**Dealing with Decline: Seeking an Interdisciplinary Solution to the Palouse Basin Aquifer Problem**

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**Abstract**

Groundwater levels in the Palouse Basin have been steadily declining for over a century. Despite research on the aquifer that started in earnest in 1967, the boundary, capacity, recharge, and discharge from the aquifer are still poorly understood. Even with this scientific uncertainty, nearly all water managers recognize the need to develop a long-term plan to provide a sustainable water supply for the communities relying on the aquifer. As part of an interdisciplinary course, six graduate students studying law, engineering, and environmental science in the University of Idaho's Waters of the West program were asked to prepare a report on how to deal with the issue of the declining aquifer in the Palouse Basin. As a group hailing from a diverse range of scientific and legal backgrounds, we (1) had to determine how to define the problem, then (2) decide how to address it. Of necessity, this question had to *integrate* the various disciplines that the students represented, as each student viewed the issue from the perspective of her or his background. Based on group discussions, we felt that the most striking issue with the declining aquifer problem was the fact that after 40 years of research, and with the general consensus that a problem did indeed exist, no proposals for addressing the long-term sustainability of water resources in the basin were being assertively presented to the public.

Based on this understanding our integrating question initially was, "How do we convey the scientific problem to the public so as to incite the public into involvement?" From this we developed a conceptual model. Then, in considering how our focus and understanding of the problem had evolved, we refined our integrating question to its present form:

How can we effectively communicate the issues at hand so that Palouse Basin residents understand the problem, appreciate the steps being taken to confront it, and grasp the significance of addressing it in a timely manner?

The following report focuses on the process of developing the integrating question and the conceptual model. As a result of this development we feel that there are three major issues that need to be expressed to the public: (1) the value and limitations of water conservation, (2) the possible solutions to the problem, and (3) the current state and limitations of scientific knowledge related to the aquifer. We feel that academia can contribute to resolving this issue, mainly by seeking to educate the public. An informed public then will have the tools necessary to address this complex issue.

﻿**Background**

Research for this project was provided by lectures from various experts in the region and assigned reading for Water Resources 506. The lectures and reading included information presented from the perspective of many disciplines, including social science, systems dynamics and modeling, and physical sciences such as geology, hydrology, and engineering. Group 4, which authored this report, was composed of students from the fields of law (2), Waters of the West science and management (1), ecology (1), and water resource engineering (2). The group had two bases: the University of Idaho's main campus in Moscow and the Idaho Water Center in Boise. While it would have been ideal, logistically, to have all group members working from the same location due to time restraints and the efficacy of "face time," a multi-venue assemblage was necessary to ensure diversity in the four participating groups. The long-distance communication added to the challenge of the project, but the tools we developed to overcome the distance barrier seem to have helped the process of integrating and understanding across disciplines.

In order to approach this problem from an interdisciplinary perspective, two main methods were used to develop an integrated understanding: the development of (1) an integrating question and (2) a conceptual model. Our approach was initially circuitous: After developing an integrating question we constructed a conceptual model that we then used to refine our integrated question. In other words, our conceptual model did not illustrate our integrating question as much as it ultimately influenced it. Based on the understanding gained from the conceptual model—how the various components of the human and physical system interacted—we refined our integrating question, and the process continued through several iterations. The Methodology section of this report focuses on the process of integrating our understanding of the declining aquifer problem through use of the integrating question and conceptual model. In addition, the section also discusses the tools we used to communicate and share information during this project. Following the Methodology section we describe the resulting understanding we gained from the integration process.

**The problem**

The residents of the Palouse Basin in northern Idaho and eastern Washington rely almost exclusively on groundwater taken from the Grande Ronde and Wanapum aquifers to meet their municipal, industrial, and domestic water demands. Because soil structure and seasonality of precipitation in the basin are almost always adequate to support dry-land farming, little irrigation has been developed in the basin (Richartz, 2010; Boll lecture, 9/6/11). As such, groundwater development in the basin is primarily limited to rural residential and stock water demand. This development occurs mainly in the shallow Wanapum aquifer (Richartz, 2010). In contrast, most deep groundwater withdrawals occur within municipalities. The basin’s two predominant municipalities are Moscow, Idaho, and Pullman, Wash., each of which supports a major land-grant university, the University of Idaho and Washington State University, respectively. The location of these universities had much to do with the early development of groundwater resources in the basin. While action was taken in the 1970s and ’80s to stabilize the smaller, shallower Wanapum aquifer (PBAC Report, 2009), water levels in the Grande Ronde have been declining for over 100 years (Id.). Because of the limited size and location of the Wanapum aquifer, it can only provide a supplemental water supply. While the scientists and engineers studying the aquifer do not expect it to go dry in the next couple decades, the declining aquifer problem presents a serious long-term issue that the people of the Palouse Basin need to address. As will be pointed out, many of the long-term solutions are costly or may require significant research to carry out. In order to guarantee the long-term sustainability of water resources in the basin and obtain the funding for potentially costly infrastructure improvements, it would be wise to address the declining aquifer problem now, before a water-supply crisis develops.  
Unfortunately, no solutions are being aggressively sought to deal with the problem. Although various researchers have significantly advanced knowledge of the aquifer, a thorough scientific understanding of the basin’s hydrology has yet to be developed.

As 40 years of scientific research in the basin make plain, the issue of sustainable water resource development cannot be solved by science alone. This should come as no surprise: As early as 1976, Liebmann classified water-resource issues as *wicked* problems. His use of the term *wicked* was based on Rittel and Webber's (1973) definition of a *wicked* problem as one that involves social policy, because it is impossible to define the policy that serves the *undisputable public good* when multiple stakeholders are involved. When there is a high level of scientific uncertainty on which policy must be based, we could say that the problem becomes even more *wicked.*

In studying the dynamic model developed by the Palouse Basin Aquifer Committee and the UI Waters of the West program, it becomes apparent that conservation alone will not resolve the issue and the economic costs of the wait-and-see approach are likely great. It was also revealing that the social research conducted by Katheryn Bilodeau and Saundra Richartz showed a limited understanding of Palouse residents regarding the problem.

**History of water supply and research in the Palouse Basin**

The Palouse Basin was initially established as a dry-land farming region in the 1880s. Relatively easy access to high-quality groundwater resources influenced the establishment of the University of Idaho in 1889 and the Washington Agricultural College and School of Science (now Washington State University) in 1890. At this nascent stage, the Palouse Basin had a notably high water table. Although the majority of agriculture centered on hog farming and dryland cultivation, the ready supply of water facilitated speedy settlement of the area. For instance, the city of Pullman was famed for its artesian wells in the late 1800s—indeed, the presence of natural springs influenced the Washington state legislature to select Pullman as the site for what is now WSU. But the springs dried up as the area’s groundwater resources were developed. In 1897, the static water level of the Grande Ronde aquifer under Pullman hovered around 8 to 9 feet below the surface of the land. By 1923 that level had plummeted nearly 40 feet (Richartz, 2010), and the depletion continued steadily. During the Great Depression to the end of the World War II, the Grande Ronde was declining between 5 and 9 inches every year.

The post-war years saw a massive increase in groundwater withdrawals in the Palouse Basin. A population boom following the end of the war coupled with the advent of new pumping technology, and cheap hydroelectricity suddenly made the large-scale development of the Palouse a viable endeavor. During this time, the city of Moscow relied mostly on the shallower Wanapum aquifer. As the city grew the Wanapum aquifer quickly began to decline. Water levels in the Wanapum were declining 21-22 inches per year in the late 1930s and were plunging 50-55 inches per year by the mid-1950s. At the same time, the Grande Ronde (which supplied the water for the rest of the basin) was declining 21-22 inches annually from 1946-1951. In what was perhaps the first instance of the recognition of the declining aquifer problem, Pullman made efforts to curtail use in the 1950s. At the same time, Moscow curtailed its use of the Wanapum aquifer and began drilling wells into the Grande Ronde. As a result, curtailments notwithstanding, the water level of the Grande Ronde had dropped 120 feet by 1962 (Richartz, 2010).

The first serious attempt to understand the declining aquifer problem took place in 1967 with the founding of an informal group known as the Pullman Moscow Water Resource Committee (PMWRC). This was also the first concerted attempt to develop a scientific understanding of the area. Yet in spite of an increased awareness of the declining water levels, the persistent depletion of the aquifers continued for decades as the towns and universities grew. The Grande Ronde had shrunk another 40 feet by the late 1980s.

A response was forthcoming: In 1992, with the help of state agencies in Washington and Idaho, the PMWRC drafted and instituted a Ground Water Management Plan (GWMP). Prior to the GWMP’s enactment, water levels in the Grande Ronde were shrinking 1.32 feet per year. After 1992, the rate of depletion was slowed to .92 feet per year. Thus, while the GWMP successfully reduced the overall withdrawals from the Grande Ronde, it did not stop them (PBAC report, 2009). And while the Grande Ronde continues to decline, water levels in the Wanapum have stabilized. This, however, is due to the fact that Moscow only uses the Wanapum for supplemental purposes and water from that aquifer never comprises more than one-third of the city’s total municipal supply. (Id.). Therefore, the Grande Ronde currently provides the majority of groundwater for the Palouse Basin. Due to an incomplete scientific understanding of the basin’s hydrology, estimates on the remaining usability of the Grande Ronde range from 50 to 500 years. That is to say, the Palouse Basin’s main source of water may be entirely depleted within our lifetimes.

**Demographic and Economic Conditions in the Basin**

Although the economical influences on the declining aquifer problem are far too complex to appropriately address in a truncated forum such as this, a couple aspects bode brief mention. Two of the primary stakeholders, Washington State University and the University of Idaho, are the two biggest employers in the Palouse Basin (www.moscowchamber.com). UI employs approximately 2,700 persons, which makes up one-third of the work force in Latah County (www.labor.idaho.gov). That total, however, is roughly one-half the number of persons employed by WSU (5,300). The two universities and the region's third-biggest employer, Schweitzer Engineering Laboratories (SEL) of Pullman (1,200 employees), together comprise 48 percent of county's labor force of 19,106 (www.moscowchamber.com). SEL, which is easily the Palouse Basin's largest private employer—-the next biggest is Gritman Medical Center in Moscow, which employs 429 (Id.)—has recently constructed a facility in Lewiston, Idaho, outside of the Palouse Basin. Although the corporation has not publicly said as much, the expansion is believed to have been prompted by the favorable tax structure of Idaho, Lewiston's corporate incentives, and the guarantee of a long-term water supply.

**Group integration**

Before it was possible to work on integrating the research, we had to develop some means of long-distance communication that would allow for the timely transmission of ideas. We also had to develop rules that would govern our collaboration. The means of communication included use of tools such as Skype, Wikispace, email, and speaker phones—all with varied degrees of success. We also established common rules that would govern the group. One of the team members took the initiative and composed a set of rules, and the group voted unanimously to enlist them. Enforcement of the rules was spelled out clearly, and relied on each group members’ conscience to make them “feel good when you contribute, feel bad when you don't.” The subconscious effect was clear and surprisingly effective. One reason it may have been successful was that the group was made of like-minded people who wanted to succeed. When a group has more invested or more risk, it may become more difficult to establish rules. The team also did not actively establish leadership or roles.

In the formative stages, group integration was slow. We made a few impersonal attempts, via phone calls and email, to connect, but ultimately face time was the solution. For that, the group decided to use Skype because it was free and accessible to everyone. Still, the group’s separation made things difficult. Getting members from the two locations together typically required a series of emails. One group member came up with the idea of a central location to capture all of the different efforts of the group—on a Wiki page. We decided it would be a good option and voted to create [http://wr506group4.wikispaces.com/](http://wr506group4.wikispaces.com/home).

Group members first viewed the declining aquifer problem from their respective disciplines. We approached the problem by identifying our possible relevance and then determining how we could identify to the problem This technique contrasts with the methodology suggested by Allen Repko—that groups should identify potentially relevant disciplines and narrow them down by three questions. Rather, we asked ourselves those questions relevant to our own experience and background, but did not use it to narrow down the disciplines. We then discussed possible problems that faced the communities affected by the problem from each discipline. We started with each disciplinary perspective before we did in depth literature review. This held some advantage because we were less likely "to be unduly influenced by what disciplinary experts have already said." (Repko).

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| At each step we tried to use the Wiki format to capture our methods and document the process. Our meeting minutes capture some of the specific steps we took to integration. For instance, the group initially felt that more research would help the community make a decision, but through discussion of the different disciplines we ultimately deduced that the problem was how the information was disseminated within the community. This development was captured in the meeting minutes as 75% of the group felt the greatest solution was more research [1-meeting minutes]. The exercise of creating a conceptual model helped the group to understand the problem and realize what was impeding the community from addressing the declining aquifer problem. |

**Methodology**

We learned that one of the biggest initial challenges in addressing a water resource issue is developing an understanding of the level of complexity the problem involves related to scientific understanding, stakeholder relationships, and community perception. Due to time constraints and the potential power wielded by communities, we felt it necessary to focus most of our attention on trying to understand the qualitative, rather than quantitative, aspects of the declining aquifer problem. To develop a qualitative understanding we used three methods: (1) brainstorming sessions, (2) development of an integrating question to address the issue from an interdisciplinary perspective, and (3) development of a conceptual model showing the interconnections between as many social and physical elements as possible. Processes 2 and 3 occurred iteratively, but for clarity we present them sequentially.

**Brainstorming sessions:** When conducting interdisciplinary research in a group, the first challenge is to develop a shared vision of the problem being approached since each group member naturally views the issue from the perspective, or lense, of his or her disciplinary background. The first step in overcoming this was to have sessions where group members freely discussed the problem. Most of the initial brainstorming occurred in the early part of our research, before we began researching the project. The early consideration of the views of group members was important, since nearly all research has the potential to bias one’s perspective. These brainstorming sessions helped us to learn how to communicate across disciplines while gaining insight that allowed appreciation and understanding of the various disciplines from which each group member came. Moreover, the sessions helped us to realize that our disciplinary perspectives tended to skew our personal understanding of the problem. In one of our sessions, an environmental student expressed that she was all about promoting conservation in favor of erring on the side of caution, while one engineering student argued that perhaps the declining aquifer problem wasn't really a problem at all if the aquifer probably has at least 50 more years of productivity.

But as we continued our research we discovered that while conservation is beneficial it does not appear to be a viable solution. We also found that the wait-and-see approach our engineer colleague initially endorsed could be costly. While these brainstorming sessions contributed significantly to our interdisciplinary understanding, they also helped us understand that when you are dealing with complex issues, those that cross the interfaces of science, technology, and social issues, stakeholders are likely to have very diverse views on the issue as well. Stakeholders are just as susceptible to biases based on their own values, opinions, education, and life experience. During the sessions we determined that the disciplines of hydrology, geology, applied science (engineering), social science, and political science could be key disciplines to include in our research. Per course instruction, we excluded law from our list of core disciplines. But it should be noted that due to the interstate location of the aquifer, the multi-jurisdictional aspect of the problem could have a significant influence on the political and social ramifications that result from any prospective resolution.

**Development of the Integrating Question:** After several brainstorming sessions it became apparent that we needed to develop a question or thesis that would provide a focus to our report. In order to address the complexity of the issue it was critical to develop a question that integrated the core disciplines identified in the group sessions. Because this question was meant to integrate across several disciplines we have referred to this question here as our *integrating question.* From our early research and brainstorming sessions, the striking problem seemed to be that the community appeared to be mining the aquifer and nothing effective was being done to stop the mining. At first we felt that perhaps the real issue was a lack of funding for research, which led to a high level of scientific uncertainty. We also thought that perhaps that scientific uncertainty was leading to apathy in the community, and that resulted in a lack of willingness to fund research. Based on this understanding, our first informal integrating question was: "How do we convey the scientific understanding of the issue at hand so as to incite the community to take action." Later, one of the group members raised the ethical consideration, that if we were trying to incite the public to take action, then we risked becoming issue advocates, thereby losing credibility with some members of our intended audience (Pielke, 2009). We revised our first formal integrating question during a class group work day by refining the original question to state, "How do we convey the geological, hydrological, political, and social impediments involved with the declining Wanapum and Grand Ronde aquifers to the community so that the community can develop a plan to provide for a consistent water supply in the future?"

A paradigm shift occurred in the group's understanding of the declining aquifer problem during construction of the conceptual model. The development of the model (discussed in the following subsection) led us to realize that there was a disconnect between the residents of the Palouse (or the general public stakeholder group) and the scientific knowledge being generated in the research process. As we discussed this issue and refined our integrating question, we developed the final draft of our integrating question: "How can we effectively communicate the issues at hand so that Palouse Basin residents understand the problem, appreciate the steps being taken to confront it, and grasp the significance of addressing it in a timely manner?” Our feeling in stating this question is that the role of the academic community is to successfully educate the public on the issues at hand. If the public knows the cost of delaying action on the issue, and they choose that option, then they have made a clear choice to define the *greater public good*. If they choose to wait, because they aren't aware of the issue, then the scientific community, and especially the interdisciplinary community, has failed to communicate the issue effectively to the public. From a disciplinary perspective, communication of issues to stakeholders may not be critical, but because the interdisciplinary community is primarily seeking to address large, real-world issues that cannot be addressed by a single discipline, our obligation to communicate our findings should be greater and should be a goal of our work.

**Development of the Conceptual Model:** We were directed in our initial attempt at developing a conceptual model of the declining aquifer problem to use the symbology presented by Heemsherk et al. (2003). Our first attempt occurred during a class break-out session. Pens and a sheet of blank paper were provided to the group members in Moscow. The Moscow team then directed a Skype camera at the paper so that the Boise members could follow the development and participate in the process. Getting started was difficult until one of the members volunteered to draw the model and channel the flow of ideas. We then established rules for distinguishing the components of the system by color, and used variously shaped boxes to represent model components, while arrows of various design connected where used to describe the inter-relationships between components. We started with a large red box labeled "DAP" for *declining aquifer problem*. Red was used to symbolize the *main problem,* while blue was used to draw the main components in the system. We felt that the main components of the system were the aquifer, population, economy, and science. While two of the components, the aquifer and population, are physically entities, the second two components, the economy and science, are more abstract. The aquifer and economy were linked by orange arrows (symbolizing bilateral influences) to the population. The aquifer—particularly its decline—is directly linked to population. An expansion in population increases the rate of decline in the aquifer. The aquifer and economy where not directly linked, since we felt the economy was not expanding or contracting in direct response to the aquifer at this point. Interestingly we did not include any direct interaction between science and the other three components. The looped arrow, from the aquifer problem to science, indicated that this problem is driving the scientific investigation of the issue. From the scientific process we then showed arrows indicating the flow of knowledge reaching the large-group stakeholders—UI, WSU, city governments, PBAC, community action groups, and political factions. We then showed the knowledge of science being disseminated by the large-group stakeholders to the population (or general public) as propaganda. We used the term *propaganda* because each entity seeks to inform the public about the problem as they view it. We did not use the term to imply stakeholders are using scientific knowledge in malicious or misleading fashion. Rather, we believed that each stakeholder viewed the problem and disseminated information about it based on the stakeholder’s particular concerns, much like a scientist tends to approach an issue from the perspective of her or his discipline. Because the public is being informed about the issue from the fragmented perspective of the large-group stakeholders, general knowledge of the issue may also be fragmented and perhaps contradictory.

By the time we completed the model, we realized that we had isolated the hydrologic process related to the aquifer to one small corner of the model while we expanded the flow of knowledge about the problem. In other words, we were seeing the problem with the declining aquifer not so much as a physical issue, but as a societal issue in how knowledge is being disseminated. A second simplified model was then produced by the Boise-based group members focusing on the *flow of knowledge*. It was the process of building the conceptual model and *seeing the flow of knowledge* that really created a paradigm shift in our understanding of the declining aquifer problem. We realized in this exercise that the public needs to be presented a *complete* picture of the issue, and perhaps the academic community, or PBAC, needs to develop an educational strategy that not only presents the issue but also verifies that the public has a more or less *complete* understanding of the issue. In subsequent sections we will discuss further a number of components that need to be provided to the public for them to gain a complete understanding of the issue.

**Current perceptions on the declining aquifer problem**

According to a recent survey, only 20.7% of residents in the Palouse Basin have “accurate groundwater knowledge.” (Bilodeau, 2009) This means that that only one in five people who rely on the Grande Ronde and Wanapum aquifers have an accurate understanding of where their water comes from and the sort of difficulties that accompany its management. Even more problematic is the study’s finding that “[a]ccurate knowledge that aquifers supply community water is strongly related to a respondent’s willingness to pay for conservation” (Id.) That is to say, the public’s low level of understanding of their water resources correlates to a similarly low level of importance for devising solutions to it. As the researcher indicated:

Talk of a limited water supply or decreasing aquifer levels may not fully be appreciated if one can turn on a tap and water flows freely. This proposition is supported by the 43.5 percent of residents who did not know the origin of their groundwater and the generally low knowledge ratings in many areas of the Palouse Basin survey. These components might contribute to residents’ tendency to refuse to pay for water conservation. (Id.)

Yet many respondents also indicated that they would support further planning for the future management of groundwater resources, thus indicating that some awareness of a problem with regard to aquifer levels. (Id.) Taking this information together with the low level of community understanding of the declining aquifer problem, it seems clear that the public is vaguely supportive of increasing our understanding of the Palouse basin’s hydrology. Somewhat contradictorily, however, the public is also fairly unwilling to personally support the advancement in knowledge, at least in an economic context. The inference that can be drawn is that while residents recognize a problem exists they do not understand how, or even if, it applies to them. Therefore, the average resident is largely indifferent to an issue that could become a crisis within his or her lifetime.

The thematic gauge used by Bilodeau, a willingness to pay for water conservation revealed that residents’ views of the declining aquifer problem were not influenced by gender, age, or socio-economic factors (Id.). The results indicated that a resident’s level of knowledge regarding water resource problems correlated with his or her willingness to pay for water conservation (Id.). Municipal water users, as compared to private well owners, were likewise more willing to pay (Id.). These qualitative results suggest that public apathy toward the declining aquifer problem is more of a communicative issue than a societal one. And this is underscored by the fact that the organization charged with addressing the problem, the Palouse Basin Aquifer Committee, is largely unknown to the public (Id.), but has been in existence for 44 years (PBAC report, 2009).

The challenge is finding a way to relate information that tells the public more about the declining aquifer problem than simply that a problem exists. The issue assuredly lies in the conveyance of the information and/or reception thereof. Only when that point is finally driven home will the community recognize the necessity of addressing the problem.

**Problems with communication**

According to Bilodeau, Palouse Basin residents viewed, in order, newspapers, word of mouth, and municipal water departments as the three most important information sources where water resource issues are concerned (Bilodeau, 2009). Each medium presents levels of effectiveness as well as limitations.

**Newspapers:** Of these three sources, only newspapers are designed—and ethically obliged—to provide an objective point of view. While word of mouth is understandably slanted—not to mention notoriously inaccurate—and information emanating from a public utility reflects that body’s perspective rather than a unified front, media groups presumably have no vested interest in the subject matter. But that objectivity can have a detrimental effect on the information’s potential impact; a reporter who resists the urge to downplay issues is just as likely to avoid an interpretation that could be construed as sensationalism. Consequently, information that ends up in print is filtered by a reporter’s judgment.

The Moscow-Pullman Daily News, a 6,200-circulation publication (Editor & Publisher, 2010) whose subscribers reside entirely within Latah County, Idaho, and Whitman County, Wash., is the newspaper of record where basin water resource matters are concerned. The nature of the Daily News presents an additional complication as to how information is conveyed. As a comparatively small publication, the Daily News typically employs recent college graduates, the majority of whom remain on staff for less than a year. While media sources normally assign a particular reporter to cover a certain topic or issue, especially one featuring a high degree of complexity (scientific and otherwise), perpetual staff turnover does not afford the Daily News that ability. So a Daily News reporter presented with water-resource information is likely approaching it with only a basic knowledge of the issues involved. Invariably, the published accounts reflect an oversimplified view. The result is a significant impact on what survey respondents overwhelmingly identified as the most important source of information regarding Palouse Basin water resource issues (Bilodeau, 2009).

**Word of mouth:** Although respondents considered this medium far less important than newspapers—only 10.5% considered it the top source of water-source information, as compared to the 45.7% who identified newspapers (Id.)—its susceptibility to opinion is disquieting. Considering how few Palouse Basin residents view the declining aquifer problem as a pressing concern, it is fair to presume that residents who rely on the word of their neighbor view the problem with a comparable lack of urgency. Moreover, the manner in which information spreads through this medium is beyond any instrument of control. The only way to counteract it is for entities to provide accurate, understandable data—and hope that candor prevails.

**Water department literature:** The problem here is not with accuracy, it’s with uniformity and completeness. Although the issues being presented to the six primary entities—four cities, two universities—appear relatively consistent under the direction of the PBAC, the rural resident who draws water from a private well isn’t apt to be sensitive to any municipal concerns. To be effective, information provided needs to be the product of a coordinated effort that encompasses all entities—including rural residents of Whitman and Latah counties. PBAC literature noticeably lacks any data regarding the groundwater consumption of private well owners. By implication, or rather omission thereof, these well owners probably do not consider themselves to be part of the problem. That would explain why they are as a group reluctant to participate in or fund water-conservation measures (Id.).

**Outreach**

Given the well-documented decline of newspapers and the inefficiency of the other aforementioned sources, it is advisable if not imperative to incorporate additional mediums into the process of informing and educating the public about the declining aquifer problem. Internet-based social media outlets are a logical focus, although it would be difficult to convey the urgency and complexity of the situation in a medium that encourages informality. At this point of communicative development, the most prudent approach would be to make sure that information is readily available to those who want it, and to present it in a straightforward manner that can be grasped by the general citizenry. A good first step would be to revise the PBAC website to make educational resources the central focus and the source for all information relevant to the declining aquifer problem.

Using ideas and practices like utilizing new media, inquiry-based learning, and participatory metacognition can be some of the methods to better help the community grasp the science, history, and reasoned pertinence of the declining aquifer problem. The complexity of this issue, and the stakeholders of said concerns, will have to be truthfully and thoroughly illustrated in order for individuals to have the framework in which to place the declining aquifer problem. Engaging the community, and placing trust in the public’s understanding and stewardship, will bring further insights and ideas to the decision space. Interdisciplinary methods of information integration and delivery will be needed if the communities of the Palouse are expected to further their own understanding of aquifer issues in our local ecoregion.

As land use may be indicative of water use and recharge, these figures may guide recommendations that encourage group specific conservation techniques. This could also create a market for alternative sources with consideration given to land/water use and the associated costs and benefits for the additional resources.

Through the use of geologic maps and climate data, instructive graphics or models (such as that presented by PBAC and Waters of the West) may emerge that will easily convey the issues for the visual learners in our audience. Effective maps, models, or even three-dimensional aquifer models showing the basaltic composition of the aquifer and relative rates of recharge and discharge with respect to an appropriately sized basin may increase understanding public comprehension of the situational uncertainty and ultimately conservation. By including the hydrologic cycle and per capita use as well as the effects of increased consumption or varied degrees of consumption or conservation in the total resource, quantification of aquifer storage, the water balance equation, and any potential for outside water resources (i.e. reservoirs or treatment and reuse of waste water) could be more easily understood.

**Conclusion: the need for an educational campaign**

Based on our conceptual model and the findings of social science research (Bilodeau, 2009), we feel the most critical step to resolve the declining aquifer problem is for either PBAC or the universities to carry out an educational campaign to inform the public of the issue at hand. This is a community problem, and it can be fixed only through the collaboration of the communities involved. While neither PBAC nor the universities are presently in a position to promote a solution, it would be wise for these entities to initiate public dialogue on the topic.

As a group we feel that the most important issues to convey to the public are:

* Scientists are a long way from understanding the aquifer.
* Historic and scientific evidence indicates that we are mining the aquifer.
* Conservation in itself is not a solution to aquifer mining.
* What is the possibility of building a storage reservoir to serve the communities? What would the long-term costs be, what legal hurdles would have to be overcome? What environmental issues are at stake?
* Is aquifer recharge possible? A pilot program should be initiated to recharge the aquifer based on where scientists think it is possible, and then test the region for response. Secondly the costs, environmental constraints, and legal issues explored related to the recharge of the aquifer using injection wells.
* And perhaps most importantly, what is the economic and community risk of doing nothing?

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