



# Open-Source Oakridge: Exploring Open-Source Software and Creating a Buildable Lands Survey for the City of Oakridge

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**PPPM 495/595: ADVANCED GIS | SCHOOL OF PLANNING, PUBLIC POLICY AND MANAGEMENT**



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This report represents original student work and recommendations prepared by students in the University of Oregon's Sustainable City Year Program for the City of Oakridge. Text and images contained in this report may not be used without permission from the University of Oregon.

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## About SCI

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The Sustainable Cities Institute (SCI) is an applied think tank focusing on sustainability and cities through applied research, teaching, and community partnerships. We work across disciplines that match the complexity of cities to address sustainability challenges, from regional planning to building design and from enhancing engagement of diverse communities to understanding the impacts on municipal budgets from disruptive technologies and many issues in between.

SCI focuses on sustainability-based research and teaching opportunities through two primary efforts:

**1. Our Sustainable City Year Program (SCYP)**, a massively scaled university-community partnership program that matches the resources of the University with one Oregon community each year to help advance that community's sustainability goals; and

**2. Our Urbanism Next Center**, which focuses on how autonomous vehicles, e-commerce, and the sharing economy will impact the form and function of cities.

In all cases, we share our expertise and experiences with scholars, policymakers, community leaders, and project partners. We further extend our impact via an annual Expert-in-Residence Program, SCI China visiting scholars program, study abroad course on redesigning cities for people on bicycle, and through our co-leadership of the Educational Partnerships for Innovation in Communities Network (EPIC-N), which is transferring SCYP to universities and communities across the globe. Our work connects student passion, faculty experience, and community needs to produce innovative, tangible solutions for the creation of a sustainable society.

## About SCYP

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The Sustainable City Year Program (SCYP) is a yearlong partnership between SCI and a partner in Oregon, in which students and faculty in courses from across the university collaborate with a public entity on sustainability and livability projects. SCYP faculty and students work in collaboration with staff from the partner agency through a variety of studio projects and service-learning courses to

provide students with real-world projects to investigate. Students bring energy, enthusiasm, and innovative approaches to difficult, persistent problems. SCYP's primary value derives from collaborations that result in on-the-ground impact and expanded conversations for a community ready to transition to a more sustainable and livable future.

# About City of Oakridge

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The City of Oakridge, Oregon, is a vibrant community nestled in the foothills of the Western Cascade Mountains, with a population of approximately 3,500 residents within city limits (nearly 5,000 when including nearby Westfir and surrounding areas). Surrounded by the extensive Willamette National Forest, the city provides ample opportunities for activities such as hiking and mountain biking, with nearly 500 miles of trails and five rivers in its vicinity. Oakridge's elevation (1,200-1,700 ft.) results in a favorable climate, characterized by over 300 sunny days annually, while avoiding the fog of the valley and the heavy snowfalls of higher elevations.



Governed by a council-manager system since 1972, Oakridge residents benefit from a robust and supportive municipal administration. The City offers a comprehensive range of services, including street maintenance, water, wastewater, and park utilities, as well as police, fire, and emergency

medical services. Additional municipal services include library access, economic development, planning and zoning, and general administrative support. Funding for city operations is derived from property taxes, franchise fees, and other revenue sources, with special projects financed through grants and loans.

In the past decade, Oakridge has secured nearly \$11 million in grants and loans for community projects and maintains an annual budget of approximately \$10 million.

The citizens of Oakridge cherish their history and cultural heritage, celebrating it through a variety of events and activities throughout the year. The long-standing Tree Planting Festival pays homage to Oakridge's timber town roots, while the Concerts in the Park series offers free performances at the Banner Bank Amphitheater in Greenwaters Park. Additionally, Oakridge features four art galleries, three nearby hot springs, and is conveniently located just 25 miles from Willamette Pass Ski Resort. The Eugene-Springfield metropolitan area, approximately 35 miles away, further enriches the community's cultural offerings with its vibrant arts scene, including music, theater, and access to the University of Oregon.

The City of Oakridge is committed to fostering a safe, livable, and sustainable

environment for its residents while promoting economic development and community engagement. As part of its ongoing planning initiatives, Oakridge is exploring various strategies to enhance its sustainability and growth, ensuring that the community continues to thrive for generations to come. The partnership between the Sustainable City Year Program and the City of Oakridge is supported by local stakeholders, enabling University of Oregon students and faculty to collaborate on projects and provide recommendations to address city-identified challenges and opportunities.

This SCYP and City of Oakridge partnership is possible in part due to support from U.S. Senators Ron Wyden and Jeff Merkley, as well as former Congressman Peter DeFazio, who secured federal funding for SCYP through Congressionally Directed Spending. With additional funding from the city, the partnership will allow UO students and faculty to study and make recommendations on city-identified projects and issues.

## Course Participants

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Finn Haefker, Senior, PPPM Undergraduate

Noah Sary, Senior, PPPM and Environmental Science Undergraduate

Elliot Nopp, Junior, PPPM Undergraduate

# Course Description

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## PPPM 495/595: ADVANCED GIS

This advanced course focused on equipping students with the skills and knowledge necessary to utilize Geographic Information Systems (GIS) for community mapping and spatial analysis, with a special emphasis on open-source GIS software. Through hands-on projects and collaborative research, students explored various GIS tools and methodologies to address real-world community planning and development challenges.

# Executive Summary

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A team of students in Advanced GIS conducted a two part project to support GIS development needs and application for the City of Oakridge.

First, students conducted a comparative analysis of four leading open-source Geographic Information Systems (GIS) products. Given that Oakridge uses open-source GIS software for their planning work, staff sought clarification on what software would best suit City needs. During the research process, students created an evaluation framework based on literature review findings to score each software program. Students then created a Qualtrics survey targeting University of Oregon students who had experience with GIS software then scored the software again based off the survey results. Students then scored these software again based off the survey results. The survey results were expected among students and City staff and reaffirmed the City's initial software choice. Although the survey could not provide a fully accurate comparison, due to its sample size and timeframe, it did provide valuable insight on student experiences with other GIS software. Although not applicable to

the City of Oakridge, the survey also highlighted potential disconnects if used in an academic setting.

The second component of this project created a buildable lands survey, which could provide City staff insight on development-feasibility and assist with densification efforts in the future. This report includes data on housing insecurity, which students researched before conducting their mapping analysis. Students then established a series of criteria based on their research, information provided by the City of Oakridge, and data that was manually created in Arc-GIS pro. Students applied these criteria as separate layers, which eventually yielded a final map showcasing parcels that could be suitable for various levels of densification. The total acreage of suitable parcels was very encouraging as it exceeded Oakridge staff's initial request to establish at least 60 acres of parcels that would be suitable for densification.

## Part 1: Exploring Open-Source GIS Options

### INTRODUCTION

In the realm of geographic information systems (GIS), open-source software has emerged as a valuable tool for smaller communities and Nonprofit Organizations (NPOs) with limited funds. Although there are a wide range of available options, navigating the open-source landscape can be a daunting task, and existing comparative literature surrounding open-source software is often limited, hard to find, and/or dated. The goal of the first part of this report is to equip small and under-funded communities and NPO's with a better understanding of the available open-source GIS software that can be used across various planning processes. By examining existing literature, information retrieved through online forums, and conducting a user survey, students established a better understanding of the costs and benefits of the leading open-source software. Student research centered around the following four software, as they were constantly included and/or highly ranked across the sources examined: Q-GIS,

GRASS GIS, gvSIG, and SAGA. This report outlines student research to conducted a comparative analysis between these software.

To effectively compare the four identified software to each other, students created a framework that consists of four main components of analysis: "Interface User-friendliness", "Spatial Analysis Functionality", "Data Integration Capabilities with Other Platforms", and "Mapping Presentation and Aesthetics". They then used this framework to analyze the four identified software; first through their findings in existing literature, and second through their survey responses. Given that GIS software is consistently changing, it is expected that existing literature will provide only a minimal amount of understanding in how these different software compare among each other within our analysis framework. Therefore, students conducted a survey to fill in the gaps.

## Q-GIS

**FIG. 1**  
Q-GIS  
software logo



## GRASS GIS

**FIG. 2**  
GRASS GIS  
software logo



**GRASS** GIS

### GVSIG



**FIG. 3**  
gvSIG  
software logo

### SAGA



**FIG. 4**  
SAGA  
software logo

## **LITERATURE REVIEW**

The student's literature review consisted of limited peer-reviewed articles, as well as less conventional forms of information such as online forums and direct user experience reports. It is important to understand that much of the existing academic literature surrounding the open-source GIS software is dated, and therefore such reports may not be entirely relevant to current software conditions. In some cases, online forums and user reports can provide a more accurate representation of the costs and benefits of software, as they are responsive to software developments. Online forums and user reports can also provide current information and open dialogue on specific software functions and/or problems that academic articles cannot provide.

Students divided their literature review into four main sections, each section corresponding to one of their selected software. Each section consisted of a basic overview of the software and provided information as it pertains to the four components of analysis that were previously listed. Given that some software is more popular than others, the amount of information regarding each software as it relates to the framework may be limited. It is important to understand that the following findings are brief and do not entirely reflect the software's capability within each evaluation component. Rather, these findings are meant to provide a general understanding of the software, showing their most notable features as they pertain to each evaluation component.

**Q-GIS**

Out of the four selected software, it is commonly understood that Q-GIS is most similar to ESRI GIS products. Q-GIS shares

several similarities with products like ARC-Map. The following tables demonstrate key features of each of the chosen softwares.

*Table 1: Q-GIS*

<b>Interface User-friendliness</b>	Q-GIS is operable with Apple, Windows, and Linux platforms. Its interface is considered user-friendly but not to the extent of ArcGIS. Q-GIS requires more steps to add data as it has multiple button options which can cause confusion.
<b>Spatial Analysis Functionality</b>	Q-GIS has a myriad of tools when it comes to spatial analysis. Given that it is open source, there is also no geoprocessing license required, unlike ESRI products, meaning that your geoprocessing capabilities are not determined by your license level.
<b>Integration Capabilities with Other Platforms</b>	Q-GIS is extremely versatile when it comes to cross-platform integration. Over 70 different vector formats are supported, while providing nearly 500 plug-ins.
<b>Mapping and Aesthetics</b>	Both ArcGIS and Q-GIS have exceptional cartographical capabilities; however, Q-GIS offers gradient fills, a more advanced symbology, and a beautiful and diverse labeling system. Q-GIS also offers a range of unique thematic mapping elements such as graduated colors, proportional symbols, and dot density, which can be applied to a heatmap display.

**GRASS GIS**

Developed by the US Army as a tool for environmental planning and land management, GRASS GIS has evolved as a popular open-source GIS software used within government agencies as well as academia. GRASS GIS excels

primarily as a free GIS software option for analysis, image processing, digital terrain manipulation, and statistics. Its navigation, user-friendliness, and mapping presentation are considered haphazard.

*Table 2: GRASS GIS*

<p><b>Interface User-friendliness</b></p>	<p>GRASS GIS is known for a very steep learning curve that is not particularly intuitive or familiar to those who learned on Arc or Q. Certain functions that GIS users get accustomed to like right clicking a layer to zoom to that feature is absent in GRASS. The program stores data differently than other platforms, creating a new folder for data with different projections, which can be tricky to get used to. However, GRASS does include an in-depth manual that details the use of its complicated modules.</p>
<p><b>Spatial Analysis Functionality</b></p>	<p>Analysis is where GRASS shines. It is loaded with over 400 tools to manipulate raster and vector data, which even unsophisticated users will find useful. The program is equipped to process advanced LiDAR data and 3D rendering. The advanced capabilities of the platform are useful to users who already have experience with GIS, and not so much for beginners experimenting with simple geoprocessing.</p>
<p><b>Integration Capabilities with Other Platforms</b></p>	<p>GRASS also does fairly well in this category. It is able to interpret many file types, including complex vectors and 3D data. Additionally, the program can run on Mac, Windows, and Linux.</p>
<p><b>Mapping and Aesthetics</b></p>	<p>Cartography is not a strong feature of GRASS. Alongside its clunky user interface, the map making elements are difficult to implement to make a polished presentable product. This small flaw does not seem detrimental considering the advanced analysis functions the software provides. The software is more focused on the processing and rendering features and less on the finalized polished product.</p>

**gvSIG GIS**

gvSIG GIS was initially developed by Generalitat Valenciana from 2002 – 2009, which is the Regional Government of Comunidad Valenciana. In 2010, the gvSIG GIS association, a nonprofit, took control, while having Generalitat Valenciana as

its “first and main honor member”. It is an open-source GIS software that was created to provide users with powerful CAD tools, mobile application for field work and 3D capabilities, and an intuitive interface.

*Table 3: gvSIG GIS*

<b>Interface User-friendliness</b>	gvSIG is operable with Windows, Linus, and MacOS. The interface’s user-friendliness has been described as “intuitive and stable”.
<b>Spatial Analysis Functionality</b>	gvSIG has many tools to enhance a user’s spatial analysis functions they carry out. gvSIG integrates a 3D plugin allowing the user to view their data in 3D. The 3D plugin has been said to compete with Esri’s 3D tag team ArcScene/ArcGlobe and Qgis2. (GIS Geography)
<b>Integration Capabilities with Other Platforms</b>	gvSIG has many tools to enhance a user’s spatial analysis functions. gvSIG integrates a 3D plugin allowing the user to view their data in 3D. The 3D plugin has been said to compete with Esri’s 3D tag team ArcScene/ArcGlobe and Qgis2.
<b>Mapping and Aesthetics</b>	Mapping in gvSIG has been characterized as coming naturally to the user, allowing them to map anything in detail. However, cartography and symbology have been characterized as “archaic”. gvSIG Mini Maps allows a user to access their map offline through their mobile phone for field collection.

**SAGA GIS**

Compared to the immense range of programs like QGIS offer users, SAGA is much more limited in capabilities. The program was developed to perform specific geoscientific functions, such as

hill shading and visibility analysis, but over time has expanded to include more traditional spatial data analysis tools. This program should not be a go-to mapping tool but should be considered for more advanced geospatial analysis.

*Table 4: SAGA GIS*

<b>Interface User-friendliness</b>	For the robustness of its capabilities, SAGA has excellent user friendliness. The program allows users to perform extremely technical and complex operations with ease, given that you are versed in advanced spatial analysis tools and terms.
<b>Spatial Analysis Functionality</b>	Where SAGA shines is not in traditional spatial analysis, but more specialized geoscientific analysis of slopes and terrain. Statistical analysis functions for this program are highly developed and allow for predictive techniques, which is beneficial for hazard mitigation work. The program can handle complex and detailed data for those with access to such rich information, such as LiDAR LAS files.
<b>Integration Capabilities with Other Platforms</b>	SAGA can run on all platforms and run without installation via USB drive. Its module-based data sets can be exported and used on other programs, like QGIS, for more polished map making.
<b>Mapping and Aesthetics</b>	SAGA lacks some of the common cartography tools utilized in other programs. For example, the software does not have built-in web publishing capabilities. For polished mapping tools and aesthetics, it is recommended to try the other programs listed above. (GIS Geography)

**TABLE 5: EVALUATION BASED ON LITERATURE REVIEW**

<b>Software Name</b>	<b>Interface User-friendliness</b>	<b>Spatial Analysis Functionality</b>	<b>Data Integration Capabilities</b>	<b>Mapping, Presentation, and Aesthetics</b>
<b>GRASS GIS</b>	2	4.5	4	5
<b>Q-GIS</b>	4	4	4	3
<b>gvSIG</b>	4	4	4	3
<b>SAGA GIS</b>	3	5	4	2

## **METHODS**

The students' primary research method outside of the literature review was through a detailed survey sent to University of Oregon students. The team conducted on-campus surveys since students might be potential users of open-source GIS software in the workforce, especially if they used the software as a student. This survey was distributed by listserv to different majors including Planning, Public Policy and Management; Landscape Architecture; Environmental Studies/Science; Earth Science;

Geography; and more. The team created and distributed a flier throughout the university, in hopes of widening responses to as many students as possible. The survey sought to adequately compare these different open-source GIS software through the same evaluative framework of analysis detailed in the introduction (Interface User-friendliness, Spatial Analysis Functionality, Data Integration Capabilities with Other Platforms, and Mapping Presentation and Aesthetics.)

# Calling all UO students!

**Are YOU a user of free GIS (Geographic Information System) tools, such as QGIS, GRASS GIS, SAGA, and others?**

**We want to hear from you!**

**Share your experiences and insights by participating in our brief survey. You will be entered into a drawing for a chance to win one of five \$25 gift card to the UO Duck Store!**

**Click the link below to start the Open Source GIS Tools survey!**

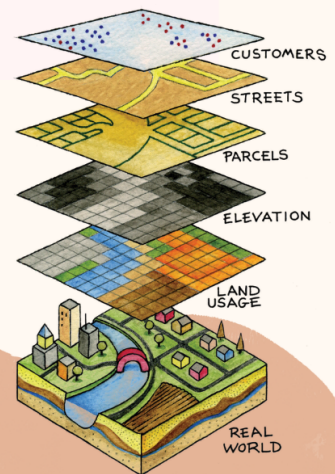
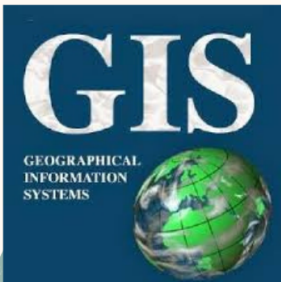


FIG. 5

Students employed a range of question types, some allowing respondents to write in answers and others having them select options from a list. As with the literature review, the students scored each area on a 5-point scale (1 being poor and 5 being excellent), applying a 5-point

scaling system for each individual survey question. Students then took the average score for each question in its respective area and applied the average of those scores as the final performance score for each area of analysis.

Are there delays or lagging interactions that hinder usability?

Never

Sometimes

About half the time

Most of the time

Always

Are online tutorials readily available and comprehensible?

No

Somewhat so

Yes

Have not looked

Are there online user support groups/communities that help you navigate GIS questions/information?

No

A few

Yes

Have not looked

PART B. SPATIAL ANALYSIS FUNCTIONALITY

Is the process to complete basic functions quick, and what type of functions do you normally perform (shape file creation, raster processing, etc)?

	Slow	Moderate Speed	Fast	Never Used	Definitely yes
Shapefile creation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
common mapping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using geo processing tools	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raster data processing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How easy is it to locate and use advanced geo-processing tools? (provide examples of adv. tools)

Extremely difficult

Somewhat difficult

Neither easy nor difficult

Somewhat easy

Extremely easy

FIG. 6

## SURVEY RESULTS AND EVALUATION

The survey yielded a total of 55 responses, from both undergraduate and graduate students across a variety of majors, with the most prominent majors being, Planning, Public Policy and Management; Landscape Architecture; and Geography. This was in line with what students had

hypothesized regarding the types of majors that would be highlighted in this survey, as all these disciplines regularly use GIS software for their university coursework. From these responses, 58% of respondents said they had used open-source GIS software, whereas 42% of respondents had not ever used open-source GIS software.

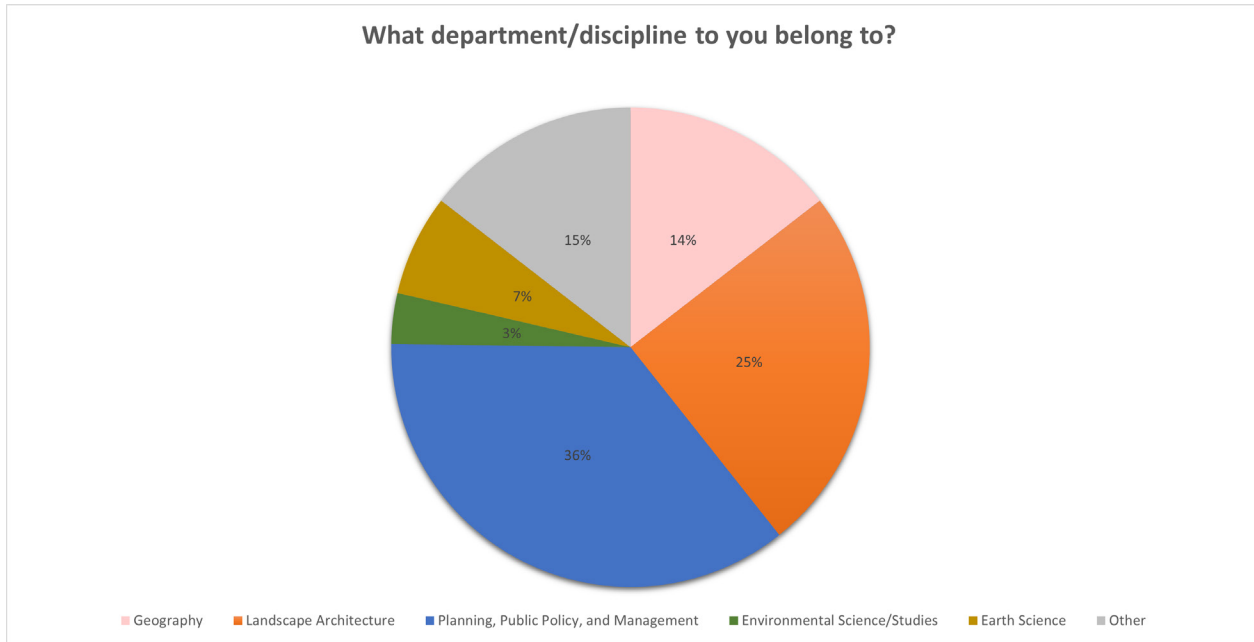
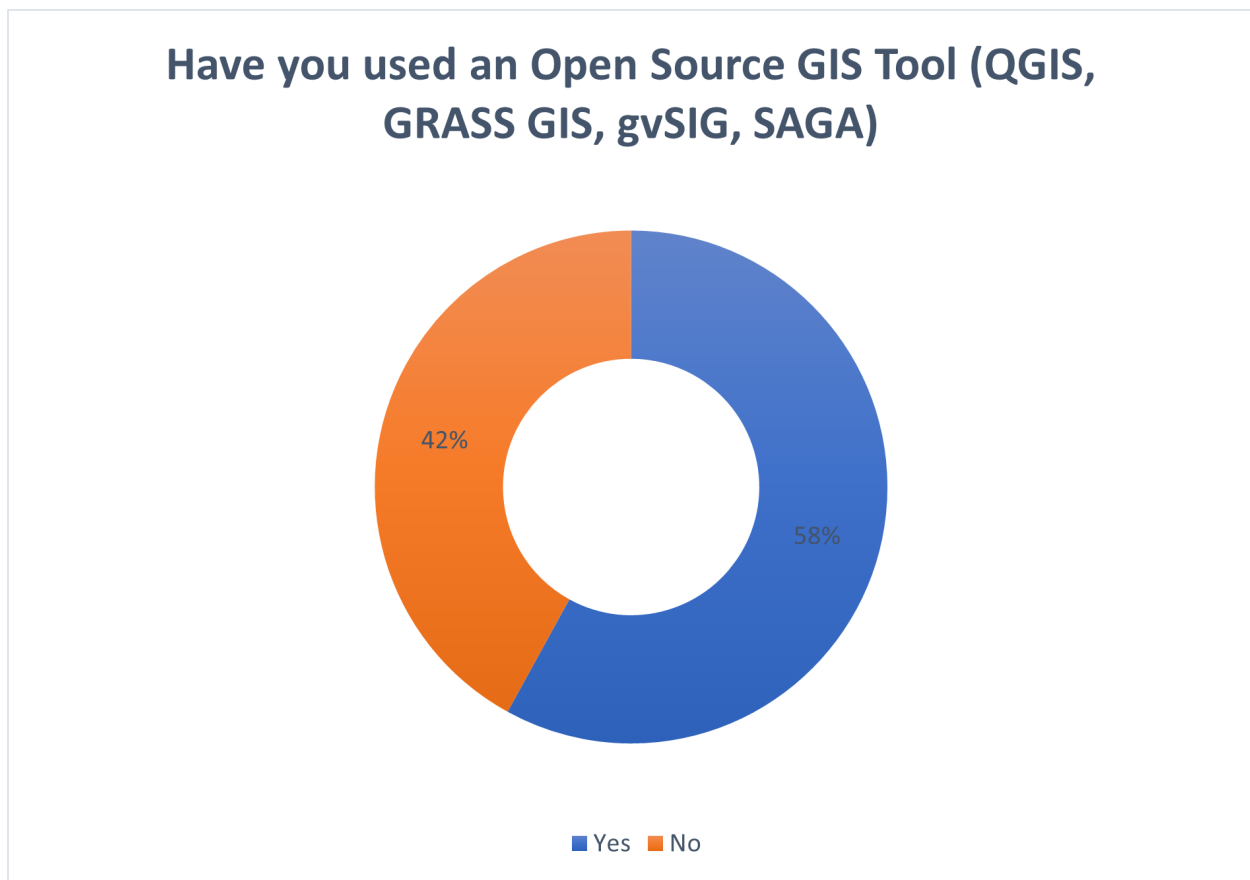


FIG. 7

**FIG. 8**

The respondents indicated that they had mainly used the open-source GIS software Q-GIS. There were no respondents who had used gvSIG or GRASS GIS, and two students had used SAGA GIS. This was not surprising to the team, as courses taught at the University of Oregon mainly use Q-GIS and ArcGIS. gvSIG, GRASS GIS, and SAGA GIS were all highly regarded in the realm of professional usage of open-source GIS software, however, this did not transfer over to university usage. These three software are very specialized for certain professionals in the planning and design professions and therefore, are

not as applicable or widely used for most students at the University of Oregon.

The survey results found that Q-GIS overall had a higher score than SAGA GIS, with an overall score of 3.63 for Q-GIS, and 3.41 for SAGA GIS. Furthermore, Q-GIS had 33 respondents who had used the open-source software, whereas SAGA GIS had only 2 respondents, which heavily skewed the overall results for SAGA GIS. This was expected, as Q-GIS was the most widely used software among university courses excluding ESRI products.

## EVALUATION TABLE BASED ON LITERATURE REVIEW

TABLE 1

Software Name	Interface User-friendliness	Spatial Analysis Functionality	Data Integration Capabilities	Mapping, Presentation, and Aesthetics
<b>GRASS GIS</b>	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
<b>Q-GIS</b>	3.64	3.42	3.76	3.67
<b>gvSIG</b>	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
<b>SAGA GIS</b>	3.64	4.5	3.6	2.9

### FINDINGS

Given that it is overwhelmingly more popular than its open-source counterparts, and is consistent across the analysis framework, Q-GIS should be considered as an open-source option for small communities with limited funds and resources.

Over 40% of survey participants reported never using any open-source GIS software, but many voiced their desire to learn, including Q-GIS. Major barriers to learning open source software included feeling intimidated and the lack of opportunities within university classes. “I know that learning open-source software would help my projects and better prepare me for jobs, but intimidation stops me,” says one fifth-year landscape architecture student. (See Appendix A) The curriculum for the university programs that use GIS should consider these considerations from students to maximize their potential

knowledge and proficiency of the software for professional usage after graduation. This showcased desire among students highlights the potential disconnect between courses being taught and what is desired within professional fields; many participants feel that understanding open-source software would benefit their professional careers.

Though this survey yielded informative results, the capacity of the team’s research base cannot provide a fully accurate comparison of such software, as it was only open for two weeks, and solely focused on University of Oregon students and excluded professionals who are more likely to be familiar with such software. Continued research should include a broader study group and include accounts from experienced users in professional fields, to gain a more comprehensive understanding and more direct applicability to small cities and NPOs.

## Part 2: Conducting a Buildable Lands Survey Using GIS

### INTRODUCTION

In the second part of the project, students applied the knowledge gained from their comparative analysis to conduct a housing supply analysis/buildable lands survey for the City of Oakridge. To tie the two sections together, students completed the GIS-mapping portion in both ArcGIS Pro as well as Q-GIS, and recorded their experience with both software. These will be referenced at the end of this section.

The students' main goal for this component of the project was to meet the request from the City of Oakridge: to establish at least 60 acres of parcels that could be further developed for housing. Of those 60 acres, the City of Oakridge hoped for at least 50 acres of R-2 development, and 10 acres of R-3.

### CONTEXT

Once home to a thriving logging industry, today, like many other rural communities, Oakridge has experienced the negative externalities that come with industry loss, including increased rates of poverty and

declining populations. Today, nearly one-third of Oakridge Residents live below the poverty line.

A variety of factors are contributing to housing insecurity in Oakridge as well as other small communities across Oregon. (Housing Needs by State, National Low Income Housing Coalition) Oakridge appears to have enough housing, just not the right type. In a 2023 housing needs analysis conducted by the City of Oakridge and various planning consultants, the three largest community needs as voiced from residents were:

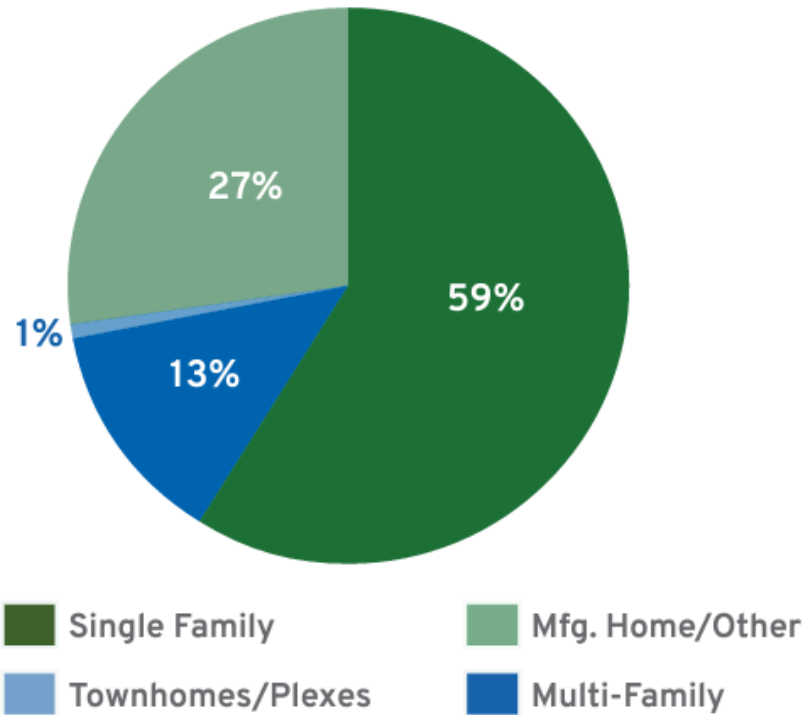
1. More affordable housing
2. More choices of housing types and sizes
3. Less competition with short-term rentals

Development history in Oakridge has resulted in a contrasting reality, with over 95% of housing being built in the last 20 years being single-detached units. (City of Oakridge)

## Existing Mix of Housing Types

**FIG. 9**

Source: Share of Unit Type by Housing Tenure 2019 ACS 5-Year Estimates



Share of Unit Type by Housing Tenure 2019 ACS 5-Year Estimates

The existing zoning landscape is overwhelmingly “Low-Density Residential”, which has historically been quite restrictive of any densification efforts. In efforts to reduce housing insecurity, in 2019 the State of Oregon passed a statewide reform that would allow middle-housing (duplexes, triplexes, and fourplexes) to be developed in R1

zones. Although Oakridge does not meet the reform requirements due to its small population, the City has adopted the reform in hopes of reducing housing insecurity. Such a scenario challenges the general assumption that small rural cities are: 1. In need of housing, and 2. Willing to take progressive measures such as densifying.

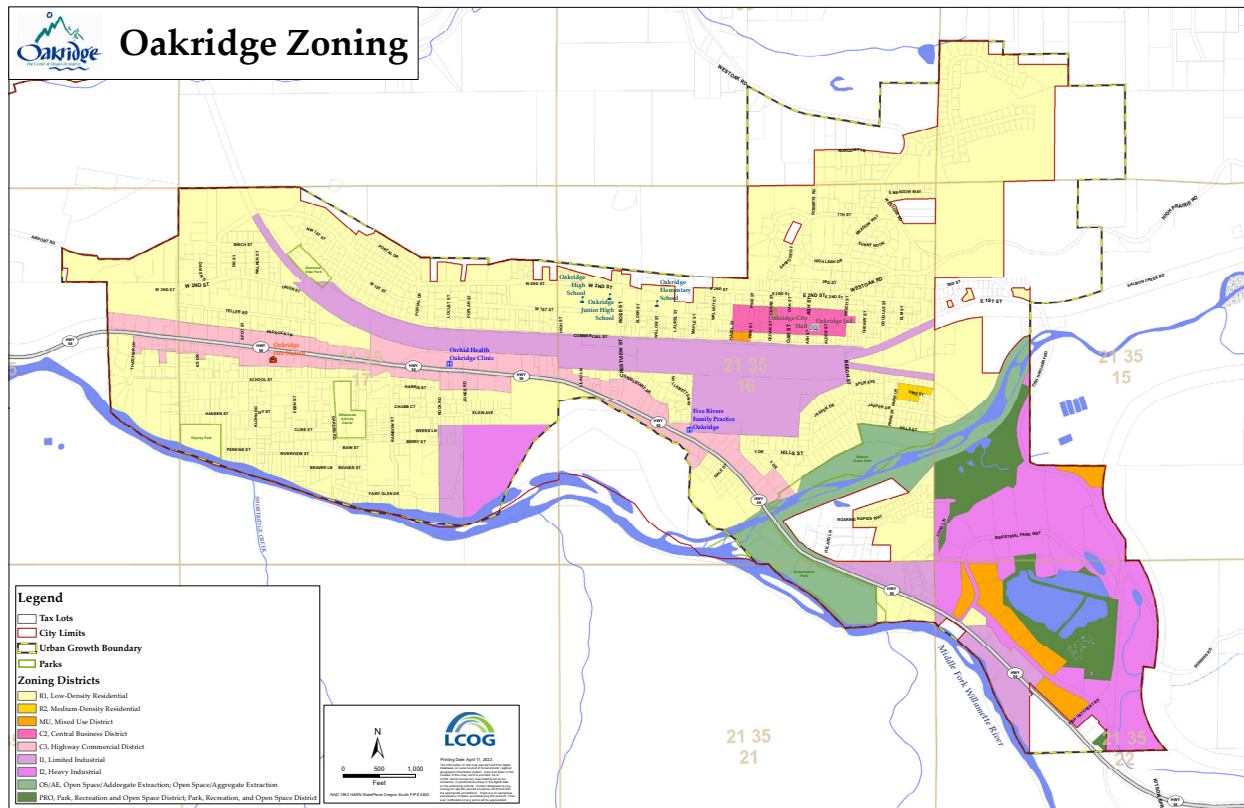


FIG. 10

Given that the City is majority zoned as R-1, there is ample opportunity to increase density and meet housing demands for projected growth.

**MAPPING**

Before starting GIS analysis, students established a criterion that they would apply to all parcels within Oakridge’s city limits. Their focus areas were zoning type, parcel status (vacant, non-vacant), parcel size and quantity, proximity to existing infrastructure and services, and natural hazards. GIS Students created individual layers in ArcGIS Pro for each one of these criteria, which they then applied to their basemap one by one, resulting in a “process of elimination” type method. The criteria reads as follows:

**Zoning Types**

Parcels must be in areas zoned R1 (low density residential), R2 (medium density residential) and/or C2 (downtown commercial). Given that there is a surplus of single-family homes, promoting development in these areas addresses the need for middle housing and increases neighborhood vitality through increased proximity to businesses.

**Existing Infrastructure**

To avoid new installation of infrastructure, parcels must have existing access to sewer lines 6” and greater, as well as access to water lines 4” and greater. Focusing on areas with existing infrastructure reduces service and development costs.

### **Parcel Status**

Although vacant parcels are desirable for larger scale development such as fourplexes, sixplexes, and low-rise apartments, focusing on only vacant parcels would result in a patchwork of parcels. Non-vacant parcels are the cost-effective types to densify given that most densification will take place in the form of accessory dwelling units (ADU's).

### **Cohesion**

There should be no isolated parcels as it increases service and development costs. After applying all criteria, students manually removed any parcels that were less than 2500 sq feet.

### **Natural Hazards**

Parcels must be outside of FEMA flood zones, and areas of steep slopes to ensure long term safety of residents. To do this, students created a command that would not select parcels within the 25- and 50-year floodplain FEMA zones. The team also created a 50-foot buffer on the northside of the UGB as it is heavily wooded and consists of a significant slope. Given that there is no accessible slope data, they manually removed parcels that were located on a slope of 25% or higher.

# ALL PARCELS

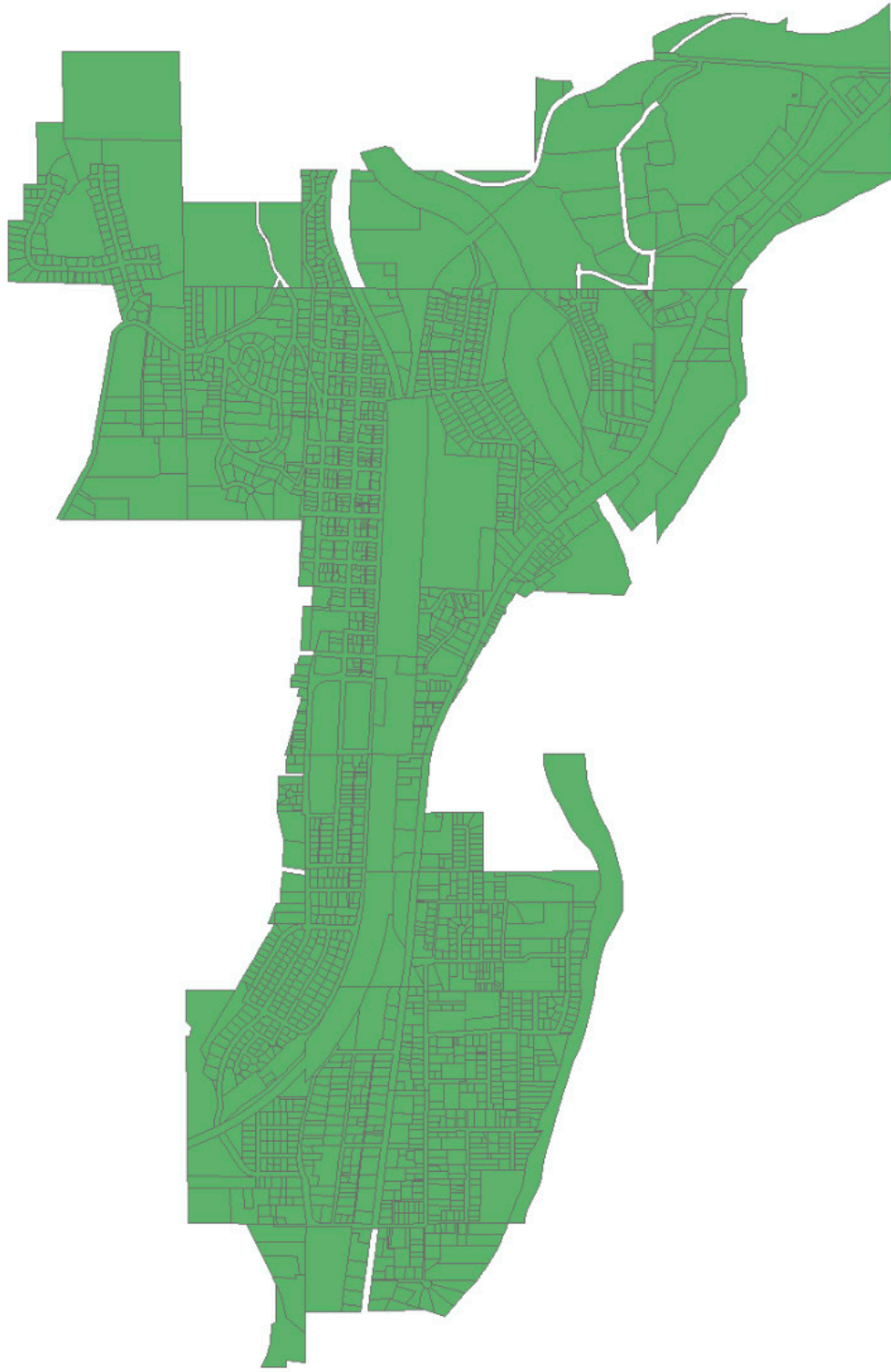


FIG. 11

# ZONING

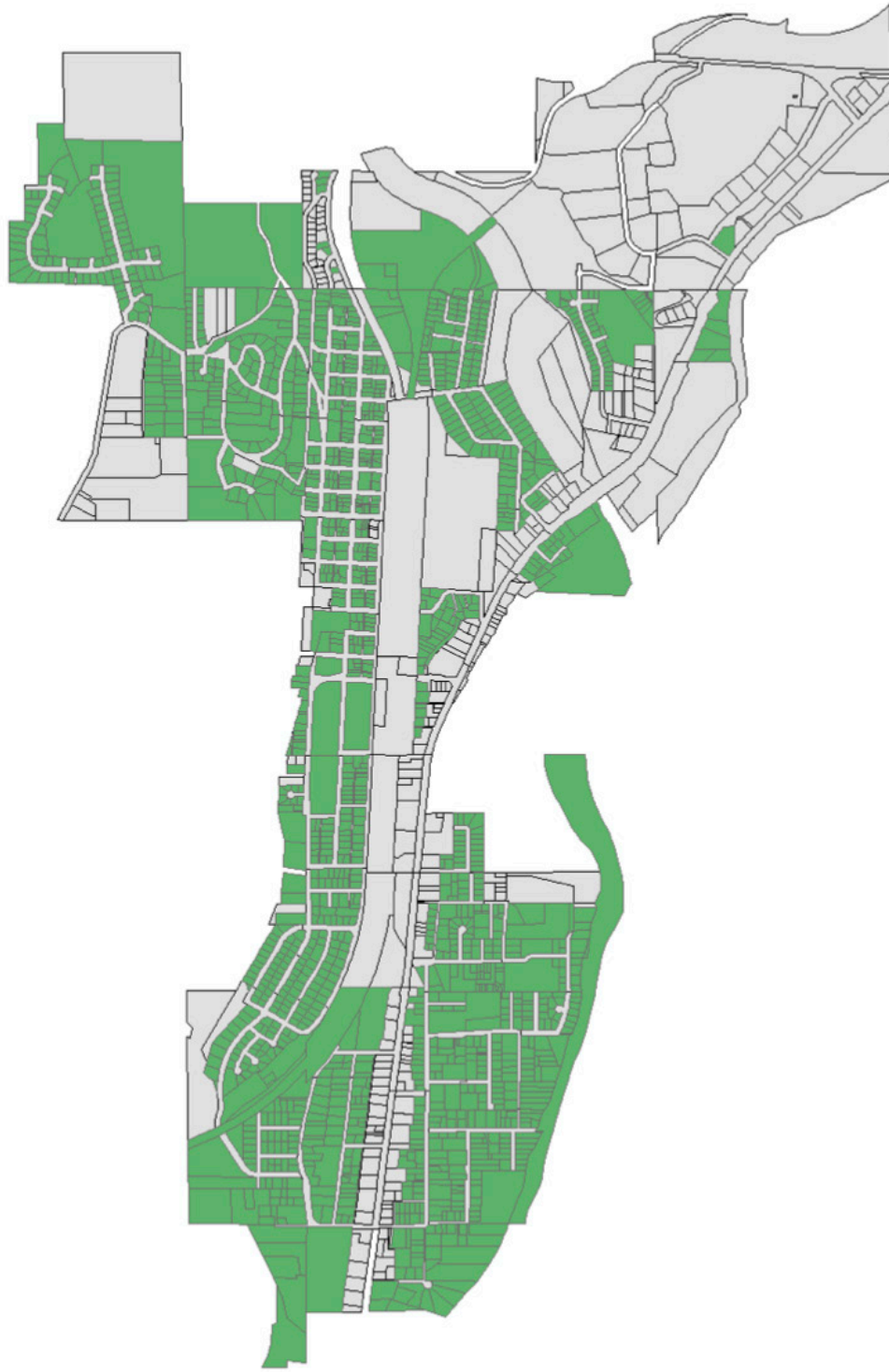


FIG. 12

# FEMA ZONES

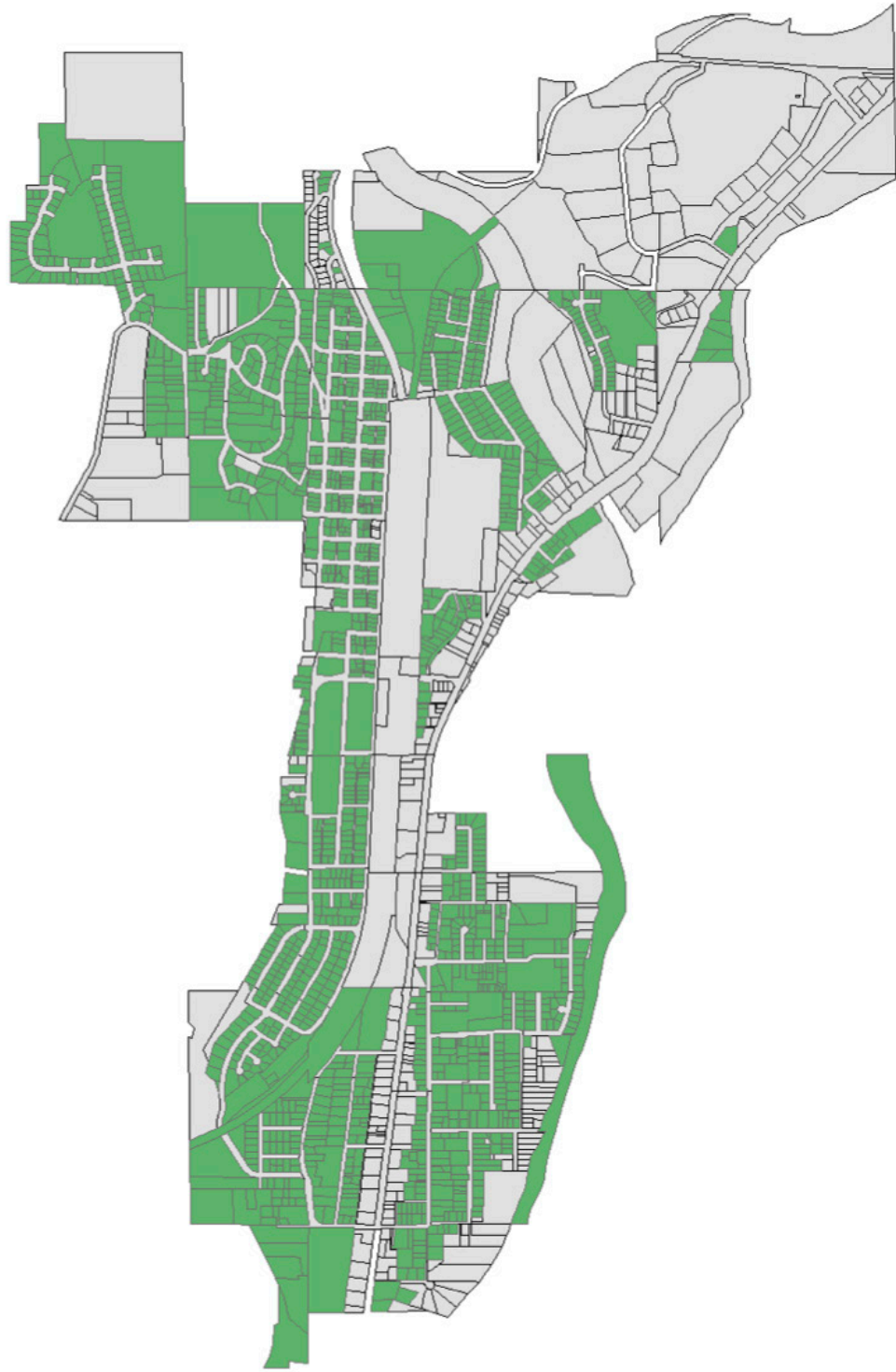


FIG. 13

# ACCESS TO EXISTING INFRASTRUCTURE

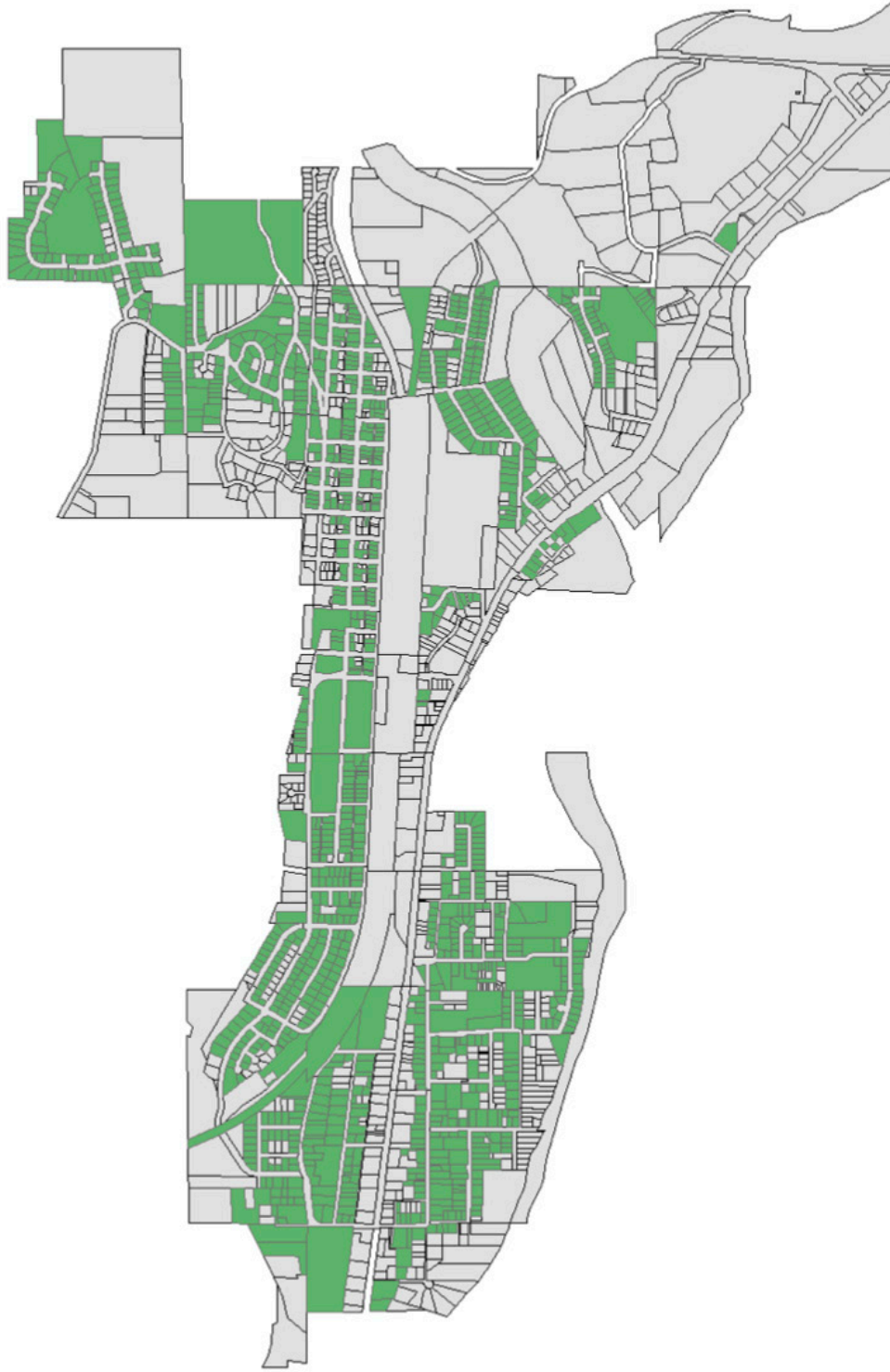


FIG. 14

# COHESION

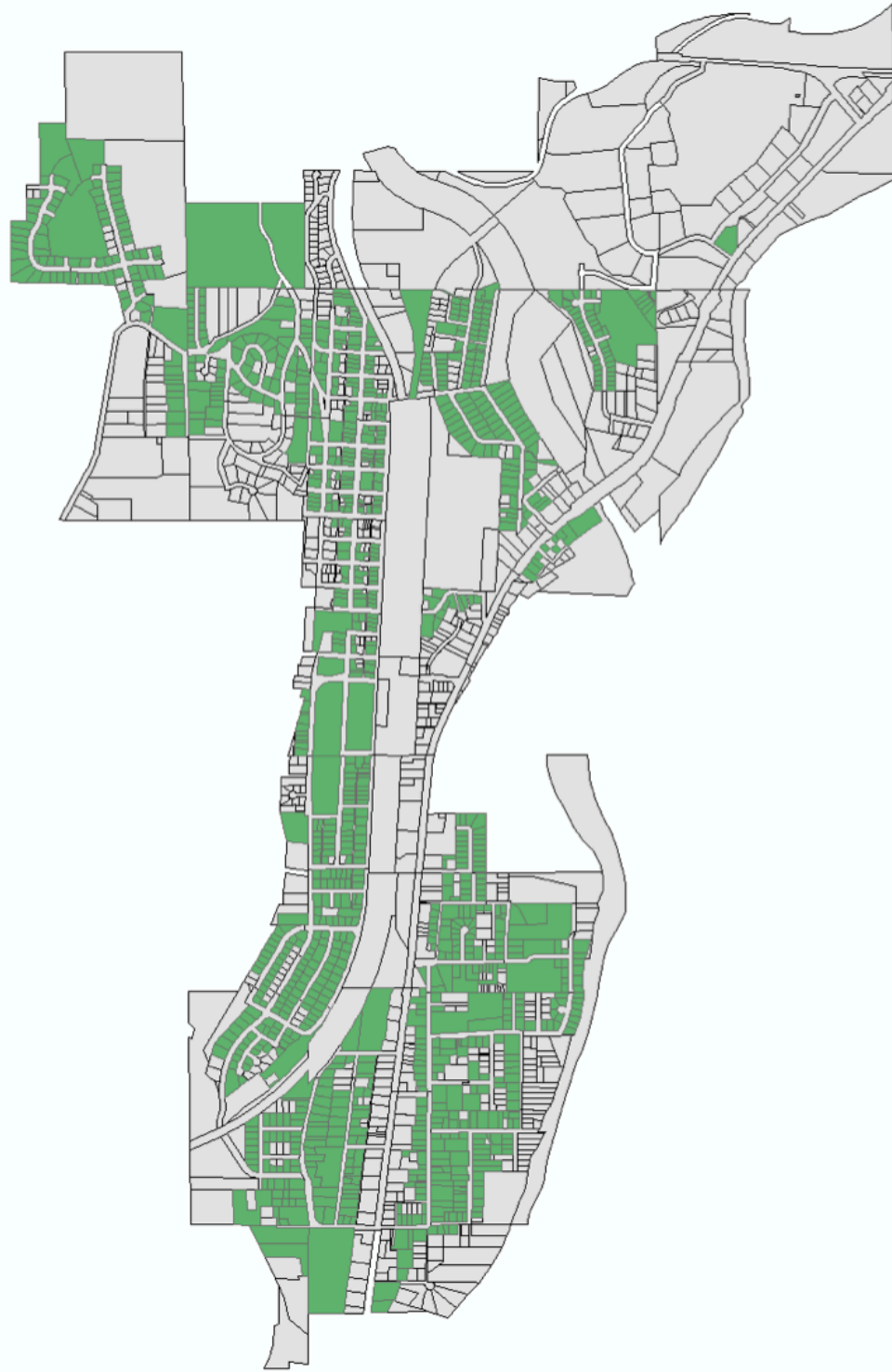


FIG. 15

# NATURAL HAZARDS

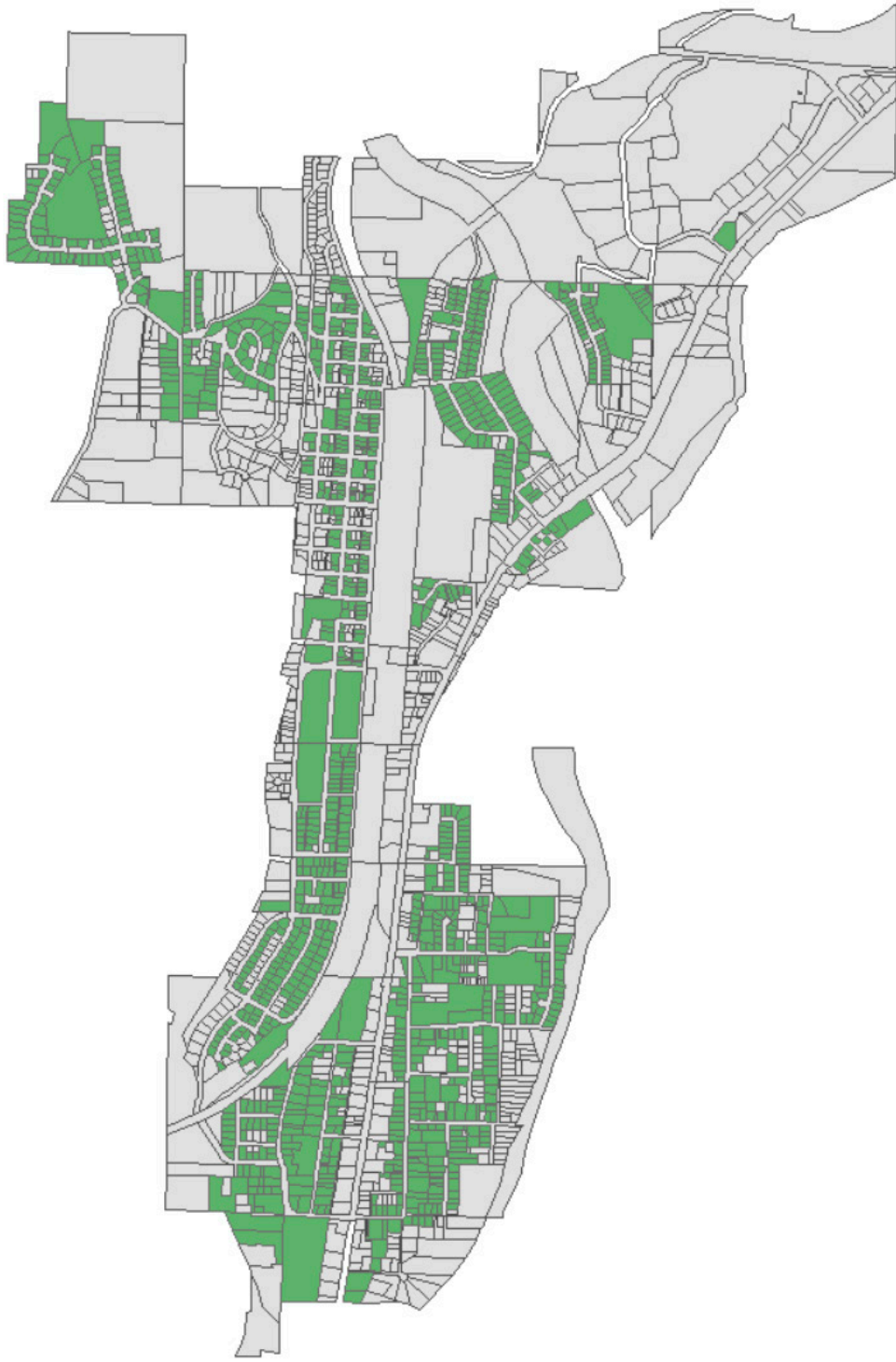
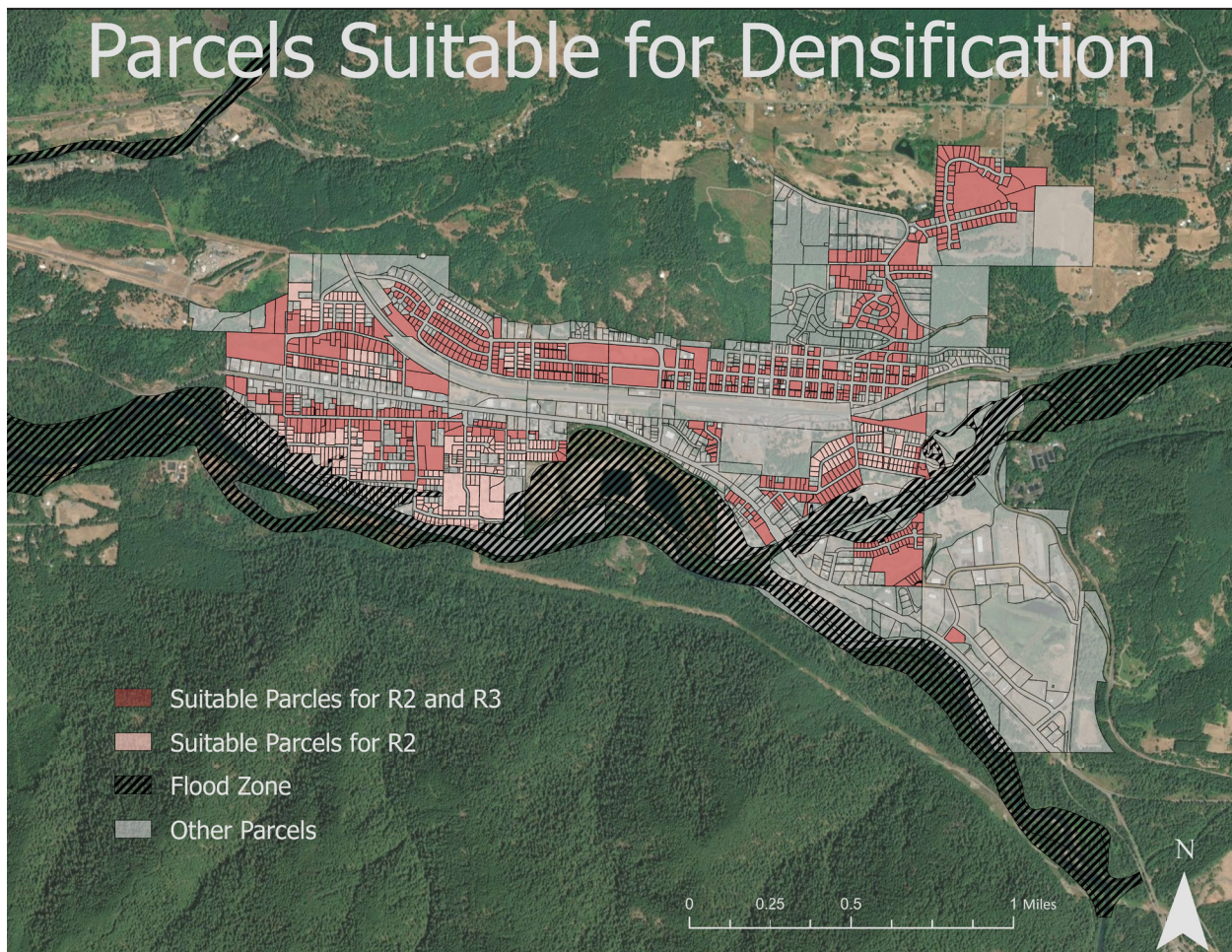


FIG. 16

## RESULTS

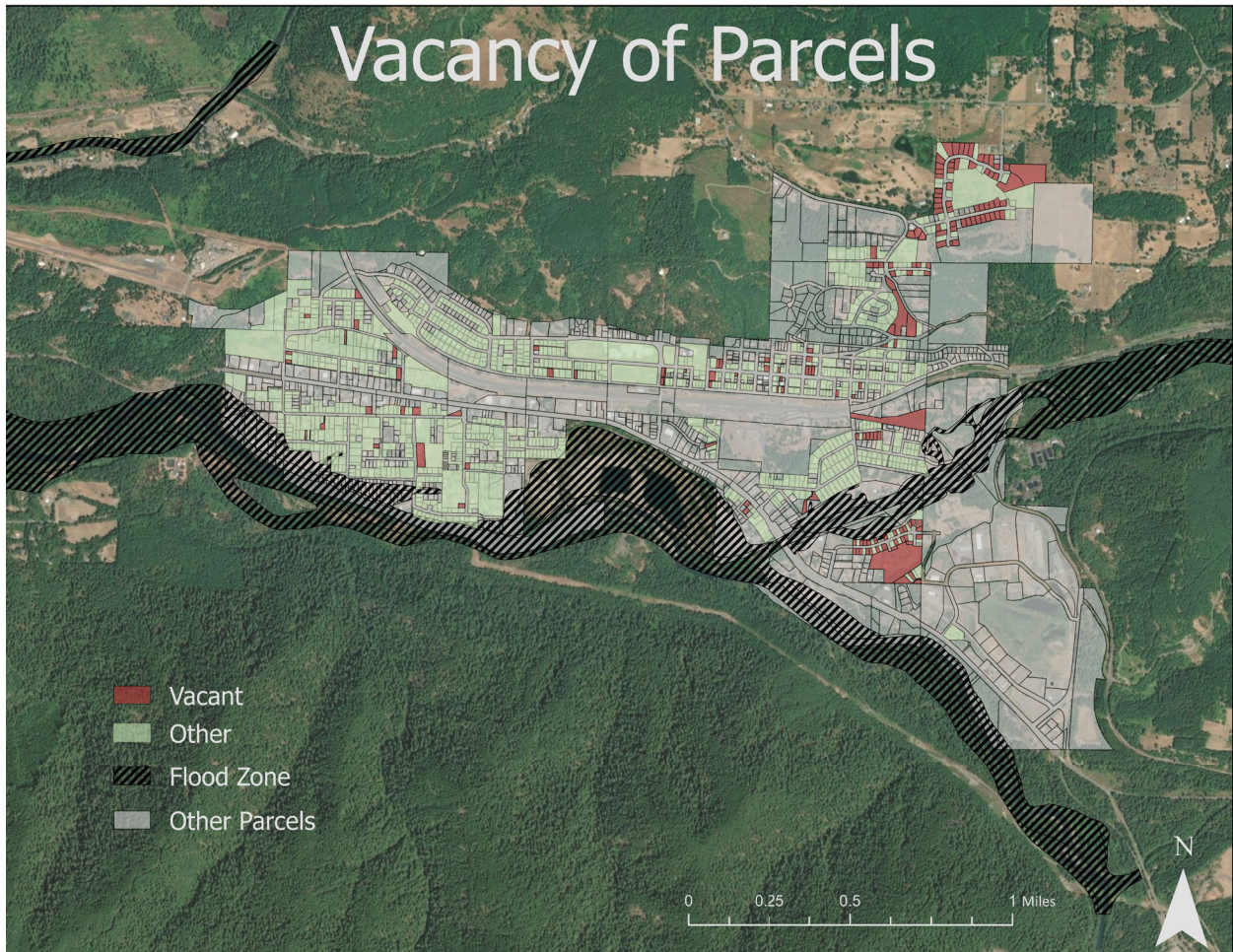


**FIG. 17**

Parcels suited for development

The student-applied criteria yielded 363 total acres of land suitable for denser development. Such a result of how much land could potentially meet the requirements exceeded the expectations of the City of Oakridge and student

expectations. The significant number of parcels suitable for R3 development is encouraging as it showcases that much of the City may be ready to support larger and denser housing development.



**FIG. 18**

Vacant parcels

The map shows that most suitable parcels are non-vacant. Therefore, although there is significant opportunity for more R-3 development, most densification efforts will likely take shape through ADU's, which in many cases, may be the most efficient, affordable, and inconspicuous form of densification.

The students' mapping analysis also addressed a handful of development questions that the Oakridge staff had initially raised. For example, certain areas such as "Little Texas", a series parcels just south of the Railroad, on the eastern side of the city, had been preferred and/

or considered for future development among City staff, but did not meet the requirements for densification, as it didn't have easy access to sewer lines and a small portion of the property is in the floodplain. In other cases, city ideas on which locations were particularly suitable were validated, including the series of parcels located in the downtown core, which if were to be densified, would anchor the businesses and enhance vitality. Furthermore, the area in the City's northeast corner of the Urban Growth Boundary was also validated as a potential location for denser, new development.

## Conclusion and Recommendations

The suitability for Site A, B, and C (see Figure 19) were determined by the baseline criteria and communicated by Oakridge staff based on the City's plans for development and other factors shown on the graphic. Analysis yielded more acreage than anticipated and students recommend three priority sites for future development:

### **SITE A**

Oakridge City staff noted that this location is a preferred place for new development. With 38 total acres, Site A has the capacity to support larger scale development that could meet demands for future population growth. The site is also relatively flat and has a low burn probability due to the absence of forestation in its proximity. Lastly, the site is removed from the highway, limiting the exposure of noise pollution to potential residents.

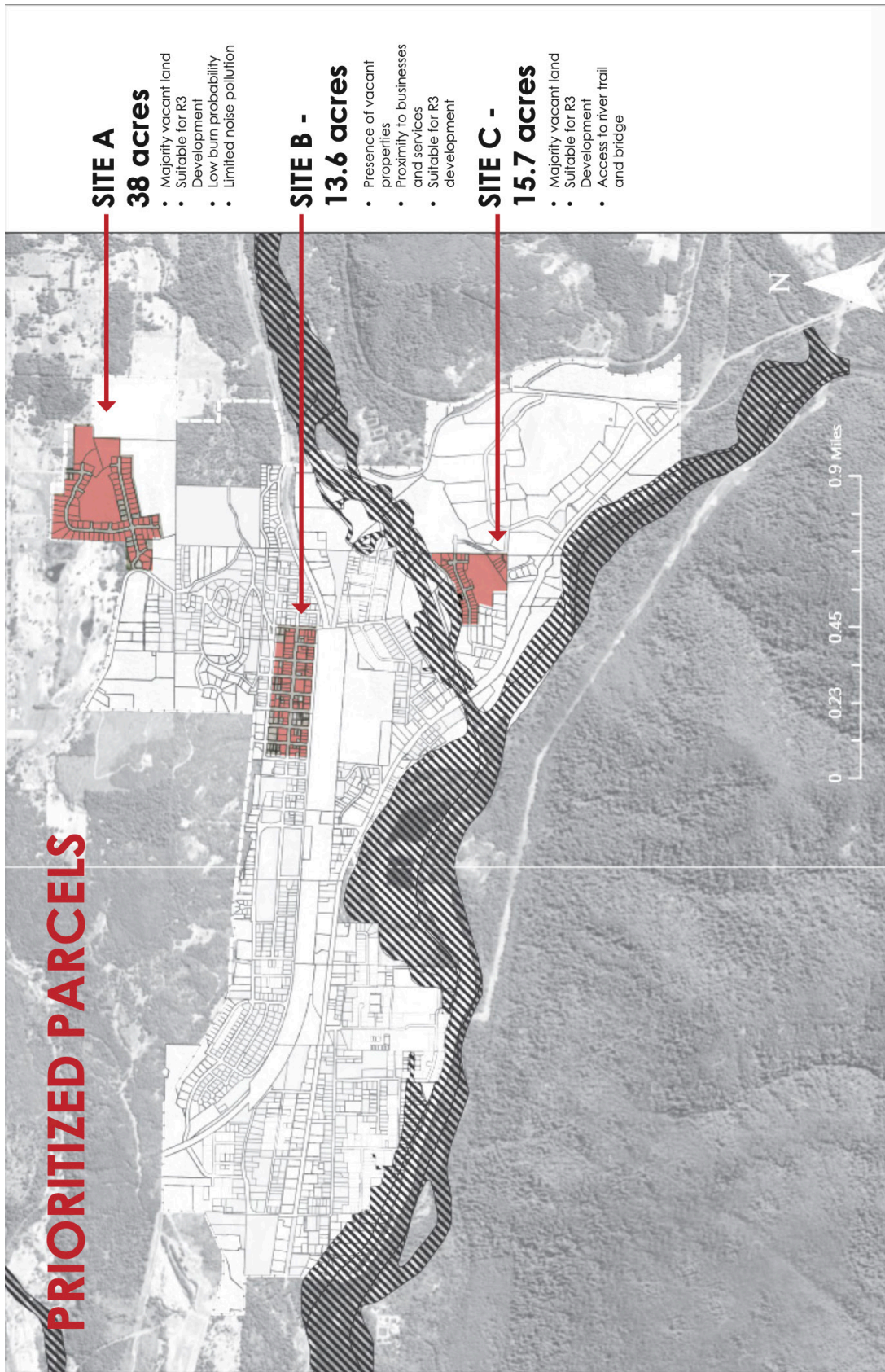
### **SITE B**

City staff hoped that Site B would meet the requirements of the mapping analysis, given its downtown location and proximity

to downtown businesses. The area can support R-3 development and has several vacant parcels. Densifying this area would anchor Oakridge's downtown core, as it would provide a support base for businesses.

### **SITE C**

Like Site A, Site C provides several vacant parcels suitable for R-3 development. This location would be an attractive development choice given its proximity to the river and access to pedestrian paths and the new river trail and bridge. Development here could promote active transportation and other types of recreation.



**FIG. 19**  
Prioritized parcels

## References

City of Oakridge. Comprehensive Plan Map. [https://www.ci.oakridge.or.us/sites/default/files/fileattachments/community/page/15001/oakridge\\_comprehensive\\_plan\\_map\\_2022.pdf](https://www.ci.oakridge.or.us/sites/default/files/fileattachments/community/page/15001/oakridge_comprehensive_plan_map_2022.pdf).

City of Oakridge. Housing Needs Analysis Report. Accessed July 28, 2024. [https://www.ci.oakridge.or.us/sites/default/files/fileattachments/community/page/22367/hna\\_report\\_oakridge\\_final\\_062923.pdf](https://www.ci.oakridge.or.us/sites/default/files/fileattachments/community/page/22367/hna_report_oakridge_final_062923.pdf).

GIS Geography. “27 Differences Between ArcGIS and Q-GIS.” <https://gisgeography.com/qgis-arcgis-differences/>.

GIS Geography. “gvSIG Software Review: Desktop, 3D and Mobile GIS.” GIS Geography. Last modified July 9, 2017. <https://gisgeography.com/gvsig-software/>.

GIS Geography. “GRASS GIS – Geographic Resources Analysis Support System.” Last modified July 9, 2017. <https://gisgeography.com/grass-gis-geographic-resources-analysis-support-system/>.

gvSIG Team. gvSIG Desktop: User Manual. Version 1.10. <https://joinup.ec.europa.eu/sites/default/files/event/attachment/gvsig.pdf>.

GIS Geography. “SAGA GIS (System for Automated Geoscientific Analyses) Review and Guide.” Last modified July 9, 2017. <https://gisgeography.com/saga-gis-review-guide/>.

GIS Geography. “The Hidden Powers of QGIS 3: Features and Plugins.” Last modified August 6, 2022. <https://gisgeography.com/qgis-3/>.

# Appendix

# EXPLORING OPEN-SOURCE GIS:

## INSIGHTS ON LEADING SOFTWARE



### INTRODUCTION AND GOALS

In the realm of geographic information systems (GIS), open-source software has emerged as a valuable tool for smaller communities and NPO's with limited funds. Although there are a wide range of available options, navigating the open-source landscape can be a daunting task, and existing comparative literature surrounding open source softwares is often limited, hard to find, and/or dated. The goal of this report is to equip small and under-funded communities and NPO's with a better understanding of the available open source GIS softwares that can be used throughout planning processes. By examining existing literature, information retrieved through online forums, and conducting our own user survey, we hope to establish a better understanding of the costs and benefits of the leading open-source softwares.

### METHODS

The survey was targeted towards University students in various fields, and consisted of 17 questions surrounding the following areas of analysis:

- "Interface user-friendliness"
- "Spatial Analysis Functionality"
- "Data Integration Capabilities"
- "Mapping and Aesthetics"

These areas were scored on a 5-point scale (1 being poor and 5 being excellent). To do this, we applied a 5-point scaling system for each individual survey question. We took the average score for each question in its respective area, and applied the average of those scores as the final performance score for each area of analysis.

### RESEARCH RESULTS

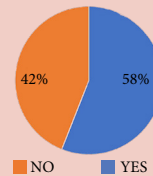
#### EVALUATION FRAMEWORK SCORING RANGE: 1-5

SOFTWARE NAME	INTERFACE USER FRIENDLINESS	SPATIAL ANALYSIS FUNCTIONALITY	DATA INTEGRATION CAPABILITIES	MAPPING PRESENTATION & AESTHETICS
GRASS GIS	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
Q-GIS	3.64	3.42	3.76	3.67
gv-SIG	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
SAGA GIS	3.64	3.5	3.6	2.9

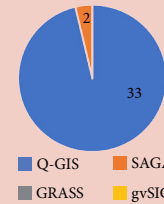
#### NOTABLE FINDINGS

- Q-GIS' is the most popular and considered to be the best overall open-source software amongst University of Oregon students.
- Survey participants have little to no experience with SAGA, GRASS, and or gvSIG, likely due to their specialized nature and lack of opportunities within their respective curriculum.
- Users feel as though a foundational understanding of ESRI products ie. Arc-map, is essential to efficiently navigating open source softwares such as Q-GIS.

"Have you used an open source software?"



"Which open source software have you used?"

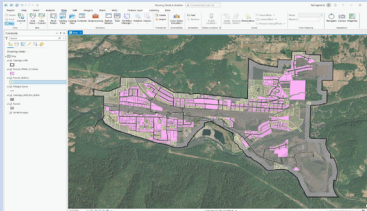


- 58% of respondents said they had used open-source GIS software, whereas 42% of respondents had not ever used open-source GIS software.
- Q-GIS had 33 respondents who had used the open-source software, whereas SAGA GIS had only 2 respondents, which heavily skewed the overall results for SAGA GIS. There were no reported users for GRASS or gvSIG.

### COMPARING Q-GIS AND ARC-GIS THROUGH CONDUCTING A BUILDABLE LANDS ANALYSIS

For the other component of our terms project, we created a build-able lands analysis for the city of Oakridge in attempt to help the city locate parcels suitable for denser housing development. In order to gain a better understanding of the differences between Q-GIS and arc-GIS for ourselves, we conducted the analysis in both softwares. Below is a list of pro's and cons we experienced while doing our analysis.

Arc-GIS



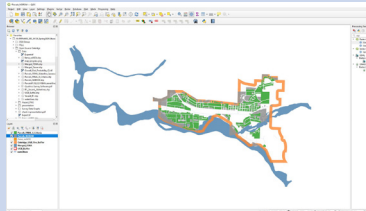
#### PROS

- Geo-processing tools are easily accessible.
- Multiple base layer options which are easily accessible.
- Adding data is quick and intuitive.

#### CONS

- Aesthetics such as colors and symbology feel dated.
- Found difficulty in editing shape file layer elements.

Q-GIS



#### PROS

- Interface is aesthetically pleasing
- Clean and plentiful symbology options
- Plentiful base-layer plug-in options.

#### CONS

- Difficulty locating certain functions.
- Geo-processing tools require multiple steps.
- Lack of search bar for navigating mapping tools

#### "What is the most challenging Aspect of using Q-GIS?"

"Figuring out coded language and transferring spatial data to programs like rhino or auto-cad without losing information."

"Merging Layers"

"How slow it can be and figuring out new functions."

"Creating complex maps to help me with site analysis and context maps. Usually easier for me to look up data and create my own in an adobe suite."

"Knowing where to start."

"Lack of explanation of tools"

### CONCLUSION

Given that it is overwhelmingly more popular than its open source counterparts, and is consistent across our analysis framework, Q-GIS should be seriously considered as an open-source option for small communities and NPO's.

The survey showcases students desire to adopt skills in open-source softwares and highlights the potential disconnect between courses being taught and what is desired within professional fields; many participants feel that understanding open source software would benefit their professional careers, but intimidation and lack of coursework restricts them.

The capacity of our research base cannot provide a fully accurate comparison of open source software, as it is solely focused on University of Oregon students and excludes professionals who are more likely to be familiar with such softwares. Continued research should include a broader study group, including professional users of open-source GIS, in order to gain a more comprehensive understanding.

### EXPLORE THE FULL PROJECT ON OUR STORY MAP



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