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Building Permits Monitor Development

and Land Use Change in Wright County

BUILDING PERMITS MONITOR DEVELOPMENT AND LAND USE CHANGE IN WRIGHT COUNTY

The Wright County Project on Land Use Change and Development Through Building Permits

William J. Craig

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INTRODUCTION

Urban sprawl, loss of prime agricultural lands, incompatible neighboring uses, degradation of the environment, unsafe building sites, leapfrog development, and dissension over paying for public services: these are the kinds of land use issues that are making headlines across the country. Many of these problems could have been averted with proper planning based on an evaluation of current land use patterns and trends.

There is a great need for continued monitoring of development and its impact on land use, yet most land use inventories occur once a decade at most. It was the hypothesis of this study that maps and tables of new development can be prepared from the normal operating files of government. In particular, building permit data can be used to monitor urban type development. If this is possible then the monitoring could be continuous. The emphasis in this study was on urban development. Other types of land use change might be monitored through air photos, satellite imagery, state permits, or assessor records.

Changes in urban land uses tend to be critical for those concerned with the environment. The changes wrought by large nuisance industries, such as mining or power, can be identified with ease, but smaller changes are more elusive. The term "urban land use" does not refer to land in cities or municipalities, but rather, to land uses that we associate with urban areas (such as residential, commercial, industrial, or institutional development) regardless of location. These developments are often scattered so that major land use changes come into being gradually and without warning. This type of development is recorded on a day-to-day basis by building per-

mits. If these permits could be collected on a regular basis, the lands they refer to located precisely, and the information organized for use within existing computer systems, warnings of changes in existing land use could be made early enough to be of benefit.

The only statewide land use map in Minnesota dates from 1969 [38]. This map was prepared by the Minnesota Land Management Information System (MLMIS), then under the Center for Urban and Regional Affairs at the University of Minnesota and now part of the State Planning Agency. Nine categories of land use were noted including two urban categories. The state was gridded into forty acre squares* and each "forty" was classified according to dominant use. If a forty contained a single non-residential urban use, such as a school or hospital, it was classified as "urban non-residential or mixed residential development" regardless of other uses. A forty without a non-residential use, but with five or more residential dwellings was classified "urban residential." These urban land use definitions hold regardless of location. (A full definition of these and other land use definitions appears in Appendix I.)

MLMIS possesses a computer mapping system which can easily map any new development that is coded to locate the change within a particular forty. Furthermore, MLMIS possesses the 1969 land use information so that the impacts of new development on land use can be measured. If it can be shown that building permits do indicate urban development, then MLMIS could map the development on a regular basis for any jurisdiction providing coded permit data. A standard statistical software package, SPSS [43], can be used for summarizing development on a tabular basis.

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*Actually quarter-quarter sections of the public land survey.

Wright County, Minnesota was chosen as a pilot area to test the viability of using building permits to monitor development and land use change. Eight years of building permits from the county were computerized and analyzed: 1969 through 1976. The study was interested in indicating whether historical records can be resurrected and made useful. The principle thrust of the study, however, was to see if current development could be monitored in an accurate and simple manner.

The chapters that follow describe the need for such a monitoring system, how permit data was prepared, how maps and tables were generated from those permits, and what level of accuracy was obtained by using building permits as a monitor of development in the pilot area. The final chapter summarizes the preceding chapters and makes recommendations based on this pilot study.

CHAPTER 1: BACKGROUND

This study was an attempt to determine whether and how building permit data can be used to monitor development and its impact on land use patterns. This chapter provides a background for the study. It first defends the need to have such monitoring and describes the problems with conventional monitoring systems. It then presents the building permit as a possible tool for performing this monitoring function by describing the original purpose of the permit and giving some examples where jurisdictions obtained useful information through ingenious summary reports of building permit data. In order to test the feasibility and costliness of such a scheme, a test area was chosen. The test and the area are described in a closing section.

THE NEED TO MONITOR GROWTH AND DEVELOPMENT

A political jurisdiction is like any other intelligent organism. Its physical makeup and its subjective desires define the type of environment it wants. This ideal environment is spelled out in its land use plan. As with other organisms, environmental changes must be continuously monitored so that negative changes can be avoided or tempered. If negative changes are unavoidable, the organism must either adapt or die. For political jurisdictions, this means altering the land use plan.

A land use plan is one part of a community's comprehensive plan. In it, community goals and objectives are laid out. The plan is usually developed by a planning staff or consultant, but extensive examination and alteration by the public are also necessary before it is adopted. The plan will usually describe the current situation, what a more desirable

situation would be in the future, and the steps necessary to complete the transition. The plan becomes a policy guide for future investment and control.

Without some form of monitoring, it is impossible to enforce this existing policy [42, p. 2]. Just as drivers go over the speed limit where a highway is not strictly patrolled, so land owners may do what they please unless someone is there to stop them. The jurisdiction may have an ordinance prohibiting commercial development in residential areas, but to maintain the ordinance it must be able to stop the development before construction starts. A standard building or zoning permit system serves to control such unlawful development.

Monitoring is also required to assure that desired densities have not been exceeded. The jurisdiction may have a land use policy restricting the density of development in an environmentally sensitive area. Unless it knows how many homes already exist in the area, it will not be able to restrict proposed development. The building or zoning permit system allows for decisions on individual proposals as they are made. But in order to make the proper decision, the jurisdiction must have a clear picture of the current land use pattern. A continually current land use map can only result from an ongoing monitoring system.

Some land use changes are more insidious than others. Individual development decisions appear sound, but the cumulative effect of these decisions may be leading the jurisdiction away from its goals. One planner describes the problem: "Large developments attract a great deal of planning and forethought, but many small development decisions leading to the establishment of long term patterns are handled routinely." [16,

p. 194]. This type of problem can be identified only by looking at trends in development. An ongoing monitoring system is required if these trends are to be identified.

When new or proposed development may be leading a jurisdiction away from its land use goals, planners will typically illustrate the problem by extrapolating current trends (requiring data at least at two points in time) to show that some goals will be lost in the future. At this point the jurisdiction has two options. It can alter its goals and accept the changes as they come or it can try to modify current trends. The latter option is assumed to be the more desirable. New zoning or other controls can be adopted in an attempt to keep development in line with the current comprehensive plan.

The comprehensive plan of a jurisdiction is its means to attain its goals. However, the plan is developed at one point in time to deal with one set of issues and concerns. Eventually the plan must be replaced because either issues or concerns will have changed. "[A] comprehensive plan must be updated in response to a change in the community brought about through recent development." [28, p. 30].

Research is one part of the work that goes into the development of a new comprehensive plan [4]. The staff produces a model explaining existing trends and outcomes given those trends. Alternative outcomes are portrayed with clear statements of how current trends will need to be modified to reach each alternative. Unless the trends can be recognized--through monitoring--these research tasks are impossible.

PROBLEMS WITH CONVENTIONAL MONITORING SYSTEMS

Conventional monitoring schemes describe changes in land use or development, but not both. Remote sensing techniques, including air photo interpretations, are the most used tool. But they are plagued with inadequacies. Government records are useful for other sorts of data, but usually present no information on spatial impacts of the development.

Aerial Photography

Air photos are most often used to measure land use patterns. They usually result in a land use map. Comparing maps from different time periods allows one to determine the location and extent of land use change. Often changes have resulted from some sort of development. Three general problems are found when using this technique: the interpretation procedure, placement of structures, and timeliness. Moreover, no measure of dollars invested in new development can be made.

Interpretations are made by people who can make errors. Even the best interpreter will have problems, such as locating a home beneath a tree canopy or distinguishing between an office and an apartment building. Typically, air photo interpretations measure land cover more than land use [32]. Some sort of ground-level verification is needed in addition. The Metropolitan Council has used field checking and, more recently, building permit data to determine the particular land use group to which a building belongs [37, pp. 41-42]. Reliance on building permits, however, cannot correct for structures missed altogether.

Placement is another problem. Both the specific placement of a structure on the map and the extent of the land to be included around the structure are issues. If the structure is not placed precisely on the map,

land use change studies may indicate growth in one location and decline in an adjacent location though no change has actually taken place. If the affected land around the structure cannot be accurately measured and located, the amount of land in particular uses and again, the locations of land use changes cannot be properly determined. The Metropolitan Council recently studied land use change in the Twin Cities area. A map of 1975 land use [36] and a report of change by broad geographic area [37] resulted. It is assumed that it was the placement problem that prohibited them from printing a detailed map of land use change and tables indicating which land uses replaced which others.

The final problem is one of timing. Photos are not available from other agencies as frequently as would be desired. The costs to the county for doing its own photography are quite high. Since 1937 high level photographs of Wright County, taken when leaves were off the trees, were made by the private sector, the state, and the federal government in 1968, 1975, and 1977; medium level photography in 1975 only; low level in 1975 only [17]. The alternative to buying existing photography would be expensive: $4 per square mile [35] or nearly $3000 per flight over the county. Interpretation and mapping expenses would be additional. These expenses are not unreasonable if done at infrequent intervals, but regular monitoring of land use is prohibitively expensive.

The problems of air photo interpretations can be summarized by looking at an example of work done in Wright County. Interpretations of air photos from 1968 and 1977 were used to determine land use and land use change. The methodology, results, and an analysis of the inconsistencies are presented in Appendix I. The dominant land use of each quarter-quarter section of

the public land survey was the basis of this interpretation. Calculations were based on summarizing a computer file of this data. The general description of land use across the county seems correct. However shifts in the geographic reference and subjective judgment of the interpreter caused some data inconsistencies. Interpretations were repeated with the second interpretation emphasizing urban land uses. Two and three times as much urban non-residential land was identified on the second interpretation as on the first. More consistency was found in the urban residential land use category, but here too the second interpretation indicated about one-quarter more land was classified urban than on the first interpretation. These inconsistencies underscore the problems of air photo interpretation as a means of monitoring changes in land use.

Satellite Imagery

Satellite data is coming into greater use for monitoring land use change [53]. The major advantage of this data is that coverage is available frequently and inexpensively. Unfortunately, satellite data retains the problems of remote sensing: interpretation and placement [16]. Current technology produces very grainy images and is not particularly useful in locating or differentiating urban land uses. Even the important difference between cultivated and pasture land is usually undiscernable.

Local Records

Development is another factor one needs to monitor. Development in terms of dollars of new investment has been summarized from the records of some local jurisdictions. The total value of new construction has been summarized from building permit data in Goodhue County (see Appendix H). Total annual counts of permits issued for new and improved structures by

type are made in most jurisdictions (see Appendix G for an example from Wright County). Changes in assessed values because of new construction could be tabulated from tax records. It is usually impossible to map this development in any detail since summaries are available for large areas only--such as a township. Individual records contain no geographic information except legal description and address. Only in rare cases is this information readily transformable to cartesian coordinates. Without such geographic precision, location of development and changes in the land use patterns of a jurisdiction are impossible to monitor.

BUILDING PERMITS AS A MONITORING DEVICE

Building permits have historically been used for a single purpose--to enforce building codes. They could serve a double function, however, if they were also used to monitor development and land use change. This flexible use of permits can be accomplished with the aid of computers. Several jurisdictions across the country have already done so. Those efforts are not adequately documented to show costs, methodology, or viability in rural areas.

Many jurisdictions have a building code to protect the health and safety of their residents. A person remodelling or building a new structure must apply for permission from the jurisdiction. If his plans meet the code he is issued a permit. The building code is part of the police powers of government. Eighty-nine percent of the population of Minnesota live in places requiring building permits* [10, 1972, p. 362].

A State Building Code was established in Minnesota in 1971 [39]. The code, as amended by the 1979 legislature is in effect in the seven county

*This figure actually includes zoning permits. These permits are the only ones required for new construction in some areas.

metropolitan area and any cities which had already adopted it. Other cities and counties may adopt it at their discretion. The language of the code gives an indication of how closely building permits could monitor development and land use change [27, p. 29].

> "No person or corporation shall erect, construct, enlarge, alter, repair, move, improve, remove, convert, or demolish any building in the city, or cause the same to be done, without first obtaining a separate building permit for each such building or structure from the Building Official.
>
> ...To obtain a permit the applicant shall first file an application in writing on a form furnished for that purpose. Every such application shall:
>
> 1. Identify and describe the work to be covered by the permit for which the application is made;
> 2. Describe the land on which the proposed work is to be done, by lot, block, tract, and street address or similar description that will readily identify and definitely locate the proposed building or work;
> 3. Indicate the use or occupancy for which the proposed work is intended;
> 4. Be accompanied by plans and specifications...;
> 5. State the valuation of the proposed work;
> 6. Be signed by the permittee or his authorized agent...;
> 7. Give such other information as reasonably may be required by the Building Official."

Each of the details spelled out on the permit application* is important to administering the building code. Some are more important than others for the purposes of monitoring development and land use change. Items 2, 3, and 5 are important for knowing the location, use, and value of new development. Location is a necessary attribute if one is interested in land use change. The other attributes are equally important. Most

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*Technically, it is the application for a building permit that contains the useful information and not the permit itself. For many jurisdictions, however, a signed copy of the application serves as a permit. The terms "permit" and "building permit" in this report will be used to stand for a successful building permit application and all the data contained therein.

important, however, is that such information must be supplied and a permit requested before any type of activity is commenced involving a structure modification. Thus any addition, removal, or movement of structures could be monitored by building permits.

If building permits are used only as a check on the building code, any standard filing system will work. If one wants to summarize dollars of new investment by different time periods or uses and map the results, a computer becomes a necessary tool. With the more flexible access of computers to records, building permits can become much more useful to the jurisdiction.

This type of work has been done in several jurisdictions across the country. The UDIS system in Fairfax County, Virginia uses permits as one means to anticipate new growth and plan for public services [25, 26]. Snohomish County, Washington has monitored development and used results to adjudicate zoning cases and develop plans [16]. It is interesting to note that the county uses the computer to prepare summaries of building statistics for the Census and other bodies. In reporting to the other agencies alone the county estimates that computerization saves "an estimated 10 man-months of clerical work" [16, p. 195]. Finally, the city of Seattle has used permit files to determine what value of development was moving into high amenity areas [24].

This study differs from the above efforts in several regards. None involved a small rural jurisdiction. All operate on current rather than historical records. None have a potential for tying into a statewide land information and mapping system. Above all, this study differs in that it fully documents the methodology, results, and costs of the effort to monitor development using building permit records.

DESIGNING THIS STUDY

This present study was designed to test how appropriate it is to use building permits for monitoring development and land use change. The test was to determine: 1) what methodology could be employed, 2) whether monitoring could be done, 3) what errors would be introduced, and 4) whether the costs justified the effort. Rather than waiting a number of years for permits to come in, the study went back and collected building permits for a period of time. This data was geocoded and computerized. Development monitoring was tested by determining the usefulness of the permits in this regard. Land use change was tested by comparing the changes indicated by the permit method with those indicated through air photo interpretation. Errors were determined by testing all results against other sources, including field tests. Costs were monitored throughout.

Selecting the Study Area

In selecting an area for this test, three criteria were applied. First, the land area would be a county and all of its component jurisdictions. Second, the county would need to have shown rapid growth. Third, it would be outside the seven counties included in the Metropolitan Council. The variety of jurisdictions would give insight into different types of problems. Rapid growth was necessary to assure a volume of permit activity sufficient to allow for generalization of the results.

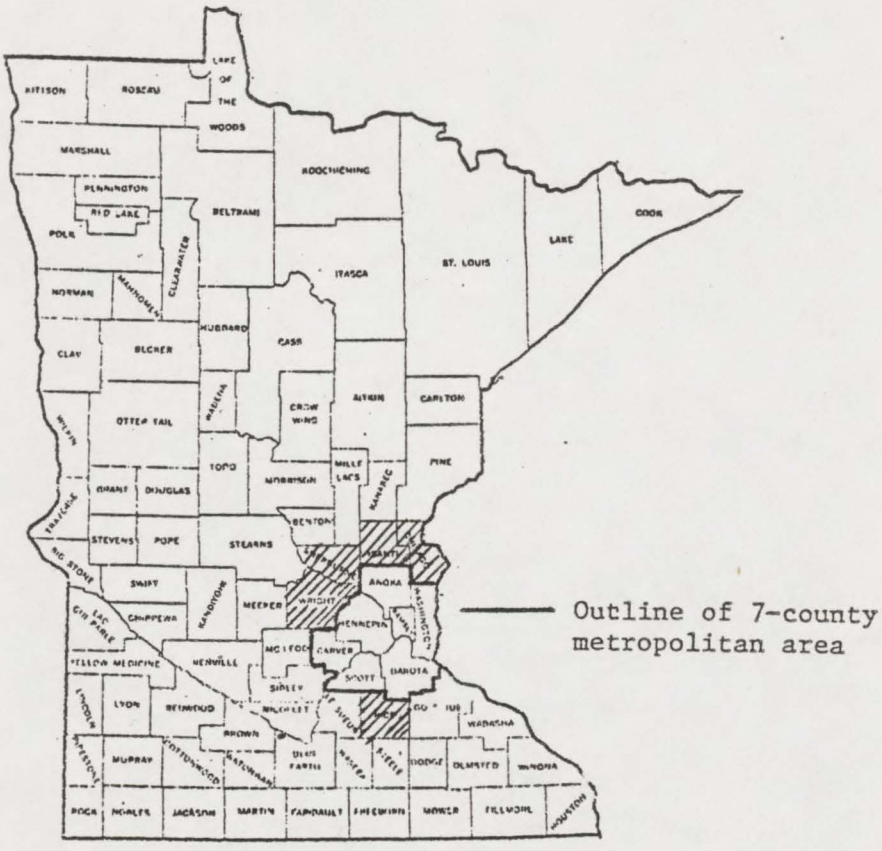
The need to monitor development and land use change is also more critical in a rapidly growing area. Here the land use plan and what is actually happening can quickly become incompatible. In recognition of this fact the state of Minnesota grants funds to update plans in areas

experiencing rapid growth [40]. Were adequate monitoring systems operating in these locations, departures from the plan could be identified quickly. When an overhaul of the plan was required, current land use and past trends would already be known.

In Minnesota, the high growth counties are concentrated in a ring around the Twin Cities. The counties all grew 20 percent or more in the first six years of the 1970s [51]. In the spring of 1976 site visits were made to Chisago, Isanti, Rice, Sherburne, and Wright counties (see figure 1). These counties were all fast growing and outside the jurisdiction of the Metropolitan Council. The counties were similar in many ways. All required building permits for construction and had staff to administer the program. While none issued certificates of occupancy, they did have inspection systems, usually sanitary, to verify construction according to approved plans. In general, the county administered the permit system in the unincorporated areas and left all urban administration to the cities. All required location information, which was quite detailed.

FIGURE 1

COUNTIES CONSIDERED AS STUDY AREA

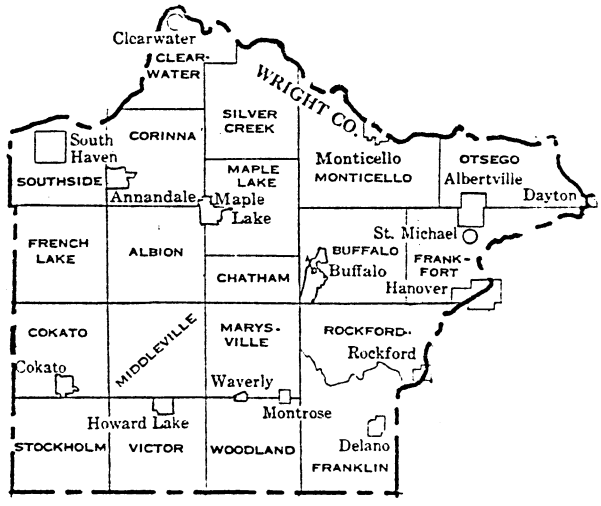


Characteristics of Wright County

Wright County was chosen as the test site. In a sense the decision was arbitrary since there was no distinguishing characteristic of the building permit system to set it apart from other counties. One sensed growth problems that were subsequently highlighted in various stories in the Minneapolis Tribune. This was one reason for selecting the county. Another was that another study of new construction using building permit

data was underway in the adjacent area of northwestern Hennepin County [1]. The permit system was viewed as efficient, but it was not seen as superior to the other counties investigated. The findings in Wright County would therefore apply to other counties with functioning building permit systems. Figure 2 displays a map of the location and extent of the cities and townships of Wright County.

FIGURE 2: CITIES AND TOWNSHIPS OF WRIGHT COUNTY



KEY: Maple Lake = a city
MAPLE LAKE = a township

Land Use Change -- Air photo interpretations of the county were available for 1968 and 1977. Though these interpretations have problems, as described earlier, they were the only county-wide land use indicators available. In 1968 Wright County was largely rural. Of the 723 square miles*: 61 percent was cultivated, 15 percent pasture or open, 10 percent forest, 6 percent water, and 3 percent marsh. In all, 96 percent of the land was in rural use. Still, 21 square miles were in residential use (3 percent) and 11 square miles in urban non-residential or urban-mixed residential use (1 percent). Less than one square mile was in either transportation or mining uses.

Major shifts in land use had taken place by 1977. Pasture land was reduced by half, to 53 square miles. Most of this land shifted to cultivated use, now 38 more square miles and in total covering 66 percent of the county. Land in urban uses grew by 66 percent to a total of 58 square miles. Most of this land had previously been under cultivation.

The Problems of Growth -- Wright County is within commuting distance of the Twin Cities. Until recently, it was a rural farming area with a stable population. From the beginning of this century until 1960, the population was stable at just under 30,000 [9]. The 1970 population had increased to 39,000. By the turn of this century the population is expected to double to 87,000 [52].

Before this rapid growth, Wright was a tranquil rural county. The county seat, Buffalo, was the largest city with 2,300 people. Most growth has been in rural areas and without much control [21]. The growth has

*This figure is higher than Census measurements [9]. It was calculated using the count of quarter-quarter sections in the computer file of land use and assuming each contained 40 acres.

created land use problems. Concern has been expressed over: 1) the loss of agricultural land [20, 21], 2) the types of environmental problems uncontrolled growth brings with it [21], and 3) the cost of providing sewer and water services to the new residents [30].

The county attempts to minimize these problems through its planning and zoning authority. The current ordinance was enacted in 1973. An independent study of the use of that authority for controlling development in shorelands found it to be quite effective [7]. Still, the rapid growth of the county has caused the controls to become outdated. In at least one area, a moratorium on construction was required while a new plan was developed [21]. The county has received a Land Use Planning Grant to create a new plan for the entire county.

CHAPTER 2: PREPARATION OF THE DATA FROM BUILDING PERMITS

This chapter describes the work involved in preparing building permit data files for monitoring development and land use change. The major steps include collecting the applications, locating the permitted activity, and computerizing these records. The tasks, difficulties, and costs are detailed in the sections comprising this chapter.

The test effort was an historical analysis collecting eight years of past records in Wright County. Yet much can be learned about how an ongoing monitoring system could and should operate from this historical work. For these reasons, this separate chapter details the data preparation methodology employed in this study.

COLLECTING BUILDING PERMITS

A photo copy was made of every building permit application for a major new structure in Wright County. The study covered 1969 through 1976. The copies were made in late October and early November of 1976 so that most construction for that year was accounted for. This span of years was chosen to match with available high level photography to allow for independent validation of land use changes.

In all, eight years of permit activity were collected. The reader will note that air photos were actually dated 1968 and 1977. The 1977 photos were taken in early spring so no new construction would have taken place. Unfortunately the 1968 photos were also from early Spring so a full building year was missed. This error was made by the author who was working with a land use map made from those photos and dated 1969 [38]. This oversight was to cause some slippage in the results presented in the next chapter.

Only permits for major new structures were collected. Additions, alterations, and outbuildings were not included. A garage or a new barn was bypassed, but a commercial greenhouse was included. The major thrust of the study was to determine changes in land use as indicated by building permit applications. Therefore, building conversions were to be gathered as well. None, however, were found.

There are many local jurisdictions that issue permits in Wright County and nearly as many means for keeping track of building permit applications. Each of the cities maintains its own system, as does Frankfort Township. The remaining area of the county, by far the largest whether measured by area or building permit activity, is administered by the county through its Office of Planning and Zoning. Each jurisdiction that issues permits was visited by car, some several times. Nearly 1,200 miles of travel were required. After locating records for the appropriate time span, the records were copied using a portable photo copier. Copier rental and use came to $220. Over 150 hours of travel, contact time, sorting, and copying were required to get copies of all permits.

The filing systems vary by jurisdiction though all are segregated by year. At the time of the collection effort, the county office kept applications by township which aided in locating the permitted activity. Even applications to build in subdivisions were kept in township files. Since that time, the county has switched its filing system to an alphabetical ordering of owners. The other scheme operating in the county is to simply file chronologically by application date. Usually the permit issuing jurisdiction maintains a copy of the permit application. In a few cases

the jurisdiction merely retains a list of permits granted. In all cases, this study effort required going through each application to determine whether it was for a major new structure. If it was, a copy was made of the application (or list).

The reliability of the filing systems also varies. The county filing system is quite efficient. The cities appear to operate more informally. In some, building activity has been sporadic. In most the clerk is part-time and has another major business interest. In such a setting it is understandable that the filing system may not be efficient for finding eight-year-old records. In a few instances the clerk has changed during the period, compounding the problem. In one instance, the clerk already knew that the earlier records had been lost.

All eighteen permit issuing jurisdictions were contacted. From three cities (Dayton, Hanover, and South Haven) no information was collected. Only a small portion of Dayton is in Wright County and the city clerk said permits in that portion were issued by the county government. Only one permit had been issued in South Haven and that was to replace a burned home. The clerk in Hanover was willing to cooperate but was in the midst of moving his business and could not make the records available.

GEOCODING PERMITTED ACTIVITY

The basic geographic unit for this analysis was the quarter-quarter section of the Public Land Survey. This unit is nominally forty acres square, with a one-quarter mile stretch on each side. In lay terms, it is a "forty." This unit is identical to that used by MLMIS, the land

information system of the State Planning Agency. There are 11,566 such units in Wright County. The rationale for using the forty and the numeric coding scheme employed are presented in Appendix L.

Each permit application contains information about where the permitted activity is to take place. In Wright County the legal description of the property was the usual means of capturing this information. A copy of the county building permit application form is presented in Appendix B. Note that the specified portion of the locational information is detailed only to the section. In Wright County no parcel can be defined to exist across a section boundary [13]. In a few cases, only a property address was available. All of the various forms of locations had to be translated to a particular forty in the numeric coding scheme. The steps and effort involved in each of these translations is described below. The speed of translation will be described as "slow," "moderate," or "fast." These terms are roughly equivalent to the following number of forties that could be geocoded in a given time period: 4-8 per hour was "slow," 9-14 per hour was "moderate," and 15-20 per hour was "fast." Different methods were used for translating locations, depending on the form of the original legal description. These are listed here along with an estimate of the proportion of permit applications located in this manner.

1. Public Land Survey legal description located to forty. This is exactly what is desired. No additional work was required. Geocoding was fast. Only 8 percent of the applications were located this way.
2. Public Land Survey description to a parcel larger than a forty. Usually these were farms and the building was assumed to take place at the homesite which was usually indicated in the

county plat book [49]. The plat book contains the name of the farm owner in 1973 which was helpful in locating the parcel. This work was slow. About 6 percent of the applications were located this way.

3. Public Land Survey description to government lot. 1936 county highway maps [23] indicating locations of government lots were used to find these sites. The location relative to the forty scheme was then coded. This work was slow but only about 2 percent of the applications had to be located this way.

4. Metes and bounds description based on Public Land Survey. Here various directions and measurements given in the description were simply plotted out on scratch paper to determine in which forty the permitted activity was to take place. Work was slow, but again only 2 percent of the applications had to be located this way.

5. Rural subdivisions (lot and block legal description).

   a. Subdivisions within a single forty. Once the subdivision was located, all permits within it could be assigned the same forty geocode. Often the subdivisions could be found in the county plat book [49]. On other occasions a copy of the subdivision plat was obtained through the county or the local private abstract company [54]. Public Land Survey corners are indicated on all plats so locations can be immediately determined. These extra steps slowed work speeds to moderate. About 5 percent of the applications were located this way.

b. Subdivisions in multiple forties. Here subdivision maps [54] were necessary. Public Land Survey corners were used to locate and draw the boundaries of the forties. Individual parcels were geocoded to the forty containing the plurality of the parcel's area if these boundaries cut through parcels. This work went slowly and over half of the permit applications were located this way.

6. Urban subdivision. Plat maps were available from most cities [55]. These maps contained the necessary lot and block numbers as well as sufficient Public Land Survey markers to facilitate the drawing of the boundaries of the forties. The same rules as above were used for geocoding parcels in multiple forties. This work went moderately fast. About 13 percent of the applications were located this way.

7. Urban address. Both city plat maps [55] and state Department of Transportation municipal maps [22] were used to locate these applications. Only where streets existed in a single forty or cross streets were numbered was geocoding possible. In the latter case the first digit of the address was assumed to locate a parcel on the block "above" the street with the same number. Thus 617 School Street would be placed between Sixth Street and Seventh Street. This work went moderately fast. About 5 percent of the applications were located this way.

In all, 4,599 permit applications for major new construction in Wright County were collected. Of these, 3,688 or 80 percent could be geocoded using the rules just described. The remainder were sent to local

(township) assessors or village clerks along with a map of their area and a request to indicate the location of each permitted activity on the map. Another 17 percent of the permit applications were geocoded in this manner. Ninety-seven percent of all permit applications (4,448) were geocoded and used in this study.

COMPUTERIZING PERMIT INFORMATION

Data was extracted from the permit applications and became the basis for the computer files used in this study. The county and other jurisdictions had collected data for their needs. For more general uses this data had two shortcomings in its existing form. First, it lacked the critical location information. This was added as described in the preceding section. Second, the filing systems were inflexible in responding to the different questions raised here. Computerizing the file removed this shortcoming. The process was quite complex and will not be detailed in the body of this report. Instead, this section will summarize the process and refer the reader to appropriate appendices for the details.

The different jurisdictions used various permit applications containing varying amounts of information. At the lowest level, only the name and addresses of the owner were available along with type of activity for which the application was made. At the other end of the spectrum was the county which collected dozens of items of information. A sample of the current county permit application form is presented in Appendix A.

A data coding procedure was established for the study which extracted information which would be useful for answering many questions about building activity, not just location and building type. Reported cost-of-

construction, floor area, and land area were coded wherever possible in order to determine the magnitude of investment. In order to estimate the origin of new owners, their zip code was coded. To determine the extent of variances granted, water and road setbacks were coded. Much of the list of data items extracted and the form of the extraction was taken from documentation developed by the Arrowhead Regional Development Commission in Duluth [18]. The Commission had been collecting and processing land use permits issued by many counties in northeastern Minnesota for a number of years. The instructions to the data coders, listing all data items and the form of capture, is presented in Appendix B. Appendices C and D supplement that appendix with categories for land use codes. Workers could code about 15 applications per hour on the average. The resulting computer file was termed the "raw permit file." Numerous edit checks of the data were made to find incorrectly coded items. These edits searched for out-of-range codes of single data items and inconsistent combinations of multiple data items. The final data file was clean and correct within these constraints.

Many of the data items on the raw permit file had too many unique values to be easily used in trying to understand building activity. These were collapsed into categories. For example, the hundreds of unique entries of acres of land area were combined into 7 ordered categories. Similarly, zip codes outside the county were collapsed into larger geographic areas. The rationale for each collapse and the resulting categories are presented in Appendix E. The resulting data file is quite useful for understanding construction activity. Most of the tables in the next chapter were generated from this file. It was termed the "modified permit file."

Finally, a data file of building activity within each forty was created. This was necessary since land use change was to be measured at the forty level. Where many structures were permitted within a single forty, one record was created summarizing this activity. For each forty with any building activity this record was created. For each year and for the study period as a whole three summaries were made: count of residential structures, average value of residential structures, and count of non-residential structures. It was this data file that was used for all of the mapping work. The file was termed the "forty file." The rules used in its creation from the raw data file and the form of the results are presented in Appendix F.

CONCLUSION

An attempt was made to create computer files containing useful information from every building permit issued for major new construction in Wright County from 1969 through 1977. This process, its difficulties, and the effort expended have been documented in this chapter.

The problems of dealing with multiple jurisdictions, with old records, and with data collected for another purpose were many, but not insurmountable. If this process were repeated, it is believed that useful data files could be created for a cost of under $5,300 (see Appendix K). Forty-five percent of this cost would be for geocoding, another 31 percent for coding, and 19 percent for travel and copying permits. Were all information, including geocoding and area calculations, available on applications and a copy sent to a central location, these costs would be drastically reduced.

CHAPTER 3: DEVELOPMENT AND LAND USE CHANGE AS INDICATED BY BUILDING PERMIT DATA

The large number of permit applications filed indicates substantial development and land use change in Wright County. When geocoded and computerized, it was hypothesized, the permit data would add information about the value, impact, nature, and location of this development. This chapter presents the results obtained in the pilot study of Wright County.

The first section contains various summary tables of development as indicated by building permits. Each table presents information on the number of permits issued for separate building types and for each jurisdiction. Many of the tables add value or cost information. They contain useful information which is not readily available from any other source. The generation of these tables, or others is trivial in personnel time or computer cost once the permit information has been computerized.

Detailed maps of the location of development can also be generated readily by computer. Three possible maps are presented and discussed in the second section.

The impact of development on the spread of urban land uses is addressed in the third and final section of this chapter. Urban change since 1968 is monitored with building permits. These results are compared to those obtained photo interpretations of changes in the same time period.

DEVELOPMENT MEASURED

The 4,448 building permits granted represent major new development in Wright County over an eight year period. The record of this development is available in scattered locations and in incompatible formats. Once the

information from the permits was computerized, however, a number of summaries were easily generated.

Before the present study, the only extant summary of building activity in the county was an annual count of permitted new dwellings and mobile homes for each township. Appendix G presents this data for 12 years on a single sheet.

Many building officials report monthly to the Construction Statistics Division of the Census Bureau on the permits they have issued. Most Wright County building officials participate in this program. Statistics resulting from this effort are inadequate in two regards. First, the reports summarize permits issued rather than construction starts. The fact that the forms are sent to Washington within days after the end of the month [50] reduces the chances of removing data on abandoned projects. Second, the geographic and topical summaries published by the Bureau are inflexible and too gross for local jurisdictions. All township data is summarized to a single line labeled "WRIGHT CO. UNINC. AREA" for example.

Putting building permits in machine readable form offers one of the least expensive and most flexible means for monitoring development. Having individual forms in a computer file allows one to query the file in many different ways seeking different measures of and insight into the development process. Following this strategy, Goodhue County, for instance, is able to prepare an annual report of construction. This report contains a count and total value of new construction by type and township. A sample of this richer report is presented in Appendix H.

Various similar reports were produced in this study for Wright County from the computerized building permit files. Each report is an attempt to

Center for Urban and Regional Affairs

University of Minnesota
330 Hubert H. Humphrey Center
301 19th Avenue South
Minneapolis, Minnesota 55455
(612) 625-1551

TABLE 1: COUNT OF PERMITTED STRUCTURES IN TOWNSHIPS BY USE, 1969-1976

Township	Total Permits Collected	Undeterminable	Single Family Detached	Mobile Home	Duplex/ Seasonal	Large Residential	Industrial	Transportation/ Communication Utility	Retail	Office	Service	Public	Cultural/ Educational	Recreational	Resource
Albion	96	-	73	22	1	-	-	-	-	-	-	-	-	-	-
Buffalo	215	1	171	31	1	-	2	1	3	-	2	-	2	1	-
Chatham	114	-	98	15	-	-	-	1	-	-	-	-	-	-	-
Clearwater	123	-	73	49	-	-	-	-	1	-	-	-	-	-	-
Cokato	52	1	31	15	-	-	-	-	1	-	2	-	2	-	-
Corinna	217	-	191	23	1	-	-	-	-	-	-	-	-	2	-
Frankfort	195	5	189	-	-	-	1	-	-	-	-	-	-	-	-
Franklin	240	2	202	36	-	-	-	-	-	-	-	-	-	-	-
French Lake	96	-	74	18	4	-	-	-	-	-	-	-	-	-	-
Maple Lake	165	2	141	18	1	-	1	-	1	-	-	-	-	-	1
Marysville	154	1	95	58	-	-	-	-	-	-	-	-	-	-	1
Middleville	71	1	43	27	-	-	-	-	-	-	-	-	-	-	-
Monticello	385	-	281	100	1	-	-	1	1	-	-	-	1	1	-
Otsego	646	-	324	319	-	-	-	2	1	-	-	-	-	-	-
Rockford	405	1	304	95	-	-	-	1	1	-	-	-	2	-	-
Silver Creek	143	-	115	25	-	-	-	-	2	-	-	-	-	1	-
Southside	135	-	106	15	10	-	3	1	-	-	-	-	-	-	-
Stockholm	40	-	25	13	1	-	-	-	1	-	-	-	-	-	-
Victor	73	1	52	13	6	-	-	-	-	-	-	-	-	1	-
Woodland	63	2	43	18	-	-	-	-	-	-	-	-	-	-	-

TABLE 2 : COUNT OF PERMITTED STRUCTURES IN CITIES BY USE, 1969-1976

Cities	Total Permits Collected	Undeter-minable	Single Family Detached	Mobile Home	Duplex/ Seasonal	Large Resi-dential	Undus-trial	Transportation/ Communication Utility	Retail	Office	Service	Public	Cultural/ Educational	Recrea-tional	Resource
Albertville	32	-	26	3	-	-	1	-	1	-	-	-	1	-	-
Annandale	32	-	26	1	-	1	-	2	-	1	1	-	-	-	-
Buffalo	274	3	246	1	3	3	-	-	9	4	2	-	2	1	-
Clearwater	12	-	5	-	-	1	2	-	1	-	2	1	-	-	-
Cokato	48	6	34	-	-	1	1	-	2	1	2	-	1	-	-
Delano	80	-	67	-	-	6	-	-	4	-	2	1	-	-	-
Howard Lake	39	8	28	-	-	2	-	-	-	-	1	-	-	-	-
Maple Lake	165	2	141	18	1	-	1	-	1	-	-	-	-	-	1
Monticello	75	4	50	-	-	5	2	-	10	2	-	-	1	1	-
Montrose	44	-	8	35	-	-	-	-	-	-	-	1	-	-	-
Rockford	42	-	38	-	-	2	-	-	-	-	-	-	2	1	-
St. Michael	81	3	76	1	-	-	-	-	1	-	-	-	-	-	-
Waverly	4	-	2	-	-	-	-	-	1	-	1	-	-	-	-

The value of new residential structures is presented in Table 3. The table summarizes residential construction over the eight year study period for the unincorporated parts of the county. Only this area is shown since this data proved to be much more complete than that for the cities. Frankfort Township was also eliminated from this table since no value information was available. A simple inflationary and cost under-reporting control existed and was used by the county for residential properties. The values presented in Table 3 were actually imputted from the living area valued at $22.60 per square foot: this was the rate used by the county before late 1977. The details of this valuation are presented on pages E7-8 in Appendix E.

Some insights into the development process can be gained from this table and Table 1. The largest amount of new residential construction, as measured by counts or value, took place in those townships most accessible to the Twin Cities. The average value of new construction however, was highest in remote Stockholm Township. Of those townships issuing over 200 single-family permits, only Franklin had an average value over forty thousand dollars. The total single-family construction over the study period amounted to nearly 86 million dollars. This construction alone would comprise nearly one-sixth of the 1976 tax base of the entire county [47]. Mobile homes were fewer in number and lower in value than single-family homes. Seasonal (and duplex) construction was more scattered, lower valued and concentrated in townships with recreation lakes.

TABLE 3: AVERAGE AND TOTAL IMPUTED VALUE OF RESIDENTIAL CONSTRUCTION IN TOWNSHIPS, 1969-76 (in 1976 thousands of dollars)

	Single Family Detached				Mobile Home				Duplex and Seasonal			
			Value				Value				Value	
Townships	# permits	# reporting area	mean	total	# permits	# reporting area	mean	total	# permits	# reporting area	mean	total
Albion	73	72	33.8	2434	22	19	19.2	367	1	1	10.8	11
Buffalo	171	169	35.8	6048	31	29	18.0	522	1	1	19.5	20
Chatham	98	95	36.3	3452	15	15	21.1	318	-	-	-	-
Clearwater	73	73	33.3	2430	49	49	18.3	900	-	-	-	-
Cokato	31	29	34.4	999	15	13	18.6	242	-	-	-	-
Corinna	191	190	35.1	6669	23	23	18.8	433	1	-	-	-
Franklin	202	200	40.4	8090	36	35	18.9	663	-	-	-	-
French Lake	74	72	33.1	2388	18	18	18.9	339	4	4	18.1	73
Maple Lake	141	141	35.1	4951	18	18	18.7	337	1	1	18.4	18
Marysville	95	93	38.8	3604	58	57	19.4	1107	-	-	-	-
Middleville	43	42	32.6	1368	27	27	18.6	502	-	-	-	-
Monticello	281	277	36.4	10093	100	95	19.9	1890	1	1	19.0	19
Otsego	324	313	32.9	10299	319	317	21.4	6802	-	-	-	-
Rockford	304	295	36.7	10822	95	91	19.5	1778	-	-	-	-
Silver Creek	115	114	39.0	4442	25	25	21.8	544	-	-	-	-
Southside	106	105	33.7	3541	15	15	20.3	305	10	10	19.8	198
Stockholm	25	24	41.1	988	13	13	19.8	258	1	1	14.4	14
Victor	52	51	34.2	1747	13	12	20.1	242	6	6	18.6	112
Woodland	43	40	35.7	1429	18	18	21.6	389	-	-	-	-

Detailed annual reports of construction activity could be regularly generated if building permits were transformed into machine-readable information. Reported cost-of-improvement data is often available to allow valuation of non-residential construction. Examples of what these reports might contain are presented in Tables 4 and 5. A base year of 1975 was chosen since it was the latest year for which a full year of permits were collected; also because permit data for cities proved to be better in the more recent years.

Reported cost-of-construction for three major uses in the unincorporated portion of the county is presented in Table 4. Single-family and mobile homes are reported separately, while the small amount of other types of construction is collapsed into a third category. Residential costs are probably undervalued [19]. A significant retail development was built in Silver Creek.

Much more non-residential (including large residential) development took place in the cities than in the rural areas in 1975. Many use columns are therefore presented in Table 5. Remaining uses were collapsed into the 'other' category. They included service, public, and cultural-educational. In three cities, Clearwater, Cokato, and Delano, the cost of this construction met or exceeded that of single-family residences. Other interesting information can be seen in this table as well.

As important as the information in Table 5 is, the information missing is more significant. Over half the cities do not collect cost data on a regular basis. While new dollar investment in some parts of the county can be easily summarized once put in machine-readable form, this lack of data collection reduces one's ability to gain an overview

of the development of the whole country. If the data is not collected at the source, when the permit application is being completed, there is no easy way to add it later.

The formulation of tables indicating amount and value of new construction is easy if the raw information is in machine-readable form. Reformatting and new breakdowns of the information are possible at a low cost once the data is in the computer. In some instances the data was not collected at the source, but this problem was largely confined to cities where no standard building permit application is in use. For the vast majority of the physical area of the county, data was collected in standard form and could be summarized.

TABLE 4: REPORTED COST OF NEW CONSTRUCTION IN TOWNSHIPS BY PERMITTED USE, 1975

Townships	Single Family Detached			Mobile Home			Other		
	# permits	# reporting cost	total cost	# permits	# reporting cost	total cost	# permits	# reporting cost	total cost
Albion	4	4	110,000	2	2	24,000	1	-	-
Buffalo	13	13	405,500	3	2	19,500	-	-	-
Chatham	6	6	205,000	1	-	-	-	-	-
Clearwater	8	8	181,316	3	1	16,000	-	-	-
Cokato	3	3	71,000	1	1	6,600	-	-	-
Corinna	12	11	405,500	1	1	7,250	-	-	-
Frankfort	17	-	-	-	-	-	-	-	-
Franklin	13	13	506,000	4	2	9,500	-	-	-
French Lake	5	5	135,000	1	-	-	-	-	-
Maple Lake	14	12	345,000	-	-	-	-	-	-
Marysville	9	9	289,000	6	6	50,600	-	-	-
Middleville	3	3	73,500	2	2	7,500	-	-	-
Monticello	39	39	1,155,000	3	3	35,700	-	-	-
Otsego	20	19	560,000	11	11	99,700	-	-	-
Rockford	25	23	696,700	4	4	43,165	-	-	-
Silver Creek	14	12	399,000	2	2	14,000	1	1	179,000
Southside	13	13	238,500	2	2	18,500	-	-	-
Stockholm	2	2	44,000	2	-	-	-	-	-
Victor	5	5	128,156	1	1	18,000	1	1	10,000
Woodland	5	5	89,500	1	1	8,500	-	-	-

TABLE 5: REPORTED COST OF NEW CONSTRUCTION IN CITIES BY PERMITTED USE, 1975

Cities	Single Family Detached			Large Residential			Retail			Industrial			Other		
	# of permits	# reporting cost	total cost	# of permits	# reporting cost	total cost	# of permits	# reporting cost	total cost	# of permits	# reporting cost	total cost	# of permits	# reporting cost	total cost
Albertville	4	-	-	-	-	-	1	1	35,000	-	-	-	-	-	-
Annandale	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buffalo	74	74	1,975,200	-	-	-	-	-	-	-	-	-	-	-	-
Clearwater	-	-	-	-	-	-	-	-	-	1	1	320,000	1	1	30,000
Cokato	6	6	203,000	-	-	-	-	-	-	1	1	23,851	2	2	161,749
Delano	23	22	594,700	2	2	355,000	2	2	93,400	-	-	-	1	1	182,000
Howard Lake	2	2	43,500	-	-	-	-	-	-	-	-	-	-	-	-
Maple Lake	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Monticello	8	5	179,000	1	-	-	1	1	17,000	-	-	-	-	-	-
Montrose	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rockford	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
St. Michael	14	13	457,540	-	-	-	-	-	-	-	-	-	-	-	-
Waverly	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

DEVELOPMENT MAPPED

There are 723 square miles of land in Wright County. The concentration or disbursement of new development is not well described by the previous tables where 33 cities and townships are the only locational measures. A clearer picture of the development of land in the county is obtained by mapping new development on a much more detailed basis.

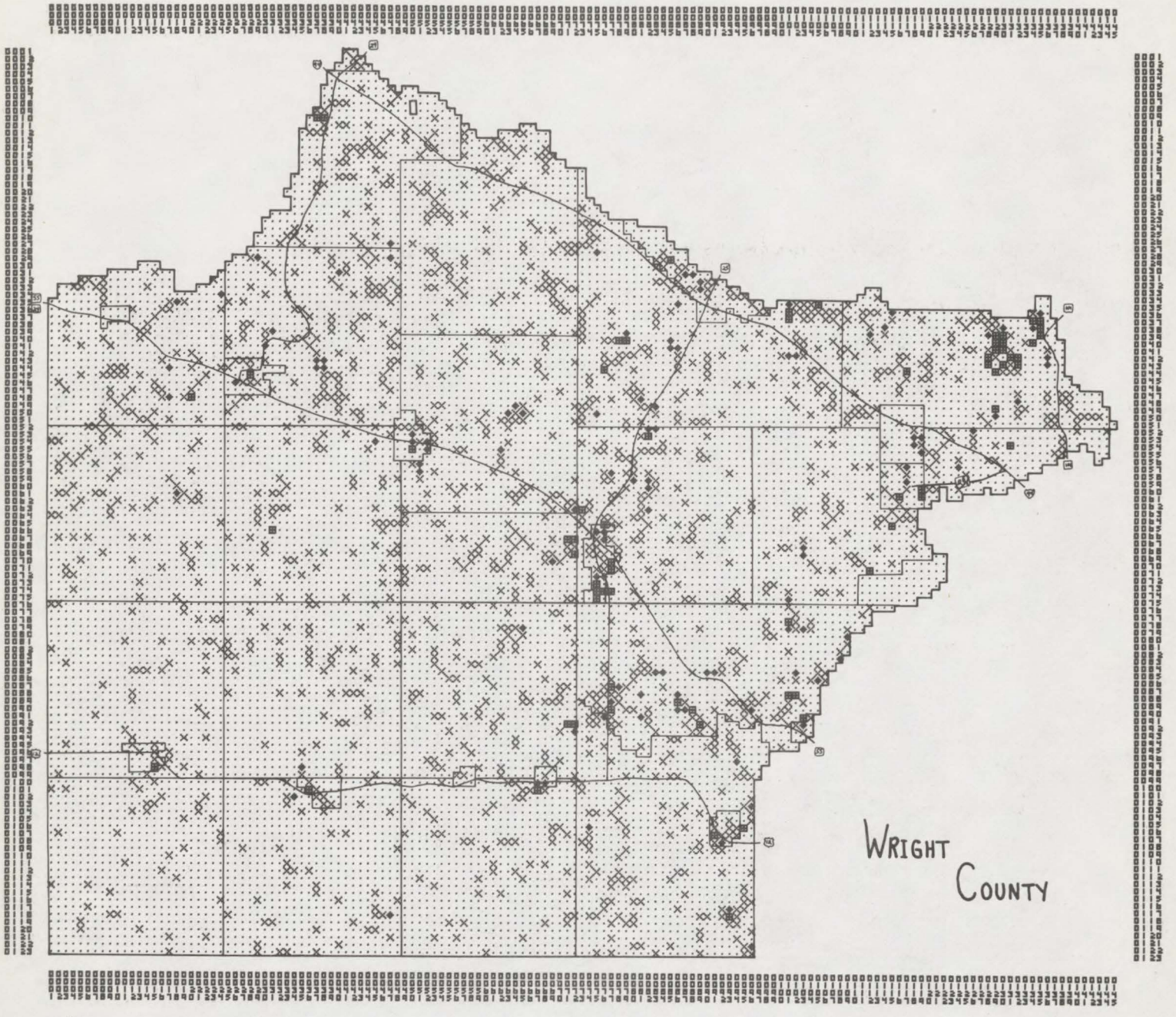
Mapping development as determined from permits by forty acre parcel offers a much finer grained look at the locations of growth and change. There are 11,566 forties in the county. Permits were summarized to forty as described above. The maps that follow present development as summarized for the entire eight year study period. An overlay aids one's orientation by showing municipal boundaries and state and federal highways. Single year maps could have been produced as well. Standardized computer software for mapping this data is available from the Minnesota Land Management Information System (MLMIS) at the Minnesota State Planning Agency. The only requirement is that each record to be mapped be located with a standard forty code (see Appendix L). Maps were produced at a cost of about 33¢ each using this software. A useful side-benefit of MLMIS is that any map can be combined with any other in the system. Thus the soil productivity or water orientation of developing forties can be determined and mapped.

For all three maps in this section, unique data levels were collapsed to facilitate mapping at a scale appropriate for this report. Larger scale maps showing all data levels have been produced. Frequency distributions of these uncollapsed data levels are presented for each map in Appendix J.

New residential structures as indicated by building permits are presented in Figure 3. Here residential structures include all residential uses in smaller structures. Development in the cities is concentrated within their small areas. In most of the townships residential development has been very scattered often with a gain of only a single house in those forties experiencing any development. For these rural areas only a major attraction like a lake or good highway access can produce concentrations of structures. Throughout the county, lakes offer the major explanation for concentration. The higher growth townships around Buffalo and nearer Minneapolis also show concentrations of new structures near lakes, though lots may be further from water. Concentrated development in Otsego Township, quite accessible to Minneapolis by interstate highway, is consuming land far from any water.

The average value of new residential construction on each forty may also be mapped. Value data, it should be remembered, was not available for all construction. Figure 4 presents this map--with developed forties collapsed into four value classes. About half the developing forties had new construction worth less than $30,000. The map shows higher values with darker symbols. The higher valued homes seem to be sprinkled randomly across the developed areas. The value of new construction is no doubt affected by the resource base and by who has come before. Rolling wooded lots on water are highly valued and would be improved with a high value home. But if the surrounding lots have already been developed with an incompatible use--say rundown lake cabins--the person prepared to build a more luxurious home will go elsewhere.

FIGURE 3: NEW RESIDENTIAL STRUCTURES PERMITTED 1969-1976



V81 = TOTAL NEW RESIDENTIAL STRUCTURES

WRIGHT COUNTY

MAP PRODUCED BY
MINNESOTA LAND MANAGEMENT
INFORMATION SYSTEM

0 1 3 6
MILES

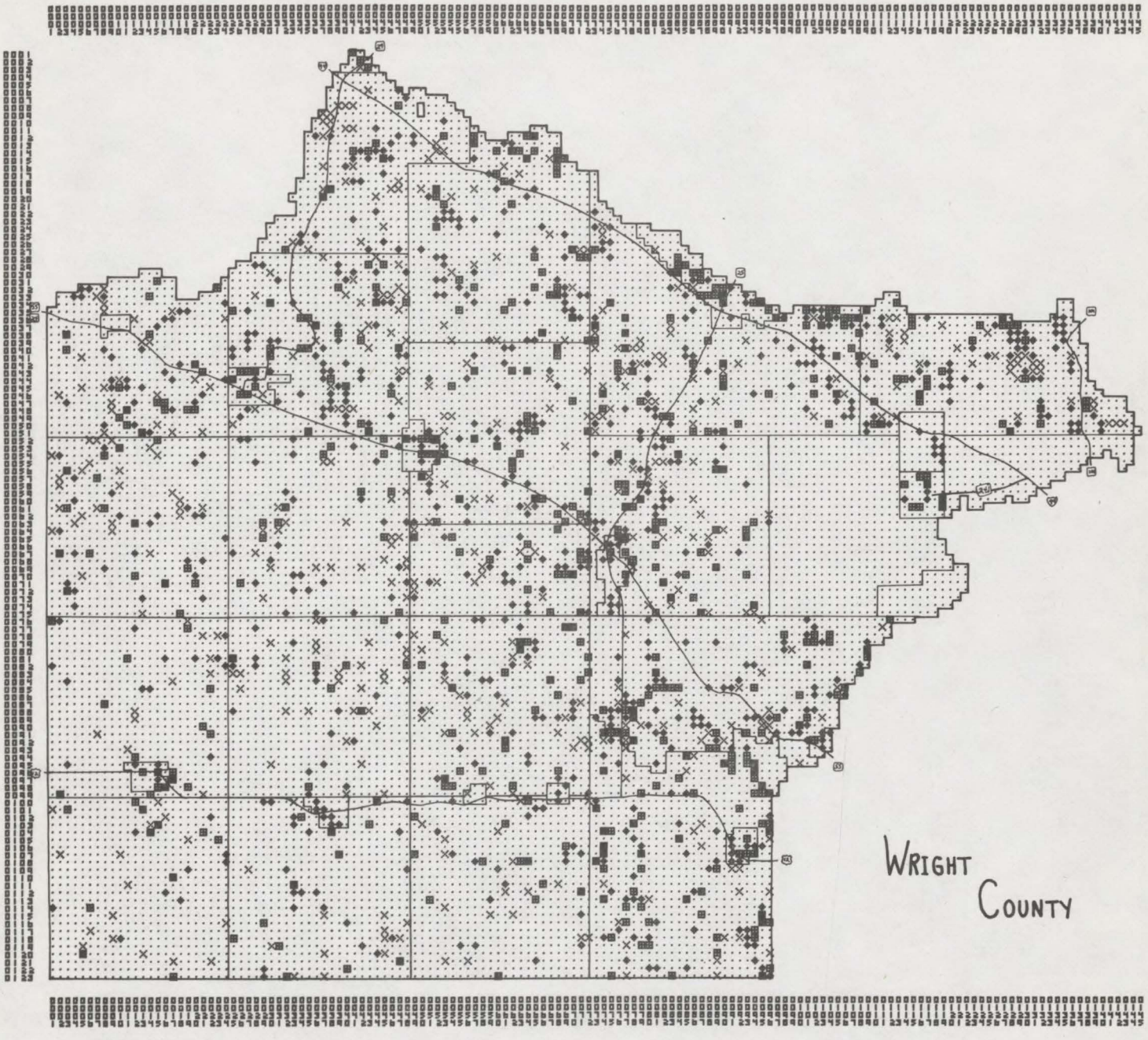
NORTH

MINNESOTA STATE PLANNING AGENCY
LAND MANAGEMENT INFORMATION CENTER
15 CAPITOL SQUARE BUILDING
550 CEDAR STREET
ST. PAUL, MN. 55101

FREQUENCY LEVEL SYMBOL LEGEND

9781	84.5%	1	...	NO INFORMATION INDICATED
1604	13.8%	2	XXX	ONE TO FOUR RESIDENTIAL STRUCTURES
112	0.9%	3	◆◆◆	FIVE TO NINE RESIDENTIAL STRUCTURES INDICATED
69	0.5%	4	▦	TEN OR MORE RESIDENTIAL STRUCUTRES

FIGURE 4: AVERAGE VALUE OF NEW RESIDENTIAL STRUCTURES PERMITTED, 1969-1976



V98 - AVERAGE VALUE OF RESIDENTIAL CONST

WRIGHT COUNTY

MAP PRODUCED BY
MINNESOTA LAND MANAGEMENT
INFORMATION SYSTEM

1 0 1 3 6
MILES

NORTH

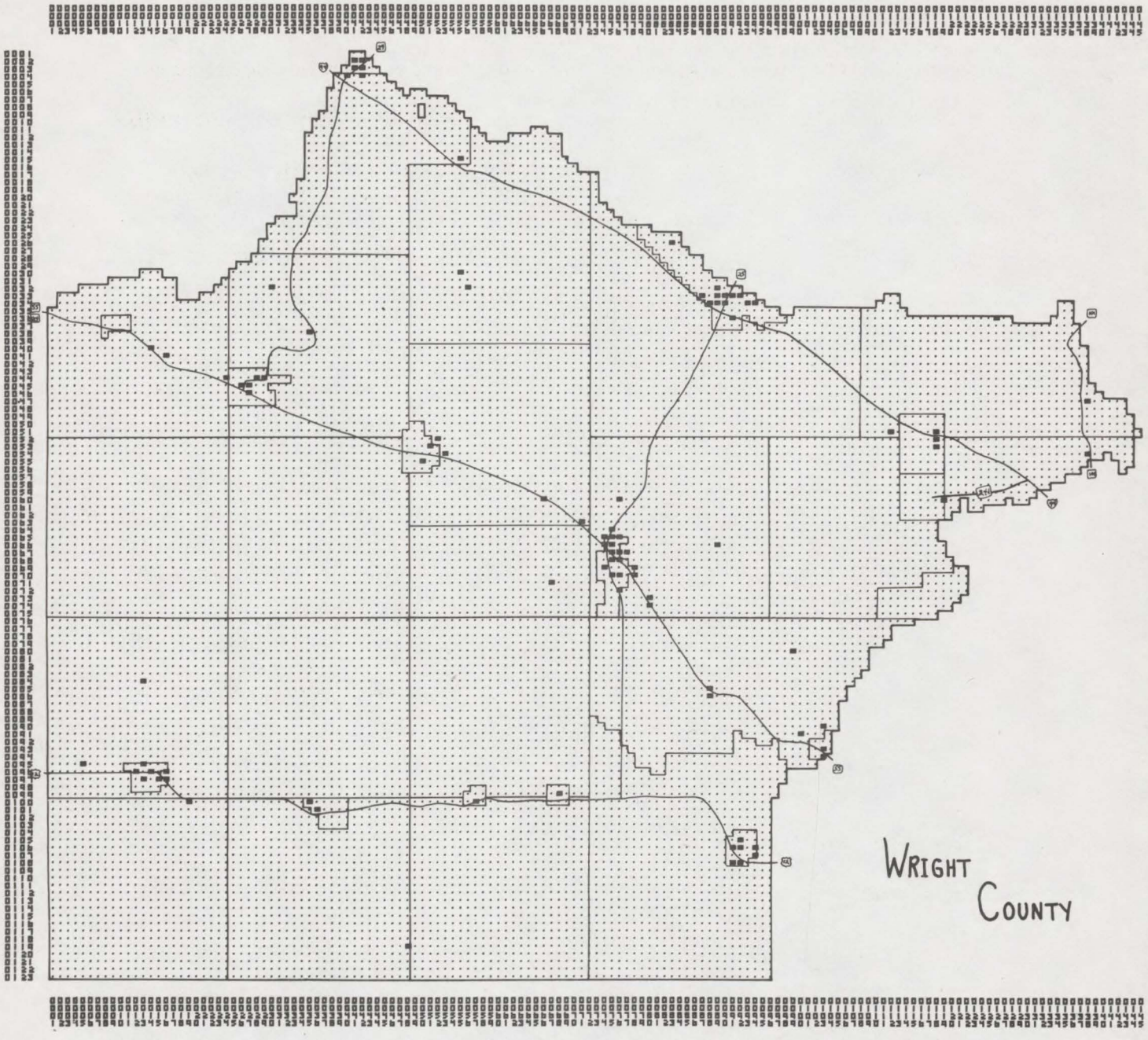
MINNESOTA STATE PLANNING AGENCY
LAND MANAGEMENT INFORMATION CENTER
15 CAPITOL SQUARE BUILDING
550 CEDAR STREET
ST. PAUL, MN. 55101

FREQUENCY LEVEL SYMBOL LEGEND

9911	85.6%	1	...	NO DATA OR DEVELOPMENT INDICATED
448	3.8%	2	XXX	LESS THAN $25,000 VALUE
706	6.1%	3	◆◆◆	$25 - 35,000 VALUE
353	3.0%	4	▒▒▒	$35 - 50,000 VALUE
156	1.3%	5	■■■	$50,000 VALUE AND GREATER

Finally, Figure 5 is the map of non-residential construction from 1969 through 1976. The map shows only forties with at least one non-residential structure. Four-fifths of all forties showing development on this map did contain a single new structure. The only concentration of forties occurs within city limits or adjacent to the city. Most other development is strung out along the state and federal highway network as shown in Figure 5.

FIGURE 5: NEW NON-RESIDENTIAL STRUCTURES PERMITTED, 1969-1976



V83 - TOTAL NEW NON-RESID. STRUCTURES

WRIGHT COUNTY

MAP PRODUCED BY
MINNESOTA LAND MANAGEMENT
INFORMATION SYSTEM

1 0 1 3 6
MILES

NORTH

MINNESOTA STATE PLANNING AGENCY
LAND MANAGEMENT INFORMATION CENTER
15 CAPITOL SQUARE BUILDING
550 CEDAR STREET
ST. PAUL, MN. 55101

FREQUENCY LEVEL SYMBOL LEGEND

11468	99.1%	1	···	NO NON-RESIDENTIAL STRUCTURES INDICATED
97	0.8%	2	■■■	ONE OR MORE NON-RESIDENTIAL STRUCTURES INDICATED

LAND USE CHANGE

The development as described in the preceding maps and tables may result in changes in land use. Using the MLMIS classification system, when a forty finally contains five homes it is classified as "urban residential." When a forty gets a single urban non-residential structure it becomes classified as "urban non-residential" or "urban mixed residential." Any change in land use classification depends on the earlier land use and the earlier base. Thus an urban mix classification would not change if another urban non-residential structure were added. A cultivated forty with four homes on it would be classified as urban residential if one more home were added.

Air photo interpretations of Wright County before and after the study period were available. Though the interpretations had problems of inconsistency, they provided the best available. The interpretations indicate the number of residential structures and the number of urban non-residential uses in each forty in 1968 and 1977. The numbers were grouped into three classes: none, one-to-four, and five or more. The 1968 interpretations served as a base. Development would take place on this base and may or may not result in a change in land use. The 1977 interpretations were used as a check, assuming no demolition or structure moves had taken place during the eight years of the study. Ideally, this section would simply present land use change from 1968 to 1977 as indicated by permits. The class groupings of the photo interpretations impeded this work. Instead a more complicated analysis was made.

For a given forty, the before and after states are known as is the count of permits granted during the study period. A forty with no homes in 1968 and a single residential permit during the study period could be expected to be in the one-to-four class of residential structures in 1977. If the forty were in the one-to-four class in 1968, the number of permit applications necessary to move the forty into the next highest class, five or more, could be as many as four and as few as one. This reasoning assumes no homes lost during the study period. The same rationale can be applied to non-residential land uses.

Table 6 summarizes these relationships in residential land use change for all forties in Wright County. A count of the number of forties in various combinations of variables is presented. Thus in 5,937 forties with no structures in 1968 and no building permits issued during the eight-year study period, the 1977 count of residential structures was zero as expected. However, for 265 forties with the same history, one to four structures were indicated in 1977. In general, the shaded portion of this table indicates what one would expect the 1977 structure count to be were both systems, permit and airphoto interpretation, operating properly. Areas above and to the right of this shaded area indicate forties where construction has been undertaken without a permit application. Areas below and to the left of the shaded area indicate that a permit was not acted upon or that structures were removed.

TABLE 6: RESIDENTIAL LAND USE CHANGE AS MONITORED BY RESIDENTIAL BUILDING PERMIT APPLICATIONS

Number of Residential Structures per 40				
air photo count, 1968	permits issued 1969-1977	air photo count 1977		
		0	1-4	5+
none	0	5937	265	18
	1	296	190	4
	2	27	69	4
	3	4	20	4
	4	3	10	6
	5+	8	8	45
1-4	0	105	3229	28
	1	11	552	25
	2	0	116	13
	3	1	33	12
	4	0	13	13
	5+	0	23	40
5+	0	8	10	181
	1	1	5	79
	2	0	0	44
	3	0	1	30
	4	0	0	18
	5+	0	0	57

The results as shown in Table 6 are not as clean as would have been hoped. The second line of the table, for example, shows an error of over 150 percent with 296 forties showing a permit issued but no structure on the air photos compared to only 190 forties indicating what one would expect, one to four structures in 1977. Interestingly, an error of similar magnitude, 265 forties, is shown on the first line of the table. This latter group had moved from no structures to the one to four class without a building permit. If the air photo interpreters had shifted their geographic reference and switched forties, as was known to happen, these errors would nearly cancel each other out. With this single large error removed, the results of Table 6 would be much easier to believe. The 105 forties with one to four structures in 1968 and none in 1977 (with no permit issued) could have been abandoned farms which were pulled down to make way for corn [19]. It is also possible that the permitting system is operating inadequately. Or perhaps an improper geocode was attached to a large number of permits and this caused these discrepancies. The omission of the 1968 building permits probably accounts for some of the error.

Table 6 presents the results of residential land use change across the entire county. Earlier, it was noted that records of the urban portion of the county were less complete than those for rural lands. However those urban areas comprise a small percent of the total county area. Table 6 was reworked to show only the rural portion of the county and no significant differences resulted.

Air photo interpretations of non-residential uses have proved very inconsistent and hardly worth pursuing. Nevertheless a similar table was produced indicating counts of forties with respect to before and after counts of non-residential uses and number of non-residential building permits. The results are presented in Table 7. Given the problems with air photo interpretations, this table is more encouraging than might be hoped. Again large errors of similar magnitude above and below the shaded area exist that would nearly cancel each other out. The first line of the second column under 1977 air photo count shows 159 forties gaining at least one urban non-residential use with no building permit. Line seven of the first column indicates 117 forties (with no building permit) losing at least one non-residential use. If these forties had been switched, the magnitude of error in the entire table would be significantly smaller. Again, replicating this table for the rural portion of the county produced no signficant results.

TABLE 7: NON-RESIDENTIAL LAND USE CHANGE AS MONITORED BY NON-RESIDENTIAL BUILDING PERMIT APPLICATIONS

Number of Non-Residential Land Uses per 40				
air photo count, 1968	permits issued 1969-1977	air photo count 1977		
		0	1-4	5+
none	0	10,946	159	2
	1	21	16	1
	2	0	1	1
	3	0	0	0
	4	0	0	0
	5+	0	0	0
1-4	0	117	202	9
	1	3	19	9
	2	1	2	2
	3	0	1	2
	4	0	0	2
	5+	0	0	1
5+	0	0	8	26
	1	1	0	6
	2	0	0	4
	3	0	1	2
	4	0	0	1
	5+	0	0	0

CONCLUSION

In many ways this chapter is the essence of the report. It was possible to inexpensively prepare useful maps and tables of development and land use change in Wright County. What is not clear is how good this data is. The beginnings of an answer to that question are presented in the development tables (Tables 1-5). In these tables indications were given of the completeness of new land use and cost data. For the most part the permits are complete in this regard. The quality question is further addressed in the tables indicating land use change (Tables 6 and 7). The low quality of the air photo interpretation data which was used as a base land use and as a check on land use change, makes it difficult to generate conclusions about the permits themselves. The chapter therefore ends inconclusively. Tests of data quality are postponed until the next chapter.

CHAPTER 4: INTEGRITY OF THE BUILDING PERMIT DATA BASE

The integrity of the permit data used in Chapter 3 remains the critical factor in knowing how valuable building permits could be for monitoring development and land use change. Four critical aspects of this issue are explored in the sections of this chapter. The first aspect is whether necessary data was provided on the permit forms collected. The second, whether this study was able to collect all the forms that were thought to be available. Third, in quantified terms, how well were changes in land use, as measured by air photo interpretation, monitored by building permits. The low quality of the air photo interpretations meant that another test was needed to know how good an indicator building permits were of what was happening on the ground. This fourth aspect was determined through field tests in four sample areas.

MISSING DATA ITEMS

From the development tables presented in Chapter 3, a picture may be formed of the completeness of the key data items on the building permits. The items checked were: use of the new building, area of residential buildings (county only), and reported cost-of-construction. In general, all but the cost-of-construction data were excellent. Usually where data was missing, it could be seen that the county and some of the cities had relatively complete data that other jurisdictions had not collected. Missing data was usually caused by selected cities simply not being interested in those items. The county and other cities had complete records.

New building uses could be determined from virtually every permit. For townships (Table 1) less than half a percent of the permits had

undeterminable land use. For cities (Table 2) 3 percent were undeterminable. It must be remembered that only permits for major new construction were collected. Other information on these applications (e.g. cost) had been used to assure that they met this criteria.

Area of new residential buildings was available for 98 percent of all residential construction permits issued by the county over the study period (Table 3). Usually the other jurisdictions did not ask this question, but no attempt was made to quantify that lack.

Reported cost-of-construction was checked for only one year, 1975. This data item was not as frequently available as those above. For townships (Table 4) 12 percent of the permits were missing this information. Actually half that lack resulted from Frankfort Township not being interested in this item. For cities (Table 5) 22 percent of the permits lacked cost-of-construction data. The six cities that did collect this information had collected it quite consistently.

COMPLETENESS OF PERMIT FILES

Having collected and computerized building permits for an eight-year period, the question of completeness arose. All <u>available</u> permits had been collected. Were these all that should have existed? The only checks available are those originating with the jurisdictions themselves. These are counts made at the end of a time period. The best sources available are for residential activity (by far the most numerous), but they are different for incorporated and unincorporated portions of the county. The completeness for these parts of the county will, therefore, be presented separately.

Incorporated Parts of the County

A centralized record of number of housing units permitted in individual jurisdictions is prepared monthly by the Federal Bureau of the Census. A yearly summary of these reports is prepared annually [10]. The information for these reports is prepared monthly by permit-issuing jurisdictions that have volunteered to participate in this program. Through most of the study period 12 Wright County municipalities participated. The participant mails the summary form to the Bureau within 7 working days following the end of the month [50]. This summary obviously contains a record of units never built for which permits had been issued. The Bureau argues that it is more interested in permits issued [50], but that this is an excellent indicator of actual construction.

Census Bureau reports of housing units permitted were compared with counts of units permitted on applications collected from each municipality. An annual summary for the participating incorporated places is presented in Table 8. Absolute equality in these numbers for each year should not be expected, but totals should be close. For both single-family homes and for total residential units, the more current totals show quite good correspondence. In the earlier years less than half of the units reported to the Census Bureau were represented with a currently available permit. Some individual places, such as Buffalo, showed good correspondence across all years but, on the whole, the pre-1973 municipal records appear to be very incomplete.

TABLE 8: COMPARISON OF CENSUS DATA WITH COPIED PERMITS ON NUMBER OF PERMITS GRANTED FOR RESIDENTIAL UNITS IN INCORPORATED PLACES

	Single Family Dwellings		Total Residential Units	
	Census	Permits Copied	Census	Permits Copied
1968	82	NA	104	NA
1969	54	19	54	19
1970	89	42	102	48
1971	163	62	179	150
1972	106	70	241	122
1973	87	73	175	130
1974	71	60	127	124
1975	141	193	146	243
1976	196	185	216	231

The discrepancy between Census Bureau totals and the collected permits can be attributed to several causes. The percentage of construction permitted but never built may be high for small rural places. The permit fees for these places were minimal, so incentives for potential builders to be certain of their decision to build before applying for a permit are low. Numerous permits were found that had been marked "never built." (Such permits were not computerized for this study.)

Another problem was that some or all permits for earlier years had been lost or misplaced. The informal nature of many municipal filing systems was discussed in Chapter 2. This is a major reason for missing permits.

Regardless of the reasons, it is clear that, for the county as a whole, many building permits for earlier years in incorporated places could not be found. Unfortunately a significant portion of this building activity was in the cities. On the other hand a small proportion of the land area was represented by the missing permits.

Unincorporated Parts of the County

A check was also made on the permits recorded vs. permits collected for the unincorporated portion of the county. Use of the Census reports was considered as the basis for comparison, but instead a summary table of single-family dwellings and mobile homes prepared by the county [56] was used for several reasons. (This table is presented in Appendix G). First, the county table presents data for each township, whereas the Census presents unincorporated places as a single subtotal. With the county data, small geographic area accuracy checks could be made. Second, the county table counts only buildings where the owner appeared to follow through with his intention to build. It was estimated by the county that only 2-3 percent of all remaining permits were not acted upon [19]. Third, it was not known whether the Census totals included Frankfort Township or not. Frankfort Township data was included for 1975 and 1976 on the county summary sheet. Finally, county data included mobile homes.

The results of this comparison, summarized to yearly totals, is presented in Table 9.

TABLE 9: COMPARISON OF COUNTY RECORDS WITH COPIED PERMITS ON NUMBER OF RESIDENTIAL BUILDING PERMITS GRANTED FOR THE UNINCORPORATED PORTION OF THE COUNTY

	Single Family Dwellings		Mobile Homes*	
	County	Permits Copied	County	Permits Copied
1968	281	NA	94	NA
1969	276	285	132	121
1970	290	296	186	194
1971	299	297	191	199
1972	389	423	144	153
1973	482	479	90	93
1974	272	292	95	82
1975	248	230	59	51
1976	390	339	52	37

* NOTE: The rapid fall off of mobile homes is explained by a mid-1973 county regulation prohibiting mobile homes on parcels under 10 acres [21].

Results of the comparison are quite good. In most cases the numbers are only a few percentage points apart. The discrepancy in 1976 can be attributed to the fact that permits were copied in mid-autumn and more permits probably were issued later in the year.

Moreover, in a few townships where numbers corresponded poorly, the county rechecked their totals and found them closer to those of this study. The reason was that the counts for the earlier years had been done only after the new zoning administration had come in and instructed the staff to create summary tables for these years. In moving quickly through the applications, the staff had misassigned several. This was very easy to do on older permit application forms which did not have a check-off system for indicating type of improvement. Thus the 1970 count of

dwellings for Otsego Township changed from 35 to 20. This study had copied 19 permits there [19]. These minor checks and changes were not incorporated into Table 9.

The comparison of records in the unincorporated parts of the county indicates that the data for these areas is relatively complete.

CONSISTENCY OF LAND USE CHANGE ESTIMATES

The land use change predicted with building permits in Tables 6 and 7 matched reasonably well with the change as indicated by air photo interpretation. The match was not as good as one would have hoped. However the large amount of inconsistency in the air photo interpretations could account for most of the mismatch. Assume that each interpretation had a 10 percent error (low), the probability that an error would occur when combining the two interpretations would be 19 percent.* This would account for most of the error in the indicated land use change.

Residential land use change was indicated in Table 6. Within the expected shaded area were 10,713 of the 11,566 forties considered: 93 percent. But of the 1,785 forties where change would have been expected because of the existence of one or more permits, only 1,366, or 77 percent, were in the shaded area. This would mean a 23 percent error in predicting change using permits. However, only 4 percent of the error would be due to the permits if all measurements were independent.

Non-residential land use change was indicated in Table 7. Within the shaded area were 11,242, or 97 percent of the forties. In the 97

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* Interpretations are assumed to be completely independent. Therefore: $1 - [(1-0.1)x(1-0.1)] = 0.19$. In subsequent calculations permits will also be assumed to be independent of these interpretations.

forties with change only 68 (70 percent) of the forties were in the shaded area. If we stay with our 19 percent photo interpretation error, which seems quite low given the discrepancies in this land use category, only 11 percent of the error would be due to building permits. That error is probably much lower, but is still not bad considering that many photo interpreted urban non-residential land uses are not related to a building, e.g. nurseries, cemeteries, golf courses, gun clubs, and athletic fields.

ACCURACY OF PERMIT DATA AS A MONITORING DEVICE

Does the development indicated in our study match with what is happening in the county? Are there buildings in place for every permit on file? Is there a permit on file for every building? These are important questions for the general administration of the permit process and for the purposes of this study. The Census Bureau studies show that nationally only 2 percent of the housing units authorized by permits are never built [10, 1972, p. 360]. Furthermore, Bureau studies in the early 1960's show that "2.2 percent of total housing unit construction in permit-issuing areas were started without the issuance of a permit" [10, 1972, p. 361]. These figures do not apply to mobile homes. The Wright County Office of Zoning and Planning felt that their mismatches would not be substantially higher [19].

The best way to verify the limited extent of mismatches was through field checking. While field checking it was also possible to verify the correctness of other steps in this research such as: had the location of these structures been properly assigned? Two townships were selected for the field tests using the following criteria: they experienced substantial

development and they contained a mix of soil types, including some of the most productive. Within each of these townships, a rural section and a subdivision were selected at random which would be checked for correspondence. Permits for those four areas were pulled from the file and the areas visited in the fall of 1977. Where apparent discrepancies were discovered, residents were asked questions to try to resolve them. Unresolved discrepancies were then referred to the Wright County Office of Zoning and Planning which used its records and the records of other county offices, assessor and recorder, to determine the source of confusion.

In all, 72 permits were available for the area studied. They were equally divided between the rural portions of the townships and the subdivisions. A summary of the results of the field check are presented below in Table 10.

TABLE 10: RESULTS OF FIELD CHECK

	Rural	Subdivision	Total
number of permits	36	36	72
no structure found	2	1	3
structure without permit	0	4	4
incorrect placement	5	0	5
duplicate	1	1	2

In three instances no structure was found to match with an existing permit. In one of these cases a home had never been built. In the other

two cases, mobile homes had since been moved out. No check was made to determine whether structures built earlier had been removed from the housing stock.

A number of new homes were found for which the study had no permit. All were in subdivisions. In three of the homes the residents and county records verified that their homes had been built during the study period yet a double check of county records turned up no permit. A permit was on file for the fourth home. This permit had not been copied by the study personnel. Closer inspection of the permit indicates that it was not completely filled out and that the study personnel may have misinterpreted the purpose to be construction of a garage and therefore omitted it.

Five permits were incorrectly geocoded. All were in the rural portion of the townships. One of these was incorrectly coded to the wrong section, presumably by the applicant. The others were slight misplacements by the local assessors who had aided in locating the permit sites.

Finally, two permits were duplicates. One was a renewal permit for a home that the study staff should have caught. The other was a replacement for an earlier mobile home with no indication that this did not constitute new land development.

All four mismatch measures are indicators of the inability of permit applications to measure what is happening on the ground. In total, the errors amounted to 14 homes in an area with 72 permit applications or 19 percent. Of these errors, 6 were a result of staff work for this project, 3 were a result of mobile homes being moved out with no record in the county Office of Planning and Zoning (more "demolitions" may have occurred),

and 5 indicated some error in the permit granting process of the county. The percentage of error is then distributed among the three sources as follows: study staff or procedure, 8 percent; removals, 4 percent; and permitting process, 7 percent.

Two adjustments could have made these results much more positive. If mobile homes had not been considered, 3 errors would have been removed. This would reduce the study to 68 permits. Justifications would be that mobile homes do not represent a permanent investment or change in land use. In fact, it was their mobility that caused the 3 errors. Second, the proportion of assessor-located construction was high in the test area and a single forty mis-coded was the cause of 4 errors. If those errors were removed along with the 3 mobile home errors, the number of errors would be reduced by half. The total percent of error would then be 10 percent, roughly distributed as follows: study staff or procedure, 3 percent; removals, 1 percent; and permitting process, 7 percent.

It is impossible to say how representative this study area was. The proximity of permit process errors with national averages is encouraging. The magnitude of other errors does not seem unreasonable.

CONCLUSION

Four tests were made of the integrity of the building permit data. In general, it was found that records kept by the county government, for rural portions of the county, were quite complete in quantity and in data items completed on each form. While some cities could match this performance, urban portions of the county were less adequately covered in these two aspects. Two additional tests were made in the rural areas. First, a

quantified analysis was made of the match between urbanizing land use change as monitored with building permits and as indicated by air photo interpretation. The building permits were superior by wide margins. Finally, a field test was made in four areas to determine, on a structure by structure basis, the extent to which permits matched structure change. Errors appeared somewhat larger than on the previous test, but were still equal to or better than air photo interpretation.

CHAPTER 5: SUMMARY AND RECOMMENDATIONS

This study has attempted to use building permits to monitor development and changes in land use. The rationale for this approach was discussed and a pilot area was chosen, data collection procedures were developed and described, the results of the pilot study were presented, and the integrity of the permit data was investigated and reported. The major findings of each of these efforts are presented below. Recommendations are then made about improvements that could be made upon the methods used in the pilot study were a permit based monitoring system to be established.

SUMMARY

Planners and decision makers need to know what development and land use changes are occurring within their jurisdiction. Without this knowledge, there is no rational way to implement policy or to plan for the future. Conventional monitoring schemes lack for timeliness, categorical or spatial detail, accuracy, and cost. Several large jurisdictions outside Minnesota have already begun to use building permit information for monitoring, but have not documented their efforts fully. This study was an attempt to test the possibility of using building permit information to monitor changes in smaller rural jurisdictions. A rapidly growing county was selected since it could benefit most from the results of this effort if it was successful. Wright County, within the expanding commutershed of the Twin Cities and with a recently high growth rate, was chosen. Wright County was seen as not significantly different from

other counties, so the results could be applied elsewhere. The implementation of a standard building permit application as part of the new state building code carries with it the promise that such a monitoring system could be feasible and even practical for other jurisdictions in Minnesota.

A methodology was developed for capturing building permit data and putting it into a useful form. Computerized data files were created of all building permits for major construction over an eight year period in Wright County, 1969-76. These files contained relevant data from the permit application as well as information about the location of the land involved.

From these computer files it was possible to generate a variety of useful maps and tables. These presentations offer helpful insight into the development process in Wright County by summarizing the type, quantity, cost, and location of the development. The cost of preparing these presentations was quite modest. The impact of this development on land use was also analyzed and discussed.

The quality of the maps and tables generated in this study was tested by examination of the building permits going into them. The permits collected by cities were generally not as complete as those collected by the counties. They contained less information and more were unavailable for this historical study. The county permits were then subjected to two tests to see how well they matched with what was happening on the ground. Field tests in four study residential areas reveal errors as high as 19 percent, but if mobile homes were eliminated and geocoding

anomalies removed, this figure would have dropped to 10 percent. Air photo interpretation errors had been 25 percent and larger. Comparing anomalies in land use change measurements, the permits did much better than air photo interpretations, with errors as low as 5 percent.

Based on this work in Wright County it appears that a monitoring system built on building permits can yield reliable and useful information. It can do this for a low cost. It can do it better than air photos. This work was based on historical records of building permits. For the errors inherent in such data, the choice of a forty acre parcel as a base unit was probably too fine a scale of measurement. Were it to operate off current records, improvements could be made which would lower costs and errors.

The cost of collecting, processing, and presenting building permit data for eight years of data was $5,506 (see Appendix K). Were the following improvements made, indicated cost savings could be made: all permits geocoded, 45 percent; permits sent to a central location, 19 percent; area calculations made on all permits, perhaps 15 percent. These savings might have reduced costs to $600. Even if work were done on an annual basis, the costs would probably not exceed $200 each year.

The benefits of the work are hard to measure. Planners, administrators, and decision-makers would simple be able to do their jobs better. One measure of benefits available was supplied by a larger county in another state arguing that the office saved more than 10 person-months in completing various required reports alone. Surely these benefits exceed the minimal costs of such a system.

In contrast, air photo interpretations do not do well. Costs are much higher. Data is not as reliable. Details of land use type, value, and other useful information are not available. Frequency of information is much lower. In practically any measure of usefulness, air photos fare worse.

RECOMMENDATIONS

Monitoring land use change and development is an important task for the state and each of its component jurisdictions. Building (or zoning) permits could be an important part of this effort. Other parts might include use of satellite data, air photo interpretation, and, in some areas, computerized assessor records. In order to assure comparability of permit data the state would need to play a coordinating role. More than that, the state may want to bear some of the cost of the system in order to encourage participation.

The cost of establishing the system would be borne by the state, but the out-of-pocket expenses of doing the work would be borne by the jurisdiction. A package of desirable outputs could be available from which the jurisdiction could choose. The outputs presented in this report offer a start at the contents of that package. The jurisdiction would be able to summarize any time period it desires.

In order to improve upon the quality of the data presented in this report a number of changes would be made to the building permit. A standard form with full instructions could be designed and made available to all jurisdictions. This would facilitate in generating comparable data which is usually not possible when dealing with multiple jurisdictions [14]. The form would be multiple parts so one page can be sent to

the state. This form would contain an area for office use where coding information can be added. Of primary concern are the following data items which must be complete: geocode to forty (or smaller for cities), indication of new land use and old land use, cost of improvements, floor area of new construction, number of housing units, and land area of parcel. Items necessary for administering the building code or zoning ordinance would also be retained. Some counties may have unique requirements, so a portion of the standard permit would be left blank to accommodate this need.

Improvements also need to be made in the administration of the permit system. Many of these sources of error in the building permit system were unrecorded removals, incomplete geocodes, and slippage between permots issued and structures built. Whereas the state building code, and many local codes, require a permit to demolish or remove a structure, this requirement must be enforced if permits are to adequately monitor change.

The capture of a correct geocode could occur if the applicant worked with a clerk and a large scale map to specify location. Inspectors would have to verify location. Slippage in the permit system is the most difficult problem to resolve. Higher application fees and penalties for building without a permit could reduce some of the problem. An independent verification scheme is probably required. Inspectors could verify when permitted structures had been completed. Air photo interpretation, for all its problems, offers another verification. Assessor records probably offer the best verification since assessors work throughout the jurisdiction and are responsible for visiting each property every four years.

The results of implementing a permit system will be useful for the jurisdiction and for the state as a whole. All will have a better understanding of the dynamics of development and be able to better do their jobs of providing the citizens of the state with a safe and desirable environment.

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56. Wright County Office of Planning and Zoning, "Dwelling and Mobile Homes," unpublished permit summary sheet, Buffalo, MN, 1978.

APPENDIX A

WRIGHT COUNTY BUILDING PERMIT APPLICATION FORM

This is a blank copy of the building permit application form used by Wright County. Over 77 percent of all permits in this study were granted by the county. This type of check-off form has been in use since 1972. The earlier form was like those in use in many cities in the county in not requesting as much specific information as is shown on this form. It was phased out in 1972.

OFFICE OF PLANNING AND ZONING
Wright County Court House
Buffalo, Minnesota

APPLICATION FOR USE AND BUILDING PERMIT

LEGAL DESCRIPTION AND LOCATION

Permit No. _____

Date _____

Lot Block Addition

Tax Parcel # Lake Name Lake Classif. Sec. TWP Range TWP Name

IDENTIFICATION: Please Print All Information

	Last Name First Initial	Mailing Address - No. Street, City and State	Zip No.	Tel. No.
Owner				
Contractor	Name			

TYPE OF IMPROVEMENT:

( ) New Building
( ) Alteration (Specify:) _____ Room
( ) Other

RESIDENTIAL PROPOSED USE:

( ) One Family Dwelling (Stick Built)
( ) Mobile Home Dwelling
( ) Garage
( ) Other Size

NON—RESIDENTIAL PROPOSED USE:

Specify: _____

ESTIMATED COST OF IMPROVEMENT $ _____

PRINCIPAL TYPE OF FRAME:

( ) Masonry
( ) Wood Frame
( ) Structural Steel
( ) Other—Specify

DIMENSIONS:

Basement: ( ) Yes ( ) No
Stories above basement: _____
Sq. feet (outside dimension) _____
Bedrooms _____ Baths _____

TYPE OF SEWAGE DISPOSAL:

( ) Public
( ) Individual Septic Tank, etc.

WATER SUPPLY:

( ) Public
( ) Individual Well

HEATING:

( ) Electric ( ) Gas ( ) Oil
( ) Coal ( ) None
Other:

TOWNSHIP OFFICERS COMMENTS:

CHARACTERISTICS:

Lot Area is _____ square feet. Water frontage is _____ feet.

Building set back from high water mark is _____ feet. (Building Line)

Land height above high water mark at building line is _____ feet

Building set back from State Hwy _____ Feet _____ County Road _____ feet from township road or street is _____ feet. All measurements from centerline.

Side yard is _____ and _____ feet. Rear yard is _____ feet.

Agreement: I hereby certify that the information contained herein is correct and agree to do the proposed work in accordance with the description above set forth and according to the provisions of the ordinances of Wright County, Minnesota. I further agree that any plans and specifications submitted herewith shall become a part of this permit application. I also understand that this permit is valid for a period of four (4) months.

_____ Application Date

_____ Signature of Owner or Contractor

Permit: Permission is hereby granted to the above named applicant to perform the work described in the above statement. This permit is granted upon the express condition that the person to whom it is granted, and his agent, employees and workmen shall conform in all respects to the ordinances of Wright County, Minnesota. This permit may be revoked at any time upon violation of said ordinances.

_____ Issuance Date

_____ Office of Planning and Zoning

Permit Fee $ _____ State Surcharge $ _____

BUILDING INSPECTORS COMMENTS _____

Variance Granted (yes) (no) Date: _____ PLANS APPROVED: _____ Date _____

Conditional Use Permit Granted (yes) (no) Date: _____

_____ Signature of Inspector

APPENDIX B

RAW PERMIT DATA FILE

This is documentation on the data base created from the permit applications. These are the instructions given to coders for transfering the data to the sheets for keypunching.

The actual items chosen for transfer and the form of capture were copied after a permit monitoring system in use in several counties in northeastern Minnesota [3]. In particular, existing use (col 50-51), primary use (col 52-53), and proposed use (col 54-56) were categorized in the same codes as in northeastern Minnesota. The possible categories for each of these uses are given in Appendices C and D. These uses, in turn, were borrowed from work in Fairfax County, Virginia [4].

Some modifications were made to the borrowed scheme. Some data items, such as zoning class, were not available on Wright County permit applications and were dropped. Other important data items such as building size, were available and were added. Finally the entire format of the punch card was modified.

It is important to note that not all data was available on every form. Different jurisdictions used different forms. Even within the county, earlier forms did not contain information such as water setbacks. Even where the questions were asked, they were sometimes not answered.

CODING MANUAL FOR WRIGHT COUNTY BUIDING PERMITS*

Col 1-12 Public Land Survey locational code - all numbers right justified. Zero fill.

(12)

Col	1-3	township number
	4-5	range number
	6	"2" signifying west
	7-8	section number
	9-10	40 code
	11-12	government lot number, if any. blank otherwise.

13-14-15 Minor Civil Division Code - Census Codes

(3)

005	Albertville C(ity)	090	Maple Lake T
010	Albion T(ownship)	095	Maple Lake V
015	Annandale C	100	Marysville T
020	Buffalo T	105	Middleville T
025	Buffalo C	110	Monticello T
030	Chatham T	115	Monticello C
035	Clearwater T	120	Montrose C
036	Clearwater C (artificial number)	125	Otsego T
040	Cokato T	130	Rockford T
045	Cokato C	135	Rockford C
050	Corinna T	137	St. Michael C (artificial number)
055	Dayton C	140	Silver Creek T
060	Delano C	145	South Haven C
065	Frankfort T	150	Southside T
070	Franklin T	155	Stockholm T
075	French Lake T	160	Victor T
080	Hanover C	165	Waverly C
085	Howard Lake C	170	Woodland T

16 Subdivision Code

(1) '1' if in subdivision, zero otherwise

17-21 Permit Number, if any.

(5) Right justify number. Leave blank if no number. User number only, no punctuation. If year is part of number, use only the last two digits of the year (e.g. 76). Choose a standard for a given issuing agency, make a note, and stick with it. For example, always line up units position on year and place a zero in the tens digit (ex. 7601) of permit number so that those unit's digit line up too.

22-23 Year (last 2 digits)

(2) Leave blank if no year

24 Owner. Insert one of the following codes if data is available:

(1)

1	owner is a person
2	owner is a contractor
3	owner is some other private concern (business, corp., etc.)
4	owner is a public agency
	Blank if data is missing

*If data for a particular item below does not exist on the permit application, leave corresponding columns of code sheet blank.

25-29 Owner Zip Code.

(5) Blank if data is missing

30 Contractor. Insert one of the following codes if data is available:

(1) If just name listed (other than owner) assume he is contractor.

1 contractor is same as owner
2 contractor is a person other than the owner
3 contractor is a contractor other than the owner
4 contractor is a private concern other than the owner
5 contractor is a public agency other than the owner
Blank if data is missing

31-35 Contractor Zip Code.

(5) Leave blank if data is missing.

36 Type of Improvement. Enter one of the following:

1 new construction
2 addition to structure (should not be appropriate for this pilot)
3 moving in structure
4 mobile home
5 advertising device - sign, billboard, etc.
6 change in land use
7 other
Blank if data is missing

37-43 Dimensions

(7) Col 37-38 number of stories above basement in tenths. (15 means 1 1/2 stories)
39-43 outside dimension in square feet
Blank if data is missing

44-45 Number of Dwelling units, if residential use. Zero if non residential.

(2) Blank if data is missing

46-49 Lot Area. The size of the land parcel in acres to the nearest tenth of an acre. The last digit should always be the 1/10 acre. If given in square feet, divide by 43,560 to get acreage. Leave blank if data is missing.
(4)

50-51 Existing Use.

(2) Enter code from Appendix C if existing use is known. If unknown, leave blank.

52-53 Primary Use.

(2) Enter the code from Appendix C which describes a general use to which the land will be used. (residential = 13)

54-56 Proposed Use.

(3) Enter the specific new use of the land from Appendix D. This relates to the activity described in the permit, rather than the broad use of the land.

57-63 Cost - In dollars, right adjusted. Leave blank if data is missing.
(7)

64-68 Lake Number

(5) A lake number should be entered if the parcel is adjacent to the lake. This number can be found in Appendix A* of this manual/Cities in Appendix B.** The first two digits are county number. The next three are lake number, right adjusted. Any unused digit should be zero filled. If the parcel is not on a lake, code zeros.

69-70 Lake Classification, if parcel is on water. Otherwise code zero.

(2) Classification code accompanies lake number in Appendix A* or B.**

71-73 Shoreline Setback.

(3) Distance, in feet, to the highwater mark if parcel is on water. Code zero if not on water.

74-77 Highway Accessibility

(1) Col 74 Type one of the following:

1 U.S. highway
2 state highway
3 county road
4 township road
Blank if data is missing

(3) Col 75-77 Distance in feet
Blank if data is missing

78 Permit Origin

(1)
0 county
1 city or township

*This appendix was simply a subset of the DNR Classification list [2].

**This appendix was simply a subset of the DNR Classification list [1].

BIBLIOGRAPHY

1. Division of Water, Soils and Minerals, "Preliminary Classification of Waters in Municipal Areas," unpublished list, Department of Natural Resources, St. Paul, 1976.

2. Division of Water, Soils and Minerals, "Public Waters Classification for Wright County," No. 86, Department of Natural Resources, St. Paul, revised 1971.

3. Dennis Erickson and William McManus, Land Use Permit Users Guide, Arrowhead Regional Development Commission, Duluth, c1976.

4. Earl Nordstrand, formerly of the Arrowhead Regional Development Commission staff, personal communication, December 1978.

APPENDIX C

EXISTING AND PRIMARY USE CODE*

AGRICULTURE 01

Lands, either wet or dry, on which the overall purpose of human activity is the growing and/or care of crops[1] or domesticated animals[2]. Included are lands on which there are buildings that directly aid in the growing of the crops and/or the care of the animals. These buildings may provide shelter for the harvested crops, shelter for the animals, or may store equipment operated in the processes of caring for the crops or animals.

SILVICULTURE 02

Lands, either wet or dry, on which the overall purpose of human activity is the growing of trees for wood fiber, saps, gums, and/or resins. Included are lands on which there are buildings and facilities that aid in the care, growth or harvesting of the aforementioned tree products.

MARICULTURE 03

Water areas, either saline or fresh, from which any type of aquatic plant or animal is regularly harvested, for any purpose whatsoever.

MINERAL/FUEL EXTRACTION 04

Lands, on which the overall purpose of human activity is to remove organic or inorganic materials from the earthsurface. These materials may be removed by any means. Included are lands on which the first refinement, such as crushing, washing, grading, or beneficiation, of these materials occurs, if they are proximous to the source of the materials.

---

[1] A crop is a plant which is intentionally grown or harvested and applied in whole or in part, for human purposes, with the exception of trees grown for wood fiber, saps, gums and/or resins. Lands on which the overall purpose of human activity is the growth of trees for these products are considered to be in the class SILVICULTURE 02.

[2] As used throughout this text, a domesticated animal is any animal of any species that is kept by humans for non-aesthetic reasons or for tangeable rewards. Pets and animals in zoo and/or exhibitions are considered to be kept for aesthetic reasons and are therefore not included in this class. Tangeable rewards are considered to be live products such as milk, eggs, wool, feather, etc.; stock increase, draft, or other products such as hides or meat.

* source: Dennis Erickson and William McManus, Land Use Permit Users Guide, Arrowhead Regional Development Commission, Duluth, c1976.

MANUFACTURING/ASSEMBLY 05

Lands, buildings or structures in which the overall purpose of human activity is the further refinement of raw materials, the physical or chemical transformation of the processed materials into different objects, or the assembly of objects.

TRANSPORTATION 06

Lands, waters, buildings, or structures in which the overall purpose of human activity is the transport or movement of goods or people from place to place, or the temporary storage of transportation vehicles.

STORAGE 07

Lands or buildings in which the overall purpose of human activity is the storage of goods.

UTILITIES 08

Lands, buildings, or structures in which the overall purpose of human activity is the creation, distribution or conversion of energy sources; the processing or distribution of water and wastewater, or the disposal of solid wastes of any kind.

ELECTRONIC COMMUNICATION 09

Lands, buildings, or structures in which the overall purpose of human activity is the creation of distribution of electronically transmitted messages or for related facilities.

COMMERCIAL 10

Lands, buildings or facilities in which the overall purpose of human activity is the sale of goods. The sale of goods directly from the factory to wholesale, retail or other dealers is not considered to be a part of the COMMERCIAL category since it is the final step in all MANUFACTURING processes.

NOTE: The one exception is the retail factory outlet store. Since it performs the same function as a retail store, the area within a factory covered by the retail outlet is considered to be a part of the COMMERCIAL class even though the remainder of the building is in the MANUFACTURING/ASSEMBLY class.

SERVICE 11

Lands, buildings, or structures in which the overall purpose of human activity is the sale of activities performed for the buyer by other persons, or the sale of advice.

INSTITUTIONAL OR ADMINISTRATIVE OFFICES 12

Lands, buildings or structures in which the overall purpose of human activity is the provision of educational, religious, or governmental institutions, or for administrative offices of any kind.

RESIDENTIAL 13

Lands, buildings or structures in which the overall purpose of human activity is that of a permanent dwelling place. (Temporary lodgings such as hotels, motels, or resorts are classified as COMMERCIAL. Camping accomodations for either tent or recreational vehicles are classified as RECREATIONAL.)

RECREATIONAL 14

Lands, either wet or dry, water areas, or buildings in which the overall purpose of human activity is personal enjoyment and outdoor pastimes. Included are lands under any ownership designated for such purposes. (Indoor sports or 'cultural' pastimes such as the theater or bowling are included in COMMERIAL.)

UNUSED OR VACANT 15

Lands, buildings or structures in which there is no human activity, at the time of survey. Included are vacant buildings, and lands held for speculation but with no other discernable activity.

UNDETERMINED 16

Lands, buildings, or structures in which the human activities can not be determined at the time of study, for any reason.

APPENDIX D

LAND USE CODES*

Land use codes describe the proposed predominant land use of each land parcel.

0 Residential

01 Single Family, detached, or semi-detached

011 Single family, detached

012 Single family, semi-detached, or garden court

013 Two or more single family, detached on single parcel (including guest house or unit in detached auxiliary building)

014 Seasonal single family, detached

019 Single family structure NEC (Not elsewhere classified)

02 Two family

021 Duplex, either vertical or horizontal

029 Two family NEC

03 Townhouse or multiplex

031 Townhouse, in ownership development

032 Townhouse, in condominium development

033 Townhouse, in rental development

034 Multiplex (except duplex) in ownership development

035 Multiplex (except duplex) in condominium development

036 Multiplex (except duplex) in rental development

037 Combination of structure types, predominantly townshouses and/or multiplexes -- rental (may include apartments)

039 townhouse of multiplex structures NEC, including cooperatives

04 Apartments

040 Garden apartments, rental (up to and including four stories)

041 Garden apartments, condominium (up to and including four stories)

042 Medium rise apartments, rental (five to eight stories)

* source: Dennis Erickson and William McManus, Land Use Permit Users Guide, Arrowhead Regional Development Commission, Duluth, c1976.

043 Medium rise apartments, condominium (five to eight stories)

044 High rise apartments, rental, without commercial/professional (nine or more stories)

045 High rise apartments, condominium, without commercial/professional (nine or more stories)

046 High rise apartments, rental, with commercial/professional (nine or more stories)

047 High rise apartments, condominium with commercial/professional (nine or more stories)

048 Combination of structure types, predominantly apartments—rental (may include townhouses and/or multi-plexes)

049 Apartments NEC, including cooperatives

05 Mobile homes

051 Mobile homes in park or court

052 Mobile homes not in park or court

053 Mobile homes, seasonal

06 Residential structures (originally designed for hotels and motels, but now primarily used as dwelling units)

061 Residential hotels and motels

07 Group quarters

071 Rooming and boarding houses

072 Membership lodgings

073 Residence halls and dormitories

074 Retirement homes and orphanages

075 Religious quarters

076 Nursing homes

079 Other group quarters NEC (except military and correctional)

08 Transient Lodging

081 Motel without restaurant and/or other commercial amenities

082 Motel with restaurant and/or other commercial amenities

083 Hotel without restaurant and/or other commercial amenities

084 Hotel with restaurant and/or other commercial amenities

085 Tourist home

089 Other transient lodging NEC

09 Other Residential

091 Garage

092 Barn

093 Suana

094 Boat house

095 Other sheds

096 Private open space, swimming pool, tennis courts, private roads, parking areas, etc.

099 Other residential NEC

1 Industrial

11 Industrial park or conglomeration

111 Planned industrial park

112 Industrial conglomeration

12 Durable manufacturing, where not in industrial parks

121 Durable manufacturing -- lumber and wood products

122 Furniture and fixtures, stone, clay and glass products

123 Primary metal industries, fabricated metal products, machinery, electrical machinery, transportation equipment

13 Non-durable manufacturing, where not in industrial parks

131 Non-durable manufacturing -- food

132 Textiles, apparel

133 Paper and allied products

134 Chemicals, rubber, and miscellaneous plastic products

135 Printing and publishing

14 Research and testing, where not in industrial parks

141 Research and testing, where not in office building or office park

15 Wholesale, warehousing and storage, where not in industrial park

151 Wholesale, not in industrial parks

16 Contract construction, where not in industrial park

161 Contract construction

19 Other industrial NEC

191 Other industrial NEC

2 Transportation, utilities, communications (operating facilities not including offices)

21 Transportation

211 Railroad, including right-of-way, terminals, maintenance

212 Rail rapid transit, including right-of-way, terminals, maintenance

213 Bus, including terminals, maintenance, and special rights-of-way

214 Motor freight transportation

215 Street and highway right-of-way

216 Auto parking

217 Air including runways, terminals, and maintenance

218 Marine terminals

219 Other transportation NEC (including freight forwarding services and taxi transportation services)

22 Utilities

221 Electric, including transmission rights-of-way, generation plants, regulating substations, etc.

222 Gas, including pipeline rights-of-way, production plants, storage, and distribution points, pressure control stations, etc.

223 Water, including pipeline rights-of-way, treatment plants, storage, irrigation distributional channels, pressure control stations, etc.

224 Sewage, including treatment plants, pressure control stations, etc.

33 General merchandise, apparel, home furnishings, drugs (where not included in shopping centers)

331 Department stores

332 Discount stores

333 Variety of junior department stores

334 Apparel and accessories

335 Furniture, house furnishings

336 Drug stores

34 Good stores (where not included in shopping centers)

341 Supermarket

342 Supermarket plus general merchandise

343 Convenience grocery

349 Other food NEC (including fruit, meat, fish, etc.)

35 Eating and drinking (where not included in shopping center)

351 Restaurants

352 Fast foods

359 Other eating and drinking NEC

36 Automotive, marine, aircraft and accessories (where not included in shopping center)

361 Motor vehicle sales (new and used)

362 Gasoline stations and car washes

369 Other automotive, marine, aircraft and accessories NEC

39 Other retail NEC (where not included in shopping center)

391 Other retail NEC

4 Office Buildings and Office Parks

41 Office Park

411 Office park

42 Low rise office (up to and including four stories)

421 General low rise office

422 Medical and/or dental low rise office

423 Government leased low rise office (ninety percent or more floor area leased to government)

424 Government owned low rise office

43 Medium and high rise offices (five or more stories)

431 General medium or high rise office

432 Medical and/or dental medium or high rise office

433 Government leased medium or high rise office (ninety percent or more floor area leased to government)

434 Government owned medium or high rise office

5 Consumer and business service land uses (where not included in office buildings or shopping centers; usually in converted houses or converted stores)

511 Finance, insurance, real estate, and professional services

521 Personal services, including laundry, photo, beauty, barber, funeral, apparel, repair, etc.

531 Motor vehicle repair when provided separately from motor vehicle sales dealers and gasoline stations

541 Other repair services NEC

551 Veterinary hospitals

591 Other consumer and business service land uses NEC

6 Public and quasi-public service land uses (where not included in office buildings or shopping centers)

611 Cemeteries

621 Hospital and health facilities (except nursing homes)

631 Post offices

641 Police stations

651 Fire and rescue stations

661 Correctional institutions

671 Military institutions

681 Welfare and charitable services

691 Other public and quasi-public service land uses NEC

7 Cultural, educational and entertainment service land uses

71 Churches, synagogues

711 Churches, synagogues

72 Civic, social, fraternal, professional, business associations

721 Civic, social, fraternal, professional, business associations

73 Libraries

731 Libraries

74 Permanent exhibitions

741 Permanent exhibitions, including museums, art galleries, monuments, planetaria, aquariums, historic sites

75 Education

751 Nursery schools (may include kindergarten)

752 Public elementary, intermediate, secondary, high and special class schools

753 Private schools, kindergarten through grade 12 or any combination of these grades; may include nursery if school contains graded classes

754 College, universities, including junior colleges and professional schools (such as law, medicine, etc.)

755 Special training schools including vocational and trade schools, business, stenographic, barber, beauty, art, music, driving, etc.

759 Other educational services NEC

76 Public assembly, both indoor and outdoor

761 Places of publice assembly including theaters, stadiums, auditoriums, exhibition halls, race tracks, etc.

79 Other cultural and entertainment service land uses NEC

791 Other cultural and entertainment service land uses NEC

8 Recreation

81 Recreation facilities and parks--outdoor (except golf courses and except swimming pools not in public parks)

811 Private (except for homeowner association facilities)

812 Commercial--open to public

813 Government-owned--open to public without fee

82 Recreation facilities--indoor (except swimming pools)

821 Private

822 Commercial--open to public

823 Government-owned--open to public with or without fee

83 Golf courses

831 Private

832 Commercial

833 Government-owned

84 Swimming pools (except homeowners association pools)

841 Swimming pools--outdoor

842 Swimming pools--indoor

9 Resource uses and undeveloped area

91 Agricultural activities

911 Agricultural activities and related services

92 Forestry activities and related services

921 Forestry activities and related services

93 Horticultural activities

931 Horticulture activities and related services

94 Resource production and extraction

941 Sand and gravel quarrying

949 Other resource production and extraction

95 Permanent conservation areas

951 Permanent conservation areas, including wildlife preserves

96 Water areas

961 Water areas

97 Vacant land

971 Vacant land

972 Improved land with dilapidated structure of no visible use, incidental shed, etc.

99 Other resource uses and undeveloped area NEC

991 Other resource uses and undeveloped area NEC

APPENDIX E

MODIFIED PERMIT DATA FILE

A computer readable (SPSS) file was created from the raw permit file to contain data items which would be more useful for tabular presentation. Some of the continuous or many level responses were collapsed for reporting purposes using certain rational decision rules. A few new data items were created out of existing items. This appendix documents these details for those data items affected. All data items in this new file are fully labeled for SPSS output.

A. CODED VARIABLES

1. Subdivision Code (col. 16): Assume yes if within an incorporated area (see INCORP below in B.3.).

2. Year (col 22-23): Fifty-two applications, all from incorporated places, had no year code and could not be used in subsequent

3. Owner Zip Code (col 25-29) and Contractor Zip Code (col 31-35): Over 150 discrete codes were collapsed into 28 categories using the rules below. Each zip area is described below by a list of those appearing zip codes which make up the zip area. A listing of the zip codes of each city with a post office was used here [6]. Other unknown zip codes may exist within the area. The listings are peculiar because of the non-spatial way they were assigned to postal areas. Apparently, within each three digit area (which is spatial) post offices were alphabetized and assigned their last two digits sequentially.

No five digit map is available outside metropolitan areas. Phone books [4] contained maps of the urbanized area around the Twin Cities and an incomplete zip code map of the seven county metropolitan area [3] exists. For Wright and all other counties, the areas covered by the five digit zip code are unknown.

a. Each "major" city in Wright county plus the three largest cities on the edge of the county (Elk River, Watertown, and Winsted) was given a unique code. This accounted for 16 categories.

b. The remaining cities in Wright county, accounting for only 8 applicants and no contractors in the eight years of the study, were assigned to a class designated "remainder Wright." These cities were Dayton, Hanover, and Silver Creek.

c. "St. Paul" was a unique class composed of zip codes 55101 through 55106 and 55116.

d. "Remainder 551xx" was just that: all other zip codes beginning with 551. For most part, this area includes the remainder of Ramsey County.

e. "550xx" consists of all zip codes beginning with 550. This is a rural service area including most of Dakota County, eastern Isanti and Anoka counties and all of Chisago and Washington counties.

f. "Minneapolis" consists of all zip codes 55402 through 55419 and 55440.

g. "Minneapolis SW Suburbs" includes 55317-8, 55337, 55343, 55379, 55420, 55423-6, 55431, and 55435-8. This area includes most of southeastern Hennepin County with St. Louis Park as the northernmost point and crosses the Minnesota River to include Shakopee.

h. "Minneapolis NW Suburbs" includes 55421-2, 55427-30, 55432-4, and 55441-5. This area includes northeastern Hennepin County, with southeastern Maple Grove as the most northwestern point, and southern Anoka county including Coon Rapids.

i. "SW Hennepin County" includes 55331, 55340, 55348, 55356-7, 55359, 55361, 55364, 55375, and 55391-2. This area is that part of Hennepin county south of state highway 55 and west of county road 18.

j. "NW Hennepin and Anoka" includes 55303-4, 55316, 55369, and 55374. The remainder of Hennepin and western Anoka County represent this area.

k "South Fringe" includes 55312, 55322, 55325, 55334, 55336, 55338, 55342, 55350, 55354-5, 55367, 55381, 55385, 55387, 55397, and 55399. Southern Meeker, McLeod and most of Carver counties are in this area.

l. "North Fringe" includes 55308-9, 55319, 55329, 55353, 55371, 55398, 56301, 56369, 56374, 56379, and 56378. Northern Meeker, southeastern Stearns, and Sherburne counties are in this area.

m. All other zip codes (few) and unspecified zip codes (many) were ignored.

4. Outside Dimensions in Square Feet (col 39-43): This data item was time consuming to code since most permit applications listed the dimensions rather than the area of the structure. The area had to be calculated. It was assumed that any garage was not included in the dimensions. This item was not collapsed, but rather used to generate RESAREA and AVAL below.

5. Lot Area (col 46-49): Again, this areal figure had to be computed quite often by the coders. Again, hundreds of unique classes resulted. The rationale for each of the seven break points was supplied by the county planning and zoning director [2] and is given below.

   a. Less than one acre. These are usually older lots-of-record predating the county planning and zoning.

   b. 1-1.9 acres. The zoning ordinance will not allow smaller lots where public water and sewer are unavailable. This lot size tends to be in newer subdivisions.

   c. 2-4.9 acres. These lots were usually defined by metes and bounds descriptions prior to 1972. They have been allowed by conditional use since 1977.

   d. 5-9.9 acres. Residential lots above five acres are exempt from zoning controls. Those smaller than 10 acres, however, require a certificate of survey.

   e. 10-19.9 acres. Lots larger than 10 acres may be farms and qualify for green acres protection.

   f. 20-39.9 acres. This category was included simply to break up the larger lots into more categories.

   g. 40 acres or more. Definitely farms.

6. Proposed Use (col 54-56): Nearly one hundred codes exist here (see Appendix D) and many never occurred in Wright County during the study period. These were collapsed into several residential categories and single categories for each of the other major uses. These other major uses were defined by the first digit of the proposed use code. Thus all uses with the first digit of "1" were lumped into an "industrial" class. The makeup of the residential classes is described below.

   a. Single family detached. Code 011.

   b. Mobile home. Includes those in parks (051) and those outside parks (052).

   c. Other residential. This was a unique subset of the other residential codes which would certainly look like residential structures on air photos. Included were seasonal homes (014) and duplexes (021).

   d. Institutional residential. Includes garden apartments (040) and all other commercial (e.g. motel) and institutional (e.g. nursing homes) residential structures (053 through 099).

7. Cost (col 57-63): Hundreds of distinct categories were collapsed to a few. All cuts were arbitrary though tied to Census of Housing break points [1]. Additional categories were added to break up groups containing a disproportionately large number of entries. Classes are listed below.

   Note that estimated costs were copied off each permit application and were not adjusted for inflation.

   a. Under $10,000

   b. $10,000 - $14,999

   c. $15,000 - $19,999

d. $20,000 - $24,999

e. $25,000 - $29,999

f. $30,000 - $34,999

g. $35,000 - $49,999

h. $50,000 and over

8. Shoreline Setback (col 71-73): Over five dozen different distances were indicated. More could have occurred but distances were usually not measured precisely, especially for those homes set beyond the minimum for the shoreland zoning ordinances. The minimum distances were used as the cutpoints to collapse this variable [2]. The specific categories are listed below.

   a. 000. Parcel known to not adjoin water.

   b. 1-74. Less than any minimum setback requirement.

   c. 75-99. Seventy-five feet is the minimum setback for general development waters.

   d. 100-199. One hundred feet is the minimum setback for recreation development waters.

   e. 200 or more. Two hundred feet is the minimum setback for natural environment waters.

9. Road Type (col 74): Type was coded "0" for the single parcel on an island.

10. Road Setback: (col 75-77): Over one hundred individual responses were collapsed to four classes using the county ordinance as a basis [5].

    a. 000. One parcel on an island.

    b. 1-64. Below all minimums.

c. 65-129. Sixty-five feet is the minimum setback from center line of a township road or public road. Many applications simply indicated that this minimum had been satisfied.

d. 130 or more. Minimum setback from county or state road.

B. GENERATED VARIABLES

1. Residential Area (RESAREA): This variable was created for residential properties (proposed uses a. through c. above). It is the mathematical product of the raw outside dimensions and the number of stories in the structure. Where stories was unspecified, it was assumed to be 1.0. Note that here the basement is assumed unfinished at the time of original construction.

Hundreds of distinct estimates resulted. For tabulation purposes, these were collapsed. Recent county rules had restricted residences to a minimum of 800 square feet [2] so this was the first break point. Other break points were arbitrarily chosen. The five distinct categories are listed below.

a. Under 800 sq. ft.

b. 800-999 sq. ft.

c. 1000-1499 sq. ft.

d. 1500-2000 sq. ft.

e. 2000 sq. ft. or more

2. Imputed Value (AVAL): The estimated cost variable had three major deficiencies [2]. First it was often missing. Second, when given, it tended to be an underestimation of actual costs. Finally, cost was always given in current dollars so it would be difficult to compare costs across years.

These deficiencies could be corrected by computing an estimated cost (imputed value) based on the size of the structure. In fact, this is what the county does when attempting to compute the permit fee which is to be based on value [2]. The county's formula was followed. For single family or duplexes (raw proposed uses 011 and 021), the value was computed as $22.60 per square foot of residential area (see above) plus $4.50 per square foot of basement. It was assumed here that the basement was under all of the area covered by the outside dimensions.
Trailers and seasonal homes (raw proposed uses 051, 052, and 014) were assumed to have no basement. The value estimate was simplified to $22.60 per square foot of residential area.

The resulting estimate was collapsed into the same categories, for the same rationale, as cost above.

3. Incorporated Area (INCORP): Each permit contains a municipal code (col 13-15). These codes were collapsed into a new variable as follows:

   a. "0" townships

   b. "1" cities

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1. Bureau of the Census, 1970 Census of Housing Vol I, part 25 (Minnesota), Washington D.C., 1972.

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4. Northwestern Bell Telephone Company, "Minneapolis and Suburban Postal Zip Codes" and "St. Paul and Suburban Postal Zip Codes," in Minneapolis 1977 Yellow Pages, Minneapolis, January 1977.

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6. U.S. Postal Service, 1978 National Zip Code Directory, Washington D.C., 1978.

APPENDIX F

FORTY FILE OF PERMIT DATA

Any given forty may have had one, two, or dozens of building permits issued during the study period. It was necessary to collapse all permits to a single record. For each forty, and for each of the eight years, three summary attributes were computed: number of residential structures, average value of residential structures, and number of non-residential structures. Other data could have been summarized, but was not for this study. In addition, these three items were summarized for the whole study period. Thus 27 attributes were created for each forty with permitted building activity. The assumptions and steps behind this summarization is discussed herein. For all three attributes, no counts were made for a structure replacing another of the same type as determined by comparing proposed (col 52-53) and existing (col 50-51) uses. (Only 13 permits indicated existing use.)

The count of residential structures was the number of permits for single family detached, duplex, seasonal home or trailer as determined by the proposed land use code (col 54-56). These structures were deemed most likely to be interpreted as residential on the air photo and most like the legal definition of homestead.

The average value of these residential structures was imputed from its size. The form of this calculation is described in Appendix E. The average was taken across each forty for only those structures for which data on outside dimensions (col 39-43) were available. The result of this calculation is an average value of all new structures in 1976 dollars. Thus comparisons across years are possible. Final results are rounded to the nearest hundred dollars and collapsed into eight classes as follows:

Class	Value Range
0	no data--either missing size data or no construction
1	under $10,000
2	$10,000
3	$15,000
4	$20,000
5	$25,000
6	$30,000
7	$35,000
8	$50,000 or more

The count of non-residential structures was the number of permits for all other proposed land uses.

Below is the record layout of the summary data for each forty. The format is (I2, 2I3, 2I2, 2X, 27I2).

	Column	Data Item
Public Land Survey Code	1-2	county number ("86" for Wright)
	3-5	township number
	6-8	range number and direction code. For Wright County the last digit is always "2" signifying "west."
	9-10	section number
	11-12	forty code--see text
	13-14	blank
1969 Data	15-16	count of residential permits for 1969
	17-18	average value of residential permits for 1969
	19-20	count of non-residential permits for 1969
1970 Data	21-22	count of residential permits for 1970
	23-24	average value of residential permits for 1970
	25-26	count of non-residential permits for 1970
	.	
	.	
	.	
1976 Data	57-58	count of residential permits for 1976
	59-60	average value of residential permits for 1976
	61-62	count of non-residential permits for 1976
Totals	63-64	eight year count of residential permits
	65-66	eight year average value of residential permits
	67-68	eight year count of non-residential permits

APPENDIX G

SUMMARY OF RESIDENTIAL BUILDING PERMIT ACTIVITY*

DWELLING & MOBILE HOMES - WRIGHT COUNTY

TOWNSHIP	1966		1967		1968		1969		1970		1971		1972		1973		1974		1975		1976		1977		TOTALS	
	D	M.H.	D	M.H.	D	M.H.	D	M.H.	D	M.H.	D	M.H.	D	M.H.	D	M.H.	D	M.H.	D	M.H.	D	MH	D	MH	D	MH
ALBION	3	5	8	3	11	5	6	7	16	2	19	4	12	4	10	6	7	5	6	2	5	1	11	0	114	54
BUFFALO	16	5	12	6	10	1	10	4	12	7	11	6	20	5	34	4	22	2	12	3	47	2	17	3	223	49
CHATHAM	8	1	14	5	23	5	25	3	9	6	11	3	13	2	24	2	3	4	6	2	10	2	24	0	170	35
CLEARWATER	8	-	2	3	5	5	10	16	9	7	13	10	16	10	16	5	11	10	7	6	9	4	14	1	120	79
COKATO	1	2	-	1	2	-	3	2	3	4	3	2	1	3	6	1	8	3	4	1	5	0	10	0	46	19
CORINNA	24	1	24	5	29	5	19	12	16	3	34	4	45	3	33	1	29	-	13	2	21	4	28	2	315	42
FRANKLIN	14	3	14	3	29	8	17	3	37	12	27	5	38	3	40	4	15	2	13	3	25	4	33	2	302	52
FRENCH LAKE	7	1	6	1	9	3	13	1	14	5	9	6	6	4	14	5	8	2	7	1	9	1	16	3	124	33
MAPLE LAKE	13	6	19	8	29	3	25	6	10	4	17	4	19	2	21	1	20	3	15	-	31	1	24	2	243	40
MARYSVILLE	8	2	8	1	8	1	12	5	10	4	10	10	16	10	11	3	7	19	12	6	15	4	22	5	139	70
MIDDLEVILLE	4	1	9	1	5	2	5	4	8	3	6	6	5	6	9	4	2	3	8	2	5	0	12	1	78	33
MONTICELLO	21	5	25	9	27	14	26	14	24	28	28	25	47	21	55	5	26	6	39	5	42	6	57	4	417	145
OTSEGO	2	1	10	4	15	14	23	23	35	62	30	78	42	33	94	31	49	25	21	13	62	14	112	15	495	313
ROCKFORD	15	2	23	11	30	13	26	18	45	18	30	15	61	28	59	8	31	3	26	6	37	3	97	4	460	130
SILVER CREEK	8	4	7	5	7	6	18	8	10	5	15	6	20	-	22	1	9	2	14	2	17	0	19	4	166	43
SOUTHSIDE	17	8	19	8	30	6	18	1	20	4	17	1	16	3	16	2	7	3	15	2	16	1	17	1	218	41
STOCKHOLM	1	-	1	1	2	-	3	-	2	3	4	2	1	3	4	1	5	-	1	3	3	1	4	1	33	15
VICTOR	3	-	7	1	5	2	12	3	6	2	4	1	6	3	6	2	8	2	7	-	9	0	5	1	78	16
WOODLAND	3	3	6	3	5	1	5	2	4	7	11	3	5	1	8	4	5	1	6	-	4	4	10	0	72	27
TOTAL	176	50	215	79	281	94	276	132	290	186	299	191	389	144	482	90	272	95	232	59	372	52	532	51	3833	1232
GRAND TOTAL	226		294		375		408		476		490		533		572		367		291		424		585		5065	

FRANKFORT TOWNSHIP: 1975 = 16 homes 1976 = 18 homes 1977 = 40 homes

source: Wright County Office of Planning and Zoning

APPENDIX H

GOODHUE COUNTY PERMIT SUMMARY*

Building permits in Goodhue County are computerized. This allows the county to have prompt and flexible reporting. Monthly summary reports are created and sent to the Construction Statistics Division of the Census Bureau. Annual reports are prepared for the county.

Here is a copy of the 1975 annual report. The total number and value of improvements permitted in each township is sumarized by five improvement types. Unfortunately no finer geographic detail is available. Summaries of other special indicators of land use change are included in the report. Finally a summary of building activity across years for the entire county is presented.

*All information in this appendix was supplied by Joyce Bucher, Goodhue County Zoning Official, personal communication, July 26, 1978.

GOODHUE COUNTY ZONING
ANNUAL REPORT - 1975
BUILDING PERMITS SANITATION PERMITS

TOWNSHIP	HOUSE ADDITIONS & GARAGES		HOUSES		MOBILE HOMES		AGRICULTURAL BUILDINGS		COMMERCIAL	
BELLE CREEK	2 -	$ 6,600.00	2 -	58,000.00	1 -	10,000.00	13 -	91,580.00	-	
BELVIDERE	2 -	15,000.00	-		2 -	16,000.00	19 -	173,800.00	-	
CANNON FALLS	9 -	45,800.00	6 -	179,189.00	-		11 -	43,770.00	-	
CHERRY GROVE	7 -	26,772.00	-		-		13 -	124,300.00	-	
FEATHERSTONE	2 -	7,000.00	4 -	64,000.00	-		9 -	60,600.00	-	
FLORENCE	8 -	19,750.00	13 -	386,500.00	-		10 -	56,165.49	2 -	10,900.00
GOODHUE	5 -	22,500.00	2 -	45,000.00	2 -	13,900.00	12 -	89,380.00	-	
HAY CREEK	10 -	32,700.00	5 -	96,500.00	2 -	13,000.00	9 -	46,640.00	2 -	25,000.00
HOLDEN	3 -	28,500.00	3 -	126,100.00	-		9 -	98,600.00	-	
KENYON	4 -	41,500.00	-		-		7 -	92,092.00	-	
LEON	6 -	34,400.00	8 -	223,300.00	1 -	8,000.00	18 -	170,160.00	-	
MINNEOLA	8 -	27,800.00	2 -	61,000.00	-		11 -	111,653.00	2 -	17,500.00
PINE ISLAND	3 -	12,000.00	1 -	40,000.00	3 -	26,100.00	22 -	199,500.00	-	
ROSCOE	4 -	22,500.00	5 -	120,000.00	-		18 -	168,200.00	-	
STANTON	8 -	25,000.00	1 -	31,000.00	3 -	24,500.00	2 -	4,530.00	1 -	7,000.00
VASA	4 -	17,300.00	5 -	109,000.00	2 -	11,500.00	11 -	78,749.50	-	
WACOUTA	3 -	9,300.00	4 -	120,000.00	-		-		1 -	2,000.00
WANAMINGO	5 -	13,000.00	2 -	65,000.00	1 -	4,600.00	7 -	91,100.00	2 -	33,000.00
WARSAW	5 -	23,800.00	2 -	82,000.00	1 -	2,600.00	10 -	49,500.00	-	
WELCH	4 -	9,500.00	4 -	70,700.00	2 -	16,000.00	10 -	85,300.00	-	
ZUMBROTA	7 -	27,218.83	3 -	104,000.00	2 -	16,500.00	18 -	192,137.00	-	
TOTALS		$469,340.83		$1,991,289.00		$164,700.00		$2,047,676.99		$96,400.00

SPECIAL USE PERMITS	58
CHANGE OF ZONE	1
SIGN PERMITS	
SEWER CONTRACTORS LICENSES	24
SOLID WASTE COLLECTORS LICENSES	10
SANTATION	101

	1973	1974	1975
HOUSES	131	114	72
MOBILE HOMES	47	50	22
AGRICULTURAL BUILDINGS	306	335	239
COMMERCIAL	12	9	10
HOUSE ADD. & GARAGES	75	86	110
SANITATION	244	221	101
BUILDING PERMITS GRAND TOTALS	$6,984,904.00	$7,266,919.80	$4,763,406.83

APPENDIX I

AN EVALUATION OF AIR PHOTO INTERPRETATION CONSISTENCY IN WRIGHT COUNTY

A central concern of this study is accuracy of the air photo interpretation of Wright County lands. If that work were invalid in some way, the ability of permit data to replicate indicated changes in land use would be reduced. This appendix examines the consistency of air photo interpretations in Wright County. It begins with an explanation of the various classification schemes. It then details how these schemes were applied in Wright County. At the heart of the appendix is an examination of the consistency of the interpretations. Comparisons are made of various interpretations for a single year and changes in use over time within a given classification scheme. Finally, conclusions and recommendations are presented.

CLASSIFICATION SCHEMES

The basic land classification scheme considered is that of the Minnesota Land Management Information System (MLMIS). It is the MLMIS data base that this study would attempt to update using building permits. More specifically, it is the urban classes of land use that building permits have a potential for updating. Therefore, other classifications of the same land, concentrating on urban schemes will be considered. These other classifications are compatible with the MLMIS system.

Basic Classification System

Nine classes of land use were recognized and coded on the MLMIS map. These classes and their general explanation were part of the map legend [7] and are replicated in Table I-1. Every forty acre parcel in the state was coded into one of these categories based on dominant use.

TABLE I-1: EXPLANATION OF LAND USE CLASSES

FORESTED — A forty in which the dominant land use consists of trees. To be considered forested, a forty must contain a scattering of trees whose crowns cover at least 10 percent of the land area.

WATER — A forty in which the dominant land use is open and permanent water.

MARSH — A forty in which the dominant land use consists of non-forested, shallow permanently wet, vegetated areas.

PASTURE AND OPEN — A forty of non-forested land not used for any identifiable purpose. Examples are grazing land or abandoned farm land.

CULTIVATED — A forty in which the dominant use consists of land which has been recently tilled or harvested mechanically.

EXTRACTIVE — A forty in which the dominant land use consists of the extraction of minerals, including ancillary facilities. Examples are mines, tailing piles, gravel pits.

TRANSPORTATION — A forty in which the dominant land use consists of facilities for the conveyance of people or materials.

URBAN RESIDENTIAL — A forty containing five or more residential dwellings, and no commercial buildings.

URBAN NON-RESIDENTIAL OR MIXED RESIDENTIAL DEVELOPMENT — A forty containing at least one commercial, industrial, or institutional development and may or may not contain residential development.

What is not very well recognized is that dominant use was interpreted in two entirely different ways: economic and spatial dominance.[10] Spatial dominance is easily defined as majority (plurality) coverage; it was confined to the "lower" land uses. Economic dominance, on the other hand, employs a hierarchy of activities. The presence of a minimum level of a particular high level use overrides all other uses in classifying the land. Thus, in the MLMIS classification scheme, a single urban non-residential land use would override all other possibilities. Barring that possibility, five residential structures in a forty would class it as urban residential. For the most part, other land uses were classified based on spatial dominance.

Urban non-residential uses include the following: [6]

> "Schools, factories, hospitals, nurseries, cemeteries, golf courses, gun clubs, athletic fields, organized recreational facilities, business districts, churches, filling stations, government buildings, warehouses, storage tanks, grain elevators, military installations, sewage disposal facilities, fish rearing areas, radio and television stations, drive-in theaters, state and county garages, prisons, motels, nursing homes, junk yards, rail stations." *

Other Classifications of Land

Two other classifications of land were recently attempted.[8] This work attempted to separate land cover from land use. It was attempted in several pilot counties including Wright by the State Planning Agency.

The new land use classification system emphasized the higher uses. It is basically an urban land use system. All work was done on a 10 acre basis and summarized to forty. The basic "call" was the number of residential structures and the number of urban non-residential land uses in the cell.** That count was actually summarized into one of the three categories for both residential and non-residential: none, one through four, and five or more. Foreseeing the summarization to forty, a unique residential structure category was added where no 10 acre cell had five or more structures but the forty did contain that many structures.[5]

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* Multifamily residential structures have presented a problem. In early MLMIS work they were included as a non-residential use; later, they were moved to the residential class.[3] It is not known which rule was in effect in the 1968 interpretation in Wright County.

**Transportation and extractive uses were called at the 10 acre level, but not systematically summarized to the forty.[5] This gap affects only a handful of forties.

Though these counts should have allowed a perfect match with MLMIS urban land use interpretations, especially given their hierarchical nature, it is probably true that the counts were high. The interpreter was no doubt straining to find buildings and overcounted them.

The urban land use classification system is intimately related to the MLMIS land use classification scheme. The two MLMIS urban land use categories, urban residential and urban non-residential or mixed residential development, can be generated from the various categories of the urban land use scheme. To the extent that non-residential use consists of structures, the urban land use classification system is also intimately tied to buildings and building permits. Certainly residential structures can be tied to building permits. Thus it is the urban land use classification system that will be used to link the urban part of the MLMIS land use scheme to building activity as monitored by building permits.

The land cover system was based strictly on spatial dominance. Seven categories of land cover are indicated in Table I-3 below.* The categories are isomorphic with the non-urban MLMIS categories. No attempt was made to sort out the various urban land uses. All work was done at the forty level.

DATA SOURCE

Photographs from two different time periods were used. Each of the different interpretation procedures were used on the two sets of photographs. The details are described below.

Photography

The State Planning Agency contracted for high level photographs of southern Minnesota twice in the past decade: 1968 and 1977.[2, 4, 11]

* In this system, a differentiation was made between upland and lowland (wet) subcategories of three land covers: forest, cultivated, and pasture and open. Those subcategories have been combined in this work.

In both years stereo coverage 9 x 9 inch contact prints resulted. The same camera, with a 6 inch focal length lens was used. Black and white panchromatic film was used on both flights. There were differences in the two procedures, however.

In 1968, the photos were 1:90,000 scale.[2] The flights were flown east-west with seven passes per degree of latitude.[11] Thus the flight lines were nearly 10 miles apart. The quality was judged uniformly good. [3]

The 1977 photos were of 1:80,000 scale.[4] The flight lines now ran north-south and were centered on USGS quadrangles; therefore eight passes per degree of longitude were made.[11] Thus the flight lines were just over 6 miles apart. New processing techniques resulted in uneven quality of the final product and some prints were returned to the contractor to be remade.[3]

Photo Interpretation Procedure

Five different interpretations of these air phtos were made. The 1968 photos were interpreted for MLMIS land use and urban land use. For 1977 these two interpretations were made and a land cover interpretation was added.

This section will summarize the air photo interpretation procedures used for each year and classification system. Highway maps were used in all cases to determine location using lakes, roads, and other features. Section lines were traced on the photos themselves. An acetate grid was used to nominally subdivide each section to quarter-quarter (forty acres or "forty") or, with an additional quartering, to 10 acre cells. All work was done using stereo pairs of prints and two Old Delft stereoscopes.

Two interpreters viewed each scene and corroborated interpretations. One interpreter had prime responsibility for the call, the other was responsible for recording. One individual was the prime interpreter on all work described here.

The 1968 MLMIS land use interpretations were made about 1970 under the Center for Urban and Regional Affairs (CURA) at the University of Minnesota. Current county highway maps (circa 1968) indicating such cultural features as individual houses were used as an aid. The flight was made late enough in the spring so docks were in and lakeshore homes, otherwise hidden beneath trees, could be inferred from their presence.

The 1977 MLMIS land use interpretations were made by CURA in July of that year. Current county highway maps (1977) were used again, but by now the Department of Transportation was indicating individual houses only where they were quite scattered. Whenever homes were clustered, the maps simply indicate the number within an encircled area. An additional problem was that lakes were still frozen when the pictures were taken so docks could not be used to infer lakeshore homes. Probably the most useful aid to interpretation was the 1968 land use map which was available in large scale.

The urban land use interpretations of the 1968 and 1977 photos were made in the fall of 1977 by the State Planning Agency. A second interpretation was made in early 1978 on a spot basis where neighboring forties showed inconsistent changes with land use growth in one and decline in the other. In the second interpretation the 1968 and 1977 interpretations were made concurrently in order to remove error apparently caused by non-uniform interpretation and grid placement.[9] Older highway

maps (1973) were used as supporting information but these maps did not contain the cultural detail of the 1968 maps.[3]

The land cover interpretation was made for the 1977 photos only. This was done in the fall of 1977 by the State Planning Agency.

CONSISTENCY

Two types of consistency checks of interpretations were made. The first check was for consistency of interpretation within each year. The second check looked for reasonable changes between years.

Internal Consistency

The 1968 and 1977 internal consistency checks compared the various land classification schemes for each year. The various schemes are compatible for a limited number of categories. Comparisons were made on those compatible categories and presented in Tables I-2 through I-4. Table I-2 compares the MLMIS land use interpretation with urban land use for 1968. Table I-3 makes the same comparison for 1977. Finally, Table I-4 compares MLMIS land use interpretation with land cover for 1977. These tables count the number of forties in Wright County that fall in each category of the two interpretations presented in the table. Thus, in Table I-2, 146 forties were found to be classified as Urban Mix (Urban Non-residential or Mixed Residential Development) under the MLMIS land use scheme and as having one or more non-residential uses under the new urban land use scheme. The "few" urban land use category means fewer than five residential structures and no non-residential uses.

TABLE I-2 1968 CONSISTENCY

MLMIS Land Use	Urban Land Use "few"	5+resid. 0 other	1 or more other
Forest	1133	11	21
Water	707	26	13
Marsh	350	0	2
Pasture/open	1705	9	42
Cult.	6863	19	152
Extract.	6	0	1
Transp.	2	0	0
Urban Resid.	48	245	41
Urban Mix	22	2	146

TABLE I-3 1977 CONSISTENCY

MLMIS Land Use	Urban Land Use "few"	5+resid. 0 other	1 or more other
Forest	1072	16	12
Water	714	23	11
Marsh	360	0	1
Pasture/Open	827	2	16
Cultivated	7495	25	122
Transportation	12	0	5
Urban Residential	65	384	56
Urban Mix	52	17	260

TABLE I-4 1977 CONSISTENCY

MLMIS Land Use	Land Cover: Forest	Water	Marsh	Pasture/ Open	Culti- vated	Barren	Structure/ Paved
Forest	898	17	22	48	115	0	0
Water	15	673	21	15	24	21	0
Marsh	25	5	194	79	58	0	0
Pasture/Open	47	11	37	445	301	3	1
Cultivated	75	38	25	235	7268	0	2
Extractive	0	0	0	10	2	6	0
Transportation	0	0	0	3	13	0	1
Urban Residential	80	143	7	132	138	1	3
Urban Mix	18	14	2	136	149	0	10

For complete internal consistency, all forties of a given row in one of these tables would be in the shaded column. In Tables I-2 and I-3, fewer than five residential structures and no non-residential use could place a forty in any of the other MLMIS land uses. However, when the first of those minimums is exceeded, the forty should be classified urban residential; when the second minimum is exceeded, urban mix. Since the land cover system employs no hierarchy, only the first seven MLMIS land uses have a comparable land cover category.

The results are very disconcerting. In each comparison great inconsistencies are found. Many forties were coded as having one use (cover) under one interpretation and another use under the other interpretation. A summary of urban non-residential, residential, and other use consistencies bears out these conclusions. For example, in Table I-2

nearly three times as many forties would have coded "urban mix" under the MLMIS land use scheme if the "1 or more other" urban land use interpretation were used to label forties urban non-residential. In 1977, Table I-3 indicates that nearly twice as many forties could have been identified as "urban mix" by the same logic. Taking the "urban mix" category of MLMIS land use as the correct interpretation, one-sixth again as many forties should have shown "1 or more other" urban land uses in 1968 and over one-quarter again in 1977.

The picture for consistency of residential interpretations is much better, but not ideal. In both years about one-quarter more urban residential forties would have been found if the urban land use interpretations had been used. If the MLMIS "urban residential" class were used as a base, about one-third more forties would have been in the "5+ residential, 0 other" urban land use class.

Table I-4 indicates that these inconsistencies are not restricted to the urban categories. Here, dominant use/cover of non-residential land are shown to vary greatly by interpretation. Switches between cultivated and pasture and open classes are numerous. Large numbers of agricultural forties are also inconsistently interpreted as forested. Percentage inconsistencies in the other classes are as large or larger.

Consistency of Change

The second consistency check was to look for rational land use changes over time. The three variables that were cross-checked here were MLMIS land use, the residential structures portion of urban land use and the non-residential portion of urban land use. These checks are presented in

Tables I-5 through I-7. As with Tables I-2 through I-4, these tables present a count of the number of forties interpreted to have attributes indicated by row and column labels. Here the shaded diagonal is meant to indicate stability. The remainder of this section will discuss the patterns.

TABLE I-5 MLMIS LAND USE CHANGE

	1977								
1968	Forest	Water	Marsh	Pasture/ Open	Cult.	Extractive	Transport.	Urban Residential	Urban Mix
Forest	831	15	24	104	130	2	1	48	10
Water	12	632	11	12	31	0	0	42	6
Marsh	32	19	172	78	47	0	0	2	2
Pasture/open	115	32	121	421	982	8	7	37	33
Cultivated	93	24	32	224	6424	4	7	111	115
Extractive	0	0	0	1	1	4	0	0	1
Transportation	0	0	0	0	0	0	2	0	1
Urban Residen.	14	25	1	4	11	0	0	246	33
Urban Mix	3	1	0	1	17	0	0	19	129

TABLE I-6 RESIDENTIAL STRUCTURES CHANGE

	1977		
1968	0	1-4	5+
0	6267	550	79
1-4	109	3965	130
5+	9	16	409

TABLE I-7 NON-RESIDENTIAL USE CHANGE

	1977		
1968	0	1-4	5+
0	10,942	170	6
1-4	120	224	25
5+	1	9	39

The MLMIS land use change is presented in Table I-5. The various land use categories have been sorted into a semi-monotonic order of increasing development. For example, one would usually expect to drain a marsh to gain more cultivated land or to chop down a forest to make a pasture. One would not expect to knock down houses to create a new lake. The reverse trends are possible but not probable. Therefore one would expect most change to occur above the diagonal rather than below it.

The actual MLMIS land use change is not what one would have expected. Nearly 30 percent of all change is indicated as a loss of development. Ninety-six urban forties lost their character--about evenly divided between residential and non-residential forties. These loss "errors" are disconcerting but the urban residential loss is not disporportionately overwhelming. Some of the changes are easy to rationalize. For example, the loss of pasture and open acreage and the increase in cultivated acreage can be attributed to increases in the price of cash gains and has been documented by the Census Bureau.[1] The urban gains are understandable but quite surprisingly large. The number of residential forties is shown to grow by 50 percent and the number of urban mix nearly doubles. The internal consistency checks described above would lead one to view much of the indicated increase with caution.

The change in number of residential structures in a forty is indicated in Table I-6. Again the categories are ordered in increasing order of development. The picture here is easier to rationalize. A small percentage of change shows a loss of development. Most of this loss could be the removal of single abandoned farm houses in scattered forties.

Finally, the change in number of non-residential urban land uses in a forty is presented in Table I-7. The categories here are also ordered by development. The pattern of development is confused. Nearly two-fifths of all change is loss of development. This could be explained by suggesting that the large number and type of land uses which qualified as non-residential precluded consistent interpretations.

Following the initial urban land use interpretations the State Planning Agency reviewed many of these same inconsistencies with special emphasis on the loss of development.[9] The conclusion was that only 10 percent of the reported loss had actually occurred. The remaining "losses" were equally attributable to either shifting the geographic identification of a structure near a forty boundary or to subjective judgement and coding errors. It was to correct these problems that reinterpretation was done in areas of major discrepancies where one forty showed loss and its neighbor showed gain.[5] A single township of one year would be interpreted, then the same township would be interpreted for the other year.[3]

After these corrections were made, a driveable route through Wright County was laid out by State Planning Agency staff to field check remaining losses. According to the Agency the results were quite satisfactory.[5] For most sites evidence existed that the loss had actually occurred, for the remainder, it was impossible to tell. In the words of one of those involved "all of the sites checked out."[5]

Those arguments are consoling, but the sheer magnitude of the losses, especially in the non-residential uses, makes one skeptical. The internal consistencies of different interpretations each single year, 1968 and 1977, adds to this skepticism.

CONCLUSIONS AND RECOMMENDATIONS

Several steps could be taken to improve the consistency of the interpretations. The first five recommendations could and should be easily implemented on future interpretations. The remaining recommendations would require substantial effort to implement.

1) The more supporting information available to an interpreter, the more likely he is to make the correct call the first time. Previous interpretations (and notes) of the same area and highway maps from the 1960's could be useful tools. The MLMIS land use interpretations had one or the other of these tools available. Building permit information could also provide support data.

2) Simultaneous interpretation of the same scheme in the same area should increase consistency. The second urban land use interpretations had this advantage but only on a spot basis. A more inexpensive alternative, if available, is the previous interpretation.

3) The comparison with earlier interpretations could be facilitated by rapid feedback of inconsistent changes on maps if the interpretations are computerized. Such a system would be of benefit only if overnight turnaround is possible. The interpreter must not have passed the study area out of mind.

4) Interpreters do better work if they work continuously on the same effort. The cold start and the many different interpretation schemes used in 1977 may have reduced accuracy on that work.

5) High level photographs do not contain enough information to allow the interpreter to identify and count individual urban land uses within a forty. However it would have been desirable and possible to add an extra category of one residential structure or one urban use. Gains and losses would have been easier to identify and rationalize.

6) If it is desirable to actually count urban land uses, lower level photography must be made available.

7) The use of a nominal grid to define the space within a section, can cause problems for interpretation. Research into a means to correct this possible cause of distortion at a reasonable cost should be undertaken.

8) In the long run, a much finer geographic scale for locating urban land uses should be employed. Such a system would be some form of cadastre with ownership, location, and use information supplied by an operational file. Location might be specified by state plane coordinate.

This document has analyzed the consistency of land use interpretations of Wright County made from high altitude air photography. Various compatible land use classification schemes were studied which allow checking of consistency of interpretations for a given year. These schemes were also repeated over time making possible consistency checks by looking at reasonable changes over time. It must be concluded that

this analysis has found a surprising and disappointing lack of consistency. The error (inconsistency) in urban non-residential interpretation is often larger than the number of consistent interpretations. It appears that the residential interpretations are more consistent, and therefore useful, in checking the validity of building permits to monitor land use change. Nevertheless, even these interpretations must be used with some caution.

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APPENDIX J

FREQUENCY DISTRIBUTION OF DEVELOPMENT MAPS

The following tables present the count of forty acre parcels with characteristics displayed in Figures 3-5 in the main report. The maps in those figures display fewer categories than were presented in the data base--see Appendix F. The categories were collapsed since the scale of presentation allowed fewer levels in order to be differentiable.

TABLE 1: COUNT OF NEW RESIDENTIAL STRUCTURES PERMITTED PER 40, 1969-76

Number of Permitted Structures	Number of 40's	Percentage	Cumulative Percentage	Percent of 40's with Activity	Active Cumulative Percentage
0	9781	84.6	84.6	--	--
1	1163	10.1	94.6	65.2	65.2
2	273	2.4	97.0	15.3	80.4
3	105	0.9	97.9	5.9	86.3
4	63	0.5	98.4	3.5	89.8
5	34	0.3	98.7	1.9	91.8
6	30	0.3	99.0	1.7	93.3
7	24	0.2	99.2	1.3	94.8
8	11	0.1	99.3	0.6	95.4
9	13	0.1	99.4	0.7	96.1
10	13	0.1	99.5	0.7	96.9
11	6	0.1	99.6	0.3	97.2
12	3	0.0	99.6	0.2	97.4
13	3	0.0	99.6	0.2	97.5
14	5	0.0	99.7	0.3	97.8
15	7	0.1	99.7	0.4	98.2
16	3	0.0	99.7	0.2	98.4
17	3	0.0	99.8	0.2	98.5
18	1	0.0	99.8	0.1	98.6
19	2	0.0	99.8	0.1	98.7
20	3	0.0	99.8	0.2	98.9
22	2	0.0	99.8	0.1	99.0
23	2	0.0	99.9	0.1	99.1
24	3	0.0	99.9	0.2	99.3
25	1	0.0	99.9	0.1	99.3
26	1	0.0	99.9	0.1	99.4
27	2	0.0	99.9	0.1	99.5
28	3	0.0	99.9	0.2	99.7
29	1	0.0	100.0	0.1	99.7
31	1	0.0	100.0	0.1	99.8
35	1	0.0	100.0	0.1	99.8
42	1	0.0	100.0	0.1	99.9
43	1	0.0	100.0	0.1	99.9
52	1	0.0	100.0	0.1	100.0
TOTAL	11566	100.0	--	100.0	--

TABLE 2: COUNT OF 40's IN RESIDENTIAL AVERAGE VALUE CLASSES, 1969-76 CONSTRUCTION

Value Class	Number of 40's	Percentage	Cumulative Percentage	Percent of 40's with value data	Cumulative Percentage
No construction or no value data	9911	85.7	85.7	--	--
$10,000	48	0.4	86.1	2.9	2.9
$15,000	141	1.2	87.3	8.5	11.4
$20,000	251	2.2	89.5	15.2	26.6
$25,000	379	3.3	92.8	22.9	49.5
$30,000	327	2.8	95.6	19.8	69.2
$35,000	353	3.1	98.7	21.3	90.6
$50,000	156	1.3	100.0	9.4	100.0
TOTAL	11566	100.0	--	100.0	--

TABLE 3: COUNT OF NEW NON-RESIDENTIAL STRUCTURES PERMITTED PER 40, 1969-76

Number of Permitted Structures	Number of 40's	Percentage	Cumulative Percentage	Percent of 40's with Activity	Active Cumulative Percentage
0	11469	99.2	99.2	--	--
1	76	0.7	99.8	78.4	78.4
2	11	0.1	99.9	11.3	89.7
3	6	0.1	100.0	6.2	95.9
4	3	0.0	100.0	3.1	99.0
9	1	0.0	100.0	1.0	100.0
TOTAL	11566	100.0	--	100.0	--

APPENDIX K

ADJUSTED BUILDING PERMIT PROJECT COSTS

The real cost of any research and development project is always higher than anticipated and higher than the cost operating the developed system. Below are adjusted costs of collecting building permits, geocoding and computerizing them, and producing output reports. Many of these costs could have been much lower; for example, if each application had contained area and forty location or coding took place at the permitting site, substantial savings could have been made in labor or supplies. In the estimates given below, no change in methodology is made. Adjustments were made only to remove the mistakes and hesitations which are a natural part of such an effort. A second column estimates the cost of doing 1000 permits on a yearly basis. Both graduate and undergraduate students were used on the project. An average labor cost of $5.00 per hour is used. Rough estimates were used in many cases, but they seem close to reality.

Activities	Project	Annual cost/1000
Collecting building permit applications		
travel (incl. travel to county)	125	60
copier rental	220	50
labor (incl. travel time)	660	330
Geocode		
labor (staff only, no local assessors time)	2400	525
Computerization including data editing		
labor for coding	1630	330
keypunching (cards and labor)	80	20
computer costs	70	15
labor for preparing computer runs	30	25
labor for correcting edited records	160	30
Generate products		
computer costs for tables shown in report	20	20
computer costs for 3 maps in report	1	1
labor for these products	10	10
General Supplies	100	20
TOTAL	$ 5506	$ 1436

APPENDIX L

THE PUBLIC LAND SURVEY CODE SCHEME

Land outside the original thirteen colonies was surveyed by the government before settlement so that it would be ready for quick transfer to the new settlers. This work was called the Public Land Survey. Land was carved into townships which were six mile on a side squares. Each township was divided into 36 sections each one mile on a side. Sections, in turn, were divided, quartering and quartering these quarters. Where surveyors encountered water--lake or stream--the land area was measured exactly and termed a government lot. Most of these government lots are smaller than 40 acres and fit within a regular grid system of the quarter-quarter section scheme [1].

The land was then transferred to settlers. The area of land varied with the times and the carrying capacity of the land. In Minnesota, the forty predominated. All legal descriptions of property are tied to the Public Land Survey. Johnson has described the tremendous influence this alienation process had on the current look of the land [2]. Roads, forests and field lines neatly align with boundaries of the Public Land Survey. Against this background, the statewide land information system in Minnesota, the Minnesota Land Management Information System (MLMIS), adopted the forty as the basic unit of data capture, analysis, and mapping.

Building permit applications were each assigned a geocode which is the numerical equivalent of the quarter-quarter section. The MLMIS geocode was used [1]. This geocode contains 14 digits as detailed in Table 1 below.

TABLE 1: GEOCODING SCHEME BASED ON PUBLIC LAND SURVEY

Column	Entity
1-2	County number ("86" for Wright)
3-5	Township number
6-7	Range number
8	Range direction (always "2" for "west" in Wright County)
9-10	Section number
11	First section quartering number
12	Second section quartering number
13-14	Government lot number (if any)

The 11th and 12th digits together specify forty. A code scheme based on the standard geometric convention for number quadrants was employed for each digit. The northeast quadrant is numbered "1," the northwest, "2," the southwest, "3," and the southeast, "4." Thus a forty normally described as "the southeast quarter of the northwest quarter" would be coded "42" in the 11th and 12th digits of the geocode.

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311 Walter Library
117 Pleasant Street SE
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