Note to Readers:

The following excerpts are derived from a 100+-page project report entitled "*Building Bridges Between Community Based Organizations and Technology: Exploring Tools for Community Participation and Economic Development for the Dudley Street Neighborhood Initiative (DSNI).*" As described below, this project fostered a Community-University partnership focused on using various GIS tools for local economic empowerment initiatives. Results from the mapping project were used in the DSNI initiative recently described in the *Boston Globe* news article "Greenhouse Helps Drive Growth in Roxbury" (www.boston.com/news/globe/archives: 5/11/05).

December 2004

The work assembled here is but one of the many seeds planted to arrest years of disempowerment, separation, and intentional disinvestment within one of the most vibrant communities in the United States. Boston, Massachusetts continues to foster a new sense of place by making neighborhoods more livable but nationwide the typical ills of many older urban neighborhoods continue to manifest. Years of neglect -- both in human capital and infrastructure -- will not be overcome within the underground tunnels of the *Central Artery* but on the streets, and in the homes, of families seeking safe and affordable places to live.

The technology that catapults Boston into a *first futures* city can also be used to energize the slow, to no growth neighborhoods that are held within its borders. Unfortunately, the communities that can ill afford to be left behind on the information highway continue to do so in record numbers. Community Based Organizations (CBO) has been able to identify critical needs but also is under attack due to receding financial and administrative support. One of the most innovative CBOs that failed to yield is the Dudley Street Neighborhood Initiative® (DSNI). Since 1984, DSNI continues to take bold steps by demanding control of the land in the Roxbury/North Dorchester *triangle* through the power of eminent domain. Now in its 20th year, DSNI is considering how the use of technology and control of data resources can foster continued community empowerment through economic development.

To assist in this effort, the Cornell University City & Regional Planning (CRP) 607 GIS Workshop class created a neighborhood advocacy team. *Sibley Consulting* responded to the DSNI request for a 'first step' evaluation of technology while providing base level mapping services. The *Sibley Consulting* team started by conducting a neighborhood assessment and partnership meetings which included DSNI and City of Boston municipal and regional agencies who provided data and project support. The process of collaboration became almost more important than the team goal to 'make maps'. DSNI suggested that the primary reason for technology adoption was to improve data management and administrative processes while maintaining 'full and complete' public participation in the neighborhood planning process. With this in mind, the team focused on the following tools: *ArcGIS* geographic information systems (GIS), *CommunityViz, WebSurveyor* and *BIackboard* for distance project management. The enclosed report summarizes the major activities of *Sibley ConsuIting* based upon the overall DSNI strategic planning goal of *community economic empowerment*. This project began in late August and ended in early December of 2004.

This report is not an instructional guide for developing a comprehensive neighborhood planning process. The team faced limitations of time, distance and the inability to fully engage the community in the mapping process. *Sibley Consulting* does provide DSNI with a practical starting point for developing a GIS through a user assessment survey, a database structure built upon mission critical goals, relevant information for development of a geodatabase, increased GIS knowledge and capacity through providing map samples and the ability to use advanced GIS technology through future project partnerships. The Brookings Institution will use the project maps and data archive in January 2005 as part of the MIT/MAPC "Intelligent Middleware for Understanding Neighborhood Markets" initiative sponsored.

The CU-DSNI project could never have been completed without the support of many who share the same ideal -- to empower our neighbors-- so that all have the chance for a more compassionate life. The *Sibley Consulting* team provided e-technology services but also created a model for public-private-non-profit partnerships that allows the process to be led by the community and not driven by the data. This team consisted of Leila Aman, Julienne Chen, Anna Karwowska, Kyu-San (Josh) Lee, Jason Luger, Dong Keun (DK) Yoon and Michelle M. Thompson.

Respectfully submitted,
Michelle M. Thompson, Ph.D.

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ABSTRACT

Technology is vital to many businesses, governments, and organizations and can be especially useful for Community Base Organizations (CBOs). The Cornell University (Fall 2004) GIS project tackled this issue by analyzing the use of data and technology with the Dudley Street Neighborhood Initiative® (DSNI). The community-university partnership between the GIS Workshop Class (Sibley Consulting) and DSNI focused on community economic empowerment. However, this partnership included many more actors and relationships such as Boston Redevelopment Authority, Boston Assessing Department and other public-private agencies that provided the group with the data and technical knowledge needed. While ArcGIS 8.3 was the primary tool, Websurveyor, CommunityViz, and Blackboard were also used for capacity building. The final report is an educational tool for DSNI's development of a geodatabase. The project will serve as a good model for future partnership projects in fostering usage of technology among CBOs.

INTRODUCTION

The CRP 607 GIS Applications Workshop class was a group of eight members of the Cornell University community, comprised of undergraduate and graduate students in the Cornell University Department of City and Regional Planning and Department of Crop and Soil Sciences. The team was formed in August 2004 under the direction of Professor Michelle M. Thompson and assisted by DK Yoon. Its initial purpose was to provide professional mapping and analysis services for the Dudley Street Neighborhood Initiative® (DSNI), a community based organization in the Roxbury/North Dorchester neighborhoods of Boston, Massachusetts.

The class provided a venue to simulate a consulting services team in a professional working environment and thus formed *Sibley Consulting.* Sibley Consulting created a community-university partnership with DSNI for several reasons. The team wanted to foster an environment that was centered on an assets based' approach through collaboration. Communities are the fundamental unit upon which planning takes place. Despite a frequent lack of accessibility to certain administrative/technical planning skills, there is no substitution for the local knowledge that only communities can contribute to the neighborhood planning process. Therefore, collaboration with other entities is often useful for the purpose of enhancing technical skills, training, problem definition, program development, and other resources that are necessary for a comprehensive planning approach. Universities are one of these entities can blend theoretical models with neighborhood knowledge for a more holistic, and reflective, approach to neighborhood planning. This approach would begin to reduce a common criticism of academia that suggests that an accurate picture of the real world and its problems is not reflected outside of the theoretical realm. On a practical level, such partnerships then allow university students to better understand the 'promises and pitfalls,' and supplement their theoretical background with practical experience while providing technical skills for communities. Thus, the community-university partnership is in true recognition of the idea that planning cannot happen in a vacuum.

In recent years, there has been a movement away from the 'top down' theoretical approach to community planning. The 'bottom up' approach is still not the norm but there has been a major shift in the approach to community planning as reflected in more resident led initiatives. In the field of city and regional planning, where most of the members of Sibley Consulting have their backgrounds, collaboration with Community Based Organizations (CBO) is of particular importance. CBOs focus on social and economic aspects of community development through issues such as neighborhood planning, affordable housing, business development, youth programs and job training where the limits of their influence is not confined by artificial boundaries but the needs that are identified.

DSNI was identified as the partner in this particular collaboration for several reasons, including its work in the above-mentioned areas but also because of its richness in

history, culture and diversity. Historically one of the most blighted and disregarded neighborhoods in Boston, DSNI was formed in 1984 to empower the residents to take control of their neighborhood and create a healthy and vibrant community in Roxbury and North Dorchester, Massachusetts. Since then, the Dudley neighborhood has become one of the most widely known CBO success stories and has attracted national attention for its bottom-up planning approach and unwavering persistence. Through these and other mechanisms, DSNI has the honor of being the only CBO in the country to have gained eminent domain authority. This power has allowed DSNI to promote redevelopment of the *triangle* and maintain the character of the community.

Having just celebrated its 20th Anniversary, DSNI is currently looking for additional ways to address the ongoing issues and concerns in the neighborhood in accordance with their mission statement,

> *To empower Dudley residents to organize, plan for, create and control a vibrant, diverse and high quality neighborhood in collaboration with community partners*[1]*.*

In order to achieve their mission, DSNI has placed their strategic focuses on three main areas:

- Community Economic Power
- Resident Leadership
- Youth Development and Opportunities

At the initial DSNI-Sibley Consulting team meeting on September 10, 2004, the DSNI staff reviewed the initial goals that had been discussed with the former DSNI IT/Mapping Liaison to make sure that the same goals were identified and that the desired deliverables were required. With these initial strategic focuses in mind, Sibley Consulting posed a few initial questions to aid in developing the framework and scope of the project:

- *How can GIS and other technologies serve as tools to help DSNI meet their goals and objectives?*
- *How can these technologies be sustainable in the long term? Namely, what resources and education should be made available so that DSNI would be able to create, maintain and use data internally?*
- *There has been a split between the "data-driven" planning approach and the "user-driven" planning approach. How could these two methods supplement one another instead of alienating one another?*

[1] www.dsni.org

- *What type of mapping and analysis would help DSNI to better understand trends and issues facing its constituency, and from there make the best possible informed decisions to help meet its goals and objectives?*

- *What future collaboration would be necessary to make a comprehensive and sustainable project that would continue to be a benefit to DSNI, the City of Boston, and also serve as a model for other CBOs in the future?*

Based upon the responses to the questions posed and after reflecting upon this preliminary meeting with DSNI and the data partners within the City of Boston and Metropolitan Area Planning Council, Sibley Consulting developed a project plan proposal highlighting the main objectives and priorities. The project plan not only considered these needs but also focused on what the impending needs would be after our 3-month project ended. The preliminary plan identified the following three main objectives that tie into one of DSNI's three strategic focuses - *Community Economic Power*. These objectives are:

1. To provide DSNI with information about GIS and the potential benefits it has to offer community based organizations;

2. To provide GIS based analysis of housing and economic development trends in the Dudley neighborhood, and

3. To design an organizational structure for the extensive data resources that DSNI can incorporate into a GIS format.

The team then laid out a strategic plan to accomplish each of these objectives. The primary objective was to identify existing resources that would foster greater community participation and understanding on the uses and applications of GIS in a neighborhood context. In order to accomplish this, the team:

1) evaluated *CommunityViz*, a community visualization and assessment tool;

2) provided resources to better understand the uses and functions of GIS;

3) evaluated *WebSurveyor*, a web-based survey analysis tool for completion of a Community Technology Survey;

4) identified other reports and analyses completed on DSNI by compiling an annotated bibliography of DSNI historical documents.

The second objective was carried out through an extensive series of mapping and analysis. The team put together over 30 base maps, a selection of which has been included here. The three areas in which this process was performed were land use control, including affordable housing, community asset identification and economic development. The *base* maps that are provided in this report are meant to provide DSNI with an idea of the type of mapping and analysis that can be performed by using these to explore existing

condition, identify data failures and update these resources with local knowledge. In the future, DSNI will be in a better position to encourage new investors by monitoring development that has been occurring, how it is affecting land and housing values, and the type of development that would be beneficial to undertake in the future.

The third objective is more extensive than the Sibley Consulting project timeframe would allow, considering that the project was started in September 2004 and completed by the end of December 2004. However, the team has set the foundation for the future design and construction of a comprehensive GIS geodatabase. Initial review of existing GIS data was conducted, as well as additional data mining and the recommendation of a data structure and organization. The creation of the DSNI geodatabase task is expected to be continued by Massachusetts Institute of Technology (MIT) and the Metropolitan Area Planning Council (MAPC) through the Brookings Institution's *Urban Markets Initiative*. The project entitled *"Intelligent Middleware for Understanding Neighborhood Markets,"* (going forward will be known as 'Middleware' project) will take the data provided by Sibley Consulting and incorporate it into a comprehensive database in order to facilitate data sharing between regional, local, and neighborhood organizations. Additionally, MIT planning students will be working closely with DSNI in the Spring of 2005 to expand on the initial mapping project using the base maps and exploring the types of questions that this initial mapping exercise was able to answer.

Although timing limitations posed by the academic calendar is often recognized to be a restriction of the community-university partnership, it is with the effort and dedication of the community and the universities that continued collaboration can be made possible. It is under the direction of Michelle Thompson, *Thompson RE Consultants* and Joe Ferreira, MIT that the scope of this project can be further expanded through continued partnership with the City of Boston Department of Neighborhood Development (DND), Boston Assessing Department the Boston Redevelopment Authority (BRA) and MassHousing.

For further information, please consult the DSNI website (http://www.dsni.org) and the Thompson Real Estate Consulting website (http://www.thompsonconsult.com/projects).

COMMUNITY EMPOWERMENT TECHNOLOGY & THE COMMUNITY CONNECTION

Community Based Organizations and GIS

In recent years, the supply and demand for spatial data has increased dramatically. Unfortunately, the data has failed to reach those who need it most. Some of the nation's greatest challenges are found in communities that lack the resources to make informed decisions that are supported by internal data management information systems. As a result, solutions are often dictated by institutions of higher learning that may have easier access to data, but do not have a complete understanding of local issues. The accepted paradigm suggests that municipal authorities with meaningful data are best able to generate optimal solutions to issues faced by a community to evaluate the 'health and economic vitality' of each neighborhood. Primarily located within *Boston's Empowerment Zone*[2], the Dudley Neighborhood has the opportunity to demonstrate the *power of place* in the manner of its residents' choosing.

Since most information has a geographic component, community based organizations that know how to acquire and interpret such data are better equipped to make strategic planning decisions. Simply, *geographic information systems* (GIS) is a tool that allows the user to maintain existing data and create new datasets that could not typically be displayed or analyzed within the same venue due to incompatible data structures. It is critical that the Community Based Organization (CBO) understand how to acquire, maintain and create data, as these are major factors that are taken into account during decision-making process. GIS is now seen as a way to 'level the playing field' whereby citizen planners have the types of information and systems that would create an environment where the community planning process started 'on the street' instead of in city hall.

Other forms of technology are important for the CBO to maintain as well. Having modern word processing, spreadsheet and database capabilities will greatly complement GIS. These have the ability to provide more in-depth analysis for the organization at little additional cost. DSNI currently already has these capabilities, and should have little trouble integrating GIS technology into their regular business activities.

INTRODUCTION TO GIS & COMMUNITY RESOURCE CENTERS (BASIC CONCEPTS)

A Community Resource Centers (CRC) is a *virtual or place-based organization that supports and encourages the use of technology by community based organizations.* CRCs have evolved from *information centers to information conduits* where information

[2]The City of Boston Empowerment Zone: http://www.ezinfo.org (12/31/04)

is dispensed through a wide variety of technological mediums. The main goal of a CRC is to provide *technology access, resources, support, training and education* to CBOs[3].

CRCs provide their neighborhood partners with an integrated solution to the multitude of issues that they face. CRCs serve as a framework for cooperation among all stakeholders, and allow for the development of effective solutions that will satisfy the greatest number of people.

GIS can serve as an important service that community resource centers can offer. If made accessible to an informed citizenry, it can offer a powerful tool for residents to generate their own solutions to questions that require a geographic component. Since the variables that GIS can help analyze do not exist independently, additional information located at these centers can help provide a more comprehensive view of the neighborhood. They also provide a forum for residents to exchange information for common benefit.

GIS BASICS – AN INTRODUCTION TO GEOGRAPHIC PROBLEM SOLVING

As part of the overall goal of the CBO management strategy, the desire and design of incorporating technology must be based on how this technology can answer 'critical questions' which reflect the needs of the community and are supported by obtaining relevant and valid data that will provide the answers. Each neighborhood will have to tailor questions that must be addressed based upon the neighborhood's individual needs. While there are similarities between neighborhoods that can offer convenient starting points for asking informative questions, these similarities alone cannot capture the nuances that help establish sense of place. Therefore, each question needs to be asked by the community individually and should reflect a *Strengths, Weaknesses, Opportunities and Threats* (SWOT)[4] analysis. These questions are typically based on the commonly held values that each resident stakeholder has.

However, these questions need to be balanced against the priorities that the neighborhood decides upon and those that are imposed from the outside. For example, a community could value both environmental remediation and historic preservation. However, funding is only available for cleaning up hazardous waste sites. A community in this situation would have to refine their questions to reflect the financial environment or, if there is sufficient support, lobby for the lower priority historic preservation funding as well. These are all factors for the community to take into account when developing questions.

A potential way to gauge public support for the identified areas of concern is through the use of web services. *WebSurveyor*, an online survey tool, provides a survey design medium that allows control over the format, design and delivery of qualitative and quantitative surveys. A further way in which one could involve and educate the public is to deploy an internet mapping service, such as ESRI's *ArcIMS*, and encourage the public

[3] Morales, Xavier and Michelle M. Thompson, *What is a CRC and Why is it Needed?*, internal memorandum dated 6 April 2004. *Thompson RE Consultants.*
[4] SWOT Community Planning Analysis: http://ctb.ku.edu/tools/en/sub_section_main_1049.htm (12/31/04)

to use it. To determine what topics the public is most interested in, the CBO could then gather statistics from surveys, as well as tracking the number of views that each online map receives as a first step. This would help the CBO focus its efforts in directions the public is most interested in. It is important to understand the implications of self-designed surveys and the inferences made when using the results. These issues have been explored in the *Web Surveyor Review* found in the appendix.

What answers require geographic solutions?

Once the community determines the questions for which it would like answers, the next step would be to decide which questions require geographic solutions. Primarily focusing on those significant geographic factors will reduce the amount of data acquisition; creation and interpretation required and allows the community to use its own resources most efficiently.

One major factor that requires a geographic solution is zoning. Zoning laws guide certain types of development to areas where the community feels it would be most beneficial. The "Dudley Mile" Zoning Map (See Appendix-Fig. 2) is a reflection of the community's desire for a commercially vibrant stretch of Dudley Street. A familiarity of this map and similar information will allow the neighborhood to most effectively revise its choices when it feels it is prudent to do so. A limitation of this map is reflected in the overabundance of residential parcels along a primarily commercial corridor. This map can be used by DSNI to research the most recent source for land use provided by the zoning, identify any changes recommended as part of the '*Roxbury Strategic Master Plan'* that is currently being proposed and cross-reference this with any allowable uses or updates made by the DSNI land trust, Dudley Neighbors Inc. (DNI)[5].

While zoning information indicates what is legally permitted in an area, maintaining a comprehensive picture of the development trends of the neighborhood will allow the community to direct its future development. While the parcel information may appear abstract to the GIS technician at City Hall, members of the community own many of these parcels. Combined with existing relationships within the community, these data provide the basis for collaborative action in shaping the direction of the area.

DSNI has sought to raise the standard of living within the community by encouraging residents to take ownership of their neighborhood. The success of this idea is supported by the considerable increases in the assessed residential land values within Roxbury over the period 1994-2004 (Appendix-Fig. 3). These data can encourage a sense of progress and vibrancy of community and can also indicate which areas require more targeted attention.

[5] Dudley Neighbors Incorporated: www.dsni.org/DNI

Demographic data is also an important factor in local decision-making. The information can help the community determine, from a quantitative perspective, which neighborhoods require the most assistance and what type of assistance would be most beneficial. Combined with powerful local knowledge of the community's needs, socioeconomic analyses can be a potent tool for affecting change. Examples of how demographics can be portrayed visually to aid in the decision-making process were provided.

A series of maps were created that provided indicators of business investments in the DSNI service area. These maps are an example of mixed methods analysis where land information (e.g. parcel data) can be combined with select commercial variables within census tracts (e.g. in this case stores but could use socio-economic features). An example of this multi-level and mixed methods analysis is provided in the appendix under the heading *Map Creation Step-by-Step: Population within 'Dudley Mile' _ mile buffer*.(Appendix- Fig. 1)
For further information and examples of how to identify the different questions that GIS can answer, as well as the functions that could be used to answer these questions, please refer to ESRI's *Getting to Know ArcGIS Desktop for ArcGIS 9*, which is included in the library of books that ESRI has donated to DSNI.

GIS RESOURCES AND REQUIREMENTS

Once the community has determined which questions require a geographic solution, data is needed that contains relevant information and the software to process it a meaningful way. Several options are available to help meet this need, although they vary in utility.

Data

Internal

GIS data developed by the CBO can be a cost-effective means of collecting information about the community. Organizations can create data in a number of traditional GIS formats. These data may be derived from existing datasets or field-collected by available staff or through community service learning projects (similar to the project completed by Sibley Consulting). If the organization desires to field-collect original data, investing or borrowing appropriate global positioning system (GPS) technology would be required. A sample project would include a survey of 'informal parks' that are part of the community fabric but are not identified as 'community' parks by the city planning departments. These informal parks can be added to the existing 'park' database to encourage the planning departments to include these in their neighborhood maintenance plans or adopt them as part of the neighborhood 'green' project. While GPS units with high accuracy (up to around 1 inch) typically cost thousands of dollars, those with accuracies of around

10 feet are available for costs in the low hundreds. Which option is best is for the community to decide.

Developing internal data sources is an important first step towards taking ownership of the data. Based on local knowledge and expertise, internal data offers multiple advantages for the CBO. Since the study area is in close proximity, data can be field-checked and updated as frequently as desired. In addition, the CBO has maximum control over data collection methods and maintenance. These data can also be customized to fit the organization's particular needs. These data may also be integrated with existing databases with GIS data.

While an extremely valuable component of any CBO is the GIS data repository, there are also several disadvantages. Collecting accurate, useable data in the field is extremely expensive and time-consuming. Unless otherwise desired, field data collection should take place only when there is a surplus of time and financial resources. Also, internal data should be harmonized with commonly accepted standards for collection and presentation so that it may be used interchangeably with external data and distributed to others. Care should also be taken that field-collected data supplements, but does not merely duplicate existing sources. Also, CBOs should be familiar with data creation and maintenance standards that are applied to *metadata*[6] (or 'data about data' and are encouraged by the Federal Geographic Data Committee.

Free and Government

Thanks to taxpayer and consumer subsidies, free data is available from government and private sources in a number of traditional GIS formats. Under President Bush's *E-Government Initiative*, the website www.geodata.gov has become the nation's official portal for geographic information at the Federal, State, Local and Private levels. For the information at the Commonwealth level, MassGIS (http://www.mass.gov/mgis/) is likely the best source. At the City level, the Boston Redevelopment Authority's The Boston Atlas (http://www.mapjunction.com/places/Boston_BRA/) provides a source of local information. The Environmental Systems Research Institute (ESRI) (www.esri.com) also provides limited free data through *ArcExplorer*[7].

Free and government data can provide communities with a cost-effective way of obtaining critical information. Since many government agencies use these data, most of them are relatively reliable and available. Since free data often receives wide use, compatibility with other organizations is enhanced. Free data often features more generous usage rights, which allows for enhanced maintenance and dissemination.

While sometimes beyond the scope of many CBOs, some government data is also available for a nominal fee. This applies mostly to remote sensing imagery, which typically is useful over large areas. Data available through ArcIMS is often not available

[6] Federal Geographic Data Committee: http://www.fgdc.gov/metadata/metadata.html, 12/31/04
[7] GIS data from ESRI: http://maps.unomaha.edu/Workshops/Career/ESRI/index4.html (12/31/04

for download, but usually an arrangement can be made with the service provider. Free data also can have errors that can require a substantial investment of time to correct. Funding deficiencies and homeland security concerns can also restrict data availability. While the nation is currently engaged in upgrading our geospatial capabilities in support of homeland security, it can sometimes hinder public access to potentially 'sensitive' data. This problem can usually be overcome by contacting the responsible agency.

Software

ArcGIS 9.0

GIS software such as ESRI's *ArcGIS 9.0* is one of the standards for GIS technology. It provides a means for the display, maintenance, manipulation and creation of geospatial data. ESRI also has some of the most extensive training programs available and holds a worldwide market. ArcGIS is also scalable, allowing the CBO to only invest in the functionality that is considered most important. *ArcGIS* is also well supported, which allows for the rapid resolution of technical problems.

While there are several sources of funding available to municipalities and CBOs to develop GIS capabilities including ESRI, *TechSoup*, CRCs and other community technology advocates including private donors. While the current market requires that the CBO have at least one ArcGIS-capable machine, the community will have to decide whether additional licenses are required and if less expensive options are satisfactory. The investment in a GIS should be considered a long-term investment of time, money and capacity building. Since DSNI had already made an initial investment in ESRI products, and additional software and maintenance support was approved, Sibley Consulting used this platform to continue the project and considered this the best alternative for ongoing GIS services.

EMPOWERMENT THROUGH DATA COLLECTION AND MANAGEMENT

Introduction to Data Structures

ArcGIS uses two primary data formats, vector and raster. Each format was developed to model certain groups of features, and discretion is required when selecting the proper data structure.

Vector data is typically represented by points and lines. These may take the form of point, line and polygon data. Point data is best suited for situations where only the location, but not extent, of the data is known. Line data best represents features such as infrastructure components such as transportation and utilities. Polygon data best represents features such as assessment parcels, where the location and extent is known. Vector data can also

contain an attribute data that includes detailed information on the features. These data can be exported to data analysis programs.

Raster data is typically represented as a regular grid, with each grid space having a discrete value. These data are typically best suited for representing features with fuzzy boundaries, such as land cover. Urban applications for raster data are typically limited to digital aerial photography.

Whether the data is displayed in a raster or vector format, ArcGIS has the capability to display a wide variety of data into map layers that can be evaluated discretely or between the various themes. A query might include the number of business locations that are in close proximity to public gardens with a teen population reaching at least 60% of the total demographic in walking distance to a 'T'-stop might be a prime location for a pizza shop. This kind of business or marketing analysis can easily be done on a desktop GIS given access to current accurate data.

Non-profit Information Management

Non-profit organizations are in a unique position to lead the geospatial information community over the next few decades. Substantial computing power and storage is available at relatively low cost. The organization is also located well within its 'study area,' which allows it to update its data as change occurs.

To be most effective, the organization should develop a *community information database management system* (CIDMS)[8] that allows it to most effectively answer its community's questions. ESRI's *ArcCatalog* offers an excellent system for organizing geospatial data. Data can be grouped into categories that are meaningful to the community. Associated metadata, or data about the data, details the properties and limitations of the information. The system can also integrate some elements of local knowledge, so that institutional memory can be preserved. Information on data maintenance can also be included, so that the process can be consistent.

The *personal geodatabase* lends itself well to this system, as it will allow the organization's data to be organized in an accurate, consistent way. The study by Kheir Al-Kodmany[9] details the experiences of three communities in the Greater Chicago area. They found that GIS enhanced their residents 'abilities to make informed judgments about the direction of their neighborhoods. A community that has more information at their disposal should be more confident to hold local power structures accountable and increase their political strength within their communities'.[10] While DSNI has clearly

[8] *Community Information Database Management System*: term coined by Julienne Chen which refers to the DMS provided for DSNI.

[9] Al-Kodmany, Kheir. Extending Geographic Information Systems to Meet Neighborhood Planning Needs: The Case of Three Chicago Communities. URISA Journal. http://www.urisa.org/Journal/protect/vol12no3/al-kodmany/al%20kodmany.pdf#search='Kheir%20AlKodmany%20'

[10] Ibid;

been able to attain its current status without GIS, augmenting the power of their positions with data, which they control and maintain, has the potential to reduce the time of debate, saving valuable resources that could be better used for other community, needs.

As with any process, the information management system should be evaluated periodically to ensure its proper operation. The community should also assess the system's ability to address its questions, as well as anticipated concerns. One of the most affirmative, and critical steps in this process is the design of the GIS database that is explained in the next section.

DEVELOPING A WEB BASED TOOL FOR DSNI

The DSNI/Cornell partnership is the first step in the development of a web based GIS tool such as NKLA for the Dudley community. With this document we will provide DSNI with the information they need to start thinking and organizing data spatially, while providing data resources and mapping examples so that the mapping process can begin immediately. Through this collaboration, DSNI will collect the resources needed to begin a database design program. However, it is important to remember that, the first priority should be to concentrate on building internal resources through a database development program, and integrate the technology into the community planning process. By first integrating the technology into the planning process and business functions of DSNI, more community support and input and thus deliver a much better product.

COMMUNITY BASED GIS DATABASE DEVELOPMENT

DSNI is a community planning organization that is actively involved in evaluating and monitoring the social, economic and physical development of their community. These activities require an enormous amount of information that is generally in the form of administrative or public records. Increasingly, public information is becoming more readily available on the internet and through subscription with data providers. However, in order to be useful, this administrative type data needs to be reinterpreted and cross referenced with local data before its meaning can be ascertained.[11] MIT has proposed an "intelligent middleware" software program that would serve as an intermediary to combine these administrative data sets with local knowledge.

Through this process, the "intelligent middleware" can construct a set of indicators that can be used autonomously by DSNI to conduct analysis on the Dudley neighborhood markets. This partnership will provide DSNI with an opportunity to align themselves with data providers and to further explore the possibilities that GIS has to offer. In an effort to both encourage internal spatial database development this document is also intended to help "prime" DSNI for this partnership with MIT. To accomplish this, the remainder of the report is dedicated to outlining the basics of database development and

[11] Ferreira, Joseph and Marc Draisen, *Intelligent Middleware for Understanding Neighborhood Markets."* web.mit.edu/11.522/www/discussion_ notes_f04/mit_umi_04jun02_pub2.pdf

design. A database design program is a demanding process, but a well-designed database program has many benefits, including maximum utility for its users.

FROM CONCEPT TO PRACTICE – CREATING A DATABASE DEVELOPMENT PROGRAM

In this section some basic principles of database design are highlighted to lay the foundation for the discussion of a geodatabase, including how spatial information is stored and how relationships and *behaviors* can be assigned to geographic features. This is the defining feature of a geodatabase model. An understanding of the basic concepts of database design and management will help inform DSNI as to how data can be translated into space and how relationships can then be defined between spatial features. The design process allows DSNI to formulate more specific ideas about the type of relationships they are interested in looking at and developing into neighborhood indicators. This section is intended to highlight the technical language and concepts that DSNI will need to be familiar with to realize database design program. It will also provide real examples using Dudley Neighbors, Inc. (DNI) data and other public resources to illustrate some of the various applications of GIS.[12]

The basic structure of a relationship database will be discussed here before examining the geodatabase in closer detail. Many of the concepts defined here will be review for those who have worked databases in the past. In this case, the purpose is to refresh one's memory of relevant terminology and illustrate how the basic relational database concept forms the foundation for a geodatabase. Using the DNI land inventory as an example, we will explore these concepts and discuss the process of transforming a two-dimensional database into a three-dimensional spatial database format.

In addition to providing context, this section is also designed to highlight important considerations related to the development, management and organization of spatial data that is specific to DSNI. There are a number of other useful resources available to DSNI that can help inform this process, many of which can be found throughout this report, as well as in the appendix.

SPATIAL AGGREGATION AND LAYERING

The benefit of storing data in a spatial format is that parcel data, for example, can be related to other datasets through larger locational features, such as census tracts or zip code boundaries. It can also be related to smaller details, such as building footprints and points to represent physical features such as trees or park benches. The sub-parcel image above shows what data is available in the attribute table. Should DNI want to maintain the additional data sources at the sub-parcel level this is possible by creating the data structure locally. Given available parcel data from other resources, it is not always

[12] Dudley Neighbors, Inc. is a community land trust in the Dudley neighborhood. For more information, please visit their website at http://www.dsni.org/DNI.

necessary, or even desired, to maintain detailed databases unless the information is absolutely critical.

Most information can be combined together as a series of layers so long as they share the same coordinate system. For example, most city governments do not maintain detailed land use inventories at the parcel level. This is because the amount of detail required for such a database and the high level of maintenance necessary to keep it updated is usually far greater than the benefit of storing the data. Furthermore, the City of Boston can obtain data on land uses through other sources, such as business licenses and zoning records.

As illustrated above, and in the Dudley mile example, data aggregation at varying levels of collection, display and analysis can produce results that engage a community in a compelling manner. A spatial database can be simple and accurately automate time series data to accommodate more complex behaviors and analyses. A higher level of aggregation means that likely more detailed information will need to be collected and maintained. Defining the level of aggregation to store data resources should reflect the need for the analysis, produce maximum results and ideally require very little maintenance at minimum cost.

RELATIONAL DATABASE STRUCTURE

A *relational database* is generally constructed with a primary table that holds the primary unique identifier (called a *key field* in ArcMap) that forms the basis of the relationship. For example, the tables below use the DNI land inventory as the primary table and relates it to other tables with information about the parcel. There are two main types of relationships: a "one to one" relationship exists when the primary record has a relationship with only one other related record (see Figure 1); a "one to many" relationship exists when the primary record has a relationship with several related records (see Figure 14). These relationships represent the basic structure of a relational database. It was a critical part of the project to have the Community advocates and Citizens understand how the City of Boston Assessors office was currently using the database structure since new parcels were being created by DNI. Prior to this project a comprehensive and accurate list of all DNI properties was not available.

Figure 1: An example of a One to One Relationship

PID	STREET	OWNER	DEVELOPMEN	YEAR_PURCH
0800123000	606 DUDLEY STREET	DNI OWNERSHIP IN PROGRESS	Dudley Village	In Progress
0800124000	604 DUDLEY STREET	DNI OWNERSHIP IN PROGRESS	Dudley Village	In Progress
0800125000	602 DUDLEY STREET	DNI OWNERSHIP IN PROGRESS	Dudley Village	In Progress
0800126000	600 DUDLEY STREET	DNI OWNERSHIP IN PROGRESS	Dudley Village	In Progress

	Unit Type	Affordable Housing Term	Year Enacted	Expiration
0800126000	Apartment	15 Years	1997	2017
0800126000	Apartment	20 Years	1998	2018
0800126000	Apartment	30 Years	2000	2030
0800126000	Apartment	30 Years	2000	2030

The relational database model is a flexible and convenient way to store and analyze data. One of the goals of this project is to provide some examples of how DSNI can upgrade their existing data sources into a comprehensive spatial database. DSNI can begin by organizing existing data sources that can easily reflect spatial features such as the parcel, or by editing existing building footprint data. In this way, DSNI can identify the advantages a spatial database provides through representations of geographic features. As previously mentioned, different features in the same extent can be displayed together for further analysis. In the next section we will take this concept one step further and examine how spatial features can be programmed to have *behavior* to represent real world relationships and networks.

GEODATABASE BASICS

In the first section of this chapter, some of the basic concepts, techniques and terminology associated with GIS were outlined. This section provides DSNI with the basic concepts and terminology necessary to understand the basic principles of a geodatabase model. In addition to this we highly recommend the following book which helped inform a great deal of this section: *Modeling our World: The ESRI Guide to Geodatabase Design*[13], by Michael Zeiler, which was published and has been donated to DSNI by ESRI. This is a very user-friendly reference piece that explores the structure, application and design of a geodatabase in detail. While DSNI does not need to become experts in creating a geodatabase, the organizational power of a geodatabase and how behaviors can be created and modeled to reflect the real world.

A geodatabase can be created very simply and increase with complexity only as needed. The geodatabase can therefore provide DSNI with a data model that will allow the flexibility to choose the scope of the program, whether it is a GIS program intended for internal uses only or a comprehensive database that can be placed online and accessed via the internet. The lessons DSNI learns working with the 'middleware' project can also be applied to the development of internal resources and capacity, in addition to building important connections with the individual data providers.

A geodatabase can be designed to identify relationships and networks between various geographic objects. For example, each parcel is assigned a land use. A geodatabase could be programmed to recognize relationships to the land use. Therefore, if a development to build a commercial building on a site zoned for residential land use was approved and entered into the database, the geodatabase would identify this anomaly. The land itself, the type of zoning and the activity that occurs on the land are all geographic objects that are tied together. Ownership data is also an example of a geographic object. There is a feature for each *objec*t in the table.

DSNI need not be concerned about the technical details of geodatabase format at this moment. The resources to learn more about the geodatabase are very extensive, and can better inform DSNI about the technical aspects of creating a geodatabase. A basic

[13] http://gis.esri.com/esripress/display/index.cfm?fuseaction=display&websiteID=27&moduleID=0

understanding of the "smart" functions that a geodatabase has to offer in addition to providing an excellent format for storing data, with local knowledge will produce a divine and holistic tool for sustainable neighborhood planning.

MAPPING SECTION

This next section highlights maps that were created by Sibley Consulting to illustrate some of the *economic development* principles that result from creating data partnerships, increasing data organization, and continuing data management. These maps are intended to serve as examples of how DSNI can approach the development of their own GIS and define relationships between geographic objects.

Creating a simple spatial dataset

In a spatial context, datasets with different levels of aggregation can be combined with one other if the boundaries or locational relationships are appropriate. This can be illustrated, again using the DNI land inventory as an example. At the parcel level, DNI maintains information specific to the parcel such as year purchased and development type. The maps following in the appendix illustrate some of the information that can be collected at the parcel level to create a basic, but useful dataset. However, although the dataset itself was simplistic, the development of the DNI land inventory is much more complex, due to the many steps of verification that were required to create the database.

DNI land by development and year purchased

From examining the maps on the next page, one can see that there are some spatial relationships between parcels in terms of the year they were purchased and their development type. These are examples of different types of analysis that can be done with a primary table. Since all of the information is collected by tax parcel data can be stored in a single table. The sample maps were created using internal DNI sources and are an example of how existing DNI data can be transformed from a two-dimensional database into a three- dimensional spatial database.

APPENDIX: SAMPLE MAPS

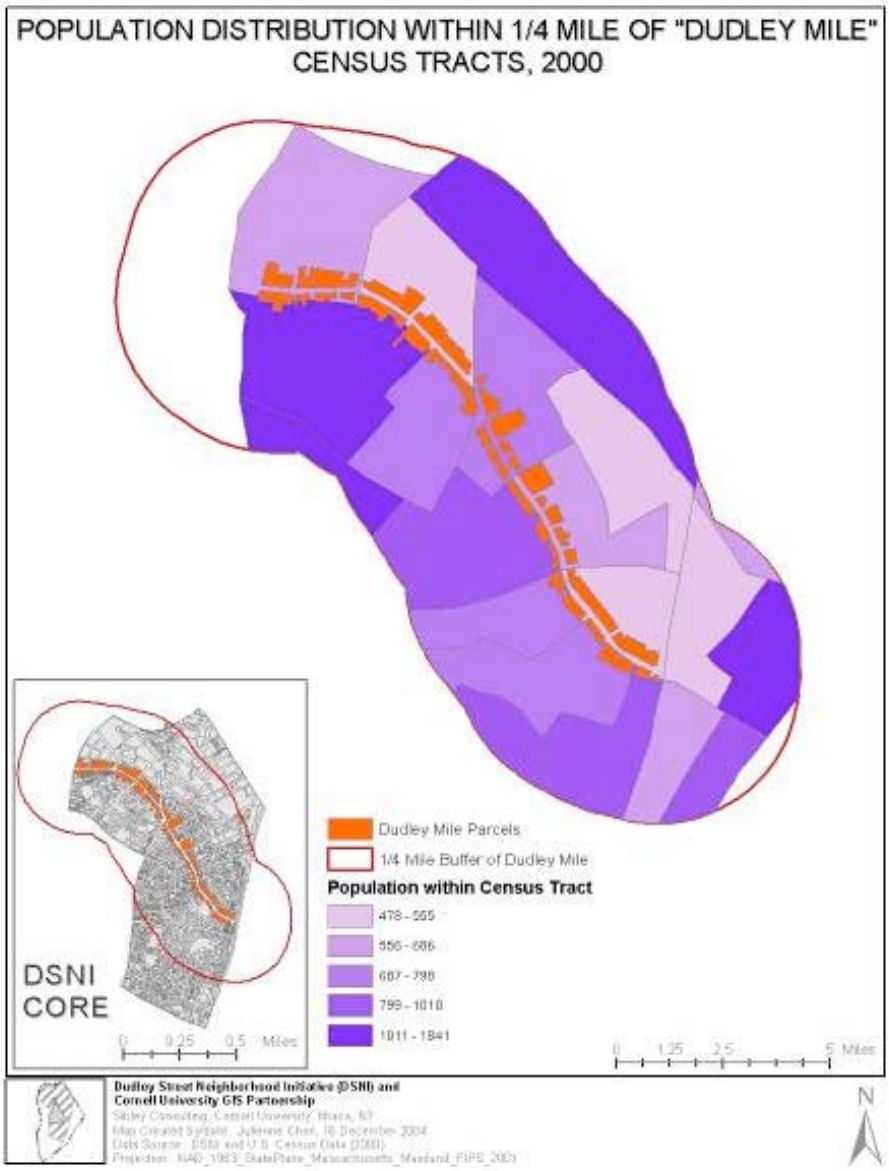

Figure 1: Population within 'Dudley Mile' _ mile buffer helps to show the different population distributions in relation to the commercial corridor within the DSNI neighborhood core boundary.

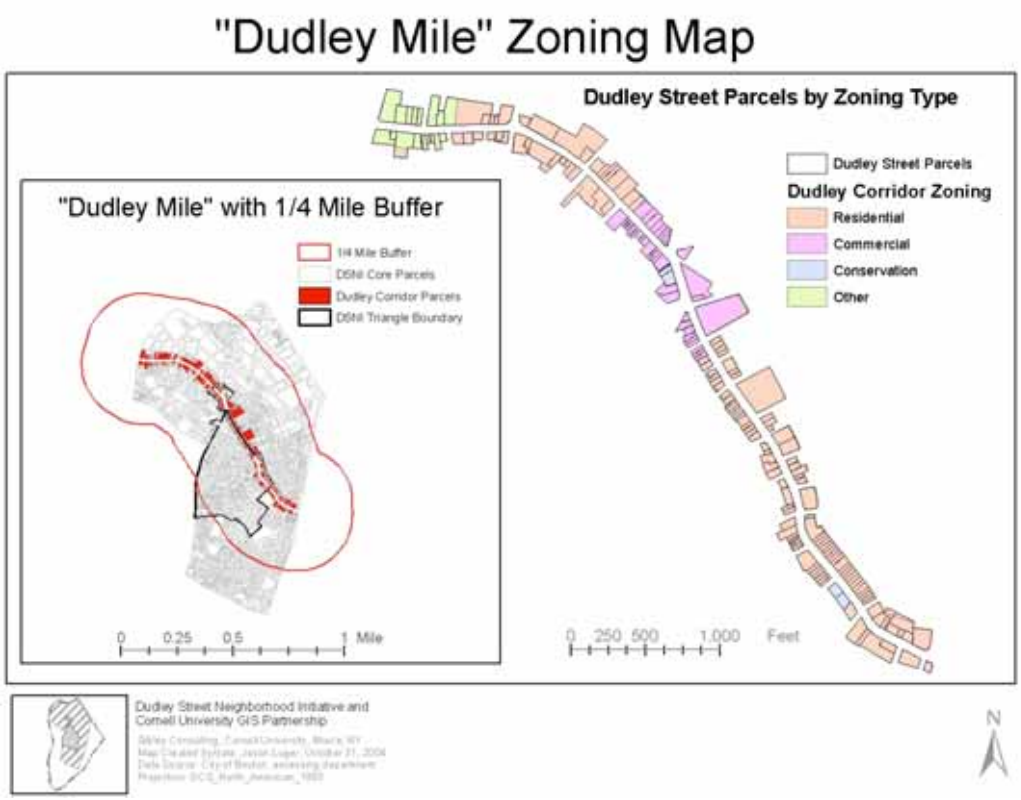

Figure 2: This map shows the zoning of each parcel along Dudley Street within the "Core." There is also an inset with a larger picture for geographical reference.

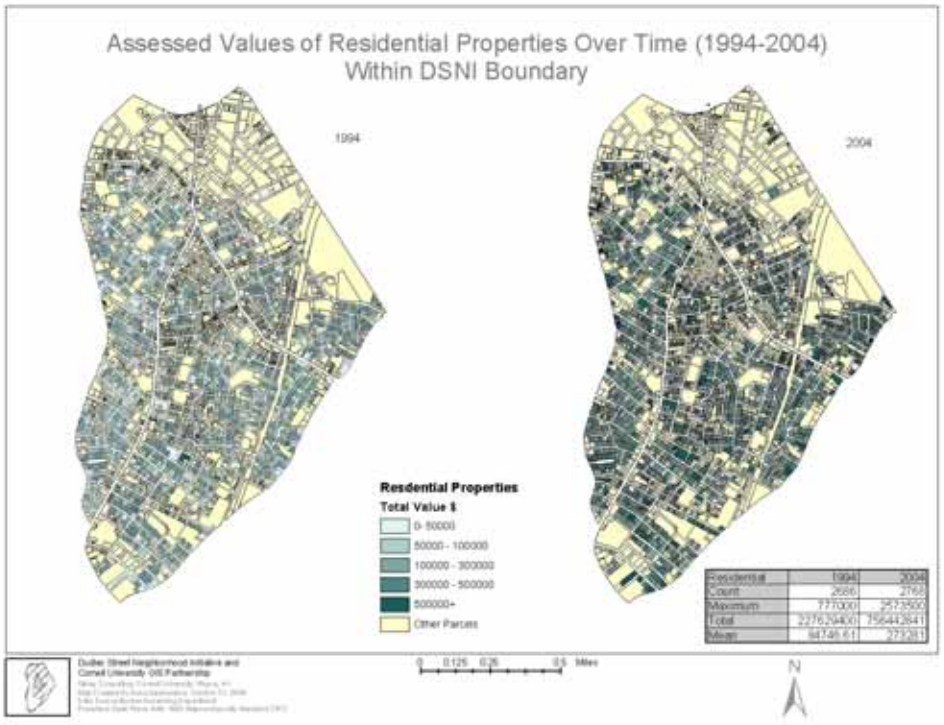

Figure 3: The following map shows the changes in assessed values of residential properties over time.

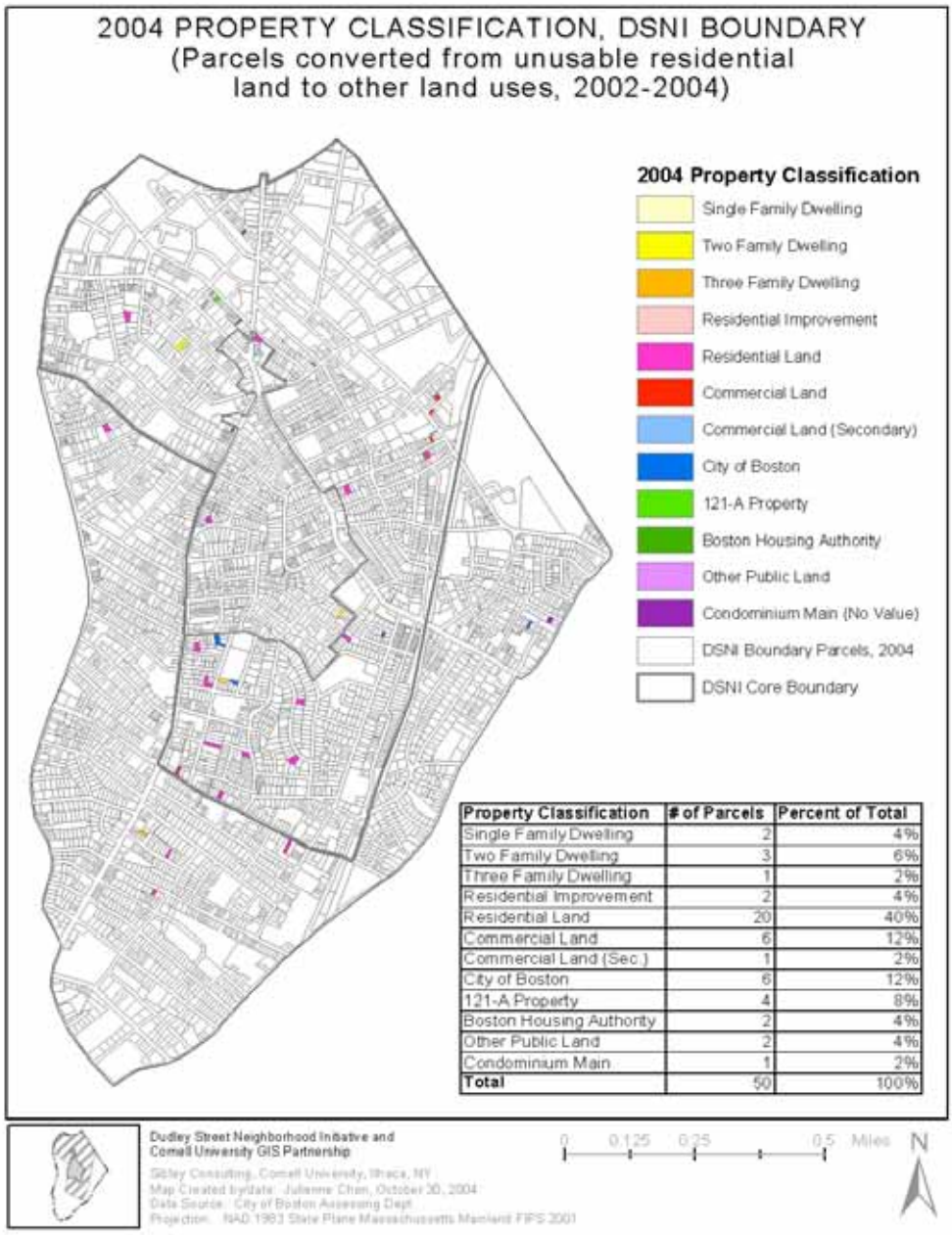

Figure 4. This map shows all parcels that were classified as unusable residential land in 2002 (Property Classification Type 132) and have since been undergone rehabilitation to be converted to a different use. The parcels on the map are classified by their 2004 land use to show to what use the parcels have been converted