	520	598	123	25.9%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	493	533	630	137	27.8%
	31–33	Manufacturing	551	666	751	200	36.3%
	42	Wholesale Trade	N/A	N/A	N/A		
	44–45	Retail Trade	304	352	412	108	35.5%
	48–49	Transportation and Warehousing	479	498	657	178	37.2%
	51	Information	595	630	678	83	13.9%
	52	Finance and Insurance	522	594	631	109	20.9%
	53	Real Estate and Rental and Leasing	526	394	408	-118	-22.4%
	54	Professional, Scientific, and Technical Services	507	638	738	231	45.6%
	55	Management of Companies and Enterprises	829	858	831	2	0.2%
	56	Administrative and Support and Waste Management and Remediation Services	336	366	439	103	30.7%
	61	Educational Services	632	N/A	N/A		
	62	Health Care and Social Assistance	571	N/A	N/A		
	71	Arts, Entertainment, and Recreation	263	234	242	-21	-8.0%
72	Accommodation and Food Services	179	196	229	50	27.9%	
81	Other Services (except Public Administration)	319	359	396	77	24.1%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)**  
(continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Henry County, VA	10	Total	463	519	562	99	21.4%
	10	Public Sector Total	549	581	665	117	21.3%
	10	Private Sector Total	452	509	542	90	19.9%
	11	Agriculture, Forestry, Fishing and Hunting	467	585	767	300	64.2%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	892	N/A	N/A		
	23	Construction	568	506	596	28	4.9%
	31–33	Manufacturing	467	591	645	178	38.1%
	42	Wholesale Trade	677	N/A	N/A		
	44–45	Retail Trade	333	372	396	63	18.9%
	48–49	Transportation and Warehousing	529	523	531	2	0.4%
	51	Information	477	N/A	463	-14	-2.9%
	52	Finance and Insurance	483	510	666	183	37.9%
	53	Real Estate and Rental and Leasing	393	470	523	130	33.1%
	54	Professional, Scientific, and Technical Services	515	N/A	614	99	19.2%
	55	Management of Companies and Enterprises	N/A	N/A	1,123		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	300	234		
	61	Educational Services	326	N/A	N/A		
	62	Health Care and Social Assistance	359	N/A	N/A		
	71	Arts, Entertainment, and Recreation	462	342	339	-123	-26.6%
72	Accommodation and Food Services	183	198	225	42	23.0%	
81	Other Services (except Public Administration)	414	391	435	21	5.1%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Patrick County, VA	10	Total	420	456	472	52	12.4%
	10	Public Sector Total	426	461	534	108	25.4%
	10	Private Sector Total	419	455	459	40	9.5%
	11	Agriculture, Forestry, Fishing and Hunting	367	405	482	115	31.3%
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	391	419	476	85	21.7%
	31–33	Manufacturing	453	516	509	56	12.4%
	42	Wholesale Trade	N/A	N/A	N/A		
	44–45	Retail Trade	266	323	372	106	39.8%
	48–49	Transportation and Warehousing	452	505	508	56	12.4%
	51	Information	405	443	476	71	17.5%
	52	Finance and Insurance	439	502	561	122	27.8%
	53	Real Estate and Rental and Leasing	528	260	299	-229	-43.4%
	54	Professional, Scientific, and Technical Services	408	356	345	-63	-15.4%
	55	Management of Companies and Enterprises	N/A	N/A	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	N/A	N/A		
	61	Educational Services	N/A	409	379		
	62	Health Care and Social Assistance	N/A	426	440		
	71	Arts, Entertainment, and Recreation	N/A	319	446		
72	Accommodation and Food Services	N/A	197	271			
81	Other Services (except Public Administration)	376	373	440	64	17.0%	
99	Unclassified	N/A	N/A	N/A			

(continued)



**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Pittsylvania County, VA	10	Total	547	509	554	7	1.3%
	10	Public Sector Total	527	550	608	80	15.2%
	10	Private Sector Total	550	500	537	-13	-2.4%
	11	Agriculture, Forestry, Fishing and Hunting	338	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	643	N/A	N/A		
	22	Utilities	1,064	1,241	1,465	401	37.7%
	23	Construction	456	475	575	119	26.1%
	31–33	Manufacturing	677	666	696	19	2.8%
	42	Wholesale Trade	424	492	518	94	22.2%
	44–45	Retail Trade	324	332	379	55	17.0%
	48–49	Transportation and Warehousing	554	651	664	110	19.9%
	51	Information	494	789	922	428	86.6%
	52	Finance and Insurance	608	515	765	157	25.8%
	53	Real Estate and Rental and Leasing	283	225	391	108	38.2%
	54	Professional, Scientific, and Technical Services	601	698	761	160	26.6%
	55	Management of Companies and Enterprises	962	732	889	-73	-7.6%
	56	Administrative and Support and Waste Management and Remediation Services	328	355	376	48	14.6%
	61	Educational Services	454	517	589	135	29.7%
	62	Health Care and Social Assistance	389	389	431	42	10.8%
	71	Arts, Entertainment, and Recreation	259	265	310	51	19.7%
72	Accommodation and Food Services	177	178	222	45	25.4%	
81	Other Services (except Public Administration)	357	403	461	104	29.1%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)**  
(continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Roanoke County, VA	10	Total	566	593	683	117	20.7%
	10	Public Sector Total	586	613	703	117	20.0%
	10	Private Sector Total	563	590	680	117	20.8%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	1,395		
	23	Construction	557	601	653	96	17.2%
	31–33	Manufacturing	863	741	810	-53	-6.1%
	42	Wholesale Trade	766	N/A	932	166	21.7%
	44–45	Retail Trade	424	411	446	22	5.2%
	48–49	Transportation and Warehousing	N/A	N/A	787		
	51	Information	756	819	1,180	424	56.1%
	52	Finance and Insurance	689	733	904	215	31.2%
	53	Real Estate and Rental and Leasing	482	602	608	126	26.1%
	54	Professional, Scientific, and Technical Services	593	645	756	163	27.5%
	55	Management of Companies and Enterprises	787	1,189	1,422	635	80.7%
	56	Administrative and Support and Waste Management and Remediation Services	326	381	426	100	30.7%
	61	Educational Services	509	569	635	126	24.8%
	62	Health Care and Social Assistance	584	694	760	176	30.1%
	71	Arts, Entertainment, and Recreation	233	212	236	3	1.3%
72	Accommodation and Food Services	207	234	257	50	24.2%	
81	Other Services (except Public Administration)	359	429	469	110	30.6%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)**  
(continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Bedford City, VA	10	Total	484	541	615	131	27.1%
	10	Public Sector Total	525	580	626	101	19.3%
	10	Private Sector Total	481	538	614	133	27.7%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	N/A	N/A	N/A		
	31–33	Manufacturing	616	614	639	23	3.7%
	42	Wholesale Trade	N/A	N/A	653		
	44–45	Retail Trade	328	386	424	96	29.3%
	48–49	Transportation and Warehousing	N/A	N/A	696		
	51	Information	614	829	1,004	390	63.5%
	52	Finance and Insurance	621	729	755	134	21.6%
	53	Real Estate and Rental and Leasing	284	390	532	248	87.3%
	54	Professional, Scientific, and Technical Services	559	565	695	136	24.3%
	55	Management of Companies and Enterprises	N/A	1,156	N/A		
	56	Administrative and Support and Waste Management and Remediation Services	N/A	287	N/A		
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	481	665	761	280	58.2%
	71	Arts, Entertainment, and Recreation	N/A	123	N/A		
72	Accommodation and Food Services	N/A	186	N/A			
81	Other Services (except Public Administration)	392	494	606	214	54.6%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Danville City, VA	10	Total	455	565	607	152	33.4%
	10	Public Sector Total	552	583	667	115	20.9%
	10	Private Sector Total	439	562	596	157	35.8%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	742		
	23	Construction	441	N/A	N/A		
	31–33	Manufacturing	489	843	941	452	92.4%
	42	Wholesale Trade	591	667	732	141	23.9%
	44–45	Retail Trade	330	364	403	73	22.1%
	48–49	Transportation and Warehousing	N/A	N/A	761		
	51	Information	N/A	648	691		
	52	Finance and Insurance	531	594	670	139	26.2%
	53	Real Estate and Rental and Leasing	366	421	494	128	35.0%
	54	Professional, Scientific, and Technical Services	641	623	784	143	22.3%
	55	Management of Companies and Enterprises	713	801	836	123	17.3%
	56	Administrative and Support and Waste Management and Remediation Services	344	317	357	13	3.8%
	61	Educational Services	431	516	638	207	48.0%
	62	Health Care and Social Assistance	581	641	684	103	17.7%
	71	Arts, Entertainment, and Recreation	211	247	280	69	32.7%
72	Accommodation and Food Services	202	220	248	46	22.8%	
81	Other Services (except Public Administration)	N/A	358	369			
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)**  
(continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Lynchburg City VA	10	Total	599	673	754	155	25.9%
	10	Public Sector Total	561	655	717	156	27.8%
	10	Private Sector Total	603	675	758	155	25.7%
	11	Agriculture, Forestry, Fishing and Hunting	240	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	556	N/A	N/A		
	31–33	Manufacturing	879	1,074	1,064	185	21.0%
	42	Wholesale Trade	706	966	1,006	300	42.5%
	44–45	Retail Trade	408	386	393	-15	-3.7%
	48–49	Transportation and Warehousing	N/A	N/A	N/A		
	51	Information	756	786	792	36	4.8%
	52	Finance and Insurance	863	1,080	1,180	317	36.7%
	53	Real Estate and Rental and Leasing	410	539	545	135	32.9%
	54	Professional, Scientific, and Technical Services	744	769	1,375	631	84.8%
	55	Management of Companies and Enterprises	746	785	834	88	11.8%
	56	Administrative and Support and Waste Management and Remediation Services	332	343	352	20	6.0%
	61	Educational Services	527	602	666	139	26.4%
	62	Health Care and Social Assistance	612	721	843	231	37.7%
	71	Arts, Entertainment, and Recreation	210	215	335	125	59.5%
72	Accommodation and Food Services	195	208	242	47	24.1%	
81	Other Services (except Public Administration)	336	377	419	83	24.7%	
99	Unclassified	N/A	N/A	784			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)  
(continued)**

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Martinsville City, VA	10	Total	448	490	530	82	18.3%
	10	Public Sector Total	533	579	643	110	20.7%
	10	Private Sector Total	437	477	511	74	16.9%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	N/A	N/A	N/A		
	31–33	Manufacturing	530	587	675	145	27.4%
	42	Wholesale Trade	726	N/A	704	-22	-3.0%
	44–45	Retail Trade	303	361	425	122	40.3%
	48–49	Transportation and Warehousing	N/A	452	N/A		
	51	Information	690	766	815	125	18.1%
	52	Finance and Insurance	789	783	824	35	4.4%
	53	Real Estate and Rental and Leasing	327	374	400	73	22.3%
	54	Professional, Scientific, and Technical Services	811	989	853	42	5.2%
	55	Management of Companies and Enterprises	880	N/A	1,614	734	83.4%
	56	Administrative and Support and Waste Management and Remediation Services	219	N/A	302	83	37.9%
	61	Educational Services	N/A	N/A	331		
	62	Health Care and Social Assistance	N/A	N/A	690		
	71	Arts, Entertainment, and Recreation	166	263	294	128	77.1%
72	Accommodation and Food Services	187	206	224	37	19.8%	
81	Other Services (except Public Administration)	264	275	279	15	5.7%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)**  
(continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Roanoke City, VA	10	Total	581	653	737	156	26.9%
	10	Public Sector Total	672	724	811	139	20.7%
	10	Private Sector Total	570	643	726	156	27.4%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	1,161	N/A		
	23	Construction	N/A	N/A	N/A		
	31–33	Manufacturing	635	773	854	219	34.5%
	42	Wholesale Trade	N/A	815	N/A		
	44–45	Retail Trade	364	436	450	86	23.6%
	48–49	Transportation and Warehousing	521	614	644	123	23.6%
	51	Information	773	883	867	94	12.2%
	52	Finance and Insurance	905	987	1,112	207	22.9%
	53	Real Estate and Rental and Leasing	464	540	568	104	22.4%
	54	Professional, Scientific, and Technical Services	830	988	993	163	19.6%
	55	Management of Companies and Enterprises	1,018	1,188	1,267	249	24.5%
	56	Administrative and Support and Waste Management and Remediation Services	314	342	530	216	68.8%
	61	Educational Services	435	434	512	77	17.7%
	62	Health Care and Social Assistance	685	734	919	234	34.2%
	71	Arts, Entertainment, and Recreation	349	391	436	87	24.9%
72	Accommodation and Food Services	225	253	295	70	31.1%	
81	Other Services (except Public Administration)	366	407	463	97	26.5%	
99	Unclassified	N/A	N/A	N/A			

(continued)

**Table B-17. Average Weekly Wage by Sector in 2001, 2005, and 2009 (\$)**  
(continued)

	NAICS	NAICS Description	2001	2005	2009	2001–2009	% Change
Salem City, VA	10	Total	622	722	827	205	33.0%
	10	Public Sector Total	11	31	52	41	372.7%
	10	Private Sector Total	611	691	775	164	26.8%
	11	Agriculture, Forestry, Fishing and Hunting	N/A	N/A	N/A		
	21	Mining, Quarrying, and Oil and Gas Extraction	N/A	N/A	N/A		
	22	Utilities	N/A	N/A	N/A		
	23	Construction	N/A	N/A	N/A		
	31–33	Manufacturing	810	904	1,066	256	31.6%
	42	Wholesale Trade	757	862	894	137	18.1%
	44–45	Retail Trade	401	540	497	96	23.9%
	48–49	Transportation and Warehousing	614	682	655	41	6.7%
	51	Information	888	367	583	-305	-34.3%
	52	Finance and Insurance	650	717	787	137	21.1%
	53	Real Estate and Rental and Leasing	435	539	630	195	44.8%
	54	Professional, Scientific, and Technical Services	839	926	1,041	202	24.1%
	55	Management of Companies and Enterprises	428	566	790	362	84.6%
	56	Administrative and Support and Waste Management and Remediation Services	652	541	512	-140	-21.5%
	61	Educational Services	N/A	N/A	N/A		
	62	Health Care and Social Assistance	N/A	N/A	N/A		
	71	Arts, Entertainment, and Recreation	203	208	285	82	40.4%
72	Accommodation and Food Services	200	214	246	46	23.0%	
81	Other Services (except Public Administration)	431	422	417	-14	-3.2%	
99	Unclassified	N/A	N/A	N/A			



Table B-18. Trends in Agriculture, 1997 to 2007

Number of Farms		1997	2002	2007	Percentage Change	Percentage Change	Percentage Change
State	County				1997–2002	2002–2007	1997–2002
NC	Caswell	644	517	562	-19.7%	8.7%	-12.7%
NC	Person	455	374	403	-17.8%	7.8%	-11.4%
NC	Rockingham	915	871	863	-4.8%	-0.9%	-5.7%
VA	Amherst	499	460	424	-7.8%	-7.8%	-15.0%
VA	Appomattox	406	389	323	-4.2%	-17.0%	-20.4%
VA	Bedford	1,454	1,289	1,428	-11.3%	10.8%	-1.8%
VA	Campbell	727	664	722	-8.7%	8.7%	-0.7%
VA	Charlotte	578	535	489	-7.4%	-8.6%	-15.4%
VA	Franklin	1,072	1,012	1,043	-5.6%	3.1%	-2.7%
VA	Halifax	1,046	905	908	-13.5%	0.3%	-13.2%
VA	Henry	362	305	340	-15.7%	11.5%	-6.1%
VA	Mecklenburg	686	581	580	-15.3%	-0.2%	-15.5%
VA	Patrick	660	629	613	-4.7%	-2.5%	-7.1%
VA	Pittsylvania	1,443	1,304	1,356	-9.6%	4.0%	-6.0%
VA	Roanoke	349	342	345	-2.0%	0.9%	-1.1%
Total, core counties		11,296	10,177	10,399	-9.9%	2.2%	-7.9%
<b>Acreege in Farm Operations</b>							
NC	Caswell	141,351	116,753	102,299	-17.4%	-12.4%	-27.6%
NC	Person	122,956	95,153	98,521	-22.6%	3.5%	-19.9%
NC	Rockingham	137,109	136,120	117,113	-0.7%	-14.0%	-14.6%
VA	Amherst	101,617	99,863	88,430	-1.7%	-11.4%	-13.0%
VA	Appomattox	79,155	84,971	75,874	7.3%	-10.7%	-4.1%
VA	Bedford	207,276	199,244	212,237	-3.9%	6.5%	2.4%
VA	Campbell	147,776	138,716	140,359	-6.1%	1.2%	-5.0%
VA	Charlotte	141,155	133,719	125,531	-5.3%	-6.1%	-11.1%
VA	Franklin	171,755	172,539	166,592	0.5%	-3.4%	-3.0%
VA	Halifax	236,249	221,684	193,683	-6.2%	-12.6%	-18.0%
VA	Henry	56,667	53,064	50,779	-6.4%	-4.3%	-10.4%
VA	Mecklenburg	169,324	168,150	157,317	-0.7%	-6.4%	-7.1%
VA	Patrick	83,193	90,569	80,027	8.9%	-11.6%	-3.8%
VA	Pittsylvania	285,003	288,647	274,289	1.3%	-5.0%	-3.8%
VA	Roanoke	30,174	30,914	29,214	2.5%	-5.5%	-3.2%
Total, core counties		2,110,760	2,030,106	1,912,265	-3.8%	-5.8%	-9.4%

(continued)

Table B-18. Trends in Agriculture, 1997 to 2007 (continued)

Number of Farms		1997	2002	2007	Percentage Change	Percentage Change	Percentage Change
State	County				1997–2002	2002–2007	1997–2002
<b>Commodity sales (\$1000)</b>							
NC	Caswell	28,557	24,065	20,703	-15.7%	-14.0%	-27.5%
NC	Person	29,334	18,122	19,287	-38.2%	6.4%	-34.3%
NC	Rockingham	37,091	28,555	31,868	-23.0%	11.6%	-14.1%
VA	Amherst	5,311	6,368	7,645	19.9%	20.1%	43.9%
VA	Appomattox	6,826	6,682	7,461	-2.1%	11.7%	9.3%
VA	Bedford	20,552	19,375	23,647	-5.7%	22.0%	15.1%
VA	Campbell	14,943	15,588	25,345	4.3%	62.6%	69.6%
VA	Charlotte	16,640	15,805	19,386	-5.0%	22.7%	16.5%
VA	Franklin	41,443	36,501	53,968	-11.9%	47.9%	30.2%
VA	Halifax	40,210	27,724	29,262	-31.1%	5.5%	-27.2%
VA	Henry	8,313	4,485	10,957	-46.0%	144.3%	31.8%
VA	Mecklenburg	41,953	26,639	32,264	-36.5%	21.1%	-23.1%
VA	Patrick	13,542	15,227	15,913	12.4%	4.5%	17.5%
VA	Pittsylvania	58,844	54,593	62,644	-7.2%	14.7%	6.5%
VA	Roanoke	5,677	3,831	4,897	-32.5%	27.8%	-13.7%
Total, core counties		369,236	303,560	365,247	-17.8%	20.3%	-1.1%

Source: U.S. Department of Agriculture, National Agricultural Statistics Service. Agricultural Census 1997, 2002, 2007.

**Table B-19. Housing Occupancy Status in the Core Study Region**

	<b>Total</b>	<b>Vacant</b>	<b>% Vacant</b>
United States	127,699,712	15,088,683	11.8%
Virginia	3,264,058	327,424	10.0%
Caswell County, North Carolina	10,254	1,584	15.4%
Person County, North Carolina	17,048	2,138	12.5%
Rockingham County, North Carolina	42,863	5,298	12.4%
Amherst County, Virginia	13,787	1,099	8.0%
Appomattox County, Virginia	6,468	740	11.4%
Bedford County, Virginia	30,950	4,074	13.2%
Botetourt County, Virginia	14,129	1,457	10.3%
Campbell County, Virginia	24,177	2,132	8.8%
Charlotte County, Virginia	6,265	1,603	25.6%
Franklin County, Virginia	26,099	4,784	18.3%
Halifax County, Virginia	17,561	2,905	16.5%
Henry County, Virginia	26,669	3,432	12.9%
Mecklenburg County, Virginia	18,728	6,196	33.1%
Montgomery County, Virginia	36,179	3,352	9.3%
Patrick County, Virginia	10,458	2,827	27.0%
Pittsylvania County, Virginia	29,885	4,158	13.9%
Roanoke County, Virginia	39,410	2,081	5.3%
Bedford City, Virginia	3,097	286	9.2%
Danville City, Virginia	23,331	3,121	13.4%
Lynchburg City, Virginia	29,780	3,163	10.6%
Martinsville City, Virginia	7,290	1,333	18.3%
Roanoke City, Virginia	46,319	4,132	8.9%
Salem City, Virginia	10,717	905	8.4%
Total	491,464	62,800	12.8%

Source: U.S. Census Bureau. 2005–2009 American Community Survey 5-Year Estimates

Table B-20. Housing Types Available in the Core Study Region

	Total	Single Unit	Duplex	Multi-family	Mobile Home	Boat, RV, Van
United States	127,699,712	85,899,738	5,028,254	28,029,446	8,639,239	103,035
Virginia	3,264,058	2,375,126	56,982	641,688	189,398	864
Caswell County, North Carolina	10,254	6,812	66	302	3,074	0
Person County, North Carolina	17,048	11,883	256	655	4,254	0
Rockingham County, North Carolina	42,863	30,480	514	3,890	7,979	0
Amherst County, Virginia	13,787	10,952	310	842	1,683	0
Appomattox County, Virginia	6,468	4,711	42	245	1,470	0
Bedford County, Virginia	30,950	24,049	212	1,255	5,434	0
Campbell County, Virginia	24,177	16,372	606	2,015	5,184	0
Charlotte County, Virginia	6,265	4,370	19	259	1,617	0
Franklin County, Virginia	26,099	18,907	295	1,633	5,256	8
Halifax County, Virginia	17,561	13,039	173	1,005	3,344	0
Henry County, Virginia	26,669	18,614	364	1,977	5,694	20
Mecklenburg County, Virginia	18,728	13,003	135	751	4,808	31
Patrick County, Virginia	10,458	7,422	71	427	2,513	25
Pittsylvania County, Virginia	29,885	21,417	168	1,072	7,228	0
Roanoke County, Virginia	39,410	30,806	779	7,104	721	0
Bedford City, Virginia	3,097	2,193	151	596	157	0
Danville City, Virginia	23,331	16,635	521	5,167	1,008	0
Lynchburg City, Virginia	29,780	20,516	1,771	7,062	431	0
Martinsville City, Virginia	7,290	5,608	371	1,299	12	0
Roanoke City, Virginia	46,319	31,069	3,399	11,442	369	40
Salem City, Virginia	10,717	7,863	309	2,117	401	27
Total	441,156	316,721	10,532	51,115	62,637	151
		71.8%	2.4%	11.6%	14.2%	0.0%

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[http://www.agcensus.usda.gov/Publications/2007/Full\\_Report/Census\\_by\\_State/North\\_Carolina/index.asp](http://www.agcensus.usda.gov/Publications/2007/Full_Report/Census_by_State/North_Carolina/index.asp)
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[http://www.agcensus.usda.gov/Publications/1997/Vol\\_1\\_Chapter\\_2\\_County\\_Tables/North\\_Carolina/index.asp](http://www.agcensus.usda.gov/Publications/1997/Vol_1_Chapter_2_County_Tables/North_Carolina/index.asp)
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## ***Appendix D: Case Studies***

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## D.1 Case Studies

Table D-1. Case Studies

Mine Name	Mine Location	Mine County	Years of Operation	Average Rainfall (in/yr)	Average Temperature (degrees F)	Population Density in County (ppl/sq)	Reference
<b>Uranium Mines</b>							
White King & Lucky Lass Uranium Mines	Lakeview, OR	Lake	~1955–1965	12–16		0.9	<p>EPA. 1995. NPL Site Narrative for Fremont National Forest/White King and Lucky Lass Uranium Mines (USDA). <a href="http://www.epa.gov/superfund/sites/npl/nar1402.htm">http://www.epa.gov/superfund/sites/npl/nar1402.htm</a>. Updated 9 Apr. 2011.</p> <p>EPA. 2001. EPA Superfund Record of Decision: Fremont National Forest/White King and Lucky Lass Uranium Mines (USDA). Office of Environmental Cleanup. <a href="http://www.epa.gov/superfund/sites/rods/fulltext/r1001536.pdf">http://www.epa.gov/superfund/sites/rods/fulltext/r1001536.pdf</a>.</p> <p>EPA. 2008. Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining Volume I: Mining and Reclamation Background. Office of Radiation and Indoor Air Radiation Protection Division. <a href="http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf">http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf</a>.</p>
Midnite Mine	Wellpinit, WA	Stevens	1954–1965, 1969–1981	18.5	58.2	12.5	<p>EPA. 2008. Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining Volume I: Mining and Reclamation Background. Office of Radiation and Indoor Air Radiation Protection Division. <a href="http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf">http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf</a>.</p> <p>EPA. Midnite Mine. <a href="http://yosemite.epa.gov/r10/cleanup.nsf/1887fc8b0c8f2aee8825648f00528583/25f296f579940d8b88256744000327a5?OpenDocument">http://yosemite.epa.gov/r10/cleanup.nsf/1887fc8b0c8f2aee8825648f00528583/25f296f579940d8b88256744000327a5?OpenDocument</a>.</p> <p>EPA. 2006. Midnite Mine Superfund Site Spokane Indian Reservation Washington: Record of Decision. Office of Environmental Cleanup. <a href="http://www.epa.gov/region10/pdf/sites/midnite_mine/midnite-mine-rod-06.pdf">http://www.epa.gov/region10/pdf/sites/midnite_mine/midnite-mine-rod-06.pdf</a>.</p> <p>U.S. Climate Data. <a href="http://usclimatedata.com/climate.php?location=USWA0486">http://usclimatedata.com/climate.php?location=USWA0486</a>.</p> <p>U.S. Census Bureau. 2000. Number of People and Density for Census 2000 Geography. <a href="http://www.census.gov/population/www/cen2000/atlas/pdf/num_d90.pdf">http://www.census.gov/population/www/cen2000/atlas/pdf/num_d90.pdf</a>.</p>

(continued)



Table D-1. Case Studies (continued)

Mine Name	Mine Location	Mine County	Years of Operation	Average Rainfall (in/yr)	Average Temperature (degrees F)	Population Density in County (ppl/sq)	Reference
<b>Uranium Mines (continued)</b>							
Canyonlands Uranium Mines	Lathrop Canyon, Moab, UT	San Juan	NA	5.59	48	1.6	EPA. 2008. Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining Volume I: Mining and Reclamation Background. Office of Radiation and Indoor Air Radiation Protection Division. <a href="http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf">http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf</a> .
Pandora Mine	Monticello, UT	San Juan	2006–present	15.18	46	1.6	EPA. 2008. Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining Volume I: Mining and Reclamation Background. Office of Radiation and Indoor Air Radiation Protection Division. <a href="http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf">http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf</a> .  Uranium Watch. 2011. Pandora Mine. <a href="http://uraniumwatch.org/pandora.ut.htm">http://uraniumwatch.org/pandora.ut.htm</a> .
Daneros Mine	Hite, Utah	San Juan	2009–expected close date of 2016. Intermittent operation	7.49	48	1.6	EPA. 2008. Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining Volume I: Mining and Reclamation Background. Office of Radiation and Indoor Air Radiation Protection Division. <a href="http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf">http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf</a> .
Orphan Uranium Mine	Grand Canyon Village, AZ	Coconino County	1956–1969	8.44	44	5.2	
Bluewater Uranium Mines	Bluewater, NM	Lincoln	1952–1966	12.79		2.5	
Homestake Mining	Milan NM	Cibola	1958–1990	10	48	5.2	EPA. 2008. Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining Volume I: Mining and Reclamation Background. Office of Radiation and Indoor Air Radiation Protection Division. <a href="http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf">http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf</a> .  Agency for Toxic Substances and Disease Registry. 2009. Health Consultation Homestake Mining Company Mill Site. <a href="http://www.atsdr.cdc.gov/hac/pha/homestake/homestakeMCOjun091.pdf">http://www.atsdr.cdc.gov/hac/pha/homestake/homestakeMCOjun091.pdf</a> .
Yazzie-312 Mine	Cameron, AZ	Coconino County	1956–1961	13.87	57	5.2	EPA. 2008. Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining Volume I: Mining and Reclamation Background. Office of Radiation and Indoor Air Radiation Protection Division. <a href="http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf">http://www.epa.gov/radiation/docs/tenorm/402-r-08-005-voli/402-r-08-005-v1.pdf</a> .

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Table D-1. Case Studies (continued)

Mine Name	Mine Location	Mine County	Years of Operation	Average Rainfall (in/yr)	Average Temperature (degrees F)	Population Density in County (ppl/sq)	Reference
<b>Uranium Mines (continued)</b>							
Arizona 1 Mine	Fredonia, AZ	Coconino County	~1988–standby till 2009	10.5	51	5.2	<p>USGS. 2011. Breccia-Pipe Uranium Mining in Northern Arizona- Estimate of Resources and Assessment of Historical Effects. <a href="http://pubs.usgs.gov/fs/2010/3050/fs2010-3050.pdf">http://pubs.usgs.gov/fs/2010/3050/fs2010-3050.pdf</a>.</p> <p>Jordan, D. 2010. Finding of Violation: Denison Mines Corp. Arizona 1 Mine. EPA Air Division. <a href="http://www.grandcanyontrust.org/news/wp-content/uploads/2010/05/uranium-denison-violation-5_4_10-fov0001.pdf">http://www.grandcanyontrust.org/news/wp-content/uploads/2010/05/uranium-denison-violation-5_4_10-fov0001.pdf</a>.</p> <p>ADEQ. 2009. Facts Regarding the Proposed Permit for Denison Mines Corp. Arizona 1 Mine. Air Quality Permits Section. <a href="http://www.azdeq.gov/environ/air/permits/download/denison/denison_fact.pdf">http://www.azdeq.gov/environ/air/permits/download/denison/denison_fact.pdf</a>.</p> <p>EPA. 2010. Letter. Arizona 1 Uranium Mine Finding of Violation. Retrieved at <a href="http://www.grandcanyontrust.org/news/wp-content/uploads/2010/05/uranium-denison-violation-5_4_10-fov0001.pdf">http://www.grandcanyontrust.org/news/wp-content/uploads/2010/05/uranium-denison-violation-5_4_10-fov0001.pdf</a>.</p> <p>Wise-Uranium. 2011. Arizona 1 Mine, Mohave County. Retrieved at <a href="http://www.wise-uranium.org/umopusa.html#ARIZONA1">http://www.wise-uranium.org/umopusa.html#ARIZONA1</a>.</p> <p>Grand Canyon Trust. 2007. Uranium mining and activities, past and present. Update for the Arizona Game and Fish Department and Commission. <a href="http://www.grandcanyontrust.org/documents/gc_agfUraniumUpdate.pdf">http://www.grandcanyontrust.org/documents/gc_agfUraniumUpdate.pdf</a>.</p>
White Mesa Mill	Blanding, UT	San Juan	1979–current (Open intermittently)	12		1.6	<p>U.S. Nuclear Regulatory Commission. Environmental Assessment for International Uranium (USA) Corporation's Uranium Mill Site White Mesa, San Juan County, Utah. Office of Nuclear Material Safety and Safeguards. <a href="http://www.radiationcontrol.utah.gov/Uranium_Mills/IUC/cell4b/envAsses%202002.pdf">http://www.radiationcontrol.utah.gov/Uranium_Mills/IUC/cell4b/envAsses%202002.pdf</a>.</p> <p>USGS. 2011. White Mesa Uranium Investigation. Utah Water Science Center. <a href="http://ut.water.usgs.gov/projects/whitemesa/">http://ut.water.usgs.gov/projects/whitemesa/</a>. (<a href="http://ut.water.usgs.gov/projects/whitemesa/">http://ut.water.usgs.gov/projects/whitemesa/</a>).</p>
Lincoln	Canon City, CO	Fremont	closed in 2005	12.8	53	21.1	Wise Uranium. 2011. Issues at Canon City uranium mill (Colorado). <a href="http://www.wise-uranium.org/umopcc.html">http://www.wise-uranium.org/umopcc.html</a> .
Smith Ranch-Highland	Wyoming	Converse	1970s–1987 conventional underground mining 1988–present in situ mining	13.4	46	3.3	Wise Uranium. 2011. Uranium Mining and Milling. <a href="http://www.wise-uranium.org/indexu.html">http://www.wise-uranium.org/indexu.html</a> . Cameco Corporation. Highland-Smith Ranch <a href="http://www.cameco.com/mining/highland_smith/">http://www.cameco.com/mining/highland_smith/</a> .

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Table D-1. Case Studies (continued)

Mine Name	Mine Location	Mine County	Years of Operation	Average Rainfall (in/yr)	Average Temperature (degrees F)	Population Density in County (ppl/sq)	Reference
<b>Uranium Mines (continued)</b>							
Crow Butte	Crawford, Nebraska	Dawes	1991–	16.8	48	6.6	Wise Uranium. 2011. Uranium Mining and Milling. <a href="http://www.wise-uranium.org/indexu.html">http://www.wise-uranium.org/indexu.html</a> Cameco Corporation. Crowe Butte <a href="http://www.cameco.com/mining/crow_butte/">http://www.cameco.com/mining/crow_butte/</a> .
Mt. Taylor	New Mexico	Cibola	1950–1989	10	48	6	Wise Uranium. 2011. Uranium Mining and Milling. <a href="http://www.wise-uranium.org/indexu.html">http://www.wise-uranium.org/indexu.html</a> .
Alta Mesa	Encino, Texas	Brooks		25.9	71	7.7	
Hobson	Texas	Karnes	1978– refurbished in 2008				
Vasquez	Texas						
Pala gana	Texas		2010–				
Kingsville Dome	Texas						
La Sal	Utah	San Juan			48	1.6	
Rim	Utah	San Juan			46	1.6	
Moore Ranch	Wyoming						
Sweetwater	Wyoming						
Willow Creek	Wyoming						
Ranger Mine	Jabiru, Australia		1980–2020 (projected)	60.63	29.3		Ferguson, B., G.M. Mudd. 2010. Water Quality, Water Management and the Ranger Uranium Project: Guidelines, Trends and Issues. <i>Water Air Soil Pollut</i> (2011) 217:347–363. <a href="http://www.springerlink.com/content/866285104206lp58/fulltext.pdf">http://www.springerlink.com/content/866285104206lp58/fulltext.pdf</a> .  World Nuclear Association. 2011. World Uranium Mining. <a href="http://www.world-nuclear.org/info/inf23.html">http://www.world-nuclear.org/info/inf23.html</a> .
Olympic Dam	Roxby Downs, South Australia	Giles Electoral District	1988–2188 (projected)	6.3	68	0.18	World Nuclear Association. World uranium mining. <a href="http://www.world-nuclear.org/info/inf23.html">http://www.world-nuclear.org/info/inf23.html</a> .

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Table D-1. Case Studies (continued)

Mine Name	Mine Location	Mine County	Years of Operation	Average Rainfall (in/yr)	Average Temperature (degrees F)	Population Density in County (ppl/sq)	Reference
<b>Uranium Mines (continued)</b>							
McArthur River Mine	La Ronge, SK, Canada		1999–current	14	29.3	0.33	Canadian Nuclear Safety Commission and Environment Canada. 2009. 2009 Annual Report on Uranium Management Activities. <a href="http://publications.gc.ca/collections/collection_2011/ccsn-cnsc/CC171-9-2009-eng.pdf">http://publications.gc.ca/collections/collection_2011/ccsn-cnsc/CC171-9-2009-eng.pdf</a> .  World Nuclear Association. 2011. Uranium in Canada. <a href="http://www.world-nuclear.org/info/inf49.html">http://www.world-nuclear.org/info/inf49.html</a> .
Rabbit Lake Mine	NE Saskatchewan, Canada		1975–2017 (projected)	13.4 (110 snow)	24.8	0.33	Canadian Nuclear Safety Commission and Environment Canada. 2007. Risk Management of Uranium Releases from Uranium Mines and Mills: 2007 Annual Report. <a href="http://nuclearsafety.gc.ca/eng/readingroom/reports/uranium/2007-annual-report-on-uranium-management-activities.cfm">http://nuclearsafety.gc.ca/eng/readingroom/reports/uranium/2007-annual-report-on-uranium-management-activities.cfm</a> .  Dagbert. M.P. 2008. Technical Report on the Midwest A Uranium Deposit Saskatchewan, Canada. Geostat Systems International Inc. <a href="http://www.denisonmines.com/content/pdf/midwesta_tech_rep_jan_31_08.pdf">http://www.denisonmines.com/content/pdf/midwesta_tech_rep_jan_31_08.pdf</a> .
Millennium	Saskatchewan, Canada						Wise Uranium. 2011. Uranium Mining and Milling. <a href="http://www.wise-uranium.org/indexu.html">http://www.wise-uranium.org/indexu.html</a> .
Hidden Bay	Saskatchewan, Canada						
Midwest	Saskatchewan, Canada						
Kiggavik	Saskatchewan, Canada						
Michelin	Saskatchewan, Canada						
Eco Ridge	Saskatchewan, Canada						
McClellan Lake	Saskatchewan, Canada						
Karamurun	Kazakhstan						
Akdal	Kazakhstan						
Tortkuduk	Kazakhstan						

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Table D-1. Case Studies (continued)

Mine Name	Mine Location	Mine County	Years of Operation	Average Rainfall (in/yr)	Average Temperature (degrees F)	Population Density in County (ppl/sq)	Reference
<b>Uranium Mines (continued)</b>							
Budenovskoye 2	Kazakhstan						Wise Uranium. 2011. Uranium Mining and Milling. <a href="http://www.wise-uranium.org/indexu.html">http://www.wise-uranium.org/indexu.html</a> .
South Inkai	Kazakhstan						
Inkai	Kazakhstan						
Navoi	Uzbekistan						
Vitimsky	Russia						
Kraznokamensk	Russia						
Arlit	Niger						
Beverly	Australia						
San Rafael	Mendoza, Argentina						
Caetite	Brazil						
Rozana	Czech Republic						
Avram Iancu	Romania						
Dobrei South	Romania						
Crucea	Romania						
Feldioara Mill	Romania						
Ingul'skii	Ukraine						
Zheltye Vody Mill	Ukraine						
Kayelekera	Malawi						
Kanyika	Malawi						
Rossing	Namibia						
Langer Heinrich	Namibia						

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Table D-1. Case Studies (continued)

Mine Name	Mine Location	Mine County	Years of Operation	Average Rainfall (in/yr)	Average Temperature (degrees F)	Population Density in County (ppl/sq)	Reference
<b>Uranium Mines (continued)</b>							
Ezulwini	South Africa						Wise Uranium. 2011. Uranium Mining and Milling. <a href="http://www.wise-uranium.org/indexu.html">http://www.wise-uranium.org/indexu.html</a> .
Dominion Reefs	South Africa						
Vaal River	South Africa						
Jaduguda	India						
Bandugurang	India						
Turamdih	India						
Kara-Balta Mill	Kyrgyzstan						
<b>Non-Uranium Hard Rock Mines</b>							
Brewer Gold Mine	Jefferson, SC	Chesterfield	1828–1995	48.64		48.3	EPA. 2005. Brewer Gold Mine. Region 4: Superfund. <a href="http://www.epa.gov/region4/waste/npl/nplsc/brwglsc.htm">http://www.epa.gov/region4/waste/npl/nplsc/brwglsc.htm</a> . Updated 1 June 2011.  U.S. Census Bureau. Number of People and Density for Census 2000 Geography. <a href="http://www.census.gov/population/www/cen2000/atlas/pdf/num_d90.pdf">http://www.census.gov/population/www/cen2000/atlas/pdf/num_d90.pdf</a> .
Cherokee County (Galena)	Galena, KS	Cherokee	pre-1970s	45.57		36.4	TOSC. Galena Lead Mine Superfund Site, Galena, Kansas. Kansas State University. <a href="http://www.engg.ksu.edu/chsr/outreach/tosc/sites/galena.html">http://www.engg.ksu.edu/chsr/outreach/tosc/sites/galena.html</a> . Updated 13 Oct. 2009.  EPA. 2010. Cherokee County, Kansas. EPA Region 7. <a href="http://www.epa.gov/region7/cleanup/npl_files/ksd980741862.pdf">http://www.epa.gov/region7/cleanup/npl_files/ksd980741862.pdf</a> .
Oronogo-Duenweg Mining Belt	Joplin, MO	Newton	Mid-1800s–1970	46.1		70.9	EPA. 2010. Oronogo-Duenweg Mining Belt. EPA Region 7. <a href="http://www.epa.gov/region7/cleanup/npl_files/mod980686281.pdf">http://www.epa.gov/region7/cleanup/npl_files/mod980686281.pdf</a> .  EPA. 1990. NPL Site Narrative for Oronogo-Duenweg Mining Belt. <a href="http://www.epa.gov/superfund/sites/npl/nar846.htm">http://www.epa.gov/superfund/sites/npl/nar846.htm</a> . Updated 9 Aug. 2011.
Tar Creek	Miami, OK	Ottawa	Early-1900s–1970s	43.08		64.8	TOSNAC. Tar Creek (Ottawa County), Oklahoma. <a href="http://www.engg.ksu.edu/chsr/outreach/tosnac/sites/tarcreek.html">http://www.engg.ksu.edu/chsr/outreach/tosnac/sites/tarcreek.html</a> .  EPA. 2011. Tar Creek (Ottawa County) Oklahoma. EPA Region 6. <a href="http://www.epa.gov/region6/6sf/pdffiles/0601269.pdf">http://www.epa.gov/region6/6sf/pdffiles/0601269.pdf</a> .

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Table D-1. Case Studies (continued)

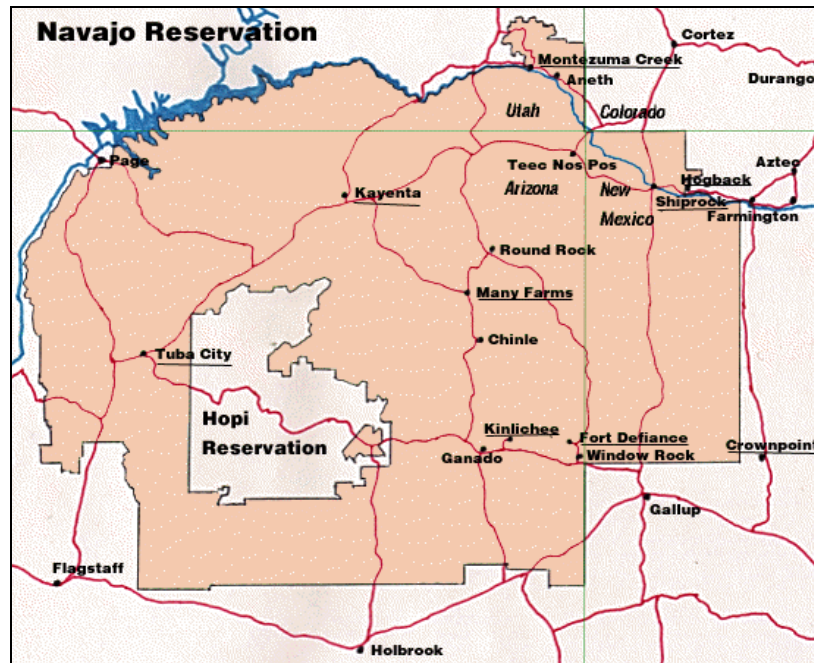
Mine Name	Mine Location	Mine County	Years of Operation	Average Rainfall (in/yr)	Average Temperature (degrees F)	Population Density in County (ppl/sq)	Reference
<b>Non-Uranium Hard Rock Mines (continued)</b>							
San Manuel Copper Mine	San Manuel, AZ	Pinal	1953	12.03		21.7	Blodgett, S., J.R. Kuipers. 2002. Technical Report on Underground Hard-Rock Mining: Subsidence and Hydrologic Environmental Impacts. Center for Science and Public Participation. Bozeman, MT. <a href="http://www.csp2.org/REPORTS/Subsidence%20and%20Hydrologic%20Environmental%20Impacts.pdf">http://www.csp2.org/REPORTS/Subsidence%20and%20Hydrologic%20Environmental%20Impacts.pdf</a> .
Priargunskiy Mining and Chemical Combine	Chita Oblast, Russia		1968–present				NTI. 2002. Russia Uranium Mining and Milling Overview. <a href="http://www.nti.org/db/nisprofs/russia/fissmat/minemill/overview.htm">http://www.nti.org/db/nisprofs/russia/fissmat/minemill/overview.htm</a> .
Henderson Molybdenum Mine	Empire, CO	Clear Creek	Ceased 1989; Operate 3 mo/3 yrs; panel caving began in 1976	18.14		19.3	Blodgett, S., J.R. Kuipers. 2002. Technical Report on Underground Hard-Rock Mining: Subsidence and Hydrologic Environmental Impacts. Center for Science and Public Participation. Bozeman, MT. <a href="http://www.csp2.org/REPORTS/Subsidence%20and%20Hydrologic%20Environmental%20Impacts.pdf">http://www.csp2.org/REPORTS/Subsidence%20and%20Hydrologic%20Environmental%20Impacts.pdf</a> .  Freeport-McMoRan Copper & Gold Inc. 2008. Molybdenum and the Henderson Mine. <a href="http://emfi.mines.edu/emfi2008/HendersonMine.pdf">http://emfi.mines.edu/emfi2008/HendersonMine.pdf</a> .

Notes: Average rainfall data were obtained from the National Weather Service annual rainfall totals for nearest city. Regional terrain was obtained from individual environmental references or Google Maps. All U.S. city populations are based on Census data; other sources were used for international data. For more information regarding existing or previously operating uranium mines, detailed information can be found at [wise-uranium.org](http://wise-uranium.org) and [world-nuclear.org](http://world-nuclear.org).

## D.2 Impacts of Uranium Mining within the Navajo Nation

The Navajo Nation, which comprises over 27,000 square miles, is located in the southwestern United States and spans northwestern New Mexico, northeastern Arizona, and southeastern Utah, as illustrated in Figure D-1. More than 250,000 Navajo people live within the Navajo lands, which are the largest Native American lands in the United States (Navajo, 2011).

**Figure D-1. Map of the Navajo Nation**



Miami University, 2003.

The Navajo lands are located in an area with expansive natural deposits of uranium ore. Uranium mining and milling expanded on the Navajo lands from the 1940s onward. The U.S. Environmental Protection Agency (EPA) identified more than 520 abandoned uranium mines on Navajo lands with mining wastes left behind. It is estimated that approximately one-third of abandoned uranium mill tailings in the United States are located within the lands of the Navajo nation. Tailings have also historically been sold or otherwise provided to the Navajo for building materials and roadway construction (EPA, 2011; IEER, 2001).

Furthermore, contamination has been more widely dispersed on Navajo lands from uranium accidents, most notably the Church Rock, New Mexico, uranium mill spill that occurred in 1979. The United Nuclear Corporation's 50-foot high earthen uranium mill tailings dam failed, causing approximately 1,000 tons of sludge and 100 million gallons of water to flow into the Rio Puerco River and shallow aquifers. Contamination was identified more than 80 miles downstream of the former dam through the city of Gallup and into Arizona. This accident is classified as the largest single release of radioactive material in the United States to date. The site entered the EPA's National Priority List for cleanup in 1983 (EPA, 2008; Shebala, 2009).



From 1988 to 1991, the U.S. Geological Survey (USGS) completed a study documenting the presence and mobility of uranium-mining constituents in the Little Colorado River basin and the Puerco River basin, which is a tributary of the former river basin. The study identified that radioactive metals exceeded EPA Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs) in many of the samples, with higher concentrations documented closer to mining areas. Furthermore, the shallow groundwater zone beneath the Puerco River contained elevated concentrations of uranium (USGS, 1994).

The Health Studies Branch (HSB) of the National Center for Environmental Health (NCEH) also sampled 199 untreated livestock well and spring water sources used from drinking water by the Navajo in 2006 and 2007. Water analytical results indicated that uranium and arsenic concentrations were present above MCLs, in addition to the presence of bacterial contamination. The study specifically highlighted five communities that appeared to be at the highest risk from arsenic and uranium concentrations in drinking water. An additional study completed by the HSB in 2008 investigated household water usage for 296 randomly selected homes within the five high-risk communities. Certain homes had potable water access, while approximately 25% of the Navajo depended solely on hauling untreated water from nearby sources. Additionally, households with potable water may still use untreated water. Drinking water and urine samples were collected for chemical analyses at each home. Overall, 11% and 3% of the water samples were above MCLs for arsenic (10 ug/L) and uranium (30 ug/L), respectively. Furthermore, 42% of urine samples contained uranium above the 95th percentile for the overall U.S. population. However, uranium in urine samples appears to be elevated from additional exposure sources in conjunction with drinking water (ATSDR, 2011b).

A birth defects study near the Shiprock, New Mexico, uranium mining area was completed using data from 13,329 Navajos born between 1964 and 1981. Although 320 types of defective congenital conditions were noted, only proximity of the mother to mine tailings or dumps was identified to be a statistically significant indicator of birth defects. Birth defects also increased if either the mother or father worked in a nearby electronics plant (Shields et al., 1992).

### **Conclusions of Navajo Nation Uranium Impacts Case Study**

As described above, the Navajo Nation has been heavily affected by uranium mining and milling-related contamination. The human health effects associated with prior uranium mining and milling within the Navajo Nation appear to be compounded by a number of factors, including

- lack of baseline and ongoing media sampling (i.e., testing drinking water before and during mining activities),
- lack of pollution control technologies (i.e., direct waste discharge into local streams),
- lack of engineering oversight and maintenance (i.e., failure of Churck Rock dam),
- lack of ongoing communication and transparency by the mining company and regulators to the Navajo people,
- lack of adequate environmental regulations or best management practices in earlier mining years (i.e., 1940s),
- lack of sufficient remediation in mining and residential areas (i.e., tailing piles).

Evaluating the factors that contributed to an adverse outcome for the Navajo can significantly aid the evaluation of the proposed uranium mine in Chatham, Virginia. It is likely that potential uranium mining and milling impacts could be significantly decreased by taking into account the factors the uranium mines and mills lacked in the Navajo Nation. Performing baseline and ongoing media sampling, installing pollution control technologies, conducting engineering oversight and maintenance, maintaining ongoing communication and transparency, and following applicable environmental regulations and best management practices would allow the potential Chatham, Virginia, uranium mine and mill to minimize its environmental and human health footprint compared with mines in other regions, such as the Navajo Nation. However, though VUI could implement these practices to minimize its overall impact, there will nevertheless be a certain level of environmental impacts associated with uranium mining and milling. Thus, remediation of certain areas must still be a possible method to further limit human health and ecological impacts during mining and milling or after operations cease.

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## D.3 Comparison of Locations

Table D-3. Comparison of Locations

	Traits	Arizona 1 Mine	White Mesa Mill	Rabbit Lake Mine and Mill		Ranger Mine and Mill	
		Data	Data	Traits	Data	Traits	Data
Socio-economic characteristics	Location	Colorado City, AZ, Mohave Co	Blanding, San Juan Co, UT	Location	NE Saskatchewan (nearest community Wollaston Lake) <sup>a</sup>	Location	Jabiru, Northern Territory (surrounded by national park)
	Population density (county)	15 <sup>b</sup>	1.9 <sup>c</sup>			Population/population density	1775 <sup>d</sup>
	Concentration measure, e.g., closest urban center and distance to it?	35 miles SW of Fredonia <sup>e</sup>	6 miles from Blanding <sup>f</sup>	Concentration measure, e.g., closest urban center and distance to it?	40 km by air from Wollaston Lake <sup>a</sup>	Concentration measure, e.g., closest urban center and distance to it?	Darwin, 256 km away
	Industry traits	Retail trade, health care and social assistance, accommodation and food service, manufacturing (top 4) <sup>g</sup>	<sup>h</sup>	Industry traits	Agriculture, other resource based industries, construction, education, other services <sup>i</sup>	Industry traits	Manufacturing, construction <sup>d</sup>
	Population (county)	200,186 <sup>b</sup>	14,746 <sup>c</sup>	Population 2006	1,126 <sup>i</sup>		
	Median household income	\$39,863 <sup>b</sup>	\$36,038 <sup>c</sup>	Median income in 2005—All private households (\$)	34,109 Canadian \$ <sup>i</sup>		
	Unemployment rate (July 2011)	10.40% <sup>j</sup>	12.70% <sup>j</sup>	Unemployment	33%		
	Persons below poverty level	17.80% <sup>b</sup>	28.30% <sup>c</sup>				
	Native population	2.20% <sup>b</sup>	50.40% <sup>c</sup>				19.5% Indigenous population
	Picture	<sup>k</sup>					

(continued)

Table D-3. Comparison of Locations (continued)

	Traits	Arizona 1 Mine	White Mesa Mill	Rabbit Lake Mine and Mill		Ranger Mine and Mill: Case 1	
		Data	Data	Traits	Data	Traits	Data
Mine	Date established	Nov.2009 (previous stint 1988-early 1990s) <sup>l</sup>	1980 <sup>f</sup>	Date established	1975 <sup>a</sup>	Date established	1980 <sup>m</sup>
	Date closed/projected close	2013 <sup>n</sup>		Date closed/projected close	2017 <sup>a</sup>	Date closed/projected close	2020 <sup>m</sup>
	Owner	Denison <sup>l</sup>	Denison <sup>f</sup>	Owner	Cameco (100%) <sup>a</sup>	Owner	Energy Resources of Australia (ERA) <sup>m</sup>
	Substance mined	Uranium <sup>l</sup>	Uranium, Vanadium <sup>o</sup>	Substance mined	U <sub>3</sub> O <sub>8</sub> <sup>a</sup>	Substance mined	Uranium <sup>m</sup>
	Probable and proven reserves (mil lbs)	0.856 <sup>n</sup>		Mill located nearby?	Yes (on site, capacity 12 million pounds) <sup>p</sup>	Ore concentration and quantity or Q/yr	Ore produced: 3,793 tonnes, 5,026 in sales in 2010 <sup>q</sup>
	Type of mining	Underground <sup>n</sup>	The mill uses sulfuric acid (H <sub>2</sub> SO <sub>4</sub> ) leaching and a solvent extraction recovery process to extract and recover uranium (U <sub>3</sub> O <sub>8</sub> ) and vanadium (V <sub>2</sub> O <sub>5</sub> ). <sup>o</sup>	Type of mining	Vertical blast-hole stopping with delayed backfill <sup>p</sup>	Type of mining	Open pit <sup>m</sup>
	Mill located nearby?	325 to White Mesa Mill <sup>l</sup>		Mine located nearby?	<sup>a</sup>	Mill located nearby?	Onsite <sup>r</sup>
	Footprint (size or area covered)	19.4 acres <sup>s</sup>	500 acres <sup>t</sup>	Footprint (size or area covered)		Footprint (size or area covered)	500 ha disturbed by mining and milling, 7860 ha lease <sup>u</sup>
	Grade (% of U <sub>3</sub> O <sub>8</sub> )	0.68 <sup>l</sup>		2010 production	3.8 million pounds U <sub>3</sub> O <sub>8</sub> <sup>a</sup>		
	Mining/milling rate (t/day)	335 <sup>v</sup>	2000 <sup>f</sup>	Estimated reserves	25.5 million pounds U <sub>3</sub> O <sub>8</sub> <sup>a</sup>		
	Milling capacity (mil/lbs)	No ore processing will be conducted on-site <sup>s</sup>	8	Total production 1975–2010	182.5 million pounds <sup>a</sup>		

(continued)

**Table D-3. Comparison of Locations (continued)**

	Traits	Arizona 1 Mine	White Mesa Mill	Rabbit Lake Mine and Mill		Ranger Mine and Mill: Case 1	
		Data	Data	Traits	Data	Traits	Data
Environmental/geographic Conditions	Average Temperature (degree F)	55 <sup>w</sup>	50.5 <sup>x</sup>	Temperature	-4 Celsius <sup>y</sup>	Temperature	34.3 C <sup>z</sup>
	Precipitation	13.27 <sup>aa</sup>	13.32 <sup>bb</sup>	Precipitation	34.3 cm rainfall + 278.9 cm snowfall <sup>v</sup>	Precipitation	Seasonal extremes, during monsoon season, 1540 mm annual average <sup>cc</sup>
	Water supply	Colorado River <sup>dd</sup>	Domestic water in towns is supplied from mountain runoff and storage <sup>cc</sup>	Water supply		Water supply	<sup>rr</sup>
	Water usage (extracting groundwater/surface water)	Limited domestic water supply and deep aquifers <sup>s</sup>	Water in a shallow aquifer down gradient of the mill is the source of numerous springs used by tribal members for drinking, for watering cattle, and by wildlife hunted by tribal members. A well completed in a deeper aquifer down gradient of the Mill is the principal source of drinking water to tribal members living in the town of White Mesa, Utah, about 3 miles from the Mill. <sup>ee</sup>	Water usage (extracting groundwater/surface water)		Water usage (extracting groundwater/surface water)	
	Land use	The BLM alone manages over two-thirds of the Strip <sup>hh</sup>	38% forest, 58% shrub/rangelands; Approximately 65.8% of San Juan County is federally owned land administered by the U.S. Bureau of Land Management the National Park Service and the U.S. Forest Service Primary land uses include livestock grazing wildlife range recreation and exploration for minerals oil and gas	Land use		Land use	

(continued)

**Table D-3. Comparison of Locations (continued)**

	Traits	Arizona 1 Mine	White Mesa Mill	Rabbit Lake Mine and Mill		Ranger Mine and Mill: Case 1	
		Data	Data	Traits	Data	Traits	Data
Environmental/geographic Conditions (continued)	Land use (continued)		Approximately 22% of the county is Native American land owned either by the Navajo Nation or the Ute Mountain Ute Tribe The area within miles of the Mill site is predominantly range land owned by residents of Blanding <sup>ii</sup>				
	Elevation (average, variance) ft	5546 ft near the mine (482-8417 range in county) <sup>jj</sup>	6160 near mine, range 3,000-13,000 for county <sup>kk</sup>	Elevation (average, variance)	491.9 m <sup>y</sup>	Elevation (average, variance)	27 m <sup>z</sup>
	Groundwater quality	Aquifer protection permit <sup>ll</sup>		Groundwater		Groundwater quality	Major concern for Aborigines
	Surface water	The U.S. Geological Survey shows mining has elevated uranium and related pollution levels slightly in some areas, but that 95 percent of springs, creeks, and wells tested in the area are within EPA standards for drinking water. <sup>mm</sup>		Surface water		Surface water	
		Fifteen springs and five wells of those sampled contained uranium levels higher than what the EPA considers safe for drinking water, and they were located next to or downstream from known ore deposits Read more: <a href="http://azdailysun.com/news/local/article_435ace73-3d20-588b-a2d1-dcadce49802a.html#ixzz1YWPizyHQ">http://azdailysun.com/news/local/article_435ace73-3d20-588b-a2d1-dcadce49802a.html#ixzz1YWPizyHQ</a> <sup>mm</sup>					
	Located 20 miles from Grand Canyon border, Colorado River		Colorado River, San Juan River, Lake Powell, Canyon Lands National Park <sup>cc</sup>				

(continued)

**Table D-3. Comparison of Locations (continued)**

	Traits	Arizona 1 Mine	White Mesa Mill	Rabbit Lake Mine and Mill		Ranger Mine and Mill: Case 1	
		Data	Data	Traits	Data	Traits	Data
Pollutants	Air	The potential annual emissions from the emergency backup generator and the ore and waste rock unloading are 1.3 tons of oxides of nitrogen (NOX), 0.08 tons of sulfur dioxide (SO2), 0.38 tons of volatile organic compounds (VOC), 0.28 tons of carbon monoxide (CO), and 1.44 tons of particulate matter with a diameter smaller than 10 microns (PM10). Fugitive emissions of PM10 from unpaved haul roads are approximately 323 tons per year. Radon-222 emissions from the mine are limited by federal regulation not to exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 millirem. Mohave County is within an area that is currently classified as an attainment area for air quality. <sup>e</sup>	Potential to Emit Totals: PM10 (including PM2.5) = 34.07, PM2.5 = 17.08 (not accounted for before), SO2 = 2.91, NOx = 39.61, CO = 10.49, VOC = 4.03, hexane = 0.63 and formaldehyde = 0.03. On the basis of data collected from sampling locations at the White Mesa Mill site for 1 year, dust-fall averaged 33 grams per square meter (g/m2) per month; the highest monthly average was 102 g/m2 occurring in August. Total suspended particulates monitoring from October 1977 through February 1978 produced a geometric mean of 18 µg/m3. This value is well below the federal and state air quality standard of 50 µg/m3. The maximum 24-hour concentration was 79 µg/m3, or approximately one-half of the federal and state standard of 150 µg/m3. Sulfation rate monitoring at the White Mesa Mill site indicates that sulfur dioxide concentrations at the site are less than 0.005 parts per million (ppm). The federal and state standard for the annual average of sulfur dioxide is 0.03 ppm. <sup>m</sup>	air		Air	

(continued)



**Table D-3. Comparison of Locations (continued)**

	Traits	Arizona 1 Mine	White Mesa Mill	Rabbit Lake Mine and Mill		Ranger Mine and Mill: Case 1	
		Data	Data	Traits	Data	Traits	Data
Pollutants (continued)	Surface water (NPDES permits)	Aquifer protection permit <sup>ii</sup>	The Mill has been designed as a facility that does not discharge to groundwater or surface water. All tailings and other Mill wastes are disposed of permanently into the Mills tailings system. Excess waters are disposed of in the tailings cells where they are subject to evaporation or reprocessed through the Mill circuit. The Mill was also designed and constructed to prevent run-on or runoff of storm water by diverting runoff from precipitation on the Mill site to the tailings cells and diverting runoff from surrounding areas away from the Mill site. The Permit therefore does not authorize any discharges to groundwater or surface water but is intended to protect against potential inadvertent or unintentional discharges such as through potential failure of the Mills tailings system. <sup>oo</sup>	Surface water (NPDES permits)		Surface water (NPDES permits)	

(continued)

**Table D-3. Comparison of Locations (continued)**

	Traits	Arizona 1 Mine	White Mesa Mill	Rabbit Lake Mine and Mill		Ranger Mine and Mill: Case 1	
		Data	Data	Traits	Data	Traits	Data
Pollutants (continued)	Ground water	Limited domestic water supply and deep aquifers <sup>s</sup>	The tailings facilities currently consist of four lined cells with leak detection systems (LOS) and a groundwater detection monitoring program consisting of six monitoring wells. These wells are sampled quarterly for chloride, potassium, nickel, and uranium. These constituents are indicator parameters to detect potential groundwater impact. Currently, there is no indication of groundwater impact from the tailing cells based on the groundwater sampling. <sup>pp</sup>	Ground water	Had 2 environmental incidents (accidental pumping and material spill), but were remedied and had negligible impact to environment <sup>qq</sup>	Ground water	
	Soil	The uranium concentrations found here are 10 times higher than the background concentrations that naturally occur in the soil, according to the U.S. Geological Survey. Arguable that this is from naturally occurring deposits of uranium and not from mining activities. <sup>tt</sup>	The soil type in this area is primarily Blanding very fine sandy loam (USDA 1962), which is deep, well-drained, and of medium texture. The soil is moderately permeable and has slow surface runoff, so water can move through the profile readily and roots can penetrate easily. Because of the moderate infiltration characteristics, erosion potential is low. <sup>ss</sup>	Soil		Soil	
	Toxic Release Inventory (TRI)	There are no TRI facilities within a 5-mile radius of the site. <sup>s</sup>		Risk management activities	Report → <sup>tt</sup>		Erosion, topography, impacts in this report <sup>uu</sup>
				Treated Water since 2007	Consistently below 0.01 mg/L (regulatory limit of 0.5 mg/L) <sup>qq</sup>		Overall, the mine has met water quality protection regime, although linkages to certain aspects of the mine's operations have not been assessed <sup>vv</sup>

(continued)

**Table D-3. Comparison of Locations (continued)**

	Traits	Arizona 1 Mine	White Mesa Mill	Rabbit Lake Mine and Mill		Ranger Mine and Mill: Case 1	
		Data	Data	Traits	Data	Traits	Data
Health	Worker—cancer			Worker—cancer		Worker—cancer	<sup>ww</sup>
	Worker—noncancer			Worker—noncancer		Worker—noncancer	Water contamination <sup>xx</sup>
	Public—cancer			Public—cancer		Public—cancer	Consumption of native foods leads to greater radiation <sup>uu</sup>
	Public—noncancer			Public—noncancer		Public—noncancer	Exposure to Aboriginal communities well below dose limit <sup>yy</sup>
Ecosystem/ecological Impacts	Land use change		Of the more than 4.9 million acres in San Juan County, approximately 60 percent of the land is administered by federal agencies. There are several national parks in the county. The entire western boundary of the county is adjacent to Canyonlands National Park, Glen Canyon National Recreation Area, the Colorado and Green Rivers, and Lake Powell. Approximately 28 miles due west of the White Mesa Mill site is Natural Bridges National Monument. Hovenweep National Monument is about 25 miles to the east-southeast. San Juan County has a total of 15 national, state, and tribal parks and recreation areas. Most of these resources are within a 50-mile radius of the site, but none are in the immediate vicinity of the site.	Land use change		Land use change	

(continued)

**Table D-3. Comparison of Locations (continued)**

	Traits	Arizona 1 Mine	White Mesa Mill	Rabbit Lake Mine and Mill		Ranger Mine and Mill: Case 1	
		Data	Data	Traits	Data	Traits	Data
Ecosystem/ecological Impacts (continued)	Land use change (continued)		Approximately 30 percent of San Juan County lands are in Indian reservations. The White Mesa Ute Indian Reservation totals more than 8,300 acres and is located 3.4 miles south of the site along both sides of US-191. Private land in San Juan County is dedicated almost entirely to agriculture. The areas most amenable to farming are in the east-central portion of the county. The principal crops are wheat and beans. There are no prime or unique farmlands in San Juan County. The arid climate, lack of irrigation, and the rugged landforms dictate grazing as the primary agricultural use. <sup>ss</sup>				
	Habitat destruction		Current vegetation consists primarily of crested wheatgrass and invasive weeds. Annual weeds, rabbit brush, snakeweed, sagebrush, and cheat grass dominate vegetation in the surrounding areas, which include some abandoned dry farms. Areas that were neither cultivated nor chained support sagebrush communities with a sparse understory of grasses, including galleta and crested wheatgrass. Forbs are rarely found. Potential vegetation consists of more than 50 percent palatable grasses such as western wheatgrass, Indian rice grass, needle-and-thread grass, and squirrel tail; 15 to 20 percent increaser grasses, including galleta and blue grama; 25 percent decreaser browse plants, including winterfat; and 5 to 10 percent big sagebrush, ephedra, and other shrubs. <sup>1</sup>	Habitat destruction		Habitat destruction	

(continued)

**Table D-3. Comparison of Locations (continued)**

	Traits	Arizona 1 Mine	White Mesa Mill	Rabbit Lake Mine and Mill		Ranger Mine and Mill: Case 1	
		Data	Data	Traits	Data	Traits	Data
Ecosystem/ecological Impacts (continued)	Depletion of water resources		Potable and nonpotable water needs at the White Mesa Mill site are supplied from existing deep wells and the Recapture Reservoir, respectively. The Entrada/Navajo aquifer is capable of yielding domestic quality water at rates of 150 to 225 gpm (216,000 to 324,000 gallons per day) and is used as a secondary source of potable water for the White Mesa Mill site. There are five deep water supply wells constructed by IUC at the White Mesa facility. <sup>ss</sup>	Depletion of water resources		Depletion of water resources	
							Ecosystem-level responses <sup>zz</sup>

(continued)

Table D-3. Comparison of Locations (continued)

	Traits	Arizona 1 Mine	White Mesa Mill	Rabbit Lake Mine and Mill		Ranger Mine and Mill: Case 1	
		Data	Data	Traits	Data	Traits	Data
Quality of Life	Safety (lesser number of crimes committed)	In 2010 Fredonia had 2 violent crimes and 25 lesser crimes, Colorado City had 4 violent crimes and 54 lesser crimes; in 2007 Fredonia had 1 violent crime and 34 lesser crimes, Colorado City had 1 violent crime and 11 lesser crimes <sup>bbb</sup>	In 2005 Blanding had 6 violent crimes and 10 lesser crimes; in 2007 Blanding had 3 violent crimes and 45 lesser crimes; in 2010 Blanding had 4 violent crime and 153 lesser crimes <sup>ccc</sup>	Safety (lesser number of crimes committed)		Safety (lesser number of crimes committed)	
	Population with a bachelor's degree	12.10% <sup>b</sup>	16.30% <sup>c</sup>	Transportation	Employees fly in to work 7 days a week	Transportation	Most people use bus system or travel by car <sup>d</sup>
	Population with a high school diploma	82.40% <sup>b</sup>	79.30% <sup>c</sup>	Total population 15 years and over	955 <sup>i</sup>	Education	No substantial change since Fox Report <sup>y</sup>
	Recreation	Grand Canyon National Park, Davis Camp, Hualapai Mountain Park. 13 Recreational facilities in the county. <sup>ddd</sup>		No certificate, diploma or degree	515 <sup>i</sup>		ERA committed \$850,000 to employment and training <sup>ccc</sup>
	Healthcare	20% of population in fair or poor health, 27% of population obese, 21% uninsured adults, 1811 people:1 primary care physician, 61,514 Medicare enrollees, 11% diabetic <sup>fff</sup>	13% of population in poor or fair health, 8% of population smokes, 25% of population is obese, 5% excessive drinkers, 219 STDs per 100,000, 19% of adults uninsured, 2478 people:1 primary care physician, 1969 Medicare enrollees, 10% diabetic <sup>ggg</sup>	High school certificate or equivalent	125 <sup>i</sup>		2001: 28.9% individuals with advanced diploma, diploma, or census <sup>d</sup>
						Recreation	Fishing, camping, bushwalking, birdwatching <sup>hhh</sup>

(continued)

Table D-3. Comparison of Locations (continued)

	Traits	Arizona 1 Mine	White Mesa Mill	Rabbit Lake Mine and Mill		Ranger Mine and Mill: Case 1	
		Data	Data	Traits	Data	Traits	Data
Noted Economic and Economic Development Impacts	Number of jobs created by mine/mill	32 <sup>l</sup>	150, 65% are Native American <sup>iii</sup>	Number of jobs created by mine/mill	335 <sup>iii</sup>	Healthcare	No substantial change since Fox Report <sup>yy</sup>
	Median Home Value 2000	95300 in 2000\$, \$179,300 in 2005-2009 <sup>kkk</sup>	\$100,500 in 2009\$ (year 2005-2009). \$86500 San Juan County in 2000. Utah's median home value in 1980 was \$113,400 in 2000\$ and \$146,100 in year 2000. <a href="http://www.census.gov/hhes/www/housing/census/historic/values.html">http://www.census.gov/hhes/www/housing/census/historic/values.html</a> <sup>kkk</sup>	Change in housing value (property values, rents), occupancy, etc		Number of jobs created by mine/mill	523 jobs, 81 indigenous <sup>iii</sup>
	Population change 2000 to 2010	29.10% <sup>b</sup>	2.30% <sup>c</sup>	Change in population		Change in housing value (property values, rents), occupancy, etc	Housing and infrastructure greatly subsidized by government (5,731,200). ERA has not contributed <sup>eee</sup>
	Change in number of firms	Number of establishments 2007: 4599, in 2010:3797 <sup>mmm</sup>	Number of establishments in 2001: 340; in 2010: 352 <sup>mmm</sup>	Change in number of firms		Change in population	
	Change in employment	Employment in 2007: 53104, Employment in 2010: 44972 <sup>mmm</sup>	Employment in 2001: 3766, Employment in 2010: 4148 <sup>mmm</sup>	Change in employment		Change in number of firms	
	Change in wages	Average Weekly Wage in 2007 \$599, Wage in 2010 \$623 <sup>mmm</sup>	Average Weekly Wage 2001 \$428, Average Weekly Wage \$609 <sup>mmm</sup>	Change in wages		Change in employment	
	Change in structure of economy (more or less ag, mfg, service, etc)			Change in structure of economy (more or less ag, mfg, service, etc)		Change in wages	
	Community perception or reputation	Many of the nearby American Indian Reservations oppose uranium in the Arizona strip due to increased cancer rates from legacy mining that took place after WWII <sup>s</sup>		Ascetic changes		Change in structure of economy (more or less ag, mfg, service, etc)	More mfg

(continued)

**Table D-3. Comparison of Locations (continued)**

	Traits	Arizona 1 Mine	White Mesa Mill	Rabbit Lake Mine and Mill		Ranger Mine and Mill: Case 1	
		Data	Data	Traits	Data	Traits	Data
Noted Economic and Economic Development Impacts (continued)				Community perception or reputation		Ascetic changes	The actual disturbed area for mining purposes is relatively small
				Social conflicts		Community perception or reputation	
	Psychosocial health impacts (alcohol, drug use, stress, depression)	20% of population engages in excessive drinking, highest smoking rate and alcohol use in AZ <sup>fff</sup>		Political influence		Social conflicts	Similar to those issues expressed in 1977 Fox Report <sup>yy</sup>
	Displacement of populations	No people currently live within 5 miles of the mine <sup>nnn</sup>	Approximately 5.6 km (3.5 miles) southeast of the site is the White Mesa Reservation, a community of approximately 320 Ute Mountain Indians. The nearest resident to the mill is located approximately 5 km (3 miles) to the northeast of the mill, which is in the prevailing wind direction. <sup>ooo</sup>	Psychosocial health impacts (alcohol, drug use, stress, depression)		Political influence	
		35 % of population with high housing costs, 13% illiteracy rate, 25% of children in poverty, 33% single parent households <sup>fff</sup>	13.9% of population not proficient in English, 22% of population with high housing costs, 12% illiteracy, 31% of children in poverty, 36% single-parent households <sup>ggg</sup>	Displacement of populations		Psychosocial health impacts (alcohol, drug use, stress, depression)	Has not changed since 1976 Fox Report, excessive alcohol consumption major problem <sup>yy</sup>
						Displacement of populations	
							Aborigines receive royalty payments (2010, \$26 million) <sup>lll</sup>
							Annual land rental 200,000 is also paid directly to tribes <sup>ppp</sup>
						Mine contributes to local economy <sup>yy</sup>	

(continued)



**Table D-3. Comparison of Locations (continued)**

a	Cameco: <a href="http://www.cameco.com/mining/rabbit_lake/">http://www.cameco.com/mining/rabbit_lake/</a>
b	<a href="http://quickfacts.census.gov/qfd/states/04/04015.html">http://quickfacts.census.gov/qfd/states/04/04015.html</a>
c	<a href="http://quickfacts.census.gov/qfd/states/49/49037.html">http://quickfacts.census.gov/qfd/states/49/49037.html</a>
d	<a href="http://www.censusdata.abs.gov.au/ABSNavigation/prenav/ViewData?&amp;action=402&amp;documentproductno=710152000&amp;documenttype=Snapshot&amp;order=1&amp;tabname=Summary&amp;areacode=710152000&amp;issue=2001&amp;producttype=Community%20Profiles&amp;&amp;producttype=Community%20Profiles&amp;javascript">http://www.censusdata.abs.gov.au/ABSNavigation/prenav/ViewData?&amp;action=402&amp;documentproductno=710152000&amp;documenttype=Snapshot&amp;order=1&amp;tabname=Summary&amp;areacode=710152000&amp;issue=2001&amp;producttype=Community%20Profiles&amp;&amp;producttype=Community%20Profiles&amp;javascript</a>
e	<a href="http://www.azdeq.gov/environ/air/permits/download/denison/denison_fact.pdf">http://www.azdeq.gov/environ/air/permits/download/denison/denison_fact.pdf</a>
f	<a href="http://denisonmines.com/Document/Details/96">http://denisonmines.com/Document/Details/96</a>
g	<a href="http://factfinder.census.gov/servlet/GQRTable?_bm=y&amp;-geo_id=05000US04015&amp;-ds_name=EC0700A1&amp;-_lang=en">http://factfinder.census.gov/servlet/GQRTable?_bm=y&amp;-geo_id=05000US04015&amp;-ds_name=EC0700A1&amp;-_lang=en</a>
h	<a href="http://factfinder.census.gov/">http://factfinder.census.gov/</a>
i	2006 Community Profile (Div. 18, Unorganized) <a href="http://www12.statcan.gc.ca/census-recensement/2006/dp-pd/prof/92-591/details/Page.cfm?Lang=E&amp;Geo1=CSD&amp;Code1=4718090&amp;Geo2=PR&amp;Code2=47&amp;Data=Count&amp;SearchText=wollaston%20lake&amp;SearchType=Begins&amp;SearchPR=47&amp;B1=All&amp;Custom=">http://www12.statcan.gc.ca/census-recensement/2006/dp-pd/prof/92-591/details/Page.cfm?Lang=E&amp;Geo1=CSD&amp;Code1=4718090&amp;Geo2=PR&amp;Code2=47&amp;Data=Count&amp;SearchText=wollaston%20lake&amp;SearchType=Begins&amp;SearchPR=47&amp;B1=All&amp;Custom=</a>
j	<a href="http://data.bls.gov/cgi-bin/dsrv">http://data.bls.gov/cgi-bin/dsrv</a>
k	<a href="http://www.grandcanyontrust.org/news/wp-content/uploads/2010/05/4558723666_06fe6b0b19_b.jpg">http://www.grandcanyontrust.org/news/wp-content/uploads/2010/05/4558723666_06fe6b0b19_b.jpg</a>
l	<a href="http://denisonmines.com/Document/Details/145">http://denisonmines.com/Document/Details/145</a>
m	World Nuclear Association: <a href="http://www.world-nuclear.org/info/Australia_Mines/emin.html#olympic">http://www.world-nuclear.org/info/Australia_Mines/emin.html#olympic</a>
n	<a href="http://www.mining-technology.com/projects/arizona-1-uranium/">http://www.mining-technology.com/projects/arizona-1-uranium/</a>
o	<a href="http://denisonmines.com/Document/Details/97">http://denisonmines.com/Document/Details/97</a>
p	Cameco—Mining: <a href="http://www.cameco.com/mining/rabbit_lake/mining_and_milling/">http://www.cameco.com/mining/rabbit_lake/mining_and_milling/</a>
q	ERA Annual Report 2010: <a href="http://www.world-nuclear.org/info/Australia_Mines/emin.html#olympic">http://www.world-nuclear.org/info/Australia_Mines/emin.html#olympic</a>
r	Environmental Incidents at Ranger: <a href="http://www.aph.gov.au/Senate/committee/ecita_ctte/completed_inquiries/2002-04/uranium/report/e06.pdf">http://www.aph.gov.au/Senate/committee/ecita_ctte/completed_inquiries/2002-04/uranium/report/e06.pdf</a>
s	<a href="http://www.azdeq.gov/environ/air/permits/download/denison/Final%20Denison%20Mines%20EJ%20Assessment.pdf">http://www.azdeq.gov/environ/air/permits/download/denison/Final%20Denison%20Mines%20EJ%20Assessment.pdf</a>
t	<a href="http://www.gjem.energy.gov/moab/documents/eis/final_eis/Volume_II/AppendixA_A3.pdf">http://www.gjem.energy.gov/moab/documents/eis/final_eis/Volume_II/AppendixA_A3.pdf</a>
u	WNA: <a href="http://world-nuclear.org/info/inf25.html">http://world-nuclear.org/info/inf25.html</a>
v	<a href="http://denisonmines.com/Document/Details/146">http://denisonmines.com/Document/Details/146</a>
w	<a href="http://www.weatherreports.com/United_States/AZ/Colorado_City">http://www.weatherreports.com/United_States/AZ/Colorado_City</a>
x	<a href="http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?utblan">http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?utblan</a>
y	Collins Bay—Canadian Climate Normals (1971–2000): <a href="http://climate.weatheroffice.gc.ca/climate_normals/results_e.html?stnID=3361&amp;lang=e&amp;dCode=0&amp;province=SASK&amp;provBut=&amp;month1=0&amp;month2=12">http://climate.weatheroffice.gc.ca/climate_normals/results_e.html?stnID=3361&amp;lang=e&amp;dCode=0&amp;province=SASK&amp;provBut=&amp;month1=0&amp;month2=12</a>
z	Climate Statistics for Jabiru: <a href="http://www.bom.gov.au/climate/averages/tables/cw_014198.shtml">http://www.bom.gov.au/climate/averages/tables/cw_014198.shtml</a>
aa	<a href="http://www.wrcc.dri.edu/cgi-bin/cliMONtpre.pl?az1920">http://www.wrcc.dri.edu/cgi-bin/cliMONtpre.pl?az1920</a>
bb	<a href="http://www.wrcc.dri.edu/cgi-bin/cliMONtvt.pl?ut0738">http://www.wrcc.dri.edu/cgi-bin/cliMONtvt.pl?ut0738</a>
cc	Australian Government Dept Sustainability: <a href="http://www.environment.gov.au/ssd/supervision/arr-mines/ranger.html">http://www.environment.gov.au/ssd/supervision/arr-mines/ranger.html</a>
dd	<a href="http://www.columbia.edu/~kk2534/Phoenix%20Water/Water%20Supply/Water%20Supply%20Info.html">http://www.columbia.edu/~kk2534/Phoenix%20Water/Water%20Supply/Water%20Supply%20Info.html</a>
ee	<a href="http://www.uacd.org/pdfs/San%20Juan%20County%20Resource%20Needs%20Assessment%202011.pdf">http://www.uacd.org/pdfs/San%20Juan%20County%20Resource%20Needs%20Assessment%202011.pdf</a>
ff	Water Classes ERA: <a href="http://onlinelibrary.wiley.com/doi/10.1111/1467-8470.00128/abstracthttp://www.energyres.com.au/ourapproach/2684_different_types_of_water.asp">http://onlinelibrary.wiley.com/doi/10.1111/1467-8470.00128/abstracthttp://www.energyres.com.au/ourapproach/2684_different_types_of_water.asp</a>
gg	<a href="http://ut.water.usgs.gov/projects/whitemesa/">http://ut.water.usgs.gov/projects/whitemesa/</a>
hh	<a href="http://grandcanyonhistory.clas.asu.edu/sites_adjacentlands_blmarizonastrip.html">http://grandcanyonhistory.clas.asu.edu/sites_adjacentlands_blmarizonastrip.html</a>
ii	<a href="http://www.ut.nrcs.usda.gov/technical/nri/RA-data/SanJuan_Res_Assmnt.pdf">http://www.ut.nrcs.usda.gov/technical/nri/RA-data/SanJuan_Res_Assmnt.pdf</a> ; <a href="http://www.radiationcontrol.utah.gov/Uranium_Mills/IUC/Denison_IUC/permit_renewal/p/PERMIT_1.pdf">http://www.radiationcontrol.utah.gov/Uranium_Mills/IUC/Denison_IUC/permit_renewal/p/PERMIT_1.pdf</a>
jj	<a href="http://forecast.weather.gov/MapClick.php?lat=36.71687068791303&amp;lon=-112.99163818359375&amp;site=vef&amp;unit=0&amp;lg=en&amp;FcstType=text">http://forecast.weather.gov/MapClick.php?lat=36.71687068791303&amp;lon=-112.99163818359375&amp;site=vef&amp;unit=0&amp;lg=en&amp;FcstType=text</a>

(continued)

**Table D-3. Comparison of Locations (continued)**

kk	<a href="http://forecast.weather.gov/MapClick.php?CityName=Blanding&amp;state=UT&amp;site=GJT&amp;textField1=37.6242&amp;textField2=-109.478&amp;e=1">http://forecast.weather.gov/MapClick.php?CityName=Blanding&amp;state=UT&amp;site=GJT&amp;textField1=37.6242&amp;textField2=-109.478&amp;e=1</a>
ll	<a href="http://www.azdeq.gov/environ/air/permits/download/denison/101210c.pdf">http://www.azdeq.gov/environ/air/permits/download/denison/101210c.pdf</a>
mmm	<a href="http://azdailysun.com/news/local/article_435ace73-3d20-588b-a2d1-dcadce49802a.html">http://azdailysun.com/news/local/article_435ace73-3d20-588b-a2d1-dcadce49802a.html</a>
nn	<a href="http://uraniumwatch.org/denisonmill.ut/daq_whitemesa_modification.100923.pdf">http://uraniumwatch.org/denisonmill.ut/daq_whitemesa_modification.100923.pdf</a> ; <a href="http://www.gjem.energy.gov/moab/documents/eis/final_eis/Volume_I/Chapter3.pdf">http://www.gjem.energy.gov/moab/documents/eis/final_eis/Volume_I/Chapter3.pdf</a>
oo	<a href="http://www.radiationcontrol.utah.gov/Uranium_Mills/IUC/Denison_IUC/permit_renewal/p/PERMIT_1.pdf">http://www.radiationcontrol.utah.gov/Uranium_Mills/IUC/Denison_IUC/permit_renewal/p/PERMIT_1.pdf</a>
pp	<a href="http://www.radiationcontrol.utah.gov/Uranium_Mills/IUC/cell4b/envAsses%202002.pdf">http://www.radiationcontrol.utah.gov/Uranium_Mills/IUC/cell4b/envAsses%202002.pdf</a> ; Water permit renewal
qq	Cameco—Environment and Safety: <a href="http://www.cameco.com/mining/rabbit_lake/environment_and_safety/">http://www.cameco.com/mining/rabbit_lake/environment_and_safety/</a>
rr	<a href="http://www.tucsonsentinel.com/local/report/051111_grandcanyon_mining/federal-plan-wont-end-uranium-mining-near-grand-canyon/">http://www.tucsonsentinel.com/local/report/051111_grandcanyon_mining/federal-plan-wont-end-uranium-mining-near-grand-canyon/</a>
ss	<a href="http://www.gjem.energy.gov/moab/documents/eis/final_eis/Volume_I/Chapter3.pdf">http://www.gjem.energy.gov/moab/documents/eis/final_eis/Volume_I/Chapter3.pdf</a>
tt	Part II-1.1.: INFO-0771_E.pdf
uu	OSS Annual Report_09-10.pdf: \\rtifile02\EHE\Projects\0212843-DRF_Uranium\Data_and_Tools\Case Studies\Ranger Case Study\OSS_Annual_Report_09-10.pdf
vv	Mudd_2011.pdf \\rtifile02\EHE\Projects\0212843-DRF_Uranium\Data_and_Tools\Case Studies\Ranger Case Study\Mudd_2011.pdf
ww	OSS Radiation Clearance Investigation.pdf: \\rtifile02\EHE\Projects\0212843-DRF_Uranium\Data_and_Tools\Case Studies\Ranger Case Study\OSS_Radiation_Clearance_Procedures_Investigation.pdf
xx	Water Contamination_2004.doc: \\rtifile02\EHE\Projects\0212843-DRF_Uranium\Data_and_Tools\Case Studies\Ranger Case Study\Water Contamination_2004.doc
yy	Impact of Uranium Mining on Aboriginal Communities: <a href="http://www.aph.gov.au/SEnate/committee/uranium_ctte/report/c11.htm">http://www.aph.gov.au/SEnate/committee/uranium_ctte/report/c11.htm</a>
zz	Biological monitoring: <a href="http://www.environment.gov.au/ssd/monitoring/magela-bio.html#assessment">http://www.environment.gov.au/ssd/monitoring/magela-bio.html#assessment</a>
aaa	OSS annual report
bbb	<a href="http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2010/crime-in-the-u.s.-2010/tables/table-8/10tbl08az.xls">http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2010/crime-in-the-u.s.-2010/tables/table-8/10tbl08az.xls</a> ; <a href="http://www2.fbi.gov/ucr/cius2007/data/table_08_az.html">http://www2.fbi.gov/ucr/cius2007/data/table_08_az.html</a>
ccc	<a href="http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s">http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s</a> Table 8 Utah
ddd	<a href="http://www.mcparks.com/">http://www.mcparks.com/</a> , 2011 County Health Ranking Arizona
eee	Kakadu Social Impact Study: \\rtifile02\EHE\Projects\0212843-DRF_Uranium\Data_and_Tools\Case Studies\Ranger Case Study\Kakadu_Social_Impact_Study_2000.pdf
fff	2011 County Health Ranking Arizona
ggg	2011 County Health Ranking Utah
hhh	AboutAustralia.com: <a href="http://www.about-australia.com/northern-territory/kakadu-arnhem-land/destinations/jabiru/">http://www.about-australia.com/northern-territory/kakadu-arnhem-land/destinations/jabiru/</a>
iii	<a href="http://www.acertgroup.com/Economic_Impact.pdf">www.acertgroup.com/Economic_Impact.pdf</a> , <a href="http://www.sjrnews.com/pages/full_story/push?article-White+Mesa+Uranium+Mill+is+an+economic+juggernaut+in+San+Juan%20&amp;id=11426678">http://www.sjrnews.com/pages/full_story/push?article-White+Mesa+Uranium+Mill+is+an+economic+juggernaut+in+San+Juan%20&amp;id=11426678</a>
jjj	Cameco Ribbit Lake Socio-Economic Impact: <a href="http://www.cameco.com/mining/rabbit_lake/socio-economic_impact/">http://www.cameco.com/mining/rabbit_lake/socio-economic_impact/</a>
kkk	<a href="http://www.acertgroup.com/Economic_Impact.pdf">www.acertgroup.com/Economic_Impact.pdf</a>
lll	ERA Annual Report 2010.pdf: \\rtifile02\EHE\Projects\0212843-DRF_Uranium\Data_and_Tools\Case Studies\Ranger Case Study\ERA_Annual_Report_2010.pdf
mmm	BLS QCEW
nnn	ADEZ Environmental Justice Report
ooo	<a href="http://www.radiationcontrol.utah.gov/Uranium_Mills/IUC/cell4b/envAsses%202002.pdf">http://www.radiationcontrol.utah.gov/Uranium_Mills/IUC/cell4b/envAsses%202002.pdf</a>
ppp	ERA Traditional Owners: <a href="http://www.energyres.com.au/ourapproach/1697_traditional_owners.asp">http://www.energyres.com.au/ourapproach/1697_traditional_owners.asp</a>

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Wise Uranium. 2011. *Uranium Mining and Milling*. <http://www.wise-uranium.org/indexu.html>

### Crow Butte

Cameco Corporation. *Crowe Butte*. [http://www.cameco.com/mining/crow\\_butte/](http://www.cameco.com/mining/crow_butte/).

Wise Uranium. 2011. *Uranium Mining and Milling*. <http://www.wise-uranium.org/indexu.html>.

### Canon City

Wise Uranium. 2011. *Issues at Canon City uranium mill (Colorado)*. <http://www.wise-uranium.org/umopcc.html>

### Mt. Taylor, Alta Mesa, Hobson, Vasquez, Pala gana, Kingsville Dome, La Sal, Rim, Moore Ranch, Sweetwater, Willow Creek, Millennium, Hidden Bay, Midwest, Kiggavik, Michelin, Eco Ridge, McClean Lake, Karamuraun, Beverly, San Rafael, Caetite, Rozana, Avram Iancu, Dobrei South, Crucea, Feldioara Mill, Ingul'skii, Zheltiye Vody Mill, Kayelekera, Kanyika, Rossing, Langer Heinrich, Ezulwini, Dominion Reefs, Vaal River, Jaduguda, Bandugurang, Turamdih, Kara-Balta Mill

Wise Uranium. 2011. *Uranium Mining and Milling*. <http://www.wise-uranium.org/indexu.html>.

### Karamurun, Akdal, Tortkuduk, Budenovskoye 2, South Inkai, Inkai, Navoi, Vitimsky, Kraznokamensk, Arlit

World Nuclear Association. *World uranium mining*. <http://www.world-nuclear.org/info/inf23.html>.



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# ***Appendix E: Transport Model Documentation***

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## **E.1 Airborne Particulate Modeling**

In this analysis, the AMS/EPA Regulatory Model (AERMOD) was used to evaluate the dispersion of dust emitted from the combined emission processes that would be expected to take place at the Cole's Hill Uranium mine. AERMOD is a steady-state Gaussian plume model that can be used to model a wide range of source types, and can calculate air concentration and deposition estimates for a variety of averaging times. Receptors may be placed in a polar or Cartesian grid, or placed in discrete locations. AERMOD requires the use of surface and profile meteorological data consisting of wind and turbulence parameters. These files are created by the AERMET preprocessor using hourly surface data observations and twice-daily upper air sounding data.

Since no current plan for the property layout was available, the analysis was run assuming a circular area source consisting of the total area and emission rates of all contributing sources. Both the open pit and underground mine types were modeled for non-ore dust emissions and ore dust emissions, as separate scenarios. Uncertainty in the magnitude of emission estimates was addressed by calculating emission rates for both a high end and low end emission scenario. The model was applied separately to each scenario to bracket the range of dispersion results.

Prior to running AERMOD, surface and upper air meteorological data must be merged together with other surface characteristics using the AERMET pre-processor. AERMET requires the input of surface characteristics, which are determined based on land cover by a separate preprocessor called AERSURFACE. Prior to beginning this series of processing steps, Danville Regional Airport (KDAN) and Piedmont Triad International Airport (KGSO) were chosen as the most representative surface and upper air meteorological stations, respectively.

### **E.1.1 Meteorological Data Selection**

Meteorological data required for use in the AERMOD modeling system consists of, at a minimum, hourly surface data and twice-daily upper air sounding data (U.S. EPA, 2004c). On-site meteorological data are often used, if available. National Weather Service surface data from a nearby, representative weather station are used to substitute for missing on-site surface data. If on-site data are not available, it is imperative to select the most representative surface meteorological station with at least 5 years of meteorological data. 1-minute Automated Surface Observing System (ASOS) data are used to supplement missing hourly surface wind data, with the application of a pre-processor called AERMINUTE.

In the case of the Cole's Hill mine, no on-site meteorological data were available. Therefore, the nearest, most representative meteorological station was used in modeling. The most recent 5 complete calendar years of surface observation data, covering 2006 through 2010, were acquired in the Integrated

Surface Hourly (ISH) data format for KDAN (U.S. DOC and NOAA, 2008–2011). KDAN was selected because it is relatively close to, is similar in landscape, and at a similar elevation to the proposed mine location. 1-minute ASOS data for KDAN were acquired from <ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin/> for the same time frame, and used to fill the missing and calm wind occurrences in the KDAN hourly observations.

Five years of upper air sounding data covering 2006 through 2010 were acquired for KGSO from <http://www.esrl.noaa.gov/raobs/Welcome.cgi> (NOAA and ESRL, 2011). KGSO was chosen as the upper air station because KDAN does not collect upper air sounding data, it is relatively close to KDAN, and the landscape and elevation are relatively similar to KDAN. Table E-1 summarizes the meteorological Station Information Used in this modeling analysis.

**Table E-1. Meteorological Station Information Used in Modeling Analysis**

Parameter	Surface Meteorological Station	Upper Air Meteorological Station
Name (Callsign)	Danville Regional Airport (KDAN)	Piedmont Triad International Airport (KGSO)
Weather-Bureau-Army-Navy (WBAN) Number	13728	13723
Latitude <sup>1</sup>	36.572872	36.096888
Longitude <sup>1</sup>	-79.334967	-79.943153
Elevation Above Sea Level	174 m (571 ft)	271.3 m (890 ft)
Anemometer Height	10.1 m (33 ft)	10.1 m (33 ft) <sup>2</sup>
Time Zone	5	5

Data Source: NOAA, 2011

<sup>1</sup>Values were refined using best professional judgment from satellite imagery starting from Lat/Long values found at <http://www.ncdc.noaa.gov/oa/climate/stationlocator.html>

<sup>2</sup> KGSO Anemometer Height not necessary for in modeling.

### E.1.2 AERSURFACE Processing

In this analysis, AERSURFACE was used to determine the seasonally varying values for albedo, Bowen ratio, and surface roughness length. Land cover was determined based on a 30-meter resolution USGS National Land Cover Data (NLCD) 1992 data file (Vogelmann et al., 2001) in GeoTIFF format, which were downloaded from <http://seamless.usgs.gov/>. Seamless files were used because the modeling domain around the surface meteorological station covers portions of two adjacent land cover data sets.

The surface roughness length was calculated based on a circle with a 1-km radius around the location of the meteorological tower. Both the Bowen ratio and the albedo were calculated based on a 10×10-km region centered at the meteorological tower. These are the prescribed methods for use with AERSURFACE (U.S. EPA, 2008). Upon examining the available land cover data, it was determined using best professional judgment that the surface characteristics calculated by AERSURFACE should be varied

by sector. 2 sectors were selected based on landuse, the first from 95° to 195° and the other from 195° to 95°.

Variations in seasonal snow cover and the arid nature of the climate can affect albedo and Bowen ratio calculations, respectively. KDAN does not experience continuous snow cover for any significant portion of the winter months. It also is not in an arid region. However, annual variations and rainfall relative to the normal range of precipitation also affects the Bowen ratio calculations for each given year. Therefore, AERSURFACE was run for wet, average, and dry conditions, and the appropriate output was used in AERMET for each year of meteorological data. Table E-2 shows all of the values entered for the major parameters in AERSURFACE.

**Table E-2. AERSURFACE Parameters and Values Entered**

AERSURFACE Parameter	Value(s) Entered
Latitude/Longitude of Meteorological Station	36.572872/-79.334967
Datum	NAD83
Study Radius	1 km
Is Meteorological Station at an Airport?	Yes
Experience Continuous Snow Cover Most of Winter?	No
Surface Moisture	Ran wet, average, and dry
Is the Meteorological Station in an Arid Region?	No
Define Surface Roughness for Multiple Sectors>	2 Sectors: 95° to 195° 195° to 95°
Temporal Resolution	Seasonal
Month/Season Assignments	Default used

### E.1.3 AERMET Processing

AERMET was used to pre-process meteorological data used in the AERMOD modeling. AERMET performs QA/QC on surface and upper air input files, then outputs surface and profile meteorological data files formatted for AERMOD processing.

Each year of meteorological data was processed separately to account for differences in annual moisture conditions at the surface meteorological location. The moisture determination, whether wet, average, or dry, was made by adding up the precipitation data found in the ISH surface data and comparing it to the gamma distribution data found in the publication *Climatology of the United States No. 20 (CLIM20)* (U.S. DOC and NOAA, 1971–2000). If the precipitation amount was in the lowest 30th percentile, the year was considered dry, while if it were in the upper 30th percentile the year was considered wet, otherwise the year was considered average (U.S. EPA, 2008). Table E-3 shows the years used for each station and the precipitation amount used to determine the moisture condition (wet, average, or dry).

**Table E-3. Determination of Moisture Conditions at Each Location Used**

Location	Year	Precipitation Amount (in)	Moisture Condition
Danville (13728)	2006	39.07	Dry
	2007	27.39	Dry
	2008	34.50	Dry
	2009	41.95	Average
	2010	39.70	Dry

Meteorological station information inputs for KDAN, such as latitude/longitude, time zone adjustment, elevation, and anemometer height were entered into AERMET, as shown in Table 1. Wind directions from the ISH data were randomized because National Weather Service Data are reported to the nearest 10°. Surface characteristics were calculated using AERSURFACE, as described in the previous section of this document.

#### **E.1.4 AERMOD Analysis**

AERMOD was run for 8 different scenario combinations, including both a high end and a low end emission factors, both a non-ore dust emission scenario and an ore dust emission scenario, and two different source configurations, one for an open pit mine and one for an underground mine. These scenarios were run to bound the expected concentration and deposition values that may result from the operation of this mine, because there is high amount of uncertainty in both the type of mining that will occur and in the determination of emission factors. Since the layout of the various sources that will operate at the mine is not known at this time, the expected sources were combined into 1 circular area source of an area equal to all the combined sources, having the combined area emission rate of all the sources. For open pit mining, the non-ore source contributions consisted of operating 40- and 85-ton trucks on haul roads and the storage of overburden, while the ore source contributions consisted of blasting, bulldozing, handling and transfer of material, wind erosion of both stockpile, tertiary grinding, wet grinding, and drying. For underground mining, the non-ore source contribution consisted of operating 40-ton trucks on haul roads, while the ore source contributions consisted of ventilation, handling and transfer of material, wind erosion of stockpile storage, tertiary grinding, wet grinding, and drying. The area source was assumed to be flat and at grade. A polar grid of receptors was applied starting at 1 m from the source and extending to 20,000 m from the edge of the source.

AERMOD was run for concentration, total deposition, dry deposition, and wet deposition with depletion. Averaging times were set to 1hr, 3hr, 8hr, 24hr, monthly, and annual. The model options of AREADPLT and FASTAREA were set for optimized area source plume depletion due to dry removal mechanisms, and for optimized area source integration, which reduces runtime.

To calculate depletion and deposition, AERMOD requires either the input of a particle size distribution (method 1), if it is well known or a significant portion of the particulate mass is greater than



10 $\mu$ m, or the fine mass fraction (smaller than PM<sub>2.5</sub>) and the mass mean diameter (method 2), if the distribution is not well known or when the portion of the mass greater than 10 $\mu$ m is not significant. In this case, the emission estimates for PM<sub>2.5</sub>, PM<sub>10</sub>, and PM<sub>30</sub> were developed based on AP-42. The particulate size distribution was developed from these values for 3 different size ranges: < PM<sub>2.5</sub>, PM<sub>2.5</sub> to PM<sub>10</sub>, and PM<sub>10</sub> to PM<sub>30</sub>. The AERMOD inputs for the 8 different source scenarios are shown in Table E-4.

**Table E-4. AERMOD Parameters and Values Entered**

AERMOD Parameter	Value(s) Entered
Model Options	FLAT CONC DDEP WDEP DEPOS AREADPLT
Averaging Times	1 3 8 24 ANNUAL
Pollutant IDs	OTHER
Source Type	AREACIRC
Source Location	Xs = 0, Ys = 0, Zs = 0
Source Parameters	High, Non-ore, Open Pit Area Emission Rate = 0.00001604 g/(s-m <sup>2</sup> ) Low, Non-ore, Open Pit Area Emission Rate = 0.00000212 g/(s-m <sup>2</sup> ) High, Ore, Open Pit Area Emission Rate = 0.00012254 g/(s-m <sup>2</sup> ) Low, Ore, Open Pit Area Emission Rate = 0.00002686 g/(s-m <sup>2</sup> ) High, Non-ore, Underground Area Emission Rate = 0.00033253 g/(s-m <sup>2</sup> ) Low, Non-ore, Underground Area Emission Rate = 0.00004395 g/(s-m <sup>2</sup> ) High, Ore, Underground Area Emission Rate = 0.00107719 g/(s-m <sup>2</sup> ) Low, Ore, Underground Area Emission Rate = 0.00023772 g/(s-m <sup>2</sup> ) Release Height = 0 m Non-ore, Open Pit Radius of Source = 1133.0 Ore, Open Pit Radius of Source = 429.0 Non-ore, Underground Radius of Source = 163.0 Ore, Open Underground of Source = 144.0 Number of Vertices = 20 (default for circular source) Initial Vertical dimension of the plume = 0 m
Particle Size Distribution	Particle Diameters = 1.25 6.25 20.0 Mass Fractions = 0.10 0.19 0.71 Particle Density = 2.62 2.62 2.62
Origin of Receptor Grid	0,0
Receptor Distances (m)	From Edge of Source 1, 25, 50, 75, 100, 150, 200, 250, 300, 350, 400, 450, 500, 750, 1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500, 5000, 6000, 7000, 8000, 9000, 10000, 11000, 12000, 13000, 14000, 15000, 16000, 17000, 18000, 19000, 20000
Polar Grid Receptor Directions	16 directions Starting at 22.5 degrees Radials every 22.5 degrees
Meteorological Stations	Surface Danville 13728 with Upper Air Greensboro 13723 5 years of 2006–2010
Profile Base	174 m
Output	Annual Average Concentration and Total Deposition

### E.1.5 AERMOD Results

The results of this analysis generally show that annual air concentrations of PM<sub>30</sub> are highest for the 1 m receptor that is directly to the east of the source, for all source scenarios. Farther from the source, the highest annual concentration of PM<sub>30</sub> values fall along the ENE and NE receptor radials. A similar result is seen for the annual total deposition values for PM<sub>30</sub>, though for the underground source, the highest total deposition is to the ENE of the source. Tables E-5 and E-6 summarize the highest non-ore and ore results of this analysis.

**Table E-5. AERMOD Results Summary for Non-Ore Scenarios**

	Open Pit				Underground Mine			
	High Emission Rate		Low Emission Rate		High Emission Rate		Low Emission Rate	
	Ann	24 Hr	Ann	24 Hr	Ann	24 Hr	Ann	24 Hr
Highest PM <sub>30</sub> concentration (μ/m <sup>3</sup> )	349.1	1,210.8	46.1	160.0	5,260.4	32,827.8	695.3	4,338.8
Highest PM <sub>30</sub> deposition (g/m <sup>2</sup> /time)	115.5	0.7	15.3	0.1	2,051.1	12.5	271.1	1.7

**Table E-6. AERMOD Results Summary for Ore Scenarios**

	Open Pit				Underground Mine			
	High Emission Rate		Low Emission Rate		High Emission Rate		Low Emission Rate	
	Ann	24 Hr	Ann	24 Hr	Ann	24 Hr	Ann	24 Hr
Highest PM <sub>30</sub> concentration (μ/m <sup>3</sup> )	2,212.4	8,781.0	484.9	1,924.7	17,179.6	112,326.1	3,791.3	24,788.7
Highest PM <sub>30</sub> deposition (g/m <sup>2</sup> /time)	771.5	4.8	169.1	1.0	6,723.1	42.7	1,483.7	9.4

For the high emission open pit source configuration for non-ore, the highest annual average concentration of PM<sub>30</sub> is 349.1 μg/m<sup>3</sup>, which occurs at 1 m directly east of the source. The highest annual total deposition value of 115.5 g/m<sup>2</sup>/yr, also occurs at this location. For the low emission open pit source configuration, the highest annual average concentration of PM<sub>30</sub> is 46.1 μg/m<sup>3</sup>, which occurs at 1 m directly east of the source. The highest annual total deposition value of 15.3 g/m<sup>2</sup>/yr, also occurs at this

location. The same pattern occurs for the source configurations for ore dust emissions. The highest annual average concentration of  $PM_{30}$  is  $2212.4 \mu\text{g}/\text{m}^3$ , which occurs at 1 m directly east of the source. The highest annual total deposition value of  $771.5 \text{ g}/\text{m}^2/\text{yr}$ , also occurs at this location. For the low emission open pit source configuration, the highest annual average concentration of  $PM_{30}$  is  $484.9 \mu\text{g}/\text{m}^3$ , which occurs at 1 m directly east of the source. The highest annual total deposition value of  $169.1 \text{ g}/\text{m}^2/\text{yr}$ , also occurs at this location.

The underground mine source configuration, shows somewhat higher  $PM_{30}$  results. The reason for this is that while the emission rate of the underground source is lower than the open pit source, the total area of sources modeled is smaller, thus the emission rate is distributed over less area. This means that the emission rate per unit area is higher for the underground mine source configuration scenario. For the high emission underground mine source configuration for non-ore, the highest annual average concentration of  $PM_{30}$  is  $5260.4 \mu\text{g}/\text{m}^3$ , which occurs at 1 m directly east of the source. The highest annual total deposition value of  $2051.1 \text{ g}/\text{m}^2/\text{yr}$ , at 1 m to the east-northeast of the source. For the low emission underground mine source configuration, the highest annual average concentration of  $PM_{30}$  is  $695.3 \mu\text{g}/\text{m}^3$ , which occurs at 1 m directly east of the source. The highest annual total deposition value of  $271.1 \text{ g}/\text{m}^2/\text{yr}$ , at 1 m to the east-northeast of the source. The same pattern occurs for the source configurations for ore dust emissions. The highest annual average concentration of  $PM_{30}$  is  $17179.6 \mu\text{g}/\text{m}^3$ , which occurs at 1 m directly east of the source. The highest annual total deposition value of  $6723.1 \text{ g}/\text{m}^2/\text{yr}$  occurs at 1 m to the east-northeast of the source. For the low emission underground source configuration, the highest annual average concentration of  $PM_{30}$  is  $3791.3 \mu\text{g}/\text{m}^3$ , which occurs at 1 m directly east of the source. The highest annual total deposition value of  $1483.7 \text{ g}/\text{m}^2/\text{yr}$ , which occurs at 1 m to the east-northeast of the source.

### E.1.6 References

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## E.2 Water Balance and Sediment Transport Modeling

### E.2.1 Abstract

A hydrological model coupled with a sediment load computation model is applied to estimate water balance for the area and compute the amount of sediment transport generated by runoff. The hydrological model which is based on Generalized Watershed Loading Function GWLF is used to compute the water balance component and daily runoff amounts. Modified Universal Soil Loss Equation (MUSLE) is applied to estimate the amount of sediment transported (tons/acre/year) based on daily runoff simulation from the hydrological model. Historical climate data from 1976–2006 are used to compute the water balance and sediment transport. The model parameters are selected as a representative of the area. In order to study the range of sediment loads from the region, three scenarios are considered. These are minimum, maximum and average impacts corresponding to minimum, maximum and average parameters, respectively. This study estimates the total sediment from the area ranges from 0.002 to 0.129 tons/acre/year with an average of 0.021 tone/acre/year.

### E.2.2 Introduction

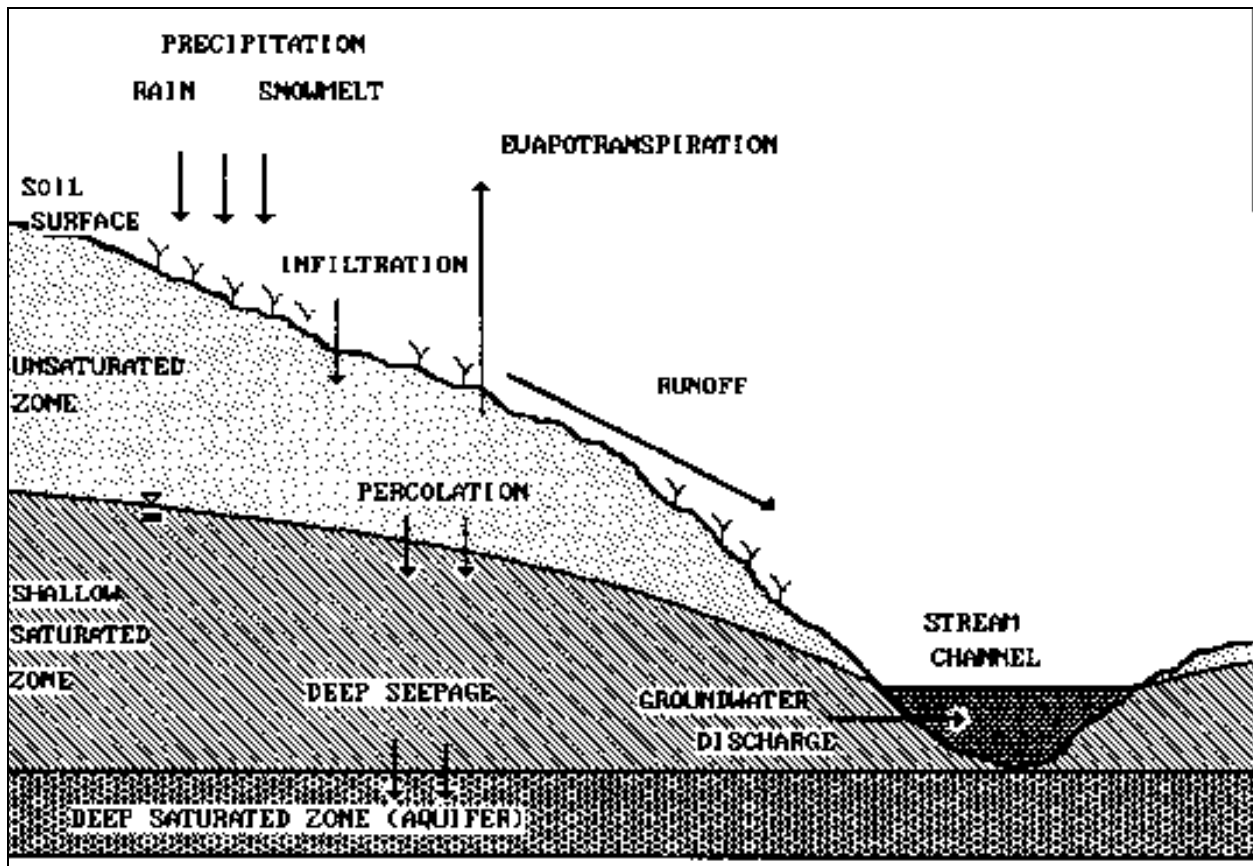
This appendix describes application of hydrological and sediment transport models to compute range of total sediment transport per hectare from the project area. Long-term climate data and wide range of soil and land use parameters are used to assess the lower, medium and upper magnitude of representative sediment loads from an area of 11.74 km<sup>2</sup>.

### E.2.3 Hydrological Model: GWLF

The Generalized Watershed Loading function GWLF (Haith et al., 1996) is applied to compute daily runoff from a representative catchment of 1 acre. GWLF computes runoff and baseflow based on a conceptual representation of a catchment with unsaturated and saturated soil layers (Figure E-1). Runoff is generated in the form of excess of infiltration and the groundwater flow is generated as gradual release from the saturated layer. The infiltrated water supplies the unsaturated layer that controls the rate of percolation rate to saturated layer. In addition to the percolation, the unsaturated layer is depleted by evaporation. The percolated water recharges the saturated layer which is depleted by ground water flow and also by seepage to deep groundwater aquifer. In the current model application to a representative 1 acre, the baseflow component is not computed on a daily basis, however the percolation to the saturated storage is considered to be the ground water flow component on annual basis.

In the following section, the equations used to compute each of the model components: snow melt, potential evaporation, runoff, and percolation are briefly described.

**Figure E-1. Schematic representation of the GWLF model (Haith, D.A., et al., 1996)**



### E.2.4 Snow Melt

The initial step in snow accumulation ablation process is to classify precipitation in to liquid rain or freezing rain/snow. The classification is achieved by mean daily temperature usually taken as 0°C. The snow cover balance of the study area is given as:

$$SNO_{day} = SNO_{day-1} + R_{day} - SNO_{melt} \quad (E.1)$$

where  $SNO_{day}$  is the water content of the snow pack on a given day

$R_{day}$  is the amount of precipitation in a day

$SNO_{melt}$  is the amount of snow melt.

For catchment based model the areal depletion curve is implemented to account for non-uniform coverage of snow due to elevation difference. In some cases a catchment can be subdivided to elevation bounds. However for the application of the model in area were relatively uniform elevation exist, the area depletion curve is not used.

The snow melt is controlled by the air temperature as well as snow pack temperature. The importance of the snow pack temperature is in reserving antecedent temperature which controls the amount of snow that can be melted with air temperature. The melted snow is treated as rainfall to generate infiltration and also percolation to the ground. For erosion purposes, the energy of rainfall of the snow melt is set to zero.

The snow pack temperature is function of mean daily temperature during the preceding days and varies as a dampened function of air temperature (Anderson, 1976). The influence of the current day's snow pack temperature is controlled by a lagging factor,

$$T_{snow(day)} = T_{snow(day-1)} \cdot (1 - \lambda_{snow}) + T_{day} \lambda_{snow} \quad (E.2)$$

where  $T_{snow(day)}$  is the snow pack temperature on a given day

$T_{snow(day)}$  is the snow pack temperature in previous day

$\lambda_{snow}$  is the snow temperature lag factor

$T_{day}$  is mean daily air temperature

The snow melt is computed as a function of snow cover, snow pack temperature and the mean air temperature as:

$$SNO_{melt} = b_{melt(day)} \left( \frac{T_{snow(day)} + T_{day}}{2} - SFTMP \right) \quad (E.3)$$

where  $b_{melt(day)}$  is the melt factor of the day (mm/day-degree C) as computed using Eq. (4.4).

SFTMP= Snow freezing temperature commonly assumed to be 0°C.

The snow melt should be constrained between the minimum value of 0 and maximum value of snow cover. Also, the above equation provides snow melt in (mm). For the land apps, all the other units are in (cm) so the snow melt calculated by equation 4 should be multiplied by 0.1 to convert from mm to cm.

The melt factor is computed as sinusoidal function of the minimum and maximum melt factor that occurs on December 21 and June 21, respectively. Table E-7 recommended values of these two parameters for ranges land use and topography.

$$b_{m_{lt}(day)} = \frac{(b_{m_{lt6}} + b_{m_{lt12}})}{2} + \frac{(b_{m_{lt6}} - b_{m_{lt12}})}{2} \sin\left(\frac{2\pi}{365}(dn - 81)\right) \quad (E.4)$$

where  $b_{m_{lt6}}$  is the maximum melt factor that occurs on June 21

$b_{m_{lt12}}$  is minimum melt factor that occurs on December 21

dn is the day number (starting from January 1)

**Table E-7. Recommended MFMAX and MFMIN Parameters Based on Forest Type and Cover**

Forest Cover	MFMAX	MFMIN
Coniferous forest /persistent cloud cover	0.5–0.7	0.2–0.4
Mixed forest Coniferous plus open and/or deciduous	0.8–1.2	0.1–0.3
Predominantly Deciduous	1.0–1.4	0.2–0.6
Open Areas flat terrain	1.5–2.2	0.2–0.6
Mountainous terrain	0.9–1.3	0.1–0.3

(ref. 42snow17.w61 iv.2.2.-snow-17-3 December 1996 by Eric Anderson, NOAA NWS)

### E.2.5 Potential Evapotranspiration: PET

GWLF uses a Hamon (1962) potential evaporation equation which uses readily available input to compute potential evaporation. The two inputs required to compute potential evaporation are mean daily temperature and number of daylight hours.

$$PET_{day} = \frac{0.021H_{day}^2 e_{day}}{T_{day} + 273} \quad (E.5)$$

In this equation,  $H_{day}$  is the number of daylight hours per day during the month containing day  $e_d$  is the saturated water vapor pressure in millibars on day,  $d$  and  $T_{day}$  is the temperature on day  $d$  (°C). When  $T \leq 0$ ,  $PET_{day}$  is set to zero. Saturated vapor pressure can be approximated as in (Bosen, 1960):

$$e_t = 33.8639 \left[ (0.00738T_{day} + 0.8072) \right] - 0.000019(1.8T_{day} + 48) + 0.001316 \quad \text{for } T_{day} > 0 \quad (E.7)$$

The total day hour is computed as

$$H_d = \frac{2 \cos^{-1}[-\tan \delta \tan \phi]}{\omega} \quad (\text{E.6})$$

where  $H_d$  = Day light hours  
 $\delta$  is the solar declination in radians  
 $\Phi$  is geographic latitude in radians  
 $\omega$  is the angular rotation of the earth.

The potential evaporation is then adjusted to the type of land use and cover by using curve factor.

$$PET_{Adj(day)} = CV * PET_{day} \quad (\text{E.7})$$

where PET adj is the cover adjusted potential evaporation. CV is cover factor which values depend on the vegetation and crop cover. The actual evaporation depends on the availability of water in the form of rain and soil moisture.

### E.2.6 Runoff

Surface runoff generated from both rainfall and snow melt is calculated using the U.S. Soil Conservation Service's curve number equation:

$$Q_{day} = \left( \frac{R_{day} - 0.2D_{day}}{R_{day} + 0.8D_{day}} \right)^2 \quad (\text{E.8})$$

where  $Q_{day}$  is runoff (cm)  
 $R_{day}$  is the sum of rain plus melt  
 $D_{day}$  is the detention parameter calculated as follows

$$D_{day} = \frac{2540}{CN_{day}} - 25.4 \quad (\text{E.9})$$

where  $CN_{day}$  is curve number of the day. The curve number is selected as a function of antecedent soil moisture condition as shown in Figure E-2 below.

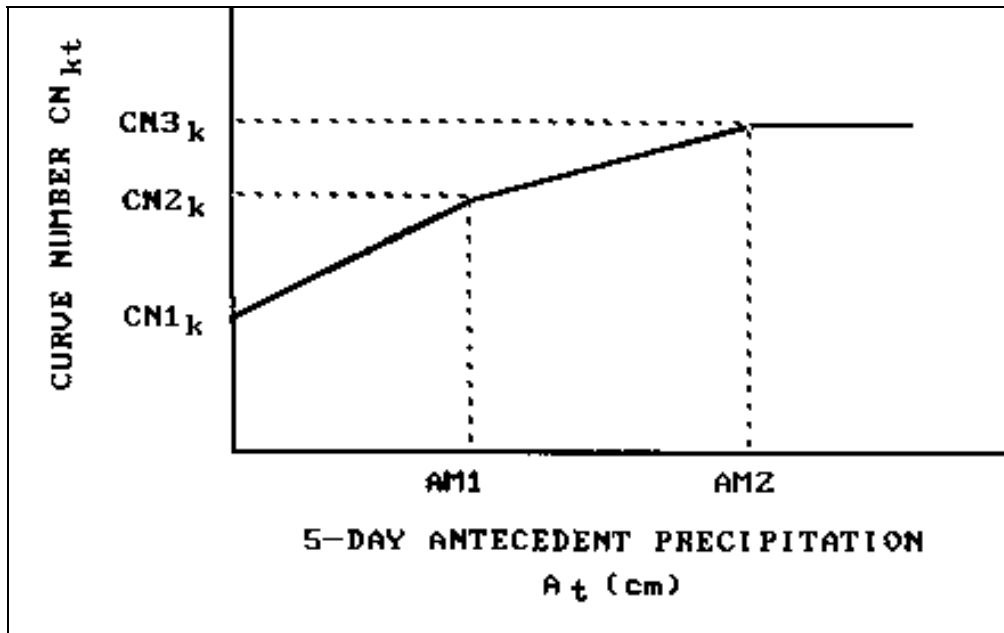
To compute the curve number for a given day, the antecedent soil moisture is computed by accumulating the last 5 days of rainfall and snow melt.

$$Amc5_{day} = \sum_{x=1}^5 R_{(day-x)} \quad (\text{E.10})$$

where  $Amc5_{day}$  is antecedent precipitation of the last 5 days.



Figure E-2. Curve Number Selection as Function of Antecedent Moisture



(GWLFL user manual) Curve numbers are selected as functions of antecedent moisture as described in Haith (1985).

Curve numbers for antecedent moisture conditions 1 (driest), 2 (average), and 3 (wettest) are  $CN1_k$ ,  $CN2_k$  and  $CN3_k$  respectively. The actual curve number for day  $t$ ,  $CN_{kday}$ , is selected as a linear function of  $A_t$ , 5-day antecedent precipitation (cm):

The model requires specification of  $CN2_k$ . Values for  $CN1_k$  and  $CN3_k$  are computed from Hawkins (1978) approximations:

$$CN1 = \frac{CN2}{2.334 - 0.01334CN2} \quad (E.11)$$

$$CN3 = \frac{CN2}{0.4036 - 0.0059CN2} \quad (E.12)$$

### E.2.7 Percolation

The daily water balances are accounted for both soil storages. For the unsaturated layer,

$$U_{t+1} = U_t + R_t + M_t - Q_t - E_t - P_t \quad (E.13)$$

Similarly, for the unsaturated zone the water balance are computed as

$$S_{t+1} = S_t + P_t - G_t - D_t \quad (E.14)$$

In the above equations,  $U_t$  and  $S_t$  are the unsaturated and shallow saturated zone soil moistures at the beginning of day  $t$  and  $Q_t$ ,  $E_t$ ,  $P_t$ ,  $G_t$  and  $D_t$  are watershed runoff, evapotranspiration, percolation into the shallow saturated zone, groundwater discharge to the stream and seepage flow to the deep saturated zone, respectively, on day  $t$  (cm).

Percolation occurs when unsaturated zone water exceeds available soil water capacity  $U^*$  (cm):

$$P_t = \text{Max}(0; U_t + R_t + M_t - Q_t - E_t - U^*) \quad (\text{E.15})$$

The soil water capacity  $U^*$  has to be defined as a characteristics of the unsaturated soil layer. This parameter can be estimated from the soil property.

Evapotranspiration is limited by available moisture in the unsaturated zone:

$$E_t = \text{Min}(CV_t * PE_t; U_t + R_t + M_t - Q_t) \quad (\text{E.16})$$

The above model provides daily runoff and percolation. The daily runoff will be used to compute sediment loading and percolations is added to generate total base flow component on annual basis.

### E.2.8 Sediment Transport

Erosion caused by rainfall is computed with the modified universal soil loss equation MUSLE (Williams, 1975). This is a modification of the original USLE which computes average annual erosion. MUSLE computed daily rates of erosion as a function of daily runoff and the USLE parameters. USLE predicts gross annual erosion as a function of rainfall energy. For MUSLE, the rainfall energy is represented by using peak flow in addition to the surface runoff. The daily variables required to compute the daily rate of sedimentation is provided by the hydrology component.

$$sed_{day} = 11.8(Q_{day}Q_{peak(day)}Area)^{0.56} K_{USLE} C_{USLE} P_{USLE} LS_{USLE} CFRG \quad (\text{E.17})$$

where  $Sed_{day}$  is sediment yield on a given day in (metric ton)

$Q_{day}$  is Surface runoff generated in the day (mm/ha)

If  $Q_{day}$  is computed in CM, multiply that by 10

$Q_{peak}$  is Peak flow computed as shown below ( $m^3/s$ )

Area in hectare

$K_{USLE}$  is soil erodibility factor (0.013 metric ton m<sup>2</sup> hr/(m<sup>3</sup>-metric ton cm))

$C_{USLE}$  is cover Management factor

$P_{USLE}$  is Support practice factor

$LS_{USLE}$  is topographic factor

$CFRG$  is coarse and fragmentation factor

Peak flow may be computed using modified rational formula:

$$Q_{peak(day)} = \frac{\alpha_{tc} Q_{day} Area}{3.6 t_{con}} \quad (E.18)$$

Q peak- (m<sup>3</sup>/s), Area (km<sup>2</sup>), tcon(hr) 3.6 is unit conversion factor

$$\alpha_{tc} = 1 - \exp[2t_{con} \ln(1 - \alpha_{0.5})] \quad (E.19)$$

$\alpha_{0.5}$  is the fraction of daily rainfall falling in the half-hour highest intensity ( see below for estimation of this parameter)

As described in SWAT User Manual Chapter 1.3.1, computation of  $\alpha_{0.5}$  requires a number of historical data analyses to generate minimum, mean, and maximum monthly half-hour rainfalls. And also, the randomness of the half-hour fraction rainfall computation can produce values that are not consistent in time. Therefore, the approach we would like to adopt that will also require less data will be the following:

1. From daily rainfall data for each day compute the maximum allowable fraction,  $\alpha_{0.5u}$

$$\alpha_{0.5u(day)} = 1 - \exp\left(\frac{-125}{R_{day} + 5}\right) \quad (E.20)$$

2. Always assume the minimum allowable,  $\alpha_{0.5min}$  is 0.02083 (reference SWAT user manual)
3. If  $\alpha_{0.5u}$  is lower than or equal to  $\alpha_{0.5min}$  then use  $\alpha_{0.5} = \alpha_{0.5u}$
4. If  $\alpha_{0.5u}$  is higher than or equal to  $\alpha_{0.5min}$  then use  $\alpha_{0.5} = 1/3(2\alpha_{0.5u} + \alpha_{0.5min})$
5. Allow adjustment factor if needed.

The following factors are provided as parameters to the model. Alternatively, the range of parameter values can be estimated (from literature, or using soil type and management). The range can then be used in the selection of parameters in Monte-Carlo simulation.

## E.2.9 Model Application

### *Location of the Project Area*

Since the specific location of the mining are is not identified an area of 11.4km<sup>2</sup> is (shown in Figure E-3) is identified as representative of the regional climate and land use type. Five NHDPlus catchment in the area around the probable project area are selected. The area of each of the catchments is given in Table E-8.

Figure E-3. Location of the Representative Catchments

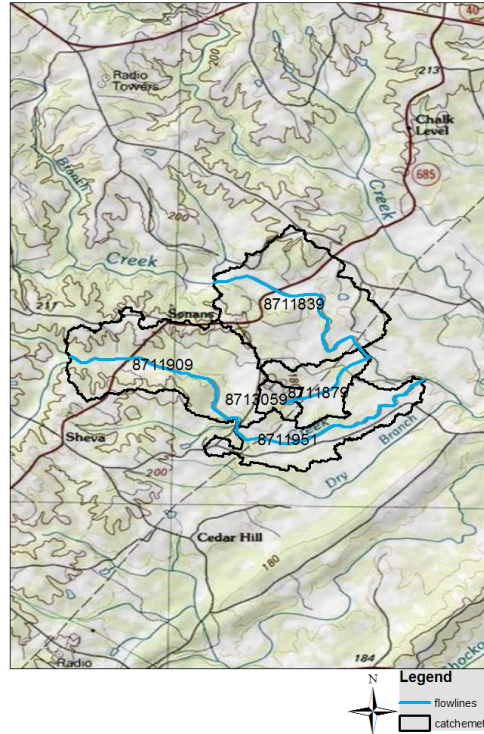


Table E-8. Catchments Studied

COMID	Area Km <sup>2</sup>
8711839	4.19
8711879	1.02
8711909	4.04
8711951	2.14
8713059	0.34
Total	11.74

### Data

The hydrological model requires two climate variables: daily precipitation and means temperature data. Historical climate data from 1976–2006 are used to compute the water balance and sediment transport. The rainfall data are obtained from gridded precipitation product that is derived from combining the archive of NCDC stations and the PRSIM data (Di Luzio et al., 2008). First, the daily precipitation data are clipped for each catchment. Then the areal weighted average of daily precipitation time series is derived for the entire area. Similarly, we derived the area weighted mean time series for the

area. In order to capture the seasonal variability of daily precipitation rates, the model is run on daily basis.

In addition to the climate data the hydrological model requires the land use and soil properties. These data are obtained from national data sets. The land use data of each catchment shown in Table E-9 are obtained from USGS national land use cover data for 2006. The soil property data are obtained from SSURGO.

**Table E-9. Land Use Cover for the Five National Hydrography Data Set (NHDPlus) Catchments: Source NLCD and SSURGO**

COMID	Cover	NLCD ID	HYDGP	CURVE_ NUMBR	Area %	Catchment Area km <sup>2</sup>
8711839	Developed, Open Space	21	B	69	6.8	4.19
	Developed, Low Intensity	22	B	68	0.3	
	Deciduous Forest	40	B	60	40.6	
	Shrub	50	B	57	0.9	
	Grassland/Herbaceous	70	B	70	3.9	
	Pasture/Hay	81	B	64	47.1	
	Cultivated Crops	82	B	75	0.4	
8711879	Developed, Open Space	21	C	79	3.3	1.02
	Deciduous Forest	40	C	73	42.0	
	Shrub	50	C	68	1.1	
	Grassland/Herbaceous	70	C	80	18.5	
	Pasture/Hay	81	C	75	35.0	
8711909	Developed, Open Space	21	B	69	5.7	4.04
	Developed, Low Intensity	22	B	68	0.6	
	Deciduous Forest	40	B	60	62.9	
	Shrub	50	B	57	2.5	
	Grassland/Herbaceous	70	B	70	2.4	
	Pasture/Hay	81	B	64	24.8	
	Cultivated Crops	82	C	82	0.9	
8711951	Developed, Open Space	21	C	79	4.7	2.14
	Developed, Low Intensity	22	C	79	0.9	
	Deciduous Forest	40	C	73	40.0	
	Shrub	50	C	68	2.8	
	Grassland/Herbaceous	70	C	80	10.3	
	Pasture/Hay	81	C	75	40.7	
	Cultivated Crops	82	C	82	0.8	
8713059	Developed, Open Space	21	B	69	11.4	0.34
	Deciduous Forest	40	B	60	40.3	
	Grassland/Herbaceous	70	C	80	7.4	
	Pasture/Hay	81	B	64	40.8	
Total Area						11.74

The catchment is dominantly covered by forest and pasture area Table E-10. The sediment transport parameters are also obtained from SSURGO and averaged over each catchment and minimum, average, and maximum of the five catchments are used in the model simulation. (Table E-10)

**Table E-10. Summary of Land Use Over the Five Catchments**

Cover	%Area
Developed, Open Space	6.4
Developed, Low Intensity	0.4
Deciduous Forest	45.2
Shrub	1.5
Grassland/Herbaceous	8.5
Pasture/Hay	37.7
Cultivated Crops	0.4

For hydrological model simulation, the main parameter of the GWLF model, the curve number (CN) is varied for the three cases. The CN used correspond to the minimum, maximum and area weighted average for the entire study area. The higher curve number generates more runoff than the lower CN. For sediment transport model, the K, SLOPE, LS factors are varied to represent spatial variability within the catchment. The other hydrologic and sediment parameters are kept the same in all three simulations. The three factors that are varied (Table E-11) have all positive correlation with the amounts of sediment transport and consequently compute a combination of low, medium, and high impacts consistently.

**Table E-11. MUSLE Parameter Ranges**

	K <sub>USLE</sub>	SLOPE_R	LS <sub>USLE</sub>	CN	P <sub>USLE</sub>	C <sub>USLE</sub>	CFRK <sub>USLE</sub>
Max	0.31	35.00	7.21	82	1	0.01	1
MIN	0.24	5.00	0.68	57	1	0.01	1
Average	0.26	22.98	4.00	64	1	0.01	1

Source: SSURGO

## E.2.10 Model Application Approach

### *Hydrological Model*

1. Five NHDPlus catchment in the area around the probable project area are selected. (see Figure E-1 and Table E-7) for the locations and the size of the catchment.
2. Precipitation data (gridded precipitation data derived from NCDC archive stations and adjusted by PRISM is used).
3. Temperature data (gridded precipitation data derived from NCDC archive stations and adjusted by PRISM is used).

4. A representative (area averaged land use type is used for the study area to estimate the curve number.
5. Soils properties are obtained from SSURGO.
6. No routing is performed for the small area.
7. Though the model is run for the period starting January 1976, the first year simulation is excluded from the analysis to reduce the effect of initial condition of soil moisture. Simulation results of 1977–2006 are used.
8. Three sets of model parameters are selected based on the available values for each type of land use. The values are selected on minimum, average, and maximum values.
9. Using long-term historical climate data three sets of simulation using the set of parameters are performed.
10. Daily sediment transport caused by runoff is computed.
11. The 30 year average water balance variable and sediment load are calculated for each of the parameter sets. Annual sediment loading rates are computed and compared to the three impact conditions.

### E.2.11 Results

The annual variability of rainfall is shown in Figure E-4. Other water balance variables also vary following the rainfall pattern with different degree. Evaporation is less sensitive to annual variability of precipitation while runoff amount follows as precipitation. The amount of annual runoff generated varies from 7% to 36% depending greatly on the set of parameters chosen, as shown in Table E-12 and Figures E-5 and E- 6. As a result, the sediment load also varies from 0.002 to 0.129 tons/acre/year. The average annual sediment transport produced is below the literature value for crop land sediment load of 0.1 tons/acre/year.

### E.2.12 Conclusions

- The water balance of the area indicates overall (12%) runoff, (26%) groundwater flow, and (62%) evapotranspiration. There is high variability of annual runoff and ground water flow and hence the sediment transport also varies annually.
- This study estimates the total sediment from the area ranges from 0.002 to 0.129 tons/acre/year with an average of 0.021 tons/acre/year.
- This preliminary study showed wide range of annual sediment transport from a representative 1 acre of land. The sensitivity of sediment delivery to the set of parameters chosen indicates that, site-specific data will be required to apply to the project site.

For deatild model outputs, daily runoff, and daily sediment transport during the last 30 years refer the Excel file: waterbalnce\_sedimet\_\_precip.xls.

Figure E-4. Example of Annual Water Balance Variability

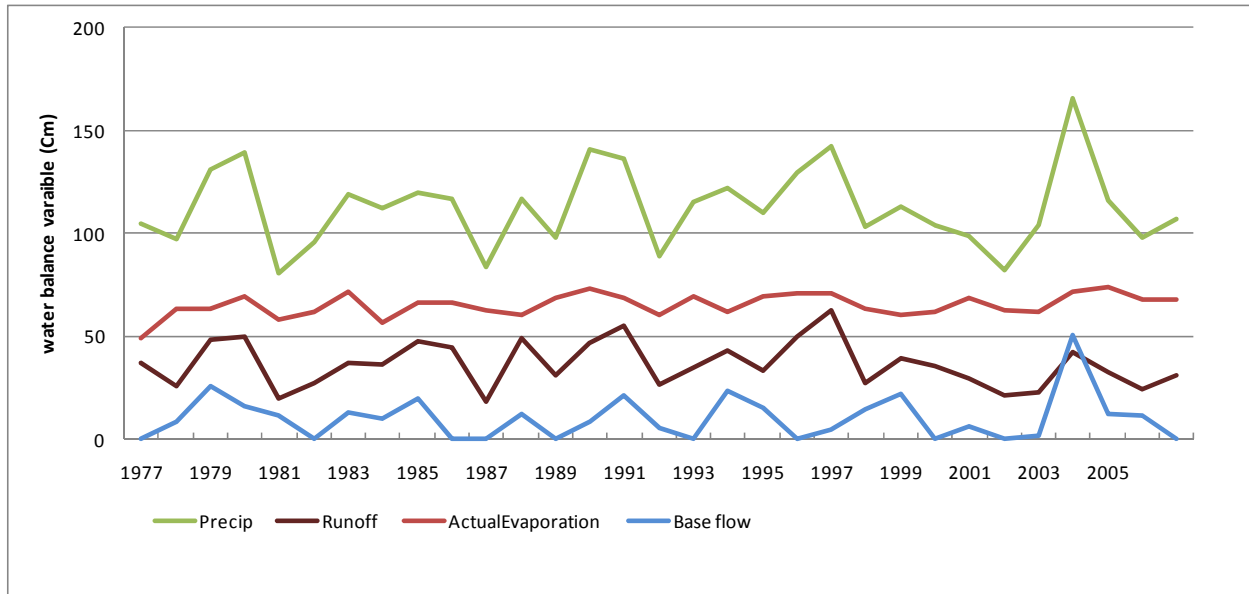
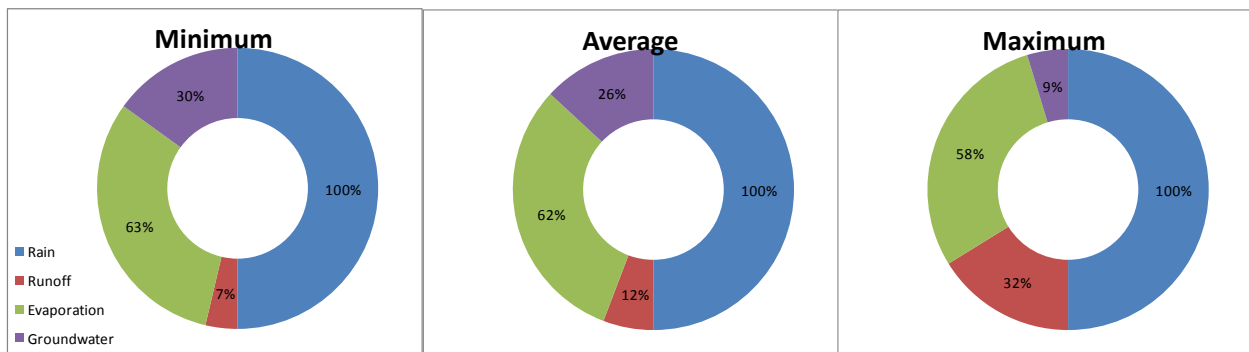


Table E-12. Annual Water Balance and Sediment Loading Using Min, Max and Weighted Average Parameters

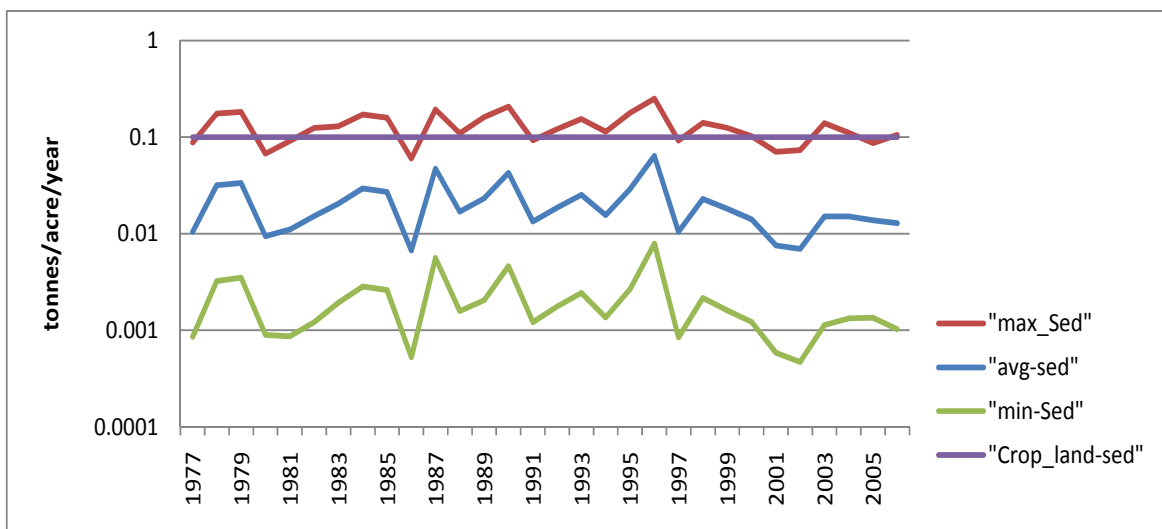
	Precip cm	Runoff cm	Evaporation cm	Percolation cm	Sediment Tons/acre
Min	112.9	8.3	70.6	34.0	0.002
Max	112.9	36.5	65.8	10.6	0.129
Average	112.9	13.1	70.3	29.6	0.021

Figure E-5. Water Balance Components Percentages





**Figure E-6. Sediment Load from the Area During the Last 30 Years Compared to Sediment Loads Rates from Untilled Crop Land**



The cropland estimate is obtained from Ouyang et al., 2005.

### E.2.13 References

- Anderson, E. A. 2002. Calibration of Conceptual Hydrologic Models for Use in River Forecasting. NOAA Technical Report, NWS 45, Hydrology Laboratory, 2002.
- Di Luzio et al. 2008 Constructing Retrospective Gridded Daily Precipitation and Temperature Datasets for the Conterminous United States. *Journal of Applied Meteorology and Climatology* (47) pp 475–497.
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- Hamon, W. R. 1961. Estimating potential evapotranspiration. Proceedings of the American Society of Civil Engineers. *Journal of the Hydraulics Division* 87(HY3):1 07–120.
- Ouyang, Da, Jon Bartholic, & James Selegan. 2005. Assessing Sediment Loading from Agricultural Croplands in the Great Lakes Basin. *The Journal of American Science* 1(2)p 14–29
- Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic (SSURGO) Database for [Survey Area, State]. Available online at <http://soildatamart.nrcs.usda.gov>.
- Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. U.S. General Soil Map (STATSGO2). Available online at <http://soildatamart.nrcs.usda.gov>
- Williams, J. R. 1975. Sediment Routing for Agricultural Watersheds. *Water Resour. Bull.* 11:965–974.

### Example of Input Parameters

# The Hydrologic and Sediment Model Parametrs Component of the LandApp Model	
# Modle Inputs	
#	
# Input variables	
# Daily precipitation units (cm)	percip_temperture.csv
# Daily Temperatur -Units (degree c)	percip_temperture.csv
#	
#	
# Parameters-	
#	
# SNOW -MODEL	
#	
# minimum snow melt factor	
Bmelt6	2
# maximum snow melt factor	
Bmelt12	0.6
# snow temperature lag	
lamb	0.9
# freezing temperature	
SFTMP	0
#	
# EVAPORATION MODEL	
#	
# location latitude (degree decimal)	
lat	46
# cover factor	
cover_factor	1
#	
# RUNOFF MODEL	
#	

# curve number condition	
cn2	70
unsat_wc	10
# first growing season day	
growing_season_start_day	59
# last growing season day	
growing_season_end_day	181
# field capacity (cm)	
field_capacity	20
# soil_depth (m)	
soil_depth	0.5
#	
# EROSION MODEL	
#	
# concentration time (hr)	
tcon	6
# area of the farm (ha)	
area	2.47
# soil erodibility factor	
KUSLE	0.04
# cover management factor	
CUSLE	0.1
# support practice management facto	
PUSLE	0.1
# topographic factor	
LSUSLE	0.2
# coarse fragment factor	
CFRG	0.1
#Conversion from HA to KM^2	
conversion_factor_ha_km	0.01

### E.3 Precipitation Frequency Table

There is a historical precipitation record at the Danville, Pittsylvania station. The station is located at lat/long 36°35'N / 79°23'W and elevation of 125.0m (410') above sea level. The station has record of precipitation from 1948 to present. The National Weather Service has used this record to estimate precipitation duration curves for the station, which can be also used as representative to the proposed uranium site. The recent most significant event that happened and which is included in the sediment transport is the large storm during Hurricane Fran Sept 5–6, 1996, which has storm of 100 year return period (see Table E-13).

**Table E-13. Precipitation Frequency for Danville Station**

Duration	Years									
	1	2	5	10	25	50	100	200	500	1,000
5-min:	0.37	0.44	0.52	0.57	0.64	0.68	0.72	0.76	0.8	0.83
10-min:	0.59	0.7	0.83	0.92	1.02	1.08	1.15	1.2	1.27	1.31
15-min:	0.73	0.88	1.05	1.16	1.29	1.37	1.45	1.52	1.59	1.64
30-min:	1.01	1.22	1.49	1.68	1.91	2.07	2.22	2.36	2.54	2.66
60-min:	1.25	1.53	1.91	2.19	2.54	2.8	3.06	3.31	3.64	3.88
2-hr:	1.48	1.8	2.26	2.62	3.09	3.46	3.83	4.2	4.71	5.1
3-hr:	1.58	1.93	2.43	2.81	3.32	3.71	4.11	4.51	5.05	5.46
6-hr:	1.94	2.35	2.96	3.44	4.11	4.64	5.21	5.79	6.62	7.26
12-hr:	2.33	2.83	3.57	4.19	5.07	5.79	6.58	7.42	8.63	9.63
24-hr:	2.75	3.33	4.23	4.97	6.05	6.96	7.94	9.01	10.57	11.88
2-day:	3.25	3.92	4.94	5.77	6.94	7.91	8.95	10.06	11.64	12.96
3-day:	3.42	4.14	5.21	6.08	7.32	8.34	9.43	10.59	12.26	13.63
4-day:	3.6	4.35	5.47	6.39	7.69	8.76	9.9	11.12	12.87	14.3
7-day:	4.13	4.96	6.14	7.11	8.48	9.6	10.79	12.05	13.83	15.29
10-day:	4.68	5.59	6.85	7.87	9.29	10.44	11.64	12.89	14.65	16.05
20-day:	6.3	7.5	9.01	10.2	11.82	13.1	14.39	15.71	17.49	18.88
30-day:	7.79	9.21	10.84	12.08	13.71	14.95	16.16	17.35	18.91	20.08
45-day:	9.85	11.6	13.49	14.91	16.75	18.13	19.46	20.74	22.39	23.59
60-day:	11.77	13.81	15.85	17.37	19.33	20.77	22.14	23.45	25.09	26.27

Reference: NOAA/NWS: <http://hdsc.nws.noaa.gov/>

Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

## E.4 Surface Water Dilution Modeling

The QUAL2K model available from the U.S. EPA was used in this preliminary modeling simulation (<http://www.epa.gov/athens/wwqtsc/html/qual2k.html>). Stream segments for the one-dimensional QUAL2K model were set up using the flowlines and value added attributes available from the enhanced National Hydrography Dataset (NHDPlus). Model segments were divided based on the divisions between NHDPlus flowlines and tributaries entering the main stream channel. The QUAL2K model provides simulation of an “arbitrary constituent” along with its intended purpose of modeling nutrients. This arbitrary constituent is tracked through a simple mass balance and, as such, does not rely on many of the QUAL2K transport input parameters (e.g., nutrient parameters, temperature, wind speed, rate constant). The simulated chemical was treated as a conservative constituent meaning that both the settling rate and first-order decay rate were set to zero.

The model was set up to run from just upstream of the wastewater effluent discharge from the site to the upstream end of Banister Lake for a total length of approximately 32.5 miles. Effluent from the site was simulated as a point source discharge to Mill Creek. Two different effluent scenarios were simulated to capture a range of potential water quality conditions:

1. High-Impact Scenario: An 830 gpm discharge with a concentration of 1 during a period of low flow (approximately 20% of average mean annual flow conditions)
2. Low-Impact Scenario: An 166 gpm discharge with a concentration of 1 during a period of high flow (approximately 200% of average mean annual flow conditions)

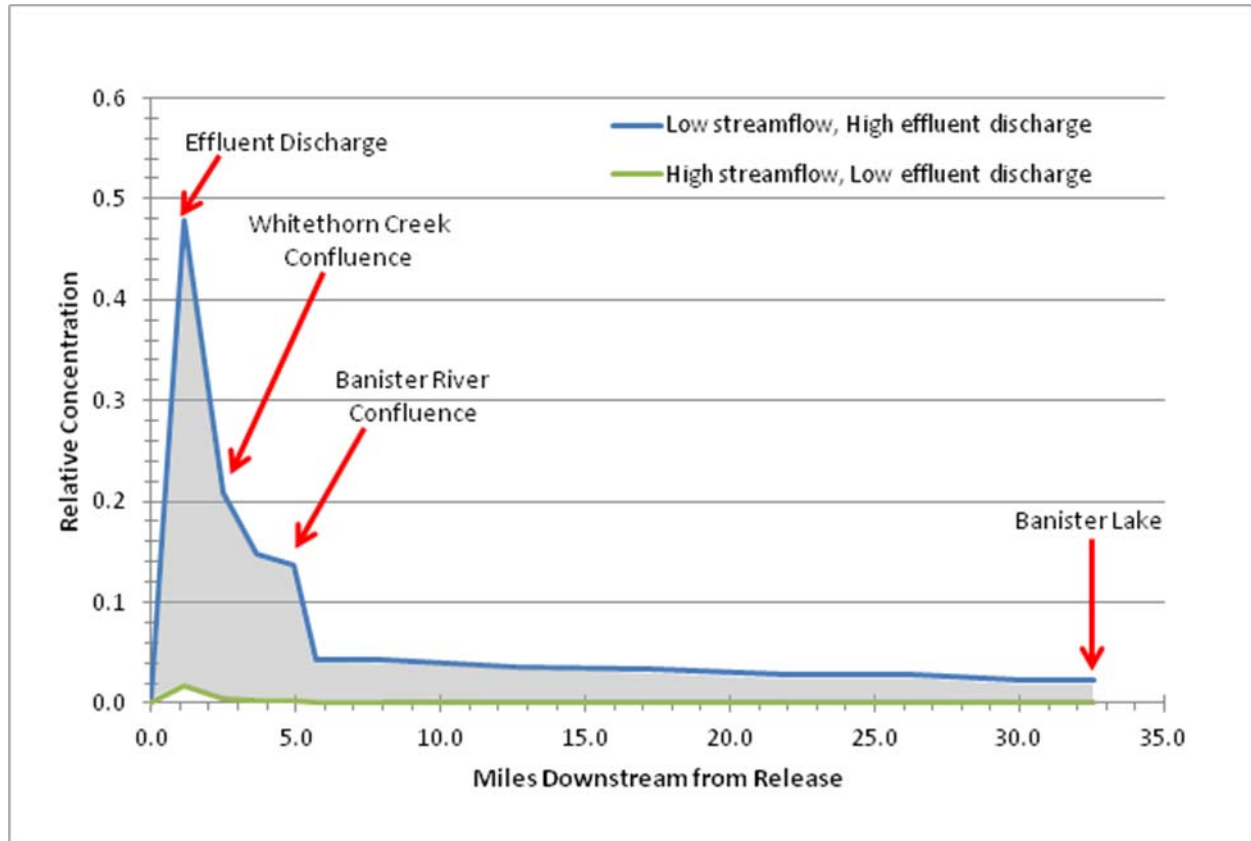
Low and high flow estimates were based on long-term annual and monthly streamflow records at USGS streamflow gage 02077000 downstream of Banister Lake. Variations of the mean average summer low flow and mean average monthly high flow were estimated and used to provide the two flow scenarios. Flows from tributaries and in Mill Creek above effluent discharge were assumed to have a concentration of 0. All tributaries, except for the Banister River, were small and were modeled as point sources to the main stream channel. The details on the model segments are presented in Table E-14.

The two extreme flow and effluent scenarios produced a range of potential water quality concentrations of due to wastewater discharge as displayed in Figure E-7. The high-impact scenario shows a peak concentration of nearly 0.5 just after discharge, with dilution downstream resulting in concentrations leveling out near 0.02 entering Banister Lake. Alternately, the low-impact scenario reveals a peak concentration of only 0.018 and a leveling out of concentrations at 0.00045. Given the wide variations possible in site design and hydrologic conditions, these concentrations represent the potential range in water quality impacts from wastewater discharge.

Table E-14. QUAL2K Simulation Reach Characteristics

Reach Label	Reach Number	Headwater?	Reach Length (km)	Location		Manning Formula			
				Upstream (km)	Downstream (km)	Channel slope	Manning's n	Bottom Width (m)	Side Slope
Mill Creek to Confluence with Whitethorn Creek	1	Yes	3.66	52.440	48.783	0.00411	0.0700	8.31	0.5000
Whitethorn Creek to Confluence with Dry Brush Creek	2		0.70	48.783	48.086	0.00341	0.0700	15.34	0.5000
Whitethorn Creek	3		3.05	48.086	45.031	0.00010	0.0800	15.34	0.5000
Whitethorn Creek to Confluence with Banister River	4		0.93	45.031	44.101	0.01362	0.0800	18.85	0.5000
Banister River (Headwater)	5	Yes	11.63	11.625	0.000	0.00080	0.0800	27.80	0.5000
Banister River downstream of confluence	6		1.61	44.101	42.496	0.00010	0.0700	33.34	0.5000
Banister River to confluence with Striking River	7		5.80	42.496	36.697	0.00010	0.0700	33.57	0.5000
Banister River to confluence with Allen Creek	8		9.29	36.697	27.408	0.00647	0.0600	36.15	0.5000
Banister River to confluence with Elkhorn Creek	9		5.69	27.408	21.720	0.00720	0.0600	37.54	0.5000
Banister River to confluence with Bye Creek	10		9.57	21.720	12.147	0.00010	0.0500	39.95	0.5000
Banister River to confluence with Sandy Creek	11		4.30	12.147	7.852	0.00057	0.0500	41.29	0.5000
Banister River to Banister Lake	12		7.85	7.852	0.000	0.0001	0.0500	46.47	0.5000

**Figure E-7. QUAL2K Simulation Results for a Range of Effluent Discharge Conditions with an Effluent Concentration Equal to One**



**E.4.1 References**

NHDPlus: <http://www.horizon-systems.com/nhdplus/>

QUAL2K: <http://www.epa.gov/athens/wwqtsc/html/qual2k.html>





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## **Appendix F: Detailed Information Supporting Socioeconomic Impact Assessment in Section 6**

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### **F.1 Estimated VUI Costs**

As noted in Section 6 above, costs expected to be incurred by VUI in developing and operating the mine and mill can be divided into capital or lump-sum costs and ongoing operating costs. Frequently, lump-sum costs are annualized and the annualized capital costs are added to operating costs to estimate the total costs incurred by the firm on an ongoing basis. This is done because the firm is likely to borrow the money to invest in the large, lump-sum costs of buildings and equipment. The costs they incur on an annual basis are the cost of servicing that debt. However, in this case we are less concerned with how the costs are experienced by VUI, and more interested in how they would be experienced by the study region. If VUI purchases capital equipment within the study region, the supplier would receive a single lump sum payment. As discussed in the Lyntek/BRS Scoping Study and Cost Estimate (Lyntek/BRS, 2010a), these expenditures would be made during the initial period of mine and mill start-up, and replacement equipment may be purchased as needed at various times throughout the life of the mine and mill. If the equipment is purchased locally, the economy would experience a large one-time increase in spending.

In the quantitative impact analysis described in Section 6, we estimated the direct impacts of VUI construction and operations, under scenarios representing different assumptions about, among other things, the share of VUI spending that occurs within the region. Underlying these scenarios are the estimated costs that would be incurred by VUI to construct and operate the proposed mine and mill. This appendix presents the costs as described by Lyntek/BRS in the *Scoping Study and Cost Estimate* prepared for VUI (Lyntek/BRS, 2010a). Section F.1.1 presents VUI's estimated construction and capital costs. Section F.1.2 presents VUI's estimated operating costs of VUI.

#### **F.1.1 Capital and Lump-Sum Expenditures**

Estimated capital costs for the mine are shown in the first column of Table F-1, which is adapted from a table in the Scoping Study and Cost Estimate (Lyntek/BRS, 2010a). The total initial capital cost of acquiring all needed mining equipment is estimated at \$19.4 million.

Table F-2 shows the capital and other one-time costs associated with the alkaline processing plant, adapted from Table 7-2 in the Lyntek/BRS Scoping Study and Cost Estimate. These capital costs total \$75.0 million.

Table F-1. Capital Costs for the Uranium Mine

<b>Mining Capital Costs</b>	<b>Estimated Cost</b>
2 boom drilling jumbo	700,000
Rock bolters	700,000
4 yd LHD	1,000,000
40t haul truck	2,400,000
Shotcrete truck	350,000
Concrete truck	350,000
Scissor lift truck	300,000
Other	620,000
<b>Decline K equip</b>	
Stope drilling jumbo	140,000
Rock bolters	700,000
8yd remote LHD	2,400,000
40t haul truck	2,400,000
Scissor lift truck	250,000
Other	2,920,000
<b>Support equipment</b>	
Stores delivery truck	220,000
Man carrier	220,000
Explosives truck	350,000
Water truck	450,000
Raise borer contract	2,000,000
Lube truck	250,000
U/g grader	600,000
Light vehicles	350,000
Trucks flatbed	50,000
Communication system	300,000
<b>Total</b>	<b>20,020,000</b>

Source: Lyntek/BRS, August 2010a, Table 7.1, pp. 35–36.

**Table F-2. Capital and Construction Costs for the Uranium Mill**

<b>Capital Equipment (Lump Sum)</b>	<b>Estimated VUI Costs</b>
Material handling	5,253,459
Grinding	6,741,655
Leaching	6,035,262
CCD, filtration	7,444,840
Precip	1,661,475
Precip, filter, package	4,492,214
Reagent system	451,872
Utilities	3,338,083
Concrete	5,202,873
Structural steel	5,465,644
Buildings	6,158,525
Electrical	2,942,108
Power substation	3,000,000
Instrumentation and control	2,051,533
Piping	1,612,743
Other	1,729,068
Engineering	6,321,726
Construction management	1,896,518
Construction labor	
Freight	1,954,596
Contractor small tools and consumables	1,250,941
<b>Total</b>	<b>75,005,135</b>

Source: Lyntek/BRS, August 2010a, Table 7.2, p. 37.

Table F-3 shows the capital costs associated with managing the tailings (waste material) resulting from the milling process. The costs in this table are derived from Table 25.7 in the Lyntek/BRS Preliminary Economic Assessment (Lyntek/BRS, 2010b). The cost for the paste tailings plant and equipment and the piping from the mill to the impoundment cells is provided in the Lyntek/BRS Preliminary Economic Assessment. The estimated cost per impoundment was computed. Total capital cost of constructing all the tailings impoundment cells is estimated at \$66,670,913; a total of 8 cells are projected, which would be constructed over time as needed. Thus, at any one time, only one would be under construction. This estimate is 1/8 of the total, the average cost of constructing a single tailings impoundment.

**Table F-3. Capital and Construction Costs for Tailings Management**

Tailings Management Activity	Tailings Capital Cost
Paste fill plant and equipment	3,948,000
Pipe to impoundment cells	19,000
Average cost per impoundment	8,333,865

Source: Lyntek/BRS, December 2010b, Table 25.7.

### F.1.2 Annual Operating Expenditures

Table F-4 presents VUI's estimated costs of operating an underground mine. VUI plans to mine the majority of the ore using a bulk method called sub-level open stoping (SLOS); the primary stopes would be mined during the period from year 2 to year 21; then, the remaining pillars would be mined using a cut and fill method during the period from year 22 to year 35. During the primary stope extraction, a mining rate of 3,000 tons per day of ore, with four mining crews working 10-hour shifts for a total of 350 days per year. Assuming that the work force and schedule are unchanged, the pillar extraction would yield 1,000 tons per day of ore. These mining rates assume that work occurs at only one mine at a time, and that the general schedule is:

1. South Coles deposit, primary stoping,
2. North Coles deposit, primary stoping,
3. South Coles deposit, pillar removal, and
4. North Coles deposit, pillar removal.

The figures shown in the VUI Cost column are based on Table 7-4 in the Lyntek/BRS Scoping Study and Cost Estimate. Costs in Table 7-4 are presented on a per-metric tonne basis. Thus, the values presented in Table F-4 are computed by first converting the costs to a per-ton basis, then multiplying that by the number of tons per year. Two columns of costs are presented for mining, representing the annual operating costs of primary stoping and pillar removal.

**Table F-4. Estimated Operating Cost Inputs for the Uranium Mine**

Mining Operating Costs (\$/MT)	VUI Operating Cost	
	Years 2–21	Years 22–36
	Primary \$/year	Pillars, \$/yr
Equipment operating	1,250,455	423,182
Supplies	4,505,455	5,234,091
Hourly labor	7,120,909	6,414,545
Administration	4,591,364	2,491,364
Sundries	1,699,091	1,457,273
Extra labor	5,166,000	2,327,500
<b>Total mining operating cost</b>	<b>24,333,273</b>	<b>18,347,955</b>

Source: Lyntek/BRS, August 2010a, Table 7-4.

Table F-5 shows the estimated VUI operating costs associated with operating the processing mill. These costs are based on Table 7-5 in the Lyntek/BRS Scoping Study and Cost Estimate.

**Table F-5. Estimated Operating Costs for the Uranium Mill**

Mill Operating Cost/Yr	VUI Costs
Raw materials	6,070,461
Hourly labor	3,546,525
Supervisor & staff	2,292,800
Electricity	1,697,205
Water-purchased	207,900
Spare parts replacement	1,563,677
Office & lab supplies	500,000
G&A	850,000
Yellowcake transport	218,725
<b>Total</b>	<b>16,947,293</b>

Source: Lyntek/BRS, August 2010a, Table 7-5.

Finally, Table F-6 shows the VUI operating costs associated with managing the tailings from the processing plant. The computation of VUI's past to underground backfill costs is based on a formula provided in the text of the Lyntek/BRS Preliminary Economic Assessment (Lyntek/BRS, 2010b). According to this formula, the operating cost for the tails past processing and transport of paste for backfill is \$2.11 per ton of ore mined. The cost of reclamation is based on Table 6-7 in the same document. Here, the costs are provided per pound of  $U_3O_8$  produced. The table lists the total estimated pounds of  $U_3O_8$  produced from the primary stopes and the pillar extraction. This information, plus the number of years that each operation is estimated to be ongoing enables computation of the pounds of  $U_3O_8$  per year from each source, which is multiplied by the cost per pound to obtain the annual operating cost of reclamation of the tailings impoundments.

**Table F-6. Estimated Operating Cost for Tailings Management**

Tailings Cost/Yr	VUI Operating Cost	
	Primary Stopes	Pillar Removal
	Years 2–21	Years 22–36
Paste to underground backfill	2,215,500	738,500
Reclamation		
Cell cover and topsoil	1,662,884	92,223
Revegetation	18,476	12,296
Closure costs	406,483	135,260

Sources: paste op cost: Section 18.5.4, Lyntek/BRS, December 2010b, p. 70; reclamation: Lyntek/BRS, December 2010b, Table 25.7.

## **F.2 Economic Impact Estimates under Alternative Scenarios: Sector Detail**

See Tables F-7 and F-8 below for impacts associated with Construction and Capital Spending (Table F-7) and Operations Spending (Table F-8) under Reasonable, Best Reasonable, and Worst Reasonable scenarios.

## **F.3 References**

Lyntek Inc. and BRS Engineering,.August 2010 (2010a). *Coles Hill Uranium Project, Pittsylvania County Virginia: Scoping Study and Cost Estimate.*

Lyntek, Inc. and BRS Engineering, December 2010. (2010b). *NI 43 – 101 Preliminary Economic Assessment, Coles Hill Uranium Property, Pittsylvania County, Virginia, USA.*

Table F-7. Alternative Scenarios: Construction Impacts by Industry Sector

Sector	Baseline Values			Reasonable Scenario Construction			Best Reasonable Scenario Construction			Worst Reasonable Construction		
	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation
Agriculture, Forestry, Fisheries and associated support activities	13,722	844.4	101.2	4	0.3	0.0	5	0.3	0.0	3	0.2	0.0
Mining, extraction of oil and gas, and support activities	416	106.9	11.1	2	1.0	0.2	2	1.2	0.2	1	0.5	0.1
Electric power, natural gas distribution water and sewer	1,795	1,136.3	173.7	0	0.3	0.0	0	0.4	0.0	0	0.2	0.0
Construction, maintenance, and repair	31,548	3,432.7	1,007.4	305	34.6	10.1	355	40.3	11.8	253	28.7	8.4
Food and beverage manufacturing	3,437	2,133.6	178.1	1	0.5	0.1	2	0.6	0.1	1	0.3	0.0
Alcoholic beverage manufacturing	807	824.8	80.5	0	0.1	0.0	0	0.2	0.0	0	0.1	0.0
Tobacco products manufacturing	420	988.7	50.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Fiber, textile, apparel, and footwear manufacturing	6,644	1,397.2	255.9	1	0.3	0.0	1	0.3	0.1	1	0.2	0.0
Wood Products Manufacturing	5,357	978.3	224.1	2	0.3	0.1	2	0.4	0.1	2	0.3	0.1
Pulp and paper, paperboard, paper products manufacturing	4,703	1,601.6	268.3	1	1.1	0.1	1	1.4	0.1	1	0.8	0.0
Petroleum and coal products	486	872.8	44.3	1	0.6	0.1	1	0.7	0.1	1	0.4	0.1
Chemical products mfg	4,463	3,535.5	305.1	1	0.9	0.1	1	1.1	0.1	1	0.6	0.1
Plastics	2,675	831.6	139.6	2	0.5	0.1	2	0.5	0.1	1	0.3	0.1
Tires and other rubber products	3,631	1,136.9	253.5	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0

(continued)

Table F-7. Alternative Scenarios: Construction Impacts by Industry Sector (continued)

Sector	Baseline Values			Reasonable Scenario Construction			Best Reasonable Scenario Construction			Worst Reasonable Scenario Construction		
	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation
Pottery, ceramics, and glass mfg	1,303	289.0	63.0	0	0.1	0.0	0	0.1	0.0	0	0.0	0.0
Cement and concrete mfg	1,410	366.0	71.4	17	5.2	0.9	17	5.2	0.9	17	5.2	0.9
Lime and stone products	37	7.1	1.5	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Nonmetallic Mineral mfg	58	16.6	2.4	6	5.7	0.5	6	5.8	0.5	0	0.0	0.0
Primary Metals mfg	1,268	862.4	83.4	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Fabricated Metals Mfg	6,553	1,931.1	470.8	10	3.4	0.9	19	6.5	1.7	1	0.2	0.0
Machinery Mfg	4,798	1,517.6	287.7	1	0.4	0.1	2	0.4	0.1	1	0.2	0.0
Electrical equipment and component mfg	4,030	1,560.3	305.0	14	4.5	0.8	18	6.1	1.1	6	1.7	0.3
Transportation equipment and parts mfg	2,715	1,030.0	161.6	1	0.2	0.0	1	0.3	0.1	1	0.1	0.0
Cabinets and furnishing mfg	4,839	703.0	190.7	1	0.1	0.0	1	0.1	0.0	0	0.1	0.0
Instruments, jewelry, sporting goods mfg	1,675	301.6	78.4	75	10.8	4.2	105	15.0	5.8	37	5.4	2.1
Wholesale trade	18,117	2,688.4	963.1	6	0.4	0.2	7	0.5	0.3	4	0.3	0.2
Retail trade	62,909	3,339.9	1,525.8	48	2.6	1.2	59	3.1	1.4	33	1.7	0.8
Transportation and warehousing	19,971	2,543.3	743.9	35	4.3	1.2	47	5.7	1.6	17	2.1	0.6
Information services	5,381	1,328.1	270.0	8	2.3	0.4	11	2.9	0.5	5	1.5	0.3
Finance, Insurance, Real Estate services	29,412	8,783.7	900.2	20	6.6	0.5	28	9.1	0.7	13	4.2	0.3

(continued)



Table F-7. Alternative Scenarios: Construction Impacts by Industry Sector (continued)

Sector	Baseline Values			Reasonable Scenario Construction			Best Reasonable Scenario Construction			Worst Reasonable Construction		
	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation
Rental services	2,280	370.7	67.4	6	1.0	0.3	8	1.3	0.3	4	0.7	0.2
Professional services	22,365	2,257.8	1,017.8	87	11.8	5.8	101	13.4	6.1	51	6.9	3.4
Business services	35,496	2,453.5	1,138.8	36	1.8	0.8	44	2.2	1.0	21	1.0	0.5
Educational services	10,391	598.3	300.4	18	1.9	0.9	22	2.4	1.1	11	1.3	0.6
Health services	53,907	5,430.3	2,554.1	30	2.8	1.3	37	3.5	1.5	20	1.8	0.8
Child care and other family care services	11,277	418.5	226.7	7	0.3	0.1	9	0.3	0.2	5	0.2	0.1
Arts and entertainment	6,373	236.9	83.8	9	0.5	0.1	11	0.6	0.2	6	0.3	0.1
Accommodations and food service	33,577	1,817.0	588.9	38	2.2	0.7	46	2.6	0.8	25	1.4	0.4
Other personal services	15,453	1,063.2	276.4	12	1.0	0.2	14	1.2	0.3	8	0.7	0.2
Religious and civic organizations	11,999	807.5	293.0	13	0.5	0.3	16	0.6	0.3	9	0.3	0.2
Household operations	6,172	53.1	53.1	2	0.2	0.2	3	0.3	0.3	1	0.1	0.1
Federal government	10,901	1,013.8	821.5	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
State and local government, excluding education	26,272	2,235.3	1,251.6	3	0.9	0.2	4	1.1	0.2	2	0.5	0.1
State and local government, education only	40,198	2,224.0	1,957.7	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Total	531,241	68,069.4	19,843.0	822	111.7	32.7	1,008	137.7	39.8	559	70.5	21.1

Table F-8. Alternative Scenarios: Operations Impacts by Industry Sector

Sector	Baseline Values			Reasonable Scenario Operations			Best Reasonable Scenario Operations			Worst Reasonable Scenario Operations		
	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation
Agriculture, Forestry, Fisheries and associated support activities	13,722	844.4	101.2	4	0.3	0.0	5	0.3	0.0	2	0.1	0.0
Mining, extraction of oil and gas, and support activities	416	106.9	11.1	335	111.9	13.8	338	148.7	18.3	247	63.2	7.8
Electric power, natural gas distribution water and sewer	1,795	1,136.3	173.7	2	1.3	0.1	2	1.7	0.2	1	0.8	0.1
Construction, maintenance, and repair	31,548	3,432.7	1,007.4	5	0.5	0.2	6	0.6	0.2	2	0.2	0.1
Food and beverage manufacturing	3,437	2,133.6	178.1	1	0.4	0.1	2	0.6	0.1	1	0.2	0.0
Alcoholic beverage manufacturing	807	824.8	80.5	0	0.1	0.0	0	0.2	0.0	0	0.1	0.0
Tobacco products manufacturing	420	988.7	50.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Fiber, textile, apparel, and footwear manufacturing	6,644	1,397.2	255.9	1	0.1	0.0	1	0.1	0.0	0	0.0	0.0
Wood Products Manufacturing	5,357	978.3	224.1	0	0.1	0.0	1	0.1	0.0	0	0.0	0.0
Pulp and paper, paperboard, paper products manufacturing	4,703	1,601.6	268.3	1	0.9	0.1	1	1.2	0.1	0	0.4	0.0
Petroleum and coal products	486	872.8	44.3	0	0.3	0.0	0	0.4	0.0	0	0.1	0.0
Chemical products mfg	4,463	3,535.5	305.1	1	0.8	0.1	1	1.1	0.1	0	0.4	0.0
Plastics	2,675	831.6	139.6	2	0.4	0.1	2	0.6	0.1	1	0.2	0.0
Tires and other rubber products	3,631	1,136.9	253.5	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0

(continued)

Table F-8. Alternative Scenarios: Operations Impacts by Industry Sector (continued)

Sector	Baseline Values			Reasonable Scenario Operations			Best Reasonable Scenario Operations			Worst Reasonable Scenario Operations		
	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation
Pottery, ceramics, and glass mfg	1,303	289.0	63.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Cement and concrete mfg	1,410	366.0	71.4	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Lime and stone products	37	7.1	1.5	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Nonmetallic Mineral mfg	58	16.6	2.4	0	0.1	0.0	0	0.2	0.0	0	0.1	0.0
Primary Metals mfg	1,268	862.4	83.4	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Fabricated Metals Mfg	6,553	1,931.1	470.8	1	0.1	0.0	1	0.2	0.0	0	0.1	0.0
Machinery Mfg	4,798	1,517.6	287.7	2	0.8	0.2	3	1.1	0.2	1	0.4	0.1
Electrical equipment and component mfg	4,030	1,560.3	305.0	0	0.2	0.0	1	0.3	0.1	0	0.1	0.0
Transportation equipment and parts mfg	2,715	1,030.0	161.6	1	0.3	0.0	1	0.3	0.1	0	0.1	0.0
Cabinets and furnishing mfg	4,839	703.0	190.7	0	0.1	0.0	1	0.1	0.0	0	0.0	0.0
Instruments, jewelry, sporting goods mfg	1,675	301.6	78.4	98	13.6	5.3	139	19.3	7.4	12	1.7	0.6
Wholesale trade	18,117	2,688.4	963.1	4	0.3	0.2	6	0.4	0.2	2	0.1	0.1
Retail trade	62,909	3,339.9	1,525.8	35	1.8	0.8	48	2.5	1.2	15	0.8	0.4
Transportation and warehousing	19,971	2,543.3	743.9	36	4.6	1.3	45	5.7	1.6	14	2.0	0.6
Information services	5,381	1,328.1	270.0	8	2.0	0.4	10	2.7	0.5	3	0.8	0.2
Finance, Insurance, Real Estate services	29,412	8,783.7	900.2	20	6.6	0.5	27	8.8	0.7	9	2.6	0.2
Rental services	2,280	370.7	67.4	5	0.9	0.2	7	1.2	0.3	3	0.4	0.1

(continued)

Table F-8. Alternative Scenarios: Operations Impacts by Industry Sector (continued)

Sector	Baseline Values			Reasonable Scenario Operations			Best Reasonable Scenario Operations			Worst Reasonable Scenario Operations		
	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation	Employment	Output	Employee Compensation
Professional services	22,365	2,257.8	1,017.8	30	4.1	1.8	57	7.7	3.6	14	1.9	0.9
Business services	35,496	2,453.5	1,138.8	24	1.2	0.6	34	1.7	0.8	9	0.5	0.2
Educational services	10,391	598.3	300.4	15	1.7	0.8	21	2.3	1.1	7	0.7	0.4
Health services	53,907	5,430.3	2,554.1	26	2.5	1.1	36	3.4	1.5	12	1.1	0.5
Child care and other family care services	11,277	418.5	226.7	6	0.2	0.1	9	0.3	0.2	3	0.1	0.1
Arts and entertainment	6,373	236.9	83.8	6	0.3	0.1	9	0.5	0.1	3	0.1	0.0
Accommodations and food service	33,577	1,817.0	588.9	28	1.5	0.5	39	2.2	0.7	12	0.7	0.2
Other personal services	15,453	1,063.2	276.4	7	0.6	0.1	10	0.8	0.2	3	0.2	0.1
Religious and civic organizations	11,999	807.5	293.0	11	0.4	0.2	16	0.6	0.3	5	0.2	0.1
Household operations	6,172	53.1	53.1	2	0.2	0.2	3	0.3	0.2	1	0.1	0.1
Federal government	10,901	1,013.8	821.5	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
State and local government, excluding education	26,272	2,235.3	1,251.6	4	1.2	0.2	6	1.7	0.3	2	0.6	0.1
State and local government, education only	40,198	2,224.0	1,957.7	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Total	531,241	68,069.4	19,843.0	724	162.4	29.2	889	219.9	40.6	385	81.3	13.0

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# Appendix G: Uranium

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## G.1 Uranium Markets and Industry Analysis

RTI examined the uranium industry to respond to two key concerns of the community: whether the mine and mill can be economically viable and successful, and whether its presence will lead to the expansion or creation of businesses in the region. With particular focus on those two areas, this section covers the markets for uranium, supply, demand and price factors, the mining and milling supply chain, and the nuclear fuel value chain.

### G.1.1 Uses for Uranium

Prior to the discovery of nuclear fission in 1939, uranium was primarily used for coloring and tinting applications, and to obtain radium (a byproduct of uranium decay) for cancer therapies. Nuclear electricity was first generated in 1951, and now supplies 14 percent of the world's electricity.<sup>1</sup> The vast majority of uranium is used for that purpose—to fuel nuclear fission reactors in civilian nuclear power plants, but it is also used in research reactors and for military fuel.

Research—or non-power—reactors are used to analyze and test materials, and to produce radioisotopes. The applications of radioisotopes span medicine, agriculture, and environmental science. In the medical field, radioisotopes are used to diagnose and treat illnesses and sterilize equipment, among many uses. Agricultural applications include investigation of fertilizers and insecticides, the improvement of animal health, and the preservation of both farmed and processed foods. Environmentally, radioisotopes are employed in the detection of a wide range of land and water pollutants.

The World Nuclear Association estimates that approximately 540 tonnes per year (1% of global supply) of uranium are used by research reactors and 3,500 tonnes (6.5% of supply) are used for naval (military) fuel.<sup>2</sup> The remaining 92.5 percent goes to civilian power reactors. Accordingly, most of the analysis herein focuses on uranium for that primary use.

### G.1.2 Supply

The world's power reactors require approximately 68,000 tonnes of uranium each year. This demand is met through primary sources (natural resources; obtained through mining) and secondary sources (derived from commercial stockpiles, nuclear weapons stockpiles, recycled plutonium and uranium from reprocessing used fuel, and from re-enrichment of depleted uranium tails).<sup>3</sup> The disarmament of nuclear weapons, particularly in the US and Russia, has been a high-value source of uranium. In 1993, the US and Russia agreed to properly turn a number of military-grade weapon stockpiles into nuclear fuel for use in commercial reactors, known as the “megatons to megawatts” agreement. As of 2011, nearly 17,000 nuclear warheads have been recycled into 12,350 tonnes of low enriched uranium to fuel nuclear power plants.<sup>4</sup>

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<sup>1</sup> <http://www.world-nuclear.org/uploadedFiles/Pocket%20Guide%202009%20Uranium.pdf>

<sup>2</sup> E-mail correspondence, Ian Hore-Lacy, Director of Public Communications, World Nuclear Association, October 21, 2011

<sup>3</sup> <http://www.world-nuclear.org/info/inf75.html>

<sup>4</sup> <http://www.usec.com/megatonstomegawatts.htm>

After a worldwide peak in uranium production in the early 1980s, the output of uranium decreased drastically for a span of nearly 13 years. Since that time, uranium mining worldwide has gradually risen and is considered by industry experts to be in a significant expansion. This high level of growth is demonstrated by the vast increase of global uranium production levels of only 35,574 tonnes in 2003 to approximately 53,663 tonnes as of 2010, and a predicted yield of 63,000 tonnes in 2012.<sup>5</sup> As shown in Table G-1, the top three uranium producing countries are Kazakhstan, Canada, and Australia, yielding 33, 18 and 11 percent of the world supply, respectively.<sup>6</sup>

**Table G-1. Production from Mines (tonnes U), 2003–2010**

Country	2003	2004	2005	2006	2007	2008	2009	2010
Kazakhstan	3,300	3,719	4,357	5,279	6,637	8,521	14,020	17,803
Canada	10,457	11,597	11,628	9,862	9,476	9,000	10,173	9,783
Australia	7,572	8,982	9,516	7,593	8,611	8,430	7,982	5,900
Namibia	2,036	3,038	3,147	3,067	2,879	4,366	4,626	4,496
Niger	3,143	3,282	3,093	3,434	3,153	3,032	3,243	4,198
Russia	3,150	3,200	3,431	3,262	3,413	3,521	3,564	3,562
Uzbekistan	1,598	2,016	2,300	2,260	2,320	2,338	2,429	2,400
USA	779	878	1,039	1,672	1,654	1,430	1,453	1,660
Ukraine (est)	800	800	800	800	846	800	840	850
China (est)	750	750	750	750	712	769	750	827
Malawi	—	—	—	—	—	—	104	670
South Africa	758	755	674	534	539	655	563	583
India (est)	230	230	230	177	270	271	290	400
Czech Repub.	452	412	408	359	306	263	258	254
Brazil	310	300	110	190	299	330	345	148
Romania (est)	90	90	90	90	77	77	75	77
Pakistan (est)	45	45	45	45	45	45	50	45
France	—	7	7	5	4	5	8	7
Germany	104	77	94	65	41	—	—	—
<b>Total World</b>	<b>35,574</b>	<b>40,178</b>	<b>41,719</b>	<b>39,444</b>	<b>41,282</b>	<b>43,853</b>	<b>50,773</b>	<b>53,663</b>
<b>Percentage of World Demand</b>	<b>85%</b>	<b>85%</b>	<b>65%</b>	<b>63%</b>	<b>64%</b>	<b>68%</b>	<b>78%</b>	<b>78%</b>

Source: WNA Market Report Data: <http://world-nuclear.org/info/inf23.html>

<sup>5</sup> <http://world-nuclear.org/info/inf22.html>

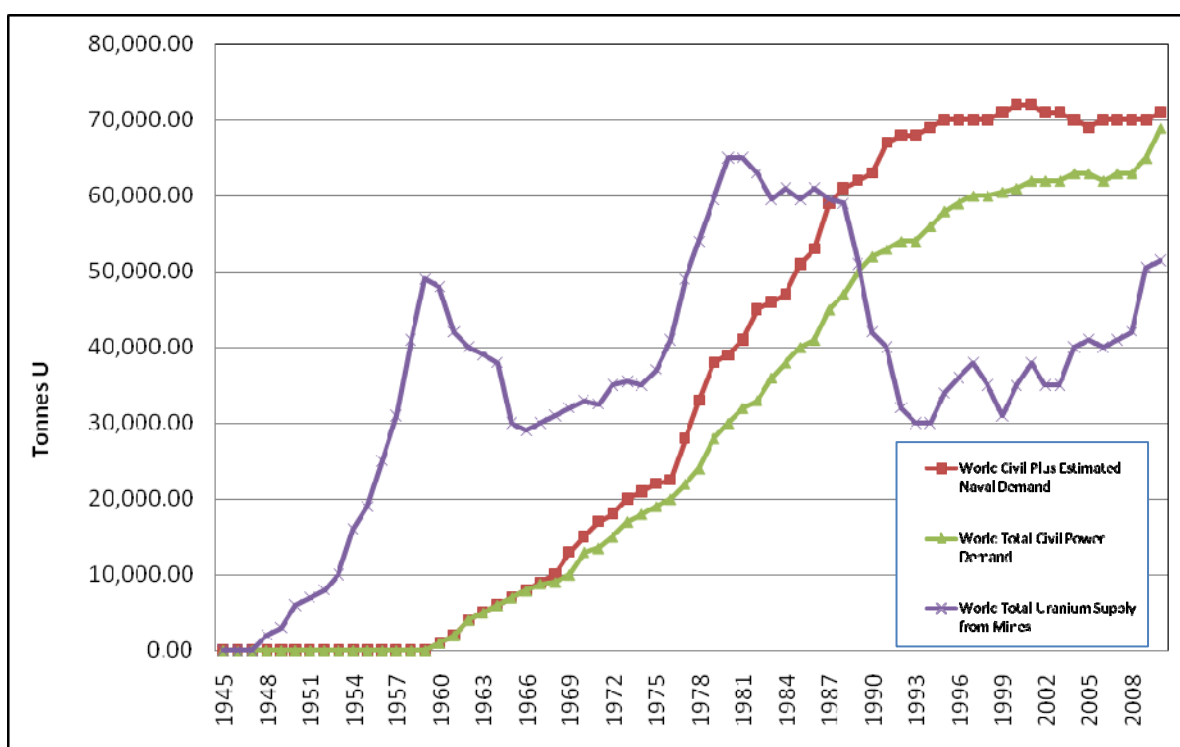
<sup>6</sup> <http://world-nuclear.org/info/inf23.html>

Notably, only 8 percent of the uranium utilized in the US in 2010 was of US origin. This means that nearly 92 percent of the uranium consumed in the US in 2010 was mined in a foreign country.<sup>7</sup>

### G.1.3 Demand and Price Factors

Figure G-1 shows historical trends in uranium demand and production. There are approximately 440 commercial nuclear power reactors operating in over 30 countries, which together require 68,000 tonnes of uranium each year from primary and secondary sources. In addition to these functioning reactors, over 60 new reactors are currently being constructed and 130 are in planning stages. Lower bound estimates by the World Nuclear Association project nuclear capacity will increase by 60% by 2030.

**Figure G-1. Uranium Production and Demand, 1945–2010**



Source: <http://world-nuclear.org/info/inf23.html>

Since 1985, the gap between demand and production has been filled by secondary sources. As these diminish, the gap will increasingly be filled by primary production. According to the NEA, nearly 5.5 million metric tons of uranium ore has been identified worldwide, with an additional 10.5 million metric tons remaining undiscovered, mostly due to two things; the economic feasibility of obtaining the raw ore, and national and international laws restricting the mining and uses of uranium.

<sup>7</sup> <http://www.eia.gov/uranium/marketing/>

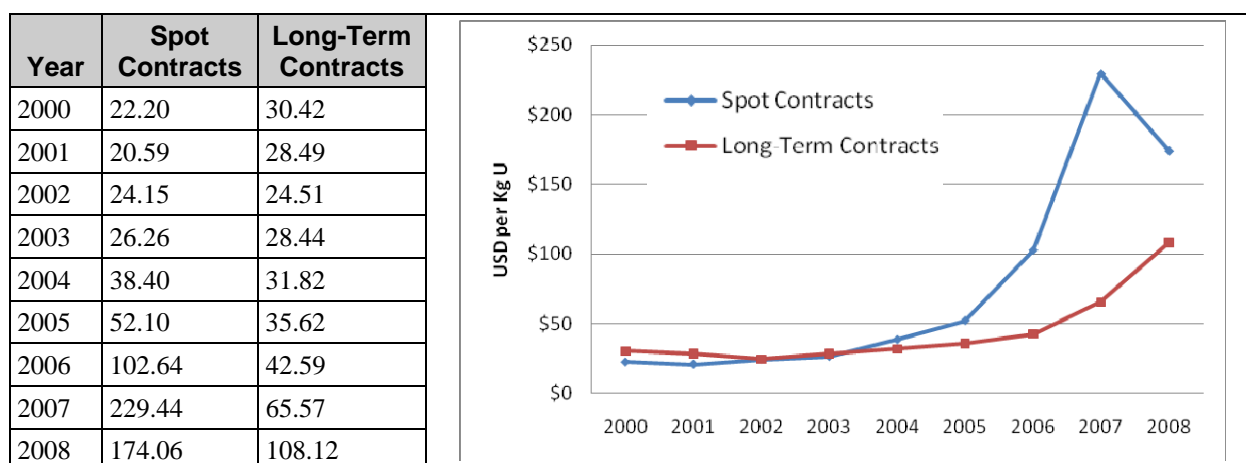


### Impacts on Pricing: Historic and Projected

Historically, uranium prices have varied greatly (see Table G-2 for recent trends). Due to the peak uranium production in the 1980s and the discovery of secondary sources, uranium prices fell drastically between 1980 and 1994, when the global uranium ore prices reached their lowest levels in nearly 20 years at about \$14 per pound. After 1994, a significant reduction in uranium exploration and production combined with increasing world demand allowed prices to recover slightly for the next few years, but a true global rebound in prices did not occur until after 2001 when uranium oxide sold for approximately \$29 per pound. Since that time, the need for fuel at new and existing power plants has spurred a huge increase in uranium prices worldwide, and as of September 2011, the long term contract uranium price is approximately \$64.50 per pound.<sup>8</sup> As a result of the increasingly favorable market conditions, plans to increase production capability on a global scale have equally risen. Significant plans for developing for the first time or increasing existing nuclear generating capacities have been announced in multiple countries, including Kazakhstan, China Australia, Brazil, Canada, and multiple African nations. These expansion plans are expected to support the continual increase of uranium prices through 2035.

Uranium pricing in the US is particularly influenced by the purchases under contract by owners and operators of civilian nuclear power reactors. Contracts are either defined as a “spot” contract, one that is considered to be a year-long agreement and usually consisting of a single delivery of the entire amount of uranium purchased, or a “long-term” contract, which generally occurs in multiple deliveries lasting more than a year after the contract is initiated. Due to the recent economic downturn, there have been significant decreases in the uranium prices of weighted-average spot contracts, down from \$229 per kilogram in 2007 to \$174 per kilogram. However, a significant increase of nearly 70% in the weighted-average price of uranium under long term contracts between 2007 and 2008 supports the assumption of the world price increase through 2035.

**Table G-2. Average Uranium Prices, United States, 2000-2008**



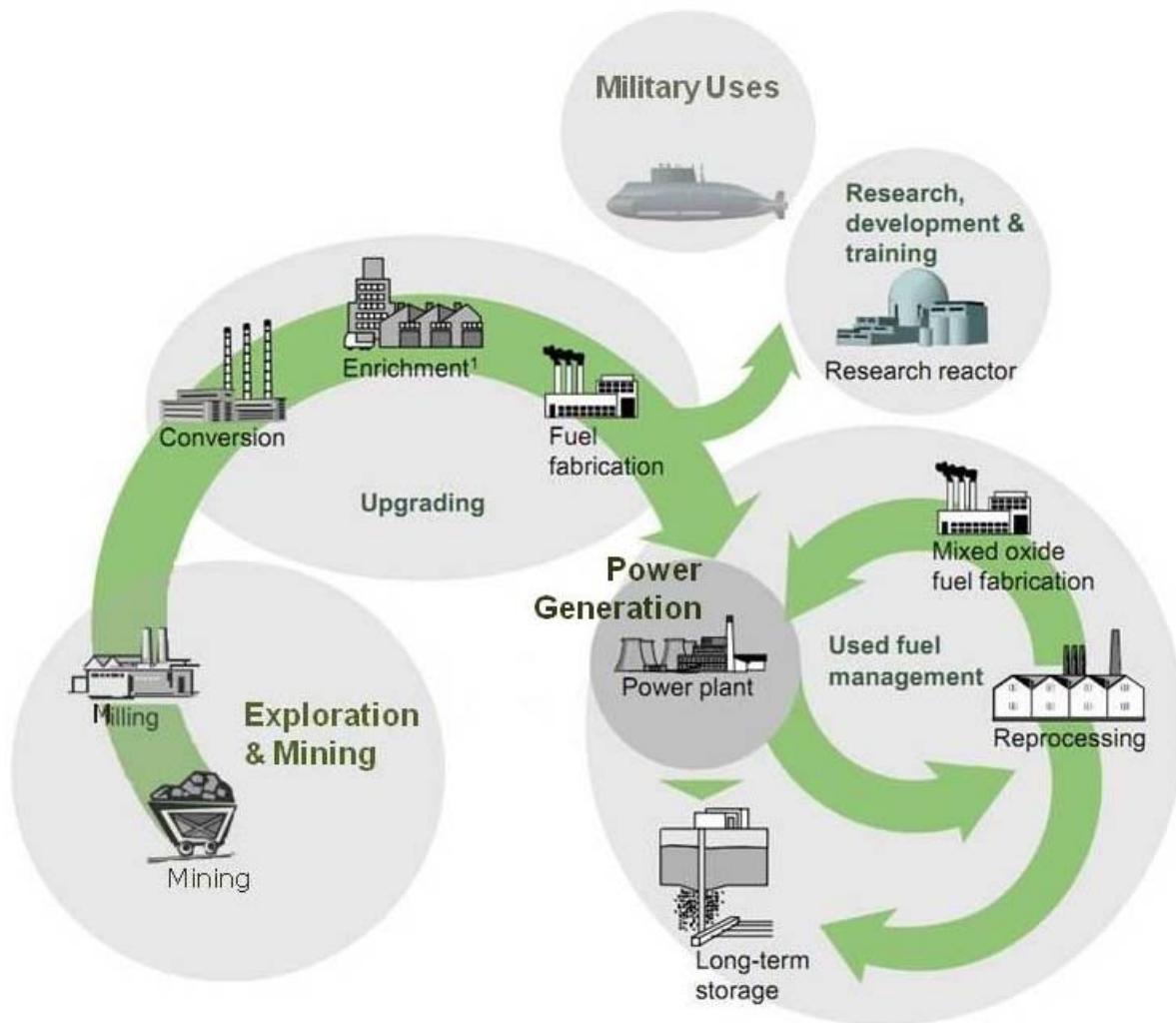
Source: OECD “red book”—pg.411

<sup>8</sup> [http://www.u3o8.biz/s/MarketCommentary.asp?ReportID=478375&\\_Type=Market-Commentary&\\_Title=Uranium-Mining-and-nuclear-industry-outlook](http://www.u3o8.biz/s/MarketCommentary.asp?ReportID=478375&_Type=Market-Commentary&_Title=Uranium-Mining-and-nuclear-industry-outlook)

### G.1.4 Nuclear Fuel Cycle<sup>9</sup>

Raw uranium ore must be highly processed before it can be used to generate electricity. Broken up into “front end” and “back end,” the nuclear fuel cycle is comprised of mining, milling, conversion, enrichment, fuel fabrication on the front end and storage, reprocessing, recycling and waste disposal of the spent fuel on the back end (see Figure G-2). In addition, the highly sensitive uranium must be transported several times during its cycle progression, requiring the use of dedicated support companies and additional regulatory controls.

**Figure G-2. Nuclear Fuel Cycle<sup>10</sup>**



<sup>9</sup> Information in this section compiled from similar descriptions of the nuclear fuel cycle from the Department of Energy’s Office of Nuclear Energy, US Energy Information Administration, World Nuclear Association, and Government of Saskatchewan.

<sup>10</sup> Graphic adapted from *Capturing the full value of the uranium value chain in Saskatchewan*, Government of Saskatchewan, Uranium Development Partnership. (2009). Retrieved from: <http://www.gov.sk.ca/adx.aspx/adxGetMedia.aspx?mediaId=767&PN=Shared>

### ***Mining & Milling***

As the first steps in the cycle, mining and milling are crucial to the acquisition of the raw uranium ore. The ore can be mined three ways: open pit, underground or via in situ recovery (ISR). Where the ore is near the ground surface, open pit mining is the optimal, and safest, method to use. When deposits are further from the earth's surface, it is necessary to employ underground methods. However, underground mining techniques require many additional safety precautions, including ventilation techniques, extraction machinery precision measures and multiple entrance and exit tunnel construction. When ore is even further underground, ISR methods are utilized to extract the uranium without physical excavation. ISR, instead, uses a solution to dissolve and mix with the uranium and then pumped to the surface, where the ore is separated from solution. Significant waste is generated during the mining stage, mostly consisting of rock waste and dust, dirt, soil, water and chemical tailings, but after being sealed, these wastes are easily covered with soil and re-vegetated to be consistent with the surrounding area's natural environment.

The milling process generally takes place on the same grounds as mining facilities so as to save time and costs associated with shipping. At the mill, the raw ore is crushed, turned into a paste with addition of sulphuric acid, and dried into a solid uranium oxide concentrate called yellowcake (Triuranium Octoxide,  $U_3O_8$ ), before transfer to a conversion facility.

### ***Conversion & Enrichment***

When the triuranium octoxide reaches a conversion plant, the solid yellowcake is turned into gaseous form, or Uranium Hexafluoride ( $UF_6$ ).

The enrichment process is extremely complex and expensive; as of July 2010, there were only three operational enrichment plants in the US. After the preliminary steps of mining, milling and conversion, the  $UF_6$  gas includes both isotopes U-235 and U-238 in a ratio of about .7 to 99.3. The main purpose of enrichment is to increase the U-235 concentration from its natural level of .7% to between 3.5% and 5%, as well as the removal of close to 85% of the U-238 isotope.

### ***Fuel Fabrication***

Fuel fabrication is the last phase of what is considered to be the front end portion of the nuclear fuel cycle. At this stage, fuel rods are formed by changing the enriched uranium into powder, which is then pressed into small pellets and put into metal tubes. In order to be used at power plants, multiple rods are grouped together to form fuel assemblies and are shipped to power plants nationwide.

### ***Power Plants***

There are approximately 104 nuclear power reactors in operation within 65 power plant facilities nationwide, which utilize varying arrangements of fuel assemblies that are situated into a nuclear reactor core to produce energy. After use, the spent fuel rods are extremely hot and radioactive and must be handled with tremendous care. The spent rods are removed from the reactor and deposited in storage ponds at the reactor site for a number of years. This storage stage allows the rods to be cooled, and radioactivity decreased, while being shielded from the general population. After about 40 years, the rods' radioactivity is down to 1/1000<sup>th</sup> of what they were upon core reactor removal.

### ***Reprocessing***

Reprocessing only occurs with the most highly radioactive waste, and is therefore a highly delicate practice. The untapped uranium and plutonium are separated, concentrated and returned to fresh reactor fuel.

### ***Overall Transportation***

As described by stage above, material must be transported several times during the fuel cycle, sometimes over long or even international distances. In the United States, the US Department of Transportation has the primary responsibility for regulating the safe transport of radioactive material. The regulatory control of radioactive material shipping is independent of the intended end use application; packages must be labeled as radioactive, and personnel must be trained in safe transport precautions.

Regarding the shipment of the highly delicate spent fuel, the US Nuclear Regulatory Commission further requires involved carriers follow only approved routes, use immobilization devices, coordinate with law enforcement agencies, provide high level monitoring and facilitate redundant communications between all parties involved, including the NRC itself. And since 1961, international shipments, regulations for transport are established by the International Atomic Energy Agency.

According to the US DOT, nuclear material packages for transport are categorized two ways, as either “type A” or “type B.” Generally, type A packages do not require shielding during storage and are designed to withstand minor accidents. Packages categorized as type B are transported more securely, requiring both shielding and cooling due to high levels of radioactivity.

### ***Nuclear Fuel Cycle Facilities***

As shown in Table G-3, there are only ten operational nuclear fuel cycle facilities in the United States. All of the yellowcake milled at the Coles Hill site will be transported to Metropolis, Illinois, in 200-liter steel drums, with no requirement for further radiation protection.

## **G.2 Uranium Industry in Virginia**

The nuclear power industry is globally networked, involving multinational, multibillion dollar behemoths, mid-size companies, and small businesses. On the fuel end of the value chain are hundreds of mining operations, but a handful of large operators stand out. Lynchburg, Virginia, which falls within the study area for this project, is home to one of those large operators, AREVA, NP. Additionally, AREVA’s joint subsidiary with Siemens, Framatome ANP, and Babcock & Wilcox (B&W) process fuel assemblies in the region, for commercial and defense customers.

AREVA is a vertically integrated energy company providing almost all of the elements of the value chain, except for owning and operating power plants. However, even that situation may change in the future. AREVA’s large plant servicing organization (AREVA, NP) is based in Lynchburg. Plant services deals with operating plants, of which there are 104 in the United States and 439 worldwide.

**Table G-3. Fuel Cycle Facilities, United States**

Licensee/Facility	Location	Type
Honeywell International, Inc.	Metropolis, IL	Conversion
AREVA	Idaho Falls, ID	Enrichment
GE-Hitachi	Wilmington, NC	Enrichment
U.S. Enrichment Corporation	Paducah, KY	Enrichment
AREVA	Lynchburg, VA	Fuel Fabrication
AREVA	Richland, WA	Fuel Fabrication
B&W Nuclear Operations Group	Lynchburg, VA	Fuel Fabrication
Global Nuclear Fuel-Americas, LLC	Wilmington, NC	Fuel Fabrication
Nuclear Fuel Services	Erwin, TN	Fuel Fabrication
Westinghouse Electric Company, LLC	Columbia, SC	Fuel Fabrication

Note: Seven other facilities are in various phases of permitting or construction, or in cold standby.

Source: US Nuclear Regulatory Commission

B&W, in addition to fuels, manufactures nuclear power reactor systems for marine applications and large components for power reactors, some of which are fabricated in other locations such as Barberton, Ohio and Mt. Vernon, Indiana. B&W is also a service provider to the nuclear industry, providing those services from Lynchburg to operators and companies across the United States as well.

The other major player in the nuclear market in the area is Flowserve/Limatorque. The Lynchburg facility makes valves, actuators, and other control devices for commercial and nuclear applications. Flowserve, the parent organization, was a Fortune 500 company with revenues exceeding \$4.3 billion in 2010. The Limatorque products are included in the flow control division that represent about one-third of corporate revenue.



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## ***Appendix H: Quality of Life***

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Table H-1. Quality of Life

Study	Type of Study	Type of Contamination	Study Region	Time Period of Study	Sample Size	Estimated Value Attached to Avoiding Cancer	Cost of Contamination
<b>Cancer Studies</b>							
Davis (2004)	Hedonic	Cancer Cluster, pediatric leukemia	Churchill County, Nevada	1990–2002	11,834	The estimated value of avoiding pediatric leukemia is \$5.6 million. Housing prices in the cancer cluster declined by 15.6% during maximum risk period.	
Akerman, Johnson, & Bergman (1991)	CVM, Bayesian	Radon	Sollentuna, Sweden		317	Annual willingness to pay for reduced radon risk ranged from \$300-\$915 (most plausible \$500). This implies the value of avoiding cancer for a 20-year old at 3% discount rate is \$776,000. Much less than most other studies, attributable to homeowners' misperception of risk.	Average annual cost of mitigating a house from radon contamination in Sweden was \$575 for a particular type of ventilation and \$215 for all other types (in 1986\$)
Gayer (2000)	Hedonic, Bayesian	Superfund	Grand Rapids, Michigan	1988–1993	16,928	Before the EPA release the Remedial Investigations the value attached to avoiding cancer was \$49.9 million, much higher than estimates in job market studies. But after the release of the Remedial Investigation the value attached to avoiding cancer was \$4.6 million. Willingness to pay to be located an additional mile away from the Superfund site is \$1,085.	
Gayer (2002)	Hedonic	Superfund	Grand Rapids, Michigan	1988–1993	1883 repeat home sales	If regulatory agency released a report that said cancer risks were lower, then the average home price increased by \$56 to \$87. The value attached to avoiding cancer is estimated between \$4.3 million to \$8.3 million.	
Ho & Hite (2008)	Hedonic	Superfund, Toxic Release Inventory	Southeast United States	2000	County level median home price from 755 counties in nine southeast states	The value attached to avoiding cancer is 4.77 million in 2000 dollars. 1 percent reduction in toxic releases could result in 3.3 billion dollars in total benefits in perpetuity.	

(continued)



Table H-1. Quality of Life (continued)

Study	Type of Study	Type of Contamination	Study Region	Time Period of Study	Sample Size	Estimated Value Attached to Avoiding Cancer	Cost of Contamination
<b>Cancer Studies</b>							
Hunt et al (2009)	Cost effectiveness study	Carcinogens: butadiene, asbestos, benzene, formaldehyde, radiation, radon and vinyl chloride	Across the United States	2005–2006	38 enforce environmental interventions	Incremental cost-effectiveness ratios (ICERs) were much higher for environmental policy prevention than clinical policies.	
Kennedy (2002)	revealed preference valuation, cvm	Radon	Northamptonshire, UK	1989–1998	134 revealed preference; 142 cvm	In the revealed preference model willingness to pay to reduce radon induced lung cancer was 180 British pounds, while it was 269 British pounds for the CVM model.	Mean expected remediation costs for radon removal were 670 British pounds
Milligan et al (2010)	CVM	Cancer prevention drug	Across the United States	2002		Analyzes what socioeconomic and demographic factors are related to the willingness to pay for cancer prevention. Age had a negative relationship, while income and probability of developing cancer had a positive relationship.	
Van Houtven et al (2008)	Choice based stated preference	Cancer prevention	Across the United States		788	The value attached to avoiding cancer is 3 times greater than immediate accident risks. The value attached to avoiding cancer is estimated to be roughly \$14 million.	
New Hampshire Dept of Environmental Services Fact Sheet		Radon	New Hampshire				The cost to remove radon from indoor air in basements ranges from \$800 to \$1,500 per household

(continued)

Table H-1. Quality of Life (continued)

Study	Type of Study	Type of Contamination	Study Region	Time Period of Study	Sample Size	Estimated Value Attached to Better Water Quality	Cost of Contamination
<b>Groundwater Studies</b>							
Boyle et al (2010)	Hedonic	Well water arsenic contamination	Buxton and Hollis townships, Maine	1992–2003	1,669 home sales in Buxton and 542 home sales in Hollis	Home prices were only depressed for 2 years once contamination was publicized. Results may suggest that property-specific contamination (private well) may not have long lasting effects like Superfunds that can depress prices for a decade.	
Abdalla, Roach & Epp (1992)	Averting Expenditures Method	Trichlorethylene (TCE)	Perkasie, PA	1989	761	Cost of adverted expenditures can be a lower bound estimation of willingness to pay for avoiding contamination.	Cost of averting contamination was estimated to be \$61.3K to \$131.3K
Lewandoski et al (2008)	Logistic Regression based on Cost Survey	Nitrate	11 Counties in Minnesota	2006	483	Average contamination remediation costs for each household per year were \$190 for bottled water, \$800 to buy a nitrate removal system plus \$100 for maintenance, or \$7,200 to install a new well.	
Beaumais et al (2010)	Contingent Valuation Method (CVM)	Improved tap water	10 OECD Countries	2008	1000	Households are willing to pay a 7.5% increase in their water bill to improve tap water quality. Countries with more health concerns regarding tap water had higher willingness to pay.	
Genius et al (2008)	Contingent Valuation Method (CVM)	Improved tap water, water supply shortages	Rethymno, Greece	2004–2005	306	Participants were willing to pay a 7.67% increase on an average water utility bill for future water improvement projects.	
Kim & Cho (2002)	Contingent Valuation Method (CVM)	Copper	Nine counties in Southwestern Minnesota	1995	186	Total willingness to pay for reduction in copper contamination for nine counties was estimated to be \$1.66 to \$2.38 million.	
Abdalla (1990)	Averting Expenditures Method	Perchloroethylene (PCE)	College Township, Pennsylvania	1988	1045	Cost of adverted expenditures can be a lower bound estimation of the estimated value attached to better water quality.	Cost of averting contamination was estimated to be \$252 per household (\$149K in total, in 1987\$)

(continued)

Table H-1. Quality of Life (continued)

Study	Type of Study	Type of Contamination	Study Region	Time Period of Study	Sample Size	Estimated Value Attached to Better Water Quality	Cost of Contamination
<b>Groundwater Studies (continued)</b>							
Poe et al (2001)	Meta-Analysis of CVM	Various	Across the United States	Various	108 observations from 14 studies	The average from 105 estimates for willingness to pay for improved water quality estimates vary from \$46 to \$1,316, in 1997\$.	
Cho, Easter, & Konishi (2010)	Contingent Valuation Method (CVM)	Arsenic	30 rural communities in Minnesota	2007	327	If the initial arsenic concentration was less than 10 µg/L then participants were willing to pay between \$6 and \$23 per household per year for improved water quality. If the concentration was greater than 10 µg/L of arsenic then households were willing to pay between \$31 and \$78 per year.	The cost of cleanup ranges from \$230-\$2,006, this is higher than the willingness to pay for many participants. Thus, the EPA new arsenic rule may result in loss of welfare in some parts of the country
<b>Surface Water Studies<sup>1</sup></b>							
Williamson, Thurston, Heberling (2007)	Hedonic	Acid Mine Drainage	Cheat River Watershed, West Virginia	1984–2005	1,608	This study focuses on the benefits of improving the water quality of the Cheat River Watershed because the river has tourism and recreational potential (fishing and whitewater rafting). Location near an acid mine drainage impaired stream has a marginal cost of \$4,783 on housing (within 1/4 mile of stream). Houses located beyond 1/4 of mile from the stream, housing prices were not affected. The study finds that cleaning the watershed would result in a benefit of \$1.7 million, through restored home prices.	

(continued)

<sup>1</sup> There are additional studies on the willingness to pay for improved water quality for surface water that were not included in this table. These papers are, however, included in the reference list for this appendix. One study Cho, Roberts, & Kim (2011) discusses the difference in perception of pollution impacts are perceived between residents who do and do not receive the economic benefits of a paper mill on the Pigeon River.

Table H-1. Quality of Life (continued)

Study	Type of Study	Type of Contamination	Study Region	Time Period of Study	Sample Size	Estimated Value Attached to Better Water Quality	Cost of Contamination
<b>Groundwater Studies (continued)</b>							
Poor, Pessagno, Paul (2006)	Hedonic	Urban development run-off (Total Suspended Solids and Nitrogen)	St. Mary's River Watershed, Maryland	1999–2003	1,377	This study examines property values in order to measure costs associated with loss of natural habitat and recreation opportunities due to decreased water quality in the Chesapeake Bay. An increase in 1 mg/L of total suspended solids results in a drop in home prices by \$1,086. For a 1 mg/L increase in dissolved inorganic nitrogen home prices on average drop by \$17,642.	
Leggett & Bockstael (2000)	Hedonic	Fecal Coliform	Anne Arundel County, Maryland	1993–1997	1,183	The purpose of this study is to evaluate the benefit of avoiding human health risks caused by fecal coliform by evaluating the impact of its concentration in the Chesapeake Bay on home prices. A 1 mg/L increase in fecal coliform on average caused housing prices to decline by 1.4%. Therefore, improving water quality near all properties on the Chesapeake Bay is valued at \$12.1 million	

(continued)

Table H-1. Quality of Life (continued)

Study	Type of Study	Type of Contamination	Study Region	Time Period of Study	Sample Size	Estimated Value Attached to Better Water Quality	Cost of Contamination
<b>Groundwater Studies (continued)</b>							
Walsh, Milon, & Scrogin (2011)	Hedonic	Various	Orange County, Florida	1996-2004	56,208	This study examines the spatial extent of the benefits of water pollution abatement in residential housing markets. General results indicate (1) the value of increased water quality depends upon the property's location and proximity to waterfront, and the surface area of the water body; and (2) aggregate benefits to non waterfront homes may dominate those realized by waterfront homeowners. Benefits of enhanced water quality include aesthetic, recreational and ecosystem services. For a one unit increase in water quality the average lakefront property increased by \$5,500, while the average nonlakefront home increased by \$700. The study finds that when looking at the region at large, total benefits to nonlakefront properties may exceed benefits realized by lakefront properties. For one particular lake in the study benefits are estimated to be \$5.4 million for waterfront properties and \$12.5 for non waterfront properties.	

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