The Clearinghouse Approach to Enhancing Informed Public Participation in Watershed Management Utilizing GIS and Internet Technology

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Abstract: Geographic Information Systems and Internet technology provide the capability to enhance informed public participation in watershed management. This is demonstrated by a case study of the endeavor resulting in the construction of the Gunpowder Watershed Clearinghouse Website. This "clearinghouse" model represents an important tool for promoting "inclusiveness" in watershed management. This is essential, as watersheds serve the needs of diverse groups of stakeholders with divergent agendas and differing jurisdictional allegiances. It is vital to engage these diverse groups because it is upon their behavior(s) that watershed health depends. When resource managers incorporate the general public into watershed management public health is guarded, conflict can be mitigated, government transparency is increased in a digestible manner, better decisions are made, and appreciation of the need to protect natural resources nurtured. This incorporation is well served by the creation of an Internet "clearinghouse" to foster a shared watershed-based geographical identity, educate at the user's convenience, and connect stakeholders with cultural and physical resources and phenomena. Allowing sharing, rather than hoarding or duplication of resources, and creating awareness among various watershed stakeholders of each other's activities supports watershed preservation and restoration.

Keywords: Watershed management, public involvement-outreach, geographic information systems, Internet, environmental education, water resources.

Introduction

The modern environmental movement places a high value on equity in resource management. A strong correlation exists between equity and empowerment, which is the power to act on ones own behalf. If indeed, "knowledge is power," then empowerment results from the effective dissemination of that knowledge. Integrating Geographic Information Systems (GIS) and Internet technologies nurtures this dissemination, enhancing informed public participation in one of the most universally relevant of all environmental concerns, watershed management.

The following is a case study of an Internet and GIS-based project to promote informed public participation in watershed management in Maryland's Gunpowder Watershed. The project is the Gunpowder Watershed Clearinghouse (GWC), on which the author serves as both an observer and a participant. This work is to serve as a prototype for similar projects in other watersheds. This case study is particularly noteworthy, as it parallels recent high-profile efforts of several levels of government, Non-Governmental Organizations (NGOs), and the general public to improve watershed management in the study area.

Place-based case studies such as this are valuable in many ways, including their ability to "translate abstract information" so that it is digestible, and to present information in convincing and concrete terms.

Contemporary studies of the impact of new media on citizen networks by authors such as Tambini (1999) examine broad themes such as the medium's potential to provide new corridors of access to the main transactions of democracy. These corridors are indicated to be information provision, preference measurement (voting), deliberation, and will formation/group organization. While such treatments are valuable for understanding the big picture at a theoretical level, they are particularly illuminating when considered in the light of a small-scale case study. Such a case study manifests the nuts and bolts of networking with new media, and the power of this approach to alter identities, allegiances, and behaviors through dissemination of information, pulling environmental issues into the public sphere for debate and discussion, and providing a platform upon which broad coalitions may form and act.

Before proceeding with an analysis of the GWC and the "clearinghouse method," an understanding of the set-
ting of the study area is necessary in order to place this public outreach project into proper context. A description of basin characteristics aids in comprehending the needs and demands of stakeholders.

Setting

The Gunpowder Watershed includes areas of Baltimore, Carroll, and Harford counties in Northeast Maryland, and Southern York County in Pennsylvania on the east coast of the United States (Smith, 1999a) (Figure 1). A total of 750 kilometers (466 miles) of first, second, and third order non-tidal tributaries exist in the Maryland portion of the Gunpowder Watershed. The Gunpowder River, the main tributary in the basin, is at minimum a seventh order stream (Johnson, 1999). This river drains approximately 1,210 km² (467 mi²) in Maryland, and 29 km² (11 mi²) in Pennsylvania. The Maryland Department of the Environment (MDE) has listed the Gunpowder River Sub-Watershed as impaired. Boward et al. (1997) provide an assessment of water quality within the Gunpowder basin. They describe water quality in the basin from poor to good, listing most stream and river segments as good. Issues include elevated bacteria and nutrient levels, strongly correlated with agricultural and urban/suburban runoff, along with elevated suspended sediment loads from agricultural runoff, erosion, and construction. There are a dozen municipal and 72 industrial discharges with National Discharge Elimination System (NPDES) permits in the watershed—each facility discharges into surface waters. Many of these streams feed into the reservoirs on Figure 1 that supply water to nearly 1.5 million people in the Baltimore metropolitan area. Therefore, the biological, chemical, and physical quality of the water in these tributaries is of vital importance.

As depicted in Figure 2, the basin is primarily rural. Based on the 1990 census, 455,000 people live in the Maryland portion of the basin, or about nine percent of Maryland’s population. Pressure from commercial and residential development is significant and is perceived by many as a threat to the Gunpowder’s natural resources. Due to its close proximity to metropolitan Baltimore, the population of the Gunpowder Watershed is growing rapidly and is expected to increase 15 percent between 1990 and 2020 (Boward et al., 1997). In particular, migration is occurring from Baltimore City to areas in and around edge cities near the southern region of the watershed where the I-695 urban circular beltway joins with “hub-and-spoke” roads (Dear and Flusty, 1998).

Origin and Purpose

The origin of this study is tied to concerns regarding surface water quality in the Gunpowder Watershed that led to the establishment of the “Gunpowder Watershed Study.” Surface water quality is an especially high profile concern in the area, as many streams in the drainage basin (including the tributaries of Loch Raven and Prettyboy Reservoirs) are designated as “Use III Natural Trout” and/or “Use III-P” waters (Figure 1). The first designation refers to water capable of carrying a self-sustaining trout population and associated organisms that, among other restrictions, must not have its temperature raised above 20°C (68°F) by human inputs. Use III-P bodies can, and in this case do, serve as public water supply (MDE, 1999a).

Figure 1. The Gunpowder Watershed (created from MDE GIS data 1999).

Figure 2. Land use in the Gunpowder Watershed (created from data from Boward et al., 1997).
The Gunpowder Watershed Study is an inter-jurisdictional watershed case analysis that gave birth to the Gunpowder Watershed Clearinghouse. It was organized due to a controversy regarding water quality violations in Piney Run caused by the Hampstead Wastewater Treatment Plant (WWTP), which is located in Carroll County and drains into Western Baltimore County (Figure 1) (MDE, 1999b). Violations were first reported in 1992. At that time Carroll County’s actions engendered conflict with the Piney Run Preservation Association (PRPA), an environmentally conscientious community group in Baltimore County. Some Baltimore County civic leaders argued Hampstead’s discharges to Piney Run to be excessive, a point upon which the U.S. District Court later agreed (Woodward, 1999). Hampstead’s discharges eventually pass into Metropolitan Baltimore’s primary drinking water supply, Loch Raven Reservoir.

The Piney Run Preservation Association claimed that MDE sampling proved the plant regularly exceeded its discharge limit, resulting in thermal pollution that raised stream temperatures above 20°C (68°F). Members of the PRPA were exasperated by what they describe as “non-responsive government,” claiming that Carroll County ignored their concerns because PRPA members do not vote in the jurisdiction. This conflict brought to light the need to improve management of water resources on a watershed-wide basis, not simply by administrative territories and their attending politics (Smith, 2000a).

In 1993, the Director of the Baltimore County Department of Environmental Protection and Resource Management (DEPREM) approached the United States Environmental Protection Agency’s (U.S. EPA), Robert Perciasape, the Assistant Administrator for Water at that time. Together they were able to secure funding for a study of the entire Gunpowder Watershed to address the Piney Run problem as well as other basin issues (Outen 1999; Woodward 1999). The stakeholder jurisdictions of the City of Baltimore, Baltimore, Carroll, and Harford counties, and the Maryland Department of the Environment set parameters for a multi-administrative study.

The project was partially funded by an EPA Small Watershed Grant, which, like many progressive grants, required a role for public participation in the process. Project meetings were open to the public, yet, it soon became obvious that attracting large, diverse, and representative numbers of the general public to meetings was inherently difficult. In fact, as Gundry and Heberlein (1984) note, this tends to be the rule, not the exception. In addition, people who attend such meetings have more years of formal education and higher incomes than most of the “client public.” Often it is difficult to gather together anyone other than those already actively involved to attend. Similar scenarios appear across the United States, and likely elsewhere. For example, a study of participation involving public range land in Wyoming reports frustratingly low rates of general public attendance at public involvement meetings (Paulson, 1998).

A search was initiated for “alternative” ways to engage the public so that they could become informed participants in preserving and restoring the Gunpowder Watershed and stay abreast of developments in the Gunpowder Study. Charlie Conklin, former President of a local NGO, the Gunpowder Valley Conservancy (GVC), was asked by the EPA to chair the public involvement team in 1997 (Conklin, 1999). Selecting an NGO leader, rather than “a bureaucrat” to lead the initiative, set an important tone. Given the burgeoning presence of the Internet in the daily lives of many stakeholders in this region, it was decided that Internet-based communication needed to be integrated into the public outreach campaign.

The project was funded in May 1998, and the author was hired to develop the Website. With EPA funding, support from MDE in the form of data, facilities, internship funding, and technical assistance — and later, technical support provided by Towson University, the author was able to collect necessary data and construct the site in approximately ten months. This Website is known as the Gunpowder Watershed Clearinghouse, or GWC (Smith, 1999a).

The title “Clearinghouse” denotes that the site is to serve as a systematized and user-friendly warehouse and transfer point for data and information for Gunpowder Watershed stakeholders and other interested parties, and a nexus that can direct citizens to external resources in order to avoid duplication. The site has for quite some time been dual hosted on both the Towson University and the Maryland Department of the Environment’s home pages. As Tambini (1999) notes, who hosts a site greatly affects perceptions and realities of content control. Therefore, MDE hosts a more static version of the site, whereas Towson University plans to have academic departments produce research related to the Gunpowder Watershed that will be appended to the site and which MDE need not vouch for. This will assist in keeping the Gunpowder community growing, learning, and sharing through symbiotic relationships. A similar approach is in progress on another of the author’s websites, The Christina Basin Watershed Education Home Page (2000) for the University of Delaware’s Water Resource Agency.

The successful release of this Web site was co-promoted and coincided with the March 20, 1999 staging of the First Annual Gunpowder Watershed Leadership Conference. The conference gathered a diverse group of watershed coalition leaders together in order to remove barriers to cooperation between actors in the drainage basin, and to ensure the health of the Gunpowder Watershed (Smith, 1999a). In addition, the “First Annual Gunpowder Watershed Earth Day Festival” was held April 22, 2000. It drew large numbers of the general public by presenting in a fun way, the theme of protecting drinking water and, garnered the support of political and natural resource leaders such as U.S. Senator Paul Sarbanes. This event was supported via the Website. Thus, there evolved an inte-
grated public outreach campaign with the GWC at its core for purposes of defining basin issues, educating, and organizing stakeholders and interested parties.

**Concept and Techniques**

**Clearinghouse Concept**

The "clearinghouse concept" is one in which diverse participants from all sectors of a population promote sharing, rather than hoarding or duplication of resources vis-à-vis an Internet-based form of outreach, one that is integrated with complementary strategies discussed in this manuscript. In water resource management this also involves providing education regarding water resources that gives meaning to data and information for the general public, and that facilitates public involvement in preservation and restoration across jurisdictions, dissimilar environments, and vested interests. Thus, a "clearinghouse" is based on methods intended to circulate both ideas and participatory opportunities to strengthen communities around shared environmental concerns in a two-way exchange of knowledge and concerns between experts and the general public. Rather than relegateing management to a few understaffed agencies, whereby government is seen as only interacting with stakeholders when it desires to enforce regulations, instead a basin-based polity is nurtured. Thus, civil society networks with managers and educational institutions to form long-term partnerships in the search for ways to pull their resources to reach common goals. It also allows one to go to the target audience that does not normally attend typical forums for interaction such as public meetings, while simultaneously providing nodes through which diverse data and information can be shared with such individuals at various scales.

A clearinghouse is not a short-term solution driven by an individual project, it is designed to provide a broad and long-term forum for communities. Unfortunately, it does have an inherent tendency to accentuate the dichotomy between the public’s "right to know," and concerns regarding legal and political liability over data and information. It can highlight conflict in the short-run, but by fostering discussion it can mitigate long-term conflict by facilitating sustainable solutions to concerns such as basin degradation. This approach provides an avenue for disseminating information in a relatively value-free way, by providing long-term multi-use data and information and positive opportunities for interaction, rather than facilitating one-sided diatribes. Also, it provides contact information to guide readers towards dedicated sources for a subjects, rather than acting as an in-depth library for particular topics. It is broader than it is deep and is therefore more broadly useful for diverse groups of citizens who wish to become involved in watershed community advocacy through the Internet. Through the "clearinghouse approach" public health is guarded by changes in environmental behavior, government transparency is enhanced in a digestible manner, and understanding of the need to protect water is nurtured.

A key component of successful public participation in watershed planning and management is to demonstrate to stakeholders that "there is something in it for them." No approach is perfect, and there are many pros and cons to using public participatory strategies. Some of these are listed in Table 1. It is easy to become bogged down in the details accompanying various watershed and public outreach scenarios. However, basic benefits to public participation can perhaps be best visualized as an escalating cycle, constantly building upon itself (Figure 3).

<table>
<thead>
<tr>
<th>Table 1. Pros and Cons of Involving the Public in Watershed Management</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros</strong></td>
</tr>
<tr>
<td>Knowledgeable citizens stand a better chance of making informed environmentally friendly personal decisions.</td>
</tr>
<tr>
<td>Creation of a watershed and environmentally-oriented identity and voting bloc.</td>
</tr>
<tr>
<td>High-profile public support of environmental work which brings pressure to bear upon politicians to offer financial support for future projects.</td>
</tr>
<tr>
<td>Infusion of unique ideas in watershed management arising from diverse participant backgrounds.</td>
</tr>
<tr>
<td>Freedom of Information Act reqeuts are met, while minimizing labor costs.</td>
</tr>
<tr>
<td>Reduction of duplication of work by connecting stakeholders.</td>
</tr>
<tr>
<td>Opportunities to improve public health through increased public awareness of hazards.</td>
</tr>
<tr>
<td>Exposing issues, thereby putting social pressure on those who may damage the watershed via pollution, etc.</td>
</tr>
<tr>
<td>Fostering a sense of shared responsibility in preservation and restoration of a shared watershed.</td>
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</tbody>
</table>

IWRA, Water International, Volume 27, Number 4, December 2002
environmental experts one can maximize geographic analysis and ergonomic fit in Web-based environmental education. This combination of resources provides the platform for the clearinghouse approach to public watershed-based education.

GIS and Internet-based visuals and text can be used to establish a geographical identity wherein the watershed is viewed as a single, yet complex, and shared resource. This connection provides the underpinning for convincing citizens to care about their watershed (and sub-sheds) and to contribute positively to its management. This also aids GIS centers in cities and counties across the U.S. in places such as Honolulu to live up to their motto of “Better Public Access to Better Public Data” (Ammerman, 1997). Thus, the powerful ability to visualize watershed characteristics can be brought to the general public when GIS and Internet technology are used in tandem. Once watershed-oriented resource data and information are brought to the grassroots level, the general public can arrive at more informed decisions regarding issues such as land use and community source water protection. This is the rationale for the creation of the Gunpowder Watershed Clearinghouse.

Proactive Versus Reactive Approaches

Creation of a clearinghouse to enhance public participation in watershed management represents a proactive approach to environmental management. Reactive approaches, on the other hand, are responses to problems once they emerge. By anticipating problems and reaching out to stakeholders before issues spiral out of control, or impacts become too large, it is possible to mitigate watershed degradation.

Literature

The literature does not provide concrete advice regarding techniques for constructing a clearinghouse. Thus, the methodology employed in developing the Gunpowder Watershed Clearinghouse was adjusted constantly as Website construction proceeded.

Relative to other fields of water resource study, there is a dearth of literature pertaining to the utilization of GIS and Internet technology to enhance public involvement and education in watershed management via the World Wide Web—this study helps to fill that void. Even high-profile studies often fail to fully consider the role of Web-based studies (Niedermeyer, 1992). Finally, the socioeconomic breakdown of who has access to computers, the Internet, public meetings, as well as long observed problems of defining who “the public” or “stakeholders” actually are continues to be problematic, even after a substantial heritage of literature from many fields exploring the topic (Dewey, 1927). Nevertheless, utilizing a spatial unit such as a basin can make establishing such relationships relatively clear in comparison to other avenues of research.

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Development of Clearinghouse

Five generalized steps are followed in development of a clearinghouse:

1. Identify stakeholders. Knowing the intended audience and its needs is essential for establishing a raison d’être for the creation of the Website.
2. Reach out to watershed stakeholders for feedback from the earliest points possible.
3. Explain what a watershed is and why the audience should care.
4. Foster a geographical watershed-based identity among watershed stakeholders.
5. Provide opportunities for informed public involvement in basin management via content.

(How dynamic a site can be is determined by time available to maintain it.)

Participatory Strategies and Partnerships

Consensus-building is as important to developing a clearinghouse as are technical skills. Therefore, the construction of a clearinghouse should parallel the building of cross-watershed partnerships and reflect the values and concerns of those both within and outside of those partnerships. Of course, those stakeholders who become actively engaged in meetings and other forums of communication will exert more influence than those not engaged in the consensus-building process. The terms “engage” and “consensus-building” are more than buzz words, for it is vitally important for those involved in the building of sites to remind themselves that such partnerships should determine site content — not merely the efforts and personal viewpoint of the person operating the relevant technology. In addition, partnerships and site construction should be transparent, so it is clear to the public how to participate and who they are working with. Black (1999) sees the foundation of partnerships as consisting of six simple and “simultaneously elegant” characteristics. These characteristics include:

- Objectives (they must be clear and common);
- Participation;
- Control (sharing it);
- Leadership;
- Formality (predictable and well advertised meetings); and
- Cordiality.

Dynes and Wenger (1971) subdivide pools of stakeholders by identifying “power actors,” who are those individuals in a given community that control resources that can contribute to solving problems. However, many times the hardest work in terms of partnering is to simply find times and places where and when partners can meet. Once participants do gather it is important to seek out the common ground vis-à-vis a clearinghouse, so that it may be enhanced, and not fall into the trap of focusing chiefly on differences (Perdikakis, 1999) (Figure 4).

During GWC construction, data and information were provided at no cost by partners such as the Maryland Department of the Environment and Baltimore County DEPREM. Some of the potentially most expensive resources necessary to support a clearinghouse include data and information. Since, as previously mentioned, watersheds rarely follow state or other administrative boundaries, multiple sources of data and information may be necessary to provide complete spatial coverage. Compiling such materials can be as time consuming as site construction, so time must be scheduled accordingly.

Determining and Reflecting Stakeholder Concerns

The first step in constructing the clearinghouse was to identify and engage the target audience. At the start of the process the Public Involvement Team addressed the following key question, “Who are the stakeholders, and how can the GWC contribute to their empowerment for the benefit of the Gunpowder Watershed?”

The three general groups targeted were environmental professionals, the general public, and teachers and students (various levels). These divisions were chosen because they are broad enough to be inclusive, yet have very specific needs. Although there is obviously some overlap in their requirements, the GWC addresses them directly by way of site construction (Table 2).
Table 2. Links Addressing the Three Main Stakeholder Groups in the GWC

<table>
<thead>
<tr>
<th>Links on the Gunpowder Watershed Clearinghouse targeted primarily at environmental professionals (EP), general public (GP), and teachers and students (TS)</th>
<th>Primary Audience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Announcements</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Bathometry of Loch Raven Reservoir</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Bibliographic resources</td>
<td>EP, TS</td>
</tr>
<tr>
<td>Census</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Contacts</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Discussion board</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Download the high performance ftp version of the Gunpowder Watershed Clearinghouse to your hard drive</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Environmental hazards, with an emphasis on</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Comprehensive Environmental Response, Compensation and Liability Act sites</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>GP Watershed Public Involvement Team Meeting Minutes</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Gunpowder Valley Conservancy survey results</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Infrared aerial photography (DOQ composites) of reservoirs</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Land use. The basin is primarily rural</td>
<td>TS</td>
</tr>
<tr>
<td>Lesson plans and directions for those wishing to submit lesson plans</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Links</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Meetings</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Ongoing projects, stakeholder and organizational contact information. Please click to view pictures of the Gunpowder Watershed and to learn how to submit your pictures for publication on this website. Point sources of pollution (NPDES)</td>
<td>GP</td>
</tr>
<tr>
<td>Political perspectives, view legislative districts by watershed.</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Recreation</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Scientific reports</td>
<td>GP</td>
</tr>
<tr>
<td>Soil</td>
<td>EP, TS</td>
</tr>
<tr>
<td>Stream data and monitoring sites</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Topography and Geology</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Transportation</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>Upper Western Shore Environmental Atlas</td>
<td>EP, GP, TS</td>
</tr>
<tr>
<td>What is a watershed? Why should I care about the Gunpowder Watershed?</td>
<td>GP, TS</td>
</tr>
</tbody>
</table>

Fostering a New Geographic Identity

For a clearinghouse to enhance informed public involvement in watershed management citizens must view their world in terms of watersheds. This mindset emerges through the adoption of a watershed-based identity. As Sanger (1997, 5) notes, “Good education already contains strategies for building a sense of place, but even much of the best of current education lacks the depth and breadth of the strategies that educators can use to form an explicit connection to place.” However, the Internet can provide a useful platform for establishing such spatial connections. For instance, the Christina Basin Watershed Education Home Page (http://www.wr.udel.edu/cb/) demonstrates on-line a technique for watershed delineations, provides practical watershed preservation tips by land use type, and offers downloadable pictures and videos of source water and basin landscapes in order to entrench a watershed-based perspective and cement stakeholder’s connections to their basins — it is part art, part science (Smith, 2000b). This can help urban residents connect with their source water; thus, garnering political will to support basin-wide pro-environmental work.

Hamming Home the Image

To foster a geographic and personal connection with the Gunpowder Watershed an image of the basin is superimposed over whatever theme is being displayed (Figure 5). Using map overlays on nearly every page is the key. The intent is to foster a geographic, environmental, and political identity, and to encourage watershed-friendly actions based on this new allegiance. The key to developing this new allegiance is to provide information that relates to multiple aspects of “watershed citizens”’ everyday lives. For some this will encourage productive participation in watershed management across political, economic, ethnic, racial, and administrative lines.

Figure 5. Hamming home a new watershed allegiance (created from MDE GIS data 1999).

Sustainability

For a clearinghouse to be sustainable those responsible for it must plan for the long-term — not only focus on what makes the site attractive at the time of release. This includes advertising through site registration on the Internet, swapping links, and cross-fertilization via meetings, conferences, and social events, as well as pitching to community and regional newspapers (Terhune, 1999), television, and word of mouth. What is the sense of developing such a clearinghouse if weak efforts to raise its profile

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fail to let people know of its existence? In addition, continual feedback from the intended audience will ensure sustained relevance. Technological issues that impact upon the site must also be addressed. Equally important, site maintenance will be made easier and more reliable by primarily utilizing long-term and multi-use data and information, and assigning a specific person(s) to maintain the clearinghouse.

**Validation**

The overall success of a long-term project such as a clearinghouse must be measured in years, and a long-term commitment to supporting the approach is necessary. A clearinghouse must be fashioned so as to be an enduring tool that is integrated into the lives of large numbers of stakeholders across the watershed. Thus, while judgments must be made concerning the value of a clearinghouse as it develops, its true value will manifest over a more substantial period of time. In addition, a worthwhile test of the validity of a clearinghouse will be the site's utility as reflected in its frequency of use. Finally, the clearinghouse approach may not be universally applicable. The assertions made in this manuscript assume that the watershed and stakeholders in question have a typically Western profile, and this approach relies upon political will, freedom of information, government transparency, organizational mechanisms, funding, and access to technology that are not universal (Smith, 1999b). However, the approach can be modified, and may be especially useful where rough topography and poor transportation curtail access to data and information or actual portions of the watershed itself.

**Impacts to Date**

As stated above, impacts are difficult to value in the short-run. Nevertheless, included among the concrete accomplishments that underscore the value of the GWC up to this date are:

- Completion of an on-line survey to help managers gauge the public's priorities concerning basin issues.
- Engagement of students of various ages, including three undergraduate and graduate college level educational opportunities.
- Formation and support of an accompanying list-serve — several years of dialogue.
- Demystification of basin management.
- Provision of concrete volunteer opportunities such as tree planting and neighborhood stream monitoring, and alerting citizens to workshops on such topics as “green building” and basin conservation through connecting to a wider regional network.
- Generous opportunities for data and information, sharing between environmental professionals and the general community.
- Lesson planning for local schools.
- Successful promotion and support of the well attended Gunpowder Leadership Conference.
- Successful promotion of the well attended Gunpowder Watershed Festival for the general public. Also, students from urban areas came to engage in restoration activities to reduce erosion and discover more about where their water comes from both in person and via the GWC.
- Supported a long series of public meetings in order to bring together managers and stakeholders from adjoining jurisdictions together to mitigate cross-watershed conflict due to surface water pollution and share basin models.
- Use of the model to inspire similar work in other areas. For example, the GWC was the model for the proposal and creation of the Christina Basin Watershed Education Home Page in Northern Delaware. That work was, in turn, formally shared with interdisciplinary groups from Delaware and Southeast Pennsylvania. Thus, such work plants a seed from which many flowers may grow.

**Conclusions and Recommendations**

Utilization of GIS and the Internet on a large scale has the potential to provide a scenario of almost “no cost” for nearly all the watershed-based data and information that most citizens in a given drainage basin desire. Thus, the clearinghouse approach, once refined and adjusted to match the vernacular environmental, political, and technological landscape, has the potential to significantly alter the way watershed-based public outreach is performed.

Certainly there is a growing appreciation of the need for such grassroots-oriented outreach efforts. And while “watershed science” may be the purview of scientists, progressive watershed management must operate on a grassroots level to be effective. According to Neville (1999, 15), “Effective watershed management on the local level is far more dependent on social and economic variables than on watershed science. Full community support is needed in order to create the necessary changes in land use laws and policies that will institutionalize the protection of natural systems and processes during development and ensure their continued health through comprehensive natural resource management.”

Because variables change over place and time each scenario will vary to some extent, and the lessons laid out in this thesis will best serve the reader if they are employed in a flexible fashion and only as guidelines. Thus, the prime requirements for those attempting to apply the clearinghouse approach to a watershed are flexibility and the capacity to work with a wide variety of stakeholders.

A detailed summary of key recommendations for anyone considering applying the clearinghouse approach is as follows:
• Incorporate a wide array of influences and expertise via diverse partnerships.
• Plan for needs far ahead of time and establish short, intermediate, and long-term objectives.
• Include those with divergent concerns — do not team-up on those with less conventional ideas.
• Select multiple and sustainable forums for continuous discussion and input throughout the construction process.
• Create a clear hierarchy in Web site production and make certain that same hierarchy applies for posting and maintaining materials on the Internet.
• If money must be spent, spend it on human resources such as a geographer to build the site. Gather technical resources and data as in-kind contributions from government, NGOs, and academic sources (they may also offer sponsorships) as often as possible.
• Incorporate as much team input into clearinghouse construction as possible.
• Have a team edit the final product for grammatical and contextual errors.
• Be realistic about availability of resources to both build and sustain a clearinghouse.
• Nurture watershed-wide participation in the process from beginning to end.
• Foster a new geographic identity by “hammering the (drainage basin) image home.”
• Publicize the Web site via multi-media throughout the construction process.
• Utilize long-term and multi-use data and information and present it in a user-friendly fashion, rather than to impress colleagues.
• Maintain strong partnerships by being appreciative of the efforts of other team members.
• Do not rely on a Web-based approach alone for outreach, or socioeconomic selectivity is almost inevitable due to differences in access to computers.

A clearinghouse is not intended to be utilized as a stand-alone tool. In fact, it should simply be part of a larger strategic package for enhancing informed public participation in watershed management. Watershed leadership conferences, public meetings, citizen land use and stream monitoring, school visits, changes to school curricula (including Internet access), exhibits, public postings, and other conventional methods of public outreach are also necessary to maximize stakeholder participation in watershed preservation and restoration. However, the Gunpowder Watershed Clearinghouse does serve as an important model by illustrating the power of GIS and Internet technology used in tandem to provide relatively low cost, long-term, multi-use, low maintenance, and comprehensive environmental education to watershed stakeholders across educational, socioeconomic, and administrative boundaries. In addition, through integration of GIS and remote sensing one can help citizens dramatically change scales of perception. This allows those without access to expensive government data or the ability to reach harsh or inaccessible regions an opportunity achieve a perspective that will allow them to see both the “big” and “small pictures” of their basins. Through the clearinghouse approach stakeholders can further their edification in watershed science, and take a proactive role in contributing to the health of one of the most universally relevant environmental features on Earth, the watershed.

Acknowledgements

My sincere thanks to those stakeholders of the Gunpowder Watershed who so graciously took time to assist in this endeavor. I thank Drs. Kent Barnes, Kenneth Hadock, Wayne McKim of Towson University. Also, Dr. Richard Eskin of MDE and Charlie Conklin for my participation in the project and for providing me with the resources to meet our shared objectives. Thanks also to Diana Alegre, Baltimore County DEPRM, and members of the Gunpowder Watershed Coalition, TU’s Associate Dean Nordal Debye, and Dr. Mark Edmonston for their technical support of the GWC. Finally, to Drs. Robert Warren, Young-Doo Wang, John Byrne, and P.E. Jerry Kauffman of the University of Delaware. Most essential to the success of all my endeavors is my wife Sarah, as well as my close friends and family — they are one and the same.

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Discussions open until June 1, 2003.
References

Terhune, V. 1999. “Gunpowder Offers Virtual Tour on Web.” The Jeffersonian, Section A: 4. The same article also appeared under different titles in the three newspapers listed below.