Introduction

School districts are often faced with difficult facility planning decisions resulting from consequences beyond their control. Often, school districts are the last to know about any land use changes in their community. This is especially true in high-growth areas where new residential development is difficult to track.

Mason City Schools in Mason, Ohio is a prime example of a high-growth district faced with numerous growing pains. Not only did the district have to find a way to accommodate the large influx of new students each year, it also had to find a way to strategically project when the growth, and consequently the enrollment would slow.

A comprehensive land use study was developed for Mason City Schools, resulting in the district having solid, accurate and up-to-date planning information at their fingertips. The district is now well equipped to participate in planning efforts. From a planning perspective, local officials should make an effort to include public school district administrators in their decision-making process and collaborate with their district as much as possible. The more up-to-date and comprehensive information a district has, the more beneficial the relationship can be for all stakeholders involved.

What is GIS?

A Geographic Information System (GIS) is a collection of computer hardware and software, geographic data, and personnel designed to capture, store, manipulate, update, analyze, and display all types of geographically referenced information (Kennedy, 2001). By visualizing the geographic arrangement of multiple layers of land use and demographic data, district officials can see pockets of growth and new development, environmentally sensitive areas and other dynamically changing areas throughout their district. Ultimately, administrators can make more informed decisions backed by readily available demographic and land use data.

GIS technology can be used in many capacities in the educational planning sector. GIS can be created to analyze student placement and attendance boundaries, redistricting needs, effects of new housing development, district-wide master planning and site-specific feasibility studies. Additionally, GIS can be used in school districts for emergency management, transportation routing and building maintenance.

A GIS also becomes extremely useful when conveying information to various audiences. By using GIS, administrators can present a large amount of statistical information in a visually pleasing way to their school board, parents, teachers and the media (Bruno, 1996).

What is a Build-Out Analysis?

The main assumption of a build-out analysis is that development will occur on all undeveloped, available land. This in-depth analysis can be a very functional tool for creating a “best-guess” scenario building identifying potentially problematic development situations before they arise.

There are two phases to a build-out analysis. The first phase involves mapping different assumptions of development patterns to identify possible future scenarios. In this phase, especially aided with increased efficiency and visualization capabilities of GIS, decision makers can visually identify land use consequences before they occur. The second phase quantifies the impact of land use and demographic changes. Such quantifiable changes can include: the number of new single-family and multi-family units, number of resulting new resident school-age children and the associated type and acreage developed.
From a practical standpoint, developing a build-out analysis using GIS can maximize the spatial arrangement of data to provide more effective and efficient planning. Incorporating GIS tools in the build-out analysis can dramatically increase the level of detail. A GIS can also integrate multiple layers of data from different sources and can overlay the information in a meaningful way.

**How a GIS-based Build-out Analysis Can Help School Districts**

Typically, school districts are the last to know about local land use planning decisions. Instead of being involved with the planning from the onset, decisions are made and districts are forced to absorb the impact of new development and the associated consequences. School districts rarely have the opportunity to adequately plan for future transportation, redistricting or master planning needs.

By conducting a build-out analysis, districts can proactively plan for an influx of students and develop better projections based on the most recent data on the surrounding growth and future development potential. Coupled with GIS capabilities, a build-out study can be used to analyze all known demographic and land use data within a district's boundary. For example, using U.S. Census Bureau data and local data on housing starts, a district could easily plot average household size and total housing yields by census tract and compare results to student composition in the same area. This type of detailed spatial analysis of previously tabular data can give the district a strong visual representation of the community. All of these GIS methods can be used independently or collectively to help create a more complete picture of a district's changing needs.

**A School District's Response to Growth**

**A Case Study in Mason, Ohio**

Mason City Schools, situated in Warren County, Ohio is a prime example of a district responding to overwhelming residential development. Positioned as a suburb of Cincinnati, Ohio and similar to other white-collar communities on the urban fringe, the City of Mason has been experiencing tremendous growth over the past 15 years. Warren County, Ohio is one of the leading counties in the nation for both commercial and residential growth (Mitchell, 2001).

**District Concerns**

From what used to be a small-town farming community, the City of Mason has grown into a fully competitive municipality targeting high-tech companies, corporate headquarters and light industry (City of Mason, 2001). The population has nearly doubled in the last 10 years, increasing from 11,452 in 1990 to 20,016 in 2000 (Ohio Department of Development, 2001).

Not surprisingly, the district's enrollment has mimicked the surrounding development, growing steadily over the past 15 years. Total district enrollment for the 2001-2002 school year was 7,352, a 156% increase from 2,866 in 1992. As a result of such growth, the district faced numerous problems. Although the district maintained good cohort-survival projections, administrators realized what was missing: the much needed housing and development component of the enrollment projection analysis.

In this study, district enrollment projections were based on a cohort-survival method, but, unlike typical enrollment projections, they also incorporated housing data from the build-out analysis to reflect the probable future growth of the district. Historic residential permit trends and results from the GIS analysis of undeveloped land were incorporated into the enrollment projections to better reflect the district's growth patterns.

**GIS Development**

The GIS created for Mason City Schools combined base layers such as road and river networks, a zoning layer and a subdivision layer with U.S. Census data, birth data, residential permit data and historical student enrollment. Once integrated into the GIS, administrators could easily see the type and age of housing in which students resided. They could also see areas of the district that would become more populated once new housing was developed.

![FIGURE 1. GIS development matrix for school district planning.](image-url)
Using the GIS, demographic, housing and undeveloped land analysis specific to the district's boundary was possible. The resulting findings were used to maximize the accuracy of student housing yields and projections.

**Undeveloped Land Analysis**

The breakdown of land use classifications and current uses were analyzed. From GIS analysis, the total amount of land within the Mason City School District boundary was estimated to be 16,322 acres. Represented in that total, 6,759 acres (41.40%) were existing subdivisions or other concentrated single-family areas, 5,909 acres (36.20%) were non-residential uses and 785 acres (4.81%) were already slated for future subdivision development. These three types of development accounted for an estimated 13,453 acres, or 82.42% of the land use within the district.

Of the 16,322 total acres calculated within the Mason City School District, it was found that an estimated 2,870 acres (17.58%) have potential for some type of future development. Additionally, 1,824 single-family lots and 846 multi-family units were determined to be available at latest count.

**Results**

Projections were developed to incorporate multiple growth scenarios and demonstrate differences in projected housing across the district. The historic housing figures were analyzed with district enrollment data to develop a total yield factor for the number of school-age children resulting from the district's single-family housing.

The housing yield throughout the district was roughly 0.6 school-age children per single-family house. This data corresponds to national findings. On average, 0.64 school-age children per household result from single-family units built in the 1990s (National Multi Housing Council, 2002). By taking the total number of single-family lots and dividing it by the associated acreage, a density of 1.74 units/acre was derived for single-family housing throughout the district.

The 2,780 acres serving as future residential development was multiplied by the historic density to approximate the number of future single-family lots. This number was then added to the currently available constructed lots. The following calculation shows the actual number of lots that could result from this density:

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(2,780 \text{ acres} \times 1.74 \text{ units/acre}) + 1,824 \text{ available units} = 6,661 \text{ potential new units.}
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Using this total, three single-family housing growth scenarios were developed for the next 10 years:

- High projection - estimating 5,975 units to be built (90% of available land zoned residential);
- Moderate projection - estimating a growth of 4,675 units (representing 70% of available land); and
- Low projection - estimating 3,350 units (50% of available land) to be developed.

The moderate housing projection was found to be the preferred scenario where it was assumed that approximately 70% of the available land would develop into new residential uses within the next 10 years. This scenario also incorporated a relatively slow decrease in the number of new units each year. This pattern is consistent with new residential permit data, suggesting that single-family development appears to be slowing.

Using the moderate figures, results from the projections incorporating housing data show that although the district's enrollment will continue to grow over the next 10 years, the rate of growth would average roughly 4% per year compared to the previous 11% average between 1992-2002.

**Conclusions**

The results of this study have given Mason City Schools much greater local knowledge of surrounding development as well as increased planning power across the district. Relative to national averages, Mason City Schools is a good example of a typical...
high-growth, single-family dominated district. Although new development cannot be stopped, it can be integrated into current plans and effectively managed. Constructing a unique, district-specific study helps emphasize the need for district administrators to be involved in local planning issues. Empowered with this type of land use and future development information, districts can coordinate their planning efforts with the local municipalities and townships.

Additionally, it is highly recommended that school districts take advantage of GIS capabilities and services. Whether the district chooses to maintain a GIS program in-house or out-sources for short-term services, having updated, readily accessible GIS information affords a school district the best possible opportunity for in-depth analysis.

From a planning perspective, the potential for valuable collaboration cannot be overemphasized. Being able to proactively plan for these types of circumstances will prove most cost-effective for districts allowing them to concentrate their efforts on curriculum development and student needs. Including public school districts in local and regional planning efforts is a win-win situation for everyone.

REFERENCES


Ohio Department of Development (2001). *Decennial Census of Population, 1900 to 2000, by Place*. Office of Strategic Research, Columbus, Ohio.

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