FINAL REPORT

# Economic Impacts of Enhanced Aquifer Protection for the Lower Portneuf River Valley Aquifer

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# Economic Impacts of Enhanced Aquifer Protection for the Lower Portneuf River Valley

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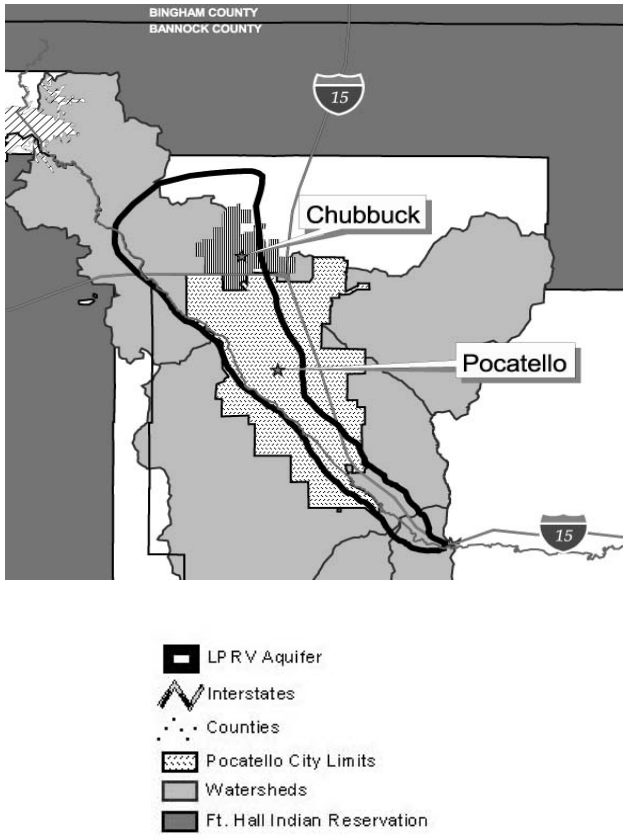
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# *EXECUTIVE SUMMARY— ECONOMIC IMPACTS OF ENHANCED AQUIFER PROTECTION IN THE LOWER PORTNEUF RIVER VALLEY*

## *Background*

In October 2000, BBC Research & Consulting (BBC) was commissioned to study the economic implications of additional regulatory measures to protect ground water quality in the LPRV. BBC worked with the Lower Portneuf River Valley Aquifer Protection Work Group to identify potential protection goals. The study ultimately described specific protection measures and examined the potential costs and benefits from those measures.




## *Reasons for Concerns*

At least three factors have led to concerns about water quality in the LPRV and local interest in considering measures to protect the aquifer: the aquifer's status as the sole source of potable water for the Pocatello area, recent recognition of water quality contamination (PCE and TCE) and vulnerability of the aquifer due to its geology and the surface activities above it.

# *EXECUTIVE SUMMARY— ECONOMIC IMPACTS OF ENHANCED AQUIFER PROTECTION IN THE LOWER PORTNEUF RIVER VALLEY*

### *Three Pronged Strategy for Protection*

Facing many similar circumstances to the LPRV two decades ago, the Rathdrum Prairie region of Northern Idaho embarked on a Sensitive Resource Designation. The LPRV can learn from what worked in the Rathdrum Prairie and what is applicable to the LPRV. Following this example, this study examined three protection strategies targeted at new business and residential activity in the LPRV:

1. Manage future septic and sewer discharge through development requirements and Sewage Management Areas,

2. Manage contamination from stormwater runoff and non-domestic wastewater disposal through stormwater management plans and non-domestic wastewater restriction, and

3. Manage critical materials risks such as fuels, industrial solvents and cleaners through critical materials plans.

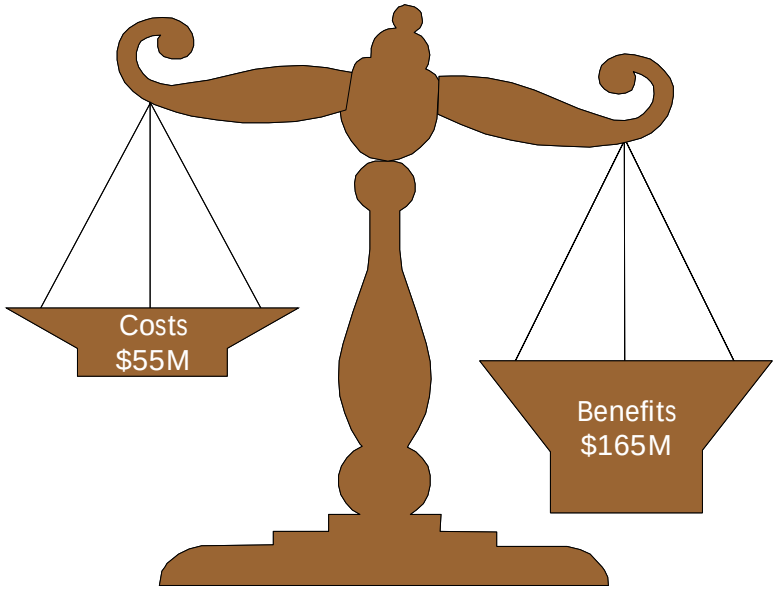
### *Costs*

Financial and economic costs of enhanced aquifer protection include direct administrative costs and indirect costs incurred by residents and businesses in complying with the regulations. BBC has estimated that annual administrative costs would be less than $500,000 per year, while annual indirect costs borne by new businesses and new homeowners could increase from about $500,000 in the initial years to about $4 million 20 years into the future. Further cost detail is provided in Exhibit ES-1. Both the magnitude of the potential costs and interviews with the Rathdrum business community indicate that enhanced aquifer protection will not have any substantial negative impact on the Pocatello area's ability to maintain current businesses or attract new firms and residents.

# *EXECUTIVE SUMMARY— ECONOMIC IMPACTS OF ENHANCED AQUIFER PROTECTION IN THE LOWER PORTNEUF RIVER VALLEY*

### *Benefits*

Economic benefits of enhanced aquifer protection stem from avoiding the need for future actions by homeowners and businesses to alleviate water quality problems (such as purchasing bottled water or on-site filtration systems), and avoiding expensive remediation activities by the public water providers. Economic development benefits may arise from added certainty regarding future water quality in the area. Annual benefits to households alone in the LPRV are anticipated to reach between $6 million and $17 million by 2020. Further benefits information is provided in Exhibit ES-2.




### *Conclusion*

Even under conservative assumptions (low end estimates for benefits, high end estimates for costs, inclusion of business costs but not business benefits), the economic benefits of implementing measures to protect water quality in the LPRV are expected to substantially exceed the costs. The initial years would be a period of investment in the future, since costs begin immediately, while benefits accrue more gradually. Annual benefits are expected to exceed annual costs within ten years of implementation, and estimated cumulative benefits over the first 20 years of $165 million far exceed estimated cumulative direct and indirect costs of about $55 million. In sum, for every one dollar in cost, there are approximately three dollars worth of benefits.

# *EXECUTIVE SUMMARY— ECONOMIC IMPACTS OF ENHANCED AQUIFER PROTECTION IN THE LOWER PORTNEUF RIVER VALLEY*

### *Exhibit ES-1. Economic Costs*

| *Category* | *2010 Annual Cost* | *Basis* | *Comment* |
|---|---|---|---|
| Administrative | Less than $500,000 | High end of Rathdrum Prairie Experience | Largely new ordinances, monitoring |
| New Homeowners | Less than $300,000 | Septic vs. Sewer System Costs | 20-35 additional households per year affected |
| Lost Wages in Affected Sectors | $1.9M | Foregone business and home development | Based on response to cost increases |
| Total<br>(This amount could grow to $4.0 million by 2020.) | $2.7M | | |

### *Exhibit ES-2. Benefits (Avoided Costs Of Water Quality Contamination)*

| *Category* | *2010 Annual Cost* | *Basis* | *Comment* |
|---|---|---|---|
| Households | $4 - $11M | $120 to $360 per household | Bottled water, on-site filtration, appliance life, etc. |
| Businesses | Not quantified | Not quantified | Product quality, workforce recruitment |
| Hazardous Material Contamination Costs | Not quantified | Not quantified | Cost of clean-up, regulatory agencies |
| Economic Development | $1M | 30 jobs | Certainty of water quality desirable |
| Total<br>(This amount could grow to $15 - $26 million by 2020.) | $5 – $12M | | |

# *STUDY INTRODUCTION*

# *STUDY INTRODUCTION*

The primary question leading to this study is whether a sensitive resource designation under the Idaho Groundwater Rule will create unacceptable economic impacts as compared with the benefits to the region. A sensitive resource designation was adopted for the Coeur d'Alene area in the Rathdrum Prairie in the early 1990s.

Water quality issues gained a certain prominence in Bannock County in recent years when it was discovered that the aquifer had been contaminated, or was vulnerable to potential contamination, from the local landfill and a gravel pit utilized by public transportation agencies. Other concerns were raised about wastewater discharge into dry wells, pollutants from stormwater runoff and septic tank lechate. Studies of the groundwater characteristics were conducted by the Idaho Geologic Survey, among others. Efforts have been undertaken to address certain past contamination issues.

To curtail further contamination of the LPRV aquifer, one option is to pursue a sensitive resource designation for the LPRV aquifer under Idaho Groundwater Rules. This rule does not prescribe specific practices or methods of protection, suggesting that local areas in Idaho determine their own formula for aquifer protection.

In examining the prospect of the LPRV sensitive resource designation, there was a specific concern about potentially negative economic impacts, unintended consequences and the broader question of whether or not a designation would be good for the LPRV. This study is intended to address those issues.

The data sources utilized in this study include existing economic and demographic information from the State of Idaho and local governmental entities, along with projections from the Idaho Power Company. One recently completed and helpful report was the Our Vision, Our Valley, published in 2000.

## *STUDY INTRODUCTION, CONTINUED*

Much of the core knowledge of the LPRV hydrogeology is based on extensive research conducted through Idaho State University by John Welhan and Chris Meehan. Additional data is available from the following sources:

- Idaho DEQ Regional and Local Monitoring Data — IDEQ maintains several databases that house data about various potential contaminant sources. These include: 1) Primary Contaminant Inventory; 2) Drinking Water Management System; and 3) Wastewater Application Permit Database.

- Idaho Department of Water Resources Ambient Monitoring Data — Idaho Department of Water Resources (DWR) in cooperation with the Idaho Department of Environmental Quality (DEQ) and the Idaho Department of Agriculture (IDA) designed and maintains a statewide groundwater quality-monitoring network. The objectives of the statewide program are to: 1) characterize the groundwater quality, 2) analyze for trends, and 3) identify areas where concentrations of constituents are anomalous.

- EPA Regional Geographic Initiatives Database —- A geographic information systems (GIS) database of wells, water quality data, soils, geology, land use, etc.

- Other Research in the Area — Several research projects have been conducted in the vicinity of the LPRV, but are focused on specific areas and issues.

This study was commissioned by the State of Idaho Department of Environmental Quality (IDEQ) and supported by the LPRV Aquifer Protection Work Group. The BBC team consisted of Ed Harvey, Doug Jeavons and Lloyd Levy with BBC and Steve Hannula from ERO Resources.

## *STUDY INTRODUCTION, CONTINUED*

The remainder of this report is divided into three sections:

- Section 1 characterizes the enhanced protection scenario, describes the measures assumed to be implemented to enhance groundwater protection in the LPRV.

- Section 2 describes the baseline scenario, including projected economic, demographic, water quality and water quantity conditions over the 20 year forecast period. Water quality related costs are also examined.

- Section 3 provides economic and fiscal impact estimates from implementing the enhanced protection scenario. This section also summarizes and compares the costs and benefits of enhanced aquifer protection in the LPRV.

# *SECTION 1.*
# *CHARACTERIZATION OF ENHANCED AQUIFER PROTECTION*

# *OVERVIEW*

***This section is the first of three which, together, address the economic impacts of enhanced aquifer protection for the Lower Portneuf River Valley (LPRV) Aquifer. Section 1 of this report offers:***

- a description of the sensitive resource designation for the aquifer underlying the Coeur d' Alene area;
- a definition of the LPRV enhanced aquifer protection scenario; and
- a description of what ordinances, rules and regulations already address the components of the LPRV aquifer protection scenario (APS).

# *THE RATHDRUM PRAIRIE PRECEDENT*

***In this study, the assumed LPRV protection scenario draws heavily upon the experience in the Rathdrum Prairie. The work accomplished, and the experience gained in protecting the Rathdrum Prairie aquifer provides relevant and important information for this study for several reasons:***

- The Rathdrum Prairie Aquifer is the only aquifer in Idaho currently designated in the Sensitive Resource category. Re-designation of the LPRV Aquifer to this category is the assumed mechanism for enhanced protection for purposes of this study.

- Certain key physical characteristics of the Rathdrum Prairie Aquifer are similar to the LPRV aquifer. Both have a high potential vulnerability to contamination from surface and near surface contaminants due to thin and porous overlying surface material. Both also have a potential for relatively rapid contaminant spreading due to the aquifers' fast moving natures.

- The Rathdrum Prairie area has considerable experience in developing specific measures to protect their aquifer; it offers an example of the potential costs and effectiveness of protection approaches.

***The LPRV protection scenario, therefore, relies heavily on the Rathdrum Prairie plan and the experience with that plan, modified for local conditions in the LPRV.***

# *SENSITIVE RESOURCE PROTECTION MEASURES FOR THE RATHDRUM PRAIRIE AQUIFER*

The Rathdrum Prairie Aquifer is the sole source of potable water for the residents and businesses of Coeur d'Alene, nearby communities and unincorporated residents in Kootenai County. Across the state border in Washington, the aquifer (termed "Spokane Valley") also provides the sole source of potable water for the City of Spokane and its environs. Since the late 1970s — and spurred further by $1 million annual Congressional appropriations to Spokane County, Idaho DEQ and Panhandle Health District from 1988-1994 — the aquifer has been the subject of extensive monitoring and analysis and considerable effort to develop and implement water quality protection measures.

The Rathdrum Prairie programs and goals are listed on the following page. In as much as the Rathdrum Prairie Aquifer Protection Program includes studies, data gathering and feasibility examinations, specific best management practices (BMPs) and best available methods (BAMs) have been adopted for this protection program in the areas of wastewater, stormwater and hazardous materials. With the exception of wastewater land application, which is not relevant to the LPRV, these BMPs and BAMs have been applied to the definition of the enhanced aquifer protection scenario for the LPRV. Wastewater land application is not relevant for the LPRV, since wastewater discharge occurs in the Lower Portneuf River and at the Pocatello Airport which is outside the study area. The wastewater, stormwater and hazardous materials programs are especially relevant to the LPRV.

Regarding the hazardous materials, the Idaho Administrative Code spells out the specific responsibilities of the Panhandle health district. Critical materials are defined as any flowable or water soluable material listed in the most current Superfund Amendments and Reauthorization Act, title 3. There are classifications for extremely hazardous substances, hazardous substances, toxic chemicals and other chemicals. Secondary containment facilities or systems are required to prevent the disbursement and percolation of these materials into the Rathdrum Prairie Aquifer. The responsibilities for carrying out these programs largely rest with the Panhandle health district, IDEQ and Kootenai County.

# *RATHDRUM PRAIRIE AQUIFER PROTECTION PROGRAM SUMMARY*

| ***Program*** | ***Program Goals*** |
|---|---|
| On-Site Wastewater | ■ Limit septic system density: no Aquifer impact (1 to 5 rule)<br>■ Higher density new development near urban centers (SMAs) |
| Wastewater Facilities | ■ Wastewater facility plans written for each city/district<br>■ Construct improvements according to the facility plans<br>■ Extend sewer lines as needed to eliminate septic system |
| Wastewater Land Application | ■ Study feasibility of land application over the Aquifer<br>■ Publish guidelines for land applying wastewater over Aquifer |
| Commercial Wastewater | ■ Prohibit commercial wastewater discharge to the Aquifer |
| Stormwater | ■ Inventory all shallow injection wells (dry wells) over Aquifer<br>■ Develop an Aquifer Stormwater Management Plan<br>■ Plan implementation, stormwater training and education |
| Hazardous Materials | ■ Emergency response for hazardous material spills<br>■ Secondary containment for hazardous materials over Aquifer<br>■ Household hazardous waste disposal facility |
| Technical Reviews | ■ Insure new government rules maintain Aquifer protection<br>■ Review and comment on proposed developments over Aquifer |
| Scientific Analysis | ■ Develop groundwater model for Aquifer<br>■ Contract with local Universities for technical analysis and data |
| Land Use Planning | ■ Update comprehensive plans and zoning ordinances<br>■ Develop a geographic information system (GIS) |
| Recharge Areas | ■ Study effects of small aquifers that drain to the Aquifer<br>■ Write management plans for Aquifer recharge lakes |
| Drinking Water | ■ Write monitoring waiver justification for Aquifer systems |
| Public Education | ■ Develop a mass media education program<br>■ Develop a public school education program<br>■ Host a national conference on wellhead protection<br>■ Survey residents to determine education program effect |

# *LPRV AQUIFER PROTECTION*

***An enhanced aquifer protection scenario must be defined for the LPRV to examine the economic impacts, costs and benefits of implementing such a program. It is necessary, therefore, to identify specific actions in the form of BMPs or BAMs which would be implemented in the LPRV. Considering the water quality issues in the LPRV (fully discussed in the Task 2 report), the LPRV enhanced protection scenario should focus on three primary areas:***

1. Reduction of future contamination from septic and sewer discharge to the aquifer;

2. Avoid contamination from stormwater runoff and non-domestic wastewater disposal; and

3. Reduction of risk of contamination from unintended spills of critical materials.

# *LPRV AQUIFER PROTECTION -- SEPTIC / SEWER DISCHARGE*

***To address the first of the three protection scenario objectives, reducing future potential contamination from septic and sewer discharge to the aquifer, the following measures are assumed:***

- limiting the density of future home development relying on septic discharge to one home per five acres, unless the location of the future development is within a Sewage Management Area (SMA).

- SMA's created under local ordinance or through state regulation. These would be areas, presumably proximate to existing sewerage service, that are contractually committed to future sewer system development under specified development progress conditions. Contracts would be between the developer, an existing sewage disposal entity and the local health district or other regulatory authority.

- Higher densities could also be permitted if the homeowner and developer agree to install a septic pretreatment system, approved by the health district or other regulatory authority, and to submit to periodic monitoring of pretreatment system maintenance by the health district or other regulatory authority.

- Any sewage effluent discharge over the aquifer must either be discharged into the Lower Portneuf River or must employ the "slow-rate application" to crop lands best management practices (BMP) developed in the Hayden Land Application Pilot Study. The BMP is reflected in the Special Supplemental Guidelines to the Idaho Wastewater Land Application Guidelines published in 1995.

***These measures are drawn largely from the Rathdrum Prairie list, adapted to more closely fit the nitrate and chloride issues in the LPRV.***

# *LPRV AQUIFER PROTECTION -- STORMWATER AND OTHER NON-DOMESTIC WASTWATER MANAGEMENT*

***To address the second of the three protection scenario objectives, avoiding contamination from stormwater runoff and non-domestic wastewater disposal, the following measures are assumed:***

- New developments larger than a single family home must develop and implement a stormwater management plan, consistent with the BMP discussed below. The local health district or other regulatory authority would register and review all new stormwater disposal systems.

- Stormwater management plans would reflect BMPs, such as the recommendations in the ***Handbook of Best Management Practices for Stormwater Management and Erosion and Sedimentation Control (1992)***. For example, for isolated systems this generally means the development of grassy swale areas at the lowest point on the property with an appropriately designed dry well (with a raised casing) in the midst of the swale to capture extraordinary runoff events.

- Non-domestic wastewater discharge to the aquifer (such as wastewater streams associated with production, cleaning and vehicle washwater) would be prohibited and these types of wastewater would be required to be sent to a local wastewater treatment plant. In some cases, as required by the wastewater treatment operator, this may require pre-treatment of the waste stream by the commercial facility.

***This list of measures is drawn entirely from the Rathdrum Prairie experience.***

# *LPRV AQUIFER PROTECTION -- CRITICAL MATERIALS*

***The final protection objective, management of critical materials, involves the following measures:***

- The health district or other regulatory authority would develop a list of "critical materials" and establish threshold quantities of those materials for purposes of the following procedures. These materials would include potentially significant contaminants to the aquifer if they were accidentally spilled or leaked. Examples of such materials could include certain fuels, industrial solvents and cleaners, etc.

- Facilities that store, handle or use materials included in the list would be required to submit a report on the types and quantities of listed materials used. If quantities exceeded the thresholds established by the health department or other responsible regulatory agency, the facility would need to submit a plan demonstrating that the material(s) cannot get into the aquifer under either normal operations or in the event of spills.

- The health district or another regulatory authority will have the authority to either approve the plan proposed by the facility or require additional measures.

- The critical materials management regulations would apply to both new facilities and new uses at existing facilities.

***The management of critical materials is drawn entirely from the Rathdrum Prairie where it has been effectively utilized.***

# *LPRV AQUIFER PROTECTION — OTHER COMPONENTS*

***In addition to the specific protection measures just identified, important components of aquifer protection include:***

- land management of recharge areas;
- enhanced public education; and
- ongoing water quality data collection.

***The recharge area for the LPRV, particularly the Bannock Range, is largely undeveloped at this time. Potential water quality impacts arising from future developments may be important for county planning and land use agencies to consider in protecting aquifer water quality. Additional monitoring wells and data collection and analysis would be included under the protection scenario to both enhance understanding of the LPRV aquifer and its water quality and to monitor changes in water quality over time. Additional funding for public education measures is also envisioned.***

# *EXISTING ORDINANCES, RULES AND REGULATIONS WHICH PROTECT THE LPRV AQUIFER*

State and local government already have adopted rules, regulations, ordinances and policies which embody some, though not all, of the LPRV enhanced protection scenario BMPs and BAMs. To the extent that these programs and policies are already on the books, the impact of their adoption as part of a sensitive resource designation would only be to reinforce what already exists. First, there are current zoning and land use restrictions which effect the decision of whether a new home will be hooked up to a sewage collection system or be permitted to utilize a septic tank. The Bannock County regulations are as follows:

| *Zone* | *Density* |
|---|---|
| Agriculture | 1 per 40 acres |
| Rural Residential | 1 per 2.5 acres with central water and sewer<br>1 per 5 acres on septic<br>1 per 0.5 acres if PUD clustered to preserve open space and with central water and sewer |
| Rural Suburban | 1 per 1 acre on well and septic<br>1 per 0.33 if clustered and on water and sewer |

## *EXISTING ORDINANCES, RULES AND REGULATIONS WHICH PROTECT THE LPRV AQUIFER, CONTINUED*

Only agricultural operations with one housing unit per 40 acres and rural suburban uses are currently allowed to utilize septic tanks. Except in the Rural Suburban Zoning category, the threshold of one home per five acres to permit septic discharge is effectively already in place in Bannock County (Robert Chambers, personal communication). As indicated previously, effluent discharged into the Lower Portneuf River eliminates the need for slow rate land application.

Secondly, stormwater control and management is currently under serious consideration within Bannock County. Stormwater feasibility studies have been completed or are underway in the study area. The employment of grassy swale and appropriately designed dry well disposal in isolated areas is not currently required in the LPRV. Non-domestic wastewater discharge to the aquifer is not yet prohibited in the LPRV. However, current incidences are believed to be minimal in number and isolated.

Finally, the management of critical materials is regulated by federal and state authorities to some extent, but the BMPs suggested for the LPRV enhanced protection scenario are not yet in place at any level of government. Specifically, secondary containment facilities for new businesses and new uses at existing facilities are not yet required.

Other components of the LPRV protection scenario principally include technical studies and monitoring and public education. These elements will represent an administrative cost, although the economic impacts will be largely confined to increased costs of government.

# *SECTION 2.*
# *BASELINE SCENARIO*

# *OVERVIEW OF SECTION 2*

***The second study task, following the definition of the enhanced protection scenario in Section1, was to develop projections of the baseline scenario -- or the changes that can be expected to take place in the LPRV in the absence of enhanced aquifer protection measures. This section describes that baseline scenario, providing some general information about study area characteristics, but primarily focusing on aspects related to water quality and water quantity.***

This section is divided into three components describing:

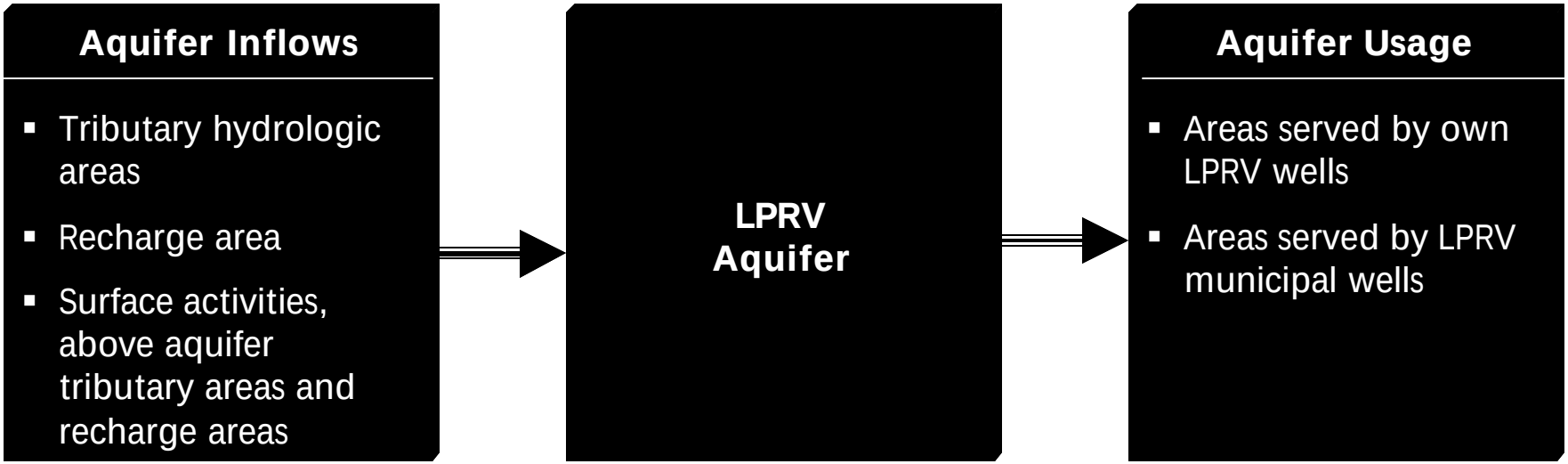
- baseline economic and demographic characteristics of the study area,
- baseline water quality and quantity characteristics of the study area, and
- baseline cost considerations for the study area.

The future is obviously uncertain. Given the 20-year study horizon, each element described in this section will ultimately differ from the projections described herein. However, the information presented in this section represents the study team's best estimates and projections based on available data and the assumptions described in this report.

# *SECTION 2a.*
# *BASELINE ECONOMIC AND DEMOGRAPHIC CONDITIONS*

## *STUDY AREA DEFINITION*

***The study area for this assessment is defined in two ways. In considering the area that would potentially be subject to enhanced aquifer protection measures, the study area is defined as all lands that can contribute to aquifer inflows of freshwater or, potentially, of contaminants from surface and near surface activities. In considering the potential financial and economic impacts of invoking enhanced protection measures, the study area has a somewhat broader definition. This definition includes all areas that rely directly or indirectly upon the aquifer for their water supply. Thus, certain areas not directly overlying the aquifer, such as portions of the cities of Pocatello and Chubbuck, are included in the study impact area definition. This somewhat complex study area definition is conceptually illustrated in the graphic below.***



# *STUDY AREA DEFINITION, CONTINUED*

***The cities of Pocatello and Chubbuck currently pump all their municipal water from the LPRV aquifer. Other withdrawals from the aquifer consist of private and other wells for domestic, industrial and agricultural self-supply. Non-municipal withdrawals in the study area are mostly within Bannock County.***

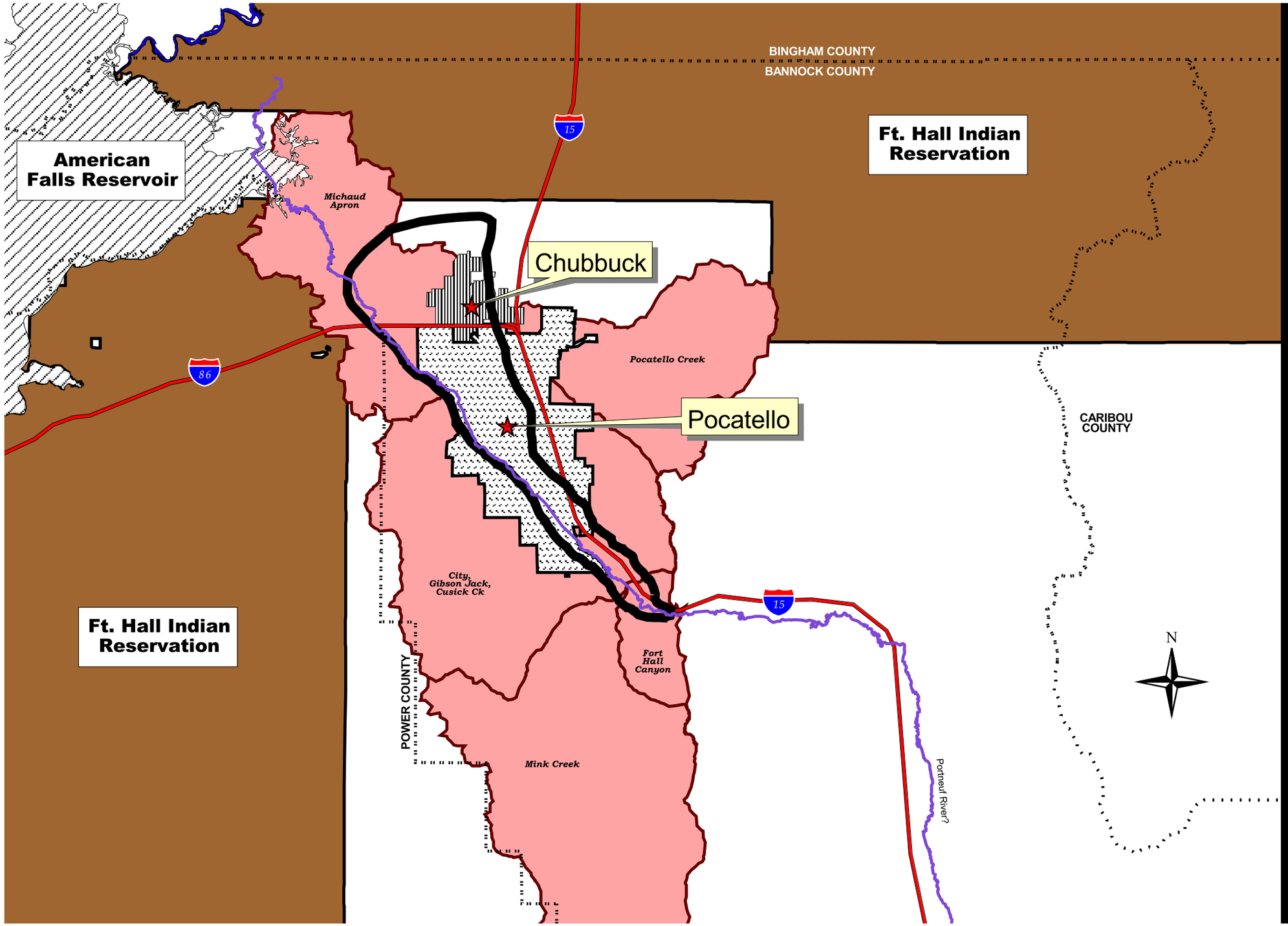
***The LPRV aquifer system itself is composed of two main parts (that are sometimes broken down into four subdivisions):***

1. The southern aquifer system flows northward from Portneuf Gap to Red Hill. In this area, the aquifer roughly parallels Interstate 15 (I-15) and the lower Portneuf River.

2. The northern aquifer system begins at Red Hill and flows northward to a point where the aquifer widens and merges with the Snake River Plain aquifer and Fort Hall groundwater.

***Portions of six surface water basins overlap the aquifer's surface, which covers an area of about 26 square miles.***

***The study area and its vicinity are mapped on Exhibit 2a-1.***




# Lower Portneuf River Valley

## Impacts of Aquifer Protection

**EXHIBIT 2a-1.**
**Study Area**

Scale in Miles: 0 — 5




- LPRV Aquifer
- Interstates
- Counties
- Pocatello City Limits
- Chubbuck City Limits
- Watersheds
- Ft. Hall Indian Reservation

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# *STUDY AREA HISTORY*

***Long a transportation corridor — first traveled by Native Americans, then by trappers, westward migrants, and fortune seekers in the gold fields — the Portneuf Valley entered a new age with the coming of the railroad in 1876. At Pocatello Junction, Union Pacific created the largest rail center west of the Mississippi. Pocatello incorporated in 1882 and, reflecting its strategic location in southeast Idaho, took the nickname "The Gate City."***

***During World War II, the United States Naval Ordnance Plant was sited in Pocatello to reline naval guns from warships. The refurbished weapons were shipped to a range at what is now the Idaho National Environmental and Engineering Laboratory for test firing of shells over distances of up to 35 miles.***

***Today the study area is a community of diverse occupations. The railroad remains a major employer. In Pocatello, Idaho State University increasingly shapes the economy and lifestyle. Diverse industries use the region's natural and human resources: mineral processing, food products, high tech manufacturing, industrial fabrication, telecommunications services, and government research and development. Still a crossroads, Portneuf Valley businesses continue to supply goods and services to travelers who now follow the nation's interstate highways instead of the Oregon Trail.***

# *CURRENT AND HISTORIC ECONOMIC & DEMOGRAPHIC PROFILE*

***The first portion of the baseline economic and demographic profile for the LPRV describes current conditions and historic trends. This information both provides a current profile of the area and establishes the background for subsequent economic and demographic projections. The following elements are described:***

- Major LPRV employers and the local economic base
- Historic and current unemployment rates
- Per capita personal income
- County and state population trends
- Population relying on the LPRV aquifer
- Water use and the economic base
- Economic development strengths and weaknesses

# *MAJOR EMPLOYERS & THE ECONOMIC BASE*

***Chief sources of income in the study area are higher education, manufacturing, transportation, business services, agriculture, high-tech and nuclear research, recreation, and tourism. The study area has an unusually diversified economic base.***

***The Union Pacific Railroad has a major freight classification yard in Pocatello, plus maintenance and repair facilities for locomotives, cars, and track maintenance equipment. The broad manufacturing base includes integrated circuits, processed foods, and medical products. There is a growing "call center" segment of the business services industry. Agriculture, including farming and potato processing, remains a small but significant export industry. Public employers in the economic base include Idaho State University and the FBI Western Data Center. Other major public sector employers are School District 25, the cities of Pocatello and Cubbuck and Bannock County.***

***Major Study Area Employers***

| *Employer* | *Employment* |
|---|---|
| Idaho State University | 3,090 |
| School District 25 | 1,495 |
| American Microsystems, Inc. | 1,250 |
| Union Pacific Railroad | 950 |
| Bannock Regional Medical Center | 884 |
| Convergys | 700 |
| J.R. Simplot Minerals & Chemicals | 652 |
| Pocatello City Government | 600 |
| Pocatello Regional Medical Center | 500 |
| Astaris (Power County) | 458 |
| Kimberly-Clark Medical Products | 405 |
| Bannock County Government | 400 |
| Heinz Frozen Foods | 360 |

Source: Bannock Development Corporation, July 2000.

***The study area is a retail hub for southeast Idaho and, because of its location on major transportation routes, it supplies goods and services to tourists, business travelers and visitors to the region's recreation areas. However, studies have shown there is considerable retail "leakage," and many local residents apparently travel to Idaho Falls or to the Salt Lake City, Utah area, to make certain purchases. Located 60 miles northwest of Pocatello, the Idaho National Environmental and Engineering Laboratory (INEEL) employs about 7,900 people, a number of who live within the study area. Pocatello houses INEEL suppliers, as well. Examples include the lab's cleanup contractor and a specialty steel fabricator.***

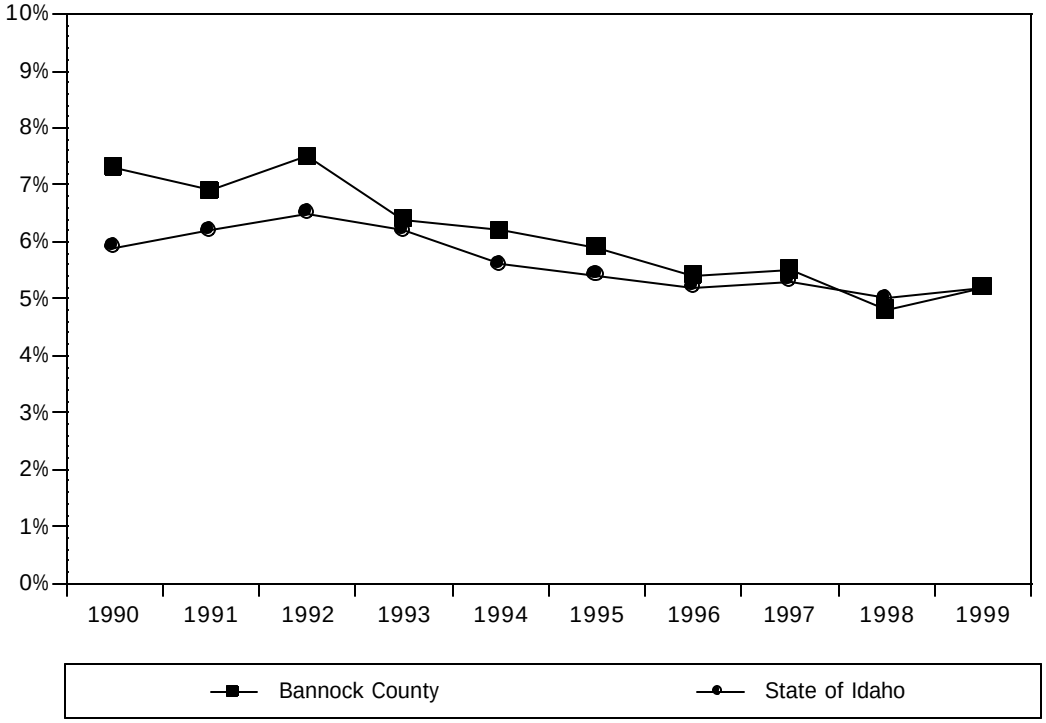
# *UNEMPLOYMENT RATES*

***Recent employment growth within the study area has substantially reduced the unemployment rate in Bannock County. The County exceeded the state average in the early 1990s, but currently mirrors Idaho.***

***Since 1996, unemployment rates for both Bannock County and the state have ranged between 4.8 percent and 5.4 percent.***

***The present tight labor market has been felt locally. Hiring entry-level employees has been more difficult for retailers, service establishments, fast food restaurants, nursing homes and contractors.***

***Unemployment Rate***
***Bannock County and State of Idaho***
***1990-1998***



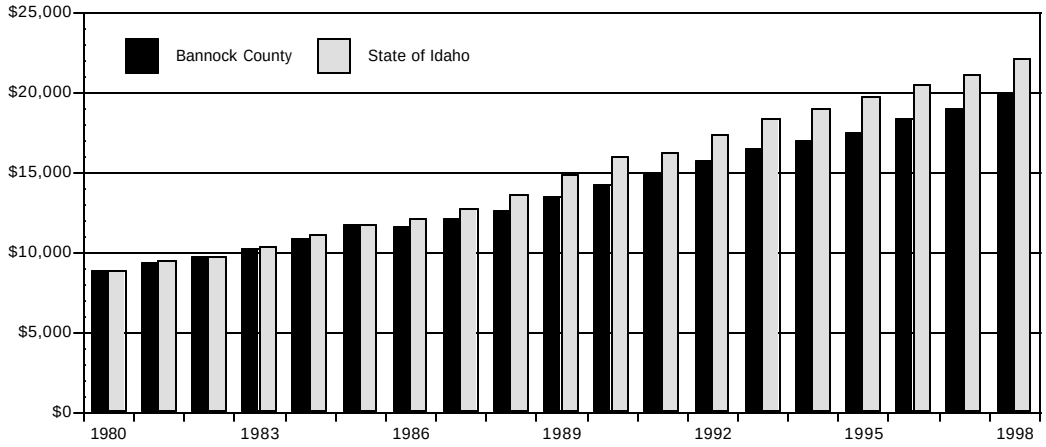

Source: Idaho Department of Labor.

# *PER CAPITA PERSONAL INCOME*

***At parity or nearly so with Idaho through 1985, Bannock County per capita personal income went flat during the last half of the 1980s while statewide personal income growth accelerated. By the mid 1990s, Bannock County per capita personal income resumed a healthy growth rate.***

***Average study area personal income has remained stable at about 90 percent of the state average over the past decade.***

***Bannock County and State of Idaho***
***Per Capita Income***
***1980-1998***



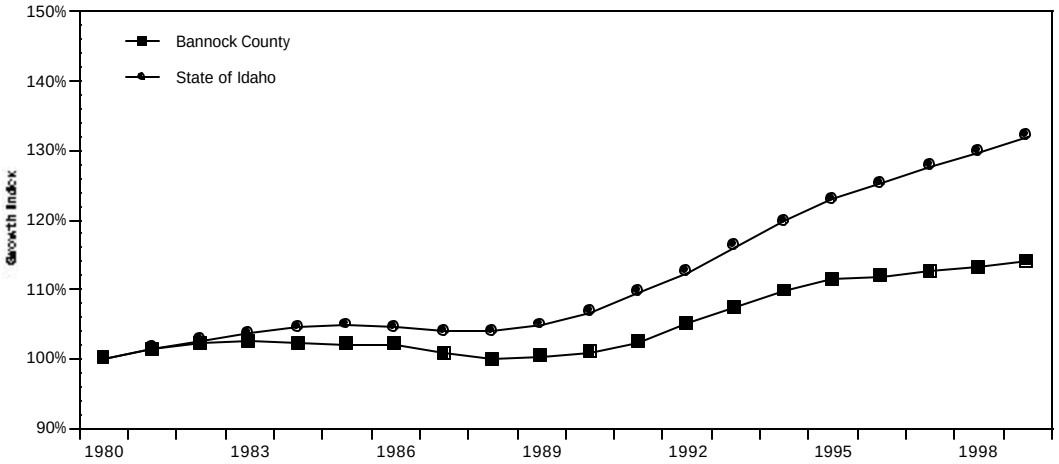

Source: BEA REIS.

# *COUNTY AND STATE POPULATION*

***From 1980 to 1999, the U.S. Census Bureau estimated that Bannock County grew by 14.1 percent compared to 32 percent for the state of Idaho as a whole. This equates to an average annual rate of 0.7 percent for Bannock County versus 1.4 percent per year on average statewide.***

***Net natural change (births minus deaths) accounted for all of Bannock County's growth in the 1980s (net natural change was 9,151, offsetting net out-migration of 8,546) and for 81 percent of growth in the 1990s (natural change was 7,203 and net in-migration was 1,652). Annual estimates were not available specifically for the study area, given its irregular geography.***

***Population Growth***
***Bannock County and State of Idaho***
***1980-1999***




Note: Growth Index is defined as 1980 population equal to 100.
Source: U.S. Bureau of the Census.

# POPULATION RELYING ON THE LPRV AQUIFER

***An estimated 69,700 persons in the cities of Pocatello, Chubbuck, and the surrounding unincorporated area rely on the LPRV aquifer as a water supply.***

- Growth has varied within the study area. While the City of Chubbuck grew 34 percent, the City of Pocatello grew 14 percent from 1980 to 2000. The self-supplied area grew about 22 percent, or 1.0 percent per year.

***Housing units with municipal sewer and water predominate within the study area, but households on septic appear to be increasing more rapidly.***

***Estimated Population Relying on LPRV Aquifer***

| *Population* | *1980* | *1990* | *2000* |
|---|---|---|---|
| City of Pocatello | 46,531 | 46,080 | 52,910 |
| City of Chubbuck | 7,080 | 7,791 | 9,470 |
| Unincorporated | 6,013 | 6,269 | 7,328 |
| Total | 59,624 | 60,140 | 69,708 |

Source: PCensus for cities; BBC estimate of self-supplied population. Estimates are as of July 1. Year 2000 adjusted for consistency with Our Valley-Our Vision forecast.

- The 1990 Census indicated roughly 2,200 homes with their own water supply wells and about 2,600 homes on septic systems in the LPRV. Some of these homes, however, are located north of the study area (defined in terms of aquifer inflows) and lie over the Snake River Aquifer.
- About 1,600 homes within the study area were on septic systems in 1990, including 550 homes in Pocatello and 35 in Chubbuck. Nearly 90 percent of homes in unincorporated portions of the study area used septic systems for wastewater disposal.
- Assuming the same proportion of new homes built in unincorporated areas during the 1990s continue to rely on septic disposal, the study team estimates that there are now approximately 3,200 homes on septic in the LPRV, including over 2,000 homes in the study area (defined in terms of aquifer inflows).
- These estimates are consistent with communications from the health department suggesting that 50 to 75 new homes on septic have been built each year in the LPRV during the 1990s.

## *WATER USE AND THE ECONOMIC BASE*

***Based on national averages, key industries within the study area's economic base are moderate to high in water use intensity. Values for the following sectors are expressed in gallons per employee per day: food processing, 469; chemicals processing, 267; hotels and other lodging places, 230; educational services, 117; electronics manufacturing, 95 gallons; business services, 73; railroad transportation, 68 (Table 23.10, Average Rates of Nonresidential Water Use from Establishment Level Data, McGraw-Hill Water Resources Handbook).***

***The top ten water consumers served by the City of Pocatello Water Utility include several of the study area's base industries: American Microsystems, Inc., Heinz Weight Watchers Foods and the Union Pacific Railroad. Other top consumers are government entities: School District 25 and Idaho State University. The FBI Western Data Center is also a large water customer of the City of Pocatello Utility. Highland Golf Course, leased to an operating company, ranks high in water consumption, too, despite irrigating only five months a year.***

***Relatively attractive water and wastewater costs play a role in the study area's economic development strategy. In 1998, the City of Pocatello charged $0.85 per thousand gallons for industrial/commercial water, $0.98 per thousand gallons of wastewater for establishments inside the City, $1.29 per thousand gallons of wastewater outside the City, and additional charges of $1.18 and $1.07 per pound per year for suspended solids and BOD respectively for amounts greater than 200 PPM. Wastewater service rates and connection fees are ranked relatively low among comparable site location markets in a six-state, intermountain region, according to Bannock Development Corp.***

# *ECONOMIC DEVELOPMENT STRENGTHS AND WEAKNESSES*

***The study area combines a positive attitude toward growth with numerous economic development strengths — among them relatively low wages, energy costs and cost of living, a skilled industrial work force, and the presence of a technology-oriented university. ISU increasingly is a seedbed for economic development, business incubation and technical training of the work force.***

***Although the preponderance of total jobs has shifted to retail and services and away from transportation, the traditional leading sector, the study area remains focused on industrial activity as a primary source of higher-wage economic development. Gateway West Industrial Center, the former World War II Naval Ordnance Plant in Pocatello, is a 200-acre complex currently home to more than 20 businesses and about 500 jobs, many in heavy industry. The industrial infrastructure that exists at the facility is unique in the state.***

***The study area's location within an important transportation corridor is a plus. However, a key economic development issue in the attraction of industrial growth in the future is limited air transportation and high truck freight costs. In addition, the telecommunications infrastructure, though advanced, lacks fiber optic capacity. As a trade center, the study area faces two strong competitors: Idaho Falls and the Salt Lake City, Utah area. In addition, the local economy remains sensitive to the fortunes of the key employers (Union Pacific, Simplot, FMC INEEL, and others). This leads to some volatility in economic performance and the potential for severe economic shocks.***

# *PROJECTED BASELINE ECONOMIC AND DEMOGRAPHIC PROFILE*

***The remainder of the economic and demographic information presented in this section describes projected growth and change under the baseline scenario. The information presented herein draws heavily from the*** *Our Valley/Our Vision* ***planning process currently underway in the study area and focuses on elements important for subsequent comparison with the Enhanced Protection Scenario and impact analysis. Consistent with the*** *Our Valley/Our Vision* ***effort, this study adopts a 20 year forecast horizon.***

## *The following elements are described on subsequent pages:*

- Baseline employment projections
- Projected numbers of new firms
- Growth in population and households relying on the LPRV
- Projected growth in households using septic wastewater disposal
- Key infrastructure considerations

# *PROJECTED EMPLOYMENT GROWTH*

***A number of key employers in the Pocatello area depend on the area's relatively abundant, high quality water supply. Therefore sustaining employment growth in the future is likely to go hand in hand with sustaining water quantity and quality as a factor in business retention and a relative advantage in competing for business location.***

***As part of the ongoing Our Valley-Our Vision process, Bannock County and the cities of Pocatello and Chubbuck have adopted a consensus baseline forecast of the economy for the Greater Pocatello Urban Area. This forecast can be viewed generally, and sector by sector, as defining what is at risk in the future in terms of the region's economic development.***

***Projected Employment***
***Greater Pocatello Urban Area***
***Our Valley-Our Vision/Bannock Planning Organization Forecast***
***With Estimated Sector Breakdown***

| | 2000 | 2010 | 2020 | Average Annual Growth 2000 to 2020 |
|---|---|---|---|---|
| Manufacturing | 3,353 | 4,546 | 5,560 | 2.6% |
| Mining | 11 | 11 | 11 | 0.1% |
| Construction | 1,898 | 2,307 | 2,765 | 1.9% |
| TCU | 2,946 | 3,265 | 3,590 | 1.0% |
| Trade | 9,549 | 12,319 | 14,986 | 2.3% |
| FIRE | 1,441 | 1,654 | 1,830 | 1.2% |
| Services | 7,497 | 9,976 | 12,734 | 2.7% |
| Government | 9,030 | 10,367 | 11,672 | 1.3% |
| Total Nonagricultural | 35,727 | 44,445 | 53,148 | 2.0% |

Source: Bannock Planning Organization data files and Intermountain Demographics for total nonagricultural employment through 2020. Idaho Power 2000 Economic Forecast for sector

***Based on current trends, the forecast projects an average annual rate of total nonagricultural employment growth of about 2% per year through the year 2020. This compares to the 3% growth rate experienced by the county as a whole for most of the 1990's. As in the past, the economy's three largest sectors — services, manufacturing and trade — are projected to be the fastest growing. The services sector is projected to grow at about 2.7% per year, the manufacturing sector at about 2.6%, and the trade sector at about 2.3%. As a whole, the area is expected to add a total of about 17,400 net new jobs over the 20-year forecast horizon.***

# *PROJECTED GROWTH IN ESTABLISHMENTS*

***Costs to business establishments are important in the evaluation of measures for protecting aquifer water quality.***

***Recent data is readily available from the Census bureau on the number and size of business establishments present in the local economy on a county-by-county basis. However, unlike employment, there are no generally available forecasts of establishment numbers to carry forward into the assessment of future economic conditions. For this analysis, employment forecasts taken from the Our Valley-Our Vision Process have been translated into a rough but reasonable estimate of future numbers of establishments and net additions to local numbers of business. The approach used here divides projected employment growth by current employment-per-establishment averages taken from Census data.***

***Projected Number of Establishments***
***Greater Pocatello Urban Area***

| *Year* | *Manufacturing Establishments* | *Total Establishments* |
|---|---|---|
| 2000 | 52 | 2,785 |
| 2010 | 71 | 3,464 |
| 2020 | 87 | 4,143 |
| Net New Establishments Per Year | 2 | 68 |

Source: Bannock Planning Organization data files and Intermountain Demographics total nonagricultural employment through 2020. Establishment estimates based on average establishment size as calculated from 1998 County Business Patterns.

***On this basis, it is projected that there will be a net addition of about 1,350 new business establishments in the Greater Pocatello Urban Area by the year 2020, an average of 68 net new establishments per year. In the manufacturing sector, it is projected that 35 net new establishments will be added to the area by the year 2020, an average of two net new establishments per year.***

# *PROJECTED POPULATION GROWTH*

***Projected population and housing growth presented in this report is based on the same growth forecast as is being used by the Our Valley-Our Vision planning process in its study of the Greater Pocatello Urban Area. Originally prepared for the Bannock Planning Organization and updated for the buildout analysis currently underway, the forecast projects that the area is expected to add almost 20,000 people over the next 20 years. The added population is expected to occupy almost 8,700 additional households within the area.***

***Projected Households & Population***
***Greater Pocatello Urban Area***
***Our Valley-Our Vision/Bannock Planning Organization Forecast***

| | *Population* | *Households* |
|---|---|---|
| ***2000*** | 69,708 | 26,505 |
| ***2010*** | 79,970 | 31,002 |
| ***2020*** | 89,500 | 35,171 |
| ***Total Growth*** | 19,792 | 8,666 |
| ***Average % Per Year*** | 1.30% | 1.40% |

***Growth rates implied by the planning forecast are 1.3% per year for population and 1.7% for households. The population growth rate is substantially greater than the rate of 0.7% observed in Bannock County as a whole for the period from 1980 to 1999. A higher rate of growth for households than for population reflects the assumption that household size will continue to decline consistent with past trends.***

# *PROJECTED GROWTH IN HOUSING ON SEPTIC*

***Growth in the Greater Pocatello Urban Area tends to consume land at a high rate, although not at the highest rate possible under current zoning. In areas where septic wastewater disposal can be permitted, this has led to a relative cost advantage in favor of on-site sewage disposal and the continuing potential for new home development on septic in the future:***

- Without other constraints, and based on continued patterns that are generally occurring today, relatively low-density residential development can be assumed to occur at the edges of the communities of Pocatello and Chubbuck. As part of the Our Valley-Our Vision process, areas with the potential for low-density development were identified and the developable acreages were quantified. If it were assumed that these areas are all developed with on-site sewage disposal, a projected 570 new households on septic potentially would be added by 2020.

- As an alternative approach to the estimate, the number of new households on septic may be projected from the historical rate of septic systems permitting. Local sources contacted about the issue estimate that approximately 50 to 75 new homes on septic have been added to the area each year since 1996. Assuming a rate of 50 per year for the 20-year planning horizon equates to a total of 1,000 new households on septic by 2020.

***New Households on Septic***
***Greater Pocatello Urban Area***
***Alternative Projections***

| ***Our Valley-Our Vision*** | |
|---|---|
| ***"Current Trends" Forecast*** | |
| Total new units on 1 acre lots | 572 |
| Share over aquifer | 70% |
| Net new units over aquifer | 400 |
| ***Permitting Trends Projection*** | |
| Annual septic permits | 50 |
| Forecast horizon (years) | 20 |
| Total new units on septic | 1,000 |
| Share over aquifer | 70% |
| Net new units over aquifer | 700 |

Source: Technical Analysis, Our Valley-Our Vision (May 2000), Table 13, for acres and units of low-density development. Personal communication with Ed Marugg, Director of Environmental Health, Southeast District Health Department, for approximate annual on-site disposal permits issued in Pocatello area. BBC estimates.

- Under current trends, areas north and west of Chubbuck are considered to be the most likely to develop at the low densities amenable to on-site septic systems. It is possible that some of this development may occur far enough north to be located in the Snake River Plain instead of over the LPRV aquifer. To account for this, it is assumed that only 70% of new households on septic will potentially impact the LPRV. The range of new households on septic with the potential for water quality impacts is therefore estimated to be about 400 to 700.

# *KEY INFRASTRUCTURE ISSUES*

***The scope and cost of facilities to address water quantity issues in the Greater Pocatello Urban Area have been addressed on a preliminary basis (HDR Engineering, preliminary draft memorandum dated January 2001):***

- The municipal water systems of Pocatello and Chubbuck are a series of wells and decentralized transmission lines near each area of demand. Most local distribution system costs are assumed by the developer and recovered in the final land sale. If future water demand is within the aquifer's capacity, expansion of the existing system may be possible. A preliminary estimate of public expenditures for water facilities to serve the most land-efficient buildout scenario is $11.5 million.
- On a preliminary basis, it has been estimated that the cost to develop Pocatello's water rights in Palisades Reservoir to serve growth beyond the aquifer's currently estimated capacity (about 10,000 additional residents) would be between $25 million and $30 million. Pocatello has rights to at least 50,000 acre-feet of storage in the Reservoir.
- Another possible water resource, the Snake River Aquifer, lies under the northern part of the Greater Pocatello Urban Area identified for future growth. However, study is needed to determine the quality, quantity and availability of water from this aquifer.

***Facilities to address wastewater issues are in the current City of Pocatello capital improvements program. Other needs have been given preliminary consideration (HDR Engineering, preliminary draft memorandum dated January 2001):***

- The cost of additional capacity and upgrades at the City of Pocatello's treatment plant are estimated at $17 million to serve projected population increases.
- New wastewater conveyance facilities that are not currently planned would be required to serve the preferred land use scenario under consideration by the Our Valley-Our Vision process. A preliminary estimate of the total cost of these system improvements is $12.9 million. This study, however, focuses on the current trends scenario, not the preferred scenario, as a baseline.

# *SUMMARY OF BASELINE ECONOMIC AND DEMOGRAPHIC SCENARIO*

***Preceding pages have described current trends and projected baseline growth and change in the economy and population of the LPRV over the 20-year study horizon. Key findings include:***

- The study area has an unusually diversified economic base that is forecasted to create about 17,400 new jobs over the next 20 years. Total employment is projected to grow at an average rate of about 2% per year, and the three largest sectors—services, manufacturing, and trade—are projected to grow the fastest.
- Population growth in the study area lagged behind the state's from 1980 until now, but the LPRV is projected to grow by almost 20,000 people and 8,700 households over the next 20 years. This equates to annual rates of about 1.3% for population and 1.7% for households, or almost twice the average pace of the last 20 years.
- Employment projections for the study area imply a net addition of about 1,350 new business establishments in the LPRV by the year 2020, an average of 68 per year. This includes 35 net new manufacturing establishments, or an average of two per year.
- Whether projected housing development will follow current trends or more compact land use patterns is the focus of the ongoing Our Valley-Our Vision planning process. The current trends forecast adopted for this baseline implies continued low-density development in areas outside of cities and, potentially, an additional 400 to 700 housing units on individual well and septic systems in the LPRV over the next 20 years.
- Available cost estimates for municipal facilities to address projected growth range from $11.5 million to $30 million for water development and from $17 million to $30 million for wastewater treatment and conveyance capacity.

***In general, the LPRV is an area that seeks to encourage growth and has a number of economic development advantages. Access to abundant, high quality water for major industrial customers and relatively low-cost water and wastewater services are important from an economic development standpoint.***

# *SECTION 2b.*
# *BASELINE WATER QUANTITY AND QUALITY CHARACTERISTICS*

# *INTRODUCTION TO BASELINE LPRV WATER QUANTITY AND QUALITY*

***The following pages describe the LPRV Aquifer, currently the sole source of water supply for the study area. Geologic and recharge characteristics are briefly summarized. Current and future water use patterns are also presented as baseline assumptions. Finally, this component of Section 2 concludes with a description of current water quality conditions and future baseline water quality assumptions.***

# *LPRV AQUIFER CHARACTERISTICS*

***The LPRV aquifer is a highly prolific, alluvial valley-fill aquifer, situated in the Portneuf Valley beginning at the Portneuf Gap and merging into the Eastern Snake Plain aquifer northwest to Tyhee. The contributing watershed includes portions of the Bannock Range and the Pocatello Range, as well as the Upper Portneuf River Valley. The LPRV aquifer is the source of supply for all human needs in the study area.***

***The general flow path of groundwater in the LPRV system is from the Portneuf Gap toward Pocatello (from southeast to the northwest) (see Exhibit 2b-1). Northwest of Pocatello, toward American Falls Reservoir, groundwater in the LPRV aquifer converges with groundwater flowing from the north out of the Fort Hall Reservation and groundwater from the Eastern Snake Plain Aquifer.***

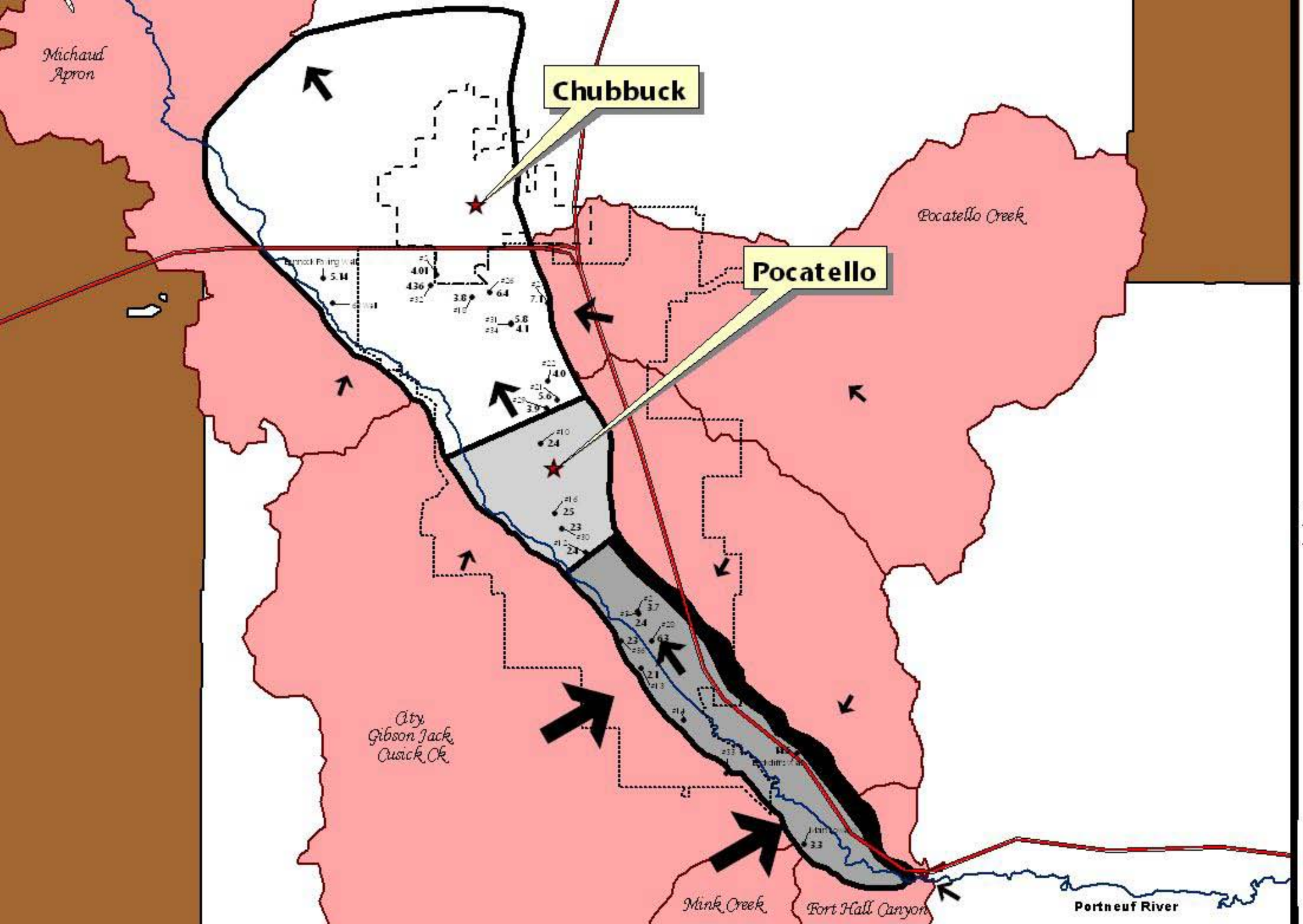
***Much of the current understanding of LPRV aquifer hydrogeology is based on the work of John Welhan and Chris Meehan, who divide the LPRV aquifer into four hydrologic subdivisions for purposes of analysis. These hydrologic subdivisions are shown on Exhibit 2b-1 and discussed below:***

- The Southern Aquifer is the principal source of water supply for Pocatello and Chubbuck.
- The Eastern Aquifer, smaller than the other hydrologic subdivisions, roughly parallels the southern aquifer, but is distinguished based on a different water quality.
- The Central Aquifer acts as a transition from the southern aquifer to the northern aquifer.
- The Northern Aquifer extends from the high bedrock located mid-way down the lower Portneuf Valley to the northwest. This portion includes the Pocatello Creek tributary.

# Lower Portneuf River Valley

## Impacts of Aquifer Protection

EXHIBIT 2b-1.
Aquifer Subdivisons, Groundwater Flow and Select Well Locations




- Water Wells
- Chubbuck City Limits
- Pocotello City Limits
- Interstates
- Northern Aquifer
- Central Aquifer
- Southern Aquifer
- Eastern Aquifer
- Watersheds
- Ft. Hall Indian Reservation

BBC Research & Consulting

# *GEOLOGY OF THE LPRV AQUIFER*

***The high productivity and the vulnerability to contamination from surface and near surface sources are rooted in the LPRV aquifer's geology. The following is a highly simplified overview of that geology.***

- The geology of the LPRV aquifer is comprised of sands and gravels ranging in thickness from approximately 100 to more than 500 feet and blanketed in areas by 5 to 20 feet of silt and loess. Interbedded units of clay are common toward the northern end of the system.

- Changes in sand and gravel composition, depth to bedrock, and bedrock type are evident along the aquifer system. The subdivision of the aquifer into four smaller areas, described on the previous page, reflects the geologic variability along the river valley.

- The Southern Aquifer has a history of excellent water yields, which are derived from coarse, gravels at depths less than 100 to 150 feet below surface. Very permeable, unconfined gravels overlying a section of low-permeability, basin fill sediments dominate this portion of the LPRV aquifer.

- The Eastern Aquifer is unconfined and is composed of silty gravels of low permeability.

- The Central Aquifer is also unconfined and is comprised of a thin sedimentary layer overlying shallow bedrock.

- The Northern Aquifer is comprised of multiple confined silty gravel and sand aquifers hosted in stratified, but poorly sorted, sedimentary basin fill more than 2,000 feet thick.

# *LPRV AQUIFER RECHARGE*

***The recharge characteristics of the LPRV aquifer provide both information about its sustainability as the sole water source for the study area and about the areas that may be particularly susceptible to contamination from surface or near surface sources.***

- Annual recharge of the LPRV aquifer is estimated at approximately 7.5 billion gallons (23,000 acre-feet) per year. The following discussion focuses primarily on the southern division of the aquifer, which initially receives the bulk of the recharge. The other aquifer hydrologic subdivisions are recharged principally through intra-basin flows from south to north.

- An estimated 70 percent of primary recharge to the southern portion of the LPRV aquifer is lateral groundwater flow from the Bannock Range. This recharge area includes the Mink Creek and the Gibson-Jack Creek sub-basins (see Exhibit 2b-1). The recharge originates from the snowpack and precipitation in the southern Bannock Range.

- Approximately 15 percent of southern LPRV aquifer recharge is derived from the upper Portneuf River basin through the Portneuf Gap, and over ten percent is derived from the other drainages, principally the Eastern Aquifer and Pocatello Creek. The evidence suggests that the Portneuf River does not significantly recharge the aquifer.

- Other recharge sources include the Pocatello Creek drainage, Pocatello Range, direct precipitation and intra-basin flow. Groundwater flowing into the LPRV watershed from areas outside of the boundaries (intra-basin flow) is unknown, but is potentially a source of recharge.

# *OVERVIEW OF LPRV WATER USE PATTERNS*

***The LPRV aquifer is the sole source of potable water supply for Valley cities, self-supplied industrial operations, agricultural operations and rural households with their own wells. Year 2000 water use is in rough balance with recharge. Increases in future water use suggest that additional supplies or greater conservation will need to be pursued.***

# *LPRV AQUIFER WATER USE*

***The LPRV aquifer provides the sole source of potable water supply for the cities of Pocatello and Chubbuck, as well as supplies for self-supplied industrial operations, rural households with their own wells and agricultural operations in the valley. Current annual water use is rapidly approaching the annual recharge estimate described previously. If water demands continue to rise at the rates experienced over the past decade, groundwater mining resulting in declining aquifer levels may begin to occur.***

***Year 2000 Water Withdrawals for Potable Use in the LPRV Aquifer***

| | *Billions of Gallons* | *Acre-Feet* |
|---|---|---|
| Pocatello Municipal System | 5.64 | 17,576 |
| Chubbuck Municipal System | 0.64 | 2,000 |
| Unincorporated Domestic | 0.60 | 1,784 |
| Total | 6.88 | 21,360 |

Note: Year 2000 municipal use data, annualized amounts, are based on 11 months through the end of November.

Source: Cities of Pocatello and Chubbuck and BBC estimates.

- Published statistics on LPRV aquifer water use are available only for the Pocatello and Chubbuck municipal water utilities. The Study Team has estimated household water use in rural areas based on a local per capita water use factor and an estimate of the self-supplied population served. Total withdrawals for municipal system and household self-supply in the year 2000 are estimated to be about 6.9 billion gallons (21,400 acre-feet).

- The LPRV aquifer also supports self-supplied industrial and agricultural operations. No available data specifically quantifies these uses. Based on rough estimates of the number of irrigated acres, local agricultural water use per acre, Unites States Geological Survey 1999, water use estimates of industrial groundwater pumping in the Portneuf watershed, the study team estimates that 0.6 to 1.3 billion gallons (2,000 to 4,000 acre-feet) per year are withdrawn from the aquifer for these non-potable purposes.

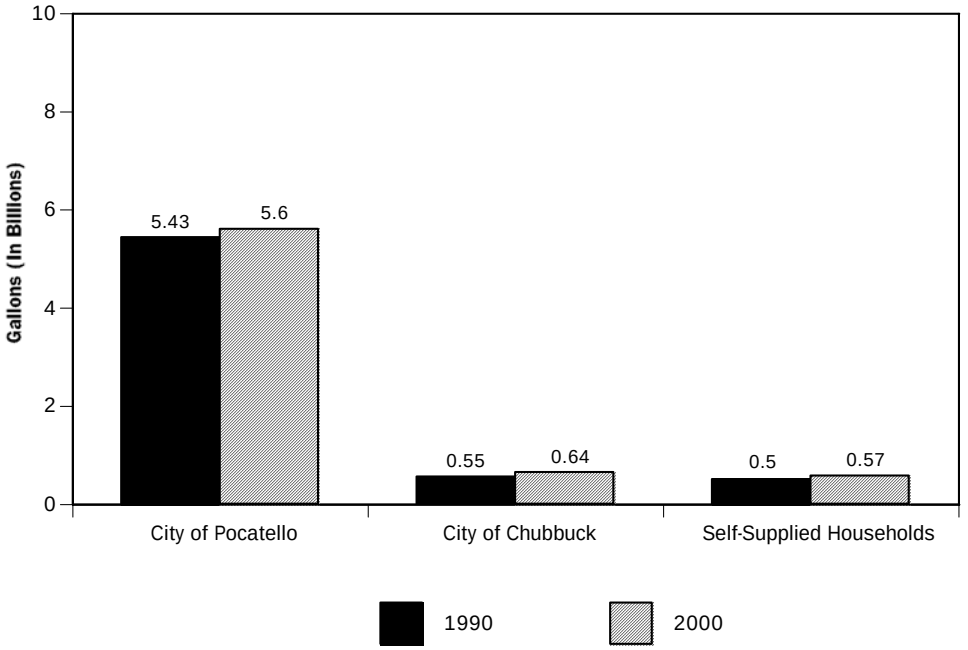
# *WATER USE TRENDS*

***In the past decade, there has been modest growth in the amount of LPRV aquifer water withdrawn by municipal water utilities and by self-supplied households in aquifer-served rural areas.***

***The accompanying chart illustrates the following water use trends:***

- Pocatello used 5.6 billion gallons (17,580 acre-feet) per year in 2000, up from 5.43 billion gallons (16,920 acre-feet) in 1990, an increase of about 4 percent. Current Pocatello water use is about 300 gallons per capita per day.
- Chubbuck used 0.64 billion gallons (2,000 acre-feet) per year in 2000, up from 0.55 billion gallons (1,720 acre-feet) in 1990, an increase of about 16 percent. Chubbuck water use is about 190 gallons per capita per day.
- Self-supplied households in rural areas used 0.57 billion gallons (1,780 acre-feet) per year in 2000, up from 0.50 billion gallons (1,560 acre-feet) in 1990, an increase of about 15 percent.

***Water Use, Lower Portneuf River Valley Aquifer***
***1990 and 2000***




Source: Cities of Pocatello and Chubbuck; BBC estimate for unincorporated domestic.

## *LPRV WATER USE PROJECTIONS*

***Based upon the growth projections developed for the Our Valley-Our Vision process, 2020 water demand in the LPRV could exceed 30,000 acre-feet per year. Future water use will reflect changes in domestic, self-supplied industrial and agricultural water demands. The following LPRV water demand projections are based upon water use per unit of demand (i.e., water per capita per day times the anticipated change in population between the year 2000 and 2020).***

- Year 2000 domestic water use in the LPRV averaged 277 gallons per capita per day, which translates into 0.3113 acre-feet per capita per year. Applying this latter ratio to expected population growth of 20,000 person between year 2000 and 2020, additional domestic water demand of about 6,200 acre-feet can be anticipated. This would mean that year 2020 baseline potable water demand would amount to 27,500 acre-feet.

- Industrial and agricultural water use self-supplied from their own wells is currently approximately 2,000 to 4,000 acre-feet per year. Increases in self-supplied water use are likely to be somewhat offset by decreases in agricultural water use, due to increased urbanization and farm consolidation. Net change water use is assumed to be an increase in 1,000 acre-feet over the next 20 years. Hence, year 2020 water demand for these self-supplied uses is expected to be 3,000 to 5,000 acre-feet or a mid-point of 4,000 acre-feet.

- In total, LPRV water demand under baseline assumptions is projected to be 31,500 acre-feet or an increase of about 30 percent.

## *IMPLICATIONS OF PROJECTED LPRV WATER USE*

***LPRV water demands of 31,500 acre-feet in the year 2020 will substantially exceed the annual recharge estimated to be approximately 23,000 acre-feet per year.***

***Clearly, new water supplies will need to be developed or water consumers will need to reduce their water use patterns. Although the purpose of this study is not to explore water supply alternatives, it is known that additional supply sources, such as the Palisades Reservoir, are being considered in on-going planning efforts. Proactive water conservation programs are also a potential option.***

***As the withdrawals from the LPRV Aquifer increase, the effects on water quality are difficult to predict. If alternative supplies are developed that can more than meet projected increases in water use, the economic impact of deterioration in LPRV quality could be reduced.***

# *BASELINE LPRV WATER QUALITY CONDITIONS — OVERVIEW*

***Baseline LPRV water quality conditions include well-publicized existing water quality issues, upon which certain progress is being made. Other issues, such as levels of nitrate, chloride and sulfate, are not presently being addressed. The considerable permeability of the LPRV geology contributes to its unusual vulnerability to water quality degradation.***

## *HISTORY OF LPRV WATER QUALITY CONCERNS*

***Historically, the study area has had numerous commercial or industrial sites that have at one time caused water quality degradation. There have been 13 U.S. EPA Superfund sites identified in the study area but, through remediation and other efforts, all except one of these sites have been removed from the Superfund list.***

***LPRV water quality concerns became highly publicized with the discovery of Trichloroethylene (TCE) in a number of Pocatello municipal wells in 1991 and Perchloroethylene (PCE) in Chubbuck municipal wells. The source of the TCE is generally believed to be from older areas in the Fort Hall Mine Landfill and work is currently underway to pinpoint the source and develop a plan to limit further contamination. The source of PCE is still unknown after being investigated by EPA and its consultants.***

***The cities of Pocatello and Chubbuck water quality records show that the overall quality of the LPRV aquifer is good, although the water is very hard and has a relatively high total dissolved solids (TDS) content. However, more recent water quality monitoring by the IDEQ, Idaho Department of Water Resources, and the City of Pocatello indicate several areas of the LPRV aquifer system have degraded water quality. TCE, PCE, nitrate, sulfate, chloride and TDS are the primary constituents of concern (COCs) that have been identified to date. The COCs vary with each portion of the aquifer, as discussed on the following page.***

## *LPRV AQUIFER WATER QUALITY — BY LOCATION*

***Principal locations of water quality concern are shown on Exhibit 2b-2. The observations regarding LPRV water quality are based upon the Idaho Statewide Groundwater Monitoring Program, IDEQ studies and various reports by John Welhan and Chris Meehan.***

- Southern Aquifer — The greatest concern in the Southern Aquifer has been the TCE plume, discovered in 1991, discussed earlier. Nitrate levels in five of the six monitoring wells used in the Idaho Statewide Groundwater Quality Monitoring Program appear fairly constant. The sixth well indicates a substantial increase in concentration between 1993 and 1997, although only two data points are available. An area near the northern end of the hydrologic subdivision is experiencing increasing salt concentrations, likely due to drawing water from the Eastern Aquifer as a result of cones of depression from municipal water supply wells in this area. Several localized, high-chloride anomalies have been observed in this aquifer and may stem from surface, or near surface, sources such as salt runoff from road de-icing, septic field leaching and/or agricultural/animal waste.

- Eastern Aquifer — This area is known to have degraded water quality and a portion of the hydrologic subdivision has been identified by IDEQ as a nitrate priority area. One municipal well was drilled in this area, but was never used regularly and was eventually abandoned because of chronically high nitrate levels. Flow of contaminated groundwater into the Southern Aquifer is a potential concern.

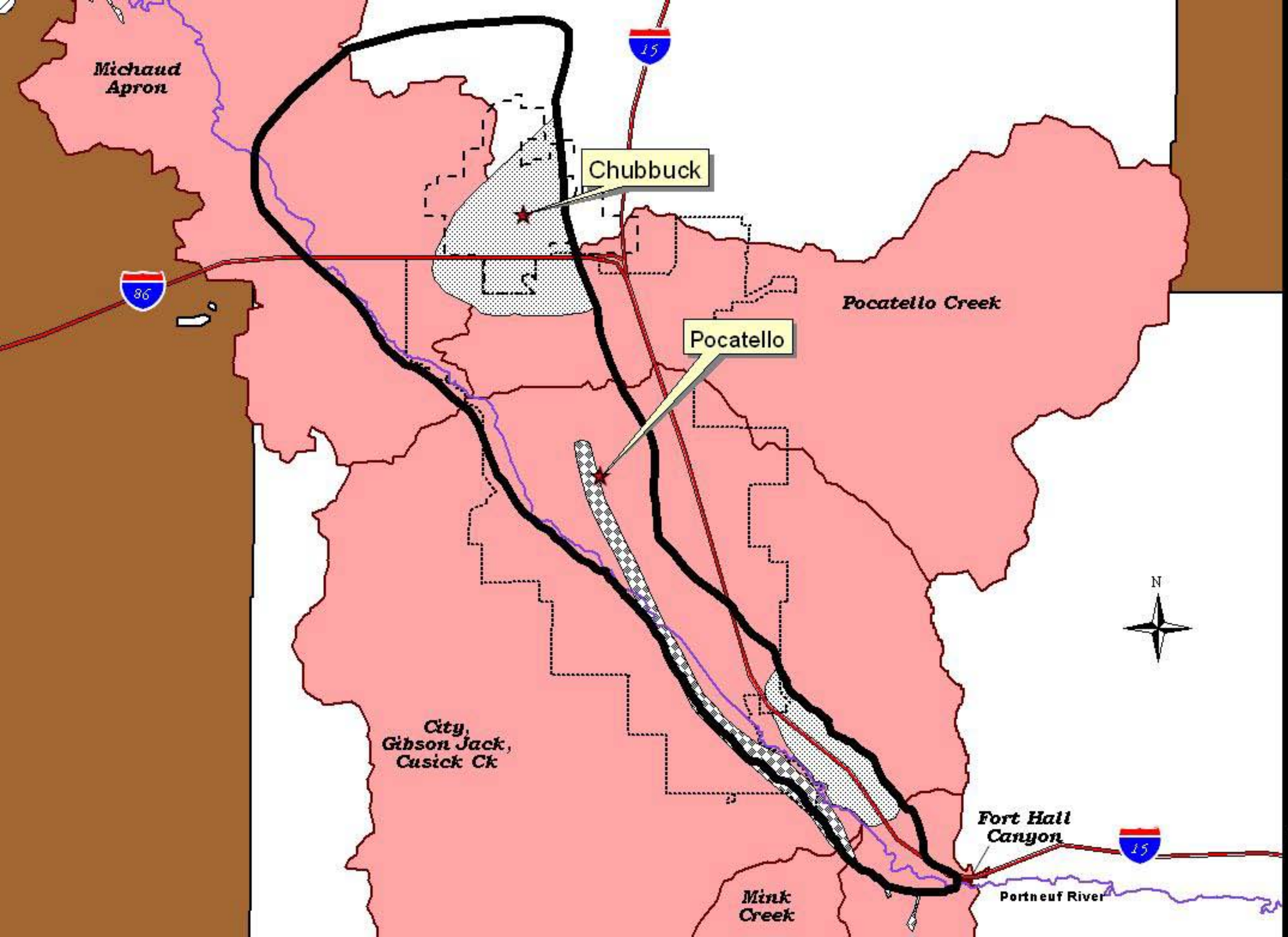
- Central Aquifer — This area is not well researched, but, as in parts of the Southern Aquifer, there is concern over migration of high salt concentrations from the Eastern Aquifer.

- Northern Aquifer — IDEQ has identified a high nitrate concentration area near the Pocatello Creek mouth as a nitrate priority area. Corresponding increases in chloride, sulfate, sodium, calcium and magnesium in the same area suggest that septic leachate may be the cause. The City of Chubbuck and the EPA have contracted for a groundwater monitoring program in this area, largely due to concerns about the nearby PCE plume affecting the Fort Hall Reservation and municipal wells in Chubbuck.

# Lower Portneuf River Valley

## Impacts of Aquifer Protection

**EXHIBIT 2b-2.**
**Known Locations of Water Quality Concern**




Scale in Miles
0 4 8

**CONCERN**

- Nitrate Priority Areas
- TCE Plume

**(Approximate Boundaries)**

- LPRV Aquifer
- Interstates
- Pocatello City Limits
- Chubbuck City Limits
- Watersheds
- Ft. Hall Indian Reservation

BBC Research & Consulting

## *CURRENT EFFORTS TO ADDRESS WATER QUALITY CONCERNS*

***Efforts have been made by Bannock County and the cities of Pocatello and Chubbuck to address several of the water quality issues mentioned above. For example, the TCE contamination in the Southern Aquifer is currently being studied. The PCE contamination in the Chubbuck area was also monitored and investigated for several years.***

***In contrast, proactive programs have not been implemented to address the concentration, distribution, and sources of other COCs -- such as sulfate and nitrate -- and indicators of potential problems such as increased chloride levels. Rising chloride levels are an indicator of potential pathways for contamination from surface spills or contaminated runoff. These contaminants are likely the result of non-point sources such as septic leachate, road salting, stormwater runoff and runoff from agriculture and ranching operations. Without proactive measures, these contaminants are likely to continue to degrade LPRV groundwater quality.***

## *LPRV WATER QUALITY TRENDS*

***This study focuses on certain water quality constituents, namely nitrate, sulfate, TDS and chloride which, in high concentration, degrade drinking water supplies. Each of these constituents naturally occur in water at low concentration levels. Increasing presence of these constituents can also be an indicator of other existing or potential contaminants.***

***The trends in LPRV water quality are quite difficult to discern because:***

- Historical water quality data has only been drawn from a small number of wells, 25 in all, throughout the LPRV.
- Concentrations of the COCs have only been monitored for the past 15 years and irregularly during that time.
- Water quality from specific wells and specific locations in the LPRV are worse than others.

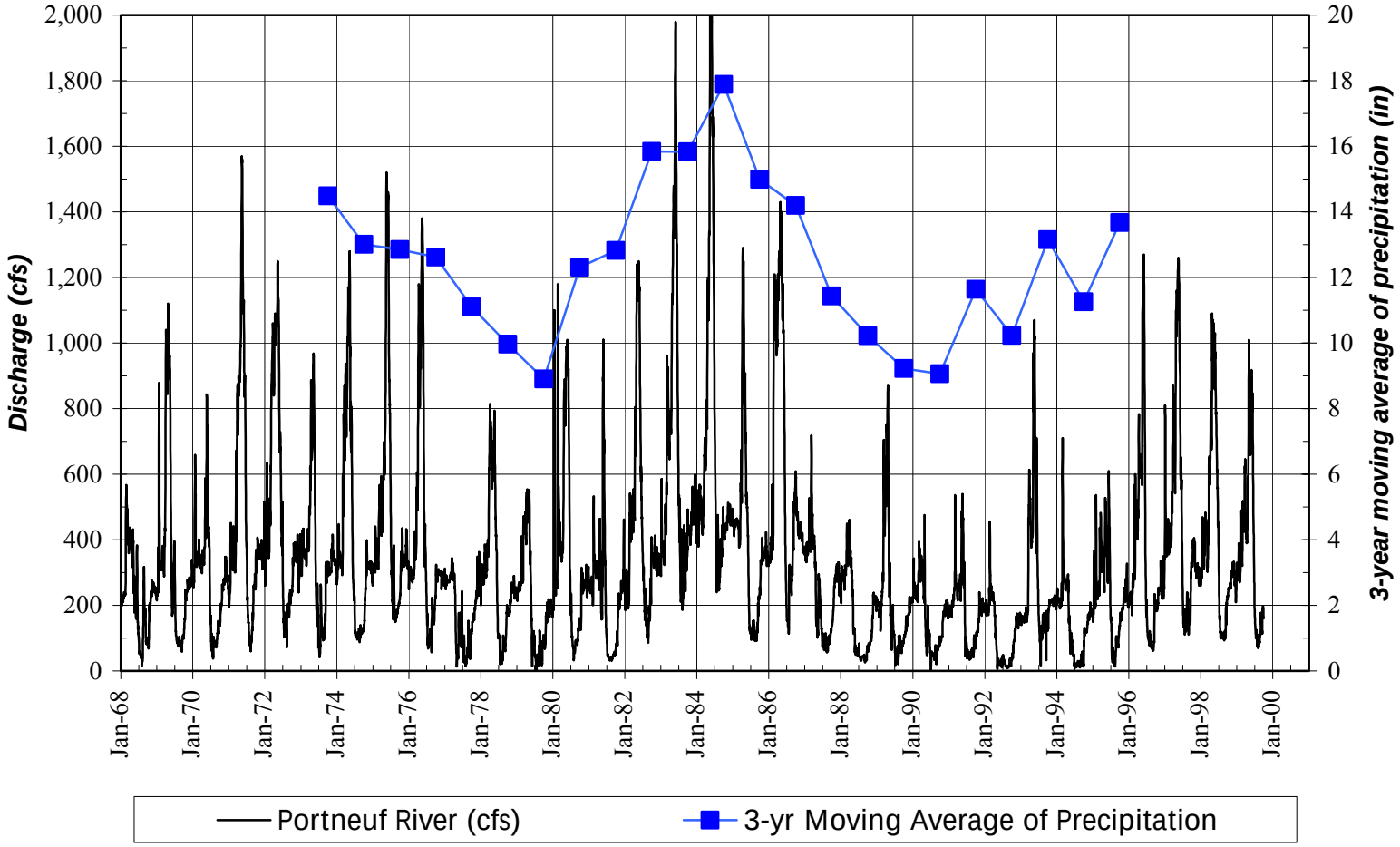
***An important explanatory variable is the precipitation which falls in the LPRV.***

## *RELATIONSHIP OF PRECIPITATION AND WATER QUALITY IN THE LPRV*

***Variations in water quality in the LPRV bear a close relationship to precipitation. Exhibit 2b-3 shows the historical trend in the Portneuf River discharge and the three-year moving average of precipitation for the LPRV. The heavy precipitation events from 1968 through the year 2000 occurred in the early 1970s and mid 1980s. Relatively drier conditions, with certain exceptions, have occurred since then.***

***As precipitation falls, it facilitates the transport of the surface contaminants through the permeable layers to the groundwater. This process can require several years of lag time to become evident in groundwater tests. Measurements of water quality in the late 1980s show significant, temporary spikes. During periods of drought or low precipitation, the leaching process is retarded and water quality appears to improve as the underground aquifer flushes from the Portneuf Gap downgradient. Excluding the effects of precipitation, there appears to be a gradual upward trend in the COCs at various wells in different locations throughout the LPRV.***

***Exhibit 2b-3. Portneuf River Discharge at Pocatello and 3-year Moving Average of Precipitation***



## *CHLORIDES*

***Chloride is a non-enforceable contaminant which has a secondary standard of 250 mg/L (milligrams per liter). This secondary standard reflects primarily drinking water taste, with water considered to be salty with chloride levels at or above the standard. Chloride is not found naturally in water and is thus an indication of contamination, usually from sewage, but sometimes from road de-icing salt and water softeners.***

***With one exception, wells monitored in the LPRV have not exhibited an exceedence of the chloride standard. The Blackcliffs Mobile Home Park well recorded a single chloride concentration value of 264 mg/L in 1980. One well in the Southern Aquifer reached 200 mg/L and a well in the Northern Aquifer reached 194 mg/L, both in the late 1980s. No other wells in the LPRV indicated excessive levels of chloride, although presence of chloride levels even at lower levels suggests some influence of human sewage. Chloride levels have been down in the late 1990s, possibly reflecting the dry period in the early 1990s.***

## *NITRATES*

***Nitrate is regulated as a primary drinking water standard at 10 mg/L. Typical sources of this contamination are leaching from septic tanks and fertilizer use. A map showing recent nitrate readings by well and geographic areas of nitrate concern is found in Exhibit 2b-4.***

***Several wells in the LPRV have recorded spikes in nitrate concentration beyond the standard. In the Northern Aquifer, wells near Pocatello Creek tended to be higher than other wells and certain increases in nitrate concentration are evident in wells downgradiant of Pocatello Creek. As indicated by measurements taken at municipal wells #26 and #27, the Pocatello Creek Basin has relatively high nitrate loads and is affecting other portions of the LPRV Aquifer through recharge or subflow. The contours illustrated in Exhibit 2b-4 show this spreading affect. The Central Aquifer does not appear to be substantially affected by elevated nitrate levels. The Eastern Aquifer, however, shows problematic nitrate levels, periodically at the Blackcliffs Mobile Home Park where exceedences are not uncommon. Some wells in the Southern Aquifer show gradual increases in nitrate, whereas other do not exhibit a discernable trend.***

# Lower Portneuf River Valley

## Impacts of Aquifer Protection

EXHIBIT 2b-4.
Aquifer Subdivisons, Select Well Locations, and Most Recent Nitrate Concentration

Michaud Apron

Chubbuck

Pocatello

Pocatello Creek

3

4

5

6

Bannock Paving 5.14

#5 (Chubbuck) 4.01

#18 3.8

#26 6.4

#27 7.1

#63

#32 4.36

#31 4.1

#34 5.8

#21 5.6

#22 4.0

#29 3.9

#10 2.4

#16 2.5

#30 2.3

#12 2.4

#2 2.4

#3 3.7

#36 2.3

#28 6.3

#13 2.1

#14

#33

Backdiffs 14.5

Main Lower 3.3

City Gibson Jack Cusick Ck

Mink Creek

Fort Hall Canyon

### Water Wells

- Well # = Well Number
- Nitrate Reading (mg/l)
- Nitrate Concentration Contour

### Aquifer Subdivisions

- Northern
- Southern
- Central
- Eastern

- Chubbuck City Limits
- Pocotello City Limits
- Interstates
- Watersheds
- Ft. Hall Indian Reservation

BBC Research & Consulting

## *SULFATES AND TDS*

***Sulfate is a non-enforceable contaminant with a secondary standard of 250 mg/L. This standard protects drinking water tastes, odor and color. Sulfate can have adverse affects on pregnant women and those with cardiac disease, also. Sulfate concentrations have generally ranged between 50 and 100 mg/L in the LPRV. The highest recorded concentration was 170 mg/L in the Southern Aquifer. One possible source of sulfates in the LPRV is roadbase material from crushed phosphate slag (Meehan and Welhan, 1994).***

***Total dissolve solids (TDS) is also a non-enforceable contaminant with a secondary standard of 500 mg/L. TDS connotes hardness and includes other constituents such as chloride, nitrate and sulfate. Most of the wells in the Northern Aquifer and several in the Southern Aquifer exceed 500 mg/L. TDS concentrations as high as 1,100 mg/L have been reported in the Northern Aquifer. TDS concentrations have increased during the 1990s.***

## *WATER QUALITY LESSONS FROM THE RATHDRUM PRAIRIE*

***Establishing precise linkages between surface activities and corresponding changes in aquifer water quality is a challenging undertaking. During the past twenty years of study in the Rathdrum Prairie, a number of rules of thumb have been developed, used for water quality modeling and become well accepted. The following factors are drawn from the*** *Rathdrum Prairie Report, August 1999****:***

- The average household generates 130 to 250 gallons of wastewater per day.
- Each septic system contributes, on average, 14 pounds of nitrogen to the aquifer each year.
- Fertilized lawns contribute, on average, 6 pounds of nitrogen to the aquifer each year.
- In the Rathdrum Prairie, an increase of four homes on septic per square mile increases the nitrate level in the aquifer by 0.5 Mg/L.

## *SUMMARY OF PROJECTED BASELINE CHANGES IN LPRV WATER QUALITY*

***Water quality in the LPRV shows an inconsistent trend geographically and temporally due to the weather. There have been exceedences of water quality standards for nitrate and TDS generally lagging several years behind the major precipitation events of the mid 1980s. The Pocatello Creek area and locations, and the Blackcliffs Mobile Home Park area have more severely degraded water quality.***

***Water quality in the LPRV appears to be tied to certain human activities on the surface. Septic tanks, stormwater runoff and agricultural use may contribute to increasing water quality deterioration. Higher than average precipitation years will accelerate the deterioration process and cause temporary spikes which are likely to exceed standards. These precipitation-driven increases will tend to be more geographically pervasive and more common as related human surface activity increases.***

## *UNCERTAINTY REGARDING WATER QUALITY CHANGES*

***Existing LPRV data is limited for drawing hard and fast conclusions about future baseline water quality. There are too few wells with data, and the well data which exists shows an inconsistent pattern. Although continuing deterioration is likely, it will be gradual and it will not be uniform throughout the study area or from year to year.***

# *SECTION 2c.*
# *BASELINE COST CHARACTERISTICS*

# *BASELINE COST CHARACTERISTICS — OVERVIEW*

***The final substantive portion of this section describes selected cost measures under the baseline scenario — with no additional proactive measures to protect water quality in the LPRV. These baseline cost measures allow for subsequent comparison with the alternative scenario — which will assume the enhanced aquifer protection scenario described in Section 1.***

### *Identification of Relevant Cost Measures*

For this study, the key cost measures are those that may be substantially different between the baseline and the enhanced protection scenario and/or those that will eventually be needed to calculate cost differentials between the two scenarios. To identify the most relevant cost measures (summarized on the following page), the study team:

- Examined the enhanced protection scenario definition provided in Section 1 to identify likely impacts on governmental, business and household costs.
- Gathered and examined existing cost information in the LPRV.
- Conducted interviews and reviewed documents describing the experience of residents, businesses and governments in the Rathdrum Prairie region with similar measures to those under consideration for the LPRV

***Cost analyses in this study generally convert relevant costs to average annual figures for purposes of consistent comparison. Rather than attempting to project generalized price inflation over the study horizon, costs are presented in year 2000 dollars.***

# *RELEVANT COST MEASURES*

| *Measure/element* | *Baseline Scenario* | *Impact Scenario* | *Not Relevant* |
|---|---|---|---|
| Administrative Costs of Enhanced Protection | $0 | To be estimated | |
| Costs of Residential Wastewater Disposal for New Homes | To be estimated | To be estimated | |
| Total Cost/Price of New Homes | To be estimated | To be estimated | |
| Economic Costs of Enhanced Protection for Local Businesses (e.g. Secondary Containment, Stormwater Disposal) | $0 | To be estimated | |
| Costs of Water Quality Degradation | To be estimated | $0 | |
| Economic Impacts (Jobs, Wages, etc.) | To be estimated | To be estimated | |
| Costs of Modified Municipal Wastewater Treatment Practices | | | See following page |
| Costs of Additional Non-domestic Wastewater Disposal Practices | | | See following page |
| Changes in Utility Costs for Wastewater Treatment and Disposal | | | See following page |

## *OTHER COST MEASURES THAT WERE EXCLUDED*

***As noted in the preceding table, several potential cost measures were excluded to either avoid double counting or because they reflect elements of the enhanced protection scenario that are already in place in the LPRV. Such measures include:***

- Costs of slow rate land application of municipal wastewater outflows — this BMP developed in the Rathdrum should not be necessary in the LPRV where wastewater outflows are not discharged over the aquifer.

- Costs of non-domestic wastewater disposal — based on interviews with Pocatello staff, virtually all industrial and commercial facilities in the LPRV are either already connected to municipal wastewater systems or discharge to areas outside the study area.

- Additional utility costs for wastewater treatment and disposal — potential increases in the costs of operation for municipal wastewater systems should be offset by additional rate and connection charge revenues, captured in other cost elements already included.

# *BASELINE COSTS OF RESIDENTIAL SEWER AND SEPTIC DISPOSAL*

***The relative costs of developing and owning homes in the LPRV that are connected to municipal sewerage systems for wastewater disposal, versus homes that utilize their own septic systems for wastewater disposal is an important element of this study — since the enhanced protection scenario can be anticipated to lead to a larger number of new homes on sewer and smaller number on septic.***

## *Home Ownership Costs — Sewered Homes*

Based on data assembled for the Our Valley/Our Vision project, current sewerage connection charges and rates for Pocatello and Chubbuck and representative homeowner financing rates, the study team calculates the average annual cost of wastewater disposal for a sewered home to be approximately $1,187 per year. This estimate results from the following calculations:

- Capital costs of sewer (reflecting developer contributions in aid of construction and plant capacity fees paid to City of Pocatello) are estimated to be approximately $11,200, on average.

- Financed over a 30-year mortgage at 8.0 APR, the homeowner's annual payment for this capital cost is approximately $995.

- Average operating charges (sewer bills) for a homeowner in the LPRV are approximately $16 per month, or $192 per year.

# BASELINE COSTS OF RESIDENTIAL SEWER AND SEPTIC DISPOSAL

## Home Ownership Costs — Septic Homes

Based on cost estimates provided by the local Health District, the study team calculates the average annual cost of wastewater disposal for a home on a septic system to be approximately $335 per year. This estimate results from the following calculations:

- Capital costs of the septic system are estimated to be approximately $3,500, on average.
- Financed over a 30-year mortgage at 8.0 APR, the homeowner's annual payment for this capital cost is approximately $310.
- Properly maintained septic systems are pumped at least once each three years, with an average pumping and disposal cost of about $75. This computes to an annual cost of $25.

## Current Home Values and Differences in Cost of Development for Sewer versus Septic

The average price for homes sold in the LPRV in 2000 was approximately $95,000 based on local realtor data.

The estimated difference in the cost of developing homes with sewer from those with septic disposal is $7,700, based on the analyses just described.

# *BASELINE COSTS OF WATER QUALITY DEGRADATION — OVERVIEW*

***Developing precise estimates of the economic costs and impacts of declining drinking water quality is a complicated undertaking for several reasons. These costs depend on several factors that are inherently uncertain, including the specific changes in water quality by type of contaminant, the timing of those changes and human physical, perceptual and behavioral responses to those changes. To help understand these costs, it may be helpful to distinguish first between more common contaminants (such as nitrates) and contamination from hazardous materials (such as fuels and solvents) and, second, to consider the relationship between water quality related costs and time.***

## *Distinction Between Common Contaminants and Hazardous Material Contamination*

Common contaminants such as nitrates, chlorides and other constituents that are found in low levels, even in pristine water supplies, differ from more hazardous contaminants in at least two ways that are important from the standpoint of economic analysis. The more common contaminants — from sources such as septic tanks, stormwater and agricultural runoff — are found in much larger volumes and accumulate in a somewhat predictable fashion based on above ground activities. Further, though these contaminants pose increasing health risks as their levels rise, the levels at which they become a serious health concern are generally much higher than for hazardous material contaminants — as reflected in the much higher Maximum Contaminant Levels (MCLs) established for the common contaminants by the EPA.

Hazardous materials contaminants — such as PCE, TCE and arsenic — can pose a serious health risk even at relatively low concentrations. Water quality contamination from such substances is not the result of routine surface activity, but instead usually occurs as a result of accidents or illegal disposal practices. This type of contamination is more commonly associated with individual incidents — such as chemical spills — and individual sources. This type of contamination is not amenable to prediction, but instead is a matter of risks and probabilities.

# *BASELINE COSTS OF WATER QUALITY DEGRADATION – COMMON CONTAMINANTS (E.G. NITRATES)*

## *Water quality related costs and time*

For the more common contaminants, costs associated with declining water quality over a period of years can be separated into two phases. The first phase, as water quality declines but contamination has yet to reach levels that force remediation by the water supplier (due to either exceedence of the MCL standard or public demand for action), can be characterized by three types of costs:

- some households and business will begin to make expenditures to mitigate their own water quality (such as purchasing bottled water, installing in—home water treatment or pre—treatment systems for business, etc.),
- rising contaminant levels may be associated with reduced appliance and fixture life and higher incidence of illness among water users who do not take steps to mediate their own water supplies, and
- the perception of declining water quality can have an impact on local views of quality of life and the ability to attract businesses that are dependent on high quality water supplies.

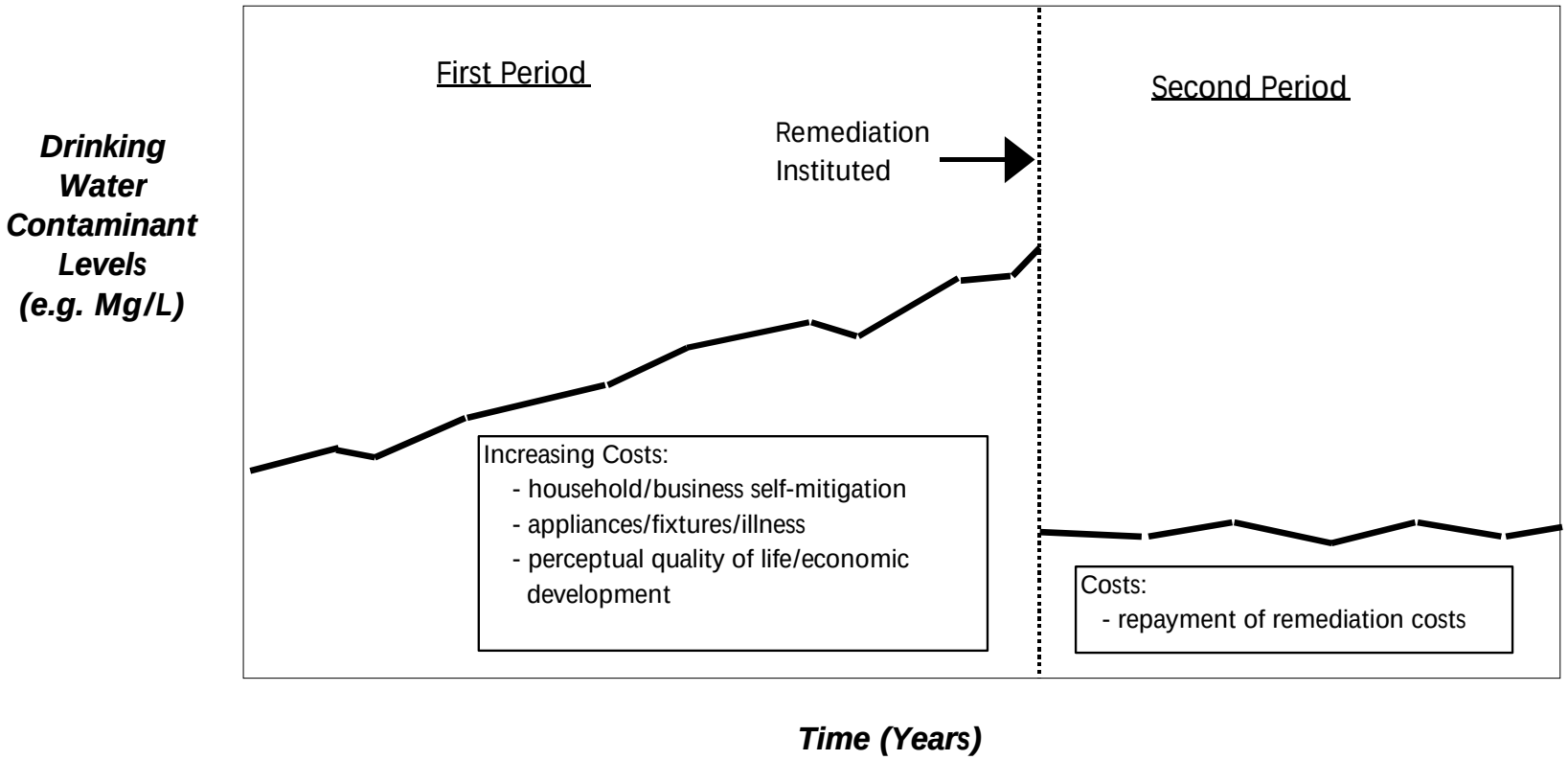
Costs during the second phase, which occurs during and after remediation by the water supplier, can be characterized more simply:

- the water supplier invests in remediation — either through enhanced treatment or development of alternative water supplies
- household and business costs return to normal.

# *BASELINE COSTS OF WATER QUALITY DEGRADATION – COMMON CONTAMINANTS (E.G. NITRATES)*

The relationship between water quality related costs and time (for more common contaminants) is illustrated below.

**Relationship Between Water Quality Degradation Costs and Time**



# *BASELINE COSTS OF WATER QUALITY DEGRADATION – COMMON CONTAMINANTS (E.G. NITRATES)*

***As described in Section 2b, there are some indications that water quality degradation from common contaminants, especially nitrates which are the most commonly measured constituent, is increasing in the LPRV aquifer. High concentrations of nitrates are associated with certain specific health risks. There are a number of communities in the U.S. that provide examples of what can occur with extreme nitrate contamination.***

Nitrates are a naturally occurring chemical compound formed in soil when oxygen and nitrogen combine. Small amounts of nitrates are not harmful and natural concentrations of nitrate are found even in pristine groundwater, usually at levels less than 2 mg/L (USEPA Region 8, 2000 and USGS, 2000).

Health problems begin to occur when nitrate levels reach higher concentration. The best known health risk is methemoglobinemia, or oxygen starvation in the bloodstream. This condition is particularly risky for infants aged 0 to 6 months, where it is known as "blue baby syndrome." EPA characterizes this risk as becoming unacceptable for infants when nitrate levels exceed 10 mg/L, although other countries have established stricter standards — such as the European Community's limit of 5.6 mg/L (USEPA Region 8, 2000 and Environmental Working Group, 2000). There is some recent evidence that high levels of nitrates may also be associated with increased risk of non-Hodgkins Lymphoma (National Cancer Institute, 1996). Nitrate contamination from septic systems and animal waste can also be associated with fecal contamination and its associated diseases.

# *BASELINE COSTS OF WATER QUALITY DEGRADATION – COMMON CONTAMINANTS (E.G. NITRATES) (CONTINUED)*

***There are a number of communities in the U.S. that provide examples of what can occur with extreme nitrate contamination.***

Severe nitrate contamination problems have occurred, or are currently occurring, in some U.S. communities both large and small, wealthy and poor. It is estimated that the Philadelphia metropolitan region contains at least 200,000 homes on septic, including nearly 4,000 within the city limits. During the past decade or so, rising nitrate levels associated with poor septic system maintanance have been found in wells throughout at least three suburban counties. In 1990, five families in suburban Bucks County contracted hepatitis A attributed to septic contamination. (Philadelphia Enquirer, May 25, 1998).

At the other end of the spectrum, the small town of Chualar in Monterrey County, California has been severely afflicted with nitrate contamination during the past few years. In May 1996, the County determined that water from the town system was no longer fit to drink due to nitrate concentration. The town was without a permanent safe water supply for more than two years and local residents had to be supplied by tank truck. The anticipated solution of replacing the communities source well is expected to cost nearly $1,000 per resident. (San Francisco Chronicle, May 12 and May 26, 1998).

# *BASELINE COSTS OF WATER QUALITY DEGRADATION – COMMON CONTAMINANTS (E.G. NITRATES) (CONTINUED)*

## *Quantitative Cost Estimates*

Since 1988, at least eight formal studies across the U.S. have used survey and contingent valuation approaches to quantify the household costs associated with groundwater contamination. Five studies have focused on estimating household consumers willingness-to-pay to avoid contamination or remediate existing contamination, while three studies have examined household purchases and expenditures to estimate the household costs of mitigating or avoiding contaminated water supplies through purchases of filters, bottled water and other tactics. These studies are summarized on the following page.

# *BASELINE COSTS OF WATER QUALITY DEGRADATION – COMMON CONTAMINANTS (E.G. NITRATES) (CONTINUED)*

**National Studies Estimating Average Annual Household Values for GW Contamination Avoidance and Willingness to Pay to Avoid or Remedy Contamination**

***Studies of Household GW Contamination Avoidance Behavior***

| ***Study*** | ***Location*** | ***Contamination*** | ***Original Avoidance Cost*** | ***Cost in Year 2000 $*** |
|---|---|---|---|---|
| Abdalla, 1990 | Centre Co., PA | Perchloroethylene | $252 | $382 |
| Abdalla, Roach, and Epp, 1990 and 1992 | Bucks Co., PA | Trichloroethylene | $123 | $171 |
| Collins and Steinbeck, 1993 | West Virginia | Bacteria, Minerals, Organics | $1,410 | $1,860 |
| | | | ***Median*** | $382 |

***Studies of Willingness to Pay to Protect GW Quality***

| ***Study*** | ***Description*** | ***Original Value*** | ***Year 2000 $*** |
|---|---|---|---|
| Doyle, 1991 | Remediate contamination | $138 | $174 |
| Edwards, 1988 | Reduce prob. Of nitrate contam. | $815 | $1,186 |
| Jordan, et al, 1993 | Reduce nitrate contam. To safe level | $135 | $161 |
| Schultz, et al, 1989/1990 | Maintain GW Quality | $40 | $53 |
| Clemons, et al, 1995 | Wellhead protection program | $21 | $24 |
| | | ***Median*** | $161 |

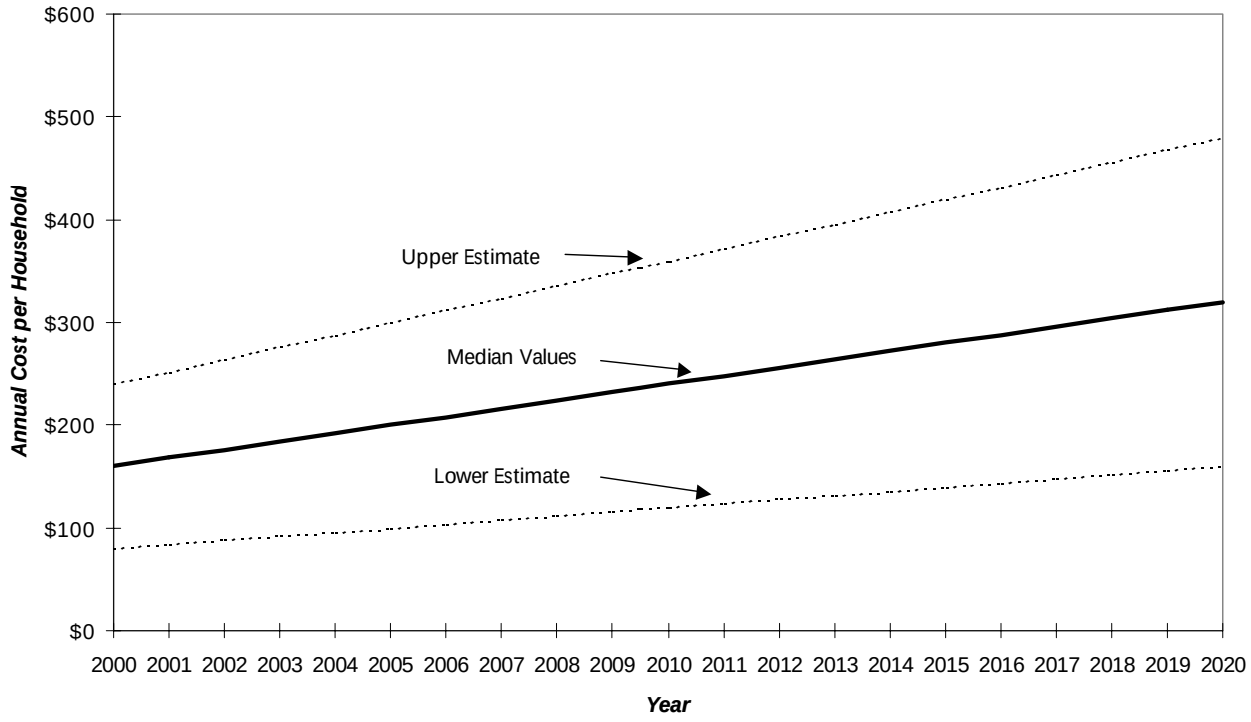
Source: ***Valuing Groundwater***, National Research Council, 1997.

# *BASELINE COSTS OF WATER QUALITY DEGRADATION – COMMON CONTAMINANTS (E.G. NITRATES) (CONTINUED)*

Since the willingness to pay studies are primarily associated with the value households place on avoiding future increase in contamination, they are perhaps the most analogous to the current situation in the LPRV. The value derived from such studies is akin to the value of an insurance policy against future declines in water quality — through establishing the enhanced aquifer protection measures. The avoidance cost studies may represent more appropriate estimates of the household cost as contamination levels approach the threshold requiring remediation by the water supplier — more closely representing the situation that may be experienced in the LPRV towards the end of this study's 20 year planning horizon. We have calculated a range of potential cost estimates based on the median values from the studies, plus or minus 50%. The figure on the following page depicts the study team's estimate of the range of household costs/values associated with groundwater quality degradation in the LPRV over the 20 year study horizon (presuming remediation by the water supplier does not occur within this timeframe).

# *BASELINE COSTS OF WATER QUALITY DEGRADATION – COMMON CONTAMINANTS (E.G. NITRATES) (CONTINUED)*

**Estimated Annual Costs per Household of Groundwater Degradation in the LPRV, 2000 - 2020**



# *BASELINE COSTS OF WATER QUALITY DEGRADATION – OTHER COSTS*

***Apart from the first phase, household costs associated with degradation from common contaminants, there are several other cost considerations.***

## *Business costs in first phase*

Like households, business may also be willing to pay to avoid further contamination and may undertake their own measures to avoid or mitigate contaminated supplies — for example by installing on—site pre—treatment equipment. Unfortunately, there is little information available to provide a basis for even generalized estimates of the magnitude of these costs.

## *Remediation (second phase) costs*

It is possible that at least a portion of the water supplies in the LPRV (i.e., Pocatello Creek area, Blackcliffs Mobile Home Park area, etc.) may become so degraded during the twenty year study horizon that water suppliers are required to provide centralized remediation — through either enhanced treatment or development of alternative supplies.

From least to most expensive, the most likely options could include:

- Develop new wells (with an estimated financed annual capital cost of about $250 per household living in the LPRV in 2020, based on estimated well system development costs from the Our Valley/Our Vision study process). However, given the fact that LPRV water uses are already approaching the sustainable capacity of the aquifer (see Page 2b-9), it is unclear whether or not this option will be viable.
- Development, treatment and conveyance of surface supplies from Pallisades Reservoir with an estimated annualized cost of about $600 per household projected to live in the LPRV in 2020), or
- enhanced treatment through large scale reverse osmosis — suitable for removing nitrates as well as other contaminants. No cost estimates specific to the LPRV have been developed for this approach, but based on prior study team work in Tucson (and accounting for differences between that area and the LPRV) costs might fall between the cost estimate for new wells and the cost estimate for new surface supplies.

### *Hazardous material contamination*

While contamination of public water supplies by hazardous materials can impose the same sorts of household, business and remediation costs, the probability of this type of contamination is much more unpredictable. However, hazardous material contamination (after detection) can require almost immediate remediation by the water supplier. Although quantitative estimates of these costs have not been projected by the study team — due to inability to predict the probability of occurrence — the cost of this risk should not be underestimated. This is particularly clear in the LPRV, where recent costs associated with PCE and TCE contamination have included about $1.5 million for new wells and treatment facilities in Chubbuck the loss of production from one of Pocatello's municipal wells and the costs of extensive studies and future actions at the Fort Hall Mine landfill and other potential source sites.

# *BASELINE COSTS OF WATER QUALITY DEGRADATION – IMPACT ON ECONOMIC DEVELOPMENT*

***As noted on page 2a-10, Pocatello's manufacturing base includes numerous industries that are dependent on relatively abundant, high quality water supplies. Further, local economic developers have indicated that new water intensive operations are currently considering relocating to the Pocatello area and water quality and quantity is important to new firms considering locating in the area (Ray Burstedt, Bannock County Development Corporation).***

***While it is not possible to precisely predict the potential impact of declining water quality on economic development in the study area, some simplified calculations can provide a reasonable, order of magnitude assessment of what may be at stake:***

- The baseline economic projections described on page 2a-13 indicate that the area is expected to experience an average net increase in manufacturing employment of about 110 jobs per year, or about 2 net new firms per year (based on current average manufacturing firm size in the area).

- Assume water quality is an important concern for one-half of all new manufacturing firms considering locating in the study area (to be conservative, we'll sssume it is not a critical factor for other types of firms considering the area),

- If one half of these firms choose another locale because of increasing water quality concerns, manufacturing growth in the Pocatello area would be reduced by 25%. This means that each year, the area would lose almost 30 new manufacturing jobs and about $1 million dollars in wages (based on 1998 average manufacturing wages of $35,000 in the area). If this phenomenon began to occur in 2010, cumulative manufacturing losses by 2020 would be 275 jobs, 5 firms and about $9.6 million in annual wages.

# *BASELINE COSTS OF WATER QUALITY DEGRADATION – SUMMARY*

***Projected baseline costs of water quality degradation are summarized in the figure below. These costs are more indicative of the general magnitude of potential costs over the study horizon than precise estimates, given the varied uncertainties described earlier. Given that several types of costs could not be reasonably quantified at even a general level, these estimates may tend to understate actual costs.***

| | *Annual Cost (Year 2000 $)* | | |
|---|---|---|---|
| ***Cost Element*** | ***2010*** | ***2020*** | ***Notes*** |
| ***Common Contaminants - Phase I*** | | | |
| Household Costs per Household | $120 to $360 | $160 to $480 | |
| Aggregate Household Costs | $4 to $11 million | $6 to $17 million | |
| Business Costs | Not Quantified | Not Quantified | |
| ***Hazardous Contamination Costs*** | Not Quantified | Not Quantified | Risk not easily amenable to prediction. Recent local experience and costs indicative of risk. Could force earlier remediation by water suppliers. |
| ***Remediaton Costs*** | Assumed To Occur After 2020 | | Range of annualized costs from $250 to $600 per household. Corresponding reduction in phase 1 household and business costs after remediation by water suppler. |
| ***Economic Development Costs*** | | | |
| Annual New Employment Foregone | 28 Jobs | 28 Jobs | Indicative estimates only, based on assumptions stated in text. Actual costs may be higher or lower. |
| Annual New Wages Foregone | $1 million | $1 million | |
| Cumulative Employment Foregone | 28 Jobs | 275 Jobs | |
| Cumulative Yearly Wages Foregone | $1 million | $9.6 million | |

# *BASELINE COSTS — SUMMARY*

***This section has described selected cost measures under the baseline scenario — including those that have the likely potential to differ between the baseline and the scenario with enhanced aquifer protection and cost elements that will be needed to calculate cost differentials between the two scenarios. These baseline cost elements and projections are summarized in the following figure:***

**Summary of Projected Annual Baseline Costs and Cost Elements**

| | *Annual Cost (Year 2000 $)* | |
|---|---|---|
| ***Cost Element*** | ***2010*** | ***2020*** |
| ***Administrative Costs of Enhanced Aquifer Protection**** | $0 | $0 |
| ***Aggregate Costs of Residential Wastewater Disposal for New Development*** | | |
| Via Septic Systems (20 to 35 new homes per year over aquifer) | $67,000 to $120,000 | $135,000 to $235,000 |
| Via Sewer Systems (385 to 400 new homes per year) | $4.5 to $4.7 million | $9.1 to $9.4 million |
| ***Aggregate Homeowner Payments for New Homes*** | $35 million | $70 million |
| ***Costs of Secondary Containment of Critical Materials**** | $0 | $0 |
| ***Costs of Enhanced Stormwater Disposal for New Facilities**** | $0 | $0 |
| ***Costs of Water Quality Degradation*** | | |
| Household Costs | $4 to $11 million | $6 to $17 million |
| Business Costs | not quantified | not quantified |
| Economic Development Losses | | |
| Manufacturing Jobs | 30 | 275 |
| Annual Wages | $1 million | $9.6 million |

*Will be compared to values in the enhanced aquifer protection scenario.

# *SECTION 3.*
# *ECONOMIC AND FISCAL IMPACT ESTIMATES*

# *INTRODUCTION — OVERVIEW OF SECTION 3*

***This section describes the third, and last, analytical element in this evaluation of economic impacts of enhanced aquifer protection for the Lower Portneuf River Valley (LPRV).***

***Two previous sections have focused on:***

- Section 1 -- Characterization of the Enhanced Aquifer Protection Scenario. This section defines the measures assumed to be implemented to protect water quality in the LPRV Aquifer for purposes of this study.

- Section 2 -- Description of the Baseline Scenario. This section describes current and projected economic and demographic conditions, hydrologic conditions and water quality related costs in the LPRV, assuming no further aquifer protection.

***In Section 3, the study team has endeavored to describe the projected effects of the enhanced protection scenario relative to the baseline scenario. This comparison produces estimates of the financial and economic impacts of implementing the enhanced protection scenario in the LPRV.***

# *INTRODUCTION — OVERVIEW OF SECTION 3, CONTINUED*

***The structure of this report includes six elements, following this overview. These elements include:***

1. A recap of the enhanced protection scenario definition.
2. Direct costs of the enhanced protection scenario.
3. Indirect costs and economic impacts of the enhanced protection scenario.
4. Benefits of the enhanced protection scenario.
5. Comparisons of the enhanced protection scenario with the baseline scenario.
6. Areas of uncertainty and potential for further research.

# *INTRODUCTION: SUMMARY OF ENHANCED AQUIFER PROTECTION SCENARIO*

***The enhanced protection scenario assumes a specific set of measures would be implemented to diminish future aquifer constituent loadings due to human activities on the ground surface and reduce the risk of contamination due to unanticipated, one-time, events such as spills or accidents. These measures are based largely on policies implemented over the past two decades in the Rathdrum Prairie region in northern Idaho. The set of measures, and the extent to which they reflect changes from current policy and practice in the LPRV, is described in detail in Section 1. The key objectives and principal management measures are summarized below.***

- Reduction of future contamination from septic and sewer discharge to the aquifer -- this measure limits the density of future home developments relying on septic disposal to no more than one home per five acres unless the homes are located in contractually agreed upon Sewage Management Areas that will be sewered in the near future.

- Avoidance of contamination from stormwater runoff and non-domestic wastewater disposal -- this measure requires larger new developments to develop and implement stormwater management plans incorporating best management practices and disallows non-domestic wastewater discharge to the aquifer.

- Reduction of risk of contamination from unintended spills of critical materials -- this measure requires businesses using, storing or handling designated critical materials to report on material use and, if use is above designated threshold quantities, to submit management plans and, in some cases, incorporate secondary containment facilities.

***These measures are assumed to apply only to new developments, businesses and material uses in the LPRV.***

# *INTRODUCTION: SUMMARY OF ENHANCED AQUIFER PROTECTION SCENARIO*

***There are three major categories of potential economic and fiscal effects associated with implementing the enhanced protection scenario. Such a strategy may impose direct costs upon residents or other sources of funding to pay for administration and implementation of the aquifer protection measures. Secondly, the strategy may impose indirect costs on residents and/businesses by requiring modifications to current practices. Finally, the strategy may provide economic benefits by avoiding further decreases in the quality of the water supply relied upon by residents and businesses. Each is addressed in turn.***

# *SECTION 3a.*
# *DIRECT COSTS OF ENHANCED AQUIFER PROTECTION IN THE LPRV*

# *DIRECT COSTS OF THE ENHANCED AQUIFER PROTECTION SCENARIO*

***The best available guideline for estimating the direct costs associated with implementing the enhanced protection scenario is the experience in the Rathdrum Prairie with very similar aquifer protection measures. Arguably, the LPRV might expect to experience lower direct costs in implementing and managing the aquifer protection effort than the Rathdrum Prairie region for several reasons:***

- the surface area of the Rathdrum Prairie Aquifer (283 square miles in Idaho) is more than ten times larger than the surface area of the LPRV Aquifer (26 square miles).

- administratively, the Rathdrum effort appears more complex as it involved 11 municipalities and Kootenai County, compared with two municipalities and one county government in the LPRV.

- most importantly, the LPRV would be able to learn from more than a decade of experience in implementing and managing efforts in the Rathdrum Prairie rather than having to be the pioneer in devising management and administrative approaches.

- The Rathdrum Prairie has grown more rapidly than the LPRV, suggesting protection measures would be less challenging in the LPRV.

***However, the Rathdrum Prairie effort also undoubtedly benefited from synergy with comparable efforts across the border in Spokane County, Washington. The economic base of the LPRV is more diversified than that of the Rathdrum Prairie, with more industry and related risks. To be conservative in estimating costs for the LPRV, the study team has assumed direct costs would be comparable to those experienced in the Rathdrum Region.***

# *DIRECT COSTS OF THE ENHANCED AQUIFER PROTECTION SCENARIO, CONTINUED*

***Direct costs will likely be highest in the early years of implementing the enhanced protection scenario and developing additional technical information regarding the aquifer. These costs will ultimately diminish to a lower level for ongoing maintenance of the protection effort. Based on the Rathdrum experience, the study team estimates that annual direct costs and staffing requirements during a five to ten year formative period would be approximately $500,000 per year and about six full time equivalent positions. After this formative period, ongoing annual costs and staffing for maintaining the program should decrease to about $275,000 per year and about four full time equivalent positions. The table above depicts more detailed annual direct costs and staffing requirements experienced in the Rathdrum Prairie.***

***Rathdrum Prairie Annual Administrative Costs and Staffing***

| | *Formative Years* | | *Maintenance Years* | |
|---|---|---|---|---|
| ***Program Area*** | ***Dollars*** | ***Staff*** | ***Dollars*** | ***Staff*** |
| Septic/Sewer Discharge | $9,000 | 0.2 | $9,000 | 0.2 |
| Stormwater/Non-domestic Wastewater | $60,000 | 1.0 | $30,000 | 0.5 |
| Critical Materials | $72,000 | 1.2 | $105,000 | 1.8 |
| Other Components | | | | |
| Public Education/Awareness | $112,000 | 1.2 | $40,500 | 0.5 |
| Groundwater Monitoring | $5,000 | 0.0 | $5,000 | 0.0 |
| Technical Assistance | $100,000 | 1.2 | $75,000 | 1.0 |
| Hazardous Materials Response | $50,000 | 0.5 | $0 | 0.0 |
| Other | $92,000 | 0.7 | $9,000 | 0.2 |
| Total | $500,000 | 5.9 | $273,500 | 4.1 |

Source: Rathdrum Prairie Aquifer Program: Past, Present and Future? Rathdrum Prairie Aquifer Policy Advisory Committee, June 1996; personal interviews with Ken Lustig, Environmental Health Director, Panhandle Health District Number One, 2001.

# *DIRECT COSTS OF THE ENHANCED AQUIFER PROTECTION SCENARIO, CONTINUED*

***The burden of these direct costs would likely be spread across several funding sources. In the Rathdrum Prairie, some of these costs are offset by fees paid for septic permits and filing charges associated with critical materials plans. A larger contribution is made by the State, which pays for technical assistance and public education administered by the local DEQ office. During the "formative years", when annual direct costs averaged $500,000 per year, the State contribution covered about 50 percent of the total annual cost, while fees met a little less than twenty percent of the remaining local funding requirement. During the "maintenance years", when annual direct costs averaged about $275,000 per year, the State contribution covered about 40 percent of the total annual cost, while fees covered a little more than twenty percent of the remaining local funding requirement. (****Rathdrum Prairie Aquifer Program: Past, Present and Future?*** ***Rathdrum Prairie Aquifer Policy Advisory Committee, June 1996).***

***To again presume the most conservative, or "worst case" from a local impact perspective, we can consider the burden if the total direct cost burden was recovered from taxpayers in the LPRV. Under these worst case assumptions, the maximum potential annual direct cost burden during the higher cost, formative years would equate to an average of about $8 per LPRV resident, per year.***

# *SECTION 3b.*
# *INDIRECT COSTS AND ECONOMIC IMPACTS OF ENHANCED AQUIFER PROTECTION IN THE LPRV*

# *INDIRECT COSTS AND ECONOMIC IMPACTS OF THE ENHANCED AQUIFER PROTECTION SCENARIO*

***The second major category of potential economic and fiscal effects are indirect costs that might be incurred by residents and businesses in the LPRV and possible negative effects on the local economy. Potential positive effects on the economy, relative to the baseline scenario, are discussed separately.***

***Within the enhanced protection scenario, there are two primary elements that might conceivably produce indirect costs and economic impacts within the LPRV:***

- measures designed to drive new residential homes onto municipal sewer systems instead of septics might have an impact on the cost of new home development within the LPRV and, consequently, might effect home ownership costs, the number of new homes sold in the study area and the industries most closely tied to new home development and sales (e.g. construction, finance, insurance and real estate).

- measures designed to reduce contaminant loadings from stormwater runoff and reduce the risk of critical material spills into the aquifer could impact the costs of developing new businesses in the LPRV. Potential secondary effects might include reductions in the number of new businesses and, consequently, new jobs in the study area.

***The balance of this discussion presents the study team's assessment of these two indirect cost/economic impact elements. First we present the impressions of both aquifer management and business development representatives in the Rathdrum Prairie concerning their experience with these issues over the past decade. We then estimate the magnitude of these potential effects in the LPRV.***

# *INDIRECT COSTS AND ECONOMIC IMPACTS — RESIDENTIAL DEVELOPMENT*

***The Sewage Management Area/septic density requirements were the single most controversial aspect of the aquifer protection strategy in the early years of the Rathdrum Prairie effort. Based on extensive documentation produced throughout the past 20 years of the Rathdrum Prairie aquifer protection effort and study team interviews with Panhandle Health Department #1 (PHD#1) and the local Department of Environmental Quality office in Coeur d'Alene, the following are some key observations from the Rathdrum experience:***

- When PHD#1 began implementing the Sewage Management Area/septic density requirements in the late 1970s, strong opposition was raised by some local developers and realtors. Opponents contended that new homes would be priced out of the market and that the economic impacts would exceed any benefits from such protection measures. Ultimately, PHD#1 prevailed in a court challenge to the requirements. (***A Case Study of Innovative Subsurface Sewage Management over the Rathdrum Prairie Aquifer, Idaho.*** PHD#1 and Gradient Corporation, 1986).

- The Sewage Management Area/septic density requirements have resulted in a number of changes in the pattern of residential development in the Rathdrum Prairie. Over the past two decades, a number of new sewer districts have been started, existing sewer systems have been expanded and an estimated $50 million dollars has been spent on wastewater system improvements. Residential development has been channeled into urbanized areas and some believe that local planning has been improved and the costs of providing public sector services to new homes has been reduced. (***Rathdrum Prairie Aquifer Protection Project: Ground Water Quality Technical Report No. 12***. Idaho Department of Environmental Quality, 1999. Study team interview with Ken Lustig, Environmental Director for PHD#1, 2001).

- While the rapid population growth in the Rathdrum Prairie demonstrates that Sewage Management Area/septic density requirements did not curtail development and the controversy has subsided, these regulations may continue to evolve. A current planning process is considering alternatives or modifications to the existing septic density rule that might provide the same level of aquifer protection while providing more flexibility in development standards. (Study team interview with Ken Lustig, Environmental Director for PHD#1, 2001).

# *INDIRECT COSTS AND ECONOMIC IMPACTS — RESIDENTIAL DEVELOPMENT, CONTINUED*

***The study team believes that the Sewage Management Agreement/septic density requirements would convert at least a portion of the new homes in the LPRV that would have been developed with septic systems into sewered wastewater development. This conversion is likely to have a modest impact on the cost of some new homes in the LPRV and might have modest effects on housing demand and economic activity in construction, real estate and other related sectors.***

- As discussed in the Section 2, Baseline Conditions, an estimated 20 to 35 new homes will be developed per year with septic disposal systems over the next twenty years, out of a projected total of 385 to 400 new homes developed each year in the LPRV. To gauge the "worst case" in terms of potential economic impact, we can assume that all of these homes would be converted to development using municipal sewerage under the enhanced protection scenario (although in reality some proportion could still be developed with septic systems at a one unit per five acre density).

- Also drawing from analysis in Section 2, the cost of developing a new home in the LPRV with municipal sewer disposal is estimated to be about $7,700 more than developing the same home with septic disposal. If we assume that this cost difference is reflected in the price difference for the home and use the current average home sale price in the LPRV of about $95,000, the impact of this cost difference on the average price of homes in the LPRV can be estimated by the following formula:

  - Impact on average price = (% of homes converted from septic to sewer development) x (% difference in price), or:
  - ***Lower end impact estimate*** = 20/385 x $7,700/$95,000 = $400 or 0.4% impact on average home price.
  - ***Higher end impact estimate*** = 35/385 x $7,700/$95,000 = $675 or 0.7% impact on average home price.

# *INDIRECT COSTS AND ECONOMIC IMPACTS — RESIDENTIAL DEVELOPMENT, CONTINUED*

- The less than one percent estimated magnitude of the impact of these regulations on the average price of new homes in the LPRV is likely less than the effect of fluctuations in market conditions from year to year and might have essentially no economic impact on the economic sectors related to new home development. Potentially, some proportion of this increase in the cost of developing new homes may be absorbed in lower profits by home developers, rather than reflected in higher new home prices.

- However, we can assess the potential "worst case" from an economic impact standpoint by applying estimates of the "elasticity" of housing demand to the estimate range of potential price increases. Elasticity is an economic measure of the percentage reduction in demand resulting from a one percent increase in price. Prior studies of the elasticity of housing demand suggest that this value may be approximately 1.2 (1997 Mackinac Center for Public Policy, citing various elasticity studies).

- Using this elasticity value, the reduction in housing demand corresponding to the estimated increase in the average price of new homes due to the enhanced protection scenario would be between 0.5% and 0.8%. This implies that approximately two to three fewer new homes could be developed each year in the LPRV.

- If one half of the approximately 3,500 LPRV jobs in the construction and finance, insurance and real estate sectors can be assumed to be directly related to new home development, this estimated decrease in new home development could result in approximately nine to 14 fewer jobs in these sectors.

- Homeowners who purchase new homes that would have been on septic systems that would now be developed with municipal sewer hookups will also experience a financial impact. As described in Section 2, these homeowners will pay an estimated $850 more per year (including both higher mortgage payments and the difference between septic operating costs and sewer rates) than if their homes were on septic systems. Less than ten percent of all new homeowners in the LPRV would experience this impact.

# *INDIRECT COSTS AND ECONOMIC IMPACTS — COMMERCIAL / INDUSTRIAL ACTIVITY*

***The suite of measures designed to reduce or prevent aquifer contamination by new commercial and industrial businesses could affect the cost of developing some new business properties in the LPRV. Experience in the Rathdrum Prairie, however, indicates that the local business community in that area has been generally supportive of these measures.***

- Panhandle Health District staff indicated to the study team that approximately 40 firms per year file critical materials reports with the Health District. About one-half of these firms use these materials at levels above the designated thresholds and, consequently, must file a critical materials management plan with the District. In most cases, the plans are simple letters that can be prepared by the business without outside engineering consultation. In these cases the actual secondary containment requirements are also met fairly simply with measures such as containment pallets for drums or double walled storage tanks. There are, however, occasional instances where secondary containment can be much more significant. The most recent, high profile example in the Rathdrum concerned a proposed new railroad refueling depot. The railroad was, however, able to develop a containment design that exceeded the District's requirements and obtain District approval.
- Study team interviews with executives at the local chamber of commerce and economic development agencies also indicated that there is little or no negative feedback from local firms concerning either the critical materials regulations or stormwater management requirements (Jonathan Coe, Executive Director, ***Coeur d'Alene Chamber***). Further, the Rathdrum protection measures were deemed to have had essentially "no impact on efforts to recruit companies" into the region (Robert Potter, Executive Director, ***Jobs Plus***, Coeur d'Alene). Both agencies indicated that their members consider the aquifer to be an extremely valuable resource that must be protected.
- One significant concern regarding business impacts was raised by sources at the Coeur d'Alene wastewater utility. The restriction on non-domestic wastewater disposal has reportedly been a problem for a number of pre-existing commercial businesses located in areas isolated from municipal wastewater collection systems. These businesses are effectively prohibited from expanding their operations (or at least the volume of their wastewater disposal) until, or unless, they can eventually connect to one of the municipal sewer systems in the area. (Don Kyle, Operations Manager, ***Coeur d'Alene Wastewater System***).

# *INDIRECT COSTS AND ECONOMIC IMPACTS — COMMERCIAL / INDUSTRIAL ACTIVITY, CONTINUED*

***The aquifer protection measures focused on new commercial / industrial activity and development (critical materials regulation, stormwater disposal and non-domestic wastewater disposal) could potentially have an impact on new business activity in the LPRV. While these impacts cannot be quantified with any certainty, The Rathdrum Prairie experience suggests they are unlikely to be a major issue. The following is the study team's generalized assessment of the magnitude of the "worst case" potential impacts.***

- There are no available estimates of the costs incurred by businesses in the Rathdrum Prairie to install secondary containment or to meet the stormwater disposal requirements. Based on descriptions of typical approaches to these problems in practice, the study team believes the stormwater disposal requirements can be met with essentially no increase in cost, while the critical materials regulations might increase the average costs of developing those particular, new commercial and industrial facilities that require secondary containment by about two to four percent.

- There are also no known estimates of the impact of such cost increases in commercial and industrial property development costs on the rate at which new businesses develop over time. However, we can get a sense of the potential magnitude of these impacts by applying the same elasticity approach used in the assessment of impacts of protection measures on residential development.

- In Section 2, the study team estimated that about 68 net new establishments would be created each year in the LPRV under the baseline scenario. Based on the level of Rathdrum critical material permitting activity, and adjusting for the slower growth rate in the LPRV, perhaps as many as ten of these establishments would require secondary containment facilities. Using the residential elasticity estimate of 1.2 together with the estimated cost increases for commercial and industrial property development of four percent (for properties requiring critical materials containment) implies that perhaps five fewer businesses will be developed ***each decade*** due to the cost increases from the enhanced protection scenario. At average LPRV employment of 13 jobs per business, this would imply about 65 fewer new jobs over the decade, or about five fewer jobs each year.

# *INDIRECT COSTS AND ECONOMIC IMPACTS — SUMMARY*

***The potential indirect costs and economic impacts of implementing the enhanced protection scenario in the LPRV are subject to much more uncertainty than the direct costs for administration and management. Prior experience in the Rathdrum Prairie suggests that, despite initial concerns, these impacts have been modest. We have endeavored to develop order of magnitude estimates of the potential impacts under "worst case" assumptions. Study team estimates of the magnitude of cost impacts suggest that these effects are likely well within the range of annual fluctuations due to other market factors. The table below summarizes the range of these potential impact estimates.***

***Summary of "Worst Case" Indirect Cost and Impact Estimates***

| *Cost/Impact Element* | *2010* | *2020* |
|---|---|---|
| Increase in average Price of New Homes | 0.4% to 0.7% | 0.4% to 0.7% |
| Annual Cost Increase for 20 to 35 homeowners per year* | $850/household | $850/household |
| Potential Reduction in Annual Number of New Homes | 2-3 Homes | 2-3 Homes |
| Potential Cumulative Reduction in New Homes | 20-30 Homes | 40-60 Homes |
| Annual Reduction in Number of New LPRV Businesses | 0.5 Businesses | 0.5 Businesses |
| Cumulative Employment Effects | | |
| From Reduced New Home Development | 9-14 jobs | 9-14 jobs |
| From Reduced New Business Development | 65 jobs | 130 jobs |
| ***Total*** | 74-79 jobs | 139-144 jobs |

*Applied only to owners of homes that are developed with sewer disposal under enhanced aquifer protection scenario that would have been developed with septic disposal under the baseline scenario.

# *SECTION 3c.*
# *BENEFITS OF ENHANCED AQUIFER PROTECTION IN THE LPRV*

# *OVERVIEW OF BENEFITS OF THE ENHANCED AQUIFER PROTECTION SCENARIO*

***The enhanced protection scenario is intended to prevent further deterioration in LPRV water quality resulting from new developments, new businesses and new business activity. As such the benefits of this scenario are in avoiding anticipated or potential declines in water quality under the baseline scenario and the economic costs associated with additional water quality degradation.***

***This section summarizes the potential hydrologic and economic benefits of the enhanced protection scenario based on avoiding the implications of the baseline scenario. Much more detail on the projected hydrologic impacts and water quality related costs of taking no action under the baseline scenario is provided in Section 2b and Section 2c (respectively) of this report.***

# *HYDROLOGIC BENEFITS OF THE ENHANCED PROTECTION SCENARIO*

***Section 2 described the physical characteristics of the LPRV aquifer, the relationships that have been found between surface activities and water quality in extensive studies of the hydrologically similar Rathdrum Prairie Aquifer and the comparatively limited data on water quality trends in the LPRV. The following are the key points from this information in terms of the hydrologic benefits of the enhanced protection scenario.***

- The LPRV Aquifer has an important combination of attributes in common with the Rathdrum Prairie Aquifer: highly permeable surface cover, relatively shallow depth to groundwater, intensive surface activity and development, and the aquifer's status as the sole supply source for the study area. These elements make the LPRV aquifer highly vulnerable to contamination and the waters it contains highly important to the region.

- Extensive technical analysis in the Rathdrum Prairie over the past twenty years has demonstrated and quantified the relationships between surface activities and water quality in that aquifer. These relationships have not been fully quantified in the LPRV.

- Apart from well publicized issues with PCE and TCE contamination, certain areas in the LPRV aquifer have elevated levels of contaminants such as nitrates and chlorides. While some wells indicate an increasing trend, there is not enough data available to conclusively determine the rate of change in LPRV water quality.

- Overall, there is sufficient evidence to indicate that the LPRV aquifer has been degraded by surface activities to this point and is highly vulnerable to further degradation. There is not enough evidence to determine how quickly, or precisely where, future degradation will occur.

# *ECONOMIC BENEFITS OF THE ENHANCED PROTECTION SCENARIO*

***Section 2 also described estimated economic costs associated with water quality degradation under the baseline scenario. These cost estimates are based largely on national studies of household responses to perceived water quality degradation and/or household willingness to pay to avoid the possibility of future contamination. Although business costs may also be significant, they could not be quantified based on previous research. The following table from Section 2 presents projected costs of water quality degradation under the baseline scenario, which become the corresponding benefits of the enhanced protection scenario.***

| | *Annual Cost (Year 2000 $)* | | |
|---|---|---|---|
| ***Cost Element*** | ***2010*** | ***2020*** | ***Notes*** |
| ***Common Contaminants - Phase I*** | | | |
| Household Costs per Household | $120 to $360 | $160 to $480 | |
| Aggregate Household Costs | $4 to $11 million | $6 to $17 million | |
| Business Costs | Not Quantified | Not Quantified | |
| ***Hazardous Contamination Costs*** | Not Quantified | Not Quantified | Risk not easily amenable to prediction. Recent local experience and costs indicative of risk. Could force earlier remediation by water suppliers. |
| ***Remediaton Costs*** | Assumed To Occur After 2020 | | Range of annualized costs from $250 to $600 per household. Corresponding reduction in phase 1 household and business costs after remediation by water suppler. |
| ***Economic Development Costs*** | | | |
| Annual New Employment Foregone | 28 Jobs | 28 Jobs | Indicative estimates only, based on assumptions stated in text. Actual costs may be higher or lower. |
| Annual New Wages Foregone | $1 million | $1 million | |
| Cumulative Employment Foregone | 28 Jobs | 275 Jobs | |
| Cumulative Yearly Wages Foregone | $1 million | $9.6 million | |

# *SECTION 3d.*
# *COMPARISON OF THE ENHANCED AQUIFER PROTECTION SCENARIO WITH THE BASELINE SCENARIO*

# *COMPARISON OVERVIEW*

***The following pages provide a comparison of relevant costs and economic effects under the enhanced protection scenario with the baseline scenario. This comparison yields estimates of the net annual benefits of the enhanced protection scenario in years 2010 and 2020. In these comparisons, the study team has also identified the parties or groups anticipated to experience each type of cost or benefit. Following the assessment of annual effects in the two selected years, we also provide a projection of total benefits and costs over the 20-year study horizon -- allowing for an estimate of the cumulative net present value of implementing the enhanced protection scenario.***

***The estimates of benefits and costs provided throughout this section draw from information and analyses developed earlier in this section -- which in turn draw from work described in both Section 1 and Section 2. While specific dollar values are presented in this section wherever possible, the reader should remain aware that many of the cost and benefit estimates are subject to considerable uncertainty. Nonetheless, the values provided herein represent the study team's best estimates of potential benefits and potential "worst case" costs and economic impacts. Because costs of enhanced protection for local business have been included, while benefits of enhanced protection for business have not, the net benefits estimates are likely understated. Specific areas of uncertainty, and the potential to address some of these areas through further research, are discussed further in the final pages of this report.***

# *COMPARISON OF PROJECTED ANNUAL COSTS IN 2010*

***The table on the following page draws together information presented elsewhere throughout this study to provide a comparison of annual costs in 2010 under the enhanced protection scenario relative to the baseline scenario. This comparison leads to an estimate that the net annual benefit of the enhanced protection scenario in year 2010 would be between $2.5 and $9.6 million. The estimated benefit/cost ratio of the enhanced protection scenario for year 2010 alone is between 1.9 and 4.7.***

# *COMPARISON OF PROJECTED ANNUAL COSTS IN 2010*

**Comparison of Projected Annual Costs and Cost Elements in 2010**
**Enhanced Protection Scenario Versus Baseline Scenario**

| *Cost Element* | *Annual Cost in 2010 (excluding inflation)* | | *Enhanced Protection Annual Benefit/(Cost) in 2010* | *Effected Parties* |
|---|---|---|---|---|
| | *Enhanced Protection* | *Baseline* | | |
| ***Administrative Costs of Enhanced Aquifer Protection*** | $0.5 million | $0 | ($0.5 million) | All LPRV residents and businesses |
| ***Aggregate Costs of Residential Wastewater Disposal for New Development*** | | | | |
| Via Septic Systems | $0 | $0.067 to $0.12 million | | |
| Via Sewer Systems | $4.8 to $5.1 million | $4.5 to $4.7 million | | Under 10% of new homeowners |
| Sub-total | $4.8 to $5.1 million | $4.6 to $4.8 million | ($0.2 to $0.3 million) | in LPRV, or LPRV new home developers |
| ***Water Quality Related Costs*** | | | | |
| Household Costs | $0 | $4 to $11 million | $4 to $11 million | All LPRV residents |
| Business Costs | $0 | not quantified | not quantified | |
| ***Impacts on Jobs and Wages*** | | | | |
| Direct employment in enhanced protection administration | 6 jobs | 0 | | |
| Annual wages | $0.2 million | $0 | $0.2 million | Administering agency employees |
| Impacts due to indirect costs of enhanced protection: | | | | |
| Lost jobs in new home construction, real estate, etc. | 9 to 14 jobs | 0 | | Construction & real estate sectors |
| Lost jobs due to regulatory costs for new businesses | 65 jobs | 0 | | Employees of foregone new businesses |
| Total jobs lost due to increased home and business costs | 74 to 79 jobs | 0 | | |
| Annual Wages Lost (midpoint estimate) | $1.9 million | $0 | ($1.9 million) | |
| Economic Development Losses Due to Water Quality Issues | | | | |
| Manufacturing Jobs | 0 | 30 jobs | | |
| Annual Wages | $0 | $1 million | $1 million | Employees of foregone new businesses |
| ***Scenario Comparison in 2010*** | | | | |
| ***Annual Net Monetized Benefits/(Costs) of Enhanced Protection Scenario*** | | | $2.5 to $9.6 million | |
| ***Annual Benefit/Cost Ratio in 2010*** | | | 1.9 to 4.7 | |

# *COMPARISON OF PROJECTED ANNUAL COSTS IN 2020*

***The table on the following page provides comparable information for year 2020. In that year, the projected net annual benefit of the enhanced protection scenario is between $11.1 and $22.5 million. The estimated benefit/cost ratio of the enhanced protection scenario for year 2020 alone is between 3.4 and 6.4.***

# *COMPARISON OF PROJECTED ANNUAL COSTS IN 2020*

**Comparison of Projected Annual Costs and Cost Elements in 2020**
**Enhanced Protection Scenario Versus Baseline Scenario**

| *Cost Element* | *Annual Cost in 2020 (excluding inflation)* *Enhanced Protection* | *Baseline* | *Enhanced Protection Annual Benefit/(Cost) in 2020* | *Effected Parties* |
|---|---|---|---|---|
| ***Administrative Costs of Enhanced Aquifer Protection*** | $0.275 million | $0 | ($0.275 million) | All LPRV residents and businesses |
| ***Aggregate Costs of Residential Wastewater Disposal for New Development*** | | | | |
| Via Septic Systems | $0 | $0.135 to $0.235 million | | |
| Via Sewer Systems | $9.5 to $10.3 million | $9.1 to $9.4 million | | Under 10% of new homeowners |
| Sub-total | $9.5 to $10.3 million | $9.2 to $9.6 million | ($0.3 to $0.7 million) | in LPRV, or LPRV new home developers |
| ***Water Quality Related Costs*** | | | | |
| Household Costs | $0 | $6 to $17 million | $6 to $17 million | All LPRV residents |
| Business Costs | $0 | not quantified | not quantified | |
| ***Impacts on Jobs and Wages*** | | | | |
| Direct employment in enhanced protection administration | 4 jobs | 0 | | |
| Annual wages | $0.1 million | $0 | $0.1 million | Administering agency employees |
| Impacts due to indirect costs of enhanced protection: | | | | |
| Lost jobs in new home construction, real estate, etc. | 9 to 14 jobs | 0 | | Construction & real estate sectors |
| Lost jobs due to regulatory costs for new businesses | 130 jobs | 0 | | Employees of foregone new businesses |
| Total jobs lost due to increased home and business costs | 139 to 144 jobs | 0 | | |
| Annual Wages Lost (midpoint estimate) | $3.6 million | $0 | ($3.6 million) | |
| Economic Development Losses Due to Water Quality Issues | | | | |
| Manufacturing Jobs | 0 | 275 jobs | | |
| Annual Wages | $0 | $9.6 million | $9.6 million | Employees of foregone new businesses |
| ***Scenario Comparison in 2020*** | | | | |
| ***Annual Net Monetized Benefits/(Costs) of Enhanced Protection Scenario*** | | | $11.1 to $22.5 million | |
| ***Annual Benefit/Cost Ratio in 2020*** | | | 3.4 to 6.4 | |

# *NET PRESENT VALUE AND "BREAK EVEN" POINT FOR ENHANCED PROTECTION SCENARIO*

***In order to assess the cumulative, net present value of implementing the enhanced protection scenario, estimates of annual benefits and costs are required for each year of the study horizon. For purposes of analysis only, the study team has assumed the scenario would be enacted in year 2001. We have also made the conservative assumption that no benefits would accrue from the enhanced protection scenario until year 2010.***

***The following table indicates that the cumulative net present value of implementing the enhanced protection scenario is estimated at approximately $56 million (using a four percent real discount rate on the uninflated annual cost and benefit estimates). The "break even" when cumulative benefits begin to exceed cumulative costs is anticipated to be 2012.***

**Present Value of Net Benefits and Projected "Break Even" Year**

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual Benefits | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $8.5 | $9.8 | $11.0 | $12.3 | $13.5 | $14.8 | $16.0 | $17.3 | $18.5 | $19.8 | $21.0 |
| (Annual Costs) | ($1.0) | ($1.2) | ($1.4) | ($1.5) | ($1.7) | ($1.9) | ($2.1) | ($2.3) | ($2.5) | ($2.7) | ($2.9) | ($3.0) | ($3.2) | ($3.4) | ($3.6) | ($3.8) | ($4.0) | ($4.2) | ($4.4) | ($4.5) |
| Net Benefit | ($1.0) | ($1.2) | ($1.4) | ($1.5) | ($1.7) | ($1.9) | ($2.1) | ($2.3) | ($2.5) | $5.8 | $6.9 | $8.0 | $9.0 | $10.1 | $11.2 | $12.2 | $13.3 | $14.3 | $15.4 | $16.5 |
| Present Value of Net Benefit | ($1.0) | ($1.1) | ($1.2) | ($1.4) | ($1.5) | ($1.6) | ($1.7) | ($1.7) | ($1.8) | $4.1 | $4.7 | $5.2 | $5.6 | $6.1 | $6.4 | $6.8 | $7.1 | $7.4 | $7.6 | $7.8 |
| Cumulative Present Value | ($1.0) | ($2.1) | ($3.3) | ($4.7) | ($6.2) | ($7.8) | ($9.4) | ($11.2) | ($13.0) | ($8.9) | ($4.2) | $1.0 | $6.6 | $12.7 | $19.1 | $25.9 | $33.0 | $40.3 | $47.9 | $55.8 |

Total Net Present Value 2001-2020 $56 million

"Break Even" Year 2012

# *SUMMARY OF SCENARIO COMPARISON AND IMPACT ESTIMATES*

***Comparisons of the enhanced protection scenario with the baseline scenario indicate the following key findings:***

- The economic and financial benefits of implementing the enhanced protection scenario are projected to substantially exceed the costs over the 20-year study horizon. Further, the annual net benefit grows as the years progress. If the benefits of enhanced protection for local business could be quantified, the net benefit would be even larger.

- In the early years, the annual costs will likely exceed the benefits. The study team estimates that the cumulative present value of the "investment" in the enhanced protection scenario could reach approximately $13 million before benefits begin to be recouped in year 2010.

- In general, the benefits of the enhanced protection scenario are widely spread amongst both existing and future, residential and business water users in the LPRV.

- While many of the costs (such as the direct administrative costs) are also widely spread throughout the study area, some costs effect more specific groups. In particular, sectors associated with new home development (construction, real estate, etc.) are anticipated to bear a specific, though relatively modest, portion of the cost. Similarly, new homebuyers who purchase properties that would have been served by septic systems but are now developed with sewer hookups are projected to experience higher annual costs, or developers will profit less.

- Because the enhanced protection scenario is focused on preventing water degradation from new activities in the LPRV, rather than addressing existing sources of potential contamination, future residents and businesses would bear the largest share of the financial and economic costs.

# *SECTION 3e.*
# *AREAS OF GREATEST UNCERTAINTY AND POTENTIAL FOR FUTURE RESEARCH*

# *UNCERTAINTY AND POTENTIAL FUTURE RESEARCH*

***This initial study of enhanced protection of the LPRV aquifer indicates that benefits of implementing additional aquifer protection measures likely will substantially exceed costs. As noted throughout the three sections, however, there are numerous areas of uncertainty pertaining to both the benefit estimates and the cost estimates. Some, though not all, of these areas of uncertainty could be reduced by further technical research and analysis. Five key areas of uncertainty, and potential strategies to enhance available information, are described below.***

- ***Hydrologic benefits of enhanced aquifer protection*** -- While this element is obviously important in the context of this analysis, it will not be easy to substantially reduce its uncertainty. More monitoring wells, more frequent data collection from such wells and enhanced analysis using the additional data will likely be required and data may need to be collected over a number of years.

- ***Water quantity concerns in the LPRV*** -- This study has indicated, based on previous research, that withdrawals from the LPRV aquifer are rapidly approaching (or may already exceed) annual recharge into the aquifer. Given the estimated volume of supply existing in the aquifer, this does not pose an immediate threat to the availability of water in the study area. While the enhanced protection scenario focuses on preserving water quality and does not address water quantity concerns, the economic benefits of aquifer protection strategies could be affected by alternative supply strategies. For example, if surface supplies were developed in sufficient capacity to serve not only new growth but also existing users in the LPRV, the economic benefits of preserving aquifer water quality would likely diminish. Clearly, the water quality protection plan should consider the water supply planning efforts and vice versa.

# *UNCERTAINTY AND POTENTIAL FUTURE RESEARCH*

- ***Indirect costs of enhanced aquifer protection*** -- While the study team does not believe that costs of secondary containment facilities would have a substantial economic impact in the study area, this issue could be clarified by more detailed research. In particular, review of authorized commercial and industrial building permits over the past few years could identify the number and types of facilities affected. Preliminary engineering cost estimates could then be developed for secondary containment equipment at representative facilities and compared to the overall cost of facility development.

- ***Economic benefits of enhanced aquifer protection*** -- Estimates of household costs due to water quality degradation are an important part of the economic analysis of enhanced aquifer protection measures. In this study, these cost estimates were based upon contingent valuation studies and other household survey research in other parts of the U.S. confronting similar water quality issues. Similar surveys and studies could be peformed in the LPRV to more precisely quantify these baseline costs and enhanced protection benefits.

- ***Primary research with the LPRV business community*** -- Surveys or more extensive key informant interviews could be performed with corporate leaders in the LPRV to address several issues. In particular, the effect of increases in the cost of developing new facilities and the perceptual impact of water quality concerns on economic development might be further clarified through such research.

- ***Refined assumptions based on public input*** – Following the publication and dissemination of these study results, certain key assumptions might be modified and/or uncertainties might be raised. The study team can devise a plan for refining those assumptions based upon further research to reduce uncertainty in these estimates.