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The Brown Superfund Basic Research Program: A Multistakeholder Partnership Addresses Real-World Problems in Contaminated Communities

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Abstract

The NIEHS funds several basic and applied research programs, many of which also require research translation or outreach. This paper reports on a project by the Brown University Superfund Basic Research Program (SBRP), in which outreach and research translation teams collaborated with state regulatory agency personnel and community activists on a legislative initiative to mitigate the financial impacts of living in a contaminated community. The Environmentally Compromised Home Ownership (ECHO) program makes home equity loans of up to $25,000 available to qualified applicants. This collaboration provides a case study in community engagement and demonstrates how research translation and outreach activities that are clearly differentiated yet well integrated can improve a suite of basic and applied research. Although engaging diverse constituencies can be difficult, community-engaged translation and outreach have the potential to make research findings more useful to communities, address some of the social impacts of contamination, and empower stakeholders to pursue their individual and collectively-held goals for remediation. The NIEHS has recently renewed its commitment to community-engaged research and advocacy, making this an optimal time to reflect on how basic research programs that engage stakeholders through research translation and outreach can add value to the overall research enterprise.

Keywords

Superfund Basic Research Program; outreach; research translation; financial consequences of contamination; Rhode Island

Introduction

The National Institute of Environmental Health Sciences (NIEHS) has a long tradition of coordinating basic research programs with community outreach, and has sought to promote science that engages communities in numerous aspects of environmental health research, from the identification of exposures of concern, to the development of research priorities, the

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collection of data and interpretation of research findings, and the implementation of effective interventions to reduce exposures and protect public health. One example is the Superfund Basic Research Program (SBRP), which is dedicated to funding multidisciplinary research "to provide a solid foundation which environmental managers and risk assessors can draw upon to make sound decisions related to [the remediation of] Superfund and other hazardous waste sites (SBRP website, accessed 1/8/2007)." In addition to supporting a diverse roster of basic and applied biomedical and engineering research, the SBRP is also committed to the timely transfer of research findings to organizations and agencies charged with cleanup of hazardous waste, and outreach to affected communities to ensure that research projects are relevant to their needs. In addition to the SBRP program, the NIEHS portfolio of publicly-invested research includes other research initiatives dedicated to community-based participatory research, health disparities, and environmental justice (1-3).

Research translation and community outreach activities that are well coordinated and well integrated can support and enhance basic and applied research programs in two ways: first, by making that research more responsive to local needs; and second, by helping to address some of the non-scientific issues surrounding contaminated sites. Research translation and community outreach programs bring academic researchers involved in basic research into frequent contact with the communities surrounding their research sites. Regular communication such as this may bring to light additional research questions that were not originally addressed in the academic researchers' plans, but are of pressing interest to the community at large. Moreover, the cleanup of contaminated sites is often hindered by issues beyond the technical aspects of site remediation. For example, a legacy of mistrust often permeates the relationship between academic scientists, regulatory officials, and the affected community. This history of mistrust can introduce tensions and miscommunications that may slow administrative or regulatory decision-making processes. Even in best case scenarios, cleanup of contaminated sites is a slow process, and although communities most fear health or ecological consequences, they are often burdened by other problems such as loss of community cohesion or financial setbacks. Research translation and community outreach programs that operate in conjunction with basic research programs can mitigate some of these collateral impacts while a community is awaiting remediation.

Among scientists who receive funding from such programs, however, some confusion remains about how best to differentiate research translation from community outreach activities, while at the same time coordinating these supportive activities to achieve their maximum potential. Research translation and community outreach engage different constituencies and have different goals. Although each type of activity targets different audiences or stakeholders, however, a well-integrated translation and outreach program should recognize that stakeholders often share common goals and objectives in the cleanup of contaminated sites and protection of human and ecological health. Research translation and outreach programs should therefore seek opportunities to bring stakeholders together to cooperate on these common goals. Cooperation may not be easy, given that relationships among stakeholders around contaminated sites are often contentious, and given that many biomedical and engineering scientists are not trained to recognize and address social problems plaguing these communities. By creating opportunities for cooperation, research translation and outreach can begin to repair trust among stakeholders, which may pave the way for the speedier application of research results to site cleanup and reuse. Thus, basic and applied research generated through a program that integrates translation and outreach components may be used more readily by communities and agencies seeking cleanup of toxic waste sites, while at the same time empowering the stakeholders in their pursuit of their individual and collectively-held goals.

This paper reports on a recent project by the Brown University SBRP, in which academic researchers and state agency personnel collaborated with community activists on the

development of a legislative initiative to mitigate the financial impact of living in a contaminated community, giving temporary relief to residents while they are awaiting cleanup . This collaboration allowed the well-coordinated yet distinct outreach and translation activities programmed through the Brown SBRP to foster close collaborative relationships among academic researchers, state agency personnel, and community members, making it possible for these participants to collaborate on an important need that had been identified by the community. This paper situates this case study in a wider context of social scientific research on contaminated communities and in the tradition of community-engaged outreach and advocacy with those communities. Because trust among stakeholders around hazardous waste sites is so often problematic, this case study shows how the inclusion of social scientists in a research translation and outreach program can bring positive benefits by contributing to a broader understanding of the context of professional-community interaction. This case study thus shows that although community-engaged outreach has many challenges, it also brings benefits and opportunities to a basic research program.

Stressors and Strains in Contaminated Communities

Numerous social scientific studies have documented the adverse impacts of contamination on individual and community well-being. Communities burdened by toxic waste often worry not only about impacts on ecological or human health, but also struggle with psychological stress and loss of community cohesion (4-7). Living with toxic contamination is inherently stressful and demands some kind of coping response. Contaminated communities are often subject to stigmatization, which compounds a range of anticipatory anxieties the community members already hold about how the contamination may impact their health and well being (6,7). Adverse ecological and health outcomes associated with toxic exposures are often identified initially by people living in the contaminated communities (7). Communities affected by pollution and concerned about environmental hazards frequently request assistance in investigating suspected toxic contamination from their local or state departments of public health, but are often frustrated with the responses. Residents of toxic communities often come to question beliefs that are usually taken for granted, such as the idea that technology and science are benign and positive forces, experts know best, the marketplace is self-regulating, and the government exists to help the people (6). One of the most robust findings from social science scholarship on people living in toxic communities shows that a loss of trust and animosity frequently develops between residents and the staff of regulatory agencies who are supposed to respond to contamination crises (6-8).

Residents of contaminated communities are often skeptical or frustrated with state government or health professionals, but residents also are frequently frustrated with academic researchers, reporting that they have too often been the subject of research that ultimately held no direct benefit to the communities. Academics seeking to enter the community must be prepared to prove their trustworthiness and to be vigilant in maintaining it over the course of the relationship (9). The principal barrier to working effectively with communities, whether in the context of a research partnership or in outreach and consultancy, is a lack of trust and respect (9,10). To overcome this legacy of distrust, academics will be more effective if they partner with community-based organizations that already serve the community of interest and are already viewed as trustworthy by the community (10). Such partnerships may be more difficult if the academic partner also has relationships with state regulators or health professionals who are often at odds with the community.

The literature on public participation and stakeholder engagement emphasizes both the benefits of and challenges to community engagement. A review of this literature reveals several clear benefits. First, involving the community in risk management often improves the quality of the information that goes into the decision-making process. This lay knowledge, or popular

epidemiology, includes the initial efforts made by the community to identify contaminated sites, as well as community-driven projects to map the extent of human health impacts or to research historic uses of the property that may shed light on possible sources or the extent of contamination (7). Second, decisions made with public cooperation often have higher credibility and greater public acceptance than decisions made through narrowly technocratic processes or directed entirely by regulatory scientists and government experts (11). There are, however, significant obstacles to public participation, especially with respect to form of participation, assessment of outcomes, and participant recruitment. Chess and Purcell found that no particular form of participation (e.g., workshops, community advisory committees, or public meetings) was clearly associated with increased participant satisfaction or confidence in decision making processes (11). Actual impact on decision making was not associated with the form of public engagement but was influenced more directly by other factors, such as the expertise of those planning the effort, the agency's commitment to public involvement, or the history and context of the site. Chess and Purcell note that public involvement processes are improved by: careful advance planning, clarification of goals, tailoring the forms of participation to the community's needs, deployment of multiple forms of participation, and collection of feedback that will allow organizers to modify a public participation plan if necessary (11). These guidelines are similar to those that motivate community-based participatory research (CBPR): (1) that research should build on the strengths and resources of the community; (2) that partners should work collaboratively in all phases of the research; (3) that research should integrate the quest for knowledge with action so that all partners might benefit; and (4) that research findings should be disseminated to all partners, including to the community as a whole (9). Although the literature on public participation reveals both benefits and challenges, the experience of the Brown SBRP team reinforces the contention that the benefits outweigh the drawbacks.

The Brown University SBRP: A Case Study in Successful Stakeholder Engagement

Brown's SBRP grant, "Reuse in Rhode Island: A State-Based Approach to Complex Exposures" began in May 2005. From the outset, the project team sought to integrate three themes: land reuse in Rhode Island, complex exposures, and a state-based approach. Accordingly, the biomedical research projects are designed to evaluate responses in sensitive and susceptible individuals to complex mixtures of toxicants, while engineering researchers are engaged in laboratory-based research to model novel strategies and processes for the remediation of complex polluted sites. Rhode Island is small, densely populated, and burdened by a long history of industrial activity. As the smallest state in the nation, Rhode Island has a clear imperative to develop remediation strategies that will enable the beneficial reuse of contaminated sites and mitigate development pressures that would contribute to sprawl and the overdevelopment of open space. Finally, the state is also a "small world" socially, with only slightly more than a million residents. Because academic researchers, government officials, and community members share the same space, they have common incentives and opportunities to work together on these goals of land rehabilitation and reuse.

Methods: Integration and Coordination of Translation and Outreach

The Brown SBRP includes both a Community Outreach Core and a Research Translation Core, which have been integrated into the overall thematic goals of work on land reuse, complex mixtures, and state-based work. The outreach core works in partnership with community-based organizations throughout the state in order to better understand the community's concerns about the remediation of existing sites and to prevent future contamination or exposure. The research translation core partners with state and federal health and environmental agencies to

conduct educational activities and provide organizational resources for physicians and other health providers, lawyers, environmental remediators, community development corporations, and local businesses. The research translation core is supervised by a tenured professor in the Division of Engineering and staffed by a full-time State Agency Liaison who holds a PhD in engineering and who is responsible for facilitating relationships with the state agency partners. The outreach core is chaired by a tenured professor with a joint appointment in the Sociology Department and the Center for Environmental Studies, and who supervises the work of graduate and undergraduate research assistants in projects with the community partners. In addition, the outreach core offers opportunities for students to work on service learning projects with community partner organizations; undergraduate students who enroll in seminars in the Sociology Department and Center for Environmental Studies can undertake one of these projects in lieu of producing a conventional term paper for the course. Service learning projects have filled a wide variety of needs for communities, from technical assistance to leadership development training. One student analyzed fare structures and automated ticketing in the Boston area's mass transit system and the impact proposed fare restructuring would have on minority communities. Another student summarized scientific reports on the contaminants present in river sediment for a watershed advocacy organization. Two students worked with middle school students to design and deliver an environmental education program and to train them in public speaking so that they could attend school committee and City Council meetings and articulate their concerns about a proposal to build a new high school on a heavily contaminated site.

The overall organizational model, therefore, is that the Brown SBRP research translation core has been designed to facilitate communication from "professional-to-professional" whereas the Brown SBRP outreach core has been arranged to facilitate communications from "professional-to-community." Although the research translation and outreach activities are conceptually distinct, the Brown SBRP team has taken deliberate steps to coordinate the activities to foster integration and cooperation. For example, the director of the outreach core is also the co-director of the research translation core, which enables cooperation between government agencies, professional groups, and community groups who share the common goal of protecting human health and environmental quality (see Figure 1). Moreover, research translation staff also do some work with community members, for example, by inviting community residents to attend scientific workshops held by Brown SBRP scientists; and outreach staff work with regulatory agency personnel to help them network more effectively with the communities impacted by contamination.

The Brown SBRP outreach core has established long-term partnerships with two community-based groups: the Environmental Neighborhood Awareness Committee of Tiverton (ENACT), a community-based organization campaigning for cleanup of manufactured gas plant waste in a residential neighborhood, and the Woonasquatucket River Watershed Council (WRWC), a nonprofit agency dedicated to the stewardship of a watershed basin that includes a Superfund site and several Brownfields within it. In addition, the outreach core also works on a more informal basis with other groups throughout the state, in order to build a statewide environmental justice network.

Both the outreach and research translation teams have allowed the needs and interests of the stakeholders to guide the discussion towards activities that would be most useful. The outreach core seeks to foster community engagement and public participation by engaging community groups more actively in the identification of specific environmental hazards; providing leadership training by experienced advocacy organizations; and training community members in science, organizational skills, grant-writing, media work, and governmental relations. The outreach team has customized outreach activities and interventions according to the needs and specifications of each group. The research translation core adopted a similar strategy in working

with regulatory agency personnel. The Brown SBRP research translation staff members sought guidance from their regulatory agency partners on technical issues they confront in their daily responsibilities. The research translation staff members have channeled this feedback to the Brown SBRP principal investigators, who are making plans for future directions of the basic research projects to meet some of these needs. Both the research translation and outreach cores thus took steps at the outset to assess needs and design activities that would be relevant and useful to their constituencies. This partnership approach, coupled with regular and frequent personal communication, helped to build trust between the cores and their constituencies.

A final and very necessary element of the relationship-building stage concerned the communication dynamics among the group. Several community environmental health groups in Rhode Island have had acrimonious relationships with state agencies, including litigation over the cleanup of several sites. At the outset of the grant, it became evident that many members of the team (within Brown, at the state agencies, and among the community groups) harbored concerns about whether the team would be able to navigate these communication difficulties effectively. The team wondered if it would be possible to establish the sort of forthright communication necessary to build partnership relationships among the key stakeholders, if the stakeholders are independently parties to relationships that involve intense disagreement or litigation. The only remedy for this dilemma was a frank conversation among the Brown SBRP leadership team, with outreach and research translation personnel present. At that meeting, all parties agreed on how important outreach and translation efforts were to the overall success of the enterprise, and team members made explicit assurances not to violate confidences shared among the partners. These steps laid the groundwork for a positive working environment among the partners, which yielded important benefits on a major outreach project in the first year of the grant. The successful outcome on this project was partly a result of the collaborative relationships the team had built among all three constituencies: academics, community members, and regulatory personnel.

Contamination in the Bay Street Neighborhood of Tiverton

In August of 2002, a municipal crew working on a sewer interceptor project in the Bay Street neighborhood of Tiverton, Rhode Island, uncovered soil and sediment that is tinted a bright blue color, characteristic of manufactured gas plant waste. Testing revealed that much of the soil underneath the roads and extending onto private properties is heavily contaminated with cyanide, lead, arsenic, benzo[a]pyrene, and other toxicants (see Table 1). The Rhode Island Department of Environmental Management (RIDEM) has determined that the likely source of the contamination was the New England Gas Company, whose Fall River coal gasification plant was located just across the state line in Massachusetts. Waste from this plant is believed to have been used as fill when the Bay Street neighborhood was developed in the early 20th century. The site occupies approximately 50 acres along the eastern edge of Mount Hope Bay (see Figure 2). In February of 2004, the town of Tiverton imposed a moratorium on digging in the neighborhood. The moratorium area includes approximately 130 properties, and affects more than 200 residents of the neighborhood. Residents within the moratorium area are prohibited from any digging or excavation that may expose the contamination.

The presence of the contamination has had a significant negative impact on the financial prospects of this working-class community. Since the contamination was discovered, the values of the homes and properties in the Bay Street neighborhood have plummeted. Home equity loans and lines of credit are nearly impossible to secure, because of the severely reduced market value of the homes in the neighborhood. Lenders are hesitant to write such loans because if the borrower were to default on the loan, the bank could not recover the debt by seizing and selling the home. Unable to leverage the equity in their homes, residents cannot secure loans for minor home repairs (such as replacing a roof or a furnace) or more substantial projects

(such as an addition or expansion needed when a child is born into the family). Homeowner equity is also an important financial resource for parents with college-aged children, and the inability to use their home's equity can limit the educational aspirations of future generations.

In order to address the negative impacts of contamination, a group of residents founded the Environmental Neighborhood Action Committee of Tiverton (ENACT) in the spring of 2003. They have dedicated themselves to working with state and federal legislators and regulatory agencies to demand cleanup of the neighborhood. Negotiating a cleanup has been a lengthy process, however, and as an interim measure, they appealed to their legislators and to their partners at the Brown SBRP outreach core for assistance in designing a remedy for the problems residents face in securing loans for home repairs and improvements.

The site is not a Superfund site, but the Brown SBRP team chose to work with this site because of its high-profile position in statewide discussions about toxic contamination, and because it is heavily contaminated with complex mixtures of toxicants. It thus exemplifies the kind of scientific issues the Brown SBRP was designed to address, as well as the kind of social or community-level issues that are so often present at contaminated sites. Even though none of the biomedical or engineering projects is thus directly engaged in remediation or assessment of the Tiverton site, the Brown SBRP team saw this site as an opportunity to test the overall program's approach of using the state as a laboratory for addressing the multifaceted problems that exist around sites burdened by complex mixtures of contaminants.

Designing and Implementing a Loan Program for Residents

In the spring of 2006, two Brown undergraduate students in the Environmental Justice seminar (jointly offered through the Sociology Department and the Center for Environmental Studies) took the design of a home-equity loan program for residents of contaminated communities on as a service-learning project. Through their research, and in cooperation with the state legislators who represent this district, they identified six possible legislative or administrative solutions to provide loans to families in the neighborhood. After reviewing the options with the legislators and with other knowledgeable policy analysts, the state legislators decided the most promising and expeditious option would be to amend the legislation for the Rhode Island Housing and Mortgage and Finance Corporation (now called Rhode Island Housing), the self-sustaining affordable housing agency charged with offering home equity loans in Rhode Island. The result was the Environmentally Compromised Home Ownership (ECHO) loan program, developed as a part of the overall Rhode Island Housing program. The bill makes loans of up to $25,000 available to homeowners living on or directly abutting a contaminated site. All loans must be repaid and Rhode Island Housing does not assume any liability for environmental cleanup.

Immediately before the legislation was due to be filed, the legislators identified a potentially serious stumbling block. They became concerned that if the legislation were worded too broadly, that the state would be deluged with applications for low-income loans from typical homeowners who were not in contaminated neighborhoods, or who had contaminated their own properties (e.g., through improper application of pesticides or other dumping). The legislators raised this concern with the Brown SBRP outreach team, who forwarded the request to their research translation partners at RIDEM. The RIDEM Division of Waste Management was asked to design a certification process so that loan officers would know that the property was qualified under this program. Because the site is not officially a Superfund site, oversight of the site investigation and remediation rests with RIDEM, which means that they are well familiar with the site assessments conducted to that point. Within two business days of receiving this request, the research translation partner at RIDEM was able to specify such a process and supply draft language for inclusion in the bill. The final bill requires that the property be certified as "known to be impacted by the release of hazardous materials or

petroleum," either by RIDEM through the state's waste management processes or under the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, i.e., Superfund). Although the bill was originally drafted to address the needs of Tiverton residents, it is written generally enough so that other Rhode Island residents struggling with toxic contamination may also benefit, whether they are adjacent to sites designated as Superfund sites or certified through the state or federal Brownfields program.

Through quick cooperation between the state legislators, the RIDEM, and the Brown outreach team, the bill was introduced in the state legislature in June of 2006, and was then signed into law on July 14, 2006. The Governor made a ceremonial signing of the bill at the home of ENACT's president. Members of the Rhode Island state and federal legislative delegations were present along with Brown outreach team members and many residents, to witness the bill's signing (see Figure 3).

The Devil's in the Details: Trust, Follow-Through, and Community Work

The Brown case study provides a local example of the importance of trust in academic-community partnerships around contaminated communities. Like the Brown team, all academic researchers who want to work in their communities must be sure to maintain trust with their community partners (9). In social scientific research, the concept of trust has been defined as having several dimensions. One dimension, termed trust as *role performance*, refers to the type of trust that depends on academic or professional credentials. Another dimension, termed trust as *interest promotion*, refers to the belief that the other party has your best interests at heart (12,13). It is this form of trust that is most critical to the formation of functional partnerships and successful stakeholder engagement. Social scientists have written extensively about trust as interest promotion not only in its abstract theoretical dimensions, but also in practical terms, as it is integral to the ethnographic method on which much social science research is based. Methods texts often describe the challenges of "getting in" to a research setting, i.e., gaining the acceptance of those who are the subject of the study (14). While academic credentials are certainly important in gaining an initial entrée to working with a community group, it is hard to overstate the importance of regular face-to-face contact and personal interactions in establishing trust as interest promotion. Although this level of effort is time consuming, it is critical for establishing a working relationship with a community partner. The Brown outreach team has found this to be true in establishing partnerships in both the community outreach and research translation initiatives.

This also points to one of the key tensions in doing this kind of work, however. Academic researchers are not typically rewarded for building relationships—they are rewarded for publishing, teaching, grantwriting, or professional service within the university or to their professional associations. Moreover, as noted earlier, communities are often frustrated by a history of entering into academic research projects that have brought them only meager benefits. Thus academic researchers who wish to partner with community groups, even in a more egalitarian or participatory fashion must be prepared to be on the receiving end of some skepticism or even downright hostility early in the relationship. Learning to handle such responses without getting defensive is another example of an important skill that often goes unrewarded in the academic world. Working with communities can be beneficial both to academics who seek to do research in communities and to the community groups themselves, but these tensions and relationship dynamics have implications for how a project is structured. The project schedule or timeline should also take these factors into account, as building partnerships is time intensive and yet hard to predict.

Given the skepticism with which communities generally view academic researchers, the Brown outreach team has been sure to follow up on the progress of the program, to monitor its

implementation and to troubleshoot any unforeseen difficulties. Although the ECHO program has been put in place, and two loans have been awarded to neighborhood residents, awareness of the program is not yet widespread throughout the neighborhood. Moreover, the program's focus on small loans may not be sufficiently robust. Several people in the neighborhood had been forced into consolidating loans and paying astronomically high interest rates because of the contamination; the ECHO program was not originally designed to give these homeowners relief. In the fall of 2007, the Brown SBRP team met with state legislators and staff from Rhode Island Housing, and agreed to find a way to amend the ECHO program to allow for consolidation or refinancing of existing high-interest loans. Approximately half of those surveyed in a community canvass conducted by the outreach team indicated they would be interested in refinancing.

The negative impacts of contamination on property values has been well-documented at the national level (15), and so the Brown outreach team is also working to spread word of this program to other states, in the hopes that Rhode Island will become a model for national action to help other contaminated communities (a copy of the legislation's wording is available upon request from the first author). The Brown outreach team was invited to make a presentation about this program at the National Environmental Health Conference in October 2006, sponsored by the Centers for Disease Control and the Agency for Toxic Substances and Disease Registry. The NIEHS featured this program on its national SBRP website and has sought updated information in order to spread awareness of this program.

Meanwhile, residents and legislators alike agree that this is but a first step. While the residents are grateful for this program and the opportunity to maintain their homes, they remain committed to their campaign for the cleanup of their properties and the restoration of their neighborhood.

Discussion

The Brown SBRP outreach and translation activities are designed to integrate the efforts of academic, community, and regulatory partners to provide both outreach and consultancy to community groups who need technical assistance and leadership development, as well as a suite of well-coordinated research translation activities that serve the goals of remediation of contaminated sites within the state. More importantly, however, the Brown SBRP experience shows that the SBRP can be a vehicle for bringing multiple forms of expertise to bear on such problems, and that academic researchers have the potential to bridge the gaps that often exist between community groups and state regulators. This bridge-building function was best served at the outset by ensuring that relationships among the partners are well defined with respect to their core functions, but allowing both research translation and outreach functions enough flexibility so that they could respond to new concerns that were identified by their respective constituencies and cooperate on common goals.

This close relationship between outreach and translation activities is fairly unique among SBRP grantees, and the Brown SBRP has attracted some attention at recent grantee meetings as a result. Researchers and program staff from other institutions have asked questions about the role of the State Agency Liaison in helping to assess the needs of the regulatory community. In response, the research translation team emphasizes the state-based approach as a key element in building credibility and trust among Rhode Island's professional and regulatory community. Researchers from other institutions have also inquired about the challenges and difficulties of working directly with community groups, often stating that they are hesitant to engage directly with the community because of the time-intensive nature of the work or concerns over political allegiances. While the Brown team has certainly experienced these barriers, they have found that taking pains at the outset to specify the relationships between the research translation and

outreach cores and their target constituencies paid off in the end by easing the anxieties that all parties had about working together, and thus led the way to the cooperation and collaboration that made the ECHO loan program possible. In particular, the inclusion of sociologists on the outreach team has raised the awareness of all team members of the long history of contentious relationships between community groups and regulatory agencies. The social scientists on the outreach team have longstanding commitments to community engaged research, and have sensitized all members of the team to the importance of trust and cooperation in community-based work. Social science involvement in SBRP and other environmental health research contributes significantly for several reasons. First, as we show in our background section, social scientists have led the way in studying the social, economic, and psychological impacts of toxic waste contamination. Second, social scientists are sensitized to the importance of trustworthy, personal connections with stakeholders, thus enabling interdisciplinary collaborations such as the ECHO program. Third, social scientists, especially medical sociologists and environmental sociologists, have a long tradition of successful collaboration with community activists. This allows them to share with their colleagues in the biomedical and engineering sciences the value of such collaborations and partnerships.

Since the passage of the ECHO loan program, the Brown SBRP partners have cooperated on other projects as well. In the summer of 2006, RIDEM was ordered by a state court to convene a stakeholders group to design a process that would ensure adequate community involvement in decisions about the remediation and reuse of contaminated sites. The Brown research translation partners at RIDEM invited the Brown outreach core director to participate on this panel. He pressed RIDEM to include members of the affected community groups in this dialog, and as a result, the stakeholders panel includes regulators, developers, business leaders, and several members of various community groups. As a group, these community representatives to the stakeholders panel represent a diverse set of communities and interests. These relationships were made possible in part through the network of community groups involved in the Brown SBRP outreach activities, but were brought into this process through the relationship between the outreach and research translation staff.

Centuries of industrial activity have left the United States with a substantial burden of toxic contamination. For more than two decades now, social scientific scholarship has demonstrated that the problems attendant upon toxic sites extend well beyond the purely technical aspects of site remediation. Contamination has substantial social and psychological effects on individuals and on the communities in which they live. In the broadest possible eco-social sense, remediation ought to restore a community's sense of wholeness, safety, and integrity, as well as restoring clean air, soil, and water to their environs. Through its history of requiring research programs to engage with the public—through outreach and research translation activities—the NIEHS has acknowledged the broader eco-social realities of the multiple impacts of contamination, and has pushed academic researchers to bridge their scientific inquiry to community concerns about health and social well-being.

The NIEHS recently renewed its commitment to this tradition of community engagement by launching a unified program hailed as "Partnerships for Environmental Public Health." NIEHS issued a Request for Information to obtain input on what academics, community stakeholders, and government officials need and expect from environmental health research. This program will fund hypothesis-driven research in which community members are full partners in the research endeavor. Doing so may demand new approaches to engaging communities, or the development of materials that will increase community awareness of environmental health. The NIEHS is already funding programs that address some of these goals, including the SBRP, but also other research programs designed around specific diseases or conditions (e.g., the Centers of Excellence on Breast Cancer and the Environment; the program on Obesity and the Built Environment) or that address specific, vulnerable populations (e.g., the Centers for

Children's Environmental Health or the Worker Education and Training Program). In response to the feedback received, the Partnerships program issued a special supplementary grant program for an additional year of funding for existing NIEHS grants that involve community outreach. The expansion of these programs through this new, broader initiative presents an optimal moment to reflect on the elements that make research translation and outreach efforts successful, in the hopes of distilling out the lessons to be learned from integrating research translation and outreach with the demands of a successful basic science program.

The Brown SBRP model is a case study that demonstrates how a basic science program can achieve such success. A robust model of community engagement is critical to Brown's success, however, on both the research translation and outreach sides. Even among basic science programs that require outreach components, few engage communities or citizen action groups as directly as the Brown SBRP does. A more typical model is for outreach activities to be directed at regional or state-level offices of regulatory agencies, or toward health care professionals or other professional groups. In this sense, communities are somewhat narrowly identified, and their role is often defined as an audience for research findings, rather than as partners in the research process. While arrangements such as these may be efficient at communicating research findings to the outside world, it is questionable whether they truly fulfill the NIEHS's expectations for the its basic research initiatives—that they will become a suite of combined research and outreach activities that proactively engage multiple stakeholders. These goals are best served by vigorous outreach programs that seek to develop a reciprocal relationship between researchers and communities.

A second critical component of Brown's success may be traced to the integration and coordination between research translation and outreach activities, and the extent to which those efforts are merged with the scientific goals of the grant, the remediation of complex mixtures and land reuse in a state-based context. In keeping with the NIEHS mandate to make research an "accountable enterprise," the Brown SBRP research translation and outreach teams have collaborated with stakeholders at two levels: regulatory agencies and community action groups. To clarify the parameters of this engagement, clear lines of communication were established at the outset, with research translation staff working primarily with regulatory agency personnel and the outreach team working more closely with community activists. These lines of communication were flexible enough, however, to allow for cooperation and communication on important goals that cut across the common concerns held by all parties. This led to success on an important outreach goal, to help a community that is coping with a profound and prolonged toxic contamination crisis. Although the scientific projects have not yet been engaged around the Tiverton site to quite the same degree as the research translation and outreach teams, the site has highlighted the pressing nature of questions about complex mixtures, and suggested some new research questions that may be incorporated into future biomedical or engineering projects. This provides a model for future outreach and translation projects, by showing how work on a specific outreach need can also serve to focus the team's attention on scientific issues that fit with the overall scientific themes of the program. Engaging with regulatory agencies and community groups around the broad themes of the grant ensures that the entire program remains grounded in research questions that matter most to the diverse constituencies served.

Investigators funded through basic research programs that include outreach and translation mandates should view these activities as an opportunity to add value to their entire suite of program activities. The Brown SBRP example demonstrates that although there may be challenges in collaborating with a diverse roster of stakeholders, academic researchers can, in fact, build bridges among these groups so that all stakeholders may participate creatively and cooperatively in finding solutions to a wide variety of problems that are often present around contaminated sites.

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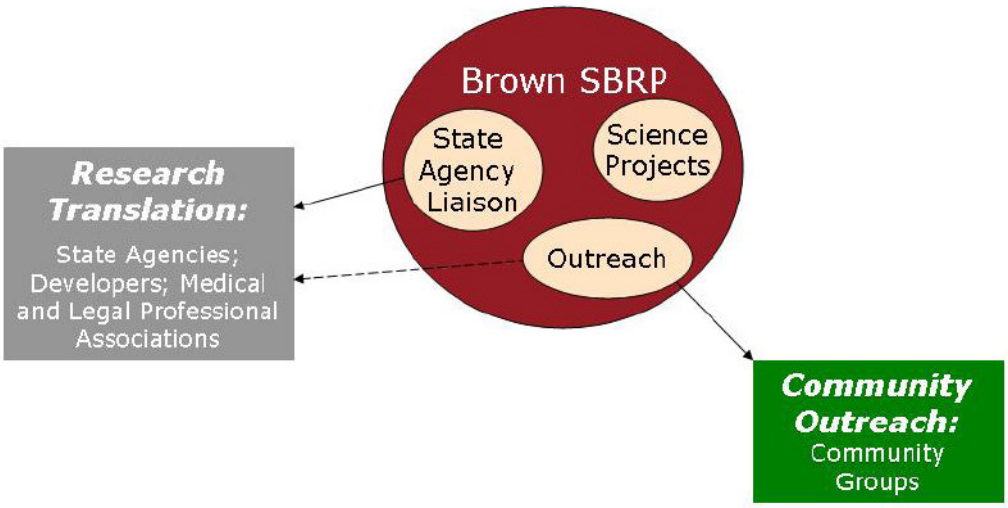

Figure 1.
The Brown Superfund Basic Research Program

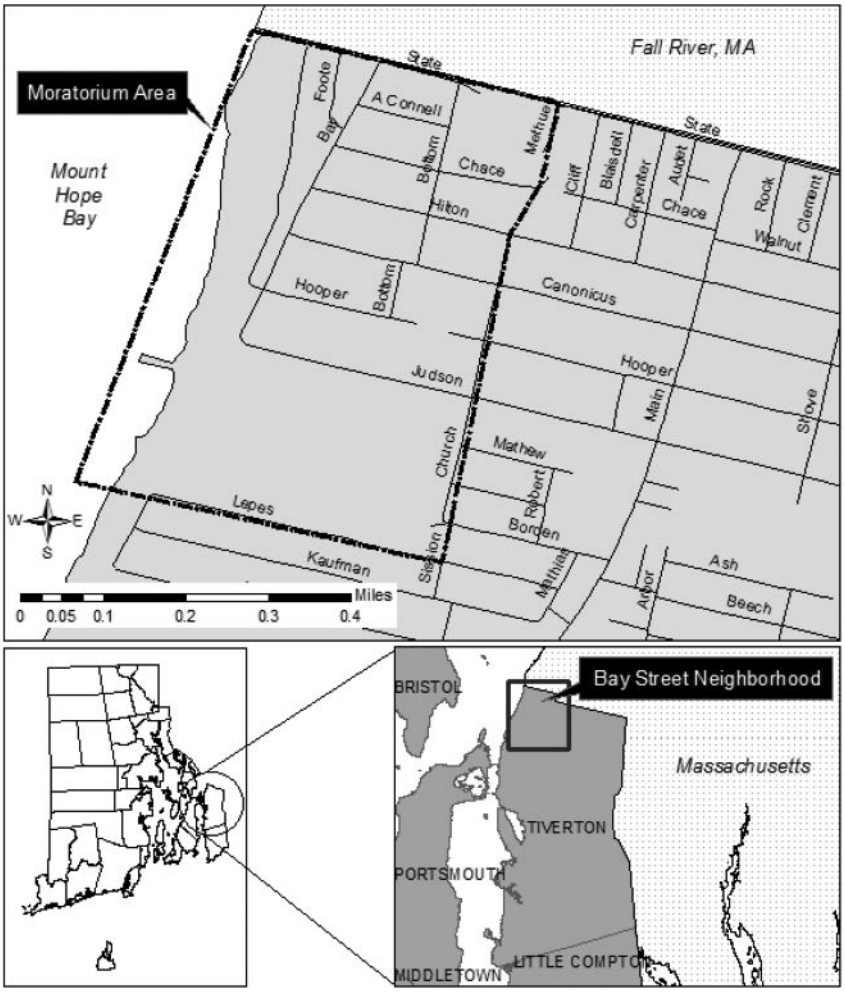

Figure 2.
Tiverton, Rhode Island.

Figure 3.
Governor Carcieri signs the Environmentally Compromised Home Opportunity (ECHO) Loan bill into law, on July 21, 2006, at the home of ENACT president Gail Corvello. From left, Sarah Fort (Brown University Superfund Basic Research Program Outreach core), Gary Rose (ENACT treasurer), Bob Ferreira (ENACT secretary), Gail Corvello (ENACT president), State Senator Walter Felag, and State Representative Joseph Amaral.

Table 1

Contaminants Discovered in the Bay Street Neighborhood.

Contaminant	RDEC limit	Levels found	Depth	Exceedance
Cyanide	200 mg/kg	216 mg/kg 482 mg/kg	0-6” 2-4’	1.1 × limit 2.4 × limit
Arsenic	7.0 mg/kg	49.8 mg/kg 131 mg/kg	0-6” 0-2’	7 × limit 19 × limit
Lead	150 mg/kg	1,220 mg/kg 5,600 mg/kg	0-6” 0-2’	8 × limit 37 × limit
Benzo[a]pyrene	0.4 mg/kg	114 mg/kg 212 mg/kg	0-6” 0-2’	285 × limit 530 × limit

Note: RDEC is the Residential Direct Exposure Criteria established by the Rhode Island Department of Environmental Management.