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Guidance for Determining the Best Disposition of Large Tracts of Decommissioned Land

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ABSTRACT *Many government agencies and other organizations hold large tracts of surplus land. Some are investigating ways to lower expenses by selling the land or transferring management responsibility. There is no generally recognized process used to decide what land can be decommissioned and what future use would be best. This paper provides guidance for land-use decisions in the form of a checklist. The checklist questions address both the socio-economic resources and current land use in the region, and the ecological resources and suitability of the tract itself. The answers will clarify regional public needs and the economic and ecological values of the land.*

Introduction

Many government agencies hold large tracts of land that are no longer needed for the agency's mission. The same holds true for large corporations that occupy sizeable properties with production facilities that are no longer in operation, many of which are considered brownfields. A major challenge facing managers and owners of these lands and buildings is how to effectively and efficiently dispose of them in ways that are safe and beneficial to nearby communities while minimizing disturbance of ecological and environmental resources. If the property is contaminated, additional difficulties arise: contaminated commercial properties are difficult to sell because buyers may acquire liability for the contamination (Page & Rabinowitz, 1993; Page, 1997; Fogleman, 2000). A critical goal of the field of environmental planning and management is to find healthy, sustainable uses for all types of land, whether large pristine expanses or

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marginal lands with surface or groundwater contamination that make re-use more problematic.

The US government owns vast amounts of property, and some of it can be considered excess. In part due to the end of the Cold War, large tracts of such land are no longer necessary for US national security missions (DOE, 1996a). Many of these large government properties are separated into areas that hold the main facilities and 'buffer' lands that serve to distance the operations from other landowners and the public in the region (Burger, 1999). Much of the buffer is undeveloped and has been relatively undisturbed for as long as the land has been owned by the agency involved. In the case of the US Department of Energy (DOE) and Department of Defense (DOD), some holdings have been sequestered in this manner for 50 years or more (Greenberg *et al.*, 1999b; Burger *et al.*, 2003). The buffer lands may have no contamination or only low levels of contamination. Some buffer lands provide open space in urban regions, while others preserve habitat for endangered species or protected remnants of ecosystems that once dominated the region (Mann *et al.*, 1996; Greenberg *et al.*, 1997; Brown, 1998; Dale & Parr, 1998; Malone, 1998; Boice, 2001; Burger *et al.*, 2003).

Ownership of these large tracts of land is costly (DOE, 1995). Managers must implement wildlife surveys and examination of sites for endangered species, critical habitat and historical and cultural significance (BWXT-Pantex LLC, 2001). There are also responsibilities to control fire hazard, leading to the need for remedies such as controlled burns and brush removal (DOE, 2001b). Some tracts require control of invasive species or of overpopulation (e.g. deer and elk herds), to prevent spread of pests in the region (DOE, 2001a). Roads, buildings, sewer and water lines and other infrastructure must be maintained (Mayer & Greenberg, 2002) and their effects on the surrounding ecosystems minimized (Forman *et al.*, 2003). In some cases, agriculture, cattle grazing, and hunting and fishing are allowed on these lands, and those activities require management, including permitting systems (DOE, 1996b).

Some agencies holding large tracts are investigating the possibility of lowering the associated maintenance and other costs by selling the unwanted land or transferring the management responsibility to another organization (DOE, 1997). The US Department of Defense has already closed many facilities (Frieden & Baxter, 2000). The US Department of Energy has begun considering such an effort for many of its sites, calling it "reducing the footprint" (Roberson, 2001). Similarly, private property owners such as corporations or non-profit organizations may wish to divest themselves of some lands no longer necessary for their operations.

Some organizations have constructed a process to guide land managers in making these decisions. However, the goal of these processes can be somewhat limited. For example, the US Department of Energy has a guidance document for real property transfers which includes checklists covering wetlands, natural and cultural resources, socio-economic impacts, various hazardous substances and environmental permits and surveys, but the stated goal is "to provide direction for US Department of Energy field elements in complying with environmental requirements associated with the transfer of real property" (DOE, 1997). In other words, the intent is to meet regulatory and legal requirements in each of those arenas after a transfer decision has already been made, rather than to make the best decision for future use by weighing both economic and

ecological parameters. This is true in spite of the fact that many of the requirements derive from the United States' National Environmental Policy Act (NEPA), which establishes that the US government's policy is "to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans" (1969). In contrast, the primary focus of the work in this document is to provide guidance for planning future use before any decisions are made, although a component is included addressing follow-up after one or more alternate future uses has been proposed. In addition, the DOE guidance, like those produced by other organizations, is tailored to the DOE's organization and needs and may not apply to other organizations. The work presented in this document is intended for a more general audience.

The US NEPA also instigated the Environmental Impact Statement (EIS), which fulfills the Act's requirement for a "detailed statement" on the environmental impact of any proposed action of a US federal agency (Golden *et al.*, 1979; Council on Environmental Quality, 1997), as well as any unavoidable "adverse environmental effects" of, alternatives to, and "irreversible and irretrievable commitments of resources" required by the proposed action (1969). While, depending on the choices of actions, much of the data to make the best future use decision may be available as a result of the process of writing an EIS, the overarching purpose of an EIS is to examine the effects of a particular action or set of actions, rather than to examine the best future use in the absence of a limited set of prescribed choices. Therefore, the decision-making process is already biased. According to the Council on Environmental Quality, constructing an EIS is "still frequently viewed as merely a compliance requirement rather than as a tool to effect better decision-making" (Council on Environmental Quality, 1997), making the data even less likely to be used to examine possible future options.

By 1997, more than 80 countries had stated policies and procedures for environmental impact assessments similar to those established in the US NEPA (Council on Environmental Quality, 1997). For new legislative proposals, for example, the European Union calls for an Environmental Impact Assessment (EIA) "if the environmental consequences of a proposed measure are significant" (Ballantine, 2001). The United Nations Environment Programme, the World Bank, and the Organisation for Economic Cooperation and Development have all encouraged nations to begin to use EIAs by creating standard guidelines that can be used 'off the shelf' or customized as needed, bypassing the need for each country to develop EIA standards starting with a blank slate (Hironaka, 2002). The World Bank, the Asian Development Bank, and the African Development Bank have each advocated EIAs for specific projects, although no loan requires a country to have a national law requiring EIAs (Hironaka, 2002). The International Organization for Standardization has also created a standard for environmental impact analyses, ISO 14011 (Lenzen *et al.*, 2003), now superseded by ISO 19011 (International Organization for Standardization, 2002). Again, the purpose of an EIA is to examine the environmental impact of a specific project, not to look at the best possible future use.

In some cases, the transfer or sale of unwanted land may entail stewardship of ecological resources before and even after the transaction (Leslie *et al.*, 1996; Johnson *et al.*, 2001). For example, some US DOE lands need remediation before transfer (DOE, 2001d). In addition, areas of US DOE sites, such as the solid waste

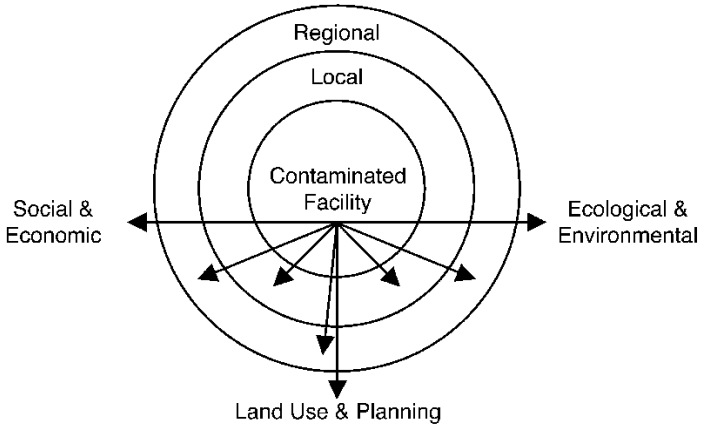

Figure 1. Determining the best future use for excess lands (including contaminated sites) involves social, economic, ecological and environmental factors—for the site itself, for the local area and for the region. All must be considered within a land use and planning framework.

storage area at Oak Ridge Reservation in Tennessee and Fermilab's solid waste management units, have long-term or permanent structures to protect the public and to monitor contamination (DOE, 2001d). Those structures, e.g. monitoring wells and landfill caps, must be inspected periodically and repaired if needed to ensure that they continue to serve their function. This particular persistent contamination is a legacy of the two World Wars and the Cold War, but similar contaminated sites occur in many countries worldwide (Weiss & Henze, 1997; Cabianca *et al.*, 2000; Duffield *et al.*, 2000; Janikowski *et al.*, 2000; Rekolainen *et al.*, 2002; Azlina *et al.*, 2003). Continued experimentation and processing with nuclear materials and hazardous chemicals are likely to produce more sites with persistent contamination in the future. Therefore, the need for stewardship of ecological resources by a responsible agency may continue after transfer or sale of such sites and is a problem faced by many countries.

There is currently no generally recognized process by which a land manager decides which land can be divested or sold within the context of the best possible future use for the people of the region and for the specific tract of land. To make the best possible decisions about future use for excess land, land managers should have a clear process. That process should incorporate both the needs of the region's population and the protection and management of the resources on the land itself. It should also be applicable to both large and small properties, and to urban and rural settings. This paper gives a foundation for that process by providing questions to be answered before decisions about the disposition of the land are made. The questions specifically address both off-site aspects, such as socio-economic resources and current land use in the local area and in the region, and on-site conditions, such as ecological resources and environmental degradation (see Figure 1). In some cases, the answers to these questions, regardless of the category of question, may not be readily available, and some research will be required to obtain the data. Once collected, the answers to these questions for a specific site will give a clear picture of regional

public needs and of the value of the land in both ecological and economic contexts.

The checklist was developed by a multi-disciplinary research group, including experts in land use, economics and ecology. The overall objective is to provide a checklist of questions for policy makers and planners to use in making decisions about the most beneficial and suitable future uses of excess land. This is a work in progress, open to suggested improvements, and is intended to provide the data necessary for a group of stakeholders, including policy makers and planners, to examine optimal future uses.

The next section discusses the various types of footprint that a site may impose, followed by a process for using the checklist and an overview of who will use it, the situations in which it will be useful and how it is organized. The checklist questions themselves are listed after that, with a subsequent comparison of potential site variability based on collecting and analyzing the checklist data for three government properties. The final discussion reviews the benefits of using the checklist, some difficulties that may arise and future needs for environmental planning for decommissioned lands.

Defining the Relevant Footprints: A Planning Perspective

The checklist questions as presented below can be useful in and of themselves, but they will be most effectively used when part of a visionary plan for the site and surrounding region. That is, the manager should explicitly consider the reality that there are different 'footprints' and how each footprint relates to intergovernmental planning needs.

There are a variety of ways to describe the footprint of any given property or site. This means that 'reducing the footprint' also takes on different meanings, depending on the parameters of the defined 'footprint'. For some meanings, reduction of the footprint is inappropriate.

In a literal sense, the footprint of a piece of land, as displayed on a plot or tax map, is the shape of the actual boundary lines. This could be called the '*property*' footprint. In this case, reduction includes selling or otherwise transferring actual ownership of parts of the property to reduce the overall amount of land within the boundaries.

Using the same literal property boundary, a landowner could arrange to manage less of the property directly. Other entities might be responsible to manage the resources on the land, for instance, or maintain the infrastructure or security over parts of the land. In this way, the '*management*' footprint might differ from the property footprint. The objective of reducing the management footprint would be to reduce staffing needs and costs and to improve efficiency. Methods would involve leasing, contracts and other legal agreements.

Again, using the same literal footprint as the outward boundary, the location of man-made facilities on the site, including buildings, paved areas and supporting infrastructure, will cover some, but not all, of the land (surface area) on the site. This '*facility*' footprint could be tightly clustered in one area of the site or dispersed across the site in various configurations. The goal of reducing the facility footprint would be to reduce maintenance, mortgage and security costs by consolidating operations in fewer buildings covering less area (Mayer, 2001). Implementing this reduction would require demolition of buildings, tearing out roads and remodelling other structures to meet new purposes.

In some cases, the landowner may be concerned solely with the three types of footprints (property, management and facility) discussed above, for the purpose of reducing the ongoing costs of ownership. However, there are other possible landowner concerns associated with additional definitions of footprint, as well as concerns that may be raised by stakeholders other than the landowner.

Viewing the footprint in other ways requires thinking 'outside the box', or, put another way, outside the literal boundaries of the property. Almost every large property (200 acres or more) extends some type of influence to the lands beyond its boundary or is connected in some way to adjacent lands. For example, ecosystems do not follow legal boundaries and are likely to cross and spill over property footprints, following natural features like watersheds. Thus, an ecosystem that begins on the edge of one large property could continue many miles beyond the site to the outer edge of a particular watershed. For an individual species found on the site, the range of its migration or, for a predator, its hunting territory may create yet another footprint shape. The influence of a stream or contaminant plume that begins on the site but flows beyond it creates another footprint, as do site wetlands that may retain flood waters that would otherwise flow offsite.

A site's '*ecological*' footprint, including all the biota and natural systems that it influences and that influence it, is likely to be much larger than the site's map boundaries. In a larger sense, it could be defined as "the impact of the site on surrounding communities … and on the resources required for the site to function" (Burger *et al.*, in press). This encompasses not only the flora and fauna whose ranges include the site, but also the amount of land and water that activities on the site require for resource use and waste assimilation (Wackernagel & Rees, 1996; Wackernagel & Yount, 1998; Gerbens-Leenes & Nonhebel, 2002). If the goal is to reduce land holdings by a certain amount of acreage, it is appropriate to define the ecosystem boundaries that may cut across the site, and the important or unique aspects of the ecological resources that logically 'fit' together with lands adjacent to the site. If the goal is to reduce the negative ecological impact of a site (and possible liability), as when the influence of site contamination or of current on-site facilities extends beyond the site or affects on-site ecosystems, it is appropriate to examine the present and potential ecological risk to eliminate or ameliorate it. Therefore, the concept of ecological footprint is useful in helping to select the portions of sites where remediation is desirable, where facilities could be decommissioned to create a healthier ecosystem or where transferring ownership or management for ecological purposes makes sense.

A site may also have a '*historic*' or '*cultural*' or '*recreational*' footprint as well. For example, a site may include buildings or prehistoric artifacts which constitute part of the cultural history of the region. It may encompass cemeteries or areas which are sacred sites for American Indians. It may include traditional or recreational hunting areas used by the local population. Some sites may have hiking trails or birding areas, or simply provide much-needed open space with a natural ecosystem in a densely populated area. That open space can provide habitat and food, an ecological use, for the native wildlife as well as filling spiritual and recreational needs for the human population. A property managed for recreation, scenery and public use can be important for the people of a local region to use for an outlet for physical well-being (Solitare *et al.*, 2000). Any or all of these footprints may be important to the landowner as well as to other stakeholders in the regional population.

Finally, a site also has a '*socio-economic*' footprint that extends well beyond the physical boundaries. This perspective is not as directly tied to the land itself as the prior footprints, but rather includes the areas where people who are affected by the site live. If a site is a major employer, there will be towns nearby, or perhaps entire counties, that may depend heavily on jobs and income from the continued operations at the site (Frisch *et al.*, 1998). This footprint could take the shape of a concentric ring around the site, but in reality, is often clustered in just one or two major directions from the site because of the orientation of roads, natural features or locations of existing population centres (Greenberg *et al.*, 1999a). Even if a site is not a major employer, its socio-economic influence can extend outward up to 50 miles from the site. A site can help to form the identity of a region in a positive way, or if it is a property with contamination, it can help to create a negative stigma for the larger region (Lowrie & Greenberg, 1997, 1999). A property owner may wish to reduce the negative impact of a site footprint by actively cleaning up and converting the property to more beneficial uses. It is important to keep the idea of economic impact in the forefront when considering ways to reduce the property, management or facility footprint, to assess whether the proposed change will affect the current economic health of the region or change the geography of the economic footprint.

There are doubtless other ways to define a footprint and to chart out the various relationships and connections of the site, its occupants and its operations to the surrounding geographic area. These footprints may overlap or and may indeed reach in opposite directions. However, taking each footprint into account to determine alternatives that cause the least disruption, and then comparing the impacts of these alternatives to specified goals can help landowners and managers to make the optimal decisions for a healthy community.

Process for Using the Checklist

Figure 2 presents the key elements that must be part of an effective decision-making process. Starting at the top of Figure 2, the objective is to determine the best use of excess or decommissioned land. There may be multiple objectives, such as reducing the physical size or negative ecological impact of the property while at the same time improving the socio-economic conditions of the region. The next step is to collect data about the site itself and about the region around it, using the checklist. This step forms the basis for the remaining steps of the process. It is similar to the data collection required for US federal agencies in constructing an EIS or an Environmental Assessment (EA). An EIS or EA would pull together some of the data, but would be related to a specific proposed project and often would address only that part of the site affected by the project.

Next, such considerations as availability and accuracy of the data and political and regulatory constraints should be reviewed. This is a key step to ensure that 'red flag' or 'show stopper' rules, regulations, agreements and practices that would prevent implementation of some alternatives are understood.

Following that, the decision maker uses the data to develop potential alternatives. The views of various groups of stakeholders should be solicited in this step, to develop alternatives that are acceptable to and have support from the resident community, at a point when data from the first step are available to support the feasibility of alternatives suggested. (Soliciting the opinions of

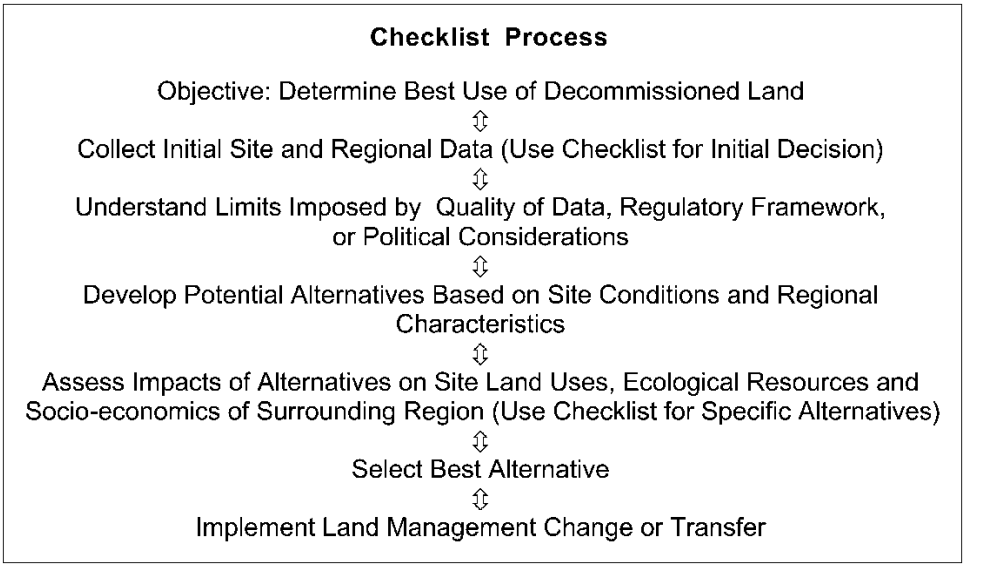

Figure 2. Using the checklist of questions to develop and assess alternatives for land management change or transfer.

various stakeholders may also be appropriate in the previous step, to account for political constraints, but care must be taken not to raise expectations before confirming that it will be possible to transfer the land.) Inclusion of the community is an essential but time-consuming and sometimes difficult step. Inclusion of stakeholder perspectives, particularly of local municipalities and counties, has been a persistent theme in research reports about the US DOE's future land use planning process (Lowrie & Greenberg, 1997; Lowrie *et al.*, 1999; Lowrie, 2000; Lowrie & Greenberg, 2000; Lowrie & Greenberg, 2001; Greenberg *et al.*, 2002b). Despite the intent of the NEPA process to incorporate the public point of view, the actual process has often fallen short (Council on Environmental Quality, 1997).

The alternatives should take into account the parcels that are identified, the type of transfer that could occur, the new agency responsible and the type of management or use to be implemented on the parcel. One option could be, for example, selling a 20-acre parcel to a neighbouring local government to build an industrial park. The fifth step in Figure 2 is to assess the impacts of the alternatives on the remaining areas of the site, on ecological resources, and on the people and economies of the surrounding region, once more ensuring that community stakeholders have input into this assessment. Again, use of the collected data will be important, but new data may be uncovered in the process. The differences in environments and economies will mean that alternatives that work at one site may not work at another. Impact assessment should be estimated for different periods of time: the immediate future, the near term horizon (e.g. next 25 years), and, if needed, the longer period of stewardship to follow. Once the possible alternatives are listed, the next step is to select the best one, incorporating the impact assessment, regulatory and political context and stakeholder concerns and preferences. Finally, land management change or transfer can be implemented.

The arrows point in both directions throughout the process, because at any point it may be necessary to go back to collect additional data, to perform additional assessments or to incorporate any new regulations or policies that affect the process, including re-defining the original goal based on clarification of the various footprints. If the land has been sold, it is unlikely that the original landowner will be able to revisit and change the decision. However, if the change has been limited to a change in management of a particular parcel, there may be some opportunity to revisit the decision, evaluate the consequences, and consider further changes. Whatever is found should then feed back to the earlier steps of the process.

Who Will Use the Checklist?

The checklist of questions is a practical tool designed to help decision makers to consider a comprehensive set of values and impacts in evaluating land use changes and land transfers. Managers who must make these decisions will use the checklist very early in the process to clarify the issues important to a particular site. The answers to the checklist questions can help to identify certain parcels that would be most appropriate for transfer, because of their natural connection to adjacent ecosystems or their importance for economic re-use by local communities. Follow-up questions will help to predict the shorter and longer-term impacts of specific land disposition decisions. It is also expected that ecologists and conservation managers responsible for providing input to land management decisions will use this tool. In addition, the questions will be useful for policy makers, the public and other stakeholders who are interested in land use and preservation. Some of the answers to these questions will prove particularly useful to regulators involved in approval of remediation plans.

Within the land-holding organization, use of this checklist may fit most logically in a division of real estate or property management, with oversight from top management. However, collecting the answers will require consultation with nearly every division in the organization, from engineering to personnel to ecology to recreation to economic development. The results from using the checklist tool could be displayed and analyzed in various ways, e.g. written into a narrative description or displayed in a table format or, in some cases, expanded to allow a spatial map of the data on the site. As with any tool, the checklist will not actually make decisions, but will improve the quality of decisions by encouraging the collection of relevant data across a range of concerns, thus guiding decision makers to an appropriate selection of choices for future use. Because conditions may change, the checklist should be revisited if substantial time passes between collecting the answers and finalizing a land-use decision.

To What Sites Does the Checklist Apply?

It is expected that the sites to which this tool will apply are large tracts of land owned by organizations such as government agencies, that is, by organizations that are in a position to make a decision about land disposition while considering factors beyond the simple market value of the land. In the US, this could include such entities as the Department of Energy, the Air Force and Army, the Department of the Interior, the Bureau of Land Management, and some state

government agencies. There may be other organizations which fall into this category as well, such as foundations and non-profit or educational organizations with large tracts of land that do not want to incur the costs of maintaining it. Large corporations that own abandoned sites that could be redeveloped for alternate use will also find this checklist useful.

Sites being considered for sale or transfer can vary greatly. A major incentive to use a checklist of this type is to capture differences relevant to future use that may otherwise be overlooked. For example, the ecosystems found may vary from desert to forest to prairie, which would clearly produce different wildlife species and habitats. The surrounding region may be urban, suburban, rural or some combination. Open space may be rare and much needed, or ubiquitous and unvalued by the local residents. Socio-economic and demographic parameters may vary, as well. Some regions may have sufficient industry for attendant opportunities for employment, while others may be primarily agricultural or recreational. Average income will not be the same for all regions. Some regions may be more dependent on a site for jobs and income than other regions. Following the checklist questions, data from three Department of Energy sites illustrate the variability which may be found among sites.

Some tracts of land to which this tool will apply will be contaminated with hazardous waste. The categories in this checklist do not include all the areas of concern that may need to be addressed if contamination on the land presents significant ecological or human health risks. Those questions are addressed in a checklist designed for high-level hazardous waste sites that examines how to choose among hazardous waste management and remediation options, including potential environmental and health impacts (Greenberg *et al.*, 2002a). That checklist may be appropriately used subsequent to the initial set of questions in this document, if the land being divested requires remediation or waste storage or will remain contaminated with long-term stewardship measures in place (Lillie & Montague, 1998; Probst, 1998; Burger, 2000; Burger & Gochfeld, 2001; DOE, 2001c; Burger *et al.*, 2003). The checklist in this document also does not attempt to include information needed for compliance with regulations or legal requirements.

Checklist Antecedents and Organization

The analysis proposed here has philosophical foundations similar to that explained by McHarg in discussing choice of highway siting in his classic book, *Design with Nature* (McHarg, 1992). He asserts that "the best route is the one that provides the maximum social benefit at the least social cost", while the philosophy in this paper would declare the same for the best future use of a tract of land. McHarg, using maps to visualize site data and emphasizing the values of current residents, analyzes the suitability of sites for urban development and infrastructure projects using criteria such as contamination (specifically mine drainage in some of his case studies), wildlife resources and environment types, uniqueness (in scenic views, recreational opportunities, history or geologic or botanic interest), hydrology and soils. Steiner continues the tradition of 'suitability analysis', defining it as "the process of determining the fitness, or the appropriateness, of a given tract of land for a specified use" (Steiner, 1991). He cites several examples of such analyses, including the US Department of Agriculture's Land Evaluation and Site Assessment (LESA) for agricultural suitability, used today (US Department of Agriculture).

What has been proposed here carries on the idea of suitability analysis, applying it to a process intended to discover the best future use of a tract of land. In this process the data collection is comprehensive but not as extensive, foregoing the creation of maps for an initial overview of the site, although maps may be needed once a potential future use is being seriously considered.

This process also has antecedents in the analysis of environmentally sensitive areas and in the EIA process for specific projects. In analysis of sensitive areas, a site's ecological parameters (such as amount of habitat, uniqueness and species diversity) are examined for the purpose of deciding whether it should be included in a preserve (Bayliss *et al.*, 2002) or to place a socio-economic value on it (Oglethorpe *et al.*, 2000). Cultural resources (e.g. archaeological) and areas needing restoration can also be taken into account in the evaluation process (Mazzotti & Morgenstern, 1997) and, if sustainable means for the residents to make a living are not taken into account as well, conflict can arise between residents and conservationists (Abakerli, 2001). EIAs traditionally include many environmental and ecological variables, but also include variables of more immediate concern to humans such as aesthetics, noise and preservation of cultural artifacts (Canter & Hill, 1979). More recently, critics and proponents of EIAs have cited its need and ability to incorporate offsite impacts (Lenzen *et al.*, 2003) and incorporation of public values (Dayton, 2002; Purnama, 2003; Wilkins, 2003). The process described in this document does include these considerations.

The checklist questions in Tables 1 and 2 represent two stages of the land transfer process:

- Table 1: Initial decision: questions used to make an initial decision whether it is possible to divest the land and to understand which future use would be best. These questions uncover site resources, regional and local values, and needs and potential impacts on the region.
- Table 2: Specific alternative: questions needed before a specific alternative future use is finalized. These questions evaluate the site and regional impacts of a specific proposal to change the land use or management.

Within each Table, the questions are divided into five categories, ordered from on-site issues to off-site parameters. The categories are ordered as follows: 'On-Site Land Suitability and Impacts', 'Ecological Value and Impacts', 'Cultural and Recreational Value and Impacts', 'Off-Site Land Suitability and Impacts' and 'Regional Socio-economics and Demographics'. This order enables the manager to look first at the site, where perhaps the information is more readily available, and then look outward to the community needs and regional concerns (see Figure 1). It also enables the manager to determine early if the land is unsuitable for transfer, or, if the land is suitable for transfer, go on to look at possible future use based on progressively expanding points of view.

In some cases, the questions have rather specific parameters associated with them. For example, several questions direct the manager to consider the last two decades worth of some type of socio-economic data. This is a commonly used standard (Hughes & Sternlieb, 1987; Miller, 1998) but may be modified for a particular situation. Other questions specify buffer zones of particular sizes which were found to be appropriate for the US DOE study but which may be modified as needed to suit other circumstances.

The questions in Table 2's sections on 'Ecological Value and Impacts' and 'Cultural and Recreational Value and Impacts' are not as extensive as they could

Table 1. Checklist for initial decision

1. On-Site Land Suitability and Impacts

1.1. What is the current mission status of the site?
1.2. What new missions are likely in the next decade?
1.3. What is the size of the site?
1.4. Is the site slated for complete closure? If so, when?
1.5. What is the projected end-state(s) for the site?
1.6. What is the type and extent (acreage, depth and volume) of surface contamination on the site?
1.7. What is the type and extent (surface acreage, depth and volume) of groundwater contamination on the site? What is known about the migration of the contamination?
1.8. Are there currently any other agencies managing lands or administering activities on the site? For each other agency:
  1.8.1. What is the purpose of the management of the lands?
  1.8.2. What is the agency?
  1.8.3. How many acres are affected?
  1.8.4. What is the legal arrangement between the agency and the primary owner/manager of the site?

2. Ecological Value and Impacts

2.1. Does the site have a designated area under any protected or preserve status (e.g. a National Environmental Research Park designated by the US Department of Energy)?
  2.1.1. How many acres are in the protected area?
  2.1.2. What percent of the site is in the preserved area?
  2.1.3. What year was the preserved area created?
2.2. Is any part of the site ecologically managed? (For example, timber removal, controlled burns, control of deer population, removal of invasive plants, ecological restoration, any action intended to change the ecosystem.) For each form of ecological management:
  2.2.1. What form of ecological management is it?
  2.2.2. What agency implements the management?
  2.2.3. To how many acres does the management apply?
2.3. How many acres are leased for agricultural use? (For example, for grazing cattle or growing crops.)
2.4. What habitats are found on the site?
  2.4.1. How many different habitats are there, using vegetation type as the indicator, e.g. forest, grassland, prairie?
  2.4.2. List the habitats.
  2.4.3. What's the major habitat in terms of area?
  2.4.4. How many acres does the major habitat occupy?
2.5. Are there wetlands found on the site? If so, how many acres?
2.6. What biota are found on the site?
  2.6.1. How many bird species nest on the site?
  2.6.2. How many bird species have been seen on the site?
  2.6.3. How many mammalian species have been seen on the site?
  2.6.4. How many amphibian species have been seen on the site?
  2.6.5. How many reptilian species have been seen on the site?
  2.6.6. How many fish species have been seen on the site?
  2.6.7. How many invertebrate species have been seen on the site?
  2.6.8. How many butterfly species have been seen on the site?
  2.6.9. How many plant species have been seen on the site?
2.7. What species found on the site are endangered or threatened or otherwise of concern? (The terms used here are those used by the United States in its wildlife protection programme, but the concepts would apply anywhere.)
  2.7.1. National:
  2.7.1.1. How many endangered species reside on the site? List them.
  2.7.1.2. How many threatened species reside on the site? List them.
  2.7.1.3. How many species which fall into other nationally or internationally protected categories (or potentially fall into those categories, for example, candidate species) reside on the site? List them and their protection status.
  2.7.2. Regional (e.g. determinations made by a state or province):

2.7.2.1. How many endangered species reside on the site? List them.
2.7.2.2. How many threatened species reside on the site? List them.
2.7.2.3. How many species which fall into other regionally protected categories (or potentially fall into those categories, for example, candidate species) reside on the site? List them and their protection status.
2.7.3. Is there any critical habitat for national or regional endangered or threatened species on the site? How many species? List them.
2.7.4. How many species of protected migratory birds or raptors use the site? List them.
2.7.5. How many invasive species reside on the site? List them.

2.8. What features are ecologically or environmentally unique about this site? This is a very open question, and it is probably worthwhile to ask this question of several people who know the site well, ecologically speaking, and to record all the answers. This should include features such as sole source aquifers, unique or rare ecosystems or geological features, wildlife preserves, recreational areas, state or federal or global ecological designations and environmental education facilities on the site, but this list is not meant to exclude anything that the local experts know to be significant.

2.9. Are there any other ecologically oriented comments that should be made about this site?

3. Cultural and Recreational Value and Impacts

3.1. Is the public allowed onto any part of the site for recreational purposes?
3.1.1. If so, how many acres are accessible for recreational purposes?
3.1.2. What are the recreational uses?
3.1.3. How are the recreational uses administered?
3.1.4. Is the public allowed on the site for controlled hunts or other limited, supervised activities?

3.2. Are there any concerns about impacts of changes to this site on the scenic or visual values of this site and its surrounding area? (For example, are there restrictions on building because of county or township plans to preserve open space or views, or has a river on-site been designated a national 'wild and scenic river' or other similar designation?)

3.3. Are there any sites sacred to protected indigenous peoples (e.g. American Indians in the US)? If so, how many acres are involved?

3.4. Are there any sites where protected indigenous peoples (e.g. American Indians) traditionally hunt, fish, or gather plants? If so, how many acres are involved?

3.5. Are there any cemeteries on the site?

3.6. Are there any archeological or historical sites? If so,
3.6.1. How many?
3.6.2. How many are listed in a list of nationally important historic places (e.g. the US National Register of Historic Places)?
3.6.3. How many are potentially eligible for a list of nationally important historic places, according to studies by the landlord agency?
3.6.4. How many have not yet been checked for potential eligibility for a list of nationally important historic places?

4. Off-Site Land Suitability and Impacts

4.1. What is the current land use off-site and immediately adjacent (within 2 miles) to the parcel?

4.2. Is there zoning? What is the zoning for the off-site area?

4.3. What are current plans for the area (any permits or approvals pending, local plans for road or school construction)?

4.4. What is the current land use pattern within the adjacent county or metropolitan area? Are there any proposed changes or developments (e.g. new highways, shopping centers, housing developments)?

4.5. How much recreational land exists within 10 miles of the site? What is it used for: hiking, fishing, hunting, swimming, etc.?

4.6. What is the value of land in the area immediately surrounding the site? How has the value changed during the last five years?

4.7. Are there any plans that could dramatically alter the value of the land (e.g. new bridge, highway, shopping center)?

4.8. Are there wildlife preserves or other types of parks or preserves adjacent to the site? For each such preserve or park:
4.8.1. What is its name?

Table 1.—*Continued*

4.8.2. How many acres in the preserve?
4.8.3. What institution administers the preserve?
4.8.4. What type of preserve is it? (That is, what is its purpose and what are the allowable uses by the public?)

5. Regional Socio-economics and Demographics

The purpose of these questions is to understand the historical demographic profile of the region in which the site is located. For data collection, the 'region' in the US is defined as the host county or counties for the site. The data should also be collected for the relevant metropolitan area, if there is one, and also for the state or other regional entity. More specifically:

5.1. What is the population size? What is the trend in population size over the last two decades?
5.2. What is the racial/ethnic profile of the population? What is the trend over the last two decades?
5.3. What is the age profile of the population? What is the trend over the last two decades?
5.4. What is the median household income from the last census? What is the trend over the last two decades? How does this compare to the state as a whole and to the US?
5.5. What housing is available in the region (e.g. %one-family homes, %mobile homes)? How has it changed during the last two decades?
5.6. What is the employment profile in the region (e.g. %manufacturing, agriculture, recreational, government, etc.)? What are the trends in the employment profile over the last two decades?
5.7. What percentage of the region's jobs and income are provided by the site?
5.8. What is the projected demographic and economic outlook (e.g. population, employment and personal income) of the region for the next two decades? (County and state officials should have this information.)
5.9. How many housing permits and commercial permits have been requested?
5.10. What has been the growth of the construction industry during the last five years?
5.11. Are there other demographic or economic indicators that are important for the region?

be for a contaminated site. The checklist in Greenberg *et al.* (2002a) encompasses a more specific and detailed list of questions for high-level waste sites which address ecological, cultural and recreational issues more thoroughly and which may be helpful in eliciting all the needed information.

Site Variability

Table 3 displays a subset of the initial data that would be collected for three different sites and for their host counties to answer the first set of checklist questions. All three sites are owned by the US Department of Energy, and their locations are shown in Figure 3. These sites were chosen because of the contrasts among them in size, contamination type and extent, natural habitat and biota, current use or constraints on use and the surrounding counties' economic conditions and demographics. Applying the checklist to these three sites demonstrates its ability to generate a descriptive profile for each site and to contrast sites. For a single site, such a profile could serve as the initial basis for discussion of future use by stakeholders or as the input to a preliminary estimate of the site's suitability for a specific purpose. In some cases, gathering the data would highlight missing information. A manager in charge of multiple tracts of land who has a particular future use in mind might want to create such a table to make a preliminary determination of the site most suited to that use, to narrow the choices. (However, that does not imply that further investigation would confirm that option as the best future use.)

Sites can vary substantially in the parameters relevant to future use, which makes the checklist as discussed here a useful tool in examining the concerns for

Table 2. Checklist for examining a specific alternative

1. On-Site Land Suitability and Impacts

1.1. What is the extent (acreage, depth and volume) of surface contamination in the land parcel?
1.2. What is the extent (surface acreage, depth and volume) of groundwater contamination under the land parcel? What is known about the migration of the contamination?
1.3. Is the infrastructure on-site suitable for the proposed use or must some be removed or modified?
1.4. Does the land management change impact wetlands, flood plains, seismic sensitive areas?
1.5. Is the parcel within a buffer zone that must be retained to protect areas necessary for national security or to protect areas with remaining contamination, long-term monitoring systems or ongoing remediation?
1.6. Has a comprehensive land use plan for the site been developed that reflects the land use and land management changes? Is it consistent with legal mandates?
1.7. If there are other agencies currently managing lands or administering activities on the site, how will the land use change affect these operations?
1.8. What will be the impact on security, maintenance and other site management needs?
1.9. Will the development affect any nearby contamination issues?
1.10. Are necessary long-term stewardship activities incorporated into the land management plan?

2. Ecological Value and Impacts

2.1. Will on-site or adjacent ecosystems, including the wildlife, be affected by the proposed use of the divested land?
2.2. Does the proposed use create any risk of contaminants being carried off-site?
2.3. Would the proposed use affect underlying aquifers or groundwater supplies? What impact would this have?
2.4. Will the proposed use interrupt long-term studies of species, populations, the ecosystem or effects of contamination?
2.5. What ecological benefits will the proposed use have?

3. Cultural and Recreational Value and Impacts

3.1. Will current on-site or off-site recreational and cultural uses be affected?
3.2. Will on-site archeological or historical sites be affected?
3.3. Will new areas of the site be surveyed for archeological or historical sites?
3.4. What cultural and recreational benefits will the proposed use have?
3.5. Will the value of scenic or visual resources be lessened by the proposed use?

4. Off-Site Land Suitability and Impacts

4.1. Does the land management change affect the ability of nearby local officials to plan for the growth and development of their communities?
4.2. Does the land management change create additional land use restrictions?
4.3. Is there a demand for the new use(s) in the region? Will the proposal increase or decrease that demand?
4.4. Must new schools, roads, sewer and water lines, police and fire stations and other infrastructure and services be provided as a result of the land management change?
4.5. What efforts have been made to provide information to and solicit feedback from local elected officials and key staff (e.g. planners, environmental protection, health officers, hazardous materials personnel) about the new land management?
4.6. What efforts have been made to provide information to and solicit feedback from other key local stakeholders (e.g. plant workers, media) about the land management options?

5. Regional Socio-economics and Demographics

5.1. Will any workers currently employed at the facility face job loss as a result of the proposed land transfer?
  5.1.1. If so, what benefits packages could be put in place to help these employees?
  5.1.2. Are there opportunities for these workers or other recently laid off workers for work during or after the land transfer process?
  5.1.3. Is there a place for these workers once the new facility opens?
5.2. What are the costs of any environmental clean-up, environmental impact statements and monitoring that are not currently underway or otherwise budgeted?
5.3. The services of various professionals (for example, planners, landscape architects, architects, engineers, ecologists and attorneys) may have to be secured to plan for the proposed land transfer and to get any requisite local, state, and/or federal approvals. What are the proposed costs and source of these funds?

Table 2.—*Continued*

5.4. What are the regional economic impacts of the proposed land transfer in terms of lost or gained jobs, regional income, lost or gained access to resources and indirect costs to the regional population? Include issues such as loss of leased range land and ongoing park maintenance.
5.5. Some regional benefits, such as those associated with establishing an ecological preserve, may be difficult to quantify. What are these benefits and how might they be quantified?
5.6. What are the costs of preparing the site for the proposed new use and construction of new facilities?
5.6.1. How many workers will be employed?
5.6.2. Is there a pool of workers available locally with the requisite skills or must workers be trained?
5.6.3. Can contractors, subcontractors, materials, and equipment be secured from within the region?
5.6.4. Where will these funds be obtained?
5.6.5. Are funding sources other than raising taxes available?
5.7. What are the costs involved in constructing any related infrastructure (e.g. roads, sewer and water, housing, stores and support services) needed by the local host region as a result of the new land use? Where will these funds be obtained (e.g. local taxes, grants, federal programmes)?
5.8. Where will the permanent workforce come from? If workers need to be secured from outside the area what are the relocation costs?
5.9. How certain are the above estimates? What is the contingency proportion built into these estimates? What are the major sources of uncertainty?
5.10. Will the land management change cause odours, noise, off-site traffic in residential areas and lower property values?
5.11. What kinds of new local, new export-oriented businesses, local service businesses, real estate transactions and other economic activity result from the process?
5.12. Does the land management change disproportionately impact some communities?

a specific site and making appropriate decisions. As shown in Table 3, the three Department of Energy sites examined exhibit many contrasts. They range in size from slightly greater than 1000 acres (Fernald) up to 375 000 acres (Hanford) (DOE, 2001d). The smaller two sites (Fernald and Brookhaven) are in much more populated areas, with over 1 million people located in the same county or counties as the site itself (US Bureau of the Census, 2002a). Median annual household income (in the county) is highest for Brookhaven, located on Long Island in New York State, and drops over $20 000 for Fernald and Hanford (US Bureau of the Census, 2002b). Mobile homes constitute almost 20% of the homes near Hanford, but Fernald, with almost the same percentage of one-family homes, has less than 2% of its housing in mobile homes (US Bureau of the Census, 2002b). Perhaps not surprisingly, Brookhaven, with the highest median income, has the highest number of one-family homes. The percentage of non-Latino whites in the population varies less than 10% (from 69.7% to 78.8%), but the constituency of the groups making up the rest of the population varies, with a larger Black community at Fernald and a larger Latino community at Hanford (US Bureau of the Census, 2002a). In making future land-use decisions, economic factors may loom larger at Hanford, given that it has the lowest median income of the three sites and quite possibly fewer employment opportunities, given the smaller population. However, development pressures may be high at Brookhaven and Fernald, where a larger number of people live nearby.

Table 3. Comparison of sites

	Hanford, WA	Brookhaven, NY	Fernald, OH
County population, 2000[1]	282 948	1 419 369	1 178 110
Host county or counties	Adams, Benton, Franklin, Grant	Suffolk	Butler, Hamilton
Acres in site[2]	375 000	5263	1050
Median household income, 1999[3]	$41 358	$65 721	$42 977
Percentage housing type[3]	One-family 57.54% Mobile home 18.96%	One-family 81.61% Mobile home 1.03%	One-family 59.41% Mobile home 1.64%
Race & Hispanic origin, % of total, 2000[1]	White 69.7% Indian 0.9% Black 1.2% Latino 25.1%	White 78.8% Indian 0.3% Black 6.9% Latino 10.5%	White 77.5% Indian 0.2% Black 18.3% Latino 1.2%
Habitat	Shrub-steppe, unconfined salmon spawning river[4]	Wet & dry pine barrens, white pine forest, wetlands[5]	Grasslands, upland and riparian forest, open field, wetlands, floodplains,[6] restored prairie[7]
Species of concern (endangered and threatened)	Spring-run chinook, steelhead, ferruginous hawk, bald eagle, American white pelican, sandhill crane, western sage grouse, Columbia yellowcress, Umtanum desert buckwheat, White Bluffs bladderpod, Columbia milkvetch, dwarf evening-primrose, white eatonella, loeflingia, Hoover's desert parsley[8]	Eastern tiger salamander, banded sunfish, swamp darter, stiff goldenrod[5]	Indiana brown bat, Sloans crayfish[5]
Contamination present	Large uncontaminated buffer area (half the size of Rhode Island); small mission areas highly contaminated[9]	Large volume of contaminated groundwater (exceeds site boundaries)[2] and sediments[10]	Large volume of contaminated soil[11]
Land management designations	National Monument managed by US Fish and Wildlife (195 000 acres on and off-site)[12]	Designated ecological preserve (530 acres); managed by US Fish and Wildlife[13]	Ecological restoration park managed by US DOE[14]

[1](US Bureau of the Census, 2002a)
[2](DOE, 2001c)
[3](US Bureau of the Census, 2002b)
[4](McAllister *et al.*, 1996; DOE, 2001a)
[5](Brookhaven Science Associates LLC, 2002)
[6](Fluor Fernald Inc., 2002; Fernald Environmental Management Project, undated-c)
[7](Fernald Environmental Management Project, undated-a, b)
[8](DOE, 2001a, b)
[9](DOE, 1999)
[10](Brookhaven Science Associates LLC, 2002)
[11](Fernald Environmental Management Project, draft 2002)
[12](DOE, 2001a)
[13](DOE, 2000)
[14](Fernald Environmental Management Project, undated-b)

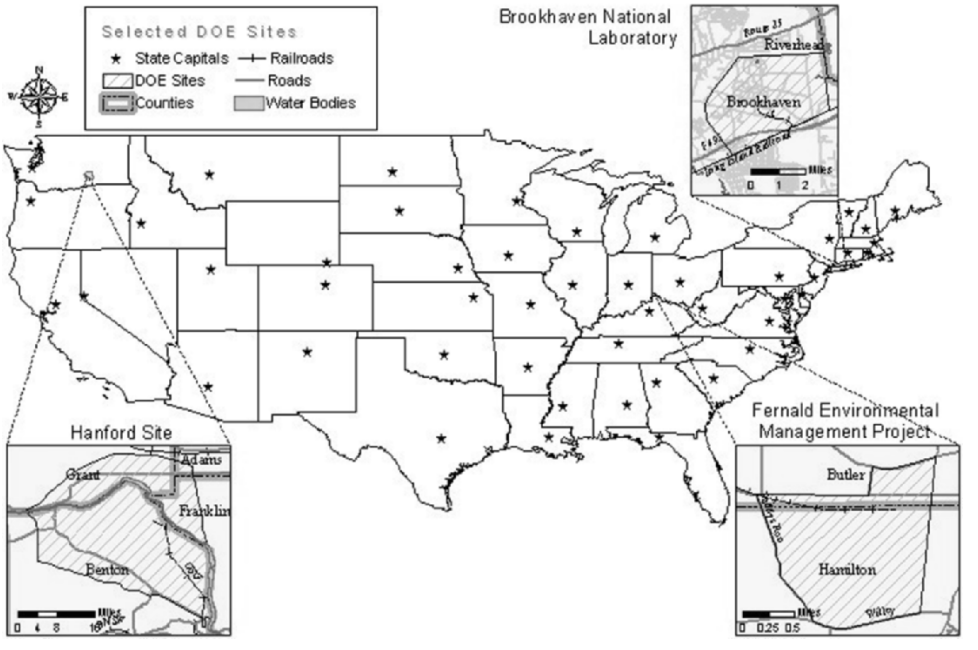

Figure 3. Representative US Department of Energy sites.

The sites vary radically in the types of ecosystems they support. Hanford has some of the last remaining shrub-steppe (DOE, 2001a), while Brookhaven has both wet and dry pine barrens (Brookhaven Science Associates LLC, 2002), also rare habitat now and protected in New York State. Fernald has grasslands, forest, floodplains, wetlands and open fields (Fernald Environmental Management Project, draft 2002), and is participating in both woodlands and prairie restoration (Fernald Environmental Management Project, undated-b). Hanford has the largest number of endangered and threatened species: it is not clear whether that is due to ecosystem parameters or whether other factors may be at work, such as more complete surveys, larger amounts of undisturbed space or more diligence in listing species of concern by the state agency responsible. In particular, it seems that Hanford has a larger number of listed plant species. Although some of Fernald's habitats are undergoing restoration, all three sites have rare habitat which does not exist in many places in this century and which supports different sets of wildlife. All three sites are also contaminated, although the type of contamination varies (DOE, 1999, 2001d; Fernald Environmental Management Project, draft 2002). This means that remedial measures will vary, too. Without the benefit of examining other open space in the area, it seems that the areas with the largest populations, Brookhaven and Fernald, would be in most need of open space and recreational areas. Of course, they are the sites most likely to have development pressures, making it all the more critical to take their ecological resources into account.

The three sites vary greatly in the extent to which they have already designated lands for alternate, non-mission related management. The Hanford site has entered into an agreement with the US Fish and Wildlife Service (FWS) to allow it to manage over half of the site's land for ecological and research purposes, while Brookhaven recently transferred management of about 10% of

its land to FWS for an ecological preserve. Fernald has not yet transferred management to another agency or organization. The DOE does, however, manage a small section of Fernald as a park.

A decision maker can use the data collected from answering the checklist questions to form a better understanding of each type of footprint created by the site under consideration. From the limited data presented in Table 3, for example, a manager could see that Hanford, a site with a huge property footprint, is likely to also have a large socio-economic footprint, as the host county has characteristics typical of a poorer rural area. The Fernald and Brookhaven sites are likely to have smaller socio-economic footprints, as the more urban areas surrounding them are not as dependent on the site for jobs and income. Ecologically, since Hanford contains a river in which protected species of salmon spawn as well as many other species of concern, it is likely to have an ecological footprint that stretches well beyond site boundaries. Brookhaven, too, has a large ecological footprint, given the presence of wetlands, pine barrens, and several species of concern all located on a relatively small parcel in the middle of a more urbanized area. In contrast, while Fernald has several different habitats (some restored), it has fewer protected species and is the smallest of the three sites. However, it may still have a large ecological footprint, depending on issues such as extent and type of contamination, and the existence and amount of other open space in that relatively densely-populated region. It can be seen that while Hanford and Brookhaven have taken steps to reduce their management footprint by turning over management of some lands to other agencies, Fernald has not yet reduced its footprint in this way. An analysis of the complete set of data, expanded considerably beyond what is displayed in Table 3, will help to create a full picture of the various footprints to guide decisions about land-use changes.

From these three representative sites, it is clear that there is great variability between sites and that the best possible future use may be different for each location. Collecting and analyzing the data for a particular location gives an integrated view of the needs and concerns for that region and site, permitting a better land-use decision.

The Checklist: Benefits of and Barriers to Effective Use

Developing a checklist requires balancing completeness and usability. Experts in any single area could conceivably prepare hundreds of detailed questions on that subject, making the checklist impossible to use. On the other hand, if the checklist asks too few questions, major problems could be overlooked. This checklist is intended to be comprehensive enough to uncover problems, but not to acquire all the information needed to solve them. For example, if the checklist reveals that a proposal would create severe job losses, then the next step is to investigate in more detail to confirm the numbers, verify the specific types of losses and explore possible mitigation measures.

Using this checklist of questions is beneficial for decision-makers in the following ways:

- *Integration of data*: By bringing together different types of information—site-specific and region-specific, socio-economic and ecological, future and current value—the checklist permits inclusion of all the relevant issues and allows

better integration of the unique characteristics of the situation. That should have the advantage of producing a decision that benefits the region better and is more widely accepted.

- *Comprehensiveness*: Managers and staff in government agencies or other organizations are often trained in one or two specialties, such as engineering or ecology or land-use planning. They are very unlikely to have expertise in all the arenas that must be taken into consideration. By putting questions representing all of these fields into one list, a decision maker is prompted to consider important aspects that would normally be outside his/her expertise.
- *Early warning*: By examining this information early in the process of considering a land-use change or transfer, certain legal, administrative or practical issues of concern can be identified and handled.
- *Comparability*: The tool will be useful for comparison among the areas of one site and/or among several sites.
- *Building relationships*: The process of using the checklist will improve communications between the different divisions of an organization working together to collect the information. This process may also build relationships between the land-owning organization and other stakeholders, such as county government officials or local environmental groups.
- *Exploratory and iterative use*: Owners of large tracts of land could use the first set of 'initial decision' questions as a preliminary process to explore opportunities to divest the land. Updating the answers periodically, perhaps annually, would allow for new information to be incorporated and could lead to discovery of additional opportunities to reduce costs.
- *Ease of use*: Checklists are transparent, easy to use and do not require scoring or weighting. With this tool, users do not need to decide if ecological value is more important than economic impact. Checklists and matrices are commonly used decision-making tools (Walton & Lewis, 1971; Dee, 1972; Dickert & Domeny, 1974; Inhaber, 1976; Rowland, 1978; Canter & Hill, 1979; National Research Council, 1994; Greenberg, 2000; Washington State Department of Ecology, undated).

Some of the barriers to effective use of the checklist include:

- *Organizational boundaries*: It may become unwieldy to implement the tool due to difficulty fitting within the organizational structure. New roles will need to be defined and new connections made between departments and divisions to overcome this barrier. In some cases, information may be guarded as the territory of one division and staff will be reluctant to share it.
- *Legal or regulatory conflicts*: There are often a host of legal requirements associated with land-use changes and with transfer of ownership, including approvals from regulators if land is contaminated and approvals from local governments on use changes. Many organizations will have only enough staff time and resources to concentrate on the information necessary to meet these obligations and will have little incentive to go beyond this. In addition, it is possible that some of the answers to the questions, if revealed, will make it more difficult to proceed with cost reduction.
- *Difficulty obtaining data*: Most property owners have never collected this type and extent of information before. This applies to data about the site itself and to the off-site impacts of the site. In some cases, collecting good quality data

will require substantial investment of resources and may indeed be impossible due to budgetary or other constraints.

- *Site size and/or complexity*: Some tracts of land will be very large or the issues (e.g. conflicting stakeholder desires or several types of contamination) surrounding them very complex. In that case, it may be difficult to find a single solution that fits the entire tract. Therefore, after preliminarily determining how to partition the land into multiple parcels, it may be necessary to work out solutions for each of the parcels. The questions included in the checklist will be useful in illuminating the best partitioning of the entire tract and the solution for each parcel, but the process may be iterative in such complex cases.

Conclusion: Environmental Planning with Regional Benefits

The question of what to do with unwanted land is an important public policy area and a key challenge for environmental planners and managers. Thousands of brownfield properties dot the urban landscape as scarred reminders of our industrial heritage. Many currently under-utilized government-owned properties are also found throughout the USA, some vast, rural and largely uncontaminated and some alike in almost all respects to classic urban brownfields. Together, there are hundreds of thousands of properties, representing millions of acres of land, that are no longer needed for their original purposes and that can be transitioned to new owners or new management that can bring some regional benefit. These new uses could provide much needed recreation space for underprivileged neighbourhoods, create ecological preserves or develop new job centres or community services. To make the best decisions about the future of these lands requires determining not just the market value of the property, but the inherent suitability of the land for different purposes, regional needs and demands, economic importance of the property and ecological values.

This paper has presented a suggested framework for evaluating this range of considerations. This list of questions is not intended to be exhaustive. There may be other questions important to the specific circumstances of a site that are not included here. In addition, it may not be practical for some land managers to implement use of this checklist due to constraints such as those discussed below. Although some data for multiple sites have been gathered, the checklist has not yet been used to make a best use decision for a particular site. It is possible that an organization trying to use it will find it inadequate in ways that could not have been anticipated. In some cases, finding good data to answer the questions will be tedious and difficult, leading to frustration with the tool. The appropriate data may not exist for some sites. It was found that data such as extent of on-site contamination and current recreational and cultural uses were not readily available for most of the US DOE sites being examined. For off-site suitability, information on nearby recreational areas must be gleaned from publicly available maps and local officials. With regard to general use of this checklist, if there is no money available to gather the data, those questions for which the budget falls short will remain unanswered and cannot inform the final decision.

In actual practice, political parameters often govern land-use decisions, such that even the most sound scientific evidence is marginalized in favour of decisions that satisfy powerful local, regional or national interests. However,

increasingly, stakeholders with widely varying interests are participating in processes which balance economics and environmental concerns in setting regulations and policies for regional land use (Council on Environmental Quality, 1997; Mazzotti & Morgenstern, 1997; Infield, 2001; Harrison & Davies, 2002; Yaffe & Wondolleck, 2002). Tools such as this one can help, not only to uncover issues and data relevant to the final decision, but also to assure the stakeholders that all the relevant issues have been addressed.

Despite possible shortcomings, this tool is a step in the direction of transparency and better integration of the many values of land. While there are many checklists, no others dealing with the future of contaminated lands incorporate such a broad set of questions about ecological, economic and social considerations. Too often scientists and managers are trained well in one of the areas and have very little expertise in the others. Because the team here had scientists from all three disciplines, the checklist integrates the different aspects of information essential to making both science and societally-based decisions about the management of contaminated lands. Its use will require communication across disciplines that traditionally have not communicated and worked together. Thus, using this tool can be a catalyst for new ideas and a kind of comprehensive environmental planning that is rare in today's organizations.

While the fate of most checklists is the bookcase shelf, this checklist will be applied to a real problem. The near-term objective is to select one or two US Department of Energy sites as case studies and apply the checklist process to uncover the best alternatives for future use. As a result of doing so, it is expected that the process will be modified to incorporate what is learned. If successful, that experience will increase the likelihood of use. It is hoped that publishing the checklist will encourage others to use it as well, adding to the collective experience.

Landowners need access to more and better quality data about land value, ecological resources and economic impacts to make wise decisions about land use. Organizational research should focus on ways to encourage blurring of traditional boundaries between disciplines. Researchers in ecology and in economics should work toward better sources of data and improved models to assess impacts and balance conflicting values. Legal and political experts should examine ways to build this type of information into existing legal documentation and policy processes.

As societal needs press for more brownfields sites to be remediated and reused, and as governments and other managers of large tracts of land issues directives to divest those lands, there will continue to be a great need for additional research on land use and land transfer decisions. Tools such as the one described in this paper will be needed to assist in these vital decisions.

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