COMMENTARY

A Weighted, Multi-Attribute, Site Prioritization and Selection Process for Brownfield Redevelopment

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Michigan is widely recognized as having one of the most innovative programs for converting brownfields into productive uses. The state provides a number of financial incentives along with suspension of retroactive liability for prospective developers. Michigan also has among the greatest number of brownfields of any state. The sheer number of sites and locations throughout the state, the cost of acquisition and cleanup, and the amount of information needed to make a reasoned decision and complete the necessary permits can make the choice of candidate sites difficult. A method to differentiate among potential sites for selection is clearly necessary. In this paper, a Brownfield Site Ranking Model is proposed for selecting sites for potential redevelopment. This process identifies 11 siting criteria derived from the review of general siting factors that can be evaluated in locating a business on a formerly used site. Such factors include commercial marketing guidelines, financial incentives, environmental regulatory compliance requirements, regional infrastructure and labor resources, and local community acceptance. These factors were integrated into a conventional, step-by-step, site identification and selection process using a multi-tiered, weighted procedure. The process was developed in cooperation with the Brownfield Redevelopment Authority of Jackson County and was tested on several prospective commercial and industrial sites. Results suggest a high degree of correlation between site characteristics and likely end uses and argue for a selection process that allows participation by local governments. The complete process, which can be computerized and adapted to a geographic information system, provides a model for commercial developers, real estate brokers, siting consultants, and local communities in selecting target sites for redevelopment.

Conventional wisdom in successful commercial real estate transactions cites three principal factors in decision making: location, location, and location. Depending on whether one is a real estate agent, a site selection consultant, or a developer, there are separate categories of decision factors pertaining to "location" including size of the property; development costs; availability of financing; regulatory compliance; proximity to labor, markets, and competitors; and infrastructure. Separating these factors to provide an objective evaluation of a particular site, particularly with regard to proposed use and local acceptance, is even more critical in the redevelopment of brownfield properties.

In the case of converting brownfields to productive uses, additional concerns are added to the list of factors to be considered in a siting decision. Brownfields are defined as abandoned, idle, or under-used industrial and commercial properties where expansion or redevelopment is complicated by real or perceived environmental contamination (US Environmental Protection Agency, 2001b). Prior contamination, strict environmental compliance and permitting requirements, expensive engineering, liability, and neighborhood opposition may stigmatize these sites. Add factors of legal uncertainty and delays caused by lack of information or financial incentives, and most developers opt for greenfields. In many metropolitan areas, this has helped feed the phenomenon known as urban sprawl.

Brownfields represent a lucrative, but largely untapped, land resource (Davis and Margolis, 1997; Dennison, 1998; Kirstenberg et al., 1997; Rafson and Rafson, 1999). The term "land recycling" has gained favor among land use planners,

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whereas economic development practitioners seek to "turn brownfields into goldfields" (Fleming, 2000). In a recent nationwide survey of 150 cities conducted by the US Conference of Mayors (1998), two-thirds of the respondents estimate that redevelopment of known brownfields could bring between $205 million and $500 million in additional tax revenues and add as many as 236,000 jobs to local economies.

Estimates suggest that there are over 430,000 brownfields nationwide (Simons, 1998); there may be as many as 45,000 sites in Michigan (Consumers Renaissance Development Corporation, 1998). Until recently, brownfields were overlooked by developers in favor of greenfields due to high costs to clean properties and upgrade infrastructure, liability concerns, market conditions, and local resistance (Consumers Renaissance Development Corporation, 1999; US Conference of Mayors, 1998). Under state and federal programs like Superfund, past efforts to clean up these sites and attract new development, jobs, and tax recovery have largely been unsuccessful. Because of these uncertainties and the lack of timely information and financial incentives, the identification and selection of brownfields for redevelopment can be a risky business.

In an attempt to level the playing field in the choice between brownfields and greenfields, the State of Michigan enacted legislation under the Natural Resources and Environmental Protection Act (Public Act 451, 1994; Michigan Compiled Laws 324.101–324.90106), aimed at reducing liability for prospective developers. The Michigan Brownfield Redevelopment Financing Act (Public Act 381, 1996; Michigan Compiled Laws 125.2651–125.2672) establishes local Brownfield Redevelopment Authorities and provides financial incentives to purchase, remediate, and develop contaminated properties. The overriding goal of the brownfield redevelopment program is to support local economic redevelopment; environmental cleanup is a secondary consideration. In addition, the US Environmental Protection Agency (USEPA) Brownfield Pilot Grant Program provides significant financial resources to communities (US Environmental Protection Agency, 2001a). The ultimate goal is to return brownfields to productive uses, stimulating local economic growth by getting these properties back on the tax rolls, providing new jobs, and attracting other businesses to the vicinity.

Even with state and federal incentives, developers, realtors, siting consultants, and economic development specialists still face many decisions about which sites to remediate, market, and purchase. Additional information regarding available financial incentives, environmental regulatory compliance, site engineering characteristics and infrastructure, and local concerns must be considered in choosing sites that would provide the greatest return on investment.

Study Objectives

The Jackson County Brownfield Redevelopment Authority (hereafter referred to as the Authority) and local units of government within the county initiated the development of a Brownfield Site Ranking Model to help developers and local decision makers decide which sites are economically viable. The Authority felt that, before seeking customers, it needed a method to screen, rank, and select brownfields that would be most attractive to potential developers. This decision was made after the Authority reviewed other brownfield programs (in Michigan and in other states) and determined that none of these included an objective, repeatable process that could be used in Jackson County.

The Brownfield Redevelopment Zone within the jurisdiction of the Authority included most of the townships and villages in Jackson County where sites were located. Therefore, active input from the local units of government was needed to ensure an acceptable selection process. Screening of sites would be done initially at the local level and then reapplied in collaboration with the Authority to provide an opportunity for both local and multi-jurisdictional interests to be considered in a redevelopment strategy. It would also allow comparison with results of market analysis; identification of potential conflicts with master plans and zoning ordinances; and input from community preference surveys, public meetings, and other forms of public involvement.

Jackson County, located in south-central Lower Michigan, was an ideal study site for this project. First, while Jackson County is representative of the small-to-medium-sized counties within the state (2000 population: 158,422), it is not adjacent to the larger metropolitan regions of the state. Thus, potential development is generally centralized in and around the City of Jackson and is primarily influenced by the growth of the city, and less by other communities. Jackson has a traditional manufacturing base that once supported the auto industry, but is now diversifying. Second, the County received a 1999 USEPA Brownfield Pilot Grant that required an inventory of potential redevelopment sites, as well as active participation by local governments and businesses. This was coupled with the financial incentives offered by Michigan for brownfield redevelopment. Third, local jurisdictions within the county have established a

countywide planning committee that includes a revenue-sharing agreement for expansion of utility and other service-based infrastructure. Such an agreement could strongly influence where future development would likely occur. This land-use planning program is unique in Michigan, and was recognized by the US Department of Housing and Urban Development for a 2001 Innovative Initiatives Award.

The Brownfield Site Ranking Model uses a series of multivariate, weighted criteria to evaluate brownfield sites for their redevelopment potential. The use of screening criteria in site selection and environmental impact assessment is well known (Canter, 1996; Ortolano, 1997; and many others). A review of the USEPA Pilot Grant programs suggested that there are no established methods for systematically prioritizing and selecting brownfield sites for redevelopment (Institute for Responsible Management, 2001; US Environmental Protection Agency, 2001a). Prior to the use of this model, the Authority chose sites to develop without substantive participation by local units of government, often accompanied by interjurisdictional disputes (Renando, 2001; Renando and Thomas, 2001).

The purpose of this study was to design and demonstrate a comprehensive, user-friendly, and repeatable process by which brownfield sites can be identified, characterized, and selected for redevelopment. It was the intent of the study to provide a way to screen a countywide inventory of potentially available sites, reduce the number of candidate sites to those that meet the needs of prospective developers based on projected end points, and determine which sites will best promote economic development within the community. A second goal was to establish a systematic way to determine which sites should be developed and in what order of priority, based on their physical attributes, on their marketability, and on community and developer preferences or criteria. A third goal was to develop a rapid, highly accurate process that could help minimize staff time and maximize return on investment.

This process was developed to address three realities associated with local land use decision making. First, nearly all land use decisions in Michigan are made at the local level. Second, it was recognized that siting and development criteria have different applicability at county and local levels based on availability of information and jurisdictional rights, prerogatives, and interests. Third, potential end use (i.e., whether a site would be developed with a use in mind or whether a site is being screened to determine a preferred use) may differ by jurisdictional level. Therefore, one of the

procedures in designing and applying this system was to break the screening into two tiers. The first would be applied at the local level and the second at the county (or multi-jurisdictional) level. This procedure enhanced the ability of the Authority to work closely with local units of government in providing data and information, decision support tools, and guidance in applying site selection and screening procedures.

Study participants included members of the Authority, which included local business leaders, the Chamber of Commerce, and the Enterprise Group of Jackson (the county economic development corporation); appointed representatives of each member jurisdiction, including 18 of the 19 townships in Jackson County; and the planning commissions of the Charter Townships of Blackman, Columbia, and Leoni. Guidance was also available through collaborative agreements with Consumers Renaissance Development Corporation, the Environmental Assistance Division of the Michigan Department of Environmental Quality (MDEQ), and the Jackson County Office of the Cooperative Extension Service at Michigan State University. The participants determined that the success of the procedure would be tested and measured by its ability to prioritize sites within the County Brownfield Redevelopment Zone that maximize the return on investment by being attractive to developers, minimize the need for economic and fiscal resources available to the Authority, and foster cooperation between county and local governments.

Study Procedure

The study used a series of workshops in which criteria and measurement assumptions were developed, refined, and then applied on existing brownfields within local jurisdictions. The first step in the process was to determine potential endpoints from which screening criteria could be developed. The second step defined assumptions used in measuring the criteria in the field. The site-screening criteria were field-tested by incorporating them into a conventional site identification, characterization, and evaluation process that would be used by a brownfield redevelopment authority in Michigan. This process typically consists of three distinct activities aimed at deciding which sites should be designated for redevelopment, investment (including government subsidies), and marketing. The initial activity is the site identification and data collection process or site inventory, the second is the screening and ranking process, and the third is the analysis and evaluation process. This process is shown in Figure 1, which identifies the three activities, as

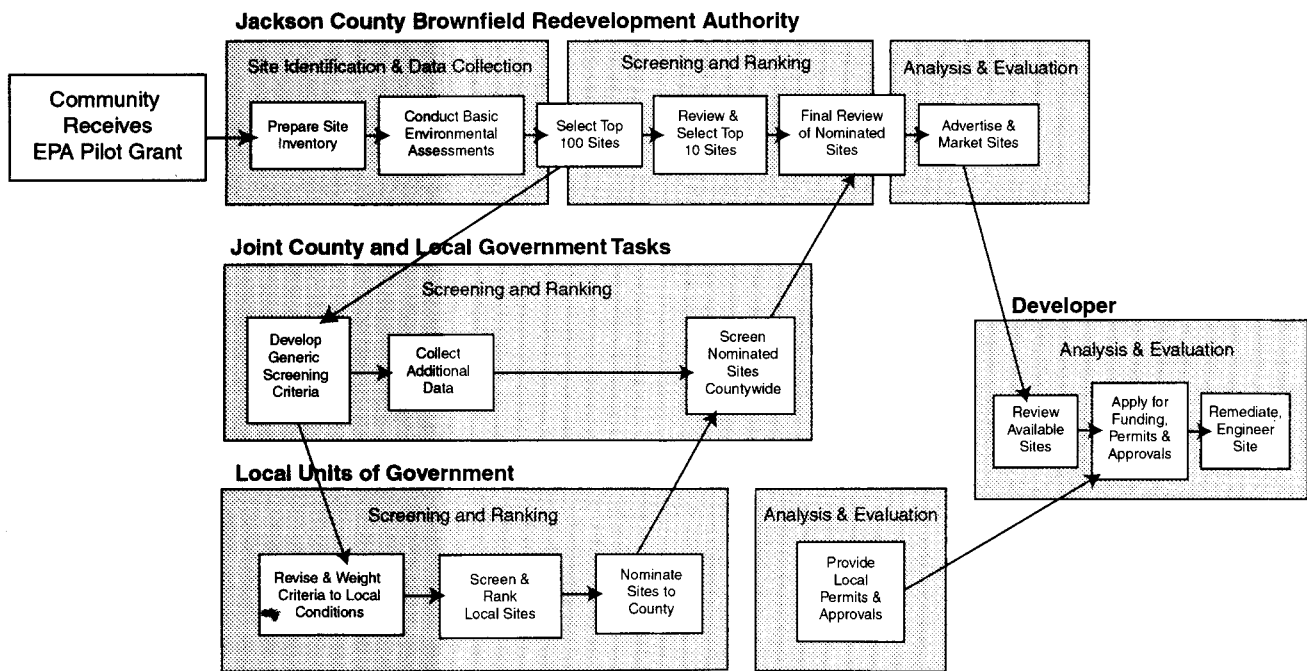**Jackson County Brownfield Redevelopment Authority**

Figure 1. The decision process used in Jackson County to redevelop a brownfield. The figure illustrates the collaboration between county and local units of government to develop the Brownfield Site Ranking Model, which is jointly developed and applied at both levels of government. In practice, the final siting decision rests with the Brownfield Redevelopment Authority and prospective developer. The local unit of government is responsible for final permits and approvals.

well as the levels of decision making and collaboration among the participants. This process was further enhanced by using a geographic information system (GIS) to map site locations, review physical information about the sites, and automate the multivariate weighting and ranking model.

Determining Potential End Use of Brownfield Properties

The main goal of the proposed site selection criteria is to provide as much information to the developer or decision maker as possible. Study participants agreed that potential endpoints of a brownfield project would include industrial, commercial/retail/office, residential, and open space land use alternatives. Criteria used to rate and prioritize sites would have to reflect both the developer's business plan, and would also be instrumental in facilitating the process of permit application, financing, and site engineering. The criteria should consider factors that are generally used in the art and science of locating commercial real estate, including local conditions such as infrastructure, site characteristics, and financial incentives. And, the criteria must take into account local restrictions, including zoning ordinances, master plans, and community acceptance.

Buchanan et al. (1997) suggest that, in a choice between brownfields and greenfields, the prospective developer must be convinced of the locational and financial advantages of the former. He lists the fear of liability of contamination as the most critical factor in this comparison. This is also reflected in the previously mentioned nationwide survey of 150 cities conducted by the US Conference of Mayors (1998). Financial concerns were ranked first among all obstacles to redeveloping brownfields, followed by environmental and liability concerns. In Michigan, by contrast, environmental contamination and resultant liability concerns have been addressed through innovative legislation, which has been discussed previously. The proposed end use will determine the level of cleanup and associated costs of contaminated properties, and the purchaser of a contaminated property will not become a potentially responsible party.

Information requirements for proposed end uses of brownfields, outlined by Devine (1996) and Moyer and Tremarche (1997), include an accurate inventory of available sites; environmental compliance status, history of incidents, and any enforcement actions; transportation access; presence of linked industries; availability of development incentives; and labor pool characteristics. These considerations are reinforced, to some extent, by Greenwald (1996), who lists

skill level and cost of labor, proximity to customers, and price of real estate as the principal determining factors. Greenwald also discounts the influence of tax incentives, claiming that communities, in their rush to attract business, often trade certain services (e.g., education and job training) that may be more essential to sustaining a good business environment. In addition, individual commercial and industrial market sectors often apply specific criteria that are most meaningful to achieving their success (these criteria are published in monthly trade journals such as *Aftermarket Business, Hotel & Motel Management, Shopping Center World,* and many others). The data development process outlined in the *Brownfield Redevelopment Guide* (National Brownfield Association, 2001) could result in additional site information regarding the site and surrounding areas, as well as the community.

Developing Siting Criteria and Prioritization Assumptions

Study participants worked with the Authority and with representatives of township, city, and village governments to develop a list of major siting criteria. The participants were instructed during a facilitated public meeting to develop a process model that could: (a) provide guidance to the Authority in the efficient use of resources in identifying, characterizing, and marketing candidate brownfields, and (b) help communities in their efforts to successfully redevelop formerly used sites rather than convert agricultural and open space to more intensive uses, potentially creating urban sprawl. The wording and relative importance of each siting criterion was developed during the workshop and then reviewed by local units of government. In addition, the draft criteria were independently reviewed by representatives of the Environmental Assistance Division of the MDEQ, Consumers Renaissance Development Corporation, and the Technical Assistance to Brownfields Community Program of the USEPA Hazardous Substances Research Center at Michigan State University.

The final draft criteria are listed in Tables 1 and 2 in decreasing order of relative importance of each criterion to the study area. Each criterion is identified in Column 1 and was subsequently broken down into more descriptive sub-criteria, as discussed below. Point values were assigned in a weighted scale to reflect relative importance of each criterion and sub-criterion (Column 2). Assigned weights were identified as percentages using an ordinal scale (Column 3), which is suggested by point values assigned to each category heading. The fourth column shows the available points for each factor that is evaluated in a comparison among sites.

The final column provides a suggested source of information needed to evaluate each criterion.

In Table 1, participants representing local units of government (townships, villages, and cities) identified and rated a set of criteria that were considered pertinent in local decision making. Participants felt that these criteria would be better addressed locally using information more readily available at the local level.

1. The status of environmental cleanup, including a determination that there is no public risk, was considered the highest-ranking criterion (30 out of a possible 120 points). As shown in the list of descriptive sub-criteria, sites with known contamination were actually given more points than remediated sites. Such sites qualified for public funds to offset cleanup costs that would normally be borne by landowners, developers, or local government. The relative importance of this criterion was high, despite protection from retroactive liability afforded by Michigan law.

2. Compatibility with local land use controls was considered next in importance, including zoning ordinances (25 points) followed by master plans (20 points). These two criteria were established to help ensure that public acceptance for a potential use is in compliance with official local laws, zoning ordinances, and master plans, and that such use will not conflict with surrounding uses. For example, if a site is not completely surrounded by compatible uses, the point value goes to the *lowest* adjacent use.

3. In addition to compliance with zoning ordinances and master plans, a separate criterion was needed to address public acceptance (or opposition) to a proposed action (15 points). When a project is proposed at the local level, a final determination will be made whether that use is compatible with surrounding land uses or whether a controversial use could simply not be built, which is typically expressed at public meetings or other public forums. Information regarding public acceptance is obtained through opinion surveys, editorials in local news media and letters to the editor, statements made at public meetings, and so on.

4. The next three criteria deal with infrastructure (10 points each). Local decision makers must determine whether existing or planned electric, gas, water, sewer, communications, and transportation resources are adequate in quantity and quality to serve potential uses, or whether systems need to be upgraded at public expense. Additional information about system capabilities (e.g., electric service is 14 kV, gas is 24-inch high-pressure pipeline, and so on) needs to be established at each site. Points are as-

Table 1. Brownfield site selection, weighting and ranking criteria and information requirements applied at the local (township, village, and city) level

Local Government Ranking Criteria	Max. Point Value	Rank Value %	Avail. Points	Information Source
Site Conditions	30			
Environmental contamination suspected		100	30	Based on local/county-supplied data
Environmental problems unknown		50	15	Based on local/county-supplied data
Environmental investigation partially complete		30	9	Results of Phase 1 ESA/BEA
Physical development constraints exist		15	4.5	MDEQ 201/307/UST database
Environmental investigation complete		5	1.5	Administrative Order Release
Compatibility with Local Land Use Controls (Zoning Ordinances)	25			
Compliant		100	25	Zoning ordinance
Compliant with reservations		50	12.5	Zoning ordinance
Not compliant		0	0	Zoning ordinance
Current Use Compatibility with Local Land Use Plans (Master Plans)	20			
Compliant		100	20	Master plan
Not compliant		0	0	Master plan
Compatibility with Surrounding Land Uses	15			
Compatible, as proposed		100	15	Master plan; zoning ordinance
Compatible, with reservations		50	7.5	Master plan; zoning ordinance
Not compatible, as proposed		0	0	Master plan; zoning ordinance
Utility Infrastructure Capacity	10			
Heavy duty water/sewer, gas, electric		100	10	Utility service specs.
Medium duty		80	8	Utility service specs.
Light duty		50	5	Utility service specs.
Incomplete		10	1	Utility service specs.
Telecommunications Infrastructure	10			
High-tech fiber optics installed		100	10	Utility service specs.
Proposed 1–2 years		80	8	Based on local/county-supplied data
Proposed 2–5 years		50	5	Based on local/county-supplied data
Basic, upgrades in over 5 years		10	1	Based on local/county-supplied data
Transportation Infrastructure	10			
Interstate access/rail/airport		100	10	Local data; type; distance
Class A/primary or state highway		80	8	Local data; type; distance
Secondary or county road		50	5	Type; distance
Local street		10	1	Local data; type; distance
Total Available Points (Local)	120			

ESA = Environmental Site Assessment; BEA = Baseline Environmental Assessment; MDEQ = Michigan Department of Environmental Quality; UST = Underground Storage Tank.

signed if infrastructure provides relatively immediate access or service with a normal hookup charge. If this is unknown, a value of zero is assigned. Regarding transportation, points are assigned if a transportation system provides immediate access not including new driveways; otherwise, an incomplete value is assigned. For purposes of site comparison, sites would have an advantage if lo-

cated within one mile of an interstate exchange as long as the route does not pass through a residential area. This was added in anticipation of high traffic volumes generated by potential commercial or industrial developments.

For the study area, the highest possible weighted point value at the local level was 120; other local communities may de-

Table 2. Brownfield site selection, weighting and ranking criteria and information requirements at the county (brownfield redevelopment authority) level

County Authority Ranking Criteria	Max. Point Value	Rank Value %	Avail. Points	Information Source
Financial Incentives	40			
Qualify for authority TIF financing		100	40	Based on local/county-supplied data
Qualify for MDEQ/USEPA Brownfield grant(s)		25	10	Based on local/county-supplied data
Qualify for community development block grant		15	6	Based on local/county-supplied data
Qualify for other local financing		10	4	Based on local/county-supplied data
Qualify for industrial facilities tax exemptions		5	2	Based on local/county-supplied data
Environmental Risk and Compliance	30			
Minor contamination, no risk		100	30	MDEQ 201/307/UST database; BEA results
Contamination can be removed, minimum risk		75	22.5	BEA results
Contamination can be contained on site		50	15	BEA results
Potential future contamination		5	1.5	BEA results
Land Re-Use Preferences	20			
Industrial		100	20	Master plan; zoning ordinance
Commercial/office		75	15	Master plan. zoning ordinance
Open/agricultural		5	1	Master plan; zoning ordinance
Residential		1	0.2	Master plan; zoning ordinance
Labor Resources	10			
Trained work force available, short response time		100	10	Census; block group labor force/sector
Trained work force available, long response time		50	5	Census; block group labor force/sector
Job training available		10	1	Based on local/county-supplied data
High unemployment		1	0.1	Michigan employment; US Census
Market Conditions	10			
Customer base located within 50 miles		100	10	Census; block group population
Proposed use will attract new markets		80	8	Based on local/county-supplied data
Competitors located within 50 miles		5	0.5	Census; block group labor force/sector
Projections long term		1	0.1	Requesting firm
Total Available Points (Regional)	110			

TIF = Tax Increment Financing; MDEQ = Michigan Department of Environmental Quality; UST = Underground Storage Tank; BEA = Baseline Environmental Assessment.

velop a different weighted value to reflect local conditions. Once a site is evaluated and ranked at the local level, the local unit of government recommends its highest-priority sites to the Authority.

The Authority then reevaluates each site using the next tier of criteria, shown in Table 2. These criteria were based on information accessible to countywide economic development corporations and other quasi-governmental units (e.g., the Authority).

1. The Authority is primarily concerned with shepherding a project through the redevelopment process. Financial incentives ranked highest (40 out of a possible 110 points) because they have a tremendous economic effect on the eventual use of the site. Qualifying for tax increment fi-

nancing (TIF), school tax recapture, or one or more brownfield grants can provide enough money to prepare a site for a client. The client might otherwise find it less expensive to develop a "greenfield" site.

2. Environmental risk/compliance (30 points) and land re-use preferences (20 points) would then be considered at the county level. As the principal fiscal agent for site redevelopment, the Authority is responsible for determining which potential uses will result in an economic return and ensuring that the site is remediated to the intended use.

3. The Authority will also need to identify and characterize labor resources (10 points) and conduct a market analysis (10 points) for a prospective end use. County government is seen as the most capable unit to conduct these analyses.

Table 3. Potential brownfield end uses by land use category and preference range

Proposed Uses	Range of Acceptability	Total Point Value
Industrial	High	120–230
Industrial	Medium	70–119
Industrial	Low	<70
Commercial/Office	High	120–220
Commercial/Office	Medium	90–119
Commercial/Office	Low	<90
Residential	High	90–120
Residential	Medium	60–89
Residential	Low	<60
Agriculture/Open Space	High	70–120
Agriculture/Open Space	Medium	50–69
Agriculture/Open Space	Low	<50

The highest point value at the county or regional level for the study area was 110 points. Other regional entities could also weight and rank sites according to different factors considered more important to their decision-making processes.

The study team then developed a range of scores for the possible end points (industrial, commercial/office, residential, or open space). This is shown in Table 3, which favors the development of industrial and commercial/office uses. The participants believed that there is a danger in redeveloping a brownfield site with known contamination into residential use. The combined value for both tiers of ranking (combined Tables 1 and 2) is 230. Participants determined that industrial sites should fall within an optimal value range of 120 to 230, commercial/office sites between 120 and 220, residential sites between 90 and 120, and agricultural/open space between 70 and 120. All participants were aware that the resultant criteria would be advisory only, and that the points assigned would be arbitrary. As might be expected, applications of this method in other locations would probably result in a different point total and, therefore, a different result, development plan, or end use of a specific site.

Mapping the Sites and Applying the Criteria

The Authority created an inventory of 100 sites that were considered economically viable, as well as qualified to receive public funds for remediation. This inventory was selected from the approximately 4,600 potential sites in the County, which included the MDEQ contaminated sites and underground storage tank databases (Michigan Department of Environmental Quality, 2001) and sites nominated by local communities or business owners. An environmental consultant provided site-specific information for 38 target sites through Phase 1 and Phase 2 environmental site assessments (American Society of Testing and Materials Standard E1527-97, as amended), as well as basic environmental assessments (BEAs) required under Michigan law. All known and suspected (volunteer) brownfields were mapped in ArcView® GIS, along with site information provided by the on-line database and the environmental site assessments. As each site was evaluated, it was then added to the GIS coverage for each township.

The mapping and evaluation process was automated in ArcView® using the Smart Places® extension to compile the data, integrate siting objectives and constraints, and assess impacts of various land-use options. The system then calculated the total point value for each site and displayed the results. After applying the weighting and ranking process, site-specific information was reviewed to provide a preliminary assessment of the potential economic, social, and environmental effects of redevelopment options on candidate sites. If one or more sites are selected for further consideration, the developer might then hire an expert to prepare the required environmental reports. (Note: This step was part of the study design required by the Authority.) Because of the amount of geospatial data needed to compare sites, other communities that have access to GIS technologies should consider using a GIS to map and compile these data.

Results and Discussion

Six sites in each township were chosen from the countywide inventory to calibrate the Brownfield Site Ranking Model; all of these sites are considered brownfields. Some results are shown in Table 4, which is a subset of the sites in Blackman Township chosen by the township planning commission. Other townships used a similar process to select sites for screening. In this example, the subtotal scores for Blackman Township (using Table 1 criteria) and for the Authority (using Table 2 criteria) were combined into a total score. The site rankings were then compared to see whether any site would potentially qualify for an industrial end use.

As shown in Table 4, Site 5 was eliminated because it is zoned commercial; sites 3 and 14 were eliminated because they were too small under the local zoning ordinance. Although Site 12 had a relatively high local score, it was downgraded by the Authority to medium value for an industrial end use because it could not qualify for tax recapture. Site 8 received a recommendation from both the township and

Table 4. Results of screening six brownfield sites selected from an inventory of 18 sites in Blackman Township, Jackson County

	Site 3	Site 4	Site 5	Site 8	Site 12	Site 14
MDEQ ID#	380142	380023	380115	380229	380106	380290
Acres	0.24	10.2	0.5	2.60	19.40	0.93
Zoning	RU-1	I-2	C-2	I-2	I-2	I-2
Contaminant	MTBE, carbon tetrachloride	PCE, TCE, benzene, lead	Unleaded gasoline	DCE, TCE, PCE, vinyl chloride	TCE, DCE, BTEX, vinyl chloride	Gasoline
Cleanup Status	Not begun	Final cleanup	Pre-ESA	ESA complete, interim response	ESA complete, interim response	Pre-ESA
Local Value	34	80	70	96	77	60
County (Authority) Value	34	63	59	75	42	66
Total Score	**68**	**143**	**129**	**171**	**119**	**126**
Redevelopment Potential:						
Industrial Range High 120–230 Medium 70–119 Low <70	Low; too small	High	Low; zoned commercial	High; part of a larger site	Medium; no tax recapture	Low; too small
Commercial Range High 140–220 Medium 90–139 Low <90	Low; surrounded by residential	Marginal; zoned industrial	Medium; small site	Marginal; zoned industrial	Marginal; zoned industrial	Marginal; zoned industrial
Residential Range High 90–120 Medium 60–89 Low <60	Medium, presence of contamination	Not acceptable	Not acceptable	Not acceptable	Not acceptable	Not acceptable
Open Space Range High 70–120 Medium 50–69 Low <50	Medium, presence of contamination	Not acceptable	Not acceptable	Not acceptable	Not acceptable	Not acceptable

RU = residential; I = industrial; C = commercial; ESA = Environmental Site Assessment.

the Authority. The site was ranked relatively high (96 of a possible 120 points) by the township planning department and was nominated to the Authority for redevelopment incentives. The Authority scored the site as favorable for development with 75 of a possible 110 points. The combined score was 171 points out of a possible 230, which placed the site relatively high on the list for potential industrial redevelopment since it totaled more than the 120 points needed to qualify as high-quality industrial. The Authority proposed an industrial redevelopment project on a 2.6-acre brownfield that is part of Site 8.

Further study of the site was then initiated. Previous use of the site was for the manufacturing of metal hardware. The site is contaminated with waste oil and potentially other contaminants. The site is located on land that is zoned industrial; adjacent areas are zoned commercial and high-density residential. The township master plan and the zoning ordinance identify preferred uses for the site regarding type, size, and distribution along with requisite setbacks, minimum square footage, and street access requirements. In addition, there are several physical site limitations, including the presence of wet and unstable soils, adjacent municipal water supply wells, and wetlands that may affect use of the site without re-engineering and without a wetland permit. Restrictions to the proposed development must be taken into consideration in the decision process along with building size; number of employees; water and sewer; heat-

ing, ventilation, and air conditioning; road access and parking; and other design criteria.

Lessons Learned

Based on the results of this project, several observations may be made. First, siting criteria should consider factors that are generally used in locating commercial real estate. Second, the criteria must incorporate local conditions such as infrastructure, site characteristics, and financial incentives. Third, the criteria must take into account local restrictions including zoning ordinances, master plans, and community acceptance. Finally, representatives of local government entities should calibrate the criteria on existing sites within local jurisdictions.

It is important that local communities have the first opportunity to review sites within their jurisdiction, since they are generally more familiar with site characteristics, past uses, and community acceptance of potential future uses. Sites with a relatively high local score are most likely to be nominated for consideration for either industrial or commercial redevelopment. The screening criteria are strongly biased toward industrial and commercial/office end uses, which reflects the strong desire by local decision makers to encourage high-return investments, tax recapture, and jobs, while reducing public exposure to potentially contaminated sites. Local decision makers preferred not to recommend brownfields for residential use and were hesitant to recommend them as open space. Moreover, sites that did not have industrial or commercial potential were unlikely to score high at the county level.

It is recommended that, before seeking prospective developers, screening be done initially at the local level and then reapplied in collaboration with the Authority, especially if such an organization encompasses more than one governmental entity. This provides an opportunity for both local and multi-jurisdictional interests to be considered in a redevelopment strategy. It also allows comparison with results of market analysis; identification of potential conflicts with master plans and zoning ordinances; and input from community preference surveys, public meetings, and other forms of public involvement.

Depending on the location, the proposed criteria could be modified to reflect local environmental concerns and impact of proposed alternatives, goals for economic growth, physical attributes of the site and surrounding areas, transportation and communication infrastructure, ability to provide necessary services, and available financial incentives. County objectives could reflect these same criteria, but on a regional growth level.

Automating the process in a GIS can be as simple or as detailed as time and funding allow. Using a GIS-based decision support system allows manipulation of the database as new information is available, and it will allow prospective commercial realtors, purchasers, and developers to rapidly review and compare prospective sites. This has the advantage of enabling access to significant amounts of geospatial data in a form that is easily manipulated on a computer. Smart Places® was used in this project because it is inexpensive and readily available, adaptable to many applications, and has an established track record as an extremely powerful decision support tool. Smart Places® allows nontechnical users to interactively review land use scenarios, sketch recommended changes, and evaluate these recommendations against local or regional objectives and constraints. Such applications can support land use decision makers in comparing the impacts, benefits, and risks of alternative land use options or scenarios. As such, it is a tool worth considering in a spatial decision support system.

Conclusions and Recommendations

Successful redevelopment of brownfields is a process that is more complex than traditional commercial real estate transactions. In addition to needing information about the location, size, cost, and proximity to labor, markets, and infrastructure, decision makers are confronted with issues of regulatory compliance, environmental contamination, compatibility with surrounding land uses, and public acceptance. The decision to develop a brownfield requires input from elected officials, advocacy groups, and the engaged public in addition to the real estate agent, the site selection consultant, or the prospective purchaser. Although innovative brownfield redevelopment programs, such as those in Michigan, have begun to address concerns about retroactive liability and cost reimbursement, there remains a tradeoff between economic growth and environmental quality, as well as a need for intergovernmental cooperation.

The main goal of this project was to create a process to evaluate and rank sites using a set of simple, repeatable site selection criteria that provided a mechanism for local participation in the process. The result was a Brownfield Site Ranking Model that was created through collaboration with a diverse group of stakeholders engaged in a countywide brownfield redevelopment program in Jackson County,

Michigan. It was hoped that the process would help to provide as much information to the developer and decision maker as possible. This will help to identify sites that will fit the developer's business plan, and will also be instrumental in facilitating the process of permit application, financing, and site engineering. Participants determined that the measure of success of the procedure would be tested and measured by its ability to prioritize sites within the County Brownfield Redevelopment Zone that: (1) maximize the return on investment by being attractive to developers, (2) minimize the need for economic and fiscal resources available to the local planners, and (3) foster cooperation between county and local governments.

The Brownfield Site Ranking Model represents a potentially useful approach to prioritize the identification, comparison, and selection of brownfield sites. Using this method, over 90 individual brownfields in Jackson County were identified, characterized (including a number of Phase 1 environmental site assessments), and ranked for redevelopment. To date, approximately 10% of these sites have active projects in some phase of redevelopment ranging from remediation to reconstruction. Although the model was developed for a specific location in Michigan, the process of using siting criteria and measurement assumptions is repeatable at other locations. A similar approach could be used in other communities or it could be replaced by a modified version that incorporates local conditions and planning objectives.

Acknowledgments

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