Groundwater Conference: Meeting Summary

Freedom, New Hampshire
April 22, 2006

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Introduction to the Day

Ted Lavery
EPA Region 1

Mr. Lavery (EPA Region 1) introduced himself and welcomed the group. He emphasized the importance of local efforts in water conservation and encouraged the audience to research state and municipal funding opportunities that can be used for source water protection efforts. Mr. Lavery introduced the speakers, thanked the Green Mountain Conservation Group (GMCG) for organizing the conference, and encouraged the audience to ask questions throughout the day.

Ground Water 101

Chi Ho Sham
The Cadmus Group, Inc.

Dr. Sham began by discussing the **multiple barrier approach** to drinking water protection. He explained that the multiple barrier approach is the practice of protecting drinking water from the source to the tap. The multiple barrier approach encourages: (1) source water protection, (2) treatment if necessary, (3) distribution system maintenance in order to prevent contamination, and (4) monitoring. Dr. Sham explained that source water protection is an important part of the multiple barrier approach because it can prevent the need for expensive treatment by maintaining high quality source water.

Dr. Sham then described **hydrologic cycle**, the processes by which water moves between the oceans, the atmosphere, and the land surface. He explained that the cycle begins when water evaporates from the land and ocean, adding moisture to the atmosphere in the form of clouds. This moisture eventually leaves the atmosphere as precipitation (e.g.,

rain, snow, ice) that returns to the land surface. Some of this precipitation runs off in a process called **overland flow**, but part of it infiltrates into the soil, percolates through the soil layer, and recharges groundwater. This input adds fresh water to groundwater reservoirs; Dr. Sham noted that most residents of New Hampshire depend on groundwater as their source of drinking water.

Dr. Sham then described the types of geological formations that can hold groundwater. He described:

- Porous, unconsolidated sedimentary deposits, such as sand and gravel
- Limestone or dolomite caverns, such as those found in Kentucky and Florida
- Rubble zones and fractures, such as lava flows found in the Pacific Northwest and
- Fractures in igneous rock, such as those in New Hampshire

He explained that the upper portion of the Earth's surface is not fully saturated with water because not all the spaces between sediment particles are filled with water. This unsaturated, upper layer is called the **zone of aeration**. The layer under the zone of aeration, where all spaces are filled with water, is called the **zone of saturation**. The line between the zone of aeration and the zone of saturation is known as the **water table**. Dr. Sham emphasized that the water table is not fixed; if more water enters the system, the water table can rise.

Dr. Sham then described the concept of **pores**, which are the spaces between sediment grains such as gravel, sand, silt, and clay. Larger grains tend to create larger pores and smaller grains result in smaller pores. Dr. Sham added that grains can be packed differently to create larger or smaller pores. Also, in poorly sorted sediments with grains of different sizes, small grains can fill in spaces between larger grains, creating even smaller pores.

Dr. Sham then introduced the concept of **porosity**, the measure of how much empty space a material has. Porosity is expressed as the percentage of a given volume of material that can be filled with water. Different materials have different porosities, for example:

- Sand or gravel (well sorted) can have a porosity of 25-50%
- Sand or gravel (mixed) can have a porosity of 20-35%
- Glacial till can have a porosity of 10-20%
- Silt can have a porosity of 35-50%
- Clay can have a porosity of 33-60%

Dr. Sham pointed out that sediments with small grain size, such as clay, can still have high porosities.

Dr. Sham also explained the concept of **permeability**, which is a measure of how easily water or other fluids are transferred through sediment. Generally, sediments with larger grain sizes have higher permeabilities because friction with sediment grains is minimized. Dr. Sham added that the term **hydraulic conductivity** refers specifically to the permeability of water, as opposed to other fluids. Dr. Sham explained that a sediment's hydraulic conductivity determines how quickly water can flow through it. He noted that water can pass through:

- Well sorted gravel at 28.3 to 28,300 feet per day
- Well sorted sand at 2.83 to 283 feet per day
- Fine or silty sands at 0.283 to 2.83 feet per day
- Silt at 0.00283 to 0.283 feet per day
- Clay at 0.00000283 to 0.00283 feet per day

Dr. Sham emphasized that high porosity does not necessarily indicate a high hydraulic conductivity.

Dr. Sham then explained why groundwater flows from point to point within an **aquifer**, which is any geologic formation that can hold and yield water. He explained that **hydraulic head differences**, which are differences in the amount of potential energy that water has at a certain location within an aquifer, are responsible for groundwater movement. These energy differences result from differences in elevation and pressure. Dr. Sham added that groundwater flows from areas of high hydraulic head to areas of low hydraulic head.

Next, Dr. Sham explained the concept of a **confining layer** or **aquitard**, which is a geologic unit that restricts the flow of water. Confining layers can keep aquifers under pressure and can also prevent aquifers from becoming contaminated. He explained that **unconfined aquifers**, those without a confining layer, are also known as water table aquifers, because when a well is drilled into the aquifer, water rises to the level of the water table. In contrast, the water levels of wells drilled into **confined aquifers**, which may be under pressure, can rise above the level of the water table or even to the land surface itself (known as **artesian wells**). Dr. Sham also pointed out that, depending on local geology, a confined aquifer may have a small **area of recharge**, which is the area where water, usually from precipitation, can infiltrate into an aquifer. These areas are often in mountainous regions.

Dr. Sham then explained that groundwater withdrawals can affect the dynamics of an entire water system. For example, drilling a well in an unconfined aquifer results in an immediate lowering of the water table surrounding the well, known as the **cone of depression**. Wells can also cause lowered water levels in lakes or streams, since groundwater sometimes supplements surface water bodies.

Dr. Sham explained the concept of **hydraulic gradient**, which is equal to the head difference between two wells divided by the horizontal distance between the wells. He

also mentioned **Darcy's Law**, along with a calculation of the volume of water that can be removed from an aquifer. This can also be measured by pump tests in the field.

Dr. Sham concluded with a discussion of contamination in groundwater aquifers. He explained that contamination in groundwater aquifers follows head differences, creating a "contaminant plume." He added that fractured rock aquifers, like those found in New Hampshire, are complex systems that can be vulnerable to contamination because water flows quickly through them, carrying contamination or pathogens. He added that U.S. EPA is working on a new rule that will further regulated water systems that receive their raw water from sensitive aquifers like fractured rock aquifers, limestone aquifers, and high energy deposit environments.

Ossipee Watershed: Geology & Hydrology

David Wunsch
New Hampshire Geological Survey

Dr. Wunsch began by presenting a geological map of New Hampshire that illustrated the different types of bedrock found in the state. The map displayed many different types and ages of bedrock. Dr. Wunsch explained that New Hampshire has diverse geology because, when the North American plate collided with an oceanic plate, rock layers in New England were scrambled. As the oceanic plate was **subducted** under the North American plate, the lower plate melted, causing pockets of molten rock to rise towards the surface. Some of these molten rock flows solidified into granite, others reached the surface, creating volcanoes. During this collision, other rocks were **metamorphosed** — their chemical structure was changed due to long exposure to heat and pressure. The resulting metamorphic rocks are brittle, dense, and crystalline.

Dr. Wunsch emphasized that the geologic map of New Hampshire shows different types of rocks, not minerals. **Minerals** are naturally occurring, inorganic solids that possess a definite chemical structure. **Rocks** are aggregates of one or more minerals. For example, the rock granite is an aggregate of the minerals quartz, feldspar, and hornblende.

Dr. Wunsch explained that much of New Hampshire's geology is a result of **glaciation**. Approximately one million years ago, the Earth's climate changed and ice sheets expanded from the poles. The most recent glacial climax was 18,000 to 20,000 years ago; during this period New England was covered with a mile of ice and sea levels were approximately 300 feet lower than they presently are. Glaciers began retreating from New Hampshire approximately 12,000 years ago, modifying the landscape as they passed. Dr. Wunsch explained that glaciers carved out **U-shaped valleys** and deposited large boulders in New Hampshire. Glacial melt also created distinct features, such as **lacustrine plains**, which are the remains of lakes that stood at the foot of glaciers as reservoirs for glacial melt. These glacial lakes captured sediment that came off the glacier as it melted, creating layers of clay at the lake bottom that can eventually act as aquitards. Glacial melt also created **outwash plains**, which are layers of sediment; **eskers**, which are deposits of sand and gravel that parallel the direction in which ice melt

moved; **kettles** or **kettle holes**, which are depressions formed by large pieces of ice that broke off of retreating glaciers, creating ponds that may be filled by groundwater in the modern era; and **alluvial fans,** which form as glaciers back up against mountains and deposit sediment loads.

The United States Geological Survey with the help of the New Hampshire Geologic Survey (NHGS) has mapped New Hampshire at a fine scale. These surveys have revealed that approximately 14 percent of New Hampshire is covered by stratified drift, which is an excellent source of groundwater. However, fewer than five percent of private wells are located in stratified drift aquifers. Dr. Wunsch explained that this discrepancy is likely due to the fact that stratified drift often occurs in valleys, which are densely populated and served by public water systems (PWSs), not private wells. Also, citizens may prefer to drill wells into bedrock because it produces softer water without the iron and manganese found in stratified drift deposits. However, bedrock wells carry risks from arsenic, uranium, and radon. Also, stratified drift aquifers can hold up to 20 percent water, while bedrock aquifers may hold only two percent.

Dr. Wunsch explained that NHGS has mapped 104,000 private wells and has geo-referenced 42,000 of these. Data from these wells indicate that the highest yielding private wells are those at intermediate depths. The NHGS also keeps a historical hydrograph of water levels throughout the state, recorded every month. One of the wells used to calculate these water levels is in the Ossipee watershed; there are several others in the Ossipee region that could be added to the monitoring network if volunteers would take water levels from them. Unfortunately, only one of NHGS's monitoring wells is located in bedrock; NHGS plans to add more bedrock wells to the survey in the future. NHGS also plans to map the entire state in the next ten years.

New Hampshire Ground Water Issues

Brandon Kernen
New Hampshire Department of Environmental Services

Mr. Kernen introduced himself as a hydrologist with the state drinking water program. He also manages the groundwater program at the Department of Environmental Services (DES). Mr. Kernen told the group that water, along with education and taxation, is one of the most important political issues in New Hampshire. Groundwater is especially important; 60 percent of New Hampshire residents receive their water from groundwater wells and 40 percent have private wells.

Mr. Kernen explained that there are two legal doctrines associated with water resources: Western and Eastern Water Law. Western Water Law is influenced by mining legal tradition. Western Water Law ranks water rights by their seniority, allowing users that have the oldest "claim" to a water resource to use it preferentially. Eastern Water Law is influenced by reasonable use, riparian rights, and public trust doctrines. Under Eastern Water Law, all water rights are equal and users are required to use a reasonable amount of water such that others' abilities to use water are not impaired. Mr. Kernen told the

group that the laws governing New Hampshire water resources follow the principles of Eastern Water Law.

Mr. Kernen explained that the Ossipee Aquifer has a low rate of recharge in the summer and winter months due to plants using water for growth in the summer, and freezing in the winter, which retards recharge. However, water use doubles in the summer months because of lawn watering. A participant asked if the increase in water use in the summer is due to irrigation of crops and to the increased summer population. Mr. Kernen agreed that these factors can also affect summertime water usage.

Mr. Kernen informed the group that in 1998 a groundwater permitting program was introduced that scrutinizes large withdrawals of groundwater. Prior to 1998, DES had no upfront permitting authority for large groundwater withdrawal projects; the only recourse was to retroactively bring the project to court. The 1998 legislation allows DES to permit any new withdrawal projects that will exceed 40 gallons per minute (or 57,600 gallons daily). An audience member asked how the 57,600 gallons daily cut off was developed. Mr. Kernen explained that existing permitting programs for community water systems use this figure as a cutoff. Mr. Kernen continued, explaining that the permitting process has two objectives: (1) to ensure that new withdrawal projects do not adversely affect existing users and (2) to ensure that new projects use groundwater resources efficiently. Projects must be re-permitted every ten years.

Mr. Kernen explained that the permitting process is not simple. Large withdrawal projects must:

- Submit a preliminary application that describes the proposed withdrawal, identifies nearby water resources, assesses potential impacts to water users and natural resources, and designs a withdrawal testing program.

- Provide a copy of the preliminary application to public water suppliers and municipalities in the study area. A public hearing can be requested within 15 days of the submission of the preliminary application. The hearing must take place within 30 days of the request.

- Conduct withdrawal testing while monitoring water levels in nearby wetlands, residential wells, and monitoring wells.

- Create and submit a final report for DES.

- Provide a copy of the final report to the public, at which point a second public hearing can be requested.

- Conduct withdrawal monitoring or implement mitigation measures if necessary.

An audience member asked why municipalities have only 15 days from the publication of the preliminary application to request a public hearing. She added that some towns may

not hold meetings often enough to address a withdrawal proposal. She suggested that towns should have 30 days to request a hearing, or the hearing should be automatic. Mr. Kernen agreed with this and added that the town council of Barrington wanted to have a public hearing but was not able to because they missed the 15 day window. Mr. Kernen added that DES is working with municipalities to ensure that they have advance notice of project proposals so that this situation can be avoided in the future. He added that a bill in the New Hampshire Legislature may give municipalities "intervener status" in this process, meaning that towns could request a public hearing at any point in the permitting process.

Mr. Kernen emphasized that the complexity of subsurface hydrology makes it difficult to predict the effects of a new groundwater withdrawal. Some surface water bodies might be affected while others might not. He added that the impact on wetlands is difficult to measure because wetlands must be assessed for their functions and the value of those functions. They must also be monitored annually to determine if changes in the ecosystem are due to groundwater withdrawal or to other phenomena.

Mr. Kernen continued by describing potential effects of a large withdrawal project. He explained that dewatering of nearby wells; impacts on surface water bodies such as wetlands, streams, and ponds; and changes in water quality are all potential effects of large withdrawal projects. He recounted two empirical examples of how new wells can affect water levels.

- A golf course that pumps water during the summer months caused aquifer water levels to drop 15 feet. After the golf course stopped pumping water, water levels returned to baseline.

- A PWS pumping near several residential wells caused water levels to drop by 40 feet. This could be a result of the cone of depression and might not affect nearby wells. However, it could affect wetlands.

Mr. Kernen then told the group that the majority of large groundwater withdrawals occur in the southern and central portions of the state; two thirds of these withdrawals are for community water systems (CWSs). He added that all large withdrawal projects that were completed before 1998 were grandfathered and were not subject to DES's permitting process. An audience member asked if grandfathered withdrawals will be required to reapply for a withdrawal permit in ten years. Mr. Kernen answered that they most likely will not need to reapply. The audience member followed up by asking if a withdrawal project that changes its intended use would be required to apply for a DES permit. Mr. Kernen answered that such a project would most likely be subject to the permitting process. Another audience member asked if the permitting process distinguishes between bottling companies and CWSs. Mr. Kernen answered that it currently does not, although the groundwater commission hopes to introduce this distinction.

Mr. Kernen gave an example of a withdrawal project that underwent the permitting process. A golf course wanted to withdraw water from a bedrock aquifer, which would

possibly impact endangered species and nearby private wells. The golf course conducted testing and observed impacts on private wells and a drop in water levels. A permit was issued with the conditions that: (1) all impacted users receive a mailing informing them of the project, (2) the golf course conduct continued monitoring of wetlands, and (3) the golf course replace two low-yielding private wells.

Mr. Kernen believes that the permitting process has weaknesses. Applicants for large groundwater withdrawal permits can divide their project so that there are several small wells, none of which exceeds the 57,600 gallons daily threshold. Companies can also apply for wells under two different names, so that no single well triggers the threshold. Developments sometimes put in a central well that does not trigger the 57,600 threshold but also does not provide sufficient volume for the development. The central well is then supplemented with private wells, increasing the total withdrawal.

Mr. Kernen closed by emphasizing the effect of dams on surface water levels, which is much greater than the effect of groundwater withdrawals. He also reminded the group that water conservation can reduce the need for large groundwater withdrawals. Since most large groundwater withdrawal projects received zoning variances, Mr. Kernen added that stringently applied zoning laws can also effectively control large groundwater withdrawal projects.

What Can Towns Do?

Paul Susca
New Hampshire DES

Mr. Susca began by explaining the multiple causes of water quality concerns, including population increase, sprawl, loss of open space, increasing scarcity of new water sources, increase in new contamination sources, overlapping **wellhead protection areas** (the land area from which water may feed a PWS supply well), and exploding water demand. Mr. Susca also identified several options for towns to address these challenges, such as land conservation, zoning and land use controls, municipal and regional actions, and demand management. The first two approaches are fairly standard; the second two are more novel.

Mr. Susca told the group that stratified drift aquifers are good candidates for protection because they have been mapped, are optimal for large wells, and can be easily monitored for contamination. Stratified drift aquifers are vulnerable to contamination because they usually exist at valley bottoms, where the majority of development takes place. Mr. Susca told the group that, although stratified drift aquifers cover only 15 percent of the state, 54 percent of known **potential contamination sources** are located above stratified drift aquifers. A participant asked what potential contamination sources are; Mr. Susca replied that they include gas stations, automobile repair facilities, dry cleaning shops, junkyards, and manufacturing sites.

Mr. Susca posed the question of what groundwater resources should be protected — stratified drift aquifers, all groundwater, locally important sources of groundwater, or wellhead protection areas. He suggested that we might protect stratified drift aquifers because of their sensitivity to contamination and their importance to CWSs. However, he added that town-wide protection of all groundwater resources would protect all citizens, not only those served by CWSs. Also, protecting all groundwater would ensure that there is a sustainable source of drinking water, as a single stratified drift aquifer may not support the future needs of the region.

Mr. Susca then presented two options for protecting groundwater: non-regulatory approaches and regulatory approaches. Non-regulatory approaches include land protection, public education, outreach to businesses, and inspection of potential contaminant sources. Regulatory approaches include land use regulations and **best management practices** (BMPs). Best management practices are methods that have been determined to be effective, practical means of reducing pollution from nonpoint sources.

Mr. Susca told the group that DES offers a land protection grant program for communities wishing to purchase land for protection. A three to one local match is required, but this can be in the form of a less than market value sale or other non-cash contributions. Applications are accepted in October and April. Contact Karla McManus at 271-3114 for more information. An audience member suggested that participants use the source water protection assessments completed by DES that identify all potential sources of contamination when prioritizing land to protect. Ms. Folts (Green Mountain Conservation Group) added that the GMCG has copies of these assessments that can be borrowed. Mr. Susca added that town planning boards should have copies as well, and copies are available electronically on DES's Web site (http://www.des.state.nh.us/).

Mr. Susca emphasized youth education and public education as an important protection approach, as well as BMPs for hazardous substances. Any business that is considered a potential contamination source must follow BMPs; however, inspections are not conducted at the state level. DES provides training for citizens who are interested in learning how to conduct inspections of potential contamination sources to ensure that they are following BMPs.

DES has identified 69 towns with groundwater protection ordinances. Sixty-two of these ordinances prohibit certain land uses, and 52 prohibit underground storage tanks. Fourteen are similar to a model ordinance drafted by DES, which DES is revising.

To conclude, Mr. Susca reminded the group that effective management of storm water, cluster or conservation zoning, water efficient landscaping standards, and demand management focused on lawn care can be effective tools in ensuring that groundwater resources are protected. He added that his program provides one-on-one planning assistance to municipalities.

An audience member asked if there are restrictions on pesticide spraying in wellhead protection areas. Mr. Susca replied that the New Hampshire Department of Agriculture

oversees pesticide application; he offered to follow up on this issue. Another audience member described a situation in Saco, Maine where water quality in the Saco River is declining and the town is not ambitiously protecting it. Mr. Susca agreed that this is a huge issue that necessitates creative solutions that foster cooperation between multiple municipalities.

Trade Agreements and the Threat to Groundwater Protection

Arnie Alpern
New Hampshire American Friends Service Committee

Mr. Alpern introduced himself and his group, which is a Quaker organization. He explained that he would discuss: (1) what New Hampshire's water has to do with globalization, (2) international trade agreements, (3) how international trade agreements affect water, and (4) what New Hampshire residents can do to prevent negative consequences from trade agreements.

Mr. Alpern began by informing the group that General Electric (GE), Tyco, Siemens, and Wal-Mart are all investing in the bottled water business. He asked why consumers will pay more for a gallon of bottled water than they will for a gallon of gasoline. He added that many water companies are international — Nestlé, which owns Poland Springs, is a Swiss company; Crystal Geyser is owned by a Japanese firm; and the Pennichuck water company of southern New Hampshire may use a French corporation to run its system. Mr. Alpern stressed that America's water resource are being internationalized by these kinds of companies.

Mr. Alpern then explained that international trade agreements not only place tariffs and quotas on manufactured goods, but can also govern how services are traded and provided internationally. The **General Agreement on Trade in Services (GATS)** would treat services similar to the way goods are currently treated under the **General Agreement on Tariffs and Trade (GATT)**. Mr. Alpern noted that, under GATS, food and safety standards could be challenged as unfair trade practices because they prohibit foreign corporations' access to domestic markets. He emphasized that free trade is increasingly concerned with reducing barriers to commerce in all of its forms.

Each country can decide which parts of its service economy it wants to include or exclude from international trade rules — this is known as a country's **schedule of commitment**. Once a good or service is placed on the schedule of commitment, it is subject to international trade rules; using the GATS, local ordinances and limits on number of suppliers could be challenged as unfair trade practices. Currently the United States has placed wholesale services, retail services, and trucking services on its schedule of commitment; however, negotiations in Geneva may expand this list.

Mr. Alpern then introduced the concept of **progressive liberalization** by which governmental restrictions on international service agreements are gradually weakened and removed. He added that international trade disputes are settled by a panel of private

arbitrators, not in court. Mr. Alpern asked participants to imagine a dispute over the number of trucks that can enter a water bottling plant in a day. Any local restrictions on this traffic could be challenged and overturned if bottled water services were placed on the schedule of commitment. He added that pumping of groundwater could be considered "transport by pipeline," which is a service that could be added to America's schedule of commitment. He continued, stating that even licensing standards and permitting processes overseen by DES could be challenged as unfair trade practices.

Mr. Alpern concluded by stating that the European Union wants "water for human consumption" to be placed on all schedules of commitment. Mr. Alpern asked the group if they want their water resources to be managed as a commodity under supply and demand or as a resource by democratically accountable officials who are motivated by the need for affordable and safe water. He closed by reminding participants that all trade agreements must be ratified by Congress. He advised participants to communicate with their representatives if they are concerned about this issue.

Panel Discussion

Panelists:

- Paul Susca (NH DES)
- Dick Krasker (Fryeburg Aquifer Resource Commission)
- David Wunsch (NHGS)
- Dave Jeffers (Lakes Region Planning Committee)
- Denise Hart (Save Our Groundwater)
- Arnie Alpern (American Friends Service Committee)
- Brandon Kernen (NH DES)

Dr. Sham facilitated.

Question: What are the four or five most important points to be made to the town selectpersons to convince them of the importance of controlling large scale water extraction for bottling companies?

Mr. Susca responded that it is important for local governments to realize that they have no regulatory authority over groundwater withdrawals. Dr. Wunsch added that planners should educate themselves so that they can understand expert testimony. Ms. Hart added that controlling groundwater withdrawals is only one step towards protecting a community's groundwater supply. She suggested that local governments should use GIS [Geographic Information System] maps of their towns to determine where proposed projects are in relation to wellhead protection areas and wetlands.

Question: In Fryeburg, the idea of a local tax on extraction of water for use outside of the area has been raised. Is anything like this being proposed in New Hampshire?

Mr. Krasker answered that this tax was defeated; he added that he does not support such a tax. He believes that the issues in Fryeburg are not due to Nestlé's bottling plant. In fact, Fryeburg's water rates are low as a result of having Nestlé as a customer.

Question: Who or what is behind organizing the world trade agreements? Also, would you comment on the privatization of water resources in third world countries?

Mr. Alpern replied that large corporations like American Express, FedEx, and Citibank asked that services be included in the GATT to create the GATS. He added that originally the United States wanted to include all services on the schedule of commitment, but this did not occur. Service industries are advocating that more services be placed on the schedule of commitment. Also, the European Union is calling for service liberalization.

Mr. Alpern addressed the second part of the question by replying that many private water companies are based in Europe. The World Bank and the International Monetary Fund (IMF) have made privatization of water services a condition of receiving a loan. He added that there is backlash against these conditions; for example, the newly elected government of Bolivia has stated that it will not follow these requirements.

Question: Mr. Alpern mentioned other issues that he expects to address in Maine — what are they?

Mr. Alpern replied that the Governors of Maine and Oregon have asked to be unilaterally excluded from the GATS schedule of commitment, so that any agreements under the GATS would not apply to Maine or Oregon's service industries.

Question: How much influence does the Governor's Office have over NH DES and EPA processes? Also, what are suggestions for how community groups can keep politics out of water?

Mr. Kernen replied that the Governor signs or vetoes new laws but does little else to control DES and EPA efforts. Mr. Alpern added that the Governor appoints the commissioner of DES and the division directors. Ms. Hart addressed the second part of the question by commenting that the role of science in policy decisions can be a complicating factor. She explained a proposal by USA Springs in 2003 that was reviewed by DES and declined for 27 separate reasons. USA Springs reapplied for the same project under a different Governor and received approval. She commented that this decision was obviously not based on science, since the science had not changed. She added that the New Hampshire Senate Bill 386, which seeks to strengthen New Hampshire's Ground Water Protection Act, may help to codify administrative rules and to create a buffer from political considerations and changes of political regimes. Mr. Kernen disagreed, suggesting that an ethics commission is the proper way to deal with these competing interests.

Question: What kinds of mitigation are acceptable as part of the large groundwater withdrawal permitting process? Are they effective?

Mr. Kernen answered that, if a proposed project will impact nearby users, providing an alternative water supply is an acceptable form of mitigation. If a withdrawal will affect surface water bodies or wetlands, the only acceptable mitigation option is to stop the withdrawal or change its timing.

Question: Even with quantity testing of an aquifer, is there really a way to know definitively what an aquifer's ultimate sustained capacity is?

Mr. Kernen replied that a single pump test is not sufficient to determine an aquifer's sustained capacity. A long term regional study could more accurately predict this number. However, short term studies are effective at estimating capacity so that risk can be minimized. Mr. Krasker added that Freyberg is undertaking a long term, regional study using almost 50 wells around the Ward Brook Aquifer. Ms. Hart added that there are two ways to approach water management: using the principles of resource management, or using the **precautionary principle**. The precautionary principle states that, in the absence of complete data, one should take the most caution possible until the phenomenon is better understood. Dr. Sham added that water conservation can be an effective tool for water management. In-home water management is a good starting point, but outdoor conservation is equally important and has been overlooked.

Question: Imagine a coordinated program of water quality testing of a sample of private wells throughout the watershed. What parameters should be tested and what agencies could be helpful or would have an interest in the results?

Dr. Wunsch replied that NHGS would be interested in these results and could help to develop such a program. NHGS has already worked with the town of Hollis to create a private well testing program. Ms. Hart added that the community can take the initiative in developing this program as well. She reported that DES personnel will teach citizens how to use well testing kits and submit their results. Mr. Susca added that DES has published a summary of why private wells should be tested, how often they should be tested, and for what parameters.

Question: How do we educate people about the real price of bottled water?

Ms. Hart suggested bringing a reusable container of water with you to avoid the habit of purchasing bottled water. She added that there is no evidence that bottled water is healthier than municipal or private water. She also emphasized the importance of conservation and encouraged participants to change their actions (e.g., lawn watering, water efficient appliances) as well as focus on bottled water companies.

Question: With respect to BMPs, would it be advantageous to have a single individual volunteer to audit businesses within the towns of the Ossipee watershed?

All panelists agreed that this would be a good idea. Dr. Sham added that Oregon has implemented a certification program on environmental friendly car repair and maintenance or "Green Garage" program that identifies automobile service facilities that follow BMPs — New Hampshire could develop a similar program.

Question: What is a wellhead protection program? What towns do not have one?

Mr. Susca replied that wellhead protection programs are typically run by water suppliers, not by towns. He added that a wellhead protection program consists of renewing the inventory of potential sources of contamination within the wellhead every three years. An inspection component for BMPs can also be added to the program.

Question: Has Boston or the Massachusetts Water Resources Authority (MWRA) ever expressed interest in the Ossipee Aquifer as an additional source for their future?

Mr. Susca answered that Boston and MRWA have not expressed interest in the Ossipee Aquifer. He added that, since Massachusetts is losing population, it is unlikely that Boston or MRWA will attempt to expand into the Ossipee Aquifer.

Question (submitted verbally): Is it true that Fryeburg has granted withdrawal permits to Nestlé beyond what the aquifer can sustain?

Mr. Krasker responded that the town did not grant any permits, as it does not have this authority. Instead, the Maine Public Utilities Commission told the Fryeburg Water Company to set up a middleman to sell water to Nestlé. Because Nestlé is a customer of the Fryeburg water company, the planning board has no control over the company's actions. A second company that is interested in using Fryeburg's aquifer will have to work with Nestlé so that the total withdrawal from the aquifer does not exceed 75 percent of the sustainable draw. Citizens of Fryeburg hope to purchase the water company when it comes up for sale to gain more control of Nestlé's withdrawals.

Dr. Sham concluded the panel discussion by emphasizing the need to balance competing priorities during developing. Dr. Sham and Ms. Folts thanked participants for attending the Groundwater Conference and encouraged them to continue pursuing their interest and concern for groundwater issues.

Appendix 1: Questions Submitted to the Panel

1. Has Boston or the Massachusetts Water Resources Authority (MWRA) ever expressed interest in the Ossipee Aquifer as an additional source for their future?

2. What is a wellhead protection program? What towns do not have one?

3. With respect to BMPs, would it be advantageous to have a single individual volunteer to audit businesses within the towns of the Ossipee watershed?

4. How do we educate people about the real price of bottled water?

5. Imagine a coordinated program of water quality testing of a sample of private wells throughout the watershed. What parameters should be tested and what agencies could be helpful or would have an interest in the results?

6. Even with quantity testing of an aquifer, is there really a way to know definitively what our aquifer's ultimate sustained capacity is?

7. What kinds of mitigation are acceptable as part of the large groundwater withdrawal permitting process? Are they effective?

8. How much influence does the Governor's Office have over NH DES and EPA processes?

9. What are suggestions for how community groups can keep politics out of water?

10. Mr. Alpert mentioned some other issues that he expects to address in Maine — what are they?

11. What does AFSC stand for?

12. Who or what is behind organizing the world trade agreements?

13. Would you comment on the privatization of water resources in third world countries?

14. In Fryeburg, the idea of a local tax on extraction of water for use outside of the area has been raised. Is anything like this being proposed in New Hampshire?

15. What actions would you recommend the six towns of the Green Mountain Conservation Group take to protect the Ossipee Aquifer?

16. What are the four or five most important points to be made to the town selectpersons to convince them of the importance of controlling large scale water extraction for bottling companies?

17. What suggestions do you have to get more towns officials alerted to groundwater protections for their towns? How do we get them to attend conferences like this one?