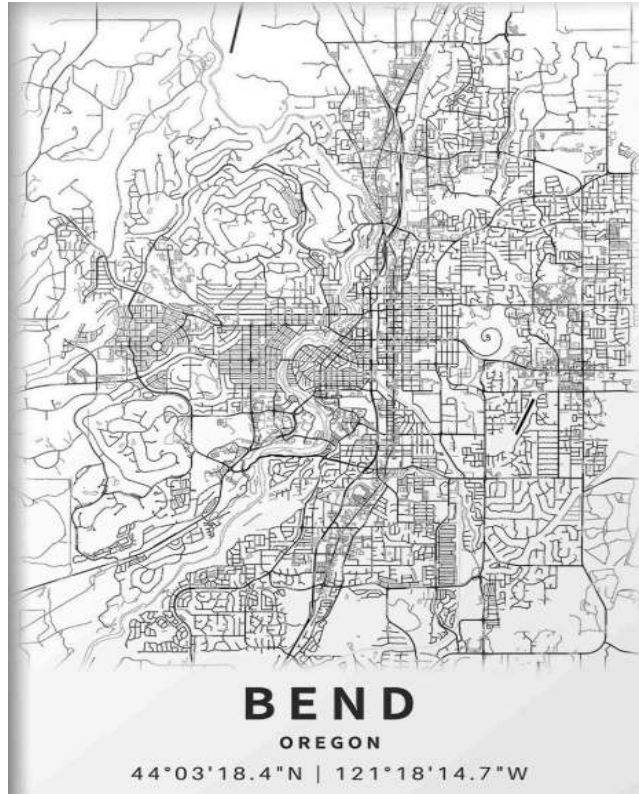


DESIGN REPORT

COST ANALYSIS OF INFRASTRUCTURE IN BEND, OREGON

(2025.STARR.01)



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Civil & Environmental Engineering Capstone

Design Report (Draft 1)

PROJECT DISCLAIMER

This report was prepared as part of a class project for the Civil and Environmental Engineering Project Management and Design course at Portland State University. The contents of this report were developed by the student authors and do not necessarily reflect the views of Portland State University. The analyses, conclusions, and recommendations contained in the report should not be construed as an engineering report or used as a substitute for professional engineering services.

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APPENDICES**A: Case Studies Summaries and Infrastructure Plots**

EXECUTIVE SUMMARY

The City of Bend is grappling with a severe housing affordability crisis, which is exacerbated by their land use regulations that are placing the burden of significant infrastructure updates on local infill developers. This requirement is creating substantial financial barriers for the rapidly growing population and developers due to Bend's aging and inconsistently upgraded infrastructure. The hindered growth constrained by Oregon Measures 5 and 50 discourages development and strains the already taxed local housing availability while also depleting the city's potential tax revenue until post-development property reassessment.

The proposed solution by STARR Designs and Architecture is a self-sustaining infrastructure fund which utilizes a Tax Increment Finance mechanism where the City of Bend would fund the upfront infrastructure costs. This funding mechanism will not only incentivize infill development by removing the infrastructure update cost barrier for developers, but it will also benefit the people who live in Bend by making more housing available, and therefore making it more affordable. Additionally, the City of Bend would also benefit by increasing their tax revenue significantly. The cost infrastructure design and analysis proposed by the STARR project group will allow STARR Designs and Architecture to show the City of Bend the evidence and data on the proposed solution to gain support and funding for developing the infill lots.

The cost infrastructure analysis was created with the assumption that quadplexes would be the standard development of choice on STARR Designs and Architecture's advice. That assumption was used, along with data gathered about potential lots to develop that were compiled in case-study analyses on the east side of Bend, as the foundational data for creating a city-level GIS analysis. The main data points gathered were geographical, utility line, and street type, along with whatever other information could be found about previous land use decisions for each property in development pre-applications. These data points were used to do preliminary cost-estimates for updating the properties, along with creating tables for the cost-analysis, including tax revenue increases. The cost analysis tables show that the city would, on average, make their investment back about ten years after each singular development was constructed. Afterwards, the tax revenue added each year would be profit for the city. This doesn't include an estimate of return rate if other surrounding lots are updated, which would expedite the time to break even. This preliminary data informed the city level GIS analysis, a tool designed to identify suitable lots for development while streamlining infrastructure cost analyses and estimating costs on a larger scale.

In conclusion, the infrastructure cost analysis presented in this report shows that it's economically beneficial if the City of Bend were to fund the upfront infrastructure costs to stimulate infill development and increase its tax base.

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This design report investigates cost-effective ways to develop infill housing in Bend for the client. Included herein is the alternatives analysis, which details the evaluation of different design options, and the facility design, which describes the design criteria and the work done for the client. The design report then describes the agencies, permits, and impact on budget and schedule in the regulatory compliance and permitting section, followed by the conclusion, which details the final product. In addition to this report a map will be developed using ArcGIS to display the potential build sites and the adjoined infrastructure to aid in future analysis and design, shown in the appendices.

1.0 PROJECT UNDERSTANDING

This section will outline the project background and purpose, then describe the site conditions as well as the stakeholders involved in the project.

1.1 PROJECT BACKGROUND

Bend was officially incorporated as a city in 1905, with a population of only 500 residents. The arrival of the Oregon Truck Line Railroad, and two lumber companies was a major turning point for the area. This attracted more workers, contributed to its population growth, and facilitated transportation and commerce. Over the years, Bend has continued to see a major increase in population which led to Bend being ranked as the one of the most overpriced housing markets in America. The median price for a home in Bend in 2021 was \$675,000, and in 2024 was approximately \$730,000, illustrating the rapid growth the city is experiencing. New estimates show this value as increasing every year. According to the Bend real-estate team at Total Real-Estate Group, only about 8% of the local workforce can afford a home. Because of this, Bend has been trying to produce more housing.

Developers in the Bend area have been trying to build housing units on the east side of Bend, shown in *Figure 1*, on infill, single family home lots. The current land use regulations in Bend state that the developers of new housing must also update the infrastructure surrounding the lot they're building on. Because of the age of the city's infrastructure, and that it's not consistently updated, this means most available lots that are good candidates to be developed need moderate to major infrastructure updates before new units can be placed. This is a dual problem for developers. The first issue with this is that because of the numerous and involved updates needed, the developer won't be making as much of a profit from their project and would make it less financially feasible, which deters developers from building in the first place. If these lots were developed, the for sale costs would push the projects outside of the current market values. The projects would then be at best unaffordable, and at worst financially impossible to justify development. The second issue is that if a developer does the infrastructure updates surrounding a property, another developer can capitalize on that by developing an adjacent property without

having to spend as much on infrastructure updates, giving them an unfair advantage. Many of these projects have been started, and abandoned due to these high infrastructure costs.



Figure 1- Project location within the state of Oregon. The red box is the Eastern side of Bend on focus. Lots analyzed are spread throughout that area. Sources: GoogleEarth.

This also creates an issue for the City of Bend, concerning their annual tax revenue. Because many of these infill lots have not been developed for quite some time, they are taxed on a value that is much lower than their market rate (from 1997). Oregon Measures 5 and 50 limit tax raises on properties unless developed and re-evaluated to 3%. If the infill housing units were built, the city would benefit from the resulting tax base increase they would receive after reassessing the property values after development. In addition to making much more money from the increased taxes off developed lots, the city would also expect to see some increased revenue from tourism.

The solution which STARR Designs and Architecture has come up with, the basis of this project, is to adjust the current zoning laws in Bend to make it easier for developers to build. The proposed idea will lead to more fair and financially feasible circumstances for developers in Bend, a large return in profits for the city of Bend due to the tax base-increase, and more affordable housing for the citizens of Bend because of the increased supply. The solution is to utilize a Tax Increment Financing funding model to address infrastructure needs on a project by project basis for infill properties. The initial funds for this plan can be generated by city wide bonds, state grants, or a combination of both. Put simply, the City of Bend would pay for the infrastructure updates within the public right of way that are needed for the properties being developed. This would equalize

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development for developers in the area and allow them to get to work building high-density housing that would benefit them, the city, and the community.

The STARR capstone group has compiled a list of case studies which compares the infill lots in the project location to their respective tax revenue increases in the infrastructure cost analysis. Each lot has been analyzed to determine what infrastructure would likely need to be updated in order to be brought up to the current City of Bend standards. Using this information, the infrastructure cost was estimated using Oregon Department of Transportation BID Items and other methods, detailed in the Analysis Assumptions and Cost Estimation Assumptions portion of this report. This was then compared to the increased value of the land, in order to compare the estimated infrastructure cost with the estimated additional tax revenue post development. The case studies for specific lots were used to create a large-scale analysis over the east side of Bend. Maps will be developed using ArcGIS to display the potential build sites and the adjoined infrastructure to aid in future analysis and design for this large scale analysis. This will aid in showing the benefit the city would experience if other similar lots were also used to develop infill housing.

1.2 EXISTING SITE CONDITIONS

Bend is surrounded by mountains and is at a high altitude, therefore is subjected to a lot of snow during the winter. These cold winters have a high impact on the construction scheduling. Soils mainly consist of dryer sand deposits. Most of the individual lots that are being considered for redevelopment are flat, and less than 15,000 square feet. Most surrounding lots from the lots of interest are single family residential homes. As an example, one of the abandoned lots that would benefit from redevelopment is 505 NE Franklin Ave. *Figure 2* shows the current state of the lot. Located on the east side of Bend, 505 NE Franklin is occupied by gravel roads, trees, and has no structures. Franklin Road, along with 5th street and the alleyway, needs development to be up to the City of Bend's 2024 Standards and Specifications for roadway development. The large trees on the lot would need to be removed before development, as well as updates to the water and sewer infrastructure.



Figure 2: 505 NE Franklin lot. Source: GoogleMaps

Many lots are similar to 505 NE Franklin throughout Bend, where at least one of the cross roads would need heavy repairs. *Figure 3* is an example of the state of curbs that would likely need to be replaced per the City of Bend codes. Using the existing site information, a site drawing of the lot was created, seen in *Appendix A*. *Figure 4* shows a small snippet of the major updates needed, shown in more detail in the appendix. In order to create these estimates, many assumptions were made to have consistent and conservative values between the case studies, and this is further detailed in the facility design section.



Figure 3: North portion of 505 NE Franklin lot, on the Franklin road side. Source: GoogleMaps.



Figure 4: Cost estimate for 505 NE Franklin, seen in *Appendix A*. This item is shown as an example, and not as the complete drawing in *Appendix A*.

1.3 STAKEHOLDERS

This section discusses the parties that will be affected by this project. Both primary and secondary stakeholders are included.

1.3.1 Primary Stakeholders

The primary stakeholders in this project are the client Ryan Starr, the citizens and government of Bend. Mr. Starr initiated this project to assist the City of Bend in contributing to developers growing infill housing in the area. Ryan Starr recognizes the necessity for infill housing in the communities of Bend and is motivated to increase their availability. He will continue to collaborate with the project group throughout the work, helping to select the most efficient methods to keep the costs of development down in the analysis, as well as for continued support and resources to ensure the analysis is completed promptly and accurately.

As discussed in the project background, the city of Bend has had a difficult time supporting the growing population, which has led to short housing supply and unattainably high priced homes. Due to the urban growth boundary, the city can no longer grow on new land. This leaves a large portion of the workforce for the city that uphold the local economy disadvantaged. Therefore, it is paramount for the citizens and the City of Bend to have more infill housing developments that can

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help make housing more affordable to a larger cross section of people. The outcome of this process will affect the city's budget and planning, and the community's quality of life. This is why the government and citizens of Bend are affected by the quality and accuracy of the project's outcomes. as it

Additionally, the infrastructure updates added via infill housing development will increase the city's revenue by increasing the land's tax density, without adding any additional infrastructure in need of additional future maintenance, leading to a more financially sound community that will benefit both the city and its citizens.

1.3.2 Secondary Stakeholders

The secondary stakeholders are the Capstone group's office manager, Evan Kristof, and the developers that will be working with the client in updating Bend's infrastructure and building the housing units. Mr. Kristof is primarily concerned with the quality of the cost analysis, and also with the project's timeline, organization and communication efficacy, both within the group and with other stakeholders. As he manages the group's project, together with the project manager Emma, he will be consulting the group throughout the cost analysis duration.

The varied developers that will be working with the client Ryan Starr and other architects, consultants, and contractors in the area have a similar stake within the project's scope. They will be working with the City of Bend to develop more infill housing units that are cost effective and therefore, their opinions are relevant to the accuracy and efficacy of the cost analysis.

2.0 ALTERNATIVES ANALYSIS

The cost analysis for each site will take into account the cost of infrastructure and cost of building for the contractors, and the profit for the contractors once the quadplexes are built. In order to estimate the profit, the for sale price of the built quadplexes needs to be estimated. The alternatives analysis will consider different ways of estimating this home value of each lot, once fully built.

2.1 ALTERNATIVES CONSIDERED

The following are the alternative methods considered in estimating the home value of a completed quadplex. Five alternatives are included, with the final alternative being held as a control, representing circumstances where the final home value is not included in the cost-estimate analysis.

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2.1.1 Alternative A: Local Realtor

Alternative A will consult a local realtor with experience selling multi-family residential homes in the western half of Bend. The realtor would give an estimate for how much a quadplex would likely go for in that portion of Bend, with no detailed analysis done for each site.

2.1.2 Alternative B: Local Multi-Family Homes

Alternative B will research local multi-family residential homes all over Bend, and estimate the value of one of the homes and the square footage of the home. Using sites such as Zillow, Realtor.com, Redfin and others, this data will then be extrapolated to quadplexes and then the cost of each quadplex will be estimated.

2.1.3 Alternative C: Similar Towns Ratio

Alternative C will consult multiple other towns of similar population size and geography. Using sites such as Zillow, Realtor.com, Redfin and others, home values for single-family residential homes and quadplexes will be compared to get an approximate ratio of one to the other. This ratio will then be applied.

2.1.4 Alternative D: Realtor and Local Multi-Family Homes

Alternative D will combine Alternatives A and B, where a local realtor will give an estimate of how much each quadplex would likely go for, and then be supported by the local analysis of multi-family residential homes.

2.1.5 Alternative E: Home Value Disregarded

Alternative E will not use the existing home values to estimate the profit for the contractor, and that factor will not be taken into consideration in the cost analysis.

2.2 CRITERIA

The criteria defined below represent the characteristics of each alternative per the client's interest. The criterias are all scored using different ranges, ranges with higher variability represent criteria that are more important to the project. In general, the greater the value the better the alternative scored in that analysis.

2.2.1 Criteria I: Accessibility

Criteria I depicts the ease of acquiring the data. Ranked 1 through 5, alternatives with 5 are very easy to gain access to. Rank 1 represents a data source that is very difficult to get access to, while ranks 2 through 3 represent somewhere in the middle of that difficulty range.

2.2.2 Criteria II: Accuracy

Criteria II depicts how accurate each alternative would be, and if there are any difficulties behind the general theory of each alternative. Ranked 1 through 5, where alternatives with ranks of 5 are very accurate, 3 are accurate but with some assumptions that need to be made about the analysis type, 1 are very inaccurate, or they have a major flaw with the theory behind alternatives. Other ranks fall somewhere in between the three ranks described above.

2.2.3 Criteria III: Evaluation Speed

Criteria III analyzes how fast the data would be able to be acquired and to be tabulated. Ranked 1 through 5, 5 representing less than 3 hours of analysis required, and 1 representing more than 3 hours.

2.2.4 Criteria IV: Rationale

Criteria IV analyzes how justifiable each alternative is. If the basis for the alternative has sound logic, then the alternative would be ranked with a score of 5. Alternatives with logic that could be easily questioned would be ranked with a score of 1. Scores of 2 to 4 are somewhere in between sound and questionable logic.

2.2.5 Criteria V: Repeatability

Criteria V depicts the ability to reproduce the data from other sources. Ranks of 1 resemble low reproducibility, and ranks of 5 would be able to be reproduced easily.

2.3 CRITERIA SCORING

Included below is the breakdown of each alternatives scoring for each criteria, and the reasoning behind each. *Table 1* shows the completed Pugh Matrix showing a more concise detailing of what is explained below.

2.3.1 Alternative A: Realtor

This alternative scored a 14, below is the reasoning for why each score was given for each criteria.

- *Accessibility*: Score of 1 given due to the availability of realtors in the area of the Bend, with the constraint that they may be unwilling or unable to help with the project due to privacy constraints of the work being performed.
- *Accuracy*: Score of 4 given due to the uniqueness of the Bend area, and the benefit of local knowledge and expertise. The score takes into account the potential bias of the Realtor, and inability to fact check the values given or provide references

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- *Evaluation Speed:* Score of 5 given due to the lack of research needed, besides finding the Realtor. No extra work would be required of the Realtor or of the Capstone Team to get more accurate results.
- *Rationale:* Score of 3 given due to the amount of uniqueness between each Realtor's opinion. The only reference to backup the information given would be the Realtor themselves. Although, the Realtor will have singular knowledge of the Bend area that may not be estimated through other means, therefore receiving a score of 2.
- *Repeatability:* Score of 1 given due to the inherent changes in values from different opinions of various realtors. There would be no guarantee of two realtors reporting the same value with a unique market such as quadplexes.

2.3.2 Alternative B: Local Multi-Family Residential Homes

This alternative scored a 20, below is the reasoning for why each score was given for each criteria.

- *Accessibility:* Score of 5 given due to the online access to sites like Zillow, Realtor.com, Redfin and others, that have lots of data on multi-family residential homes.
- *Accuracy:* Score of 3 given due to the use of local Bend data, so there will be no misinterpretation from different towns and different situations. But, there is a lack of quadplexes in Bend, so some interpolation will be required to value the multi-family residential homes based on square footage, not a direct correlation between quadplexes. Most of these multi family homes are old as well, and won't represent newly built quadplexes as accurately.
- *Evaluation Speed:* Score of 2 given as the data collection and research required would likely take longer than three hours to complete.
- *Rationale:* Score of 5 given because of the ability to check all values and information researched. The use of local data also makes it more reliable.
- *Repeatability:* Score of 5 given due to the logical and numerical nature of the alternative. Procedures and steps could be written down and followed to ensure a similar output.

2.3.3 Alternative C: Similar Towns Ratio

This alternative scored a 19, below is the reasoning for why each score was given for each criteria.

- *Accessibility:* Score of 5 given due to the online access to sites like Zillow, Realtor.com, Redfin and others, and plenty of online information about towns of similar sizes and geographies.

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- *Accuracy*: Score of 2 given due to the statistical nature of the evaluation method, using other similar instances to estimate the given situation. The inability to exactly correlate with the city of Bend creates an assumption that needs to be made and the lack of cities that are similar to Bend creates an accuracy issue for this alternative.
- *Evaluation Speed*: Score of 2 given as the research into multiple types of land and home developments and in different cities will likely take longer than three hours to complete for accurate results.
- *Rationale*: Score of 5 given because of the ability to check and cross reference research from different sources.
- *Repeatability*: Score of 5 given, similar to Alternative B, because of the logical and numerical nature of the process. Assumptions, steps, and processes could be documented and followed to ensure repeatable results.

2.3.4 Alternative D: Realtor and Local Multi-Family Home

This alternative scored a 17, below is the reasoning for why each score was given for each criteria.

- *Accessibility*: Score of 3 given because of the difficulty in finding a credible realtor willing to help with the project.
- *Accuracy*: Score of 4 given due to the ability to compare the realtor values with local multi-family residential homes.
- *Evaluation Speed*: Score of 3 given due to the time to gather information about the local home markets, and time to compare the realtor values to the local data.
- *Rationale*: Score of 4 given because of the use of a Realtor and the inability to pull direct references from the source. Although, because of the cross reference of local data, the criteria scored a 4 and not lower.
- *Repeatability*: Score of 3 given because of the fluctuation of opinions from realtor to realtor, but the local data would be able to give some ‘datum’ for the realtor values.

2.3.5 Alternative E: Home Value Disregarded

This alternative scored a 13, below is the reasoning for why each score was given for each criteria.

- *Accessibility*: Score of 5 given because data is easily accessible.
- *Accuracy*: Score of 1 given because the lack of information is inherent to inaccurate work.
- *Evaluation Speed*: Score of 5 given because no evaluation would be required.

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- *Rationale:* Score of 1 given because the lack of inclusion for the end value of the home is inherently illogical.
- *Repeatability:* Score of 1 given because there would be no data to reproduce, therefore no repeatability from the process.

2.4 RECOMMENDED ALTERNATIVE

The recommended alternative based on the criteria described above is Alternative B, the use of Local Multi-Family Homes in the City of Bend to calculate the estimated price of quadplexes. Alternative B was the highest scoring alternative, although Alternatives C and D were within one point of Alternative B.

3.0 ANALYSIS RESULTS

This section will detail the design process for the case studies and the city level analyses. The case studies analysis will discuss the preliminary assumptions on infrastructure, while the cost estimation will discuss the assumptions necessary for calculating and creating the infrastructure price evaluation tables and GIS plots. Details about the tax increases these lots will experience post-development are included, along with all the assumptions for the estimation. Also included in this section are the ordinarily high-priced infrastructure updates that cause many case study locations to be costly to develop. The city level analysis similarly discusses all assumptions, and processes specific to the GIS section of the analysis.

3.1 CASE STUDIES ANALYSIS

This section will detail the processes to gather the information, build assumptions and create the infrastructure plots and cost estimation tables used to analyze each case study location. Also included is a discussion on the tax benefits the City of Bend will experience from these lots being developed, and the amount of time that it will take those tax benefits to pay for the city required infrastructure within the right of way. Appendix A shows the summaries of each lot, as well as the infrastructure plots.

3.1.1 Preliminary Analysis

Preliminary analysis of each case study occurred first within the process in order to gather any existing information on the lots, as well as understand the general requirements necessary for most properties in the City of Bend. To prepare the case study analysis and get an estimate on how many quadplexes could be built on each property, the following step-by-step process was completed using mapping tools, City of Bend data, and the City of Bend Standard Manual. This information would then be used and confirmed during the development of the cost estimates.

The first step was using Google Earth and Google Maps to analyze the existing infrastructure on each property. Preliminary values for existing road, sidewalk, and other widths were noted as well

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as the current state of the infrastructure. After that the public Bend Data Viewer website, the Deschutes County Property Information database, as well as the Bend Standard's manual were used to gather specific information about the types of roads (arterial, collector, or local), the area of the lots, and the current utilities. For the lot areas, the assumption was made that for every 4000 square feet of land, one quadplex could be developed, per the minimum quadplex area requirements from the Bend Development Code for Single Family Residential zoned lots. Most of these lots analyzed sustained one to three quadplexes. The Bend Development Code specifies minimum depths of 50 feet and widths of 40 feet for the building of quadplexes on Single Family Residential Lots, which restrains the number of quadplexes able to be built for some case study locations. Some lots had to install completely new infrastructure in order to accommodate this development code. Most lots analyzed were zoned as Single Family Residential, but other zoning types including Medium Residential, High Residential, and Commercial Lots were analyzed as well. Specific requirements for these lots are detailed and explained in *Appendix A*. For ease of analysis purposes, the infrastructure sizing requirements within the public right of way were the same for Single Family Residential zoned lots and the others analyzed.

Each quadplex lot would need one sewer and water lateral, providing service to the lot. The road types were defined by the Bend Data Viewer website, but cross-checked with Bend's standards for roadway designs to see the updates required. These were used to define the depth of aggregate and asphalt necessary for repaving of the adjacent roads, if necessary. Road types were also taken into account for right of way setbacks, where some lots had different road types defined than the existing infrastructure, therefore a loss of land would need to be accounted for in the lot area. Lots that had alleyways on either side of them would need to be paved through the length of the lot.

The utility maps were used to decide if the water and sewer infrastructure needed to be updated. Per the City of Bend's current size requirements, a minimum of 8 inch diameter water mains, 2 inch diameter water service lines, 6 inch diameter sewer mains, 6 inch diameter sewer service lines, and 1.5 inch water meters are necessary. If the current infrastructure didn't reflect these standard requirements then they would need to be updated. If water and sewer mains needed updates, then they would have to be updated through the entirety of the section that is not up to current standards. Electricity, fire codes, planters, and road paint were not included in this analysis. All the steps taken were done in order to create the infrastructure analysis for each plot shown in *Appendix A*.

3.1.2 Cost Estimation

This section will depict the cost estimation process including the assumptions and conclusions going into each item for the case studies. Using the above analysis of each case study, as well as ODOT Bid Item information and some recommendations from professionals in the sector, a conservative value for the construction cost was calculated. The cost estimation values were broken down into two different sectors, one depicting the city required infrastructure cost that is

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within the city's right of way, and the other depicting the cost taken on by the developer. The assumptions are depicted first, followed by the breakdown of city required infrastructure and costs taken on by the developer, and finally the conclusions are summarized from the cost estimation processes.

3.1.2.1 Cost Assumptions

Most values for the construction cost estimation are from the ODOT Bid Item list from 2024. Due to the lack of sufficient information for Region 4, the region that Bend is in, all regions were used in order to have adequate values to compute averages. Using all regions also allows for a more conservative approach, because the cost of materials is usually higher in the other regions than solely in Region 4. Because of this conservative approach, no calculations were done to estimate the cost of construction materials by the time these lots would be estimated to be constructed. Specifically, the cost of asphalt is very conservative, which is estimated at \$260 per ton, where most costs within the private sector are closer to \$100 per ton in the Bend area, estimated by professionals in the Bend area. All values were calculated this way, with the expectation of tree removal, permits, temporary traffic control, and curbs.

Due to time constraints within the project the permitting, tree removal, temporary traffic control, and curb values were estimated with the help of professionals in the civil engineering community. It is recommended that further study is done to value these items for more accurate results. The permits included are the Tier 2 and Tier 3 Right of Way permits for building extensive infrastructure within the cities right of way on collector, local, and arterial roads. The total cost for these permits were \$7,191, rounded up to \$10,000 to account for any missing permits. Also included are the Type II Land Use applications, Public Facilities Improvement Agreements, and a Building Permit for Multi-Family developments. An additional \$15,000 contingency was added for engineering permitting costs for sewer, water, and other mechanical installations and inspections. The total for this section of permits is approximately \$28,563, rounded up to \$30,000 to account for other miscellaneous permits. All of these values were estimated from the City of Bend's Fee Schedule from January 1st of 2025 to June 30th of 2025, the most recent permitting values.

Geoffrey Owen, a professional engineer with 30 years of experience in the construction sector, recommended that most lots would cost \$20,000 for the temporary traffic control with the assumption that the road could be fully shut down. Owen also recommended that for large trees, an estimate of \$2,500 for tree removal is practical for these applications. Concrete curbs were rounded up to a price of \$50 to account for difficulties in construction, such as curb cuts and other issues. Other values necessary for calculations were assumed as follows: for trenches, an excavator bucket of 24" was assumed for these smaller projects, the density of aggregate and asphalt were assumed to be 105 lbs/ft³ and 145 lbs/ft³, respectively, and values for the thickness of aggregate and asphalt were taken from the City of Bend standards, and depended on the road type classified by the city. For the construction of the quadplexes, Starr stated that a reasonable value

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is approximately \$200 per square foot, with the assumption that 10% of the lot spacing was lost due to the Development Code from the City of Bend.

When comparing values from the GIS data to the cost estimate tables, not all values will be exactly as seen in the infrastructure plots, seen in *Appendix A*. The various pipe removals and constructions were added to the aggregate and asphalt amounts to account for the restoration to the road work after the changes to those pipes, if the road has existing asphalt. The values for concrete walks will also be smaller in comparison to the infrastructure plots, due to the assumption of a 100 square feet driveway that would need to be constructed, all though not shown on the infrastructure plots. The removal of concrete walks and driveways were estimated from Google Maps imaging, and are not shown on the infrastructure plots but are described in the assumptions for each case study in *Appendix A*.

3.1.2.2 Breakdown of Construction Costs

The construction costs were separated into two sections, the infrastructure within the right of way, and the infrastructure for the property specific development. This separation allows for easy comparison between the total required infrastructure costs and the city-required infrastructure that is being expected of these developers. This also allows for calculations to see how quickly the city-required infrastructure plots would be paid off by the tax increase from the developments of the housing, further detailed in the Tax Increases section.

The city components included development of paved roads on existing gravel or old paving that needed to be maintained. The paving areas that were defined as needing to be repaved had a Pavement Conditions Index ratings of less than 40%, as defined in the City of Bend's Standards and Specifications. Also included are curbs, sidewalks, sewer and water mains that need updating. If sewer and water mains need updating, then the aggregate and asphalt required to refill those trenches were also included, given that the road didn't need to be fully repaved. Connections to existing structures for those sewer and water mains are also included in this section. If trees or clearing and grubbing were necessary for removal for these components, then it was considered a city cost. Permits for those infrastructure updates are included in this section, including the Right of Way Tiers 2 and 3 permits. The temporary traffic control for the construction within the right of way is also included. This was calculated by taking the fraction of the cost to build all materials that would need temporary traffic control for the city components to the total cost for all temporary traffic control. This value was then multiplied by the \$20,000 for the total temporary traffic control to partition the temporary traffic control between the two construction cost sections.

The developer cost estimate included the clearing and grubbing, driveways, and trees not included within the city components. Sewer and water laterals serving the to be built quadplexes were placed on the developer, as well as asphalt and aggregate required for the trenches for those laterals. Water meters and the connections to existing structures for those laterals are included in this section as well. The construction of the quadplexes, and permits for the building of the

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quadplexes were also included. The permits for the private development are the Type II Land Use Applications, Public Facilities Improvement Agreement, the building permits, and any engineering fees. Temporary traffic control for the developer is the rest of the assumed total cost of \$20,000, that wasn't accounted for in the city component.

3.1.3 Tax Increases

In order to estimate the tax increase that these lots will experience from the development, the property value after the quadplex construction also had to be assumed. This value was estimated using current multi-family homes in the east side of Bend that were being sold, per the alternatives analysis where this alternative was the most suited for the estimation process. Attached in *Table 2* shows the values for each of these homes, as well as the square footage and the age. Most of these homes are from the 1970s, and therefore the for sale price per square foot is on the lower side, as expected. It is also recommended in later studies to compare the cost of quadplex construction to the estimated for sale price. Due to some of the high costs for infrastructure updates, the for sale price would be higher. This value was still used in the calculations, because it will be another conservative approach to the entire estimation process. Assuming that the quadplexes are approximately 4,000 square feet, and per the Bend Development Code only 90% of that land can be used for the two-story quadplexes themselves, then the for sale cost would be estimated to be \$1.29 million for one quadplex.

Table 2: Development of the average square footage price of multi-family homes in Bend, using Zillow.

	For Sale Cost	Sq Ft	\$/sq ft	Home Type	Year Built
	\$775,000.00	3220	\$240.68	Duplex	2001
	\$715,000.00	2776	\$257.56	Duplex	2006
	\$699,000.00	2792	\$250.36	Duplex	2003
	\$699,000.00	2496	\$280.05	Duplex	1945
	\$825,000.00	2664	\$309.68	Duplex	2005
	\$2,780,000.00	4416	\$629.53	Quadplex	1979
	\$1,045,000.00	3216	\$324.94	Duplex	2020
	\$689,000.00	1706	\$403.87	Duplex	1971
	\$650,000.00	1706	\$381.01	Duplex	1971
	\$699,000.00	1930	\$362.18	Duplex	1972
	\$1,750,000.00	3592	\$487.19	Multi-Family	1971
	\$2,050,000.00	7600	\$269.74	Multi-Family	1991
	\$899,000.00	1778	\$505.62	Duplex	1970
	\$998,000.00	3256	\$306.51	Triplex	1978
	\$1,275,000.00	4187	\$304.51	quadplex	1978
	\$895,000.00	2224	\$402.43	Duplex	2022
AVERAGE	\$1,090,187.50	3097	\$357.24	-	1986

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Using the Deschutes County Property Change Tax Estimator, the taxes post construction can be estimated for each lot. Necessary inputs are the \$1.29 million for sale value per quadplex built, and the account number of the lot from the City of Bend's database, then the post-development taxes were estimated. The baseline increase for the base taxes are 3% each year, according to Oregon's Measure 5 and 50 that limits the increase each year. As an example, provided is the tax table for 505 NE Franklin Lot, shown in *Table 3*. Both the current tax and the total tax after developments were increased by that respective lot's interest rate. The tax delta shows the comparison between the two tax values. All other lots underwent a similar process. *Appendix A* is a detailed analysis for each lot, including 505 NE Franklin Ave, showing the assumptions and all tables discussed in this section for each lot.

Table 3 Post-Development Tax Analysis of 505 NE Franklin Lot.

Year	Current Taxes	Post-Development Taxes	Tax Delta	Remaining Infrastructure Cost to Pay Back
0	\$2,137.28	\$20,768.00	\$18,630.72	-\$285,925.29
1	\$2,201.40	\$21,391.04	\$19,189.64	-\$266,735.65
2	\$2,267.44	\$22,032.77	\$19,765.33	-\$246,970.32
3	\$2,335.46	\$22,693.75	\$20,358.29	-\$226,612.03
4	\$2,405.53	\$23,374.57	\$20,969.04	-\$205,642.99
5	\$2,477.69	\$24,075.80	\$21,598.11	-\$184,044.88
6	\$2,552.03	\$24,798.08	\$22,246.05	-\$161,798.83
7	\$2,628.59	\$25,542.02	\$22,913.43	-\$138,885.39
8	\$2,707.44	\$26,308.28	\$23,600.84	-\$115,284.56
9	\$2,788.67	\$27,097.53	\$24,308.86	-\$90,975.69
10	\$2,872.33	\$27,910.46	\$25,038.13	-\$65,937.57
11	\$2,958.50	\$28,747.77	\$25,789.27	-\$40,148.29
12	\$3,047.25	\$29,610.20	\$26,562.95	-\$13,585.34
13	\$3,138.67	\$30,498.51	\$27,359.84	\$13,774.50
Years til Infrastructure is Paid Off				13

3.1.4 Case Studies Analysis Summary

Within the case studies analysis, most lots can be broken into two sections. Larger lots, often corner lots, that need major infrastructure updates and the smaller, mid-block lots that are sometimes already on developed water and sewer mains. Shown in *Table 4* is a breakdown of all case studies and the results from the analysis. The city required infrastructure costs are either upwards of \$300,000, or are below \$100,000 larger due to water and sewer main installation. The values with higher required infrastructure costs tend to have a very large impact on the total cost of the development, articulating the problem described in Section 1.1 All lots that have these

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major requirements tend to be paid back in more than ten years, although the average is less than that.

Table 4: Summary of Case Study data, further detailed in *Appendix A*.

Section # in Appendix A	Lot Address	City Required Infrastructure Costs	Percent of Total Cost	Initial Tax Delta	Years to Pay Back
A.2	505 NE Franklin	\$304,556.01	13.19%	\$18,630.72	13
A.3	1911 NE 8th St	\$77,341.15	3.15%	\$21,676.03	3
A.4	703 NE Norton Ave	\$330,257.81	10.79%	\$35,995.48	8
A.5	442 NW Colorado Ave	\$50,447.12	3.80%	\$13,043.07	4
A.6	546 NW Colorado Ave	\$100,259.70	10.55%	\$7,707.79	11
A.7	424 NE Hawthorne	\$234,607.66	9.87%	\$19,403.31	11
A.8	235 NE Kearney	\$202,159.22	4.23%	\$46,703.65	5
A.9	430 NE Emerson	\$33,209.53	3.45%	\$8,451.11	4
A.10	543 NE Marshall Ave	\$293,097.53	10.12%	\$25,737.51	10
A.11	1522 NE 5th St	\$269,646.13	18.20%	\$10,770.38	19
AVERAGE		\$189,558.19	8.74%	\$20,811.91	8.8

3.2 CITY LEVEL ANALYSIS

The purpose of this analysis was to determine which properties in the Bend area would be suitable for development of quadplexes, as well as the cost to improve the current existing infrastructure in a much faster manner than the individual analyses. Using GIS integrated with Python, some of the cost estimation process could be automated using the existing infrastructure GIS maps and data. This information would then be used to demonstrate the benefits of local government subsidizing the cost of infrastructure improvements on the city level scale. See *Appendix B* for the city level analysis maps made which detail the current outdated infrastructure per the City of Bend's current Standards and Specifications, along with highlighted properties that are ideal for development. These maps are useful in detailing how large of a problem this is for the City of Bend while also offering data that can be used in creating solutions for more developments.

3.2.1 GIS Assumptions and Methods

The GIS files used for this analysis and the detailed steps taken in this project are listed in *Appendix C*. The GIS analysis was performed using files from the City of Bend's Data Viewer, and the Deschutes County public data website, with very similar methods to the case study

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analysis, just on a larger scale. The data was imported into ArcGIS and referenced using the common coordinate system NAD 1983 StatePlane Oregon South FIPS 3602 (Intl Feet). Data showing all property boundaries in the Bend area was reduced to only properties that were classified as vacant by the City of Bend and could be used for development, as shown in *Appendix C*. Python was then implemented to find what infrastructure required improvement in order to meet current city standards. This included water and sewer infrastructure, sidewalk, and asphalt. The Standards and Specifications for these values were the same as detailed for the individual case studies. The cost of updating infrastructure at each lot was then calculated, using the same conservative values described in Section 3.1.2. .

3.2.2 Summary

Cost estimate values for the water, sewer, etc. were able to be calculated to start getting a general ballpark figure of the total cost estimates for a lot. Due to constraints within the ArcGIS program, progress was hindered by any cost estimate values requiring area quantities, such as sidewalks and required asphalt updates. The source of this problem came from automating the process so that a new polygon would be made with the attribute table of the infrastructure in question. This polygon would also require dimensions directly relating to the property boundaries of the desired lot, projecting from the boundary to the curb across the centerline of the road. The newly constructed polygon would be directly referenced from a single property, so if 2 lots exist on opposite sides of a road, their corresponding polygons for asphalt and sidewalk improvement would overlap, but wouldn't necessarily be the same. It is recommended that in further studies these portions are developed further to have a more complete understanding of the total infrastructure costs for each lot. Estimation of the tax increases that these lots would experience would also need to be developed, as current tax revenue information is not publicly available as GIS data. A data set detailing the current taxes for each lot would need to be developed, and an equation for the estimated increased tax revenue would also need to be researched to achieve a comparison comparable to the case studies analysis estimated increased tax revenue. Further development of this tool would not only aid the City of Bend in this conversation about their infrastructure update costs, but it could be used for other cities experiencing similar problems, with access to similar datasets.

Although further research and development is required to be able to use this GIS tool on a larger scale, the benefits of being able to analyze what lots are currently ready for development is very useful for the City of Bend. The maps detailed in *Appendix B* show the infrastructure that is out of the City of Bend's current Standards and Specifications for water, sewer, sidewalks, and street quality. These maps provide good intel on how much infrastructure actually needs to be rebuilt in order to be brought up to code.

4.0 REGULATORY COMPLIANCE AND PERMITTING

The main permits that are needed for the required infrastructure updates are both the tier two and tier three right of way permits for medium and high impacts to the city street system, release permits, and building and related trade permits. The right of way tier three permit authorizes major construction, excavation, or alteration within the public right of way that impacts significant public infrastructure. For housing developments this includes new street construction, and utility updates or installations. The right of way traffic control tier two permit addresses how the impact of construction on traffic flow, pedestrian movement, and public safety will be mitigated and authorizes the implementation of a traffic control plan to safely manage vehicles and pedestrians around a construction zone. Release permits that are necessary include conditions and approvals that need to be met and released before certain development steps. Some examples are plat recordation release for subdivisions, like when building multiple quadplexes, utility connection releases and permits, building permit final inspection and occupancy release, and bond releases for public facility improvement agreements. Finally, the building and related trade permits that will be needed include the individual building permits, electrical permits, mechanical permits, plumbing permits, and demolition permits, as well as the engineering permitting and inspection requirements. In addition to the permits required for the housing developments, the other regulatory approvals that would be required to complete the projects are land use applications and reviews, and the public facility improvement agreement (PFIA). Land use applications and reviews authorize zone changes or urban growth boundary expansion while the PFIA is a contract between the developer and the City of Bend that ensures the infrastructure improvements are constructed to city standards, complete within a specific timeframe, financially guaranteed, and dedicated to the city.

Most of these permits require detailed engineering plans that are up to their respective codes and standards that have been stamped by licensed professionals. These plans include utility layouts, traffic control plans with proper phasing and detour routes. Proper documentation is necessary for any subdivision requests, any connections to existing utilities as well as releases for new utilities going to individual homes along the same blocks, as well as any zone changing or urban growth boundary, as well as payment of the permits required. Additionally, public notification, coordination with transit, inspections, and communication with the required regulatory agencies for each permit are required.

The regulatory agencies in charge of the various permits discussed above are the Community and Economic Development Department's Private Development Engineering Division, Bend's Permit Center, and the city's Public Works Operations for enforcement and inspections. The City of Bend Planning Division and Private Development Engineering Division, City of Bend Utility Department, and the City of Bend Building Safety Division are also all departments that have a hand in the permitting process. Lastly, the regulatory agency in charge of the land use applications

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is the City of Bend's Community and Economic Development Department Planning Division. Some regulatory agencies are specific to unique permitting proposals, and may not be detailed in this section.

5.0 CONCLUSION

The analysis detailed above shows that it is more cost effective and reasonable for the City of Bend to fund the cost of infrastructure updates needed to put in new housing developments throughout East Bend. The infrastructure cost analysis plots and tables developed articulate that most lots would be able to pay off their city required infrastructure updates within the city's right of way in approximately nine years, just from the increased tax revenue from these lots being developed. Most lots that took longer than the average nine years to repay the cost post development were likely due to installation of a water main through the entire block. Other lots that require full repaving of roads and alleys also have high city required costs, and can take longer to pay off because of that high initial cost.

The infrastructure cost analysis prepared for this project includes a sample of case studies with in-depth research that shows that the proposed Tax Increment Financial model is something that could benefit the development in the City of Bend. With the help from the City of Bend, not only would the city profit from the increased tax revenue from the developments, but the relationship between the developers and the City of Bend could improve. This would help facilitate further development within Bend, and create a better community focused on beneficial change for the city. These case studies also helped with the creation of the GIS project that analyzes the current state of infrastructure within Bend.

The GIS system allows developers to identify ideal properties and blocks for development, and facilitates the conversation needed between the City of Bend and the developers that are asking for resources. Potentially, this system could even be used by the City of Bend itself to proactively plan repairs of roads or other preparations to clear the way for developers and to expedite the city's improvement even further. If this project is continued, the GIS system could be used as a tool in automating the cost estimates of the infrastructure updates. Having an automated way to calculate the infrastructure cost and compare them with estimated tax revenue increases will allow for the projects and the financing of them to be expedited. Not only would this benefit the City of Bend, but other cities with similar problems and comparable datasets could benefit from the creation of this tool as well.

The limitations of the design are within the design's scope and sophistication. The design's scope is limited because it lacks a more advanced statistical model in the cost analysis that includes compounding interest, and the likelihood of other nearby lots being developed after the infrastructure has been brought up to code. Within the case study data, there is a lack of sophisticated estimated values for the cost analysis because of the broad assumptions made, which

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are detailed more in the assumptions section. The estimated values in the analysis tables are conservative, meaning the estimated construction cost values are likely higher than they would be in practice because of the use of ODOT Bid Items. In addition to high construction values, the price per square footage of the “for sale” prices of the quadplexes are low estimates due to the old infrastructure used in its determination. These values impact the base tax increase the lots will experience post development, and because the price per square footage is low, so is the tax increase. Therefore the actual repayment period will likely be faster than the estimations given. Despite the assumptions made, the analysis still procured worthwhile information on the current cost of infrastructure for these underdeveloped lots to become quadplexes.

STARR Design and Architecture's next steps are communicating with Bend’s local government to gain their support and allocate funding for the infrastructure cost updates within the city right of way, planning a meeting based on this report with the local representatives, gathering community support, and getting a petition in advance if possible. Other resources that can be investigated are Bend’s transportation utility fee, which helps fund street maintenance, or the Bend urban renewal agency, which manages funding and might have specific funding mechanisms that can help. Additionally, Bend’s general obligation bonds, along with the state’s transportation funding, might be able to help fund infrastructure updates.

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APPENDICES

The following appendices are attached.

A. Case Studies Summaries

Included in Appendix A is a summary of the specific assumptions and the individual taxes for each lot. The infrastructure plots are also included.

B. City Level Analysis Maps

Included in Appendix B are separate maps detailing the city wide infrastructure that is out of date and underdeveloped.

C. Calculations and Procedures

Included in Appendix C are the calculations for calculating the cost estimates for each lot, as well as the procedures for the creation of the City Level Analysis Maps

D. Rubric

Included in Appendix D is the unique rubric for the 2025.STARR.01 capstone project.

E. Comment Log

Included in Appendix E is the comment log from the previous Draft I of the Design Report.

Appendix A

Case Study Summaries

TABLE OF CONTENTS**A.1 - 505 NE FRANKLIN****A.2 - 1911 NE 8TH ST****A.3 - 703 NE NORTON AVE****A.4 - 442 NW COLORADO AVE****A.5 - 546 NW COLORADO AVE****A.6 - 424 NE HAWTHORNE****A.7 - 235 NE KEARNEY AVE****A.8 - 430 NE EMERSON AVE****A.9 - 543 NE MARSHALL AVE****A.10 - 1522 NE 5TH ST**

A.1 505 NE FRANKLIN LOT

Lot Summary

The lot on 505 NE Franklin, at the intersection of Franklin and 5th St is approximately 10,500 square feet, with a width of 140 feet and depth of 75 feet. Currently the lot is zoned as an RS lot, or Standard Density Residential zoning. Because the Bend Development Code requires a minimum of 4,000 square feet for quadplexes on this type of zoning, provided a minimum width of 40 feet and a minimum depth of 50 feet for RS lots, this lot fits two quadplexes. Each quadplex will be built on approximately 5,250 square feet in area each, and each plot will have a width of 70 feet and a depth of 75 feet. Due to Bend Development Code lot coverage limits, the maximum building size allowed for two story buildings is equal to 90% of the lot size, meaning each quadplex will be approximately 4,725 square feet. With a construction price of \$200 per square foot, the quadplexes cost approximately \$1.9 million. The for sale value price, estimated at \$352 per square foot, means the final development cost will be approximately \$3.3 million.

The lot currently has no buildings on it, and one major tree. Franklin road is a minor arterial, with sidewalks that would need to be updated. 5th Street is an existing gravel local road that needs to be fully updated with sidewalks and asphalt, including the alleyway along the lot. This newly developed corner will need two ADA ramps, and all other corners on the intersections already have existing ramps. The existing water mains are insufficient for the lot development, and a full water main needs to be updated through the block of 5th Street, as well as the removal of the current water service line to the lot. Sewer infrastructure is up to current code. See attached *Figure A.1* for the drawing of this lot and the updates required.

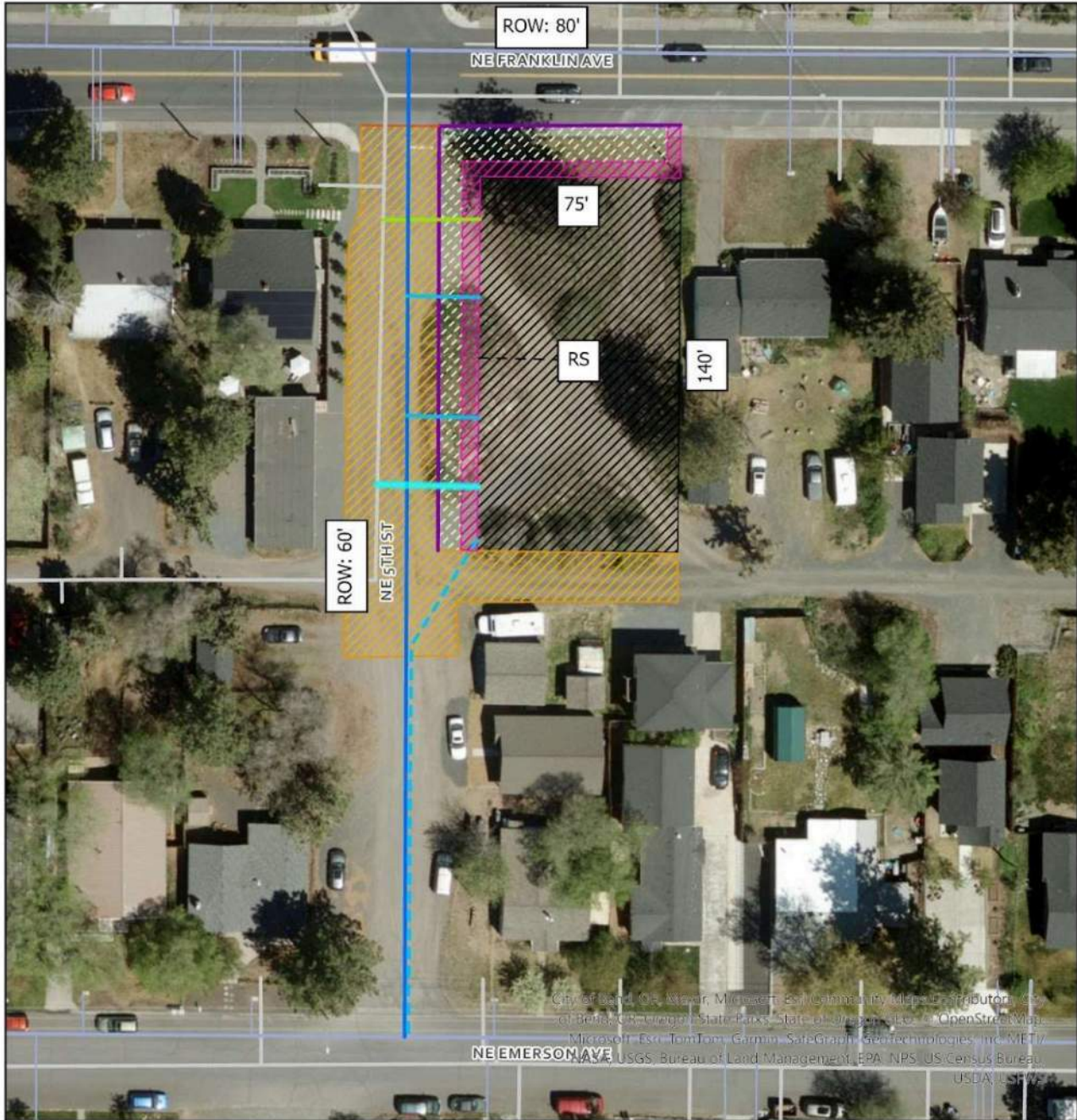
Infrastructure Costs

The infrastructure costs are dominated by the removal and installation of the water main. The total public infrastructure is approximately 13% of the total construction cost for this project. Breakdown of the costs can be seen in *Table A.1.1*, attached below. Some values are not shown in the infrastructure plots, like the removal of walks and driveways which was calculated using the frontage length of the property multiplied by the six foot depth of the existing sidewalk.

Tax Increase

The public infrastructure would be paid off in approximately 13 years from the time of completed quadplex construction, shown in *Table A.1.2*. This value tends to be on the higher side in comparison to the other lots, due to the water main construction. Any other lots supported by the new water main infrastructure would have similar opportunities for development, which would raise the additional tax income for the street as well, and therefore shorten the repayment time. Once this cost is paid off, the development is providing additional tax income in excess of \$27,000 per year.

Appendix A



Site Name: 505 NE Franklin Ave		<div><div><div>N</div><div><div></div><div>0</div><div>0.01</div><div>0.02</div><div>Miles</div></div></div></div>		Notes: Lots are subdivided to allow for multiple quadplexes to be developed. Sewer main is up to code, as well as adjacent pedestrian crossings.
Project Name: 2025.STARR.01	Figure #: A.1	Legend		
<div><div><div><div></div></div><div>Portland State</div><div>UNIVERSITY</div></div><div>Civil & Environmental Engineering 2025 Capstone</div></div>		<div><div><div>Sawcutting</div><div>New_Curb</div><div>New_Sidewalks</div><div>New_Paving</div><div>Case Study Locations</div><div>Future_ROW</div><div>LotSegmentation</div><div>Landscape</div></div><div><div>Gravity_Main</div><div>Gravity_Lateral</div><div>Existing</div><div>New</div><div>Replaced</div><div>Removed</div></div><div><div>Water_Main</div><div>Water_Lateral</div><div>Existing</div><div>New</div><div>Replaced</div></div></div>		

Appendix A

Table A.1.1: Infrastructure costs for 505 NE Franklin Lot.

				505 NE FRANKLIN	
Bid Item #	Description	Average Price	Units	Amount	Cost
<i>PUBLIC INFRASTRUCTURE WITHIN CITY RIGHT OF WAY</i>					
0310-01	Removal of Pipe Mains	\$71.87	Foot	193.00	\$13,870.91
0310-0102	Removal of Walks and Driveways	\$13.32	Sq Ft	225.00	\$2,997.00
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	29.06	\$204.00
NA	Tree Removal	\$2,500.00	LS	1.00	\$2,500.00
0320-01	Clearing and Grubbing	\$29,802.00	Acre	0.00	\$0.00
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	0.00	\$0.00
0445-060008	8in Ductile Iron Pipe, 5 ft depth	\$298.64	Foot	369.00	\$110,198.16
0490-0104	Connection to Existing Structures	\$1,995.78	Each	2.00	\$3,991.56
0495-01	Trench Resurfacing	\$206.57	Sq Yd	0.00	\$0.00
0640-01	Aggregate Base	\$77.87	Ton	221.15	\$17,221.03
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	203.60	\$52,935.83
0759-01	Concrete Curbs	\$50.00	Foot	274.04	\$13,702.00
0759-01280	Concrete Walks	\$20.27	Sq Ft	1,544.00	\$31,296.88
0759-01541	Extra for New Curb Ramps	\$1,772.03	Each	2.00	\$3,544.06
1040-0101	Topsoil	\$549.90	Cubic Yard	44.91	\$24,694.58
NA	Temporary Traffic Control; Public Specific	\$20,000	LS	0.87	\$17,400
NA	Public Permits	\$10,000	LS	1.00	\$10,000
Total Public Infrastructure Cost					\$304,556.01
<i>PROPERTY SPECIFIC INFRASTRUCTURE</i>					
0310-01	Removal of Pipe Laterals	\$71.87	Foot	37.00	\$2,659.19
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	0.00	\$0.00
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	73.00	\$13,933.51
1170-0103	2in Water Service Connection Piping	\$130.00	Foot	54.00	\$7,020.00
1170-011	1 ½" Water Meter Assembly	\$3,402.50	Each	2.00	\$6,805.00
0490-0104	Connection to Existing Structures	\$1,995.78	Each	4.00	\$7,983.12
0495-01	Trench Resurfacing	\$206.57	Sq Yd	0.00	\$0.00
0640-01	Aggregate Base	\$77.87	Ton	0.00	\$0.00
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	0.00	\$0.00
NA	Tree Removal on Entire Lot	\$2,500.00	LS	1.00	\$2,500.00
0320-01	Clearing and Grubbing of Entire Lot	\$29,802.00	Acre	0.24	\$7,183.81
0759-0126	Concrete Driveways	\$35.13	Sq Ft	100.00	\$3,513.00
NA	Construction Cost for Quadplex	\$200.00	Sq Ft	9,450.18	\$1,890,036.00
NA	Temporary Traffic Control; Property Specific	\$20,000	LS	0.13	\$2,600
NA	Property Permits	\$30,000	LS	2.00	\$60,000
Total Property Specific Cost					\$2,004,233.63

Appendix A

Table A.1.2: Comparison of existing taxes and taxes post-development, and the year that the city-required infrastructure costs would be paid in full on the 505 NE Franklin Ave lot.

Year	Current Taxes	Post-Development Taxes	Tax Delta	Remaining Infrastructure Cost to Pay Back
0	\$2,137.28	\$20,768.00	\$18,630.72	-\$285,925.29
1	\$2,201.40	\$21,391.04	\$19,189.64	-\$266,735.65
2	\$2,267.44	\$22,032.77	\$19,765.33	-\$246,970.32
3	\$2,335.46	\$22,693.75	\$20,358.29	-\$226,612.03
4	\$2,405.53	\$23,374.57	\$20,969.04	-\$205,642.99
5	\$2,477.69	\$24,075.80	\$21,598.11	-\$184,044.88
6	\$2,552.03	\$24,798.08	\$22,246.05	-\$161,798.83
7	\$2,628.59	\$25,542.02	\$22,913.43	-\$138,885.39
8	\$2,707.44	\$26,308.28	\$23,600.84	-\$115,284.56
9	\$2,788.67	\$27,097.53	\$24,308.86	-\$90,975.69
10	\$2,872.33	\$27,910.46	\$25,038.13	-\$65,937.57
11	\$2,958.50	\$28,747.77	\$25,789.27	-\$40,148.29
12	\$3,047.25	\$29,610.20	\$26,562.95	-\$13,585.34
13	\$3,138.67	\$30,498.51	\$27,359.84	\$13,774.50
Years til Infrastructure is Paid Off				13

A.2 1911 NE 8TH ST LOT

Lot Summary

The lot on 1911 NE 8th St, at the intersection of NE Seward Ave and 8th St is approximately 12,632 square feet, with a width of 125 feet and depth of 80 feet. The lot is zoned as an RS lot, or Standard Density Residential zoning. Because the Bend Development Code requires a minimum of 4,000 square feet for a quadplex on this type of lot, provided a minimum width of 40 feet and a minimum depth of 50 feet, this lot fits three quadplexes. Each quadplex will be built on approximately 4,211 square feet in area each. Each plot would have an approximate width of 42 feet and depth of 80 feet. Due to Bend Development Code lot coverage limits, the maximum building size allowed for two story buildings is equal to 90% of the lot size, meaning each quadplex will be approximately 3,790 square feet. With a construction price of \$200 per square foot, the quadplexes cost approximately \$2.3 million. The for sale value price, estimated at \$352 per square foot, means a final development value of approximately \$4 million.

The lot currently has a building on it that would need to be removed. NE 8th St and NE Seward Ave are local roads, and NE Seward Ave needs a sidewalk. Four curb ramps are necessary on the north and south west corners of Seward and 8th St, and the other corners have ADA ramps already installed. The existing water mains are insufficient for the lot development, new water service lines are needed, as well as the removal of the current water service line to the lot. Also sanitary sewer pipes need to be upgraded to the current code. See *Figure A.2* for the drawing of this lot and the updates required.

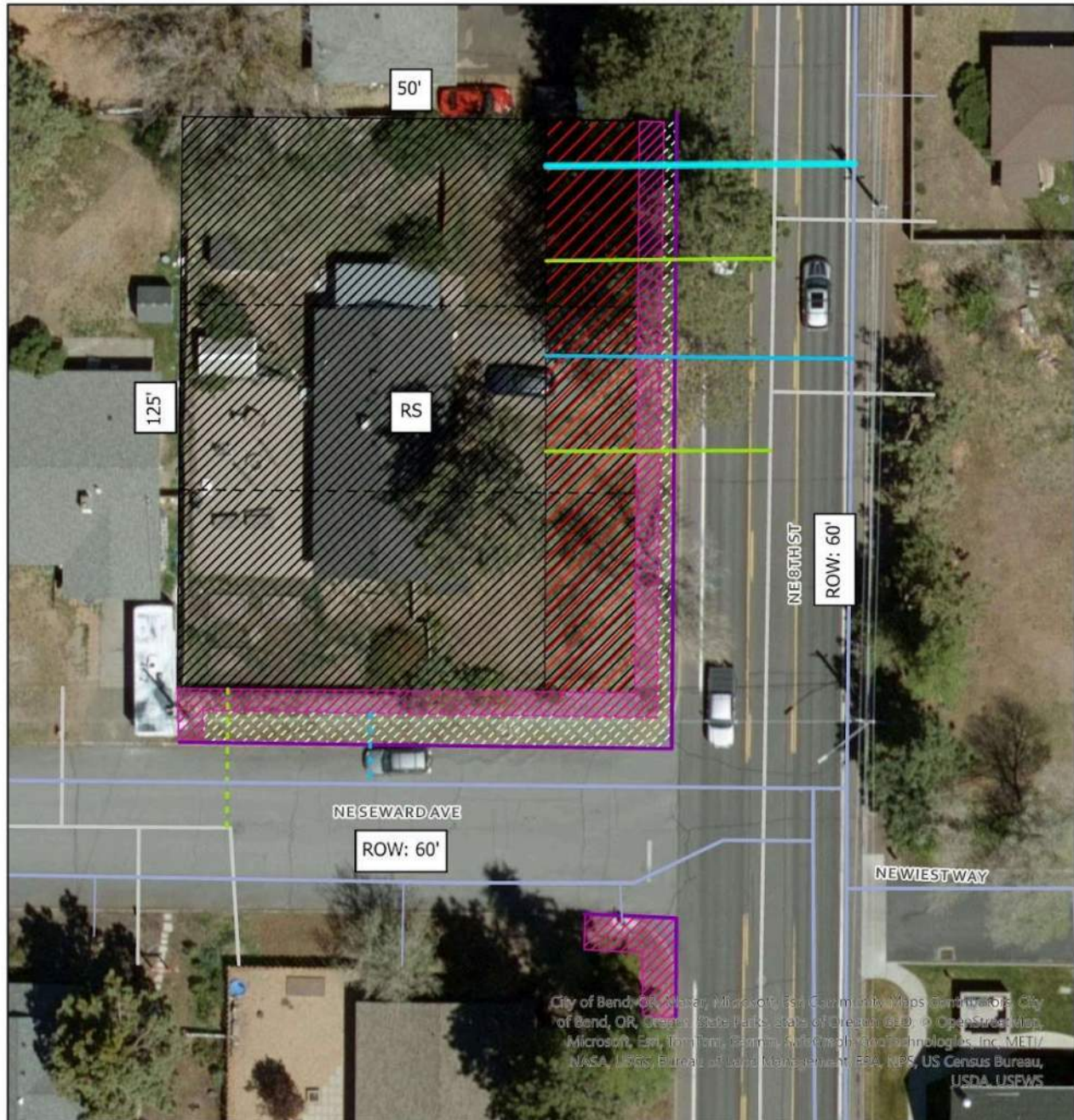
Infrastructure Costs

























The infrastructure costs are dominated by the removal and installation of the water main. The city-required infrastructure is approximately 3.2% of the total construction cost for this project. Breakdown of the costs can be seen in *Table A.2.1*, attached below. Some values are not shown in the infrastructure plots, like the removal of walks and driveways which was calculated using the frontage length of the property multiplied by the six foot depth of the existing sidewalk.

Tax Increase

The city required infrastructure would be paid off in approximately 3 years from the time of completed quadplex construction, shown in *Table A.2.3*. This value tends to be on the lower side in comparison to the other lots, due to the high number of quadplexes that would be able to be developed, raising the base taxes on the lot. Once this cost is paid off, the development is providing additional tax income in excess of \$23,600 per year.

Appendix A



Site Name: 1911 NE 8th St		<div><div><div>N</div><div></div></div><div><div>0</div><div></div><div>0.01 Miles</div></div></div>			Notes: Lots are subdivided to allow for multiple quadplexes to be developed. Future ROW depicts the additional setback for ROW widening on 8th Street. Sewer and water mains are up to code, as well as adjacent pedestrian crossings on 8th street.
Project Name: 2025.STARR.01	Figure #: A.2	Legend	Gravity_Main	Water_Main	
<div><div>Portland State UNIVERSITY</div><div>Civil & Environmental Engineering 2025 Capstone</div></div>		 Sawcutting	 Existing	 Existing	
		 New_Curb	 New	 New	
		 New_Sidewalks	Gravity_Lateral	 Replaced	
		 New_Paving	 Existing	Water_Lateral	
		 Case Study Locations	 New	 Existing	
		 LotSegmentation	 Replaced	 Replaced	
		 Landscape	 Removed	 Removed	
			 Removed	 Replaced	

Appendix A

Table A.2.1: Infrastructure costs for 1911 NE 8th St

				1911 NE 8TH ST	
Bid Item #	Description	Average Price	Units	Amount	Cost
<i>PUBLIC INFRASTRUCTURE WITHIN CITY RIGHT OF WAY</i>					
0310-01	Removal of Pipe Mains	\$71.87	Foot	0.00	\$0.00
0310-0102	Removal of Walks and Driveways	\$13.32	Sq Ft	0.00	\$0.00
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	0.00	\$0.00
NA	Tree Removal	\$2,500.00	LS	0.00	\$0.00
0320-01	Clearing and Grubbing	\$29,802.00	Acre	0.00	\$0.00
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	0.00	\$0.00
0445-060008	8in Ductile Iron Pipe, 5 ft depth	\$298.64	Foot	0.00	\$0.00
0490-0104	Connection to Existing Structures	\$1,995.78	Each	0.00	\$0.00
0495-01	Trench Resurfacing	\$206.57	Sq Yd	0.00	\$0.00
0640-01	Aggregate Base	\$77.87	Ton	0.00	\$0.00
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	0.00	\$0.00
0759-01	Concrete Curbs	\$50.00	Foot	288.01	\$14,400.50
0759-01280	Concrete Walks	\$20.27	Sq Ft	1,364.63	\$27,661.05
0759-01541	Extra for New Curb Ramps	\$1,772.03	Each	4.00	\$7,088.12
1040-0101	Topsoil	\$549.90	Cubic Yard	20.35	\$11,191.48
NA	Temporary Traffic Control; Public Specific	\$20,000	LS	0.35	\$7,000
NA	Public Permits	\$10,000	LS	1.00	\$10,000
Total Public Infrastructure Cost					\$77,341.15
<i>PROPERTY SPECIFIC INFRASTRUCTURE</i>					
0310-01	Removal of Pipe Laterals	\$71.87	Foot	45.00	\$3,234.15
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	556.00	\$3,903.12
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	129.00	\$24,622.23
1170-0103	2in Water Service Connection Piping	\$130.00	Foot	149.00	\$19,370.00
1170-011	1 ½" Water Meter Assembly	\$3,402.50	Each	3.00	\$10,207.50
0490-0104	Connection to Existing Structures	\$1,995.78	Each	6.00	\$11,974.68
0495-01	Trench Resurfacing	\$206.57	Sq Yd	61.78	\$12,761.44
0640-01	Aggregate Base	\$77.87	Ton	14.60	\$1,136.51
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	13.44	\$3,493.53
NA	Tree Removal on Entire Lot	\$2,500.00	LS	1.00	\$2,500.00
0320-01	Clearing and Grubbing of Entire Lot	\$29,802.00	Acre	0.29	\$8,553.17
0759-0126	Concrete Driveways	\$35.13	Sq Ft	100.00	\$3,513.00
NA	Construction Cost for Quadplex	\$200.00	Sq Ft	11,251.55	\$2,250,309.60
NA	Temporary Traffic Control; Property Specific	\$20,000	LS	0.65	\$13,000
NA	Property Permits	\$30,000	LS	3.00	\$90,000
Total Property Specific Cost					\$2,458,578.94

Appendix A

Table A.2.2: Comparison of existing taxes and taxes post-development, and the year that the city-required infrastructure costs would be paid in full on the 1911 NE 8th St lot.

Year	Current Taxes	Post-Development Taxes	Tax Delta	Remaining Infrastructure Cost to Pay Back
0	\$3,050.97	\$24,727.00	\$21,676.03	-\$55,665.13
1	\$3,142.50	\$25,468.81	\$22,326.31	-\$33,338.82
2	\$3,236.78	\$26,232.87	\$22,996.10	-\$10,342.72
3	\$3,333.88	\$27,019.86	\$23,685.98	\$13,343.26
Years til Infrastructure is Paid Off				3

A.3 703 NE NORTON AVE LOT

Lot Summary

The lot on 703 NE Norton Ave, at the intersection of NE Norton Ave and NE 7th St, is approximately 16,100 square feet, with a width of 140 feet and depth of 115 feet. The lot is zoned as an RS lot, or Standard Density Residential zoning. Because the Bend Development Code requires a minimum of 4,000 square feet for this type of zoning, provided a minimum width of 40 feet and a minimum depth of 50 feet. Due to the minimum width and depths of RS lots, only three quadplexes can fit because of the mandatory 40 ft frontage lengths on all lots. Each lot is divided into approximately 5,467 square feet in area each, each plot with a width of 47 feet and depth of 115 feet. Due to Bend Development Code lot coverage limits, the maximum building size allowed is equal to 90% of the lot size, meaning each quadplex will be approximately 4,920 square feet. With a construction price of \$200 per square foot, the quadplexes cost approximately \$3 million. The for sale value price, estimated at \$352 per square foot, means a final development value of approximately \$5.2 million.

The lot currently has a building on it that would need to be removed. NE 7th St and NE Norton Ave are local roads. NE 7th St road needs major updates. The roads are uneven with debris all over. Major cracks are visible, which shows the need for an update. The lot also needs updated sidewalk infrastructure. The existing water mains are insufficient for the lot development, therefore new water service lines are needed. A main pipe through NE 7th St, as well as the removal of the current water service line to the lot is required. Also, sanitary sewer pipes need an upgrade to the current code. See attached *Figure A.3* for the drawing of this lot and the updates required.

Infrastructure Costs

The infrastructure costs are dominated by the removal and installation of the water main. The city-required infrastructure is approximately 10.8% of the total construction cost for this project. Breakdown of the costs can be seen in *Table A.3.1*, attached below. Some values are not shown in the infrastructure plots, like the removal of walks and driveways which was calculated using the frontage length of the property multiplied by the six foot depth of the existing sidewalk.

Tax Increase

The city required infrastructure would be paid off in approximately 8 years from the time of completed quadplex construction, shown in *Table A.3.2*. Once this cost is paid off, the development is providing additional tax income in excess of \$44,000 per year. Any other lots supported by the new water main infrastructure would have similar opportunities for development, which would raise the additional tax income for the street, and therefore shorten the repayment time.

Appendix A

Table A.3.1: Infrastructure costs for 703 NE Norton Ave.

703 NE NORTON AVE					
Bid Item #	Description	Average Price	Units	Amount	Cost
<i>PUBLIC INFRASTRUCTURE WITHIN CITY RIGHT OF WAY</i>					
0310-01	Removal of Pipe Mains	\$71.87	Foot	0.00	\$0.00
0310-0102	Removal of Walks and Driveways	\$13.32	Sq Ft	0.00	\$0.00
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	0.00	\$0.00
NA	Tree Removal	\$2,500.00	LS	3.00	\$7,500.00
0320-01	Clearing and Grubbing	\$29,802.00	Acre	0.05	\$1,367.63
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	50.00	\$9,543.50
0445-060008	8in Ductile Iron Pipe, 5 ft depth	\$298.64	Foot	349.00	\$104,225.36
0490-0104	Connection to Existing Structures	\$1,995.78	Each	3.00	\$5,987.34
0495-01	Trench Resurfacing	\$206.57	Sq Yd	0.00	\$0.00
0640-01	Aggregate Base	\$77.87	Ton	210.39	\$16,382.89
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	193.69	\$50,359.47
0759-01	Concrete Curbs	\$50.00	Foot	336.21	\$16,810.50
0759-01280	Concrete Walks	\$20.27	Sq Ft	1,998.99	\$40,519.53
0759-01541	Extra for New Curb Ramps	\$1,772.03	Each	4.00	\$7,088.12
1040-0101	Topsoil	\$549.90	Cubic Yard	80.15	\$44,073.47
NA	Temporary Traffic Control; Public Specific	\$20,000	LS	0.82	\$16,400
NA	Public Permits	\$10,000	LS	1.00	\$10,000
Total Public Infrastructure Cost					\$330,257.81
<i>PROPERTY SPECIFIC INFRASTRUCTURE</i>					
0310-01	Removal of Pipe Laterals	\$71.87	Foot	44.00	\$3,162.28
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	0.00	\$0.00
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	126.00	\$24,049.62
1170-0103	2in Water Service Connection Piping	\$130.00	Foot	72.00	\$9,360.00
1170-011	1 ½" Water Meter Assembly	\$3,402.50	Each	2.00	\$6,805.00
0490-0104	Connection to Existing Structures	\$1,995.78	Each	5.00	\$9,978.90
0495-01	Trench Resurfacing	\$206.57	Sq Yd	0.00	\$0.00
0640-01	Aggregate Base	\$77.87	Ton	0.00	\$0.00
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	0.00	\$0.00
NA	Tree Removal on Entire Lot	\$2,500.00	LS	1.00	\$2,500.00
0320-01	Clearing and Grubbing of Entire Lot	\$29,802.00	Acre	0.37	\$11,014.82
0759-0126	Concrete Driveways	\$35.13	Sq Ft	100.00	\$3,513.00
NA	Construction Cost for Quadplex	\$200.00	Sq Ft	14,489.80	\$2,897,959.68
NA	Temporary Traffic Control; Property Specific	\$20,000	LS	0.18	\$3,600
NA	Property Permits	\$30,000	LS	3.00	\$90,000
Total Property Specific Cost					\$3,061,943.30

Appendix A

Table A.3.2: Comparison of existing taxes and taxes post-development, and the year that the city-required infrastructure costs would be paid in full on the 703 NE Norton Ave lot.

Year	Current Taxes	Post-Development Taxes	Tax Delta	Remaining Infrastructure Cost to Pay Back
0	\$3,213.93	\$38,161.00	\$34,947.07	-\$295,310.73
1	\$3,310.35	\$39,305.83	\$35,995.48	-\$259,315.25
2	\$3,409.66	\$40,485.00	\$37,075.35	-\$222,239.91
3	\$3,511.95	\$41,699.56	\$38,187.61	-\$184,052.30
4	\$3,617.31	\$42,950.54	\$39,333.24	-\$144,719.06
5	\$3,725.83	\$44,239.06	\$40,513.23	-\$104,205.83
6	\$3,837.60	\$45,566.23	\$41,728.63	-\$62,477.20
7	\$3,952.73	\$46,933.22	\$42,980.49	-\$19,496.71
8	\$4,071.31	\$48,341.21	\$44,269.90	\$24,773.19
Years til Infrastructure is Paid Off				8

Appendix A

A.4 442 NW COLORADO AVE

Lot Summary

The lot on 442 NW Colorado Ave, one lot to the east of the intersection of NW Colorado and NW Lava Road is approximately 6,970 square feet, with a depth of 114 feet and width of 60 feet. The lot is currently zoned as an RM lot, or Residential Medium. Because the Bend Development Code requires a minimum of 4,000 square feet for RM lots, provided a minimum width of 30 feet and a minimum depth of 50 feet, this lot fits one quadplex. Due to Bend Development Code lot coverage limits, the max building size allowed is equal to 90% of the lot size, meaning the quadplex will be approximately 6,273 square feet. With a construction cost of \$200 per square foot, the quadplexes cost approximately \$1.3 million. The for sale value price, estimated at \$352 per square foot, means a final development value of approximately \$2.2 million.

The lot currently has no buildings on it, and two major trees. NW Colorado road is a minor arterial, with sidewalks that would need to be removed and updated to be property tight. NW Lava road is an already paved local road, with existing sidewalk infrastructure. The alleyway through the lot of interest and the neighboring lot to NW Lava Road would need to be paved. The existing water and sewer mains are sufficient for the lot development. New sewer and water lateral connections to the lot would need to be constructed. See *Figure A.4* for the drawing of this lot and the updates required.

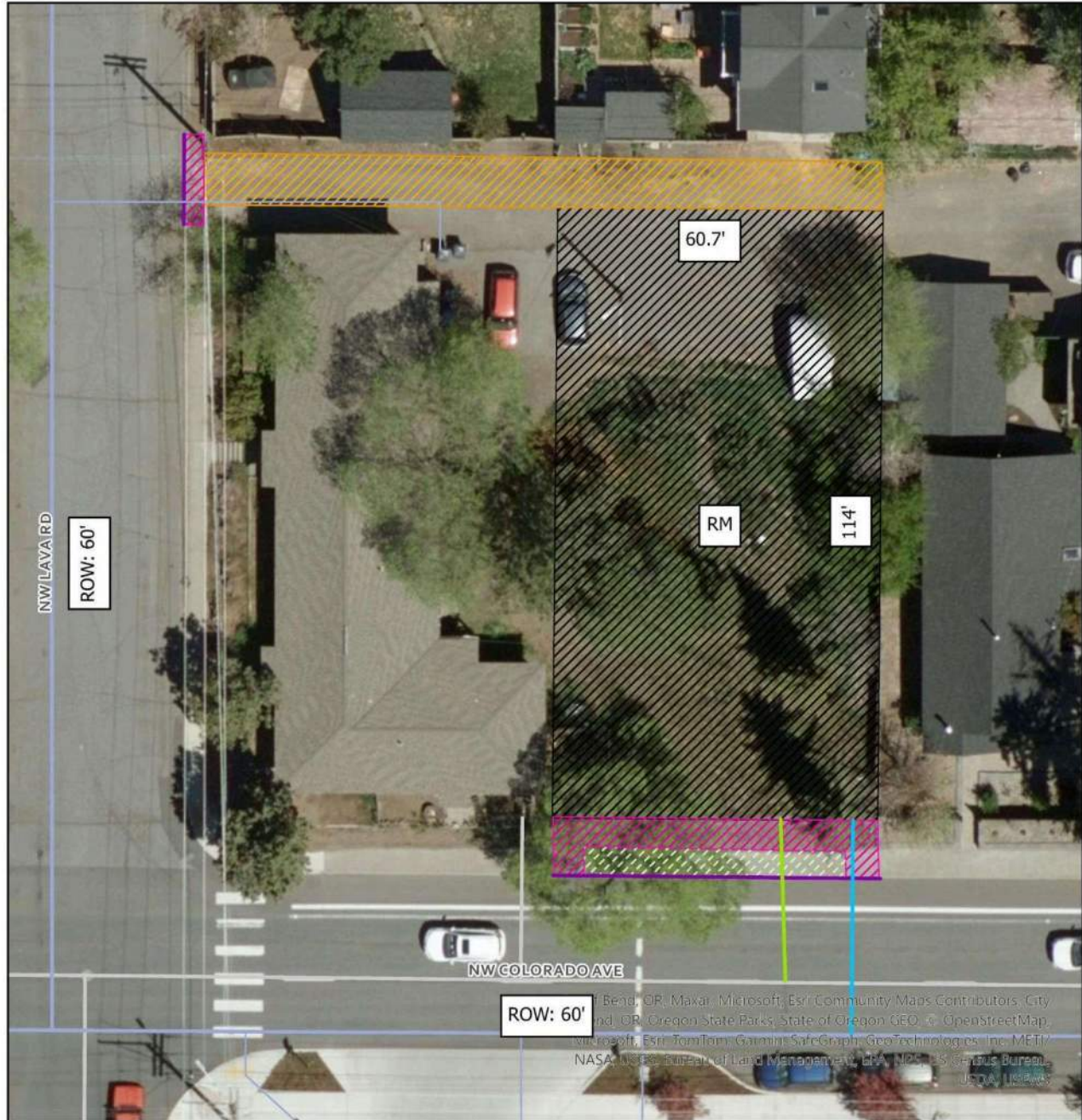
Infrastructure Costs


The infrastructure costs are dominated by the cost to build the quadplexes, and no major city-required infrastructure is necessary besides the paving of the alleyway. The city-required infrastructure is approximately 3.8% of the total construction cost for this project. Breakdown of the costs can be seen in *Table A.4.1*, attached below. Some values are not shown in the infrastructure plots, like the removal of walks and driveways which was calculated using the frontage length of the property multiplied by the five foot depth of the existing sidewalk.

Tax Increase

The city required infrastructure would be paid off in approximately 4 years from the time of completed quadplex construction, shown in *Table A.4.2*. This value tends to be on the lower side in comparison to the other lots, due to the minor infrastructure updates in addition to only one quadplex being able to be developed. Once this cost is paid off, the development is providing additional tax income in excess of \$14,600 per year.

Appendix A



Site Name: 442 NW Colorado Ave		<div><div><div>N</div><div>0</div><div>0.01 Miles</div></div></div>			Notes: Sewer and water mains are up to code.
Project Name: 2025.STARR.01	Figure #: A.4	Legend	Gravity_Main	Water_Main	
<div><div><div></div><div>Portland State UNIVERSITY</div></div><div>Civil & Environmental Engineering 2025 Capstone</div></div>		<div><div><div>Sawcutting</div><div>New_Curb</div><div>New_Sidewalks</div><div>New_Paving</div><div>Case Study Locations</div><div>Future_ROW</div><div>LotSegmentation</div><div>Landscape</div></div></div>	<div><div><div>Existing</div><div>New</div><div>Gravity_Lateral</div><div>Existing</div><div>New</div><div>Replaced</div><div>Removed</div></div></div>	<div><div><div>Existing</div><div>New</div><div>Replaced</div><div>Water_Lateral</div><div>Existing</div><div>Removed</div><div>New</div><div>Replaced</div></div></div>	

Appendix A

Table A.4.1: Infrastructure costs for 442 NW Colorado Ave.

				442 NW COLORADO	
Bid Item #	Description	Average Price	Units	Amount	Cost
<i>PUBLIC INFRASTRUCTURE WITHIN CITY RIGHT OF WAY</i>					
0310-01	Removal of Pipe Mains	\$71.87	Foot	0.00	\$0.00
0310-0102	Removal of Walks and Driveways	\$13.32	Sq Ft	300.00	\$3,996.00
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	0.00	\$0.00
NA	Tree Removal	\$2,500.00	LS	1.00	\$2,500.00
0320-01	Clearing and Grubbing	\$29,802.00	Acre	0.00	\$0.00
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	0.00	\$0.00
0445-060008	8in Ductile Iron Pipe, 5 ft depth	\$298.64	Foot	0.00	\$0.00
0490-0104	Connection to Existing Structures	\$1,995.78	Each	0.00	\$0.00
0495-01	Trench Resurfacing	\$206.57	Sq Yd	0.00	\$0.00
0640-01	Aggregate Base	\$77.87	Ton	30.84	\$2,401.70
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	28.39	\$7,382.60
0759-01	Concrete Curbs	\$50.00	Foot	77.91	\$3,895.25
0759-01280	Concrete Walks	\$20.27	Sq Ft	368.26	\$7,464.63
0759-01541	Extra for New Curb Ramps	\$1,772.03	Each	0.00	\$0.00
1040-0101	Topsoil	\$549.90	Cubic Yard	4.74	\$2,606.93
NA	Temporary Traffic Control; Public Specific	\$20,000	LS	0.51	\$10,200
NA	Public Permits	\$10,000	LS	1.00	\$10,000
Total Public Infrastructure Cost					\$50,447.12
<i>PROPERTY SPECIFIC INFRASTRUCTURE</i>					
0310-01	Removal of Pipe Laterals	\$71.87	Foot	0.00	\$0.00
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	140.00	\$982.80
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	30.00	\$5,726.10
1170-0103	2in Water Service Connection Piping	\$130.00	Foot	40.00	\$5,200.00
1170-011	1 ½" Water Meter Assembly	\$3,402.50	Each	1.00	\$3,402.50
0490-0104	Connection to Existing Structures	\$1,995.78	Each	2.00	\$3,991.56
0495-01	Trench Resurfacing	\$206.57	Sq Yd	15.56	\$3,213.31
0640-01	Aggregate Base	\$77.87	Ton	3.68	\$286.17
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	3.38	\$879.67
NA	Tree Removal on Entire Lot	\$2,500.00	LS	1.00	\$2,500.00
0320-01	Clearing and Grubbing of Entire Lot	\$29,802.00	Acre	0.16	\$4,768.32
0759-0126	Concrete Driveways	\$35.13	Sq Ft	100.00	\$3,513.00
NA	Construction Cost for Quadplex	\$200.00	Sq Ft	6,272.64	\$1,254,528.00
NA	Temporary Traffic Control; Property Specific	\$20,000	LS	0.49	\$9,800
NA	Property Permits	\$30,000	LS	1.00	\$30,000
Total Property Specific Cost					\$1,328,791.43

Appendix A

Table A.4.2: Comparison of existing taxes and taxes post-development, and the year that the city-required infrastructure costs would be paid in full on the 442 NW Colorado Ave lot.

Year	Current Taxes	Post-Development Taxes	Tax Delta	Remaining Infrastructure Cost to Pay Back
0	\$831.93	\$13,875.00	\$13,043.07	-\$50,447.12
1	\$856.89	\$14,291.25	\$13,434.36	-\$37,012.76
2	\$882.60	\$14,719.99	\$13,837.39	-\$23,175.36
3	\$909.07	\$15,161.59	\$14,252.51	-\$8,922.85
4	\$936.35	\$15,616.43	\$14,680.09	\$5,757.24
Years til Infrastructure is Paid Off				4

Appendix A

A.5 546 NW COLORADO AVE

Lot Summary

The lot on 546 NW Colorado Ave, on the lot at the intersection of NW Colorado and NW Staats St is approximately 4,356 square feet, with a depth of 114 feet and width of 40 feet and is zoned as an RM lot, or Multi-Dwelling zones. Because the Bend Development Code requires a minimum of 4,000 square feet per quadplex on RM lots, provided a minimum width of 40 feet and a minimum depth of 50 feet, this lot fits one quadplex. Due to Bend Development Code lot coverage limits, the max building size allowed is equal to 90% of the lot size meaning each quadplex will be approximately 3,920 square feet. With a construction price of \$200 per square foot, the quadplexes cost approximately \$0.8 million. The for sale value price, estimated at \$352 per square foot, means a final development value of approximately \$1.3 million.

The lot currently has no major infrastructure or trees. NW Colorado road is a minor arterial, with sidewalks that would need to be removed and updated to be property tight. NW Staats St is an already paved local road but with low quality pavement that needs to be repaved, with no existing sidewalk infrastructure. The alleyway through the lot of interest to NW Staats St would need to be paved. The existing water and sewer mains are sufficient for the lot development. New sewer and water lateral connections to the lot would need to be constructed, as well as removal of the existing water lateral that is out of date. See *Figure A.5* for the drawing of this lot and the updates required.

Infrastructure Costs



The infrastructure costs are dominated by the cost to build the quadplexes, and no major city-required infrastructure is necessary besides the paving of the alleyway. The city-required infrastructure is approximately 10.6% of the total construction cost for this project. Breakdown of the costs can be seen in *Table A.5.1*, attached below. Some values are not shown in the infrastructure plots, like the removal of walks and driveways which was calculated using the frontage length of the property multiplied by the five foot depth of the existing sidewalk.

Tax Increase

The city required infrastructure would be paid off in approximately 11 years from the time of completed quadplex construction, shown in *Table A.5.2*. This value tends to be on the average side in comparison to the other lots, due to the minor infrastructure updates in addition to only one quadplex being able to be developed. Once this cost is paid off, the development is providing additional tax income in excess of \$10,600 per year.

Appendix A



Site Name: 546 NW Colorado Ave			Notes: Sewer and water mains are up to code. All other corners are up to date.																										
Project Name: 2025.STARR.01	Figure #: A.5																												
 Portland State UNIVERSITY Civil & Environmental Engineering 2025 Capstone		<table><tr><td>Legend</td><td>Gravity_Main</td><td>Water_Main</td></tr><tr><td> Sawcutting</td><td> Existing</td><td> Existing</td></tr><tr><td> New_Curb</td><td> New</td><td> New</td></tr><tr><td> New_Sidewalks</td><td>Gravity_Lateral</td><td> Replaced</td></tr><tr><td> New_Paving</td><td> Existing</td><td>Water_Lateral</td></tr><tr><td> Case Study Locations</td><td> New</td><td> Existing</td></tr><tr><td> Future_ROW</td><td> Replaced</td><td> Removed</td></tr><tr><td> LotSegmentation</td><td> Removed</td><td> New</td></tr><tr><td> Landscape</td><td></td><td> Replaced</td></tr></table>	Legend	Gravity_Main	Water_Main	Sawcutting	Existing	Existing	New_Curb	New	New	New_Sidewalks	Gravity_Lateral	Replaced	New_Paving	Existing	Water_Lateral	Case Study Locations	New	Existing	Future_ROW	Replaced	Removed	LotSegmentation	Removed	New	Landscape		Replaced
Legend	Gravity_Main	Water_Main																											
Sawcutting	Existing	Existing																											
New_Curb	New	New																											
New_Sidewalks	Gravity_Lateral	Replaced																											
New_Paving	Existing	Water_Lateral																											
Case Study Locations	New	Existing																											
Future_ROW	Replaced	Removed																											
LotSegmentation	Removed	New																											
Landscape		Replaced																											

Appendix A

Table A.5.1: Infrastructure costs for 546 NW Colorado Ave.

546 NW COLORADO					
Bid Item #	Description	Average Price	Units	Amount	Cost
<i>PUBLIC INFRASTRUCTURE WITHIN CITY RIGHT OF WAY</i>					
0310-01	Removal of Pipe Mains	\$71.87	Foot	0.00	\$0.00
0310-0102	Removal of Walks and Driveways	\$13.32	Sq Ft	200.00	\$2,664.00
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	66.02	\$463.46
NA	Tree Removal	\$2,500.00	LS	0.00	\$0.00
0320-01	Clearing and Grubbing	\$29,802.00	Acre	0.00	\$0.00
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	0.00	\$0.00
0445-060008	8in Ductile Iron Pipe, 5 ft depth	\$298.64	Foot	0.00	\$0.00
0490-0104	Connection to Existing Structures	\$1,995.78	Each	0.00	\$0.00
0495-01	Trench Resurfacing	\$206.57	Sq Yd	0.00	\$0.00
0640-01	Aggregate Base	\$77.87	Ton	120.38	\$9,374.19
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	110.83	\$28,815.37
0759-01	Concrete Curbs	\$50.00	Foot	178.11	\$8,905.50
0759-01280	Concrete Walks	\$20.27	Sq Ft	571.16	\$11,577.41
0759-01541	Extra for New Curb Ramps	\$1,772.03	Each	2.00	\$3,544.06
1040-0101	Topsoil	\$549.90	Cubic Yard	18.76	\$10,315.72
NA	Temporary Traffic Control; Public Specific	\$20,000	LS	0.73	\$14,600
NA	Public Permits	\$10,000	LS	1.00	\$10,000
Total Public Infrastructure Cost					\$100,259.70
<i>PROPERTY SPECIFIC INFRASTRUCTURE</i>					
0310-01	Removal of Pipe Laterals	\$71.87	Foot	12.00	\$862.44
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	82.00	\$575.64
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	29.00	\$5,535.23
1170-0103	2in Water Service Connection Piping	\$130.00	Foot	35.00	\$4,550.00
1170-011	1 ½" Water Meter Assembly	\$3,402.50	Each	1.00	\$3,402.50
0490-0104	Connection to Existing Structures	\$1,995.78	Each	2.00	\$3,991.56
0495-01	Trench Resurfacing	\$206.57	Sq Yd	16.89	\$3,488.74
0640-01	Aggregate Base	\$77.87	Ton	5.32	\$414.27
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	5.51	\$1,432.60
NA	Tree Removal on Entire Lot	\$2,500.00	LS	0.00	\$0.00
0320-01	Clearing and Grubbing of Entire Lot	\$29,802.00	Acre	0.10	\$2,980.20
0759-0126	Concrete Driveways	\$35.13	Sq Ft	100.00	\$3,513.00
NA	Construction Cost for Quadplex	\$200.00	Sq Ft	3,920.40	\$784,080.00
NA	Temporary Traffic Control; Property Specific	\$20,000	LS	0.27	\$5,400
NA	Property Permits	\$30,000	LS	1.00	\$30,000
Total Property Specific Cost					\$850,226.18

Appendix A

Table A.5.2: Comparison of existing taxes and taxes post-development, and the year that the city-required infrastructure costs would be paid in full on the 546 NW Colorado Ave lot.

Year	Current Taxes	Post-Development Taxes	Tax Delta	Remaining Infrastructure Cost to Pay Back
0	\$1,166.69	\$8,874.48	\$7,707.79	-\$100,259.70
1	\$1,201.69	\$9,140.71	\$7,939.02	-\$92,320.68
2	\$1,237.74	\$9,414.94	\$8,177.19	-\$84,143.49
3	\$1,274.88	\$9,697.38	\$8,422.51	-\$75,720.98
4	\$1,313.12	\$9,988.31	\$8,675.18	-\$67,045.79
5	\$1,352.51	\$10,287.95	\$8,935.44	-\$58,110.35
6	\$1,393.09	\$10,596.59	\$9,203.50	-\$48,906.85
7	\$1,434.88	\$10,914.49	\$9,479.61	-\$39,427.24
8	\$1,477.93	\$11,241.93	\$9,764.00	-\$29,663.25
9	\$1,522.27	\$11,579.18	\$10,056.92	-\$19,606.33
10	\$1,567.94	\$11,926.56	\$10,358.62	-\$9,247.71
11	\$1,614.97	\$12,284.36	\$10,669.38	\$1,421.67
Years til Infrastructure is Paid Off				11

A.6 424 NE HAWTHORNE*Lot Summary*

The lot on 424 NE Hawthorne, on the road NE Hawthorne and one lot in from 4th St is approximately 11,300 square feet, with a depth of 114 feet and width of 40 feet. The lot is zoned as an RS lot, or Standard Density Residential zoning. Because the Bend Development Code requires a minimum of 4,000 square feet for quadplexes on RS lots, provided a minimum width of 40 feet and a minimum depth of 50 feet, this lot fits two quadplexes. Both lots are approximately 5,650 square feet. The sizing constraints require the new lots to follow the “Flag Lot” layout standards. Due to Bend Development Code lot coverage limits, the max building size allowed for two story buildings is equal to 90% of the lot size meaning each quadplex will be approximately 5,085 square feet. With a construction cost of \$200 per square foot, the quadplexes cost approximately \$1 million. The for sale value cost, estimated at \$352 per square foot, means a final development value of approximately \$1.8 million.

The lot currently has some buildings on it, and no major tree. NE Hawthorne road is a minor arterial, with sidewalks already up to date along the frontage. Sidewalks would only need to be removed for construction of pipe laterals. The alleyway behind the lot is already paved. The existing water main is insufficient, and would need to be replaced through NE Hawthorne. The main cost comes from this construction of the water main, and all the connections to existing water laterals along NE Hawthorne Ave. The existing water and sewer laterals are insufficient for the lot development and would need to be replaced and rebuilt. The sewer main is up to current code. See attached *Figure A.6* for the drawing of this lot and the updates required.

Infrastructure Costs



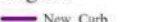







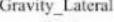




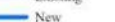

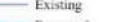
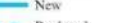

The infrastructure costs are around the average for this case study in comparison to the others analyzed. Most of the cost comes from long water main updates. The city-required infrastructure is approximately 10% of the total construction cost for this project. Breakdown of the costs can be seen in *Table A.6.1*, attached below.

Tax Increase

The city required infrastructure would be paid off in approximately 11 years from the time of completed quadplex construction, as seen in *Table A.6.2*. This value tends to be on the median side in comparison to the other lots, due to the major water main update necessary. Once this cost is paid off, the development is providing additional tax income in excess of \$26,000 per year.

Appendix A



Site Name: 424 NE Hawthorne		 		Notes: Lots are subdivided to allow for multiple quadplexes to be developed as a "flag lot" per the Bend Development Code. Sewer main is up to code.
Project Name: 2025.STARR.01	Figure #: A.6	<div><div><div>Legend</div><div> New_Curb</div><div> New_Sidewalks</div><div> Case Study Locations</div><div> Road_Centerlines</div><div> LotSegmentation</div><div> Landscape</div></div><div><div>Gravity_Main</div><div> Existing</div><div> New</div><div>Gravity_Lateral</div><div> Existing</div><div> New</div><div> Replaced</div><div> Removed</div></div><div><div>Water_Main</div><div> Existing</div><div> New</div><div> Replaced</div><div>Water_Lateral</div><div> Existing</div><div> Removed</div><div> New</div><div> Replaced</div></div></div>		

Appendix A

Table A.6.1: Infrastructure costs for 424 NE Hawthorne.

424 NE HAWTHORNE					
Bid Item #	Description	Average Price	Units	Amount	Cost
<i>PUBLIC INFRASTRUCTURE WITHIN CITY RIGHT OF WAY</i>					
0310-01	Removal of Pipe Mains	\$71.87	Foot	358.00	\$25,729.46
0310-0102	Removal of Walks and Driveways	\$13.32	Sq Ft	375.00	\$4,995.00
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	716.00	\$5,026.32
NA	Tree Removal	\$2,500.00	LS	0.00	\$0.00
0320-01	Clearing and Grubbing	\$29,802.00	Acre	0.00	\$0.00
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	0.00	\$0.00
0445-060008	8in Ductile Iron Pipe, 5 ft depth	\$298.64	Foot	358.00	\$106,913.12
0490-0104	Connection to Existing Structures	\$1,995.78	Each	10.00	\$19,957.80
0495-01	Trench Resurfacing	\$206.57	Sq Yd	79.56	\$16,433.79
0640-01	Aggregate Base	\$77.87	Ton	18.80	\$1,463.57
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	17.30	\$4,498.87
0759-01	Concrete Curbs	\$50.00	Foot	74.62	\$3,731.00
0759-01280	Concrete Walks	\$20.27	Sq Ft	619.26	\$12,552.40
0759-01541	Extra for New Curb Ramps	\$1,772.03	Each	0.00	\$0.00
1040-0101	Topsoil	\$549.90	Cubic Yard	10.74	\$5,906.33
NA	Temporary Traffic Control; Public Specific	\$20,000	LS	0.87	\$17,400
NA	Public Permits	\$10,000	LS	1.00	\$10,000
Total Public Infrastructure Cost					\$234,607.66
<i>PROPERTY SPECIFIC INFRASTRUCTURE</i>					
0310-01	Removal of Pipe Laterals	\$71.87	Foot	19.00	\$1,365.53
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	116.00	\$814.32
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	14.00	\$2,672.18
1170-0103	2in Water Service Connection Piping	\$130.00	Foot	44.00	\$5,720.00
1170-011	1 ½" Water Meter Assembly	\$3,402.50	Each	2.00	\$6,805.00
0490-0104	Connection to Existing Structures	\$1,995.78	Each	4.00	\$7,983.12
0495-01	Trench Resurfacing	\$206.57	Sq Yd	12.89	\$2,662.46
0640-01	Aggregate Base	\$77.87	Ton	3.05	\$237.11
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	2.80	\$728.87
NA	Tree Removal on Entire Lot	\$2,500.00	LS	0.00	\$0.00
0320-01	Clearing and Grubbing of Entire Lot	\$29,802.00	Acre	0.26	\$7,748.52
0759-0126	Concrete Driveways	\$35.13	Sq Ft	100.00	\$3,513.00
NA	Construction Cost for Quadplex	\$200.00	Sq Ft	10,193.04	\$2,038,608.00
NA	Temporary Traffic Control; Property Specific	\$20,000	LS	0.13	\$2,600
NA	Property Permits	\$30,000	LS	2.00	\$60,000
Total Property Specific Cost					\$2,141,458.11

Appendix A

Table A.6.2: Comparison of existing taxes and taxes post-development, and the year that the city-required infrastructure costs would be paid in full on the 424 NE Hawthorne lot.

Year	Current Taxes	Post-Development Taxes	Tax Delta	Remaining Infrastructure Cost to Pay Back
0	\$3,562.83	\$22,401.00	\$18,838.17	-\$234,607.66
1	\$3,669.72	\$23,073.03	\$19,403.31	-\$215,204.34
2	\$3,779.81	\$23,765.22	\$19,985.41	-\$195,218.93
3	\$3,893.20	\$24,478.18	\$20,584.98	-\$174,633.96
4	\$4,010.00	\$25,212.52	\$21,202.52	-\$153,431.43
5	\$4,130.30	\$25,968.90	\$21,838.60	-\$131,592.83
6	\$4,254.21	\$26,747.97	\$22,493.76	-\$109,099.07
7	\$4,381.83	\$27,550.40	\$23,168.57	-\$85,930.50
8	\$4,513.29	\$28,376.92	\$23,863.63	-\$62,066.88
9	\$4,648.69	\$29,228.22	\$24,579.54	-\$37,487.34
10	\$4,788.15	\$30,105.07	\$25,316.92	-\$12,170.42
11	\$4,931.79	\$31,008.22	\$26,076.43	\$13,906.01
Years til Infrastructure is Paid Off				11

Appendix A

A.7 235 NE KEARNEY AVE

Lot Summary

The lot on 235 NE Kearney, two lots east of the at the intersection of NE 2nd St and NE Kearney Ave is approximately 6,970 square feet, with a depth of 114 feet and width of 40 feet. The lot is zoned as a CL lot, or a limited commercial district within the Bend Central District overlay and located between 2nd and 3rd street. Because this lot is within this area, it can be built to be a 6 story tall building. To avoid the complexities of affordability classifications, a 6 story building is assumed. Therefore the total square footage on the plot, based on the allowable building area of 94 feet by 30 feet per the Bend Development codes, is approximately 16,920 square feet. With a construction cost of \$200 per square foot, the development would cost approximately \$3.4 million. The for sale value price, estimated at \$352 per square foot, means a final development value of approximately \$6 million. The other values, like sewer and water laterals, would likely have to be larger than outlined in the cost estimate.

The lot currently has a building on it and no major trees. NE Kearney is a local road, with sidewalks that would need to be removed and replaced to be property tight. The alleyway is already paved. The existing sewer mains and laterals are sufficient for the lot development. An existing water main would need to be replaced and rebuilt to be up to code for the development required, through the entirety of NE Kearney Ave. The current water service line would also need to be updated to fit the code. See *Figure A.7* for the drawing of this lot and the updates required.

Infrastructure Costs

The infrastructure costs are dominated by the cost to redo the water main throughout the entire road. The city-required infrastructure is approximately 5.5% of the total construction cost for this project, due to the cost of building the assumed 8 story building. Breakdown of the costs can be seen in *Table A.7.1*, attached below. Some values are not shown in the infrastructure plots, like the removal of walks and driveways which was calculated using the frontage length of the property multiplied by the five foot depth of the existing sidewalk.

Tax Increase

The city required infrastructure would be paid off in approximately 6 years from the time of completed quadplex construction, shown in *Table A.7.2*. This value tends to be on the high side in comparison to the other lots because of the massive water main that needs to be replaced, and the fact that only one quadplex can be built on the lot. Once this cost is paid off, the development is providing additional tax income in excess of \$40,900 per year. Any other lots supported by the new water main infrastructure would have similar opportunities for development, which would raise the additional tax income for the street, and therefore shorten the repayment time.

Appendix A



Site Name: 235 NE Kearney Ave		<div><div><div>N</div><div>00.01 Miles</div></div></div>		Notes: Sewer main and the lateral are up to code.
Project Name: 2025.STARR.01	Figure #: A.7	<div>Legend</div> <div><div><div>Sawcutting</div><div>New_Curb</div><div>New_Sidewalks</div><div>New_Paving</div><div>Case Study Locations</div><div>Future_ROW</div><div>LotSegmentation</div><div>Landscape</div></div><div><div>Gravity_Main</div><div>Existing</div><div>New</div><div>Gravity_Lateral</div><div>Existing</div><div>New</div><div>Replaced</div><div>Removed</div></div><div><div>Water_Main</div><div>Existing</div><div>New</div><div>Replaced</div><div>Water_Lateral</div><div>Existing</div><div>Removed</div><div>New</div><div>Replaced</div></div></div>		
<div><div><div><div></div><div>Portland State</div><div>UNIVERSITY</div></div><div>Civil & Environmental Engineering 2025 Capstone</div></div></div>				

Appendix A

Table A.7.1: Infrastructure costs for 235 NE Kearney.

				235 NE KEARNEY	
Bid Item #	Description	Average Price	Units	Amount	Cost
<i>PUBLIC INFRASTRUCTURE WITHIN CITY RIGHT OF WAY</i>					
0310-01	Removal of Pipe Mains	\$71.87	Foot	318.00	\$22,854.66
0310-0102	Removal of Walks and Driveways	\$13.32	Sq Ft	500.00	\$6,660.00
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	636.00	\$4,464.72
NA	Tree Removal	\$2,500.00	LS	0.00	\$0.00
0320-01	Clearing and Grubbing	\$29,802.00	Acre	0.00	\$0.00
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	0.00	\$0.00
0445-060008	8in Ductile Iron Pipe, 5 ft depth	\$298.64	Foot	318.00	\$94,967.52
0490-0104	Connection to Existing Structures	\$1,995.78	Each	7.00	\$13,970.46
0495-01	Trench Resurfacing	\$206.57	Sq Yd	70.67	\$14,597.61
0640-01	Aggregate Base	\$77.87	Ton	16.70	\$1,300.04
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	15.37	\$3,996.20
0759-01	Concrete Curbs	\$50.00	Foot	49.74	\$2,487.00
0759-01280	Concrete Walks	\$20.27	Sq Ft	271.00	\$5,493.17
0759-01541	Extra for New Curb Ramps	\$1,772.03	Each	0.00	\$0.00
1040-0101	Topsoil	\$549.90	Cubic Yard	6.85	\$3,767.83
NA	Temporary Traffic Control; Public Specific	\$20,000	LS	0.88	\$17,600
NA	Public Permits	\$10,000	LS	1.00	\$10,000
Total Public Infrastructure Cost					\$202,159.22
<i>PROPERTY SPECIFIC INFRASTRUCTURE</i>					
0310-01	Removal of Pipe Laterals	\$71.87	Foot	54.00	\$3,880.98
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	108.00	\$758.16
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	8.00	\$1,526.96
1170-0103	2in Water Service Connection Piping	\$130.00	Foot	46.00	\$5,980.00
1170-011	1 ½" Water Meter Assembly	\$3,402.50	Each	1.00	\$3,402.50
0490-0104	Connection to Existing Structures	\$1,995.78	Each	2.00	\$3,991.56
0495-01	Trench Resurfacing	\$206.57	Sq Yd	12.00	\$2,478.84
0640-01	Aggregate Base	\$77.87	Ton	2.84	\$220.76
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	2.61	\$678.60
NA	Tree Removal on Entire Lot	\$2,500.00	LS	1.00	\$2,500.00
0320-01	Clearing and Grubbing of Entire Lot	\$29,802.00	Acre	0.16	\$4,768.32
0759-0126	Concrete Driveways	\$35.13	Sq Ft	100.00	\$3,513.00
NA	Construction Cost for Quadplex	\$200.00	Sq Ft	16,920.00	\$3,384,000.00
NA	Temporary Traffic Control; Property Specific	\$20,000	LS	0.12	\$2,400
NA	Property Permits	\$30,000	LS	1.00	\$30,000
Total Property Specific Cost					\$3,450,099.68

Appendix A

Table A.7.2: Comparison of existing taxes and taxes post-development, and the year that the city-required infrastructure costs would be paid in full on the 235 NE Kearney lot.

Year	Current Taxes	Post-Development Taxes	Tax Delta	Remaining Infrastructure Cost to Pay Back
0	\$2,893.35	\$37,185.00	\$34,291.65	-\$202,159.22
1	\$2,980.15	\$38,300.55	\$35,320.40	-\$166,838.82
2	\$3,069.56	\$39,449.57	\$36,380.01	-\$130,458.81
3	\$3,161.64	\$40,633.05	\$37,471.41	-\$92,987.40
4	\$3,256.49	\$41,852.05	\$38,595.55	-\$54,391.85
5	\$3,354.19	\$43,107.61	\$39,753.42	-\$14,638.43
6	\$3,454.81	\$44,400.83	\$40,946.02	\$26,307.59
Years til Infrastructure is Paid Off				6

A.8 430 NE EMERSON

Lot Summary

The lot on 430 NE Emerson, on the road NE Emerson and two lots in from 4th St is approximately 4,792 square feet, with a depth of 140 feet and width of 35 feet. The lot is zoned as a RH lot, or a High Density Residential zone. The Bend Development Code requires an RH zoned lot with a quadplex to be a minimum of 2,500 square feet with a minimum width of 30 feet and depth of 50 feet, therefore this lot fits one quadplex. The Bend Development Code has no lot coverage limit for RH lots and buildings are limited by 5 foot yard setbacks, and 10 foot front yard setbacks, with varied setbacks with alleys. The RH lots are also limited to building heights to 50 feet, meaning four stories. Taking these constraints into account, the quadplex can be assumed to be 25 feet wide by 120 feet deep, and 4 stories tall for a total area of approximately 12,000 square feet. With a construction cost of \$200 per square foot, the building would cost approximately \$2.4 million. The for sale value price, estimated at \$352 per square foot, means a final development value of approximately \$4.2 million.

The lot currently has no buildings on it, and one major tree. NE Emerson road is a minor arterial, with sidewalks that would need to be updated along the frontage of the lot. The alleyway behind the lot would need to be paved along the length of the lot. The existing water and sewer mains are sufficient for the lot development, but a water service line needs to be replaced with a 2 inch service line. The sewer lateral is up to current code. See *Figure A.8* for the drawing of this lot and the updates required.

Infrastructure Costs
























The infrastructure costs are lower for this case study in comparison to the others analyzed. Most of the cost comes from updating the gravel alleyway along the lot. The city-required infrastructure is approximately 1.3% of the total construction cost for this project. Breakdown of the costs can be seen in *Table A.8.1*, attached below.

Tax Increase

The city required infrastructure would be paid off in approximately 2 years from the time of completed quadplex construction, shown in *Table A.8.2*. This value tends to be on the lower side due to the lack of major infrastructure updates that need to happen, and a very initially low tax value. Therefore the tax delta is high for this specific lot. Once this cost is paid off, the development is providing additional tax income in excess of \$26,600 per year.

Appendix A



Site Name: 430 NE Emerson Ave		 0 0.01 Miles		Notes: Sewer and water mains are up to code, as well as the sewer lateral.	
Project Name: 2025.STARR.01	Figure #: A.8	Legend			
 Portland State UNIVERSITY Civil & Environmental Engineering 2025 Capstone		 Sawcutting	 Gravity_Main Existing		 Water_Main Existing
		 New_Curb	 New		 Replaced
		 New_Sidewalks	Gravity_Lateral	Water_Lateral	
		 New_Paving	 Existing	 Existing	
		 Case Study Locations	 New	 Replaced	
		 Future_ROW	 Replaced	 Removed	
		 LotSegmentation	 Removed	 New	
		 Landscape		 Replaced	

Appendix A

Table A.8.1: Infrastructure values for 430 NE Emerson.

				430 NE EMERSON	
Bid Item #	Description	Average Price	Units	Amount	Cost
<i>PUBLIC INFRASTRUCTURE WITHIN CITY RIGHT OF WAY</i>					
0310-01	Removal of Pipe Mains	\$71.87	Foot	0.00	\$0.00
0310-0102	Removal of Walks and Driveways	\$13.32	Sq Ft	0.00	\$0.00
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	17.48	\$122.69
NA	Tree Removal	\$2,500.00	LS	0.00	\$0.00
0320-01	Clearing and Grubbing	\$29,802.00	Acre	0.00	\$0.00
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	0.00	\$0.00
0445-060008	8in Ductile Iron Pipe, 5 ft depth	\$298.64	Foot	0.00	\$0.00
0490-0104	Connection to Existing Structures	\$1,995.78	Each	0.00	\$0.00
0495-01	Trench Resurfacing	\$206.57	Sq Yd	0.00	\$0.00
0640-01	Aggregate Base	\$77.87	Ton	18.64	\$1,451.61
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	17.16	\$4,462.11
0759-01	Concrete Curbs	\$50.00	Foot	41.50	\$2,075.00
0759-01280	Concrete Walks	\$20.27	Sq Ft	188.13	\$3,813.40
0759-01541	Extra for New Curb Ramps	\$1,772.03	Each	0.00	\$0.00
1040-0101	Topsoil	\$549.90	Cubic Yard	4.52	\$2,484.73
NA	Temporary Traffic Control; Public Specific	\$20,000	LS	0.44	\$8,800
NA	Public Permits	\$10,000	LS	1.00	\$10,000
Total Public Infrastructure Cost					\$33,209.53
<i>PROPERTY SPECIFIC INFRASTRUCTURE</i>					
0310-01	Removal of Pipe Laterals	\$71.87	Foot	27.19	\$1,954.15
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	42.68	\$299.61
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	5.85	\$1,116.59
1170-0103	2in Water Service Connection Piping	\$130.00	Foot	21.34	\$2,774.20
1170-011	1 ½" Water Meter Assembly	\$3,402.50	Each	1.00	\$3,402.50
0490-0104	Connection to Existing Structures	\$1,995.78	Each	2.00	\$3,991.56
0495-01	Trench Resurfacing	\$206.57	Sq Yd	6.04	\$1,248.14
0640-01	Aggregate Base	\$77.87	Ton	1.43	\$111.16
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	1.31	\$341.69
NA	Tree Removal on Entire Lot	\$2,500.00	LS	1.00	\$2,500.00
0320-01	Clearing and Grubbing of Entire Lot	\$29,802.00	Acre	0.11	\$3,278.22
0759-0126	Concrete Driveways	\$35.13	Sq Ft	100.00	\$3,513.00
NA	Construction Cost for Quadplex	\$200.00	Sq Ft	12,000.00	\$2,400,000.00
NA	Temporary Traffic Control; Property Specific	\$20,000	LS	0.56	\$11,200
NA	Property Permits	\$30,000	LS	1.00	\$30,000
Total Property Specific Cost					\$2,465,730.82

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Table A.8.2: Comparison of existing taxes and taxes post-development, and the year that the city-required infrastructure costs would be paid in full on the 430 NE Emerson lot.

Year	Current Taxes	Post-Development Taxes	Tax Delta	Remaining Infrastructure Cost to Pay Back
0	\$1,272.04	\$26,378.00	\$25,105.96	-\$33,209.53
1	\$1,310.20	\$27,169.34	\$25,859.14	-\$7,350.40
2	\$1,349.51	\$27,984.42	\$26,634.91	\$19,284.52
Years til Infrastructure is Paid Off				2

A.9 543 NE MARSHALL AVE

Lot Summary

The lot on 543 NE Marshall Ave, one lot east of at the intersection of NE 6th St and NE Marshall Ave, is approximately 7,013 square feet, with a depth of 140 feet and width of 50 feet. The lot is zoned as a RS lot, or Standard Density Residential zoning. The lot to the east is another abandoned lot, of the same square footage, dimensions, and zoning. For the purposes of this analysis, both are being analyzed for the true potential of updating multiple lots. Comparisons are shown of the values for this development if only 543 NE Marshall Ave is developed and if both adjacent lots are developed.

Because the Bend Development Code requires an RS zoned lot with a quadplex to be a minimum of 4,000 square feet, provided a minimum width of 40 feet and a minimum depth of 50 feet, each lot will support a single quadplex for a total of two quadplexes. Due to Bend Development Code lot coverage limits, the max building size allowed for two story buildings is equal to 90% of the lot size meaning each quadplex will be approximately 6,312 square feet on each lot. With a construction cost of \$200 per square foot, the quadplexes cost approximately \$2.5 million. The for sale value price, estimated at \$352 per square foot, means a final development value of approximately \$2.2 million, with a total of approximately \$4.4 million for both quadplexes. If just analyzing 543 NE Marshall Ave, the construction cost is approximately \$1.3 million, with a for sale price of \$2.2 million.

The lots currently have a building and no major trees. NE Marshall Ave and NE 6th St are local roads, and new sidewalks are to be placed at the front of the property. An existing water main would need to be replaced and rebuilt to be up to code for the development required, through the entirety of NE Marshall Ave. The current water service line would also need to be updated to fit the code. See *Figure A.9* for the drawing of this lot and the updates required for both adjacent lots to be developed.

Infrastructure Costs

The infrastructure costs are dominated by the cost to redo the water main throughout the entire road. The city-required infrastructure is approximately 10% of the total construction cost for these lots, but is 18% for the development of just 543 NE Marshall. Breakdown of the costs can be seen in *Table A.9.1* and *Table A.9.2* for both lots to be developed and just one, respectively. Some values are not shown in the infrastructure plots, like the removal of walks and driveways which was calculated using the frontage length of the property multiplied by the five-foot depth of the existing sidewalk.

Tax Increase


The city required infrastructure would be paid off in approximately 11 years from the time of completed quadplex construction, shown in *Table A.9.2* if both lots were developed. If only one lot is developed, than the repayment period is 20 years. This value tends to be on the high side in comparison to the other lots because of the massive water main that needs to be replaced, and the

Appendix A

fact that only the two quadplexes can be built on the lot. Once this cost is paid off, the development is providing additional tax income in excess of \$33,600 per year with both lots being developed. Any other lots supported by the new water main infrastructure would have similar opportunities for development, which would raise the additional tax income for the street, and therefore shorten the repayment time as shown in this case study example.

Appendix A



Site Name: 543 NE Marshall Ave		<div><div><div>N</div><div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div><div>00.010.02 Miles</div></div></div>		Notes: Sewer main and lateral are up to code. Adjacent lots both analyzed for infrastructure updates.
Project Name: 2025.STARR.01	Figure #: A.9	Legend	<div><div>Gravity_Main</div><div>Water_Main</div><div>Existing</div><div>New</div><div>Replaced</div></div> <div><div>Gravity_Lateral</div><div>Water_Lateral</div><div>Existing</div><div>New</div><div>Replaced</div><div>Removed</div></div>	
<div><div></div><div>Portland State UNIVERSITY</div><div>Civil & Environmental Engineering 2025 Capstone</div></div>		<div><div>Sawcutting</div><div>New_Curb</div><div>New_Sidewalks</div><div>New_Paving</div><div>Case Study Locations</div><div>Future_ROW</div><div>LotSegmentation</div><div>Landscape</div><div>Existing</div><div>New</div><div>Replaced</div><div>Removed</div></div>		

Appendix A

Table A.9.1: Infrastructure values for 543 NE Marshall Ave and the adjacent lot.

				543 NE MARSHALL	
Bid Item #	Description	Average Price	Units	Amount	Cost
<i>PUBLIC INFRASTRUCTURE WITHIN CITY RIGHT OF WAY</i>					
0310-01	Removal of Pipe Mains	\$71.87	Foot	461.00	\$33,132.07
0310-0102	Removal of Walks and Driveways	\$13.32	Sq Ft	200.00	\$2,664.00
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	922.00	\$6,472.44
NA	Tree Removal	\$2,500.00	LS	1.00	\$2,500.00
0320-01	Clearing and Grubbing	\$29,802.00	Acre	0.00	\$0.00
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	0.00	\$0.00
0445-060008	8in Ductile Iron Pipe, 5 ft depth	\$298.64	Foot	461.00	\$137,673.04
0490-0104	Connection to Existing Structures	\$1,995.78	Each	10.00	\$19,957.80
0495-01	Trench Resurfacing	\$206.57	Sq Yd	51.22	\$10,580.97
0640-01	Aggregate Base	\$77.87	Ton	82.08	\$6,391.86
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	75.57	\$19,647.98
0759-01	Concrete Curbs	\$50.00	Foot	99.94	\$4,997.00
0759-01280	Concrete Walks	\$20.27	Sq Ft	591.63	\$11,992.34
0759-01541	Extra for New Curb Ramps	\$1,772.03	Each	0.00	\$0.00
1040-0101	Topsoil	\$549.90	Cubic Yard	17.98	\$9,888.02
NA	Temporary Traffic Control; Public Specific	\$20,000	LS	0.86	\$17,200
NA	Property Permits	\$10,000	LS	1.00	\$10,000
Total Public Infrastructure Cost					\$293,097.53
<i>PROPERTY SPECIFIC INFRASTRUCTURE</i>					
0310-01	Removal of Pipe Laterals	\$71.87	Foot	55.28	\$3,972.97
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	173.24	\$1,216.14
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	25.00	\$4,771.75
1170-0103	2in Water Service Connection Piping	\$130.00	Foot	86.62	\$11,260.60
1170-011	1 ½" Water Meter Assembly	\$3,402.50	Each	2.00	\$6,805.00
0490-0104	Connection to Existing Structures	\$1,995.78	Each	4.00	\$7,983.12
0495-01	Trench Resurfacing	\$206.57	Sq Yd	19.25	\$3,976.24
0640-01	Aggregate Base	\$77.87	Ton	4.55	\$354.12
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	4.19	\$1,088.52
NA	Tree Removal on Entire Lot	\$2,500.00	LS	0.00	\$0.00
0320-01	Clearing and Grubbing of Entire Lot	\$29,802.00	Acre	0.16	\$4,798.12
0759-0126	Concrete Driveways	\$35.13	Sq Ft	100.00	\$3,513.00
NA	Construction Cost for Quadplex	\$200.00	Sq Ft	12,600.00	\$2,520,000.00
NA	Temporary Traffic Control; Property Specific	\$20,000	LS	0.14	\$2,800
NA	Public Permits	\$30,000	LS	1.00	\$30,000
Total Property Specific Cost					\$2,602,539.60

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Table A.9.2: Infrastructure values for 543 NE Marshall Ave and the adjacent lot.

				543 NE MARSHALL	
Bid Item #	Description	Average Price	Units	Amount	Cost
<i>PUBLIC INFRASTRUCTURE WITHIN CITY RIGHT OF WAY</i>					
0310-01	Removal of Pipe Mains	\$71.87	Foot	461.00	\$33,132.07
0310-0102	Removal of Walks and Driveways	\$13.32	Sq Ft	200.00	\$2,664.00
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	922.00	\$6,472.44
NA	Tree Removal	\$2,500.00	LS	1.00	\$2,500.00
0320-01	Clearing and Grubbing	\$29,802.00	Acre	0.00	\$0.00
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	0.00	\$0.00
0445-060008	8in Ductile Iron Pipe, 5 ft depth	\$298.64	Foot	461.00	\$137,673.04
0490-0104	Connection to Existing Structures	\$1,995.78	Each	10.00	\$19,957.80
0495-01	Trench Resurfacing	\$206.57	Sq Yd	51.22	\$10,580.97
0640-01	Aggregate Base	\$77.87	Ton	82.08	\$6,391.86
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	75.57	\$19,647.98
0759-01	Concrete Curbs	\$50.00	Foot	99.94	\$4,997.00
0759-01280	Concrete Walks	\$20.27	Sq Ft	591.63	\$11,992.34
0759-01541	Extra for New Curb Ramps	\$1,772.03	Each	0.00	\$0.00
1040-0101	Topsoil	\$549.90	Cubic Yard	17.98	\$9,888.02
NA	Temporary Traffic Control; Public Specific	\$20,000	LS	0.86	\$17,200
NA	Property Permits	\$10,000	LS	1.00	\$10,000
Total Public Infrastructure Cost					\$293,097.53
<i>PROPERTY SPECIFIC INFRASTRUCTURE</i>					
0310-01	Removal of Pipe Laterals	\$71.87	Foot	55.28	\$3,972.97
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	85.72	\$601.75
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	12.42	\$2,370.61
1170-0103	2in Water Service Connection Piping	\$130.00	Foot	42.86	\$5,571.80
1170-011	1 ½" Water Meter Assembly	\$3,402.50	Each	1.00	\$3,402.50
0490-0104	Connection to Existing Structures	\$1,995.78	Each	2.00	\$3,991.56
0495-01	Trench Resurfacing	\$206.57	Sq Yd	9.52	\$1,967.46
0640-01	Aggregate Base	\$77.87	Ton	2.25	\$175.22
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	2.07	\$538.61
NA	Tree Removal on Entire Lot	\$2,500.00	LS	0.00	\$0.00
0320-01	Clearing and Grubbing of Entire Lot	\$29,802.00	Acre	0.16	\$4,798.12
0759-0126	Concrete Driveways	\$35.13	Sq Ft	100.00	\$3,513.00
NA	Construction Cost for Quadplex	\$200.00	Sq Ft	6,300.00	\$1,260,000.00
NA	Temporary Traffic Control; Property Specific	\$20,000	LS	0.14	\$2,800
NA	Public Permits	\$30,000	LS	1.00	\$30,000
Total Property Specific Cost					\$1,323,703.61

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Table A.9.3: Comparison of existing taxes and taxes post-development, and the year that the city-required infrastructure costs would be paid in full on the 543 NE Marshall Ave lot and the adjacent development.

Year	Current Taxes	Post-Development Taxes	Tax Delta	Remaining Infrastructure Cost to Pay Back
0	\$3,353.65	\$27,690.00	\$24,336.35	-\$293,097.53
1	\$3,454.26	\$28,520.70	\$25,066.44	-\$268,031.08
2	\$3,557.89	\$29,376.32	\$25,818.43	-\$242,212.65
3	\$3,664.62	\$30,257.61	\$26,592.99	-\$215,619.66
4	\$3,774.56	\$31,165.34	\$27,390.78	-\$188,228.89
5	\$3,887.80	\$32,100.30	\$28,212.50	-\$160,016.38
6	\$4,004.43	\$33,063.31	\$29,058.88	-\$130,957.51
7	\$4,124.57	\$34,055.21	\$29,930.64	-\$101,026.87
8	\$4,248.30	\$35,076.86	\$30,828.56	-\$70,198.31
9	\$4,375.75	\$36,129.17	\$31,753.42	-\$38,444.89
10	\$4,507.02	\$37,213.04	\$32,706.02	-\$5,738.87
11	\$4,642.23	\$38,329.44	\$33,687.20	\$27,948.33
Years til Infrastructure is Paid Off				11

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Table A.9.4: Comparison of existing taxes and taxes post-development, and the year that the city-required infrastructure costs would be paid in full on just the 543 NE Marshall Ave lot.

Year	Current Taxes	Post-Development Taxes	Tax Delta	Remaining Infrastructure Cost to Pay Back
0	\$2,703.12	\$13,845.00	\$11,141.88	-\$293,097.53
1	\$2,784.22	\$14,260.35	\$11,476.13	-\$281,621.39
2	\$2,867.74	\$14,688.16	\$11,820.42	-\$269,800.97
3	\$2,953.77	\$15,128.81	\$12,175.03	-\$257,625.94
4	\$3,042.39	\$15,582.67	\$12,540.28	-\$245,085.66
5	\$3,133.66	\$16,050.15	\$12,916.49	-\$232,169.17
6	\$3,227.67	\$16,531.65	\$13,303.99	-\$218,865.18
7	\$3,324.50	\$17,027.60	\$13,703.10	-\$205,162.08
8	\$3,424.23	\$17,538.43	\$14,114.20	-\$191,047.88
9	\$3,526.96	\$18,064.58	\$14,537.62	-\$176,510.26
10	\$3,632.77	\$18,606.52	\$14,973.75	-\$161,536.50
11	\$3,741.75	\$19,164.72	\$15,422.97	-\$146,113.54
12	\$3,854.01	\$19,739.66	\$15,885.65	-\$130,227.88
13	\$3,969.63	\$20,331.85	\$16,362.22	-\$113,865.66
14	\$4,088.71	\$20,941.80	\$16,853.09	-\$97,012.57
15	\$4,211.38	\$21,570.06	\$17,358.68	-\$79,653.89
16	\$4,337.72	\$22,217.16	\$17,879.44	-\$61,774.44
17	\$4,467.85	\$22,883.68	\$18,415.83	-\$43,358.62
18	\$4,601.88	\$23,570.19	\$18,968.30	-\$24,390.31
19	\$4,739.94	\$24,277.29	\$19,537.35	-\$4,852.96
20	\$4,882.14	\$25,005.61	\$20,123.47	\$15,270.51
Years til Infrastructure is Paid Off				20

A.10 1552 NE 5TH ST

Lot Summary

The lot on 1552 NE 5th St, two lots north of the intersection of NE 5th St and NE Olney Ave, is approximately 6,273 square feet, with a width of 76 feet and depth of 88 feet. The lot is zoned as a RS lot, or Standard Density Residential zoning. Because the Bend Development Code requires an RS zoned lot with a quadplex to be a minimum of 4,000 square feet, provided a minimum width of 40 feet and a minimum depth of 50 feet, this lot fits one quadplex. Due to Bend Development Code lot coverage limits, the max building size allowed for two story buildings is equal to 90% of the lot size meaning the quadplex will be approximately 5,646 square feet. With a construction price of \$200 per square foot, the quadplexes cost approximately \$1.1 million. The for sale value, estimated at \$352 per square foot, means a final development value of approximately \$2 million.

The lot currently has a building on it and one major tree to be removed. NE 5th St is a local road, and NE Olney Ave is a minor arterial; new sidewalks are to be placed at the front of the property. An existing water main would need to be replaced and rebuilt to be up to code for the development required, through NE 5th St. The current water service line would also need to be updated to fit the code. See *Figure A.10* for the drawing of this lot and the updates required.

Infrastructure Costs

The infrastructure costs are dominated by the cost to redo the water main throughout the entire road. The city-required infrastructure is approximately 18.2% of the total construction cost for this project. A breakdown of the costs can be seen in *Table A.10.1*, attached below. Some values are not shown in the infrastructure plots, like the removal of walks and driveways, which was calculated using the frontage length of the property multiplied by the five-foot depth of the existing sidewalk. Clearing and grubbing is the asphalt area for the city required infrastructure

Tax Increase

The city required infrastructure would be paid off in approximately 19 years from the time of completed quadplex construction, shown in *Table A.10.2*. This value tends to be on the high side in comparison to the other lots because of the massive water main that needs to be replaced, and the fact that only one quadplex can be built on the lot. Once this cost is paid off, the development is providing additional tax income in excess of \$18,800 per year. Any other lots supported by the new water main infrastructure would have similar opportunities for development, which would raise the additional tax income for the street, and therefore shorten the repayment time.

NE PENN AVE

NE 5TH ST

ROW: 60'

88'

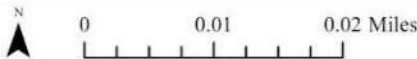





























































RS

63'

13'

NEOLNEY AVE

City of Bend, OR: Wexar, Microsoft, Esri Community, Mapbox, Google, City of Bend, OR: Oregon State Parks, State of Oregon: MDT, Oregon Department of Transportation, Microsoft, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI, NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA, USFWS

Site Name: 1552 NE 5th St			Notes: Lots are subdivided to allow for multiple quadplexes to be developed. Sewer mains are up to code.																										
Project Name: 2025.STARR.01	Figure #: A.10																												
 Portland State UNIVERSITY Civil & Environmental Engineering 2025 Capstone		<table><tr><td>Legend</td><td>Gravity_Main</td><td>Water_Main</td></tr><tr><td> Sawcutting</td><td> Existing</td><td> Existing</td></tr><tr><td> New_Curb</td><td> New</td><td> New</td></tr><tr><td> New_Sidewalks</td><td>Gravity_Lateral</td><td> Replaced</td></tr><tr><td> New_Paving</td><td> Existing</td><td>Water_Lateral</td></tr><tr><td> Case Study Locations</td><td> New</td><td> Existing</td></tr><tr><td> LotSegmentation</td><td> Replaced</td><td> Removed</td></tr><tr><td> Landscape</td><td> Removed</td><td> New</td></tr><tr><td></td><td></td><td> Replaced</td></tr></table>	Legend	Gravity_Main	Water_Main	 Sawcutting	 Existing	 Existing	 New_Curb	 New	 New	 New_Sidewalks	Gravity_Lateral	 Replaced	 New_Paving	 Existing	Water_Lateral	 Case Study Locations	 New	 Existing	 LotSegmentation	 Replaced	 Removed	 Landscape	 Removed	 New			 Replaced
Legend	Gravity_Main	Water_Main																											
 Sawcutting	 Existing	 Existing																											
 New_Curb	 New	 New																											
 New_Sidewalks	Gravity_Lateral	 Replaced																											
 New_Paving	 Existing	Water_Lateral																											
 Case Study Locations	 New	 Existing																											
 LotSegmentation	 Replaced	 Removed																											
 Landscape	 Removed	 New																											
		 Replaced																											

Appendix A

Table A.10.1: Infrastructure values for 1522 NE 5th St.

				1552 NE 5TH ST	
Bid Item #	Description	Average Price	Units	Amount	Cost
<i>PUBLIC INFRASTRUCTURE WITHIN CITY RIGHT OF WAY</i>					
0310-01	Removal of Pipe Mains	\$71.87	Foot	269.04	\$19,335.90
0310-0102	Removal of Walks and Driveways	\$13.32	Sq Ft	0.00	\$0.00
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	671.92	\$4,716.88
NA	Tree Removal	\$2,500.00	LS	3.00	\$7,500.00
0320-01	Clearing and Grubbing	\$29,802.00	Acre	0.09	\$2,570.57
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	0.00	\$0.00
0445-060008	8in Ductile Iron Pipe, 5 ft depth	\$298.64	Foot	318.40	\$95,086.98
0490-0104	Connection to Existing Structures	\$1,995.78	Each	5.00	\$9,978.90
0495-01	Trench Resurfacing	\$206.57	Sq Yd	70.76	\$14,615.98
0640-01	Aggregate Base	\$77.87	Ton	104.52	\$8,139.15
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	96.23	\$25,018.98
0759-01	Concrete Curbs	\$50.00	Foot	273.65	\$13,682.50
0759-01280	Concrete Walks	\$20.27	Sq Ft	1,253.62	\$25,410.88
0759-01541	Extra for New Curb Ramps	\$1,772.03	Each	6.00	\$10,632.18
1040-0101	Topsoil	\$549.90	Cubic Yard	10.83	\$5,957.25
NA	Temporary Traffic Control; Public Specific	\$20,000	LS	0.85	\$17,000
NA	Public Permits	\$10,000	LS	1.00	\$10,000
Total Public Infrastructure Cost					\$269,646.13
<i>PROPERTY SPECIFIC INFRASTRUCTURE</i>					
0310-01	Removal of Pipe Laterals	\$71.87	Foot	49.15	\$3,532.41
0310-0119	Asphalt Pavement Sawcutting	\$7.02	Foot	209.08	\$1,467.74
0445-030006	6in Sanitary Sewer Pipe, 10 ft Depth	\$190.87	Foot	21.42	\$4,088.44
1170-0103	2in Water Service Connection Piping	\$130.00	Foot	83.12	\$10,805.60
1170-011	1 ½" Water Meter Assembly	\$3,402.50	Each	2.00	\$6,805.00
0490-0104	Connection to Existing Structures	\$1,995.78	Each	3.00	\$5,987.34
0495-01	Trench Resurfacing	\$206.57	Sq Yd	23.23	\$4,798.85
0640-01	Aggregate Base	\$77.87	Ton	5.49	\$427.38
0744-0302	Level 3, ½ inch ACP	\$260.00	Ton	5.05	\$1,313.72
NA	Tree Removal on Entire Lot	\$2,500.00	LS	1.00	\$2,500.00
0320-01	Clearing and Grubbing of Entire Lot	\$29,802.00	Acre	0.14	\$4,291.49
0759-0126	Concrete Driveways	\$35.13	Sq Ft	100.00	\$3,513.00
NA	Construction Cost for Quadplex	\$200.00	Sq Ft	5,645.38	\$1,129,075.20
NA	Temporary Traffic Control; Property Specific	\$20,000	LS	0.15	\$3,000
NA	Property Permits	\$30,000	LS	1.00	\$30,000
Total Property Specific Cost					\$1,211,606.16

Appendix A

Table A.10.2: Comparison of existing taxes and taxes post-development, and the year that the city-required infrastructure costs would be paid in full on the 1522 NE 5th St lot.

Year	Current Taxes	Post-Development Taxes	Tax Delta	Remaining Infrastructure Cost to Pay Back
0	\$1,636.62	\$12,407.00	\$10,770.38	-\$269,646.13
1	\$1,685.72	\$12,779.21	\$11,093.49	-\$258,552.64
2	\$1,736.29	\$13,162.59	\$11,426.30	-\$247,126.34
3	\$1,788.38	\$13,557.46	\$11,769.09	-\$235,357.25
4	\$1,842.03	\$13,964.19	\$12,122.16	-\$223,235.10
5	\$1,897.29	\$14,383.11	\$12,485.82	-\$210,749.27
6	\$1,954.21	\$14,814.61	\$12,860.40	-\$197,888.87
7	\$2,012.83	\$15,259.05	\$13,246.21	-\$184,642.66
8	\$2,073.22	\$15,716.82	\$13,643.60	-\$170,999.06
9	\$2,135.42	\$16,188.32	\$14,052.90	-\$156,946.16
10	\$2,199.48	\$16,673.97	\$14,474.49	-\$142,471.67
11	\$2,265.46	\$17,174.19	\$14,908.73	-\$127,562.94
12	\$2,333.43	\$17,689.42	\$15,355.99	-\$112,206.95
13	\$2,403.43	\$18,220.10	\$15,816.67	-\$96,390.28
14	\$2,475.53	\$18,766.70	\$16,291.17	-\$80,099.12
15	\$2,549.80	\$19,329.70	\$16,779.90	-\$63,319.21
16	\$2,626.29	\$19,909.59	\$17,283.30	-\$46,035.91
17	\$2,705.08	\$20,506.88	\$17,801.80	-\$28,234.11
18	\$2,786.23	\$21,122.09	\$18,335.85	-\$9,898.26
19	\$2,869.82	\$21,755.75	\$18,885.93	\$8,987.67
Years til Infrastructure is Paid Off				19