CHAPTER 1

INTRODUCTION

The primary goal of this research is to determine the value that society places on long-term environmental health risks, accounting for the intertemporal nature of benefits that stem from measures taken to address such risks. As a vehicle for examining the questions surrounding time preference and stated preference valuation methodology, this research focuses on groundwater protection as a specific case of a broader class of environmental health risks. However, it is important to note that the fundamental questions this study seeks to address are relevant for any long term public investment in a non-market good. Investments in such goods pose specific problems, as a traditional economic market for the good does not exist, and the benefits of the investment will typically accrue over many years into the future and possibly to future generations, while the major costs of the project are incurred immediately and their burden falls upon the present generation.

The task of valuing non-market goods is not a simple one. The stated preference, or direct, method usually employed to value such goods, the contingent valuation method (CVM) technique, is highly controversial due to its hypothetical nature. While indirect methods, such as averting expenditures, have been used to value environmental health risks, stated preference methods are the only available option for measuring non-use values, which may account for a significant portion of total economic value. Non-use values may include values for the use of others (social use values), bequest, option and existence values. Modified forms of the CVM, such as conjoint (CJ) analysis, have not been fully explored and may provide an attractive alternative to the contingent valuation method for the valuation of environmental health risks. Prior to a more detailed exploration of the problems this study seeks to address and why groundwater protection is such an appropriate context for examining these problems, we first discuss the importance of groundwater as a natural resource.

1.1 Groundwater as a Vital Natural Resource

Groundwater is an important, but often under-appreciated, natural resource in the United States. Approximately 157,000 public water systems in the United States draw all or part of their drinking water from underground sources ("Q & A", 2000). Seventy-five percent of cities in the United States use groundwater as a partial or primary source of drinking water, while half of all Americans rely upon groundwater for their primary drinking water supply. Groundwater is particularly important as a drinking water source for rural America; ninety-five percent of the country's rural population uses groundwater for its drinking water supply (US EPA, 2000d). Thirty-five percent of Massachusetts' six million residents obtain their primary drinking water from groundwater sources, and 69% of the towns in Massachusetts rely partially or solely on public groundwater supplies (US Geological Survey, 1995). In addition to its critical role as both a public and private drinking water supply, groundwater is used for irrigation and livestock watering, as well as in industrial, commercial, and mining production processes. Reliance on groundwater has been increasing due to the difficulty of developing new surface water supplies, the higher degree of treatment required for surface water, and potentially conflicting demand for recreation on surface waters.

Groundwater is often directly connected to rivers, streams, lakes, and other surface water bodies. It is estimated that 492 billion gallons of groundwater per day are discharged to surface water bodies (US EPA, 2000d). Thus, groundwater also plays a substantial role in the overall quality of surface water. Surface water bodies may become contaminated if groundwater acts as a transporter of contaminants.

Previously it was believed that soil provides a protective barrier for groundwater resources. However, in recent years there has been growing concern about groundwater contamination. Such contamination may take many forms, such as chemical or bacterial contamination. Residential, agricultural, and industrial activities all have the potential to contribute to groundwater contamination. In addition, groundwater contamination can occur naturally. Beginning in the 1970s, every state in the country has reported cases of contaminated groundwater. Data from the Centers for Disease Control indicate that between 1971 and 1996 there were 318 groundwater related disease outbreaks reported in the United States (“Q & A”, 2000). In 1984 the U.S. Office of Technology Assessment (OTA) reported that approximately 1-2% of the nation’s groundwater was contaminated (US EPA, 2000d). The report acknowledged that this estimate is a lower bound, as monitoring for contamination has focused on public water systems. Individual homeowners are responsible for monitoring the quality of their private water supply systems, and little is known about contamination levels in these private water supply systems. Section 106(e) of the Federal Clean Air Act requests that each state monitor groundwater quality and report their findings every two years to Congress in their State Water Quality Report; this process is known as the 305(b) process. However, these reports have typically been based on known or suspected contamination sites, and the data has been obtained from public supply systems. In 2000, the 305(b) report of the state of Massachusetts to Congress stated that as of November 1999, contamination had resulted in the permanent or temporary closing of 260 public water sources in 101 communities; all but four of these sources were groundwater supplies. Monitoring data shows that Volatile Organic Compounds (VOCs) have been detected in 44 of these supplies, while 17 supplies have had nitrates levels that exceed the Maximum Contaminant Level (The Commonwealth of Massachusetts, 2000).

1.2 Statement of Research Problem

Groundwater protection requires substantial current investment, and the benefits of groundwater protection programs may not be realized for many years. Investment in groundwater protection programs necessitates forgoing some present consumption. For example, suppose protective measures take the form of a privately installed filtration system. In this case, the homeowner must give up some amount of his income, and hence the consumption of other goods, to purchase the system. On the other hand, if the state or local government implements a protection program, the public monies used for groundwater protection cannot be used for another purpose, such as police protection or education. Alternatively, the government may decide to collect additional revenues to pay for the protection programs, thereby lowering the taxpayer’s disposal income and forcing her to forgo some consumption of other goods. Consequently, effective and responsible public policy requires decision makers to obtain and consider groundwater values that accurately reflect the preferences of society. The weight that society places on benefits received today, versus benefits received at some future date, must be determined, as well as the form of groundwater protection (private or public) most preferred.

There is a considerable and long standing debate surrounding valuation methodology. The contingent valuation method (CVM) has drawn heavy criticism. Much of this criticism stems from the use of hypothetical questions to elicit individuals' willingness-to-pay for a particular resource or program. A modified form of the CVM, conjoint (CJ) analysis, asks individuals to rate, rather than price (as in the CVM), alternative programs. Conjoint analysis may be particularly attractive in valuing health-related issues, such as protection from groundwater related illness, where individuals have often been unwilling to place a dollar value on life.

Prior studies, which will be discussed in detail in Chapter Three, indicate three problems in the valuation of groundwater protection programs. First, previous groundwater valuation studies have focused solely on the individual's willingness-to-pay (WTP) for protection, ignoring the intertemporal aspect of groundwater protection programs. Decisions involving health issues almost always have a time element; both individuals and society are usually required to make trade-offs between the present and the future. Many programs aimed at preserving or maintaining good health yield benefits that may not be realized until many years into the future. Groundwater protection programs require that substantial amounts of money be invested in the present, while the benefits of such programs are likely to occur over a number of years in the future. Different types of water quality programs will vary in the specific health effects they address, as well as in their time horizons. The rate at which the individual discounts different health effects is central to evaluating the relative attractiveness of each alternative. The higher the individual's rate of discount, the less value he places on benefits that occur in the future. More generally, much of current government policy is directed at long-term problems. Moore and Viscusi (1990b) argue that the entire thrust of EPA policy depends on the discounting debate, as policy is currently focused on addressing long term health risks.

Secondly, many groundwater protection valuation studies have either focused on a single type of contamination, such as nitrate, or have not specified the type of contamination. This poses a problem because the various forms of contamination differ in the adverse health effects they produce. Consequently, values for groundwater protection must reflect the specific form or forms of contamination the proposed programs address. In other words, individuals must know exactly what it is they would be "buying" when asked, in a hypothetical context, if they would indeed support a particular protection measure in favor of the current situation that they face. Otherwise, the willingness-to-pay values for protection elicited from stated preference methods have little meaning.

Finally, very little comparative analysis of the contingent valuation and conjoint techniques has been conducted though these are the only methods available for measuring both use and non-use values. Further comparative analysis is necessary to explore the strengths and weaknesses conjoint analysis may have relative to the contingent valuation method in valuing groundwater and other non-market goods. It is also necessary to consider the role that uncertainty plays in valuation using stated preference methods. An individual may easily indicate that he supports a particular program by a 'yes' vote, but researchers must ask him, as well as themselves, just how certain he is about that decision, and to consider seriously how likely he would be to support the program in reality.

1.3 Research Objectives

Consequently, this research has two main objectives: to value the health risks associated with chemical sources of groundwater contamination and to determine the rate at which the individual discounts future benefits. This study also tests the hypothesis that discount rates decline as the time horizon involved increases. Finally, this study examines whether individuals have different values for public versus private forms of groundwater protection. In pursuing these objectives, conjoint analysis and contingent valuation techniques are compared through the development of a survey instrument that employs both techniques separately and also combines the two, thereby producing an improved methodology for valuation of water resources and other non-market goods.