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Building Roseburg Public Library's Community Demographics Dashboard

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By

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Abstract

In a globally connected society becoming increasingly reliant on data, community GIS practitioners help bring spatial data to community organizations and other community partners in the form of data acquisition, collection, analytics, visualization, and presentation. Many Community GIS practitioners help their community partners better serve their community by harnessing the power of GIS, including community partners who advocate for and provide services to their community. Public libraries are one such service-providing entity that has been struggling in modern times, especially in rural areas. The Center for Geography Education in Oregon received grant funding in 2020 from the Institute of Museum and Library Services for the GIS-Mapping Exchange, a program meant to provide funding and help connect public libraries with GIS technology while fostering relationships with local GIS professionals. During the summer of 2022, a partnership was formed with the Roseburg Public Library in central Oregon. This report documents not only an example of community GIS, but also a pilot project for the GIS-Mapping Exchange. The goal of this partnership was to create operations dashboards for the library, summarizing their active library cardholder data alongside demographic data from the 2020 US Decennial Census, the 2020 American Community Survey, and current Student Enrollment data from the Oregon department of education. The data for these dashboards was prepared using Esri's ArcGIS Pro and hosted on ArcGIS Online along with the dashboards themselves. These dashboards will be used to gain insight into the spatial distribution of active library cardholders and the demographics of the community they're serving, helping the library conduct better outreach and apply for grants.

Introduction

Positioning in Community GIS

Maps are a particularly authoritative variety of data visualization that we engage with regularly. They help us navigate, living on the smart devices we carry in our pockets and around our wrists. We see them on the backs of airplane seats, at transit stations, rest stops, and other roadside attractions. We're bombarded with them during elections, weather reports, scrolling through news feeds, and giggling through meme groups. Arguably, more maps are produced now than ever before (Wood et al, 2010).

Living in the age of the internet, we have seen the rapid expansion of data being created and collected by a wide variety of entities, both private and public. Public data collection happens across several sectors simultaneously, such as health care, law enforcement, and education. In the US, another common form of public data collection is the decennial census and the American Community Survey. Much of the data collected by these entities is made publicly available, with varying degrees of accessibility depending on the agency. Some of it might be embedded directly in a web page or tucked away into some obscure corner of a government website, or it might need to be requested (or even purchased) through a contact form. Yet, a recent survey of state GIS data catalogs found that many states, often in collaboration with state universities, make publicly and freely available their authoritative GIS and nonspatial datasets in some form of data catalog, which is a promising trend (GIS-Mapping Exchange, 2022).

But once you have managed to locate and/or retrieve the data, then what? Is it in a useful or usable format? Depending on the size of the database, a spreadsheet alone has limited potential, so that data needs to be digested by statistical and visualization software (such as a GIS) in order to produce meaningful insights. But the production of digital maps, along with spatial statistical analysis, is not a common skill set nor is it a pathway devoid of technical, technological, and financial barriers. Thus, while it can be assumed that anyone can learn to 'do' GIS mapping, many simply have not, and thus the need for Community GIS presents itself.

A number of groups have begun making headway in addressing this need. Non-profit organizations like the Mapping Action Collective and the Anti-Eviction Mapping Project work with community partners to address more political, justice, and social needs (Mapping Action Collective, 2021; Anti-Eviction Mapping Project, 2020). Universities may also be uniquely equipped to address the barriers that communities might encounter by providing access to spatial data, technology, and analytics as well as being able to tap into the university's existing network of community partners (Robinson et al, 2017). University programs involved in such work include Syracuse University's Syracuse Community Geography program (SCG, 2022) and University of Minnesota's Center for Urban and Regional Affairs' Community Geographic Information Systems program (CURA CGIS, 2022). Some similar examples that are not strictly called 'Community Geography/GIS' include Portland State University's Center for Spatial Analysis and Research (CSAR, 2022), the Center for Geography Education in Oregon (C-GEO, 2022), and the Population Research Center (PRC, 2022).

In 2020, C-GEO (mentioned above) received grant funding to pilot a project seeking to connect public libraries with geospatial technology and GIS professionals. This program sees libraries as pre-existing community hubs of information which could likely benefit from enriching their operations with GIS, if they're not already doing so. For instance, a public library in Hopkinsville, Kentucky has a pre-existing bicycle rental service that they help operate, as well as a new maker space within their library, so they want to use GIS to create pamphlet sized maps for their bicycle renters as well as having staff trained in GIS so they can disseminate GIS skills to their patrons. As a member of the team administrating the grant project, I spent time doing outreach and preparing online learning and data resources for our librarian subgrantees. My work with C-GEO ultimately led me to pursue a partnership with the Roseburg Public Library (RPL) in my hometown of Roseburg, Oregon for this project.

Project Timeline

From first contact to handing the project off to the Roseburg Public Library and the City of Roseburg, this project took about six months to complete. The following timeline outlines key tasks over the course of the project:

July 2022:

- Contact RPL by email.
- Discuss project potential.
- Meet virtually to agree on project deliverable and timeline.

August 2022:

- Write and finalize project proposal.
- Gain access to RPL's cardholder database and City of Roseburg's ArcGIS Online Organization.

September 2022:

- Identify practicum advisor and finalize administrative tasks.

October – November 2022:

- In-depth virtual meetings with RPL, finalizing deliverable concept.
- Bi-weekly virtual progress meetings with RPL.
- Data wrangling and exploration.

November – December 2022:

- Bi-weekly virtual progress meetings with RPL.
- Building and testing dashboard using ArcGIS Online.
- Finalizing data structure.

December 2022 – January 2023:

- Virtual meetings as needed.
- Finalizing Dashboard.
- Developing and documenting data and dashboard update procedure.

Community Partnership

Defining a Problem

During the summer of 2022, after working with libraries alongside C-GEO, I emailed the director of the Roseburg Public Library expressing my interest in fostering a partnership for this project. At first, they were not immediately sure how they might benefit from a partnership, as they already had a city employee available to address any daily operational GIS needs. I clarified what could potentially come from our partnership and helped them understand what their responsibilities and level of involvement could be, then asked them to *think about what they need to better serve their community*.

The Roseburg Public Library, for many years, was funded and operated by Douglas County, but in 2016 the county voters opposed a tax levy that would have funded the county's eleven libraries. By June of 2017, the Roseburg library branch closed to the public for the foreseeable future. While the tax levy was opposed by the county majority, the city of Roseburg overwhelmingly approved the levy, so the city manager Lance Colley, on the brink of retirement, made it his mission to secure funding and re-open the library. Within a year, its space was split with Douglas County's Educational Services department and over $750k was raised to support the library's re-opening.

The new library director, along with the youth services librarian, are the only two full time employees at the Roseburg Public Library, and both of them moved to the area from out of state when the library re-opened. They explained that while they anticipate continued growth in library cardholders as time goes on, neither of them has a deep anecdotal knowledge of the demography of the surrounding communities, and they have very limited information about the demography of their current cardholders. On top of those challenges, the COVID-19 pandemic has taken a toll on a lot of rural communities and libraries, Roseburg included (Oregonian, 2022). Inspired by similar projects, they had identified a need for some insight into their community demographics and, more specifically, they wanted a tool of some kind that would enable them to do better outreach while providing data-driven insights that could help them apply for grants to better serve their community.

Defining a GIS Solution

In my experience working with other community partners, I have found that there is some amount of data exploration that needs to happen before deciding on the final GIS solution to address such a need. In this case, I needed to look at the structure of the existing library cardholder database, and I also needed to determine what geographic enumeration units would be most appropriate and meaningful to the library for summarizing data. We decided on utilizing Elementary School Attendance Boundaries, Roseburg's Wards, and Census Block Groups. The Elementary School Attendance Boundaries, which cover a geographic area larger than the city of Roseburg itself, would be the primary enumeration unit because of the library's close partnership with local public schools, and the fact that students and teachers within the school district geographic area are allowed to get library cards for free. The wards are Roseburg's more official 'quadrants', the outermost boundary being the Roseburg city limits - everyone who lives within this boundary is eligible for a free library card. The Census Block Groups will be an intersect feature providing the ability to utilize census and American Community Survey data.

We ultimately decided on creating a set of operations dashboards to compile cardholder and community demographics - one for internal use only, containing sensitive cardholder information, and another which would be made available for public presentation, excluding any sensitive information. Next, I had to determine how we would deliver such a solution. The library director introduced me to the GIS Lead at the City of Roseburg's Public Works department, and I was given access to use their ArcGIS Online organization to build and host the data dashboards. After finding a home for the dashboards, I set up recurring meetings with the director of Roseburg Public Library so that they could be kept informed and provide feedback on any progress I was making. Additionally, I portioned the project out into phases that helped me organize what I had to do into a rough order of operations:

- **Phase one:** Data Acquisition and Exploration.
- **Phase two:** Spatial Analysis and Geo-Enrichment.
- **Phase three:** Building the Dashboard.

- **Phase four:** Geoprocessing Automation and Updating the Dashboard.

Phase One

Data Acquisition and Exploration

Roseburg Public Library's cardholder data contained sensitive information and required that I sign a non-disclosure agreement in order to retrieve and use it. The library cardholder database contains around 2,900+ active cardholders but included very little demographic information (just the cardholder's age and the age of the account), however, it did contain address information which made it a candidate for geocoding. Using ArcGIS Pro, I first tried using Oregon's free statewide locator to geocode the database and had around 260 rejected addresses, along with several tied matches. Oregon's locator has very limited settings, so I attempted to adjust my results by suppressing certain fields from the field map in the locator, which produced a better match percentage but far more tied matches, as well as several false-positive matches, so Oregon's locator would not be sufficient. Next, I used Esri's world locator, which only rejected 12 of the addresses! However, Esri's world locator costs credits to use, and the batch of addresses we would need to geocode at any given time would be in the range of 3,000+, which would result in an estimated 100+ credit expenditure (about $10+ USD). I wanted to provide a reliable free option for the library and the City of Roseburg to use, so I created a custom address locator by combining the Oregon Department of Transportation's Public Roads dataset and Douglas County's House Points. Using this custom locator resulted in only 19 rejected addresses and 2 tied addresses, which were sufficient results for a totally free geocoding option. I compared the geocoding results from the custom address locator to the results from the Esri world locator by summarizing the number of points inside each Elementary School Attendance Boundary and found there to be a negligible difference in accuracy that would not have a significant impact on the usability of the data if the custom address locator were used.

The Roseburg Wards shapefile was retrieved from the City of Roseburg, and the Elementary School Attendance Boundaries, as well as public school locations, were retrieved from the Oregon Department of Human Services. Census Block Groups were retrieved from the National Historical GIS (NHGIS) along with several demographic variables compiled in CSV spreadsheets: total population and population by race/ethnicity from the 2020 United States Census, age by language, educational attainment, median household income, and receipt of public assistance from the 2020 American Community Survey. Variables that I originally picked but eventually discarded were means of transportation to work, presence and types of computers in households, and presence and types of internet access in households. It was ultimately decided that these variables wouldn't serve to enhance the library's outreach projects. In addition to census and American Community Survey variables, the library director also pointed out school district demographic reports provided by the Oregon Department of Education, which serve as the basis for my student demographic analysis. This dataset came in the form of a spreadsheet and a pdf report and required a small amount of manual data entry to combine the two.

Another important variable that I wanted to capture was drive time from the library. In order to achieve this, I recreated a network dataset from a road network dataset that I retrieved from Douglas County with assistance from the GIS Lead at Douglas County's Public Works department. With her help, I learned that the Copy Features tool in ArcGIS Pro can accept the URL to an ArcGIS rest service layer to quickly and easily copy web services that you might find online, as in **Figure 1** below. Along with the network dataset, I also retrieved a point dataset from Douglas County (updated any time a new address is approved) containing the location and address of every household in Douglas County (including Roseburg and surrounding areas). This housing dataset represents single family residential households as well as multi-family residential units as individual points.

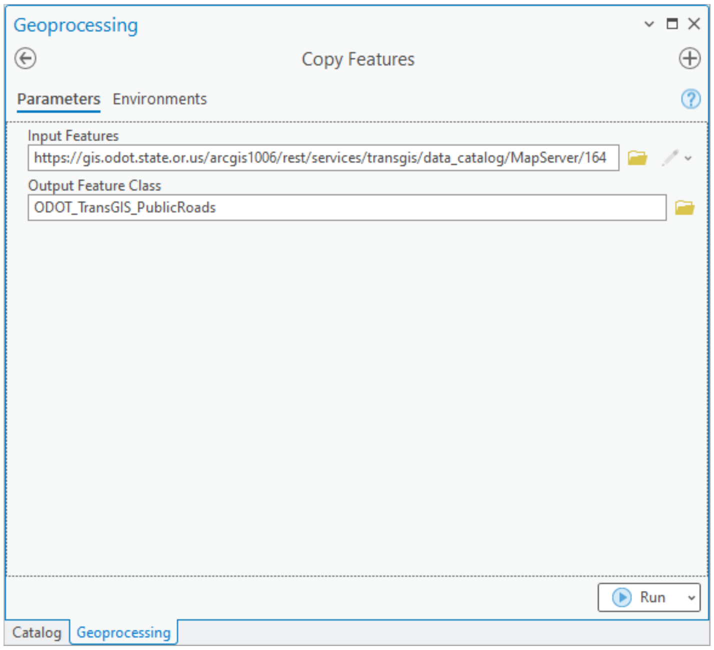


Figure 1: Copy Features tool with rest service URL as input

Phase Two

Spatial Analysis and Geo-Enrichment Using ArcGIS Pro

ArcGIS Online includes a wide array of features and applications for collaborating on and delivering spatial data to the web and is ultimately where the dashboards for this project will reside. However, when compared to its desktop software counterparts, it is lacking in deeper analytical capabilities. Thus, the following processes described in this section were performed using ArcGIS Pro version 3.0.3.

Census Data

The census and American Community Survey variables were retrieved at the Block Group level, so in order to use those variables I needed to perform an intersection between the Block Groups and the Elementary School Attendance Boundaries, as well as between the Block Groups and the Roseburg Wards. Not only that, I needed to perform some form of interpolation in order to re-aggregate the Block Group level data into these new enumeration units. I initially performed a pretty standard areal interpolation:

1. ***Calculate area of each feature in Block Group layer (total block group area).***
2. ***Intersect new enumeration unit layer with Block Group layer.***
3. ***Calculate the new area of each intersected feature (intersected feature area).***
4. ***Calculate areal interpolated population using:***

total block group population*(intersected feature area/total block group area) = areal interpolated population

which results in a total population of around 18,000 for the Roseburg city boundary. These are *okay* results, about 5,000 off from the 2021 estimate from the US Census' Population Estimate Program, but I was able to achieve more accurate results by counting the number of households per block group and intersection area and performing a housing-based interpolation:

1. **Calculate number of households within each feature in the Block Group layer (block group households).**
2. **Intersect new enumeration unit layer with Block Group layer.**
3. **Calculate number of households within each intersected feature (intersect feature households).**
4. **Calculate housing-based interpolated population using:**

Total Block Group population*(intersected feature households/block group households)

which resulted in a population estimate for Roseburg that was only 12 lower than the latest census estimate. Because the housing dataset represented each multi-family residential unit as an individual point, it made it simpler to get an accurate result without having to perform a more complicated dasymetric mapping technique. This form of housing-based interpolation was used for all of the census and American Community Survey variables. Household variables in the American Community Survey could also be interpolated using the percentage of block group houses in each intersected area, as in:

(target household ACS variable*(intersect area households/block group households))/(total household ACS variable*intersect area households/block group households)

Student Data

The student demographic variables from the Oregon Department of Education included total students, percent eligible for free or reduced lunch, and a racial/ethnic breakdown of student population per school attendance area. Student demographics were only calculated for the public-school attendance areas: elementary school, middle school, and high school. There are eight elementary school attendance areas, which are nested in two middle school attendance areas, which are nested in one high school attendance area. To transform this data, I performed a table join between the nonspatial table of student demographics and the spatial elementary school attendance boundaries, using the elementary school as the join field. This took the records from the elementary school attendance boundaries and joined duplicate records of each record in the student demographics table, so that for instance every feature in the elementary school attendance area layer that shared a common elementary school would have the student demographics from that school appended to it. I then exported just this table (not the geometry) and performed a similar interpolation method to derive elementary school, middle school, and high school student population for every intersect area in the elementary school attendance area layer:

school population*(intersect area houses/school attendance area houses)

Drive Time

In order to assess drive time to the library, I created a network dataset from the road network dataset that I retrieved from Douglas County, which was designed for use as a network dataset in network analysis. I spent time creating a driving travel mode, creating cost attributes such as time and distance, enabling a road hierarchy, and enabling speed limits. With this network dataset I performed an Origin Destination Cost Matrix between the house points and library cardholder points, deriving total drive time and distance to the library from all the points. I then performed a spatial join between the member points and each of the enumeration units, as well as the house points and each of the enumeration units, summarizing the mean, minimum and maximum drive time, and distance to the library for households and active library cardholders for each intersect area.

Cardholder Age and Account Age

Finally, library cardholder age and account age were calculated and summarized by performing a spatial join between the cardholder points and the school attendance boundaries, and then using the Summary Statistics tool on the resultant feature. The result is two standalone tables, one summarizing the count of each cardholder age within each school attendance boundary and one summarizing the count of each cardholder account age.

Phase Three

Building a dashboard using ArcGIS Online

Data and Tables

After all the data was prepared, it was added to two separate geodatabases (one for the internal dashboard and one for the public dashboard) and uploaded to ArcGIS Online. As mentioned previously, the end goal of this partnership is to produce two dashboards - one for internal use and one for public consumption. Both dashboards are presented in the same way, the only differences between the two is that the public dashboard does not contain the library cardholder points or the house points, and it does not include a widget for selecting homes and getting a list of addresses. The following sections pertain primarily to the construction of the dashboard for internal use.

Aesthetic Choices

Map

The first step was to create a web map using the prepared data, which included enabling and editing the pop-ups and feature labels and setting the visibility range for layers and their corresponding labels. For the enumeration units, I chose to symbolize each layer by the number of library cardholders as a percentage of the total population, using a standard green-yellow-red color scheme, and natural breaks with 10 classes. House points were set to be a small, muted black and semi-transparent triangle. Library cardholder points were set to be small, turquoise squares with black outlines and subtle drop shadows. The public schools and the library were set to be simple point of interest shapes, one a blue schoolhouse with a white circular background and one a green book with a white circular background. The basemap I chose for this map was a stock basemap provided by Esri called 'Human Geography Map', a subdued, light gray basemap including roads, waterways, and labels. I moved the roads, waterways, and label layers from the basemap then added them to rearranged them in my main map view.

Dashboard Theme

At first my main concern with the look and feel of the dashboard was to make it easy to read and use. I have seen a lot of 'dark theme' dashboards but felt that this project deserved something lighter and airier. With input from the library director, I chose to implement a theme consisting of a very light champagne yellow background, with white/gray dashboard element backgrounds, teal and blue element borders, teal, green, and pink indicator text, and teal and pink charts. To me, the dashboard feels colorful but subdued and not garish.

Dashboard Layout and Data Elements

Esri Dashboards start out as a completely blank canvas, allowing you to add and arrange a variety of data visualization elements, including maps, charts, indicators, lists, and more. Creating a dashboard involves a certain level of separation from the ordinary rules of cartography, stepping away from data generalization and into the realm of data densification. I spent a good deal of time looking at other dashboards for inspiration and trying out different layouts to learn how they could be arranged (Johns Hopkins University, 2022; Will County, 2022; City of Buckeye, 2022). Arranging elements in a dashboard has a sort of fractal-like quality whereby every element you add can have another element added on any side of it, and so on. Additionally, elements can be stacked on top of each other, creating a sort of tabbed look if they have got enough room on the screen for the tab titles, otherwise it condenses the tabs into a selector that allows you to switch between elements. You can also create groups of elements that move with one another and can be stacked on top of other groups of elements. Researching these other dashboard layouts helped me realize that I could create logical groupings and stacks of different elements, which I ended up doing for this dashboard. A persistent challenge, however, was determining how much screen space these elements should occupy, so I opted to allow users to adjust that spacing manually to accommodate a variety of screen sizes.

Figure 2 below shows the overall layout of the finished dashboard that I made for the Roseburg Public Library, with numbers highlighting the following elements:

1. Collapsible Sidebar
2. Dashboard Information Panel
3. Main Map
4. Cardholder Age Chart
5. Cardholder Account Age Chart
6. Language by Age Chart
7. Educational Attainment Chart

8. General Population Indicators and Racial Chart
9. Student Population Indicators and Racial Chart
10. Address List

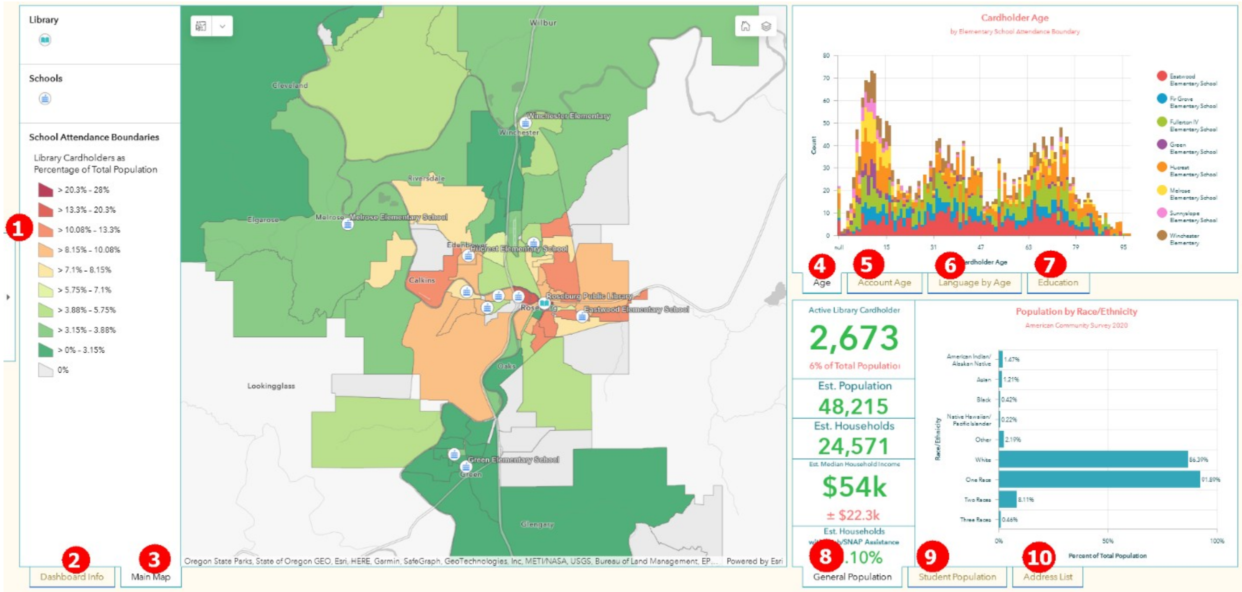


Figure 2: Dashboard Overview

The first element I inserted was the web map as well as a map legend to provide clarity to the map data being displayed, which occupies about 55-60% of the left half of the screen (**Figure 3**). I also stacked on top of the map a Rich Text element containing information about the dashboard, basic usage instructions, data sources, and acknowledgements, which serves as a splash screen that users land on when the dashboard initially loads (**Figure 4**).

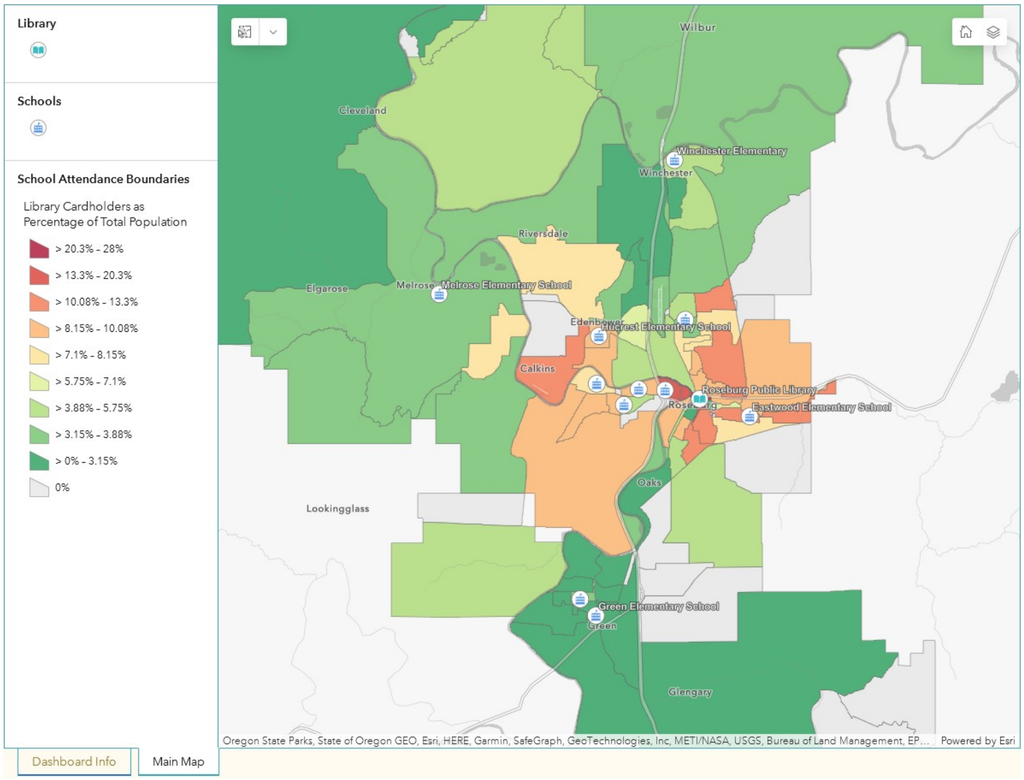
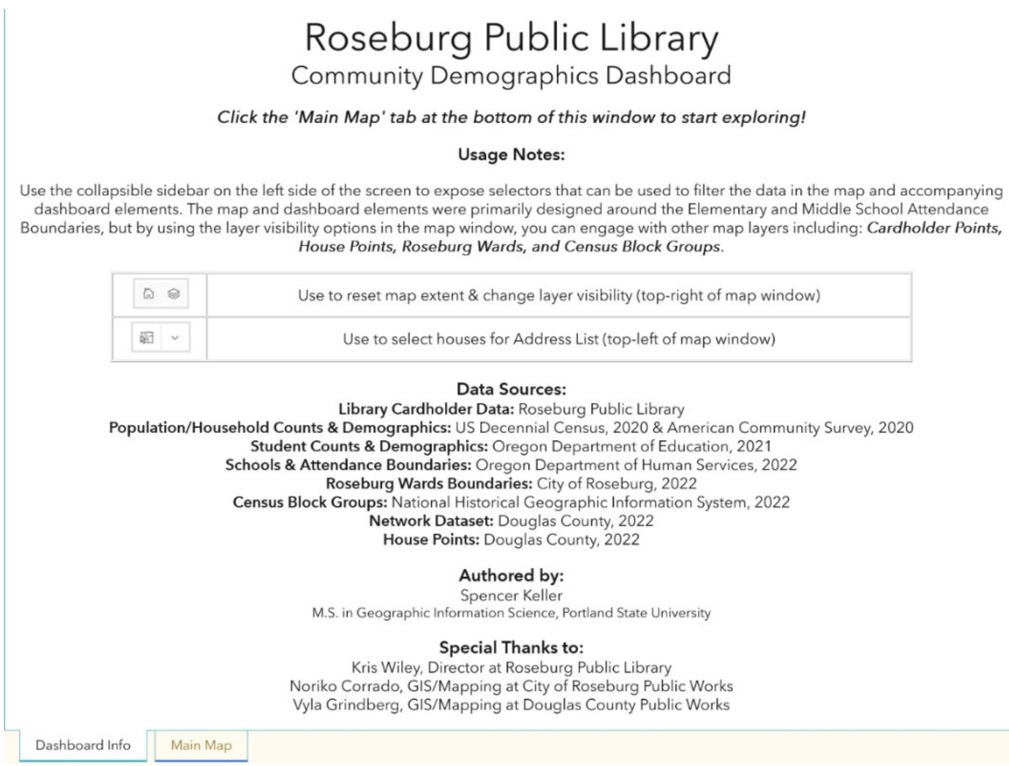


Figure 3: Main Map and Legend



Roseburg Public Library

Community Demographics Dashboard

Click the 'Main Map' tab at the bottom of this window to start exploring!

Usage Notes:

Use the collapsible sidebar on the left side of the screen to expose selectors that can be used to filter the data in the map and accompanying dashboard elements. The map and dashboard elements were primarily designed around the Elementary and Middle School Attendance Boundaries, but by using the layer visibility options in the map window, you can engage with other map layers including: ***Cardholder Points, House Points, Roseburg Wards, and Census Block Groups***.

	Use to reset map extent & change layer visibility (top-right of map window)
	Use to select houses for Address List (top-left of map window)

Data Sources:
Library Cardholder Data: Roseburg Public Library
Population/Household Counts & Demographics: US Decennial Census, 2020 & American Community Survey, 2020
Student Counts & Demographics: Oregon Department of Education, 2021
Schools & Attendance Boundaries: Oregon Department of Human Services, 2022
Roseburg Wards Boundaries: City of Roseburg, 2022
Census Block Groups: National Historical Geographic Information System, 2022
Network Dataset: Douglas County, 2022
House Points: Douglas County, 2022

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Vyla Grindberg, GIS/Mapping at Douglas County Public Works

Dashboard Info | Main Map

Figure 4: Dashboard Information

Next, I added a collapsible sidebar on the left side of the screen, which contains 'selectors' which can be used to filter data throughout the dashboard. To this sidebar I added three selectors: a Middle School Attendance Boundary selector (**Figure 5**), an Elementary School Attendance Boundary selector (**Figure 6**), and a Mean Drive Time selector (**Figure 7**). The school attendance boundary selectors allow you to select one or more middle schools and elementary schools, which in turn filters the map and any dashboard elements that can be linked to those attendance boundary names (which is most other elements). The Mean Drive Time selector allows the user to enter a minimum and maximum drive time and then filters layers and dashboard elements based on the mean drive time to the library.

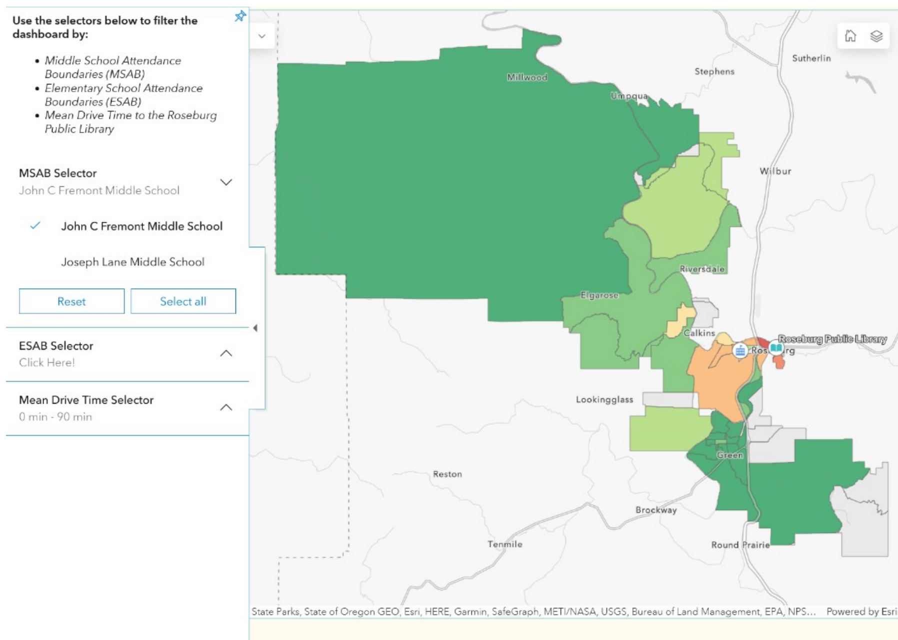


Figure 5: Middle School Attendance Boundary Selector

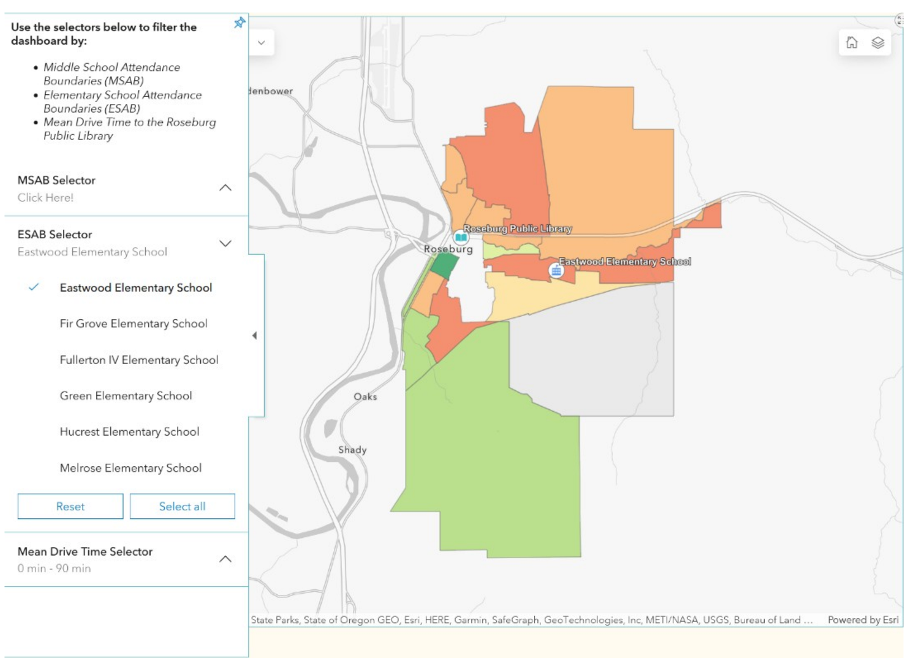


Figure 6: Elementary School Attendance Boundary Selector

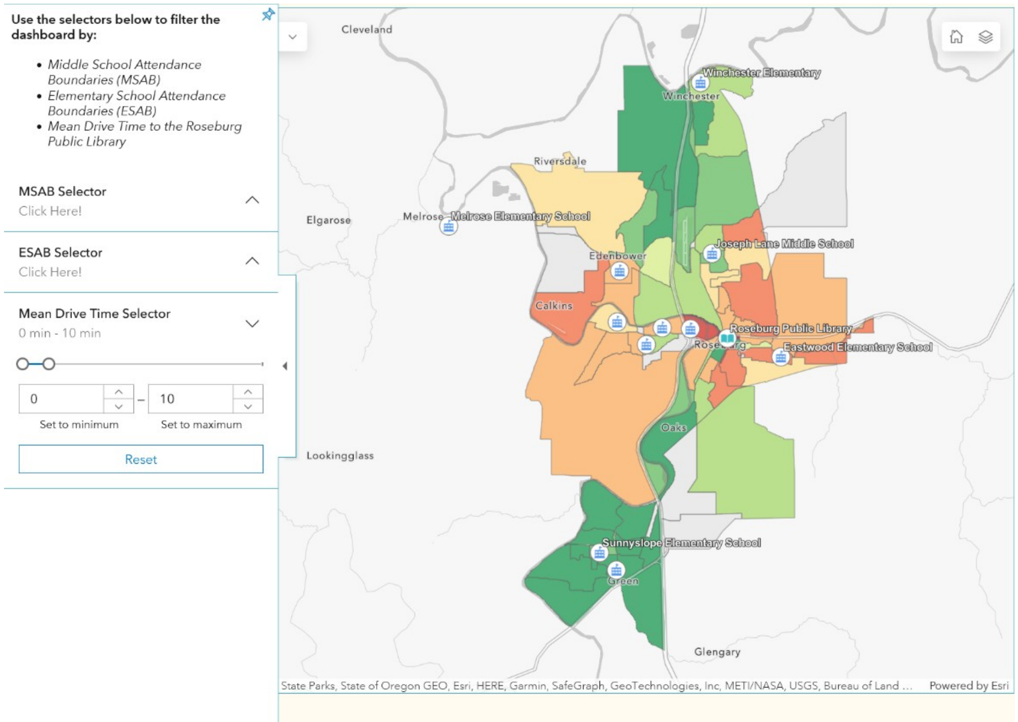


Figure 7: Drive Time Selector

Next, I added a section on the right side of the map, split horizontally across the middle. On the top I stacked four charts – one showing the distribution of library cardholder age across elementary school attendance boundaries (**Figure 8**), another showing library cardholder account age across elementary school attendance boundaries (**Figure 9**), a chart showing language spoken by age (**Figure 10**), and a chart showing educational attainment (**Figure 11**).

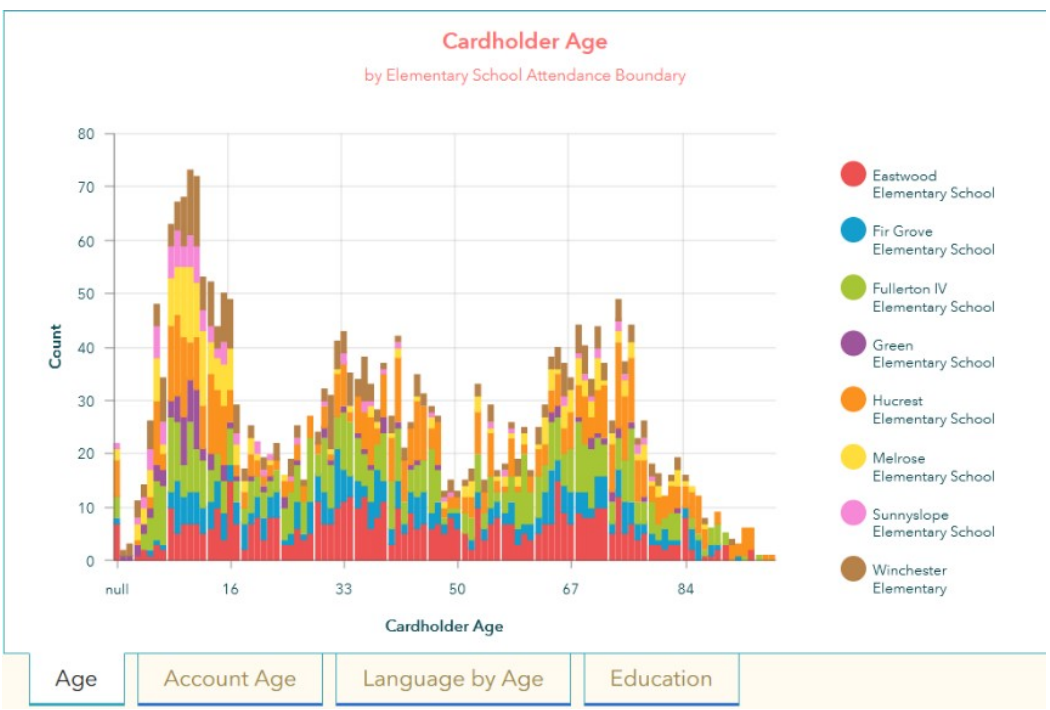


Figure 8: Cardholder Age Chart

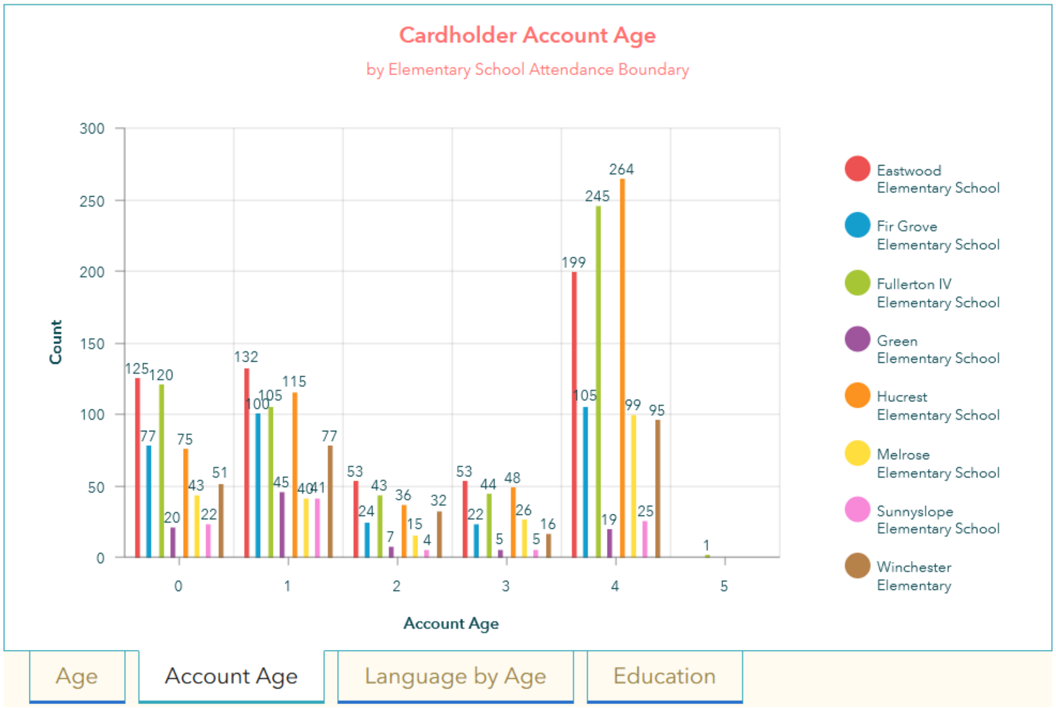


Figure 9: Cardholder Account Age Chart

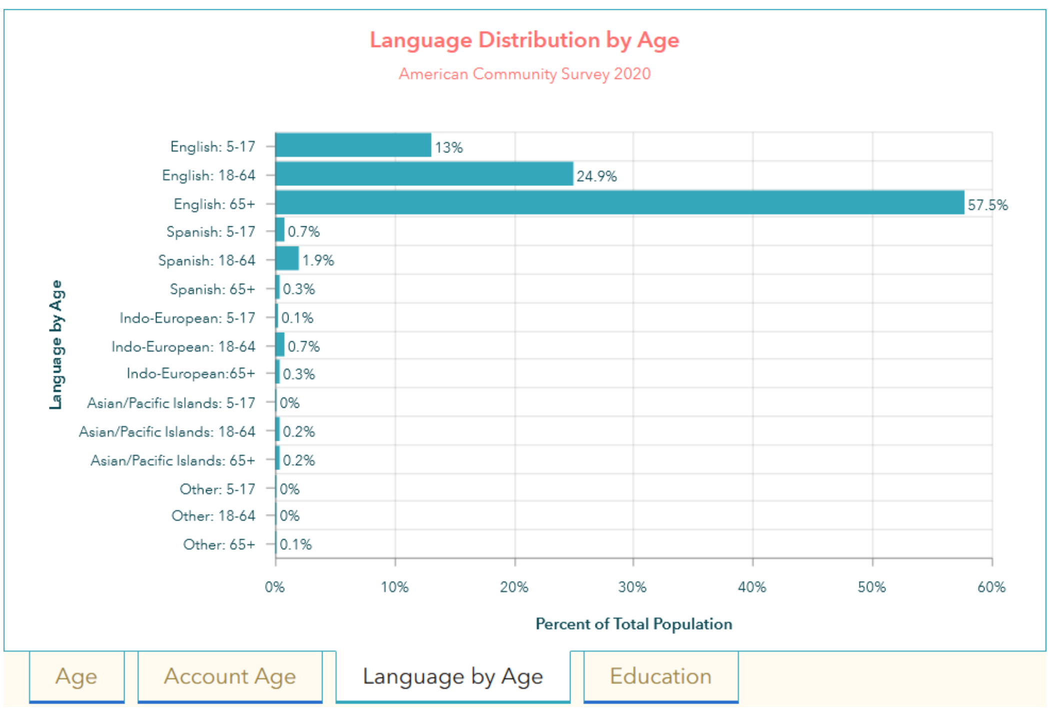


Figure 10: Language by Age Chart

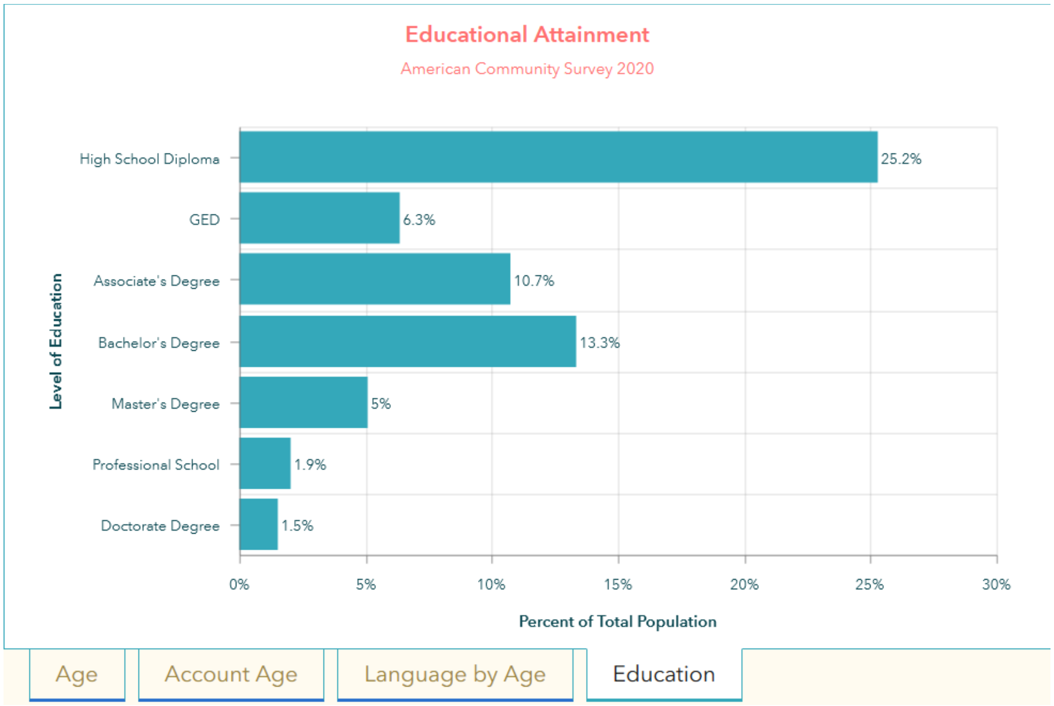


Figure 11: Educational Attainment Chart

On the bottom half of the section, I added two stacked groups of indicators and charts, as well as a list. The first group contains general population demographics and includes indicators for the count of active library cardholders, the estimated total population, estimated number of households, estimated median household income, and estimated percentage of households receiving Cash/SNAP public assistance. This group also includes a chart showing the population breakdown by race/ethnicity (**Figure 12**).

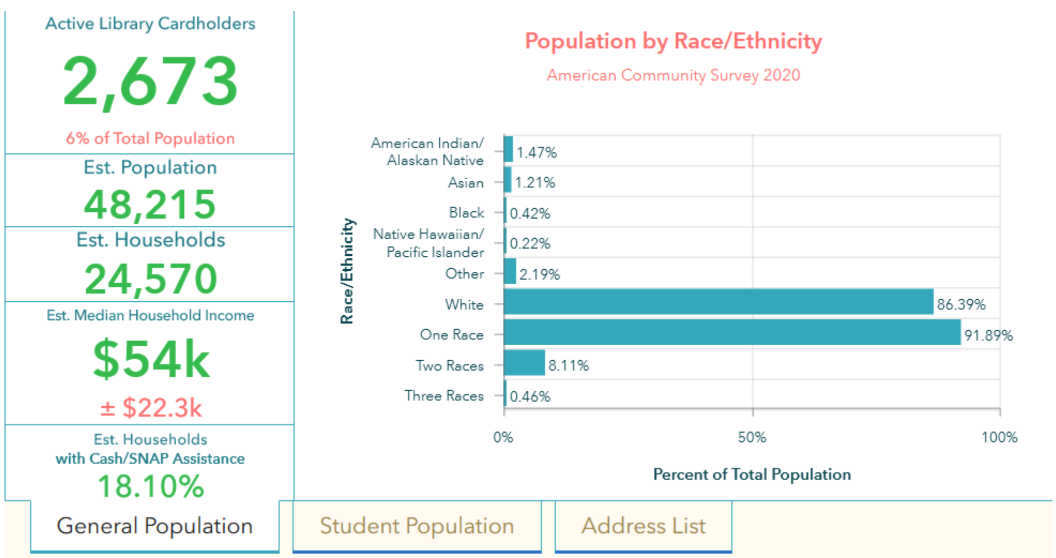


Figure 12: General Population Indicators and Racial Chart

The second group on the bottom right contains student population demographics and includes indicators for the estimated total number of students, estimated number of high school students, estimated number of middle school students, estimated number of elementary school students, and the percentage of students in each elementary school attendance boundary (including all age groups) that are eligible for free or reduced lunch. This group also includes a similar chart as the other, except it shows the student population broken down by race/ethnicity (**Figure 13**).

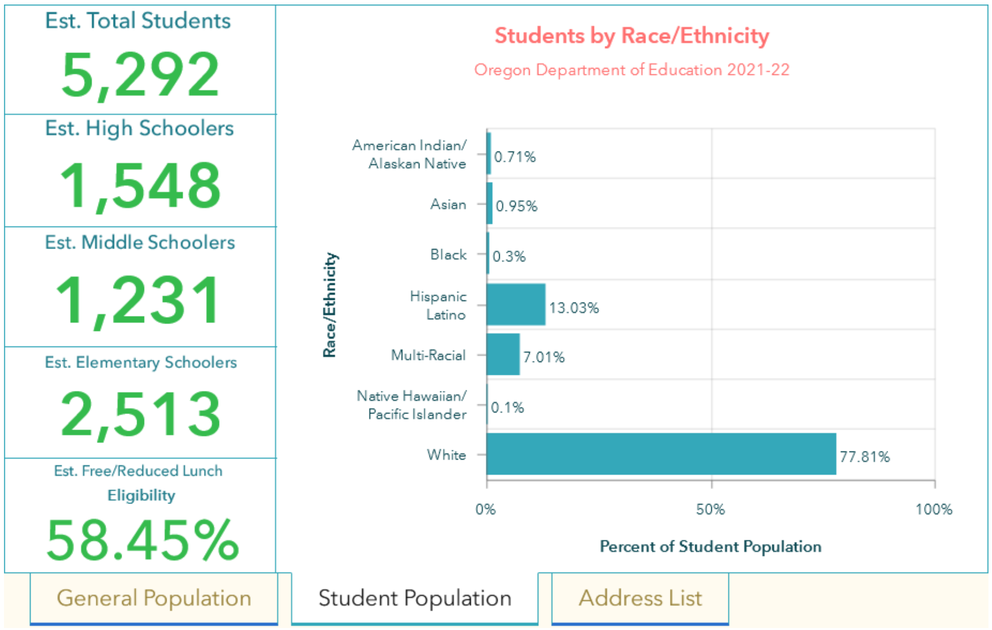


Figure 13: Student Population Indicators and Racial Chart

The Address List element is empty by default until the user enables the visibility of the Houses layer and then makes a selection using the selection tools in the map. After households are selected on the map, the list will populate with the addresses of the selected households. The list is formatted to allow the user to copy and paste the addresses into an external application of their choosing. This element allows up to 5,000 households to be listed simultaneously (**Figure 14**).

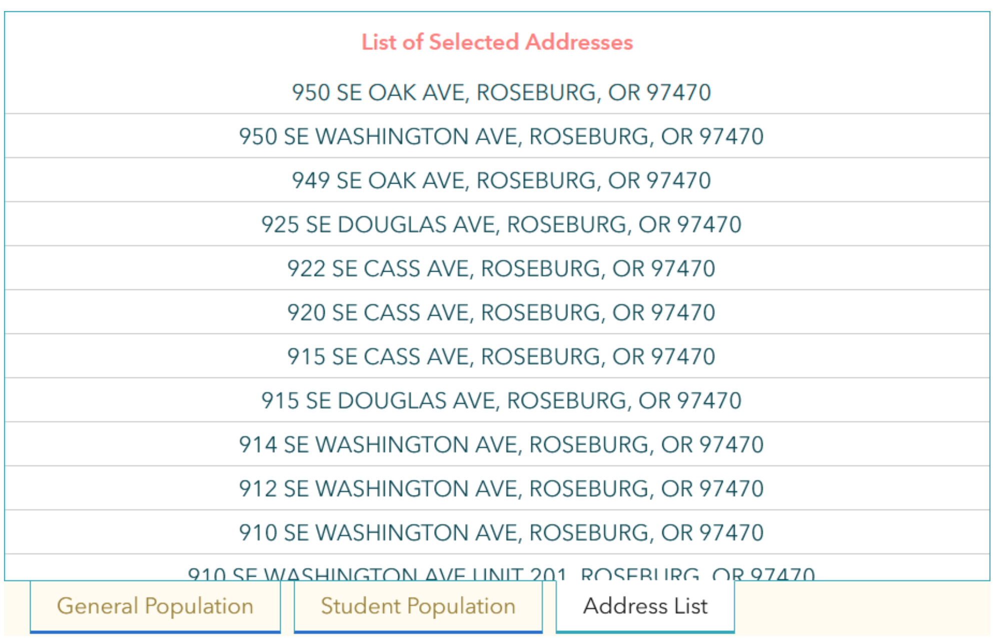


Figure 14: Address List

Tuning for Dashboard Performance

Throughout the process I was still finding myself learning new things and needed to backtrack and rethink the way I was designing my databases in order to maximize the potential of the dashboard. For instance, a lot of the functionality of a dashboard can be integrated using the layers and standalone tables you have present in a map along with pre-built filters, but at times the need arises to perform new calculations in order to enrich your dashboard in ways your database wasn't hard coded for. However, if you implement too many of these calculations, you will inevitably bog down the system and make your dashboard less responsive, so it is important to in some cases widen your tables ahead of time to include those additional calculations in order to avoid overwhelming the system with too much computation, ultimately helping to keep your dashboard more responsive.

Phase Four

Geoprocessing Automation

There are a few key reasons for needing to produce an automated workflow for the geoprocessing in this project. First, the process of data exploration can be iterative and time consuming, and you can inevitably save yourself a lot of time by performing processes in batch and making custom models in Model Builder to repeat analyses. In the Model Builder workflow generated for this project, there are close to 60 geoprocessing tools that run back-to-back taking approximately 2 minutes from start to finish. This would significantly longer to set up and run manually without the custom model. Second, processing data in Model Builder allows you to implement some quality control by enforcing settings on the array of tools that are implemented, which can minimize user error when running repetitive tasks. This is also handy when updating data on ArcGIS Online, as it is best to ensure everything in the updated dataset maintains the same naming structure as that in the original. Third, and perhaps most important for this particular project, is that the maintenance and ownership of this data and dashboard will leave my hands at the end of the partnership, and whoever takes it over (likely the GIS Lead for the City of Roseburg's Public Works department) will need to be able to efficiently update the dashboard, which will include repeating the geoprocessing workflow.

For this workflow I ended up making six sub-models and chaining them together, seen grouped on the next page in **Figure 15**.

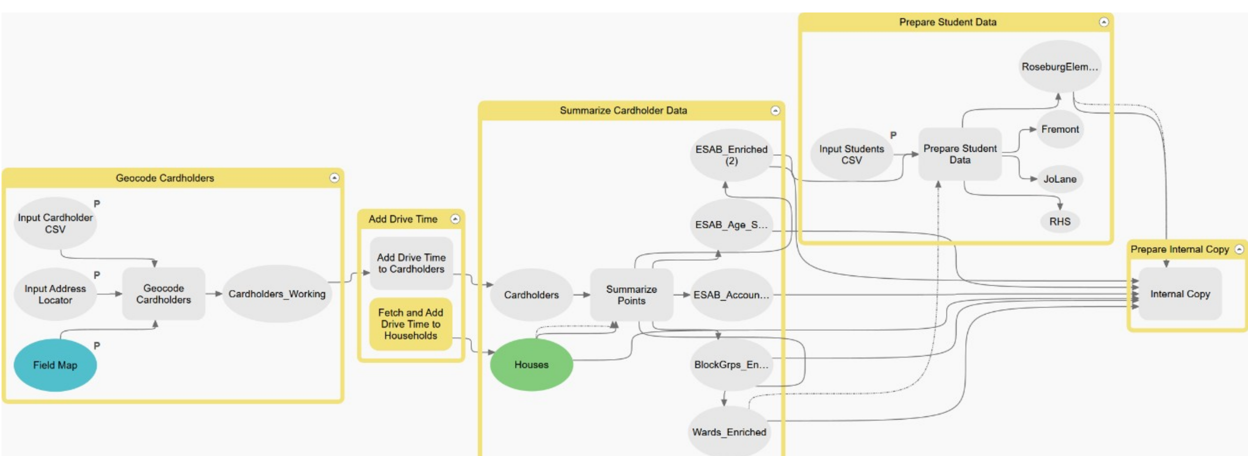


Figure 15: Full Workflow Model

The first sub-model accepts as input a spreadsheet of library cardholder addresses, first calculating cardholder age and account age, then geocoding the addresses, producing a temporary point feature class (**Appendix I**). The next sub-model adds mean drive time to the cardholder points by performing a spatial join between the cardholder points and the pre-made drive time polygons, producing a finished point feature class, and saving it to the internal geodatabase (**Appendix II**). Similarly, the next sub-model checks if data can be accessed from the rest service URL for Douglas County's household points dataset, and if so, copies the dataset to the local machine. If the sub-model can't access data from the rest service URL, indicating that the URL has changed or the data no longer exists, it then uses a stored copy of the data. After a data source has been confirmed, it performs the same spatial join, adding mean drive time to the household points and producing a finished point feature class, saved to the internal geodatabase (**Appendix III**). The next sub-model accepts the cardholder points and household points as input and summarizes those features within each enumeration layer, producing geo-enriched copies of each enumeration layer along with standalone tables with summaries of cardholder age per area and cardholder account age per area, all saved to the public geodatabase (**Appendix IV**). The next sub-model joins the student demographics table with the geo-enriched elementary school attendance boundaries, summarizes the households within each attendance boundary, then calculates elementary, middle, and high school student population per area, compiling this data into a new table saved in the public geodatabase (**Appendix V**). The final sub-model takes all of the spatial layers and all of the standalone tables that were saved to the public geodatabase and saves a copy of each into the internal geodatabase (**Appendix VI**).

Updating the Dashboards

The dashboards will be hosted on the City of Roseburg's ArcGIS Online Organization and maintained long term by the GIS Lead from the City of Roseburg's Public Works department and the director of the Roseburg Public Library. The updating procedure requires the library director to retrieve and create two separate datasets. They first must extract a copy of the cardholder addresses from their database and perform a small amount of data cleanup if needed. Next, they have to download student enrollment and free/reduced lunch data from the Oregon Department of Education and compile it into a spreadsheet template that I provided.

Once those two datasets are prepared, they are handed off to the GIS Lead at the City of Roseburg who will use those datasets as input in the Model Builder models that I created. Afterwards, the resultant public and internal geodatabases are uploaded to ArcGIS Online, updating the existing datasets. This process will overwrite the underlying data within the web maps and dashboards, leaving intact all of the symbology in the map as well as the data connections in the dashboards. Due to the high cost of ArcGIS licenses, I was given access to create and publish content on their ArcGIS Online Organization but could not afford to get access to an ArcGIS Pro license. Because of this limitation, while designing this update workflow I could not utilize ArcGIS Pro's inherent connection to the ArcGIS Online Organization it belongs to, hence the need to manually upload the geodatabases to ArcGIS Online in order to overwrite the data.

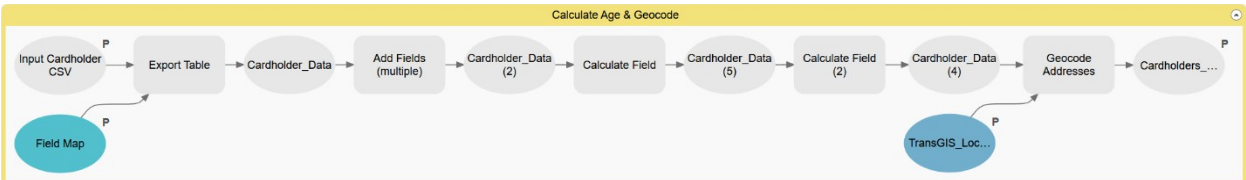
Lessons Learned

This project has helped me reconnect with my hometown in a way that I could not have foreseen previously. My parents still live in Roseburg and when I heard that the library closed in 2017, I was shocked, so it has been a very gratifying experience being able to contribute to its continued success in this new era. It was interesting to learn that the library director and youth services librarian were both from out of state when they came to open the new library - that fact made this project more meaningful since I was helping facilitate a deeper understanding of the surrounding Roseburg community by people who are also serving the community. This tool allows them to derive more authoritative insights about the community while they are not able to collect such demographic data from their cardholders.

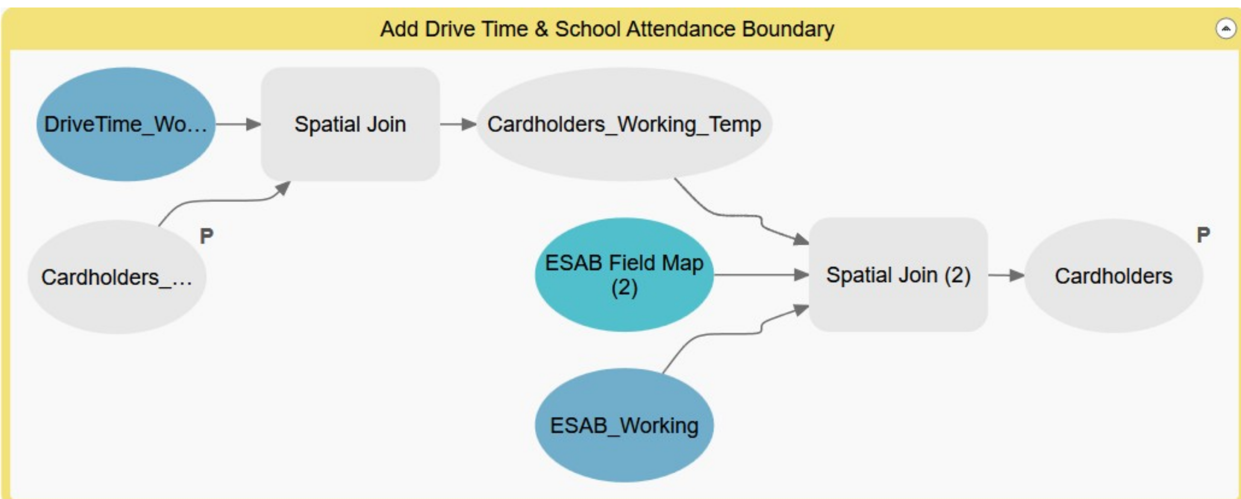
The most challenging part for me was grappling with data exploration. One thing to note is that while we did have check-in meetings every two weeks, it would likely have been beneficial to schedule work-focused meetings with the community partner toward the beginning of the project wherein we collectively looked over potential datasets and worked through the data exploration as a team. This could have likely saved me a lot of time as I was periodically stuck wondering which variables would be most important, or whether certain variables or layers would add anything significant to the end result. This sort of work meeting could also gently open the community partner up to working with and thinking about geospatial data.

The final dashboards were enthusiastically received by the library director. I had the opportunity to chat with them about the results and overall, they were pleased with what I came up with, happy that it was produced in such a short period of time and thrilled to see that I included everything (and more) than they asked for, even when it initially went against my better judgment. Throughout the project I noted how nice it was working with someone who knew what they wanted and was not afraid to be explicit about it. This sort of frankness is key in a community partner relationship, as you do not want to fall into the trap of the GIS expert deciding what should be included in the final product. This open communication also lends itself to a healthy criticism that is necessary to iteratively develop the best possible product for the community partner. Hopefully this project can serve as an example of just one of many ways that a library might harness the power of GIS to better serve their community!

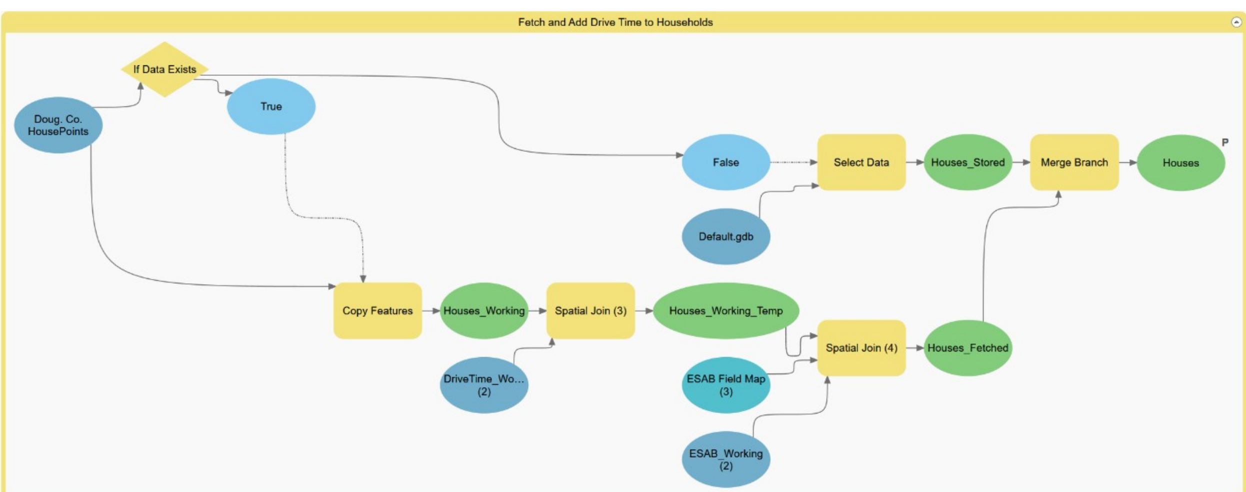
Appendix



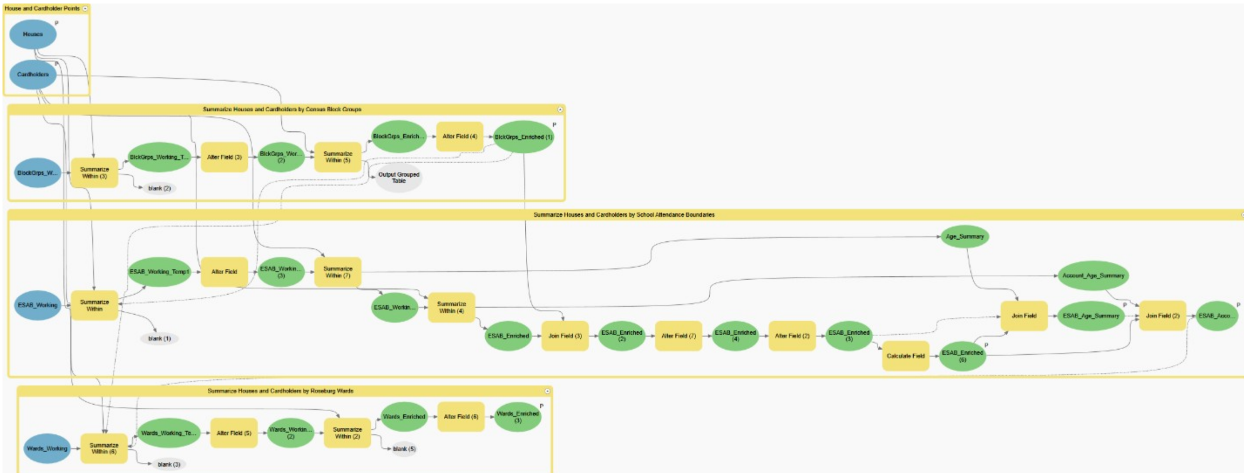
Appendix I: Calculate Age and Geocode Cardholder Addresses Model



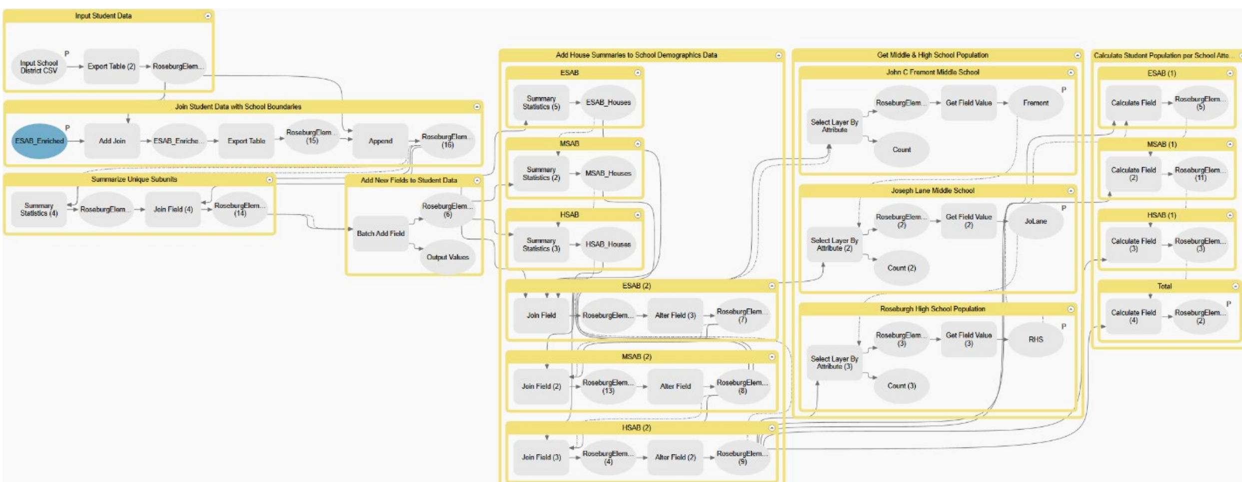
Appendix II: Add Drive Time and School Attendance Boundary to Cardholder Points Model



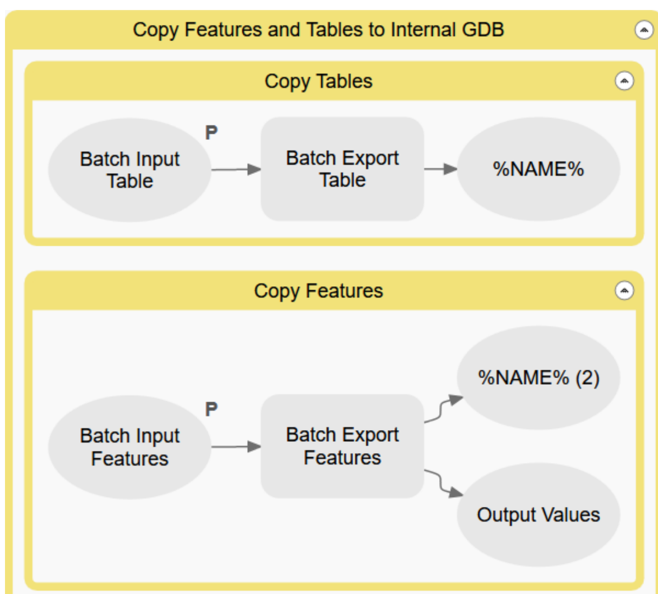
Appendix III: Fetch and Add Drive Time and School Attendance Boundary to Household Points Model



Appendix IV: Summarize Cardholder and Household Points Model



Appendix V: Prepare Student Data Model



Appendix VI: Prepare Internal Copy Model

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