Geospatial Genealogy:
Visualizing and Exploring Ancestral Place

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I. Background

One of the longings of many people immersed in family history is that we want to know where "our people" lived, worked, and worshiped. It is part of our link with our family past. We want to stand where our ancestral fathers and mothers stood, and walk where they walked; we want to see the ancestral family home, church, and cemetery, or at least where they once stood. No doubt this is particularly true when that past, and the places linked with it, have been defaced, damaged, or destroyed.

We believe that the tools of geospatial science provide a powerful means for letting us accomplish these longings – on the ground these tools can guide us, for example, to the exact places where great-grandfather lived and where he married his bride. At the computer, these same technologies permit us to do nearly the same thing, which becomes particularly valuable in cases where travel to distant places is not feasible.

Geospatial genealogy

Building on previous work in a similar vein, the term we introduce in this paper is *geospatial genealogy*, by which we mean the linking of traditional genealogical records and databases with the mapping, analysis, and visualization capabilities of online mapping programs like Google Earth and the more powerful capabilities of geographic information systems (GIS). The term geospatial simply refers to objects on the earth and their locational relationships to each other.

We envision our work as fitting into a larger schema that we call *geospatial macrogenealogy*. *Macrogenealogy*, in our view, looks beyond individual family trees by combining data from metrical and other genealogical sources to create what Wagner (2006) calls a "community forest."[1] It goes beyond family lineages and even distant kinship links to include all persons within a geographic area. Although family links are still vital, macrogenealogy, in our view, examines a wide range of relationships within a community as they are revealed in the historical records – these could include economic, social, cultural, and political relationships and patterns.

Geospatial at its simplest refers to using maps to record and analyze geographic, or spatial, patterns. Traditionally, the tools employed were printed maps and perhaps map overlays on transparent paper or plastic. Today the tools of the geospatial analyst focus on computer-based geographic information systems (GIS), and related tools such as GPS and remote sensing (air photos and satellite images).

Technological advances over the past 30 years have enabled geographers to combine these methods, using GPS to identify locations, remote sensing (satellite images and air photos) to identify objects visible from overhead, and geographic information systems for electronic mapping and analysis. Together, these geospatial technologies provide a powerful means for conducting pattern-and-process research.

We view geospatial macrogenealogy as being multiscalar geographically, ranging in scope from the community level (town, village, shetl, etc.), through the regional level (multiple to numerous communities in a county, raion, voivodeship, etc.), and up to the state or national level and beyond. The scale concept is flexible and is best viewed as a continuum from the smallest settlement to the globe, rather than as discrete groups segregated by size. In our initial research, we are focusing on the single town of Rawa Ruska, although we hope to expand our work geographically outward.

Related Research

It must be noted that the past three to five years have seen accelerating interest in applying computer-based mapping technologies to various aspects of family history, and we acknowledge the contributions made by others within this field.

For example, at this conference in 2008 a group from BYU (Moore, et al. 2008) used the term "geospatial family history" and described a tool, Family Tree Mapper, that could be used to map the locations of multiple generations from a single family. Similarly, Shular (2009) described using geographic information systems technology (GIS) to map ancestral homesteads, migration trails and key events, surname distributions and settlement patterns, and DNA groups. Dallen Timothy and Jeanne Kay Guelke (2008) published an edited volume exploring a wide range of topics relating to geography and genealogy.

In the following pages, we first describe the origins of our research and outline our data sources. Then we develop two threads. The first corresponds to the use of popular online mapping programs (Google Earth, in this case) to visualize and explore ancestral "places," ranging in scale from individual homes and buildings to entire towns. The second focuses on using geographic information systems together with genealogical records to explore the life of a village spatially and temporally.

II. Study Area and Data Sources

In this section we discuss "our" place of interest, Rawa Ruska, Ukraine, and the various data sources we have used in developing the concepts associated with geospatial genealogy.

Rawa Ruska

Karen Roekard, one of the authors of this paper, is a descendant of Hasidic Jews who lived in the region of Galicia, in what is now Ukraine. Some of her ancestors, including many killed in the Holocaust, lived in the villages of Rawa Ruska and Belz, near the present Ukrainian border with Poland.

She describes her discovery of her ancestral villages and how our collaboration began:

> "In 2005, I was fortunate to be able to live out my obsession with the idea of visiting Rawa Ruska and Belz, the eastern European towns in which my father was born and brought up. That should have been the end of it but on a torrentially raining day when it was impossible to drive anywhere, I found a tax list from 1812 in the Scientific Library in Lviv. On it were my ancestors' names, names that my nephews now carry in our generation, and the same house numbers from almost a century later, as I had found on the JRI-Poland (Jewish Records Indexing Poland) records. I didn't know it yet, but I was infected with the archival research "bug."
>
> In 2006, I went back and ended up spending two weeks in the Historical Archive in Lviv, collecting and photographing many other records including the "key" to identifying where each house and building was located in the town: the cadastral map. I was able to follow my ancestors throughout the 19th and early 20th centuries, as they stayed put, changed residences or expanded throughout the town, as they gave birth, as they died.
>
> But that wasn't enough for me. I became obsessed with the idea of seeing where every Jewish resident of 1812 and 1854 lived. I enlarged the maps and by hand wrote in the names of every Jewish family. The outlines of the old Jewish neighborhood became obvious as did the fact that while not what we would call "integrated," the Christian and Jewish residents of the town were not segregated, either.
>
> In June 2008, while participating in the Silberman seminar at the US Holocaust Memorial Museum, I showed my maps to University of Kansas Geography Professor Stephen Egbert and he invited me to join him in an experiment to explore, and define, what it might be possible to learn from examining genealogically relevant material through the lens of geography, of 'place.'"

Just as we are using geospatial genealogy to more fully connect with ancestors, their neighbors, and their patterns of life in two small towns in Ukraine in the 19th and early 20th centuries, we believe that other family historians will be able to use these same tools in a similar fashion, albeit in other times and places.

Data Sources

The key to our research, the Rosetta Stone, so to speak, is the cadastral map. Cadastral maps, in short, are maps of property ownership. They are used to show, at a minimum, the boundaries and ownership of real property parcels (real estate) within a given jurisdiction such as a city, county, or parish. Cadastral maps may also contain additional information such as unique identifying lot or house numbers, tax values, the locations of structures and other improvements, or adjacent street names.

However, the cadastral map would be meaningless without other records that contain the "house number link" to the cadastral map. Following are the primary record sources for our project.

(1) Contractual Material: These records – the Tabula Register Collection - are the original town books into which people copied the contracts they had undertaken – business, real estate, marriage and probate – and thus, the contracts were made legal. In Rawa Ruska, and the rest of "Galicia," these books were kept from ~1772 to ~1882. These records are in the Central State Historical Archives in Lviv, Ukraine.

(a) Books of Contracts: The contracts themselves have names of all the parties involved and often (especially in the real estate contracts) their house numbers, parents, spouse and/or children's names, and location of their property by identification of neighbors and geographic landmarks.

(b) Index Books of Real Estate Transactions: These books are an index of the real estate books and contain names of parties involved, former names, house numbers, old house numbers if changed, parents, spouse and/or children's names.

(2) Property Owners/Taxpayer Lists: These records contain listings of people who owned property and/or paid taxes within Rawa Ruska.

(a) 1812 Taxpayer's List: This assessment divided the community into the two categories of Christian or Jew and created separate lists for each. It contains name of taxpayer, house number for which they are paying taxes, and amounts paid on house, grounds, and farm animals. The original records were located in the Scientific Library in Lviv, Ukraine.

(b) 1854 Property Owner's List: This listing combined the Ukrainian, Polish and Jewish communities into one listing that followed an alphabetical, by family name, format and includes name, affiliation, and all properties owned (including house numbers) by each individual. The original records are located in the Central State Historical Archives in Lviv, Ukraine.

(c) 1934 Jewish Taxpayer's List: This listing contains only Jewish names and only their name and the amount of taxes they were assessed in 1932, 1933, and 1934. There are no house numbers on this listing. The originals of these records are in the Central State Historical Archives in Lviv, Ukraine; a decent microfilmed copy is available in the Archives of the Jewish People in Jerusalem, Israel.

(3) Vital Records: These records cover legally sanctioned or acknowledged life cycle events for which records were kept – Births, Deaths & Marriages. In Rawa Ruska people seemed to register these events by religious affiliation: Roman Catholic (seemingly Polish) and Eastern Catholic (seemingly Ukrainian – and for a period of time, written in Ukrainian) and Jewish. Christian records for Rawa Ruska are available through to the 1940s, albeit the latter years are a bit incomplete, possibly due to the war. Jewish records,

though representing a population that was murdered and that no longer has living representation in the town, are being withheld under 100-year “privacy laws” and are available only through the 1st decade of the 20th century. Microfilmed copies of Christian Birth, Death and Marriage records are easily available through the LDS Church’s microfilm data base. An abbreviated amount of information from the Jewish records (but not house numbers) is available online from JewishGen.org. The originals are in the Archiwum Glowne Akt Dawnych, The Central Archives of Historical Records in Warsaw.

Content of Vital Records: It can be assumed that: (a) Birth records will always have the baby’s and mother’s name and date of birth (plus baptism or circumcision and “legitimacy”); usually name of father, midwife, at least one set of grandparents and witness’ to registration; sometimes occupations and house numbers. Christian records all have ”station” and house number. Starting in the 20th century, Jewish records consistently recorded house numbers. (b) Death records usually contain date of death, name of deceased, age, cause and sometimes names of parents and/or spouse. Christian records usually contain house number; Jewish records do not. (c) Marriage records (Christian) generally have at least the date, partners and their parents names, religion of each partner, witness name and house numbers. Unfortunately, the Jewish marriage records for Rawa Ruska are missing. There are some indexes of Christian records that are very helpful because of the clarity of penmanship with which names are written.

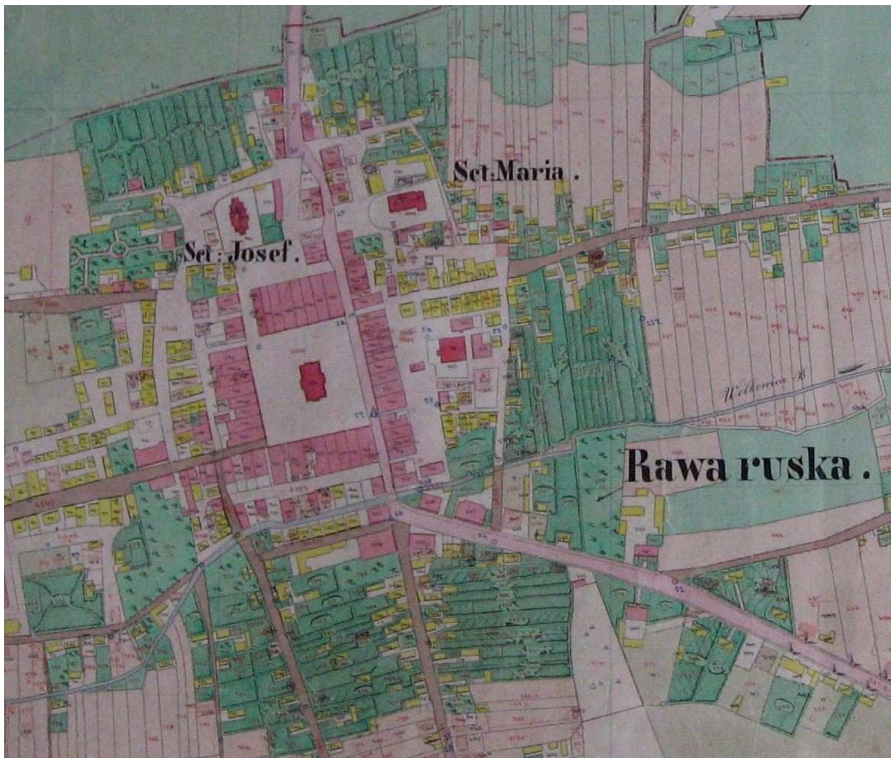

Figure 1. Rawa Ruska cadastral map, cropped to highlight the town of Rawa Ruska and surrounding fields. Buildings in pink are brick, those in yellow are wood.

III. Using Google Earth and a Cadastral Map to Explore Rawa Ruska

We have begun exploring the use of Google Earth as an easy way to overlay 19th century cadastral maps of towns in Galicia on top of present-day satellite images. This can be done by adding a photo of a cadastral map in Google Earth as an "image overlay." The map is then moved and stretched into place using features you can see on both the map and the satellite image as reference points.[2] These might be road intersections or large permanent buildings such as churches. Any surveyed map can be used – it doesn't have to be a cadastral map.

The best part of overlaying the cadastral map is that once it is positioned correctly you can use a slider to make the map appear transparent or opaque, or anything in between. This lets you see where buildings and roads have disappeared, where they have been added or changed, and perhaps most exciting, where they still exist. The image overlay of your map can be saved to your Google Earth Places and can also be shared with others. Making image overlays can be easily accomplished by referring to Google Earth's online help. (We have also created a brief write-up that details how to do this.)

Figure 2 illustrates the effect created by overlaying a cadastral map on a satellite image in Google Earth. It can readily be seen that the building on the town square and the synagogue (red squares) no longer exist. The two Christian churches (Sct. Josef and Sct. Maria – yellow circles), on the other hand, are still standing. Further examination reveals that many of the residential structures, especially around the town center, have disappeared. In some cases, new structures have been built, while in others the land is vacant.

We have found that in some cases where a building has disappeared it is possible to zoom in to Google Earth and see the outlines of the foundation of the building, even after it has long disappeared. Such outlines, which may be from stones or cement rubble or perhaps from vegetation growing poorly in the shallow soil over the former foundation, are "relict" features from bygone eras that provide visual cues and reminders of what once was. In other cases, of course, there are no traces at all, except the virtual or "ghost" features seen only on the old cadastral maps.

Visual exploration of an ancestral village like Rawa Ruska is only the beginning, of course. By cross-referencing the house numbers found in vital records with the corresponding numbers on the cadastral map it is possible to identify geographic coordinates for specific homes, buildings, and other locations. These can then be uploaded to a GPS that can guide the genealogical tourist to the exact spot (usually within a few meters) of where the building stands today – or, in the case of the destroyed synagogue in Rawa Ruska, where it once stood.

Figure 2. Screen captures of Rawa Ruska from Google Earth. The picture on the left is a satellite image of Rawa Ruska as it appears today. On the right, the 1854 cadastral map has been overlaid on the modern satellite image as a transparency. Refer to text for further explanation.

A further dimension can be added once the original site of interest has been located on the ground. You can take photos of the location and "geotag" them by adding the geographic coordinates to the EXIF metadata of each photo. This can be done manually using any one of several free or inexpensive pieces of geotagging software or directly in the field with a GPS-equipped camera. The advantage of geotagged photos is that they can easily be added to Google Earth or similar programs as an additional and important way of visualizing the ancestral village or home. It would be a relatively simple matter to modify the photo's popup in Google Earth to include genealogical information about the former occupants of a home, for example.

IV. GIS, Geospatial Genealogy, and Rawa Ruska

At a very superficial level GIS is sometimes thought of as computerized map making. While there is some truth to this, the capabilities of GIS go far beyond the ability to use computer programs to draw maps. A geographic information system consists of computer hardware (normally a high-end PC or "workstation"), specialized GIS software, and geographic ("geospatial") data. One definition of GIS puts it this way: "A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information." (ESRI, 2010)

The roots of GIS go back to the 1950s and 1960s, when government agencies and university laboratories began harnessing the power of computers to assist in collecting, storing, and mapping complex data sets for purposes such as censuses, land use planning, and utilities management (Longley et al., 2005). With ever increasing computer hardware capabilities, especially in data storage, processor speeds, and graphics, coupled with developments in spatial analytical algorithms, GIS has become a powerful analysis and management tool. Today, virtually all levels of government, from municipal up to national, have GIS departments, sections, or "shops" to manage and communicate their geospatial data. GIS is also used extensively in the private sector for applications ranging from route planning to analyzing potential locations for warehouses or retail outlets. GIS is a multi-billion dollar industry, complete with specialized university programs, textbooks, and annual industry conferences.

Genealogy databases vs. GIS databases

Places, while important in family history research, often are poorly represented in genealogy databases. In genealogical research, locations typically are thought of as a nested hierarchy of places, starting at the national scale and proceeding down to the name of a town or village at the finest level of detail. Traditionally, locations have been given as town, county, and state for the US or, in the case of countries outside the US, town, province, and country (this, of course, varies widely from location to location). In the organization of GEDCOM files, places are treated as strings of characters rather than as separate data fields that could be more easily searched and parsed as can name and date fields. Occasionally a specific locational feature like the name of a church, synagogue, or cemetery might also be included, although these tend to show up in Notes fields. Street or building addresses, as such, are rarely included and generally there is no specific data field, or set of fields for them in family tree software.

In GIS databases, on the other hand, the key piece of information is always location, whether it be latitude and longitude or other map coordinate system. Everything else in the GIS database is tied to the location – the "everything else" might include things like the street address, the name of the property owner, the number of occupants of the home, the value of the property, the size of the home on the property, and so on. These pieces of information are called "attributes" in GIS. Conceptually, we often think of a GIS database consisting of a series of maps or map layers stacked on top of each other (Figure 1).

Because of the underlying database structure, GIS is much more than the computer equivalent of a paper map. In particular, GIS combines the power of database queries with graphic presentations. For example, a GIS analyst might say, "Show me all the houses within the county boundaries that have an assessed value of less than $250,000 that are located greater than 300 feet from a fire hydrant." In this case, we are assuming that map databases already have been created for county boundaries, assessed property values, and the locations of fire hydrants. The result of the query can be displayed on a map or in the tabular form familiar to database or spreadsheet users. In only a matter of

seconds, the query could be changed to another set of variables and parameters. Because of this ability to access the underlying databases and display the results graphically, GIS maps are sometimes referred to as “smart maps.”

Creating our GIS Database of Rawa Ruska

In our case, the key map layer is an 1854 cadastral map of Rawa Ruska showing the locations of houses and buildings along with their numbers (Figure 3). These building numbers are included in some of our other record sources and enable us to tie various genealogical attributes to the houses through time.

The Rawa Ruska cadastral map was photographed in the archives at Lviv using a digital camera. To prepare the map for inclusion in a GIS, the photograph was used as a visual backdrop in ArcGIS, a commercial GIS software program, and each of the buildings was traced using the mouse cursor, a process called screen digitizing, then saved in the GIS. The outlines of Rawa Ruska’s buildings and houses shown in Figure 3 formed the base map layer for our GIS and were now ready for attributes such as house type (brick or wood), tax value, owner’s name, religion/confession of owner, and many others.

Attributes were entered and organized using an Excel spreadsheet – we also could have used a database program or entered the attributes directly into the GIS program’s own database. The spreadsheet was then imported into the GIS database. This was done by matching the house numbers in the GIS database to the same house numbers in the corresponding column in the spreadsheet. With the base map and attributes in place, we were now ready to perform some basic queries to explore the residential patterns in Rawa Ruska.

Figure 3. Buildings and houses in Rawa Ruska after being screen digitized from the cadastral map and saved in the GIS database.

Initial GIS Results

At the simplest level, a query can be made to discover information about each house or building. For example, by using the mouse to click on a particular house, an attribute window will pop up showing all the data attributes for that house. In Figure 4, house number 40 has been selected (outlined in red) – we can see from the attribute database table that the owner in 1812 was Hertz Baran, that he was Jewish, and that his house was constructed of wood. Conversely, we could have opened the attribute database table from which we selected a house number or owner and seen the house highlighted on the map.

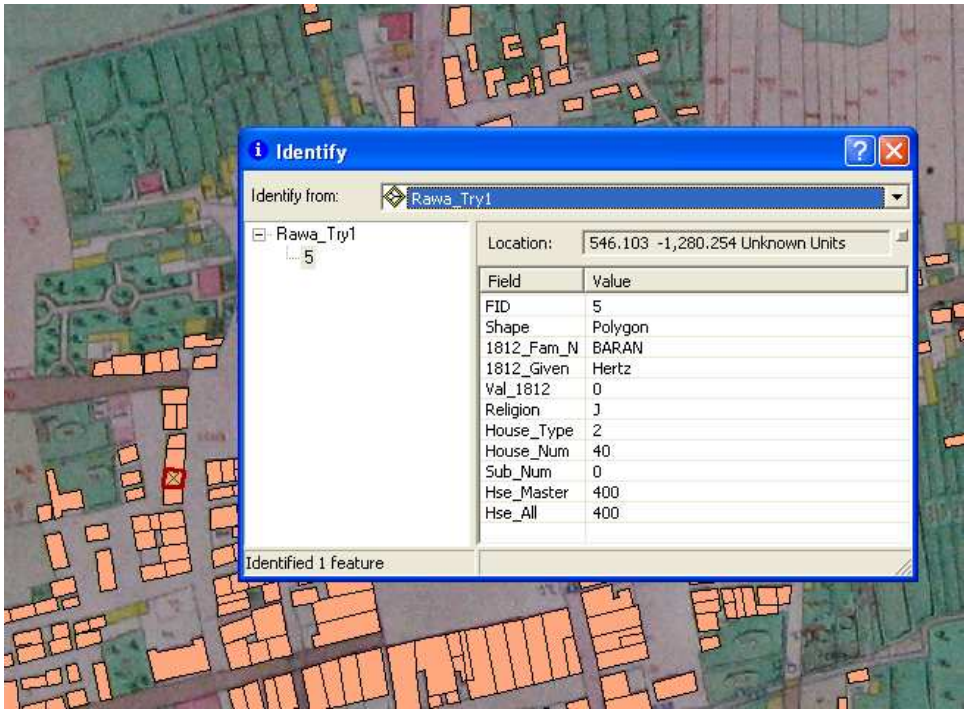

Figure 4. Example of a simple query. House number 40 has been selected and the attribute database table has popped up to show the attributes tied to that house. We can see, for example, the owner's name, his religion, the house number, and construction type (wood) of the home.

In a somewhat more complex fashion, a query can be built that will highlight all the houses and buildings that fall into a particular category. For example, we can ask the GIS to show us all the houses occupied by Jews in 1854 (Figure 5). As a result of the query, we can see the geographic, or spatial, patterns of Jewish residences in Rawa Ruska in that year. Not surprisingly, we see several clusters or neighborhoods of homes where Jews lived in close proximity to each other. Also not surprisingly, we see very few Jewish residences in the neighborhoods of the two Christian churches, Saint Joseph and Saint Mary (Sct. Josef, Sct. Maria on the maps). We also see most Jews living in wooden rather than brick structures, which no doubt is a reflection of the overall poverty of the Jewish community in a relative sense (this judgment was easily made by visual means, but we also could have performed a query that would specifically show the number of Jewish

homes that were brick or wood). We further can see that very few Jews live in residences facing the town square and we see that it appears that there is not a single residential area restricted only to Jews. In fact, their homes are found in most parts of the town itself as well as in the surrounding rural area.

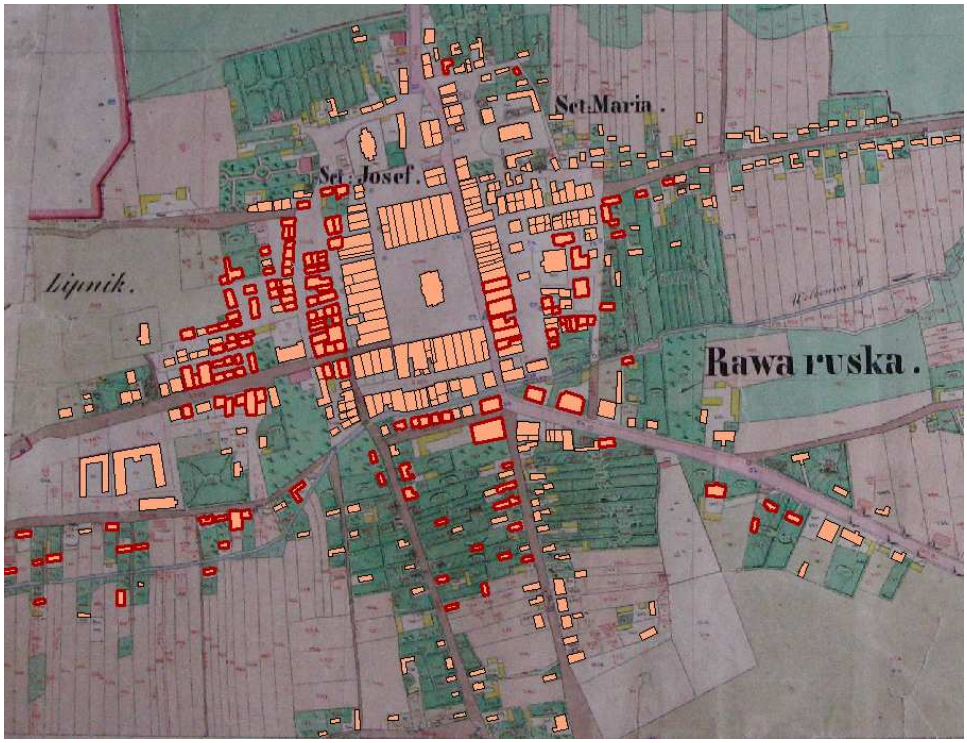

Figure 5. Homes listed as owned by Jews in Rawa Ruska in 1854 (outlined in red).

VI. Future Plans/Dreams

As we began our research, at first we envisioned somewhat limited goals – maps of individual residences or perhaps all residences by confession or ethnicity for a single year, for example – such as those seen from our initial results. Now our goals have begun to expand as we increasingly come to understand the potential power of geospatial technologies and genealogical databases.

As it stands now, we have identified the following goals for future development:

- Add and link other records from Rawa Ruska to the geographic database. In some cases, these may be vital records of various types, in others, they may be records of donations to various causes.
- With the extended database, further explore the spatial patterns in Rawa Ruska as the basis for understanding the processes that led to the patterns in the first place.

We know, for example, that by the early 1900s many Jews lived in homes surrounding the town square – when and how (and why) did that happen?

- Expand our analysis to surrounding settlements in Eastern Galicia (especially the town of Belz). We are confident this is possible because of the large number of existing cadastral maps and corresponding cadastral and vital records that use house numbers.
- Develop the interface between the disparate database worlds of genealogy and GIS. This is perhaps the most important problem facing us. To this point, we have primarily used "brute force" methods to link genealogical and GIS databases. We need to identify and develop more elegant solutions that will permit broader application of these technologies by more family history researchers.
- Finally, we wish to widely publicize this effort to genealogists working in other realms, both topically and regionally to build further capabilities in visualizing our ancestral lands and homes.

Notes:

[1] We acknowledge that our view of macrogenealogy is somewhat at variance with that of Wagner, who views macrogenealogy or "global genealogy" as involving "issues and tools relevant to genealogy as a whole." Our geospatial genealogical research most likely would fall under the heading of "confined microgenealogy" in his taxonomy. Despite our differences in terminology, we are indebted to him for describing his thought-provoking vision of the scope of academic genealogical research.

[2] The tools in Google Earth for matching cadastral or other maps to the underlying satellite imagery are essentially crude tools for performing a procedure known as image rectification. Ideally, image rectification would be done using image processing software, where numerous control points are combined with mathematical models to "rubber sheet" an image to fit the earth's geographic coordinate system.

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