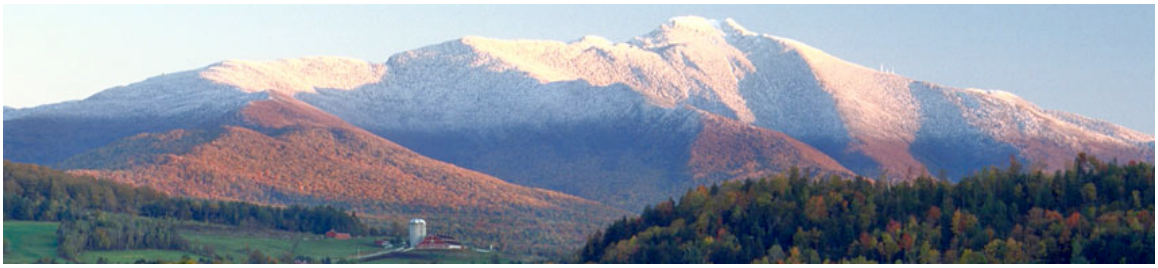
When the well goes dry, know the value of water
-Benjamin Franklin

Vermont Common Assets Trust

Groundwater



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Also available at: http://www.uvm.edu/~ccasey/VCAT%20-%20Groundwater.html

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Introduction:

Water is a rival, non-excludable resource that is essential to all life on earth. Two-thirds of Vermonters depend on groundwater for drinking and other necessary water uses, (VNRC, 2007). In addition to domestic use, other sectors, such as agriculture and industry rely on groundwater, as does the production of consumer goods that incorporate water into the finished product (i.e. bottled water). Another tremendously important function of groundwater in Vermont is the way in which it interacts with surface water in recharging surface water stocks (lakes, ponds) and flows (streams, rivers) that aquatic ecosystems rely on.

Conventional markets fail to appropriately manage this ecosystem good as well as the services it provides. Markets fail to take sustainable scale into consideration and often contribute to an inequitable distribution of wealth. Without proper institutions to regulate and monitor use of groundwater, corporations and heavy users benefit from managing the resource irresponsibly, making short-term private gain a priority. Society is left paying for something that is a part of the commons and should benefit everyone, while private interests deplete the resource and degrade the ecosystem. This problem of open access results from a lack of enforceable property rights. An institution is needed to prevent individuals and corporations from over exploiting this essential resource. Water resources are a part of our shared inheritance and should remain available for various public good uses, as laid out in the recent bill, S044. This bill declared water to be a common asset of all Vermonters.

Water is a complex resource whose economic characteristics depend on the source it is extracted from and the uses it is put toward. Developing an appropriate scale for groundwater extraction and suitable policies to regulate and tax use of this common resource are dependent on a clear and comprehensive understanding of hydrogeology. A few simple definitions are helpful in understanding the complexities surrounding use of groundwater. Technically, groundwater is water below the earth's surface, which saturates the substrate that contains it. An aquifer is a saturated substrate that creates a reservoir of usable water. Above this saturated layer is the unsaturated region made up of soil or rock. Depending on the geology of the area, an unsaturated layer may not exist, or it may be hundreds of feet thick. The line between these two layers (saturated and unsaturated) is known as the water table. Water table depth, flow and aquifer type vary immensely in relation to geology. Typically, groundwater in Vermont is contained either in bedrock fractures or glacial deposits of sand and gravel (Mulholland, 2008).

Water can be categorized as either a fund service (as it sustains all ecosystems and life) or a stock flow resource (when used for drinking, irrigation, industry, etc.), and although many water resources are renewable as a result of the hydrological cycle, water from fossil aquifers is nonrenewable. It is difficult to assign property rights to water, but essentially they should belong to the community. An institution,

such as a common asset trust would allow Vermonters to better manage this resource for current and future use. For instance, currently several bottling companies are extracting water in Vermont and shipping the water out of the state, and in some instances, out of the country. This type of activity directly impacts Vermonters and allows bottling companies to profit from our common property. A Vermont Common Asset Trust could potentially put an end to this trend.

The proposed Vermont Common Asset Trust (VCAT) is an opportunity for Vermonters to sustainably manage this precious resource and capture some of the economic benefits of groundwater extraction that are currently unaccounted for with market institutions. VCAT would allow society to capture rent and apply that money to manage ecosystem services. Ecosystem services are poorly accounted for by markets, so an institution is instrumental in sustaining those resources which provide ecosystem services and in ensuring just distribution and efficient allocation of those resources.

A lack of research and monitoring institutions also deprives Vermonters of accessible and updated information regarding the use of this essential resource. Vermont is the only state in New England that does not have policies to regulate commercial water bottling industries, (VNRC, 2007). To date, this has not posed a major problem because groundwater is relatively plentiful and is not viewed as a scarce resource. Vermont is blessed with an abundant water supply; with the exception of a few isolated incidents, Vermonters have always had enough water to satisfy all their desired uses. Similar to other mineral resources, the water extracted from aquifers is a stock flow resource. The resource may not appear scarce, but if it is depleted more quickly than the recharge rate, it may not be as abundant as assumed. Furthermore, if demand is steadily growing and the resource is finite, it will become scarce. Given water's importance, we should be proactive concerning imminent scarcity, not reactive.

When water is abundant, people are willing to pay the extraction price, but no more. As the resource becomes scarce, uses low marginal value are the first to be sacrificed. If scarcity increases, increasingly important uses must be foregone, and if the resource reaches a point of extreme scarcity, it must be reserved for essential uses. In light of water crises across the country and around the world, it would be foolish to ignore the possibility of increased water scarcity in our own region in the coming decades. By depleting aquifer resources faster than they are replenished, future generations may be forced to make serious sacrifices in exchange for the present generation's nonessential, wasteful uses.

Although to date, Vermont has not experienced any water quantity problems, in the future as populations and demand grow, or if private interests are allowed to exploit the resource, water quantity and water rights may become a more serious issue. Water quantity issues could occur at a localized level as a result of drilling too many wells and lowering the water table into a depression zone, or they could be experienced at a watershed level if more groundwater is withdrawn from a region than can be renewed by recharge. Excessive pumping of groundwater could also

interfere with stream flow. Areas where water is being pumped for use by bottling companies are especially susceptible to decreased stream flow and damaged aquatic ecosystems because unlike areas where water is being used for domestic or agricultural uses, the water pumped does not eventually return to the original source. High or unsustainable levels of use can also lead to reduced rates of aquifer recharge. In addition, issues of water quantity can exacerbate groundwater contamination problems.

As previously mentioned, groundwater was recently declared a public trust resource in Vermont. Generally, people agree and understand that water is and should be accessible as a common good. Now that groundwater has been declared a public trust resource, our aim is to determine a sustainable scale of groundwater extraction for each watershed within Vermont. This sustainable scale will vary by region and depend on the hydrogeology and aquifers in each watershed. Adequate information is needed concerning the amount, location, and flow of groundwater and mapping of this resource in order to determine a sustainable scale of extraction. Also, there is a lack of sufficient information about which private corporations are benefiting from extracting groundwater and how much they are profiting. This research will contribute to the potential inclusion of groundwater as a resource for VCAT, and is supported by our sponsors, Josh Farley and Gary Flomenhoft of the Gund Institute at the University of Vermont.

Goals & Objectives:

The goal of this research was to define the sustainable scale of groundwater extraction in Vermont. In order to achieve this goal, it was necessary to accomplish various objectives. The first objective was to aggregate the completed and ongoing research on this topic in order to assist the current and future projects. The second objective was to reach consensus among local experts on regional sustainable extraction rates. The final objective was to identify the organizations and institutions that currently manage groundwater in Vermont.

Methods:

To achieve the goals and objectives of this research project, the primary method employed was a Delphi survey. A Delphi survey is an iterative multistage process that is designed to transform expert opinion into group consensus, in order to predict future activity patterns (Farkas, 1980; Hasson et al, 2000). A Delphi survey will help to determine the sustainable scale of groundwater extraction in Vermont. The process consists of systematically collecting subjective opinions from a panel of experts, then allows the experts to review the summarized responses, and make changes to their answers as influenced by the data provided by the other experts (Farkas, 1980). After the first round of questionnaires is collected, the analyzed results are summarized and distributed with a second questionnaire. In

light of the results, participants will be asked to alter and refine their answers as well as answer any additional questions. This process aims to achieve a consensus by providing insight into the most likely outcome of the addressed problem (Farkas, 1980).

In the first questionnaire, participants will respond to eight open-ended questions. The first round survey questions can be found in Appendix A. The questions asked in the second round questionnaire will be determined after analyzing the results of the first questionnaire and will focus on obtaining more specific information. To minimize the role of dominant participants and their potential to bias the responses of other participants, the summarized responses will be anonymous (Farkas, 1980). The panel of experts that this survey is going to be distributed to consists of the eight Vermont Watershed Coordinators from the Department of Environmental Conservation (DEC), in the Water Quality Division of the Agency of Natural Resources (ANR). Their contact information is listed in Appendix B. Another important aspect of a Delphi survey is the controlled feedback to the respondents. The summarized responses will focus only on the information relevant to the goals of this research project and attempt to limit the amount of irrelevant data (Farkas, 1980). Once there is adequate time to synthesize the feedback, the group will communicate the results back to survey participants. This provides the participants the context to answer the second round of questions. The process will repeat for a second and possibly third round, given the time constraints of the semester.

Also of importance for collecting information to determine a sustainable scale are key contacts who include the Secretary of ANR, George Crombie; Laurence Becker, the director of the Vermont Geological Survey; and the Water Program Director of the Vermont Natural Resource Council, Jon Groveman (VNRC). Crombie is responsible for issuing state groundwater extraction permits and can provide valuable information about the number of permits being issued and the quantity of groundwater being extracted by different the commercial interests holding the permits. Becker is the State Geologist and is a lead contact about the geological mapping conducted in Vermont that includes information on groundwater. Another contributing source of information from this project comes from our project sponsor, Gary Flomenhoft, a professor at the GIEE, involved with drafting legislation for VCAT, and Peter van Shaick, an independent researcher contributing his expertise to the VCAT project. Weekly meetings were held on Wednesday mornings to discuss the progress of this research project with Gary, Peter and members of the other groups working on VCAT projects in CDAE 237.

Results:

Status of Groundwater Mapping in Vermont

An important component of understanding Vermont's groundwater as a natural resource to be included in VCAT, is having knowledge about where aquifers are located, the quantity of groundwater available and the interactions between groundwater and surface water. This information requires mapping of groundwater in the state and is pertinent for making decisions related to policy, land use planning and water extraction. Groundwater and aquifers are natural resources that are not well understood and mapping is a valuable tool for enhancing understanding and promoting sustainable use. The following discussion describes groundwater mapping in Vermont.

1966-1975: While there has a surge of groundwater mapping efforts conducted in recent years, an interest in groundwater mapping emerged in the mid-1960s following a period of drought (2003 Report). Between 1966 and 1974, the Environmental Geology Series booklets and Groundwater Favorability Maps were developed (ANR Groundwater website). The Groundwater Favorability Maps are a series of generalized maps of groundwater availability that were published between 1966 and 1968. There is a map available on the ANR website for the following eleven basins: Batten Kill, Walloomsac River and Hoosic River Basins; West-Deerfield River Basin; Ottauquechee-Saxtons River Basin; Otter Creek Basin; White River Basin; Wells-Ompompanoosuc River Basin; Winooski River Basin; Nulhegan-Passumpsic River Basin; Lamoille River Basin; Lake Memphremagog Basin; and Missisquoi River Basin. Between 1971 and 1975, Geology for Environmental Planning produced a series of maps for the following six regions: Barre-Montpelier, Rutland Brandon, Burlington-Middlebury, Johnson-Hardwick, Milton-St. Albans and Brattleboro-Windsor. The maps cover about 66% of the state's land area and provide potential groundwater quantities (2003 Report). Each region has a groundwater potential and bedrock geology map, along with several others, and these maps are also accessible on the ANR website. Also, starting in 1966, every well that was drilled in the state had to be reported with information about location, depth, yield, woner, and other characteristics (2003 Report).

2003**:** The 2003 Report to Legislature on the Status of Groundwater and Aquifer Mapping in Vermont was required under Act 133 of the 2002 Legislative session. It addresses the status of aquifer mapping, groundwater classification, and mapping of contaminants that could affect drinking water supplies (2003 Report). In addition to the earlier mapping mentioned above, this report also discusses the handful of mapping projects conducted between 1976 and 1982. Groundwater is classified into 4 categorical classes, with all groundwater classified by default as Class III, until evaluated and reclassified. There are several obstacles to completing aquifer mapping statewide including a variety of different data sources and formats, different levels of data accuracy and obtaining adequate funding. The Report identified three levels of mapping research that each build upon each other in levels of detail, skill, time and resources required: Basic Mapping, Expanded Mapping and Premium Mapping. Each level has a certain timeline, resources and partners. Included in this report are appendices of interest such as an explanation of terms and groundwater resources relevant data.

2006: In 2006, Act 144 established a legislative study committee to examine potential regulatory programs to protect groundwater in Vermont. Section 4 of Act 144 designated ANR responsible for initiating groundwater mapping, working with USGS, and getting funding from the USEPA.

2007: In 2007, ANR delivered the Report On Act 144, Sec 4, Groundwater Mapping: to the House Committee on Fish, Wildlife and Water Resources and the Senate Committee on Natural Resources and Energy. This report describes four groundwater-mapping efforts of ANR: a groundwater mapping pilot program, radionuclide and arsenic mapping, groundwater source protection areas (SPAs) and the interim permit program.

The groundwater mapping pilot program was used to examine well data and identify areas with potential to yield significant quantities of groundwater (Act 144 Sec 5). These maps are intended for use at the planning level for the following municipalities: Arlington, Manchester, Wallingford, Brandon, Woodstock, Williston and Dorset. The program is limited to working in one to two towns per year and is funded by the STATEMAP federal grant. This program is part of the second stage outlined in the 2003 Report to Legislature.

The radionuclide and arsenic mapping is of importance for understanding contaminants that can affect drinking water. There is a compilation and assessment of statewide radioactivity data available on the ANR website, including instances related to public water supplies. There is also a mapping project focusing on arsenic in the Waterbury-Stowe area.

SPAs are land areas above groundwater that are used as by public water systems source and have specific plans to protect drinking water sources. The SPA program is run by the Water Supply Division. There are 450 SPAs and more than 75% have received hydro geologic analysis.

The interim permit program is also mentioned and requires new commercial and industrial users of groundwater to obtain a permit for withdrawals more than 50,000 god. The information is to be used by the State Geologist for future mapping efforts. (Act 144 Sec 4 sec 5).

Current Mapping Initiatives: The most recent progress report for groundwater mapping is from State Geologist Laurence Becker in October 2008. This progress report can be found in Appendix E. At present, the intent is to create a robust State GIS system that can be used by stakeholders at all levels in order to better inform future decision-making (Becker, 2008). The four objectives of the GIS system include (1) statewide data improvement, (2) new statewide groundwater favorability maps, (3) low yielding and well interference analysis, and (4) procedure development. For (1) statewide data improvement, the creation of a water well database and digitization of existing maps have been completed. Two efforts that are still in progress are a growth area determination study and making water

quality data available for all users to be able to access and understand in the GIS system. The Vermont Geological Survey is working on the (2) new statewide favorability maps and are currently revisiting the well parameter analysis and analyzing the general favorability maps. (3) Low yielding and well interference analysis is discussed at length in the following section, but the first report has been delivered and results are being incorporated into the GIS system. Lastly, (4) the development of procedures will be established once all of the information from the efforts underway has been completed. These procedures are intended to help State regulators make decisions about permitting well drilling in areas of low yield and interference, as well as areas of water quality concern (Becker, 2008).

Interference Analysis

An interference assessment looks at a specific radius surrounding the site of groundwater extraction and monitors how pumping different quantities of water from that site affects the surrounding area. In the late 1970s, public water systems began testing new wells for interference with neighboring wells as part of water source permitting. Interference assessments are useful in determining whether permits should be issued to bottled and bulk water suppliers. Permits may not be issued if their pumping has the potential to interfere with yields from existing water supplies or with minimum stream flow requirements.

Currently, a statewide effort is underway by the Agency of Natural Resources (ANR) that focuses specifically on areas of well interference and areas of low yielding wells. In addition, they are compiling water quality data, potential contamination sites, and attempting to identify potential higher yield areas for future supplies. Impacts from public water system well pumping are known to occur and interference testing is required as part of mitigation to insure that no adverse impact results. Over the past decade, groundwater issues include areas of low yielding wells, tighter health standards for naturally occurring elements, and concerns about locating and protecting future municipal sources of drinking water. Today virtually all wells are permitted under rules adopted by the ANR. According to Act 144, Section 5, passed in 2006, the ANR is required to report the following:

(1) An analysis by the ANR of whether the withdrawal of groundwater or bottling of drinking water in certain geographic areas of the state has impacted the use or quality of groundwater or surface water for domestic drinking water or other purposes;

(2) A listing of any areas identified under subdivision (1) of this section, a summary of how the ANR responded to groundwater or surface water shortages in those areas, and agency recommendations on how to avoid similar impact areas in the future;

(3) A compilation of groundwater supply information included in the well completion or closure reports submitted to the ANR in the last 15 years by licensed well drillers;

(4) The amount of drinking water approved for bottling per day from each source in the state permitted under 10 V.S.A. § 1675 for use by a bottled water facility;

(5) Any groundwater mapping completed by the Agency; and

(6) Any other information deemed relevant by the Agency, (VANR, 2008).

Concurrently, the Public Community Water Systems Groundwater Interference Project is being undertaken by the Vermont Rural Water Association (VRWA) for the Department of Environmental Conservation Water Supply Division (WSD). Public Water Systems include municipalities, fire districts, mobile home parks, schools, non-agricultural businesses, and in state bottled water sources. Under the Water Supply Rule, bottled or bulk water suppliers are also considered public water systems (VANR, 2008). As of October 2008, the primary tasks completed by this project were the development of a personal geodatabase date entry system; the entry of a limited amount of pumping test and well interference data; the identification of the public community water system (PCWS) wells around the state for which well interference information exists; and the compilation of a database indicating the pumping test status for each of these systems, (Hanson, 2008). The work for this project began July 7, 2008 and is being managed by Rodney Pingree of the WSD. The database will include only systems and facilities that are currently active because only these systems would potentially cause present day groundwater interference effects.

An interference review process is prompted when Public Water Systems and non-public water sources apply for a new Source Permit. Non-public water systems above a specified size or water demand also trigger yield and interference review. When applying for a permit, applicants are required to provide information locating all current water uses within a specified radius of the proposed source. If an applicant wishes to deepen, hydro-fracture, or perform any other source alteration

that could affect water quantity of an existing water source, then a Source Permit is required. The impact on the surrounding water uses must be tested by the applicant through pump testing the proposed source and monitoring the potentially affected water uses for adverse interference. During this process, careful consideration must be given to the potential impact the project's water demands will have on surrounding activities such as neighboring water supplies, bodies of water, storm and wastewater discharges, wetlands, and other vulnerable features. If the tests reveal adverse interference, then those applying for the permit must mitigate the interference prior to a Source Permit being issued.

Assessment and analysis of interference across the state will hopefully prove useful in determining aquifer recharge rates and sustainable extraction rates. In the coming years this data will be available for a greater area of the state.

Delphi Results

While the Delphi survey was an ineffectual aspect of the project, the information that the group's contacts provided was invaluable to the future success of the Vermont Common Assets Trust. In total, the group contacted nearly 20 men and women that were identified as having some sort of expertise in the area of groundwater through their work in the government, non-profit, and education sectors. The response rate was about 22%, with most comments offering encouragement for the research being done, or pointing the group to another arm of the state bureaucracy. None of the responses however contained usable information beyond where to look next. Table 1 displays information about the experts who were contacted for the survey and their responses.

Name	Contact	Title	Date Sent	Response	Comments
Ben Copans	802-751-2610	W.S.C.	30-Oct	IC	No info. Contact WSD
Jim Ryan	802-476-0132	W.S.C.	30-Oct	IC	No info. Contact WSD
Josh Gorman		W.S.C.	30-Oct	NR	
Ethan Swift	802-786-2503	W.S.C.	30-Oct	NR	
George	802-241-	Secretary Natural	30-	NR	

Crombie	3600	Resources	Oct		
Gary Schultz	802-241-3434	State Hydrologist	30-Oct	NR	
Rodney Pingree	802-241-3418	State Hydrologist	30-Oct	NR	
Scott Stewart	802-241-3426	State Hydrologist	30-Oct	NR	
Dennis Nealon	802-241-3411	State Hydrologist	30-Oct	NR	
Ken Yelsey	802-241-3427	State Hydrologist	30-Oct	NR	
Karen Bates	802-879-2339	W.S.C.	30-Oct	NR	
Marie Caduto	802-885-8958	W.S.C.	30-Oct	NR	
Barry Gruessner	802-527-6210 Ext 35	W.S.C.	30-Oct	NR	
Ryan McCall	802-241-1006	W.S.C.	30-Oct	NR	
Paul Bierman	802-656-4411	UVM Geology Dept.	13-Nov	IC	
George Pinder	802-238-0892	UVM CEMS	13-Nov	NR	
Suzanne Levine	802-656-2515	Rubenstein School	13-Nov	NR	
William Breck Bowden	802-656-2513	Rubenstein School	13-Nov	IC	"can't help, but it's high time someone did some basic research on this."

Among the earliest experts identified by the group were the regional watershed coordinators. It was felt that the watershed coordinators would have the advantages of localized knowledge as well as experience in dealing within the current regulatory framework. It was soon discovered however that regional watershed coordinators dealt exclusively with surface water, and had little information concerning their area's groundwater.

Having found the regional watershed coordinators to be ineffective towards learning about the state's groundwater, the group turned to state policy makers. Secretary of the Agency of Natural Resources, George Crombie, had 5 separate attempted contacts, each as unsuccessful as the last. State Hydrologists were also identified through their recently mandated work in groundwater mapping across the state. The responses from hydrologists to the Delphi survey was less than enthusiastic, those that responded mostly pointed to the chief hydrologist Rodney Pingree. Pingree could not be contacted.

After becoming thoroughly frustrated with the state water bureaucracy, the group set its sites on academia. UVM Professors across a wide array of disciplines were contacted, including the Geology Department, Engineering and Mathematics, and the Rubenstein School with the hope that at least one response to the Delphi Survey could be received. While the professors were vastly more supportive of the research, all felt that the questions fell outside their area of expertise.

The lack of knowledge concerning the state's groundwater resources is telling in and of itself. It suggests that the current management structure is not likely equipped to adequately deal with future challenges. This could be a result of the timing of the project, as ACT 199 which mandated that the state map out and itemize groundwater, was passed during the summer of 2008 and is just starting to be implemented. It will be interesting to see what aggregate quantities of groundwater the survey will account for, as well as the amount of permits issued in relation to that quantity.

The Delphi survey was also effective in that it helped the group to conceptualize the relationships amongst the various disconnected agencies. Because of the preliminary nature of the research done between September and December of 2008, much of the work involved figuring out who was actually doing the current work as opposed to what their findings were. Now that there is a general sense of who is working on groundwater issues, it should be a matter of a few phone calls to get information relevant to the proposal. A Delphi Survey could be very effective if the state experts are doing their jobs in the next coup

Current Management of Groundwater:

The current management of groundwater resources in Vermont involves a complex web of organizations and institutions. Connectivity, influence and communication vary wildly between these entities. Current management and regulation takes place on national, state, non-governmental and municipal levels. Interactions occur both within and between these levels.

On the national level, the United States Government attempts to manage and regulate groundwater use using the Environmental Protection Agency (EPA) and the United States Geological Survey (USGS). The EPA implements national water quality and supply programs and organizes regional and state enforcement of these policies (EPA, 2006). The EPA creates mechanisms to address legislation passed in the US Congress regarding environmental and public health standards. The USGS informs this policy making process through scientific investigation of ground and surface water. The USGS collaborates with state natural resource agencies in order to more efficiently collect and share data. In Vermont, the USGS consults with the Vermont Agency of Natural Resources (VANR).

The EPA is subdivided into regional constituents and offices. Region 1 represents the New England states. Within each region, any state that proves itself capable of meeting national standards and administering national water legislation using state regulation may be given authority over these maters by the EPA. If a state does not obtain primacy for all or some of the well classes, EPA implements the program directly through one of its Regional offices. Currently, EPA implements the program for all well classes in 10 states and some well classes in 7 states. All of the states in Region 1 have been granted primacy (EPA website).

The major programs being administered by Region 1 are the National Pollutant Discharge Elimination System (NPDES), the New England Drinking Water Program (NEDWP) and the Underground Injection Control Program (UIC) (EPA, 1989). Municipal officials apply to the NPDES for municipal, industrial and commercial wastewater discharge permits. The UIC issues groundwater discharge permits to municipal officials and regulates groundwater injection. Under the direction of the EPA's Office of Groundwater and Drinking Water (OGWDW), the NEDWP implements public health and safety initiatives with municipal officials. The regional quality standards defined by the NEDWP are also used as the benchmark for the Water Quality Division (WQD) of the VANR. Furthermore, the VANR secretary is responsible for ensuring that all state regulatory bodies comply and uphold EPA standards.

On the state level, the Vermont Legislature is the primary regulatory body for surface and groundwater resources. The two major institutions used for this management are the VANR and the Vermont Department of Health (DOH). Another instrumental group at this level is the Vermont Natural Resources Council (VNRC).

The VNRC is the VT affiliate of the National Wildlife Federation and the only environmental advocacy group with daily presence at the Vermont Legislature. The Vermont DOH, in collaboration with the Water Supply Division of the VANR and Region 1 of the EPA, produce groundwater support documents (such as the groundwater protection handbook).

Two pieces of State Legislature have had an especially formative effect on Vermont's water management infrastructure. The first is Act 250, also known as the Land Use and Development Act, which was Vermont's first body of environmental regulations and controls. Act 250 had important structural impacts regarding ground and surface water management. The law created the nine District Environmental Commissions to issue and deny permits for projects of more than 10 acres or 10 housing units. This piece of legislation also created the Vermont Environmental Court, which hears appeals of Act 250. Although the District Environmental Commissions approve about 98% of the applications, projects generally get modified during the hearing process in order to meet state standards (Act 250).

The second formative piece of legislature is chapter 48 of title 10 of the Vermont Statutes. Chapter 48 outlines the desirable ends of Vermont's water management system, defines and classifies source types and extraction types, defines duties and the powers of the ANR secretary and details the application, license, penalties and appeals processes. Most importantly, this chapter defines the role of the VANR secretary and the Groundwater Coordinating Committee (GWCC) in protecting water as a public trust resource (VT statutes). The GWCC cooperates with the DEC and its subdivisions to confront groundwater contamination, such as the recent approaches to remedying MTBE contamination. Collectively, the VANR secretary and the GWCC represent the greatest legislative authority regarding groundwater. Future efforts to influence water management in Vermont may be best directed towards this group.

The Vermont Agency of Natural Resources is the umbrella bureaucratic organization dealing with ground and surface water in Vermont. Revenues received by the VANR derive from general fund allocations, federal grants, grants from other sources and fees (such as fishing and hunting licenses, state park fees, permit fees, etc.) Fines administered by the Agency may return to the general fund or be "collected" in the form of a Supplementary Environmental Program (SEP). In the case that an SEP is ordered, the offending organization or business must fund a specific project related to the infraction (such as training for an industry group on environmental issues). SEPs are assigned with frequency, either in lieu of or in addition to a fine. Unlike fines, fees can be directed to restricted funds.

The VANR is subdivided into various departments, one of which is the Vermont Department of Environmental Conservation (DEC). The DEC is responsible for protecting Vermont's environmental and public health by managing its resources responsibly. The subdivisions of the DEC that are instrumental in surface and groundwater issues are the Water Supply Division (WSD), the Water Quality

Division (WQD), and the Legal Division. The Vermont Geological Survey, although not a division of the DEC, provides research and information for the DEC divisions (VANR website). The VGS works with the WSD and GWCC to develop strategies for mapping aquifers. The mapping of Vermont's aquifers was requested of these groups and funded by the Vermont Legislature. The Water Quality Division oversees the 8 Vermont Watershed and enforces national standards for drinking water. Finally, the Legal Division advises the writing process of all DEC policies and legislation.

Operating closely with the DEC is the Natural Resources Board (NRB), a citizen's council independent of the VANR. The NRB is subdivided into two panels, one of which is the Water Resources Panel (WRP) (Act 250). The WRP the ultimate rulemaking authority over groundwater issues.

The citizen-elected municipal officials determine specific town ordinances and policies. While given local authority and micromanagement responsibilities, it is the duty of municipal officials to ensure that all policies made at the state and national level are adhered to.

Discussion:

In October, the state began collecting and reviewing permits for large (i.e. commercial) groundwater extractions. As of the time of this writing, 10 companies had applied for such permits, notably including big names like Coca Cola, Polar Beverages, Nestle, and Perrier. Although the permits are currently under review, the amount given out for fiscal year 2009 should give a good indication for the scale envisioned by the state for commercial groundwater extraction.

Interesting to note is the case of one permit applicant, Ice River Springs. While Ice River was applying for said permit in Vermont, they had sought out a TIF (tax-increment financing) agreement in Pittsfield MA, which is really a subsidy for the company's bottling plant. Essentially the company has already began exporting Vermont's natural resources, taking the majority of jobs and profits outside of the state. If this is going to be a precursor for what is to come, current management structures are vastly inadequate. A case study of the impact of Ice River's business plan on Vermont's tax revenues could be helpful in illustrating the need for establishing the Common Assets Trust.

While VCAT may be able to collect money for these types of activities, it does have the potential to cost the state money. International trade agreements, which aim to promote "free trade" often do the opposite, restricting consumers from making decisions on the products they regularly interact with. It is not far-fetched to think that big companies would fight this legislation tooth and nail through frameworks setup under NAFTA and related trade agreements. Chapter 11 of NAFTA addresses issues of fair treatment for investors, making it difficult for states to discourage certain economic activities (i.e. water bottling) in favor of others.

Another issue in establishing VCAT will likely be political pressure. While the legislation already has the backing of Burlington representative Hinda Miller, the bill faces an enormous uphill battle in the face of the established bureaucracy and anybody who stands to lose money from rent collection. An essential question that future research must address is where the trust will fit into the already sprawling bureaucracy that has been put in charge of managing the state's groundwater. Adding another layer to an already bloated management structure will likely not have the desirable effect, while cutting and merging programs will most certainly create an internal backlash. Finding specific leverage points will be a formidable task if VCAT is to succeed.

Mapping:

There are several groundwater-mapping initiatives in Vermont that have been completed and are still in progress that address quantity, quality and interactions. If further attempts are made to distribute a Delphi survey in order to determine sustainable scale of Vermont's groundwater, the specific people responsible for these mapping projects should be considered experts and contacted. Another group of experts that had not been considered are the employees of public water systems responsible for SPAs. An SPA is developed and approved based on extensive resources, some including published and unpublished reports, pump testing, flow conditions, structure, topography and surficial and bedrock geology. Someone working and understanding groundwater for drinking water supply purposes would most likely be able to provide information about sustainable scale for extraction.

Recommendations:

Our hope is that the research we completed this semester will aid in achieving the ultimate goal of determining sustainable scale of water extraction. We recommend that future student groups build off of the progress we made over the course of the Fall 2008 semester. This paper, the website we constructed, and the attached appendices should serve as a good starting point.

The following list of literature is highly suggested reading:

Groundwater Efforts Act 144 Section 4 and Section 5
Chapter 48 of title 10 of the Vermont Statutes (Chapter regarding groundwater as a public trust)
Act 250, The Land Use and Development Act
2003 Report on Groundwater and Aquifer Mapping

In addition to doing this initial literature review, we recommend establishing contacts with regional experts and scheduling meetings early on. Important people to contact include Jon Groveman at VNRC, and state geologist Laurence Becker. Of all the contacts we made, they were the most receptive and helpful in answering our questions. Also, students should feel free to contact Conor Casey, Emily Falta, Molly Greene, and Sam Lederfine Paskal when getting started early in the semester for further advice.

We highly recommend the continuation of weekly advisor meetings for any students who continue this project in subsequent semesters. Every Wednesday morning throughout the semester, we met with Gary Flomenhoft and Peter van Shaick to discuss issues surrounding common assets and public trusts. During these meeting we shared any useful resources we had found, reported on the progress we made in the past week, and outlined what next steps we intended to take. These meetings were productive for a number of reasons. The guidance provided by Gary and Peter was valuable and their knowledge aided in our understanding of the economic and ecological questions we attempted to answer in our research. Also, it was beneficial for our group to come together at least once each week. The meetings helped us maintain focus and motivation toward our project's goals and objectives.

There are also many ways to expand our understanding of Vermont's current management of groundwater. The VANR, GWCC and NRB encompass most of the policy-making clout within this structure. Therefore, we recommend further investigation of the subdivisions and mechanisms of these organizations. There seems to be potential for VCAT to work with some of the existing institutions such as the VGS, the GWCC and the NRB. The GWCC is defined by Chapter 48 of Title 10 of the Vermont Statutes, which aligns very closely with the ultimate goals of the proposed VCAT. Also important would be a better understanding of the VNRC (how it operates, how it receives funding, etc).

Regarding money flows, we recommend further investigation of fund allocation within the VANR and percentages of VANR revenue derived from each source. A much more thorough investigation of the Supplementary Environmental Program system would also be highly useful. Because the programs are executed in lieu of a fine payment, they may impact the capture of economic rent. Also, it would be important to discern the effectiveness of these programs. What are some examples of SEPs? Are they sufficient "payment" for policy violations? Which businesses in Vermont have administered SEPs?

We also recommend a continued examination of political power structures, it would be useful to know how policies are proposed and amended. How much influence does the VNRC exercise over the Vermont legislative decisions? Who reconciles differences in policy decisions between the NRB and the VANR? How would VCAT work within or challenge this system?

Also, while the Alaska Permanent Fund is a valuable example of a CAT, further research should examine different management structures to be used for VCAT. Because VCAT would potentially include a number of different natural resources, decision makers would have to establish if all the resources would be managed similarly or if different institutions would be designed for the different resources. In the case of groundwater, boundaries are especially difficult to determine because watersheds are based on surface geology that may be different from aquifer boundaries, however, groundwater and surface waters are intricately connected.

Conclusion:

As human demand for groundwater resources begins to outstrip the available supply around the world, competition for what remains has begun, and will continue to proliferate. The issue has left policy makers scrambling for solutions that are able to satisfy demand across a diverse population of stakeholders, while at the same time taking ecological consequences into account. How human societies meet this challenge will have a profound impact on future generations, and some have gone as far as to speculate that the next major war will be fought over access to water.

While Vermont will likely not have to face this challenge within the next decade, policy makers have began to take notice and search for solutions to plan accordingly. The first such step was incorporating groundwater into the Public Trust Doctrine, making lawmakers legally accountable for ensuring that the said resource is managed for public interest. The proposed Vermont Common Assets Trust looks to take this a step further by actively managing the groundwater commons through establishing aquifer quotas, rent collection, and citizen dividend payments.

Because groundwater was only recently declared a public trust resource, information as to its' use and availability is highly compartmentalized, if it even exists. The purpose of this project was to gain a better understanding of available groundwater resources in the state of Vermont, as well as whom the current users and managers are. In order to do this, the research group identified key issues and stakeholders to participate in a round of Delphi surveys. The surveys were meant to get a better understanding of perceptions across the various stakeholders, as well as aggregate available information for use in the proposed legislation. While this first attempt to conduct a Delphi survey was unsuccessful in securing an expert consensus opinion on an appropriate sustainable scale for groundwater extraction, it made significant headway into learning about the complexity of groundwater management institutions and identifying the next steps required to do so.

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Appendix A: Delphi Survey Round 1

Delphi Survey

1. What is the sustainable rate of extraction for your watershed? (gallons/month)

2. What are the biggest threats to managing groundwater in your watershed?

3. Who are the biggest commercial/industrial users in your watershed?

4. What sort of information do they report to you regarding their use of groundwater?

5. Would you consider current groundwater extraction monitoring to be effective?

6. Do you think the current permits appropriately reflect sustainable extraction rates in your watershed?

7. Is current knowledge of your watershed's groundwater adequate?

8. What sort of information (if any) would help you do your job more effectively?

Appendix B: Project Contacts

WATERSHED COORDINATORS
Agency of Natural Resources
Department of Environmental Conservation
Water Quality Division

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<u>Other Contacts</u>

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Appendix C: Survey Cover Letter

Dear Watershed Coordinator:

You have been contacted as part of a research project to help determine sustainable use of Vermont's natural resources in support of the proposed Vermont Common Assets Trust (VCAT) which was proposed by the legislature in the 2007/8 Senate bill S.44. We are current UVM students in the department of Community Development and Applied Economics and the VCAT proposal is an initiative being researched by our class with support from The Gund Institute of Ecological Economics. The trust aims to sustainably manage the State's common assets (groundwater, spectrum, carbon dioxide absorption capacity, etc.) and collect fees from the private use of public resources. This revenue could be distributed in an annual dividend check to each Vermont resident, similar to The Alaska Permanent Fund, which collects royalties from oil drilling. As you are well aware, groundwater was recently declared a state public trust resource and it is one of the resources being considered to be included in the VCAT.

Attached is a Delphi Survey, which is going to be used to collect information about your watershed's groundwater. A Delphi survey is a structured group interaction process that is directed in "rounds" of opinion collection and feedback. Opinion collection is achieved by conducting a series of surveys using questionnaires. The results of each survey round will be presented to the group and the questionnaire used in the next round is built upon the results of the previous round.

In this first round of the Delphi survey, we wish to identify the sustainable extraction rates of Vermont's groundwater for each watershed. After the first round is completed, you will be provided with results from the other watershed coordinators of Vermont. At this point, you are encouraged to respond to the results and incorporate them into your answers for the second questionnaire. The ultimate goal is to gather the relevant information for estimating sustainable use and potential revenue from private use of Vermont's public groundwater resources.

If you could return this survey by November 14th it will help us conduct our research in a timely manner since we are working within the parameters of a semester period. We appreciate you taking the time to complete this questionnaire and please contact us if you have any questions.

Sincerely,

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Emily Falta efalta@uvm.edu

Molly Greene mgreene@uvm.edu

Sam Lederfine Paskal slederfi@uvm.edu

Appendix D: Links to Groundwater Maps

Groundwater Favorability Maps:
http://www.anr.state.vt.us/DEC/GEO/grdwatermapinx.htm

Report on the Status of Groundwater and Aquifer Mapping in the state of VT-2003:
http://www.anr.state.vt.us/DEC/GEO/pdfdocs/RptLeg.pdf

Bedrock and Superficial Maps:
http://www.anr.state.vt.us/DEC/GEO/mapsonlineinx.htm

Appendix E: Groundwater Mapping One-Time , DEC Work Plan - Progress October 2008

Intent – Create a robust State GIS system with map output that can be queried by citizens, professionals, State scientists, analysts and regulators to use as a base for further decision making.

1. Statewide Data Improvement

1. Water Well Database – ANR cleans up database as agreed upon base to finalize other aspects below is Complete

2. Statewide Geology – Complete digitization for statewide maps and existing detailed geology as applied to groundwater. 1961 bedrock map done. Working with Vermont Center for Geographic Information and contractor on 1970 surficial geology data. Complete

3. Growth Area Determination – Add groundwater use, public GW system distribution areas, and future needs indicated, estimated water use information, and other parameters to compliment census data. USGS into second quarter of study

4. Water Quality Data – Make data on contaminated sites, solid waste, in direct discharges, DOH data, geologic study data, public well water quality concerns and commercial and industrial extractions available for easy presentation and query by the GIS system. ANR GIS and DEC Programs – Hazardous, Solid Waste, and Wastewater in process

2. New Statewide GW Favorability Maps – GIS Query and 1:100,000 maps

1. Well Parameter Analysis – Analyze yields, depths, etc. for all wells. Start up analysis by Vermont Geological Survey/ANR in ACT 144 section 5 report to legislature, January 2008, revisiting for general bedrock favorability

2. General Favorability: Higher to Lower – Make general determination by integrating water well data, digital geology, and other factors as information base to compliment search for resources. Vermont Geological Survey puts water well database over statewide bedrock geology, analyzing; GIS project started with gravel wells and new digitized surficial geology for sand and gravel resources

3. Low Yielding and Well Interference Analysis

1. Lower Yield Areas – Focus from above analysis on areas with the lowest yields with added geologic context. Part of Statewide look related to well data placed over bedrock

2. Well Interference Areas – Analyze public water supply pump tests and the cumulative impact in areas where there are concentrations of extractions (will likely correlate with certain growth areas). Vermont Rural water, contractor, first report delivered

4. Procedure Development

1. Low Yield and Interference – Establish procedures for State regulators to use data to make decisions about permitting of proposed wells in areas of low yield and interference, includes procedures for consultants to improve water well locations as part of process. At end of information development

2. Water Quality – Establish procedure (if the data are sufficient) for State regulators to use information to make decisions about permitting of proposed wells in areas of water quality concerns. At end of information development

Appendix F: Literature Review

1) Current Issues Concerning Groundwater in New Hampshire and Maine:

The last groundwater survey done by USGS showed that New Hampshire's total water use was is 450 million gallons per day. Thermoelectric power production along with domestic, industrial, and commercial use accounted for the majority of this water. The watershed with the most water use is the Merrimack River Basin because of the coal and oil burning electric power facility in Bow, N.H. The watershed with the second most water use is the Upper Androscoggin River Basin where industries such as paper, electrical equipment, chemical, and machinery in Coos County are located.

The issue of groundwater protection truly came to light when the state of New Hampshire filed a law-suit against makers and blenders of chemical compound Methyl Tertiary-Butyl Ether or MTBE. Defendants include a number of power and oil-producing corporations. At the Superior Court case, the state presented a recently published Environmental Science and Technology study stating that the contamination of US groundwater could cost as much as $85 billion (Evans, 2008). As the MTBE pollution suit progressed, the defending corporations argued that they had been using MTBE as part of their "federal officer" role and that they were directed by the US Environmental Protection Agency to use the chemical. They argued that liability should be transferred. A federal appeals court then rejected this argument. This ruling ensured that the case would not be brought to a Manhattan federal court and would be forced the case back into state courts(Norman, 2007).

New Hampshire has also developed a Water Supply Land Conservation Grant Program. This program offers funding assistance for acquiring land that will be protected. It also supports obtaining restrictive easements to prevent current landowners from developing in a way that could contaminate groundwater (NHDES).

Maine's groundwater supply is contained within bedrock wells and surficial wells. Approximately 68% of Maine's residents rely on groundwater for drinking water, sanitary uses and protection from fires. Furthermore, about half of the population also drinks from private wells. Due to the geology of the state, dispersed population and the absence of any large regional aquifers, contamination has been quite rare and isolated. However, since the 1970s, instances of contamination from industrial waste have been on the rise. (GWPC)

During the 1950s, Maine defined a water classification system, which set forth water quality goals, management guidelines, designated uses and legislation regarding activities such as wastewater discharge and extraction. The water quality statute contains rather malleable antidegradation provisions in order to confront changing ecological and social needs. (DEP)

In 1994, Maine implemented the Wellhead Protection Program and Source Water Assessment Program through its Drinking Water Program. These groups assess water quality, organize and publicize water data and advise the management of contamination. The Maine Department of Environmental protection has complete regulatory oversight of state groundwater. (GWPC)

Like in New Hampshire, the issue of Maine's groundwater became a subject of public debate in response to a court case. The Poland Springs bottling company has opened three bottling plants in the state, which extract approximately 110 million gallons of water per year from aquifers along the south-west border. Some support the industry and see these plants as sources of jobs and economic growth in the region. Those in opposition complain of contamination, over-extraction and noise.

Jim Wilfong, a former state legislator, who attempted unsuccessfully to apply a 20-cent-per-gallon water tax, has led groundwater legal protection for the state of Maine. (Economist, 2008)

2) Vermont's Existing Legal Framework & Current Issues

The Vermont Common Assets Trust (VCAT) is an opportunity for Vermonter's to capture some of the economic benefits of their natural resources that are currently unaccounted for with market institutions. Groundwater in Vermont is one of the natural resources being considered for inclusion in VCAT. In Vermont, groundwater accumulates in bedrock formations and nearly two-thirds of Vermonters depend on groundwater for drinking water (VNRC).

The available literature focusing on the current situation of groundwater in Vermont is largely concerned with the recent passing of a groundwater protection bill, S.304, and the efforts that led up to the passage of the bill. The Vermont Natural Resources Council (VNRC) was responsible for lobbying for this bill and their website provides an archive of articles related to groundwater in Vermont.

In June of 2008, the groundwater protection bill was passed by the state, placing groundwater in a public trust, and turning it into a commonly owned resource (Barringer, 2008). By declaring groundwater as a common resource, it now has the same status as surface water and it must be managed in the best interest for all Vermonters (VNRC). In order to protect VT groundwater, the bill proposed three solutions: (1) establish funding for mapping and classifying all drinking water, as a responsibility of the Agency of Natural Resources (ANR), (2) create a statewide comprehensive groundwater protection program that regulates and manages groundwater withdrawal, along with creating opportunity for community decision making, and (3) declare groundwater as a public trust resource (VNRC). The bill also defines priority water use and states that in a time of water shortage, public use and agriculture are given preference (VNRC). The permit program for large quantities of water extraction requires that any commercial or industry water users must get a permit to extract more than 57,600 gallons per day (gpd) (40 gallons/minute for 24 hours), with the exception of large farms, water utilities, fire districts and some geothermal systems (Barringer, 2008; VNRC). It also requires commercial and industrial water users to report extraction starting at 20,000 gpd averaged monthly (VNRC). ANR will grant permits only if permit seekers can show that their withdrawal will not negative effect existing water supplies, wetlands or water quality. Additionally, they must meet any applicable development plans (state, regional or town), and provide an estimate of the amount of water that will leave the watershed (VNRC). The bill seeks to incorporate public involvement by requiring anyone applying for a permit to notify all residents within the zone of influence and hold informational meetings.

Previous to the passage of the bill, Vermont groundwater law was limited to Title 10, Chapters 48 and 56. These chapters are implemented through the Vermont Water Supply Rule (WSR), and focus on public water supply and drinking quality, there was nothing regulating the quantity of groundwater use, even for commercial and agricultural activities (VNRC). Vermont was the only New England state without policies regulating commercial water bottling industries (VNRC). So the new bill fills this gap in the law, before Vermont is faced with water scarcity issues.

Also of interest regarding groundwater in Vermont, is the case of a private landowner, Peter Antonovich, wishing to extract groundwater for a bottled water company. The town of East Montpelier agreed to place a three-year moratorium on large extraction of groundwater because concerned citizens recognized there was a lack of available data regarding the future impacts on their environment and economy (Ives, 2008).

3) Potential Revenue Collection for Vermont's Groundwater

While Vermonters currently do not face serious competition for groundwater resources, the issue is currently receiving a great deal of attention. This is likely fed by increasing demand from an expanding population, as well as commercial, industrial and agricultural need. Additional pressure is being received from regional and national water shortages, which create economic incentives for the growing trade in water as a commodity. Effective rent capture and revenue generation will be necessary in the years to come in order to properly manage Vermont's groundwater.

Complicating matters to effectively evaluate revenue potential for Vermont's groundwater is the lack of good information. Currently, Vermont is the only state in the Northeast without any groundwater maps. (Groveman, 2007) Without knowing resource characteristics such as recharge rates and aggregate quantities, valuation becomes a difficult matter. What is known is that currently 9 bottled water companies operate out of the state, with a 10th pending legislation outside Montpelier. [The proposed Montpelier Spring Water Company has been estimated to gross $25 million over 3 years. (Ives, 2008)]

Other states have begun to outline what they see as possible rent collection through water taxes, such as the Water Dividend Trust of Maine. The bill, (now defeated) was headed by former state legislature Jim Wilfong, and proposed a $.20 tax on every gallon extracted from the state's groundwater for resale. Wilfong calculated the profits found in a 24 oz bottle of water to conclude that One Acre Foot of water sold could generate $1,300,875.50 profit when sold at just $.85. (Wilfong, 2004) This represents an enormous windfall of nearly $40/gallon to bottling companies who have essentially privatized a public resource. One possible option would be to simply add an additional tax on these companies' profits, which would then be incorporated into the trust fund revenue stream.

The problem with this approach is that it becomes imprecise in allocating how much water goes to commercial and industrial uses, and how much is pumped for personal uses. Another option would be to cap the amount of water permit holders are allowed, and charge for use after that point. Colin McLung was able to find the amount one bottling company, Clear Springs, was withdrawing on average per month. McLung found that Clear Springs was withdrawing 2,352,825 gallons per month, well over the cap of 1,728,000 million outlined in the 2008 bill that declared groundwater a public trust resource. In Vermont, citizens are charged a penny per gallon over their monthly usage caps. Taking the difference between Clear Source's extraction and the withdrawal limits, and multiplying by one cent, the trust fund would be able to collect $6,248.25 per month, or $74,979 per year from Clear Source alone. Assuming the other 9 bottling companies are extracting similar amounts of water from Vermont's wells, the trust could collect nearly $7.5 million per year. Dividing this by the 623,908 population of Vermont (Census, 2000) would allow for a $12/capita rebate.

Sources for revenue exist outside of water bottling companies as well. Vermont's Yankee Nuclear Power Plant must pump thousands of gallons daily to transfer heat energy and cool the reactors, which could potentially be taxed. Additional fees could be levied on well drillers who indirectly profit from access to Vermont's well water, and citizens who drill these wells, with higher fees going to wells that recharge more slowly. The mining and agriculture sectors of the economy are also large users of groundwater resources, however agriculture would be a politically difficult issue to incorporate into the trust.

4) Common Resource Trusts; Using the Alaska Permanent Fund as a Model

Common resource trusts are institutions that manage assets created by nature or society that should be available for the benefit of all. Examples of this form of management exist in many countries and states and on different scales. Such trusts protect over nine million acres of land in the U.S. alone, and in Britain the National Trust manages more than six hundred thousand acres of undeveloped land, six hundred miles of coastline, and two hundred historic buildings and gardens, (Barnes, 2006). A common trust that has proved particularly successful is the Alaska Permanent Fund. This fund, established in 1976, has effectively managed Alaska's mineral resources for the benefit of current and future generations of residents. In considering the future of a common asset trust for Vermont, an examination of the formation and current management of the Alaska Permanent Fund is illuminating.

The creation of such a fund came about partially in response to the government's mismanagement of windfall oil revenues from the Prudhoe Bay oil lease sale in 1969, (Kasson, 1983). The Alaskan government appropriated more than $900 million in revenue, but the Alaskan people saw little direct benefit result from the sale, (Kasson, 1983). In response, an Act was passed that established the Alaska mineral lease bonus permanent fund, which stated "that it is essential to preserve a portion of the revenue derived from mineral lease bonus sales, a nonrenewable resource, for future generations of Alaskans, and further, that this purpose best can be served by preserving this income in a permanent fund to be used for investment capital by Alaska residents," (Alaska Permanent Fund Corporation, 2008).

This Act was further amended in 1976. The amendment to Alaska's constitution states:

> At least twenty-five percent of all mineral lease rentals, royalties, royalty sale proceeds, federal mineral revenue sharing payments and bonuses received by the state shall be placed in a permanent fund, the

> principal of which shall be used only for those income producing investments specifically designated by law as eligible for permanent fund investments. All income from the permanent fund shall be deposited in the General Fund unless otherwise provided by law, (Alaska Permanent Fund Corporation, 2008).

The creation of this General Fund began the question and debate over how to manage it. The State Investment Advisory Committee was given the task of investigating potential organizational structures and investment options for the Fund, (Kasson, 1983). A diverse range of interests were represented on the committee which was composed of the legislature, government officials, consumer groups, people from the business community, and members of the general public. Public hearings and forums also aided in designing the Fund. Public response concluded that money in excess of current needs should be placed in the Fund, and that the income should be used to benefit current and future Alaskans. Alaskans voiced that the structure of the Permanent Fund should allow public accountability but that when necessary political decision making should also play a role.

The benefits from mineral wealth which belong to all citizens could be distributed several ways: by low-interest loans, tax relief, or expanded government services. Originally, the permanent fund was envisioned as a development bank that would provide small business loans. This proposal and others were turned down on the basis that they would allow only a select group, not all Alaskans, to be beneficiaries. The Alaskan Governor at the time, Hammond, eventually proposed the idea of a Permanent Fund dividend program which would directly distribute a portion of the oil revenues in the form of a check made out to each individual, (Kasson, 1983). This type of fund structure would provide benefits to all Alaskans from the earnings of their resource wealth and equitably impact the rich and poor.

After three years, extensive deliberation, and many versions of various bills, the final structure and use of the fund was established. In order to insulate the Fund from politics and special interests, a public corporation independent from state government was created. Government would provide oversight to the corporation to ensure it would not become too independent, but ultimately the corporation would be held accountable to the public. Direct distribution of funds gave each citizen a personal stake in oil revenue and provided an incentive to oppose pork barrel spending.

In 1980 legislation was passed that created the Alaska Permanent Fund Corporation, (Kasson, 1983). The fund continued to accumulate mineral revenues as before, but now a specific body of trustees was given responsibility for distributing that revenue. Oversight was and is provided by the Legislative Budget

and Audit Committee, but the Legislature has a whole has generally stayed away from the Fund, (Anderson, 2002).

Over the past three decades the Fund has grown in value and the size of the annual dividend has increased so that approximately $1 billion is distributed annually to 600,000 citizens, (Goldsmith, 2004). The dividend accounts for nearly 6 percent of total household income. The amount paid to citizens is "half of the realized earnings of the Alaska Permanent Fund," (Goldsmith, 2004). This formula is designed to provide some stability to the annual payout, in addition to protecting the Fund for the long term from political pressure to maximize the dividend in the short term. During the first years after inception the Fund grew slowly, but rising oil prices caused several dramatic growth spurts, and at the end of 2002, the Fund had accumulated $23.6 billion (Goldsmith, 2004).

Every citizen receives the same amount regardless of circumstances. This system favors low income individuals and families with children. Alaska's distribution of income is one of the most equitable in the entire U.S.; it is possible and likely that the implementation of the annual dividend has had a great effect on this income equality. The Economic Policy Institute showed that during the '90s the income of the poorest fifth of Alaska families increased 28 percent compared to a 12 percent increase for the entire U.S., whereas the richest fifth saw only a 7 percent increase in Alaska compared to a 26 percent increase across the U.S., (Goldsmith, 2004).

Another important economic effect of the Permanent Fund Dividend is the stabilization of cash flow to rural Alaska where incomes are among the lowest in the U.S., (Anderson, 2002). Non-government sources of income in these areas are inconsistent and uncertain. The dividend has acted as a safety net against unexpected reductions in household income and has helped in stabilizing the entire economy of the state in addition to ensuring that future generations will also benefit from Alaska's mineral wealth.

5) Delphi Survey Method

The Delphi method was originally developed by the Rand Corporation for the American military as way of forecasting future technological developments, but has since been applied to a variety of other concerns and uses, (Lang, 1994). Delphi Surveys are a method for structuring a communication process that allows a group of individuals to effectively deal with a complex problem. This survey technique asks a series of open-ended questions to a group of experts on a particular topic. The definition of 'expert' in the context of Delphi Surveys is fairly broad. It includes not only professionals or individuals with technical expertise in a certain discipline, but also non-academic experts who have significant experience or knowledge on the topic being discussed, (Turoff, 1975). It is an especially effective methodology when dealing with issues that have high levels of uncertainty and subjectivity. It is often

employed when little information exists on a topic. Also, in situations where little or poor communication exists between those who have the most knowledge on a topic or when it may be too costly or time consuming to plan face-to-face meetings of experts, the Delphi method is useful.

A Delphi can be an effective tool when dealing with issues surrounding regional planning, policy development, possible budget allocations, university campus and curriculum development, or developing causal relationships in complex economic or social trends, or in exposing priorities of social and environmental goals, (Turoff, 1975).

The way the survey is employed is fairly flexible and there are few specific guidelines or rules as to how to perform a Delphi. Typically a small monitor team will prepare a questionnaire and determine a group of individuals who are knowledgeable on the subject of interest. It is important that a variety of individuals are involved in the survey in order to ensure a meaningful exchange of ideas. The survey may involve between ten and fifty participants, (People and Participation, 2008). As the participants in a Delphi survey are often very busy it is usually necessary to allow them plenty of time—multiple weeks, if not months—to fill in each round of the survey. Another time consuming task for the monitor team is to remind and encourage participants to fill in the survey since dropout rates can be quite high, (People and Participation, 2008).

Once the set of questions is completed by the chosen experts and returned to the monitor team who compiles and summarizes the results. The monitor team is responsible for interpreting the results and coming to a concise, but complete understanding of how the group views the issue. They identify where the group agrees, disagrees and attempts to understand what is meant by relative terms such as importance, desirability, feasibility, etc., (Turoff, 1975). In the case of a significant disagreement, the monitor team needs to frame the second set of questions so as to identify the underlying reasons for the disparity. It is important that the monitor team not ignore disagreements, but explores them fully; otherwise dissenters may be discouraged and discontinue their involvement in the survey which could lead to generating an artificial consensus, (People and Participation, 2008).

The results from the first round are then fed back to the same group of individuals along with a revised questionnaire. The responses remain anonymous during this second round of questioning. This anonymity gives the respondents a great degree of freedom in expressing themselves. During the second round the respondents are given the opportunity to revise their initial reactions to the questions and respond to the revised questions after taking into consideration comments from fellow experts. It is a process that involves multiple iterations and possibly more than two rounds of questioning. The goal is often to reach some form of consensus among the group of experts surveyed, (Turoff, The monitor team needs to be careful not to underestimate the demanding nature of a Delphi. Completing the survey can often be a timely process, and if the process is not an integral part of

the experts' job function then consideration should be given to compensating participants for their time.

Another potential conflict that arises is balancing a breadth of individuals and expertise and wanting the process to be efficient and not overly time-consuming. For sufficient cross-pollination of ideas, it is important to have a variety of respondents, but consensus and resolution is more difficult to generate with greater numbers of participants. Other weaknesses of this method include the possible difficulty in motivating people to contribute their time and ideas, low rates of participation, and results may be biased, (People and Participation, 2008).

Strengths of the Delphi method include that participants are able to fill the survey out in their own time and have the freedom to express their opinions and critique ideas anonymously throughout the process. Also, discussions are not dominated by one person's authority, and a relatively wide set of ideas can be generated compared to if individuals were to fill in the questionnaire without multiple iterations, (People and Participation, 2008).

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