A GUIDEBOOK FOR EVALUATING THE INDIRECT LAND USE AND GROWTH IMPACTS OF HIGHWAY IMPROVEMENTS

Appendices
SPR 327

A GUIDEBOOK FOR EVALUATING THE INDIRECT LAND USE AND GROWTH IMPACTS OF HIGHWAY IMPROVEMENTS

Appendices

SPR Project 327

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16. Abstract

In 1998, the Oregon Department of Transportation undertook a study of the impacts of highway capacity improvements on land uses and growth, particularly at the urban fringe. The objective was to better understand the "cause and effect" relationships among highway capacity, travel demand and development patterns. A variety of factors to resulting growth were evaluated for their ability to predict growth. Case studies of six communities provided an in-depth understanding of the pressures which drive development decisions and land use change.

This guidebook provides guidance to ODOT staff for completing environmental analysis and documentation on indirect land use impacts of highway improvements, based on findings of the study. One finding was that most highway capacity increases do not cause development to be dramatically different from local land use plan guidance, or from what would have occurred in absence of the highway improvement. In Oregon, local governments hold the tools to determine development patterns, using zoning and public utilities such as water, sewer and roads.

This guidebook is not a directive, but a compilation of recommendations for a systematic look and consistent approach to predicting the indirect land use impacts of highway improvements. Appendices A-F of this report provide background on the study findings, including the literature review, growth trends analysis and six in-depth case studies. Also included in the appendices are a discussion of population and employment forecasting issues and a summary of ODOT processes for project evaluation.

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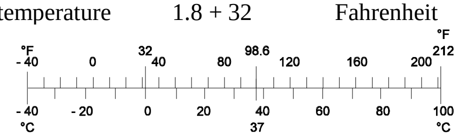
SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
In	Inches	25.4	Millimeters	Mm
Ft	Feet	0.305	Meters	M
Yd	Yards	0.914	Meters	M
Mi	Miles	1.61	Kilometers	Km
		AREA		
in^2	Square inches	645.2	millimeters	mm^2
ft^2	Square feet	0.093	meters squared	M^2
yd^2	Square yards	0.836	meters squared	M^2
Ac	Acres	0.405	Hectares	Ha
mi^2	Square miles	2.59	kilometers squared	Km^2
		VOLUME		
fl oz	Fluid ounces	29.57	Milliliters	ML
Gal	Gallons	3.785	Liters	L
ft^3	Cubic feet	0.028	meters cubed	m^3
yd^3	Cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
		MASS		
Oz	Ounces	28.35	Grams	G
Lb	Pounds	0.454	Kilograms	Kg
T	Short tons (2000 lb)	0.907	Megagrams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9	Celsius temperature	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	Millimeters	0.039	inches	in
m	Meters	3.28	feet	ft
m	Meters	1.09	yards	yd
km	Kilometers	0.621	miles	mi
		AREA		
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
ha	Hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME		
mL	Milliliters	0.034	fluid ounces	fl oz
L	Liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
		MASS		
g	Grams	0.035	ounces	oz
kg	Kilograms	2.205	pounds	lb
Mg	Megagrams	1.102	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celsius temperature	1.8 + 32	Fahrenheit	°F



***** SI is the symbol for the International System of Measurement (4-7-94 jbp)

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All parts of this guidebook were improved by the review and comment of the Technical Advisory Committee:

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Staff at the cities of Albany, Bend, Corvallis, Grants Pass, Island City, and McMinnville contributed to the case studies, as did ODOT staff and focus group participants in each.

A GUIDEBOOK FOR EVALUATING THE INDIRECT LAND USE AND GROWTH IMPACTS OF HIGHWAY IMPROVEMENTS

APPENDICES

APPENDIX A

OVERVIEW OF THE PROJECT RESEARCH

OVERVIEW OF THE PROJECT RESEARCH

The main objective of this project was to develop a basis for identifying the indirect impacts of highway improvement projects on land use. Specifically, any major highway improvement project that ODOT undertakes will require an Environmental Assessment (EA) or an Environmental Impact Statement (EIS), which in turn requires an assessment of the project alternatives' impacts on land use. Figure A.1 shows the primary elements of the research effort. The guidebook and other products of the research have been prepared with the assistance and review of a Technical Advisory Committee. The following is a brief description of the research activities and final deliverables for the project.

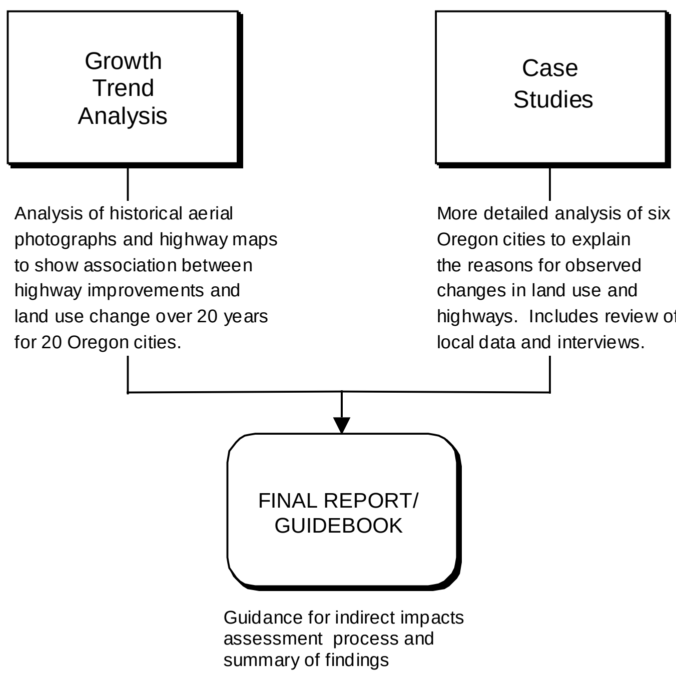

Figure A.1: Structure of the Research

In 1994, ECONorthwest (ECO) produced a working report for the Oregon Department of Transportation (ODOT) addressing the question: to what extent do Oregon's state highway improvements contribute to the premature conversion of rural lands to urban uses? The report, *The Effects of Transportation Improvements on Rural Lands: A Framework for ODOT Policy*, described the forces acting to convert rural lands, and the role that transportation improvements play in the process. Due to a lack of definitive empirical data, ECO did not go beyond theory and develop quantifiable measures for analyzing the transportation and land use interactions. ODOT and ECO agreed that such analysis would not take place as part of that study; instead, ECO would investigate and report on the feasibility and cost of developing quantitative measures of the magnitude of specific roadway improvements on land use development.

At the conclusion of its study, ECO developed a framework to provide reasonable estimates of the direction and magnitude of the effect of various factors on land use. In 1998, following the framework outlined in the 1994 report, the Center for Urban Studies at Portland State University (PSU) and ECO undertook a new research project and developed a methodology by which these effects could be analyzed. The research included a growth trend analysis of urban development patterns with particular emphasis on state highway corridors (see Appendix C). The research also included a set of case studies examining specific land use changes as a function of state highway modifications (see Appendix D).

The growth trend analysis used historical land use information derived from aerial photography to examine the change in urban development for selected cities over time. The detailed case studies analyzed trends in local transportation improvements, land development, public facilities, public policies, and market conditions. This information complements the results of the growth trend analysis for an overall understanding of historic urban development impacts from state highway capacity increasing projects.

GROWTH TREND ANALYSES

The first phase of the project focused on land use changes and urban growth that occurred in 20 selected Oregon cities. A review of pertinent literature was used to set the theoretical context for the analysis (see Appendix B). The literature on the effect of transportation infrastructure on the development of land is large, but reaches few definitive conclusions and provides little empirical guidance. While there is widespread acknowledgment that the provision of roads opens land up to development and that land closer to road access points is more valuable than land further from access points, there is relatively little analysis of whether this is due to increased levels of development or simply the movement of activity that would have occurred in any case. The academic and other literature has analyzed the effect of road improvements on state and regional economic development, with the results helping to provide context for evaluating the effect of specific road improvements.

The Growth Trend Analysis focused on the spatial trends in land use change that have occurred in Oregon over a twenty-year period. Spatial indicators were used to describe the patterns of urban development. While the development of a comprehensive, predictive model was beyond the scope of this project, the methodology and results can be used for impact assessment analyses. Several spatial measures were used to analyze urban development activities resulting from highway accessibility improvements. Logit regression analyses were then used to test the significance of these spatial measures in predicting the location of urban development. A primary objective of this research was to identify the historical relationship between capacity increasing highway improvements and urban land use conversion.

CASE STUDY ANALYSES

The case studies evaluate the impacts of major improvements to state highways (lanes or interchange) at the urban fringe (primarily inside, secondarily outside, UGBs). Six case studies were completed for this project: five for highway widenings (Albany, Bend, Corvallis, La Grande/Island City, and McMinnville) and one primarily for a new alignment and partially for a widening (Grants Pass).

The case study analyses were both quantitative and qualitative. To conduct the baseline analysis, we reviewed environmental documents, land use plans, and capital improvement programs. Those sources are the basis for the description of existing conditions before the case study highway improvements.

As with most policy research, the intent of the case studies was to isolate the impacts (the effects) uniquely attributable to a change in public policy (highway improvement). Figure A.2 illustrates the concept.

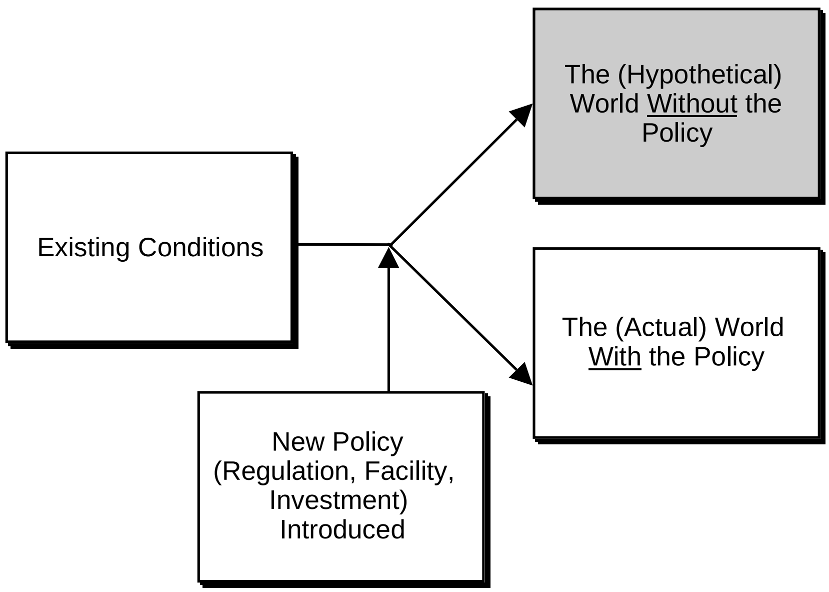

Figure A.2: Conceptual Case Study Method

The shaded box represents a world that does not exist, but one that an analyst must somehow describe. It is a world that would have existed but for the introduction of the new policy. The case study can document, to the extent the data allow, what happened after that improvement (box on bottom right). Describing what would have happened without the improvement (the shaded box) is more speculative, but, in concept, it is required if one were to comment on the differences that a policy makes. As applied to this case study, the method does not formally define a hypothetical world and compare it to an actual one. Rather, it relies on expert opinion about the contribution of the project to the changes observed between “Existing Conditions” and the “Actual World”.

INDIRECT IMPACTS GUIDEBOOK

The final product of this research is a framework to guide the indirect land use impact assessment process. With the focus on practice and application, the guidebook is organized in a way that puts supporting information in the background (as appendices), with the main text being the recommended evaluation techniques. The hope is that users of the guidebook will have time to refer to the appendices that provide more detail about the research that leads to the recommended techniques, variations on those techniques, and their limitations. The guidebook is divided into four chapters and six appendices:

Chapter 1: Introduction.
Chapter 2: A framework for evaluating the indirect impacts of highway improvements on land use.
Chapter 3: Steps for evaluating the indirect impacts of highway improvements on land use.
Chapter 4: Sample analysis and report.
Appendix A: Overview of the Research Project.
Appendix B: Literature review.
Appendix C: Growth Trends Report.
Appendix D: Case Study Report.
Appendix E: Population and employment forecasting issues
Appendix F: ODOT process for project evaluation

APPENDIX B

LITERATURE REVIEW

Indirect Land Use and Growth Impacts

LITERATURE REVIEW

SUMMARY

This literature review summarizes the studies reviewed to provide context for the research on indirect land use impacts. It is part of a larger study sponsored by the Oregon Department of Transportation (ODOT) to help asses the land use impacts of future highway projects. Significant highway improvement projects that ODOT undertakes require environmental analysis[1], which in turn require an assessment of the improvements on land use.[2] The study consists of three research components and a final report. The three research components are:

- *Literature Review.* Review of state and national studies to summarize empirical estimates of the relationship between highway and land use change, especially at the urban fringe (Appendix B).
- *20-Site Analysis.* Analysis of historical aerial photographs and highway maps to show the association between highway improvements and land use changes over 20 years in 20 Oregon cities (Appendix C).
- *Case Study Analysis.* More detailed analysis of highway projects and land use changes in six Oregon cities (Appendix D).

This research led to the development of *A Guidebook for Evaluating the Indirect Land Use and Growth Impacts of Highway Improvements: Final Report*, which is published as a separate document from these appendices.

The literature on land use impacts from transportation improvements focuses primarily on direct impacts. Direct impacts are the physical, social, and economic effects that can be causally linked to the transportation investment. It is important to understand these direct relationships first in order to understand potential indirect relationships. While direct impacts tend to have immediate spatial and temporal effects, indirect impacts tend to be more widely distributed and long-term in nature. These distinctions between direct and indirect impacts provide clues as to why there is a huge literature on direct impacts and very little devoted to indirect impacts.

The literature on land use impacts from transportation improvements is also very theoretical. Because the dynamics of land use change rely in large part on local and regional economic factors, it is difficult to construct a general framework of analysis that applies to a broad range of circumstances. Discussions of land use and transportation interactions are therefore abstract and provide little practical advice on how to predict impacts, especially those occurring at a distance from the transportation improvement and perhaps several years into the future. The studies that

[1] Depending on the scale of the project, ODOT might prepare an Environmental Impact Statement (EIS) or an Environmental Assessment (EA). Larger projects generally require a more detailed EIS.

[2] In addition, of course, to other environmental and socioeconomic impacts.

are most applicable to the current research project are probably the case study style articles in publications such as the Transportation Research Record. These articles generally summarize analyses conducted by researchers, engineering consultants, or transportation agencies and have practical methodological value.

INTRODUCTION

There is an interdependent relationship between land development and the provision of transportation infrastructure. Transportation services must be available to provide access before land can be developed, but the demand for development also creates a demand for access, which in turn increases requests for improvements to the transportation infrastructure. This interdependence complicates efforts to determine the effect of road improvements on land development, because most road modernization improvements are at least partially in response to growing demand.

The following is a review of two important sections of the literature. One examines the effect of infrastructure development (highway construction) on overall levels of economic development or growth, while the other looks at the effect of road construction on the allocation of economic development among geographic areas within a region.

GUIDANCE FROM REGULATORY AGENCIES

The National Environmental Policy Act of 1970 (NEPA) requires an Environmental Impact Statement (EIS) evaluation to distinguish between direct impacts and indirect impacts. The distinction between direct impacts and indirect impacts is important, because this research was focused on the indirect impacts of transportation on land use.

The NEPA, as amended, is the federal statute most relevant to the assessment of indirect impacts. The NEPA, however, does not include any specific references to indirect impacts. The Council on Environmental Quality (CEQ) clarified the meaning when it issued its NEPA regulation in 1978. The CEQ says direct effects "…are caused by the action and occur at the same time and place." Indirect effects "…are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable." Moreover, indirect effects "…may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems." The CEQ differentiates direct and indirect effects from the term cumulative impact. A cumulative impact "…is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions…" *(CEQ 1986).*

NEPA is based on a concern about "adverse" environmental impacts, but it is clear that impacts can be either positive or negative, and that both are important for decision making. Also, the definition of indirect impacts refers to impacts that are "reasonably foreseeable." This definition is problematic because reasonably foreseeable is not clearly defined.

The Federal Highway Administration (FHWA) also provides guidance on conducting an environmental review of transportation projects. That guidance refers to the need to discuss “secondary” impacts, induced development and adverse effects. It does not specifically address indirect impacts, and provides little that goes beyond CEQ definitions regarding the evaluation of indirect land use impacts. *(FHWA 2001).*

The California Department of Transportation (CalTrans) produced the "Community Impact Assessment: CalTrans Environmental Handbook Volume 4" to provide guidance in meeting environmental regulations and procedures *(CalTrans 1997)*. This handbook addresses social, economic, and public service impacts as well as land use and growth impacts.

The Wisconsin Department of Transportation published "Indirect and Cumulative Effects Analysis for Project-Induced Land Development" a technical reference guide for evaluating the indirect and cumulative effects of transportation projects *(WisDOT n.d.)*. This document provides a framework for the analysis, discusses background and reference information, and provides details of analysis techniques. Both the Wisconsin and California publications provided useful models for the development of the ODOT guidebook, and offer additional tools for the land use analyst.

OTHER LITERATURE

The literature on the effect of transportation infrastructure on the development of land is large but reaches few definitive conclusions and provides little empirical guidance *(Giuliano 1989; Bourne 1980)*. There is widespread acknowledgment that the provision of roads opens land up to development and that land close to road access points is more valuable than land further away. Relatively little analysis has been done, however, to identify whether the provision of roads is due to increased levels of development or simply due to the movement of economic activity that would have occurred in any case. Academic literature has analyzed the effect of road improvements on state and regional economic development, with the results helping to provide context for analyzing the effect of specific road improvements *(Fisher 1997; Forkenbrock and Foster 1990; Rietveld 1994; Brooks et al. 1993).*

This review focuses largely on the urban impacts, although there are substantial possibilities for road improvements to affect rural economic development as well. In particular, the economic literature concentrates either on state level data *(e.g., Holtz-Eakin and Schwartz 1995; Hulten and Schwab 1991; and Morrison and Schwartz 1996)* or on the effect of urban road investments on the level of economic development *(e.g., Deno 1988 or Duffy-Deno and Eberts 1991)*. The key finding of this literature is that total investments in road infrastructure are sufficiently large in most urban areas that marginal investments for road improvements appear to have little impact on the rate of local economic growth. In *The Effects of State and Local Public Services on Economic Development*, Fisher notes, "Of all the public services examined for an influence on economic development, transportation services, and highway facilities especially, show the most substantial evidence of a relationship. Of the 15 studies reviewed, a positive effect of highway facilities or spending on economic development is reported in 10…[however]…the magnitudes of the estimated effects of highway spending on economic development appear to be quite small." *(Fisher 1997)* Hence, the road system is generally acknowledged as being very important in terms of the local economy, but the amount of infrastructure affected over relatively short periods is sufficiently small that it shows little impact on the overall level of growth. These studies are necessarily rather crude in their attempts to identify the impact of investment, but the results are consistent with expectations.

In 1998, the National Cooperative Highway Research Program (NCHRP) reviewed and summarized the literature on the effect of road development on land use *(NCHRP 1998)*. Three types of induced growth effects are identified with respect to transportation projects: projects planned to serve specific land development, projects that stimulate complementary functions, and projects that influence intraregional land development location decisions. In the first category, development is planned prior to the road improvement and the improvement is integral to the land use development, e.g., road improvements to provide access to a new regional shopping center. Such improvements allow land development to occur; but the development clearly causes the demand for the road, so the development is not directly induced by the road improvements. In the second case, the development directly serves activity associated with the improvement. The examples presented are "gas stations, rest stops, and motels at highway interchanges" *(NCHRP 1998)*. These activities are to some extent induced by the existence of the road. The last category is the one most related to the concerns of this study:

> This category of induced growth occurs when the transportation facility will likely influence decisions about the location of growth and land development among various locations within a region, a phenomenon commonly referred to as intraregional development shifts. This category is associated with highway and transit modes. On a regional basis, the impact of highway and transit projects on economic growth appears to be minimal; however, the localized effect of such projects on land use can be substantial. If the conditions for development are generally favorable in a region – i.e., the region is undergoing urbanization – then highway and transit projects can become one of many factors that influence where development will occur. Extensive research on the topic of the impact of highway on intraregional locational decisions by others, and a lesser amount of related research on transit impacts, has produced certain generalizations about the circumstances of transportation-induced development shifts. These generalizations relate to the potential nature (type and density) and location of such development shifts; the timing of such shifts is very difficult to forecast as it is highly dependent on the national economy and other factors. Where transportation projects do influence land development, the general tendency is toward relatively high density commercial or multifamily residential development near facility nodes: up to 1.6 km (1 mi.) around a freeway interchange; up to 3.2 to 8 km (2 to 5 mi.) along major feeder roadways to the interchange; and up to 0.8 km (0.5 mi.) around a transit station. The exception is the urban fringe where low land prices and high land availability favor single-family residential development *(NCHRP 1998, 79-80)*.

Hence, the effect of road improvements on land development is associated with two important factors: the overall level of growth and related deficiencies in the transportation system. The effect of the road on improving accessibility to specific areas then affects the relative likelihood of development there as opposed to other places.

ISSUES

The development of transportation infrastructure can have several types of effect on land development. The provision of transportation services is one of the key inputs into the overall level of development in a region. On the other hand, each individual transportation improvement contributes to the overall level of development but also facilitates development in specific areas. This is particularly evident in suburban areas that have high levels of radial access to central business districts as well as emerging employment concentrations at the urban fringe *(Greene 1980; Erickson and Gentry 1985)*. A related concern is whether the infrastructure can influence the type of development that is likely to occur, or more relevantly, the density at which development is likely to occur. This study is interested in this latter influence of transportation development, and with separating the effect of infrastructure on the overall level of development from its effect on the location of development that otherwise would have occurred.

There are several distinctions that should be made in evaluating the impact of road improvements. The first is between urban and rural; the second is between average and marginal impacts; and the third is between different types of highway improvements that provide varying amounts of local access, e.g., the through-route function versus the local access function for roads.

The impact of road improvement on the location of economic activity depends, in part, on the level of economic growth. Where access is limited by low mobility (levels of service) on the road system (i.e., from congestion), road improvements are likely to affect the overall level of economic development. Where access is not severely limited, however, people seem to be able to accommodate new traffic demands by altering behavior, e.g., traveling outside of the peak. Thus, this analysis tells the reader that he/she needs to know something about the overall level of economic activity before trying to evaluate the land use impact of road improvements on land use. Where growth is slow to moderate, the impact is largely one of moving the location of activities, with little change in the level of activity. However, the impact of road improvements in rapidly growing areas is more likely to be to accommodate a level of development that otherwise would not have been feasible. In these circumstances, the road improvement is likely to affect the overall level of activity as well as the distribution of activity.

The effect of road improvements on the distribution of land use activity has received much less statistical analysis than the impact on overall levels of economic development. In particular, there is little discussion of the effect that ready availability of accessible land has on the density of development. Anas et al. *(1988)* summarize the discussion, "Highly accessible land is still underpriced and hence is developed at inefficiently low density. So the resulting land use pattern is likely to be inefficiently dispersed (not clustered enough). It is more difficult to say if the pattern is also inefficiently decentralized (too spread out from the center)…" The literature on this topic relies heavily on the impact of land price on the density of development. Making land available for development is an increase in supply that reduces the price of such land. The lower price then induces lower density of development *(Fare and Yoon 1981; McDonald 1981; Jackson et al. 1984)*. Metro, the Portland, Oregon metropolitan regional government district, has been analyzing the effect of land price on the substitution of capital for land in the provision of housing and has been working on generating models of this effect for residential construction *(Condor and Larson 1998)*. However, much less analysis is available on the effect of land price on the density of commercial and industrial development. From an economic perspective the ultimate determinant of the impact of road improvements on density of development is likely to work out through the effect on land prices.

For a given land price gradient, differential access is likely to affect the location of activity rather than the level of activity or the density of development. Where large amounts of land with good access are available, the relatively low price of the land should lead to a lower density of development than in situations where limited availability leads to high prices for land. This points out a key issue in analyzing effects of a single improvement on the density of development: in most cases, no single improvement is likely to affect such a large quantity of land that it will significantly alter the price of land with good access. Hence, it would be difficult to trace the effects of an individual road improvement project on density.

Following Mohring's *(1961)* early work on highway benefits, a wide range of analyses have been performed that measure the influence of transportation accessibility on land values *(De La Barra 1989; Pendleton 1963; and Alcaly 1976).* Many of these studies focus on the effect of transportation investments on urban form while others use land value analyses for highway impact assessment purposes *(Langley 1976, 1981; Adkins 1957).* Researchers have also identified land value effects at the urban fringe which typically identify transportation improvements as having a significant relationship with growth pressures *(Shonkwiler and Reynolds 1986; Shi, Phipps, and Golyer 1997).* In these cases, land values are seen as a proxy indicator for potential land use development, where land prices will influence the type and intensity of development.

Previous efforts to quantify the impact of road improvements on land development have been very limited *(Deakin 1989).* Some studies have analyzed historical development trends in highway corridors to illustrate the clustering associated with highway improvements *(Baerwald 1982; Hartgen and Li 1994).* However, detecting and quantifying agglomeration economies for highway corridor improvements requires detailed historical land use information that typically is not easy to assemble or analyze. In many cases, projections of the impact of road development, as required, for example, in a Draft Environmental Impact Statement (DEIS), start with an assumption of a fixed amount of activity and travel, then try to determine the effect of the road improvement on mobility (travel times) and other traffic conditions *(e.g., see ODOT 1995).* For example, in reviewing the DEIS for the proposed Mt. Hood Corridor project, "With the no build alternative, travel demand is expected to level off because of the limited roadway capacity available" *(ODOT 1994; CH2M Hill 1993).* Often there are statements that deteriorating travel conditions and rising congestion might prevent the expected level of development if road improvements are not made.

More recent studies try to identify likely land use impacts, but there is seldom any quantitative analysis of the effect that the road improvement is likely to have on the future development of land and subsequent demand for use of the road. *(e.g., David Evans and Associates 1993; ODOT 1996).* To conduct such an analysis, it would be necessary to determine both the impact of the road improvement on the total amount of economic activity that would occur in a specific area and the allocation of that activity, both with and without the road improvement. Where the effect is largely a reallocation of activity, some method must be generated to evaluate the impact of the reallocation on the total supply of accessible land, and the effect of this supply change on the price of land and hence on density. Estimating these effects is substantially complicated by the other policy factors that are likely to affect the ability to bring land into development, such as the availability of urban infrastructure, land use regulations, suitability of the land for development, and the other amenity characteristics of the land (such as views or access to recreation). To overcome some of these difficulties, analysts have relied on "expert panels" and other forms of public involvement to incorporate factors that are not easily quantified *(CalTrans 1997; Mulligan and Horowitz 1988).*

The literature is more specific about particular aspects of the transportation and land use relationship. There are empirical analyses on the connection between transportation improvements, land values, and economic development. The results of these analyses, along with supporting economic theory, tend to indirectly account for land use changes. Compared to land value and aggregate economic development analyses, there are few empirical studies of land use impacts resulting from transportation investments. One reason is that information on changes in land use over time is very difficult to obtain while land sales transactions and aggregate economic activity (employment, sales, production, etc.) is much more accessible.

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APPENDIX C

GROWTH TRENDS REPORT

Indirect Land Use and Growth Impacts

GROWTH TRENDS REPORT

INTRODUCTION

In 1994, ECONorthwest (ECO) produced a working report for the Oregon Department of Transportation (ODOT) addressing the question: to what extent do Oregon's improvements to its highways contribute to the premature conversion of rural lands to urban uses? The report, *The Effects of Transportation Improvements on Rural Lands: A Framework for ODOT Policy,* described the forces acting to convert rural lands, and the role that transportation improvements theoretically play in the process (*ECONorthwest 1994*). Due to a lack of definitive empirical data, however, ECO did not go beyond theory to develop quantifiable measures for analyzing transportation and land use interactions. ODOT and ECO agreed that such analysis would not take place as part of that study, but that ECO would explore the feasibility and cost of developing such measures.

At the conclusion of its 1994 study, ECO developed a framework to provide estimates of the direction and magnitude of the effect of various factors on land use. Using this framework, ODOT asked the Center for Urban Studies at Portland State University and ECO to develop a methodology by which to assess historical land use changes related to the location of state highway projects. The purpose of this study is to build upon the 1994 ECO report by measuring the impacts of highway improvements on land use, identifying land use and transportation variables, and defining the methodologies and model specifications for impact analysis procedures. This study consisted of two phases:

- Phase I included a trend analysis of urban development patterns with particular emphasis on the location of state highway corridors. In this phase, aerial photographs were analyzed to determine the extent of urban development for cities over time, and a geographic information system (GIS) overlay was used to estimate the rate of urbanization.

- Phase II included a set of detailed case studies examining specific land use changes as a function of state highway modifications.

The combined results of Phase I and II were used to prepare guidelines that ODOT can apply during the highway impact assessment process when considering induced indirect land use changes.

BACKGROUND

Much like many other states, Oregon has experienced significant rates of growth in and around its urbanized areas. The growth has not been limited to metropolitan areas; many non-metropolitan cities in the Willamette Valley have experienced population increases in the range of 4% to 9% annually between 1970 and 1997 *(Center for Population Research and Census*

1998). In an attempt to manage growth impacts, Oregon has instituted a statewide policy of urban growth boundaries (UGBs). These boundaries are used to contain and direct urban development and provide coordination between jurisdictions (*Knaap and Nelson 1992; Weitz and Moore 1998*).

As urban areas increase in size, road and highway construction projects are used to facilitate both work-related and non-work-related travel demand. In the period from 1975 to 1995, per capita vehicle miles traveled increased by more than 50% within the Willamette Valley (*Gregor 1998*). Much of this increase has been attributed to an increase in the number of single-occupancy commuters. The challenge has been to accommodate local and regional travel demand with highway projects while not encouraging dispersed development, especially at the urban fringe. It has been shown that, while new development generates demand for new transportation facilities, increased accessibility from new highway facilities also induces urban development (*Moore and Thorsnes 1994*). In this dynamic relationship between transportation and land use it is not known, however, whether capacity improvements induce development as increased accessibility does.

To address these concerns, ODOT has been in the process of improving its ability to analyze the indirect land use impacts of highway improvements. ODOT has undertaken this study to better understand the relationship between capacity-increasing highway improvements within urban fringe areas, associated rates of development, and land use changes in surrounding areas. This information can then be used to improve the impact assessment procedures used for transportation projects in compliance with the National Environmental Policy Act (NEPA) and other laws and regulations.

The purpose of Phase I (Growth Trends Analysis) was to examine the spatial trends in land use change that have occurred in Oregon over a twenty-year period. For this analysis, spatial indicators were relied upon to describe the patterns of urban development. While the development of a comprehensive, predictive model was beyond the scope of this project, the following methodology and results can contribute to a proposed impact assessment framework. Detailed case studies (Phase II) provided analyses of trends in local transportation improvements, land development, public facilities, public policies, and market conditions. This information will complement the results of the growth trend analysis for an overall understanding of urban development impacts from state highway capacity increasing projects.

METHODOLOGY

A primary objective of this study was to identify the historical relationship between capacity-increasing highway improvements and associated land use impacts. The research assessed the induced land use effects of highway improvements on the conversion of land to urban uses. To do this, historical trends in urban development patterns were examined using aerial photography and spatial analysis within a Geographic Information System (GIC). As part of this, the research employs geographical factors to examine the potential of ODOT roadway improvements to cause conversion of land to urban uses. The methodology is similar to that of Chapin and Weiss *(1962)* who presented one of the first comprehensive, grid-cell based land development pattern analyses. Similar to this study, they did not propose a predictive model; rather, they sought to describe factors influencing development patterns. Their model, however, was not longitudinal, as is the analysis presented here.

This investigation was part of a statewide focus to track development trends over a twenty-year period for twenty selected cities in Oregon. A set of spatial measures was used as predictors of urban development activities associated with highway accessibility improvements. Logit regression analyses were then used to test the significance of these spatial measures in predicting the location of urban development. A primary objective of this research was to identify the historical relationship between capacity-increasing highway improvements and urban land use conversion. The analysis provides quantifiable indicators that can potentially be used in the impact assessment phases of highway project review.

The growth trend analysis was based on aerial photographs from 1970 to 1990. Aerial photography at a 1:20,000 or 1:40,000 scale for these time periods were available from U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service for 25 of the 36 Oregon counties. A GIS was used to overlay the extent of urban development over time (derived from aerial photography) to determine the location of new urban development. Historical highway improvement information was overlaid on the urban growth patterns delineated from the aerial photos to examine the coincidence of changes in land use with changes to the highway system.

SELECTION OF URBAN AREAS

The first step in the process was to identify the twenty urban areas that were most suitable for trend analysis. To do this we used the following four criteria:

1. **Availability of a time series of aerial photographs**.
   Given the selected methodology, it was important that aerial photographs be available at regular time intervals for each of the selected urban areas. The analysis assessed the rates of urban development/growth based upon aerial photos from 1970, 1980, and 1990; so it was preferable that data for estimates of growth rates be comparable for each of the 20 urban areas. This meant that aerial photographs for each of these time periods were needed in order for an urban area to be selected.

2. **Substantial growth**.
   Because this study was about growth at the urban fringe, there was more interest in growing cities than in stagnant ones. In this case urban growth was measured in terms of historic population change. Growth could have been measured in a number of ways, but population was common, adequate, and likely to be correlated with other measures of growth such as employment change or building permit issuance. As cities grow in population size, they generally grow in urbanized area as well. Subsequent research on slowly growing or declining urban areas could provide a broader range of comparisons. Additional research could look at why urban areas with similar levels of highway accessibility experienced different rates and forms of urban development.

3. **Relevant highway improvements.**
   This study focuses on the relationship of major highway improvements to land use development activities. Though documentation of urban development trends, independent of major highway improvements, may be interesting to many people, it was not ODOT's focus. Thus, the preference was that most of the selected urban areas had such improvements. However, fringe areas that experienced significant growth without substantial highway improvements could also serve as important control cases. An initial list of highway projects was provided by ODOT staff.

4. **Variation in city type, size, and geography**.
   To make the study as generalizable and applicable to statewide concerns, it was important to include urban areas that varied in size, composition, and geography. Some small cities have experienced substantial population growth rates over the last twenty-five years (200% or more). However, a 200% change in population for a city of 500 persons has different land use implications than does a 50% change for a city of 50,000. For this reason, the rate of population growth was not in itself an adequate criterion for selection purposes. It was also important that a variety of city types in regard to economic activities and geographic location be considered. For instance, local economies relying on tourism experience different types of land use impacts than do local economies relying on high-technology manufacturing. In addition, metropolitan cities experience different urban development pressures than do non-metropolitan cities.

From a list of thirty candidate urban areas, the project Technical Advisory Committee (TAC) selected the twenty that they felt would be most relevant to this study. Table C.1 shows the twenty Oregon cities selected for the growth trend analysis.

Table C.1: Cities Selected for Growth Trend Analysis

City	County	Population 1970	Population 1990	% Change 1970-1990
Albany	Linn	18,181	29,540	62.5%
Aumsville	Marion	590	1,650	179.7%
Bend	Deschutes	13,710	20,447	49.1%
Canby	Clackamas	3,813	8,990	135.8%
Central Point	Jackson	4,004	7,512	87.6%
Columbia City	Columbia	537	1,003	86.8%
Corvallis	Benton	35,056	44,757	27.7%
Dallas	Polk	6,361	9,422	48.1%
Florence	Lane	2,246	5,171	130.2%
Grants Pass	Josephine	12,455	17,503	40.5%
Hillsboro	Washington	14,675	37,598	156.2%
Klamath Falls	Klamath	15,775	17,737	12.4%
Lincoln City	Lincoln	4,196	5,908	40.8%
Madras	Jefferson	1,689	3,443	103.8%
McMinnville	Yamhill	10,125	17,894	76.7%
North Plains	Washington	690	997	44.5%
Redmond	Deschutes	3,721	7,165	92.6%
Sherwood	Washington	1,396	3,093	121.6%
Troutdale	Multnomah	1,661	7,852	372.7%
Woodburn	Marion	7,495	13,404	78.8%

Source: Center for Population Research and Census, Portland State University

Figure C.1 shows the geographic distribution of the selected locations. The twenty cities represent sixteen different counties, generally from the western portion of the state. In addition, sixteen of the cities had identified highway projects.

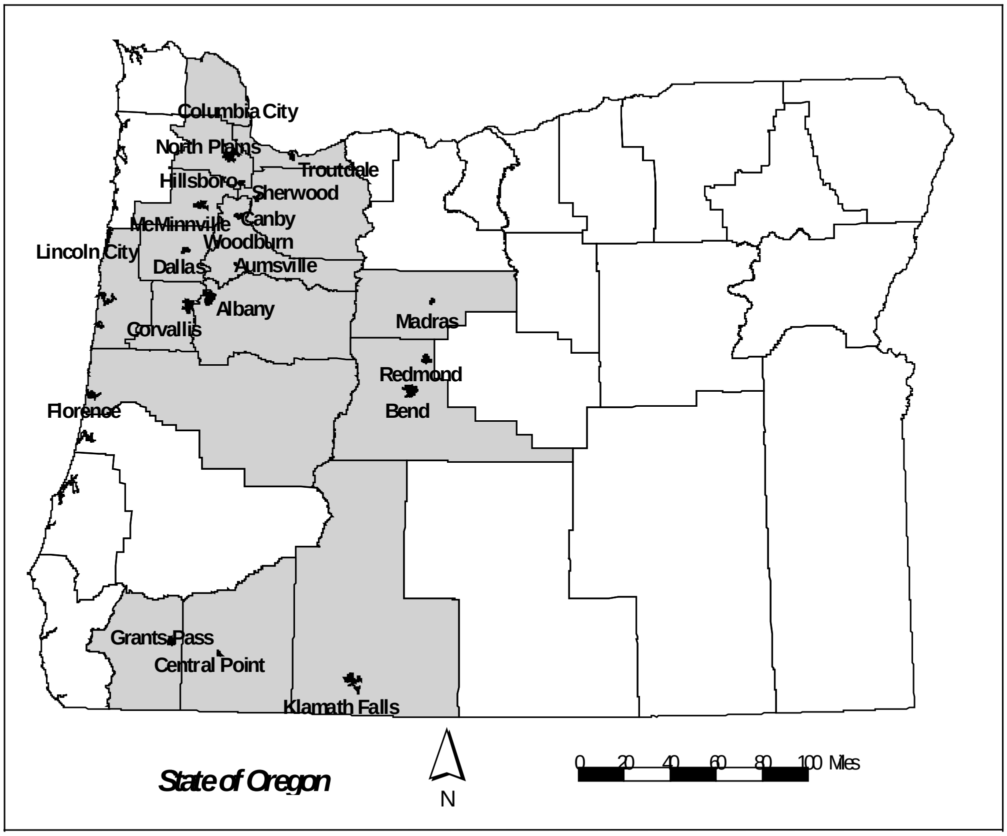


Figure C.1: Cities Selected for Growth Trend Analysis

The selected cities range in population (1990) from 997 (North Plains) to 44,757 (Corvallis). These cities had grown an average of 64.9% from 1970 to 1990. This was significantly higher than the 35.9% increase realized by the state of Oregon over this same time period. Average annual growth rates from 1970 to 1990 range from a low of 0.6% (Klamath Falls) to a high of 8.1% (Troutdale).

URBAN CHANGE DETECTION PROCESS

The process used to convert aerial photography to GIS coverages of urban development for the twenty cities included the following steps. Aerial photos obtained from the U.S. Department of Agriculture, Farm Service Agency, Aerial Photography Field Office (USDA-FSA-APFO) for 1970, 1980, and 1990 were used to estimate the extent of urban development over time. The photography provided the physical coverage for each of the selected urban areas and ranged in fractional scale from 1:20,000 for the 1970 time period to 1:40,000 for 1980 and 1990. All aerial photography was obtained as printed images that needed to be first converted into a digital format so that they could be analyzed within a GIS. Because individual photos do not generally cover entire urban areas, a set of photos had to be assembled to provide a complete geographic view of each urban area. The resulting mosaicked images were then registered to an existing layer of geo-referenced highway features from the United States Geological Survey (USGS). Figures C.2 through C.7 shows each step illustrated with a simplified example of the process used to estimate the change in urban development over time.

Areas were classified as “urban” if development (residential, commercial, or industrial structures) was visible from the aerial photography. Other unvegetated areas that had no structures but were contiguous to developed areas were also classified as urban. Areas located toward the center of urbanized areas that had dense vegetation, with no visible structures or impervious surfaces, were more likely to be considered urban because of their proximity to urban land uses than were similar areas at the urban fringe. For example, recreational open space within cities would generally be considered urban, while a farm at the urban fringe would not (although farmhouses and out-buildings would be considered urban). In addition, areas considered to be at the urban fringe were those at the boundary of areas of contiguous urban development. The urban fringe may or may not have coincided with a city incorporated limits or urban growth boundary (UGB). Because this analysis was concerned with conversion of land to urban uses, physical characteristics dictated how areas were classified, rather than legal or administrative designations.

Figure C.2: Step 1. Aerial Photographs are Scanned to Obtain Digital Graphic Image

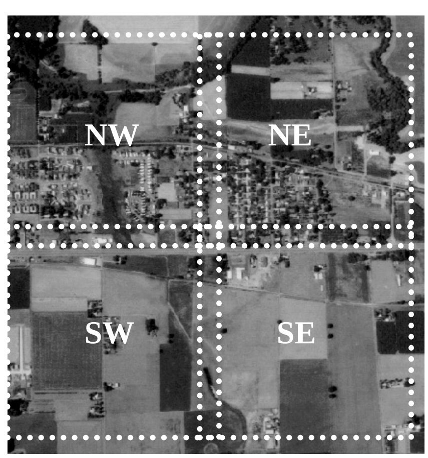


Figure C.3: Step 2. Scanned Photos are Assembled in a Mosaic and Cropped to Desired Map Extents

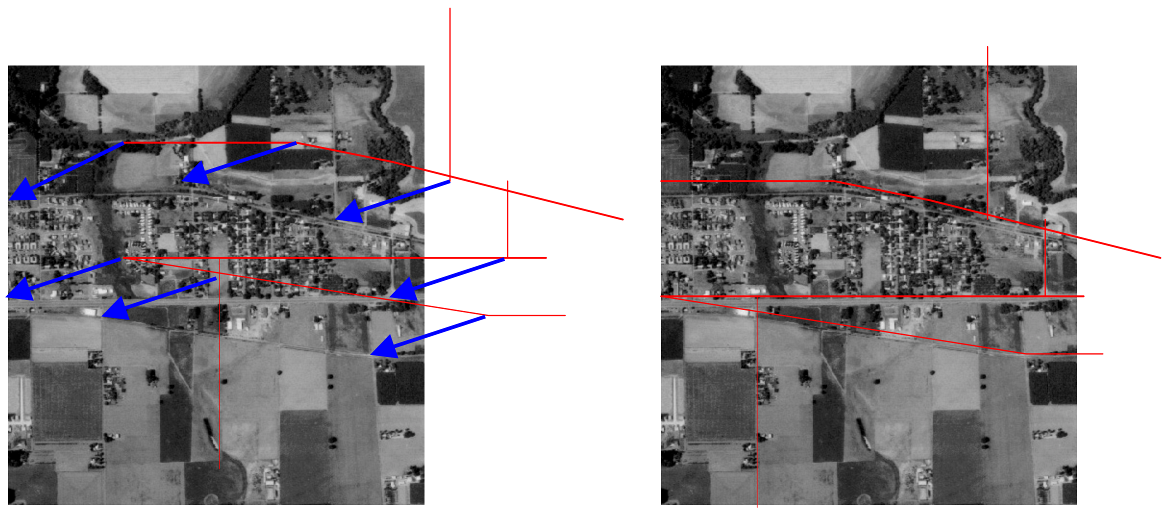
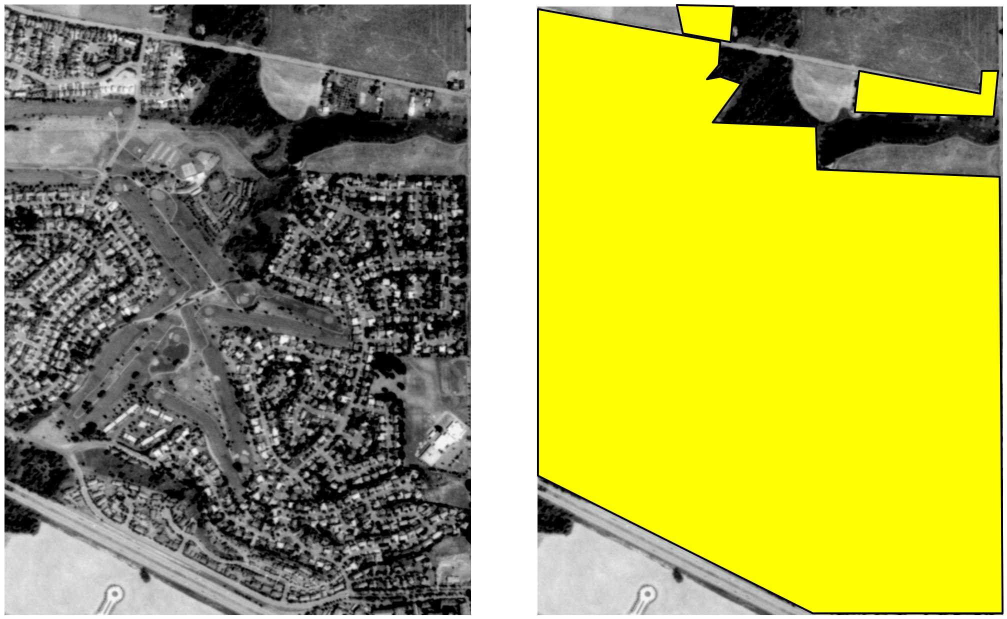


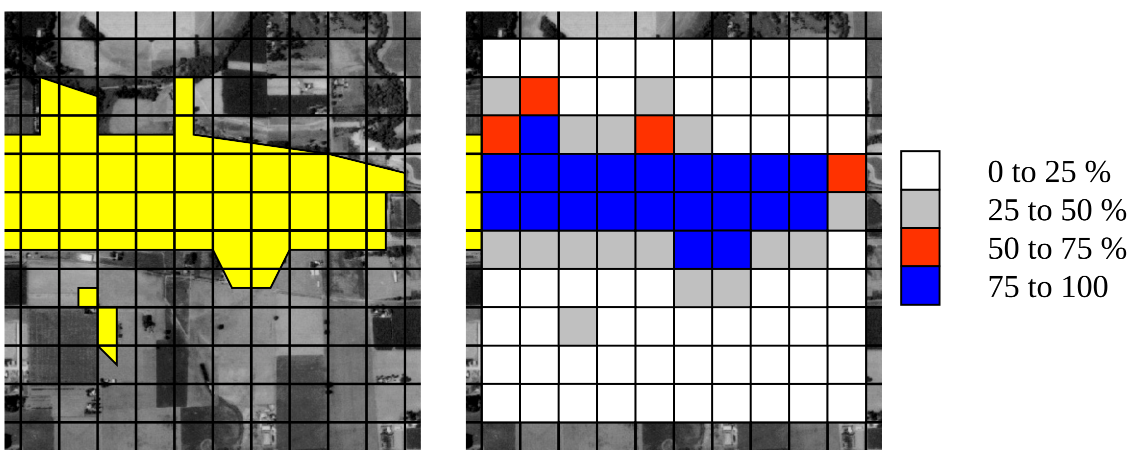
Figure C.4: Step 3. The Image is Registered and Rectified to an Existing Geo-Referenced Coverage

Figure C.5: Step 4. The Boundaries of Urban (Developed) Areas are Digitized from the 1970 Aerial Photos



1990

Figure C.6: Step 4. The Boundaries of Developed Areas are Digitized for the 1990 Aerial Photos



Note: For analysis purposes, the degree of change is a binary variable: 0 for 0% change and 1 for > 0% change

Figure C.7: Step 5. A Grid Coverage is Overlaid on the Digitized Coverage of Developed Areas and the Percent of Developed Area within Each Grid Cell is Calculated

URBAN CHANGE DETECTION RESULTS

Based upon the estimates of urbanized area from the aerial photography, it was evident that significant urban development had occurred in nearly all of the twenty selected cities. For each city, the analysis of land use change was limited to areas up to 1.61 km (1 mi) outside of the 1990 incorporated limits. This 1.61 km buffer was used so that growth outside of city limits which was still geographically related to each city would also be included. In this way, discontiguous development was included while excluding areas that may not have been influenced by growth-inducing activities associated with the city.

On average, rates of change were over twice as high during the period from 1970 to 1980 compared to the period from 1980 to 1990 (see Table C.2). For the twenty-year period from 1970 to 1990, these cities expanded at an average rate of 72.2%, or an average annual conversion of approximately 39.1 hectares (96.5 acres) per city. Rapid rates of urbanization were not limited to cities that were initially small in geographic size. Both smaller communities like Aumsville, Sherwood, and Troutdale and larger communities like Albany, Hillsboro, and McMinnville more than doubled in size. City population size and the rate of urban expansion from 1970 to 1990 exhibited a relatively weak, negative correlation (r = -0.232).

Table C.2: Rates of Urban Development for the 20 Selected Cities

City	Acres			% Change		% Change 1970 to 1990
	1970	1980	1990	1970 to 1980	1980 to 1990	
Albany	4,789	9,928	10,573	107.3%	6.5%	120.8%
Aumsville	135	323	414	139.3%	28.2%	206.7%
Bend	2,705	4,745	7,224	75.4%	52.2%	167.1%
Canby	1,018	1,415	1,562	39.0%	10.4%	53.4%
Central Point	3,699	4,211	4,882	13.8%	15.9%	32.0%
Columbia City	280	333	401	18.9%	20.4%	43.2%
Corvallis	5,254	6,710	7,709	27.7%	14.9%	46.7%
Dallas	1,496	1,875	2,024	25.3%	7.9%	35.3%
Florence	na	1,049	1,184	na	12.9%	na
Grants Pass	3,862	4,642	6,074	20.2%	30.8%	57.3%
Hillsboro	6,847	9,166	13,958	33.9%	52.3%	103.9%
Klamath Falls	7,837	9,468	9,850	20.8%	4.0%	25.7%
Lincoln City	na	1,419	1,419	na	0.0%	na
Madras	906	1,067	1,231	17.8%	15.4%	35.9%
McMinnville	2,203	3,679	4,655	67.0%	26.5%	111.3%
North Plains	284	330	383	16.2%	16.1%	34.9%
Redmond	1,914	2,461	2,747	28.6%	11.6%	43.5%
Sherwood	464	978	1,338	110.8%	36.8%	188.4%
Troutdale	532	1,144	1,357	115.0%	18.6%	155.1%
Woodburn	1,491	1,845	2,346	23.7%	27.2%	57.3%
Average				40.7%	21.8%	72.2%

Note: Complete sets of 1970 aerial photography were not available for Florence and Lincoln City

In addition to the total geographic extent of urban development for the cities, the density of development and land usage was also seen as an important indicator of growth trends. Measures of increases in the physical size of a city did not provide an indication of how intensely land was being used. For this reason, the rates of land consumption per person and per housing unit were compared for 1970 and 1990 (see Tables C.3, C.4, and C.5). The totals for developed areas in Table C.2 were different from those shown in Table C.3. Table C.3 shows the change in developed area within the 1990 incorporated limits so that comparable density estimates can be shown at each time interval. Table C.2 includes all urban development associated with each city (in some cases this includes discontiguous development).

Table C.3: Rates of Urban Development for the Selected Cities (Within 1990 City Limits)

City	Acres			% Change		% Change 1970 to 1990
	1970	1980	1990	1970 to 1980	1980 to 1990	
Albany	4,050	6,466	6,794	59.7%	5.1%	67.8%
Aumsville	106	250	311	135.8%	24.4%	193.4%
Bend	2,341	3,285	4,725	40.3%	43.8%	101.8%
Canby	874	1,224	1,286	40.0%	5.1%	47.1%
Central Point	843	923	1,061	9.5%	15.0%	25.9%
Columbia City	187	225	264	20.3%	17.3%	41.2%
Corvallis	4,217	5,116	5,599	21.3%	9.4%	32.8%
Dallas	1,139	1,464	1,571	28.5%	7.3%	37.9%
Florence	na	1,039	1,174	na	13.0%	na
Grants Pass	2,977	3,216	3,749	8.0%	16.6%	25.9%
Hillsboro	4,736	5,282	8,920	11.5%	68.9%	88.3%
Klamath Falls	3,937	4,339	4,453	10.2%	2.6%	13.1%
Lincoln City	na	910	910	na	na	na
Madras	617	678	768	9.9%	13.3%	24.5%
McMinnville	1,897	2,994	3,696	57.8%	23.4%	94.8%
North Plains	226	239	282	5.8%	18.0%	24.8%
Redmond	1,849	2,250	2,446	21.7%	8.7%	32.3%
Sherwood	354	662	774	87.0%	16.9%	118.6%
Troutdale	241	813	998	237.3%	22.8%	314.1%
Woodburn	1,227	1,522	1,783	24.0%	17.1%	45.3%
Average				46.0%	18.4%	73.9%

Note: Complete sets of 1970 aerial photography were not available for Florence and Lincoln City

As Table C.4 shows, nearly two-thirds of the selected cities experienced increases in population density for the twenty-year period from 1970 to 1990. Canby and Central Point had the largest gains in density at over two additional persons per acre of urbanized land. On the other hand, the population density for Bend decreased by slightly more than 1.5 persons per acre, and McMinnville decreased by about 0.5 persons per acre. Population densities increased on average by 0.31 persons per acre.

Along with average population densities for the selected cities, housing unit densities also increased slightly during the same time period (see Table C.5). With the exception of Aumsville, Bend, and Grants Pass, all cities experienced increases. The largest housing density increases occurred in Central Point (two units per acre) and Canby (one unit per acre). Aumsville and Bend experienced the largest decreases in housing densities at 1.6 and 0.25 units per acre respectively. In general, it appeared that the urban development patterns in the selected cities had either increased or maintained 1970 density levels.

Table C.4: Population Density, Change from 1970 to 1990

City	Population 1970	Population 1990	Change 1970-1990	Persons/Acre 1970	Persons/Acre 1990	Change 1970-1990
Albany	18,181	29,540	62.5%	4.489	4.348	-0.141
Aumsville	590	1,650	179.7%	5.566	5.305	-0.261
Bend	13,710	20,447	49.1%	5.856	4.327	-1.529
Canby	3,813	8,990	135.8%	4.363	6.991	2.628
Central Point	4,004	7,512	87.6%	4.750	7.080	2.330
Columbia City	537	1,003	86.8%	2.872	3.799	0.928
Corvallis	35,056	44,757	27.7%	8.313	7.994	-0.319
Dallas	6,361	9,422	48.1%	5.585	5.997	0.413
Florence	2,246	5,171	130.2%	na	4.405	na
Grants Pass	12,455	17,503	40.5%	4.184	4.669	0.485
Hillsboro	14,675	37,598	156.2%	3.099	4.215	1.116
Klamath Falls	15,775	17,737	12.4%	4.007	3.983	-0.024
Lincoln City	4,196	5,908	40.8%	na	6.492	na
Madras	1,689	3,443	103.8%	2.737	4.483	1.746
McMinnville	10,125	17,894	76.7%	5.337	4.841	-0.496
North Plains	690	997	44.5%	3.053	3.535	0.482
Redmond	3,721	7,165	92.6%	2.012	2.929	0.917
Sherwood	1,396	3,093	121.6%	3.944	3.996	0.053
Troutdale	1,661	7,852	372.7%	6.892	7.868	0.976
Woodburn	7,495	13,404	78.8%	6.108	7.518	1.409
Weighted Average				5.185	5.490	0.305

Note: Density based on developed areas – see Table C.3

Table C.5: Housing Unit Density, Change From 1970 to 1990

City	Housing Units 1970	Housing Units 1990	Change 1970-1990	Units/Acre 1970	Units/Acre 1990	Change 1970-1990
Albany	6,402	12,322	92.5%	1.581	1.814	0.233
Aumsville	350	529	51.1%	3.302	1.701	-1.601
Bend	5,039	9,004	78.7%	2.152	1.906	-0.247
Canby	1,360	3,245	138.6%	1.556	2.523	0.967
Central Point	600	2,831	371.8%	0.712	2.668	1.956
Columbia City	123	361	193.5%	0.658	1.367	0.710
Corvallis	10,637	17,307	62.7%	2.522	3.091	0.569
Dallas	2,218	3,672	65.6%	1.947	2.337	0.390
Florence	816	2,741	235.9%	na	2.335	na
Grants Pass	5,984	7,480	25.0%	2.010	1.995	-0.015
Hillsboro	4,962	13,347	169.0%	1.048	1.496	0.449
Klamath Falls	6,304	7,832	24.2%	1.601	1.759	0.158
Lincoln City	2,547	4,023	58.0%	na	4.421	na
Madras	609	1,374	125.6%	0.987	1.789	0.802
McMinnville	3,464	6,778	95.7%	1.826	1.834	0.008
North Plains	164	309	88.4%	0.726	1.096	0.370
Redmond	1,439	2,932	103.8%	0.778	1.199	0.420
Sherwood	492	1,239	151.8%	1.390	1.601	0.211
Troutdale	409	2,509	513.4%	1.697	2.514	0.817
Woodburn	2,960	4,922	66.3%	2.412	2.761	0.348
Weighted Average				1.756	2.217	0.460

Figures C.8 and C.9 show there was a positive correlation between the changes in urbanized area and the rates of population change. With the exception of Troutdale, with a 373% population increase, the observations form a relatively flat cluster around the 100% population change level. With the exceptions of Central Point (372% housing unit change) and Troutdale (513% housing unit change), there was no perceptible trend in percent change in urbanized area and the percent change in housing units from 1970 to 1990 (see Figure C.9).

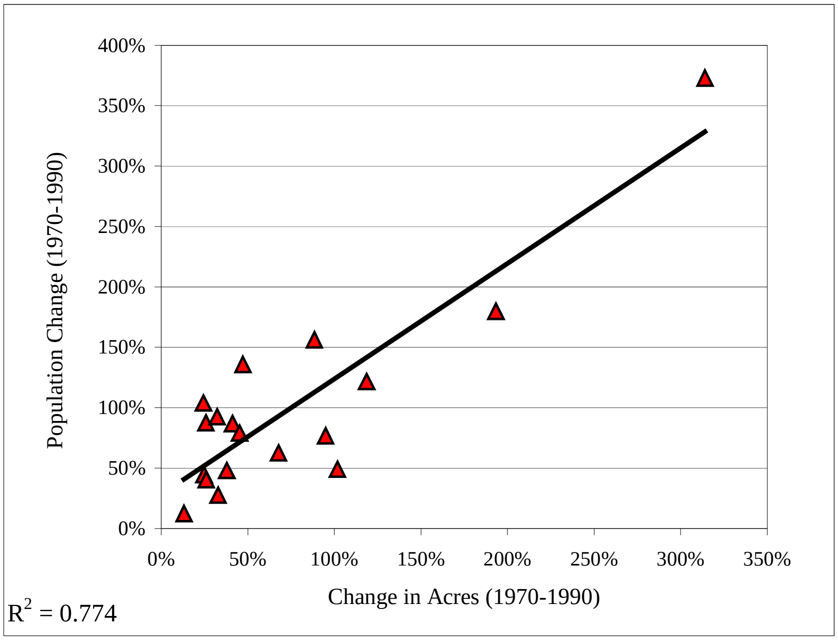


Figure C.8: Percent Change in Urban Acres and Rate of Population Change

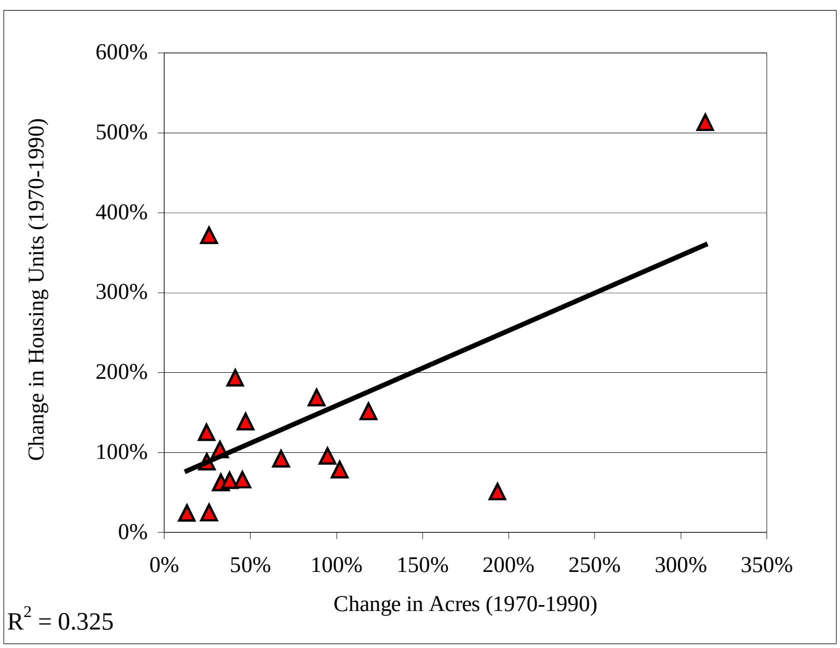


Figure C.9: Percent Change in Urban Acres and Rate of Housing Unit Change

LOGIT REGRESSION ANALYSIS

In addition to the amount of land being converted to urban uses, this analysis was particularly concerned with whether conversions were related to the location of capacity-increasing highway improvements. Typically the relationship between land use impacts and transportation facilities is seen as a function of physical proximity and market demand, so this analysis attempted to isolate the correlation between the location of urban land conversion and the location of highway improvements, and assumed that demand for urban land uses existed. The analysis controlled for other spatial measures that typically indicate the likelihood of land being developed into urban land uses. These measures are summarized in Table C.6. To account for nonlinear distance relationships, squared distances were included for each of the primary spatial measures. For example, along with the variable D_HIGHWAY (linear distance to the nearest highway) was D_H2, which was the linear distance to the nearest highway squared.

Table C.6: Land Use and Spatial Measures (Variable Names)

Measures	Comment
Linear distance to nearest highway (miles) (D_HIGHWAY, D_H2)	Development potential expected to be higher near transportation facilities
Linear distance to UGB (miles) (D_UGB, D_U2)	Rate of development expected to be slower approaching growth limit
Linear distance to city center (miles) (D_CENTER, D_C2)	Decreasing likelihood of development as distance from center increases
Linear distance to nearest highway project (miles) (D_PROJECT, D_P2)	Potential for development should be higher near accessibility enhancements
Within 1990 city limits (0, 1) (IN_CITY)	Less growth should be occurring outside of incorporated limits
Neighborhood urban index (1970) (NEIGH70)	Conversion potential should be higher for land near previously developed areas
Years since nearest highway project completion (YEARS)	Growth impacts expected to occur over time
Land zoned as commercial (0,1) (Z_COM)	Rate of development dependent on local economic conditions
Land zoned as industrial (0, 1) (Z_IND)	Rate of development dependent on local economic conditions
Land zoned as rural/agriculture/open space (0, 1) (Z_RUR)	Limited development should occur in areas zoned for these uses
Land zoned as single-family residential (0, 1) (Z_SFR)	Most urban development should be directed to land zoned for these uses
Land zoned as multi-family residential (omitted) (Z_MFR)	Control variable
Spatial lag (SPATIAL)	Controls for spatial autocorrelation

The ‘within city limits’ variable was binary (0, 1), where 1 = within city limits and 0 = not within city limits. The ‘neighborhood urban index’ was the average percent urbanized of surrounding grid cells in 1970. This value was calculated for each cell using a neighborhood function within the GIS. Figure C.10 shows an example of how cell values were calculated.

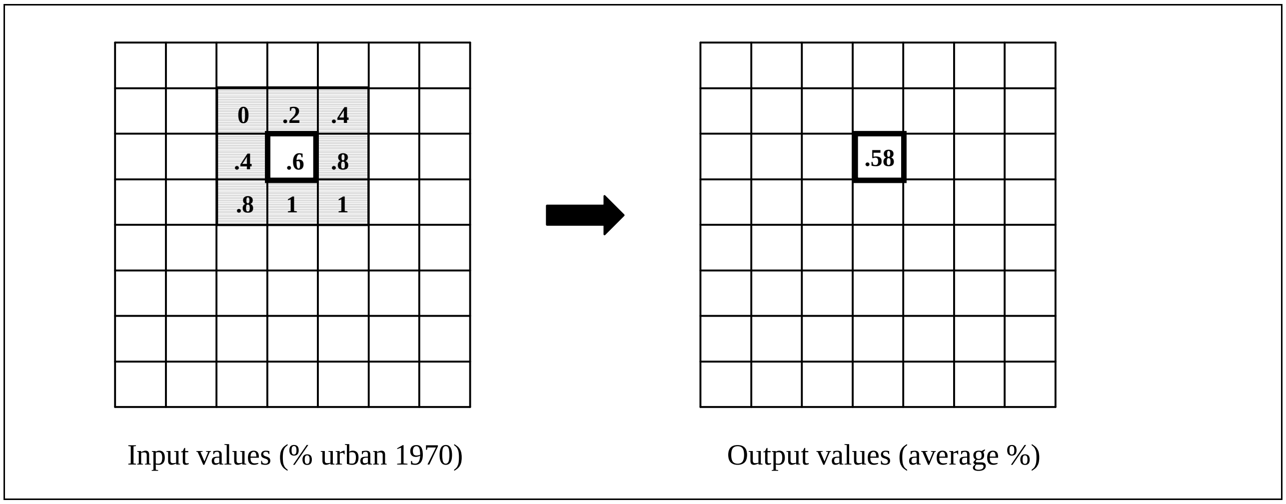


Figure C.10: The Neighborhood Function on an Individual Cell

LOGIT REGRESSION RESULTS

A logit regression model incorporating the land use characteristics and spatial measures shown in Table C.6 tested the significance of proximity to highway projects as a factor in the rate of land use conversions. If the nearness to a highway project significantly affected accessibility and increased development potential close to the improvement, the coefficients for D_PROJECT should be negative. This means that as the distance to a highway project increases, the likelihood of being urbanized should decrease over time. The unit of analysis was the overlay grid cell [approximately 2.3 ha (5.75 acres) – 152.5 m (500 ft) on a side]. A binary dependent variable (CHANGED) indicated whether any new development occurred in a grid cell between 1970 and 1990. While the change in the percentage of urban land area within each grid cell was estimated by the method described earlier, the distribution of values tended to be bimodal with most of the grid cells either showing no change or 100% change. If a grid cell was completely urban in 1970, it was not included in the regression equation. In addition, grid cells also had to be within the 1990 city limits or up to 1.61 km (1 mi) outside of the city limits to be included.

The logit regression equations successfully predicted the location of urban land use conversion between 79% (Aumsville) and 95% (Florence) of the grid cell change for nineteen of the twenty cities. Lincoln City was not included in the logit analysis because the aerial photo analysis did not detect significant land use change for the time period of interest. Overall, the most consistent predictors of urban land use were the variables for being within 1990 city limits (IN_CITY) and the spatial lag variable (SPATIAL). As might be expected, the coefficient for IN_CITY was positive in practically every case that the coefficient was statistically significant at the 0.01 level (see Table C.7). This means that in nearly every case, urban development was more likely to occur inside city limits rather than outside controlling for the other locational factors.

Table C.7: Logit Regression Results with CHANGED as the Dependent Variable

Variable	Albany	Aumsville	Bend	Canby	Central Point	Columbia City	Corvallis
D_CENTER	**-0.649**	-8.486	**2.784**	**-3.039**	1.280	-4.722	**1.886**
D_C2	**0.155**	5.842	**-0.502**	0.443	**-1.642**	1.705	**-0.269**
D_HIGHWAY	0.100	0.232	**1.853**	-1.081	1.534	1113.957	0.179
D_H2	-0.109	-0.657	-0.200	0.230	0.141	3665.396	0.008
D_PROJECT	**-0.415**		0.030			-1114.070	**-2.808**
D_P2	**0.102**		**-0.803**			-3672.090	**0.691**
D_UGB	**-3.485**	0.267	**2.716**	-2.907	**-6.262**	-3.625	**-1.573**
D_U2	**3.870**	-5.211	-0.261	-1.471	**4.835**	6.465	**2.387**
IN_CITY	**1.052**	0.115	**0.441**	**1.164**	**1.292**	0.065	**1.792**
NEIGH70	**6.236**	-5.711	**2.005**	**-4.173**	1.434	2.092	**1.610**
YEARS	0.027		**0.079**				**-0.173**
Z_COM	0.937	0.801	**0.967**	1.751	0.988		**1.136**
Z_IND	-0.394	0.960	**1.809**	-1.325	-0.516	-0.373	**-0.846**
Z_RUR	**-1.187**	-0.472	**-1.023**	-1.960	**-3.276**	-0.546	**-2.038**
Z_SFR	0.195	**1.774**	0.046	0.591	**-1.746**	0.750	0.206
SPATIAL	**6.504**		**3.364**	**12.687**	**9.124**	**5.185**	0.561
(Constant)	0.684	2.088	**-7.219**	**4.257**	**1.805**	1.557	**-2.146**
% Correct	83.9%	78.8%	84.6%	91.7%	87.5%	94.7%	83.1%
N	5,354	354	5,014	1,234	1,454	1,170	3,829

Note: Coefficients shown in bold are significant at < 0.01
% Correct as reported by SPSS statistical output

Table C.7: Logit Regression Results with CHANGED as the Dependent Variable (cont.)

Variable	Dallas	Florence	Grants Pass	Hillsboro	Klamath Falls	Lincoln City	Madras
D_CENTER	**-7.529**	-0.124	1.101	**-4.306**	**2.182**	--	**5.310**
D_C2	**1.681**	0.187	-0.420	**0.728**	**-0.330**	--	**-2.146**
D_HIGHWAY	0.040	5.210	**-1.792**	**-2.593**	**-2.887**	--	**-7.930**
D_H2	-0.871	-2.276	-0.143	**0.813**	**0.902**	--	**4.040**
D_PROJECT	-0.829	-4.219	**2.297**	**2.928**	**1.524**	--	**-10.103**
D_P2	0.428	1.011	**-0.923**	**-1.528**	**-0.517**	--	**3.249**
D_UGB	-1.978	-3.921	0.386	**-1.033**	**2.158**	--	3.413
D_U2	-0.832	3.407	**-3.315**	**0.963**	**-0.843**	--	-6.568
IN_CITY	**1.495**	**0.954**	**0.970**	**-1.287**	-0.331	--	0.599
NEIGH70	**-7.947**	-1.406	-0.273	**4.922**	**1.878**	--	-3.192
YEARS			-0.039	0.025	**0.581**	--	0.628
Z_COM	0.542	-0.527	0.4318	**1.559**	**2.115**	--	0.628
Z_IND	-1.646	-0.494	0.436	**-0.668**	**1.980**	--	**3.815**
Z_RUR	-0.730	**-2.293**	**-3.544**	**-2.083**	0.058	--	1.587
Z_SFR	0.556	-0.313	**-1.431**	**1.535**	**1.938**	--	**2.378**
SPATIAL	**9.525**	**5.472**	**5.560**	**9.059**	**3.712**	--	**13.505**
(Constant)	**6.152**	-0.937	1.435	**6.632**	**-8.139**	--	2.301
% Correct	91.7%	94.9%	84.4%	90.4%	92.4%	--	89.4%
N	1,897	1,663	2,178	4,280	6,231	--	1,115

Note: Coefficients shown in bold are significant at < 0.01
% Correct as reported by SPSS statistical output

Table C.7: Logit Regression Results with CHANGED as the Dependent Variable (cont.)

Variable	McMinnville	North Plains	Redmond	Sherwood	Troutdale	Woodburn
D_CENTER	-0.913	17.710	**4.849**	**-5.953**	**4.702**	-0.970
D_C2	-0.226	-7.838	**-1.950**	**1.365**	**-5.802**	-0.272
D_HIGHWAY	**-2.502**	3.888	**-2.919**	1.349	**3.330**	-1.312
D_H2	**0.713**	-4.429	**1.671**	**-1.860**	**0.900**	1.810
D_PROJECT	0.234	7.613	-0.650	**4.733**	**3.173**	**-4.132**
D_P2	-0.040	**-6.432**	0.144	**-1.351**	-0.380	**0.973**
D_UGB	0.725	-10.226	**6.409**	**-3.695**	**-2.967**	**-5.441**
D_U2	-0.235	8.809	**-2.001**	**5.361**	**1.511**	**5.662**
IN_CITY	**1.419**	**3.539**	**1.263**	**1.960**	0.633	**2.453**
NEIGH70	-0.551	10.852	**-4.847**	-4.928	**6.111**	-0.355
YEARS			**0.500**			
Z_COM	-1.303	3.192	-0.791	0.129	0.201	0.202
Z_IND	-1.042	-0.748	**-3.272**	0.794	0.181	0.475
Z_RUR	**-2.343**	-1.488	-1.318	**1.361**	0.167	-0.867
Z_SFR	-1.006	0.615	0.218	**1.549**	**0.740**	1.012
SPATIAL	**1.762**	**33.992**	**9.907**	**9.525**	**6.726**	**10.918**
(Constant)	**3.678**	**-9.027**	**-5.280**	0.684	**-4.812**	**4.756**
% Correct	88.9%	91.2%	93.7%	86.3%	88.9%	88.7%
N	3,277	339	2,645	1,320	1,714	1,601

Note: Coefficients shown in bold are significant at < 0.01
% Correct as reported by SPSS statistical output

In terms of the spatial index, in all cases the coefficient was positive and reasonably high indicating the strong influence of adjacent land use activities on spatial development trends. Surrounding land that becomes predominantly urban will exert pressure on nearby properties to urbanize as well. Other variables that were reliable predictors of urban status were the distance to the center of the city (D_CENTER and the squared term D_C2) and the distance to the UGB (D_UGB and the squared term D_U2). In just over half of the cases where the distance to the center of the city variable was significant, the probability of urban development increased with increasing distance. In each of the six cases, the squared term was negative indicating that the development potential declined with increasing distance. In most cases where the distance to the UGB variable was significant, development activity was less likely to have occurred with increasing distance to the boundary *(see Kline and Alig 1999, for discussion about UGB effects on conversion of Oregon forest and farmland).*

In nine of sixteen cases (four cities did not have identified highway projects) the coefficients for the distance to the nearest highway project (D_PROJECT) were statistically significant. For five of the cities, the coefficients were positive and for four they were negative. Controlling for other locational factors, the likelihood of development with increasing distance from highway projects was highest for Sherwood and Troutdale. The highest likelihood for development to be concentrated near highway projects occurred for Madras and Woodburn. A negative relationship between distance and urban development was expected if capacity increasing highway improvements were having a significant impacts on development patterns. These mixed results indicate that the impacts of highway projects cannot be generalized across city types. The results also indicate that the location of projects was an inconsistent predictor of urban development. Because many of the selected cities only had one highway project being analyzed, the length of time that a highway project had been completed (the YEARS variable) could not be included in many of the regression equations. In 3 of 4 cases that the coefficient was significant (Bend, Klamath Falls, and Redmond) the sign was positive, with Corvallis being the exception.

The urban status of surrounding properties (the NEIGH70 variable) and the land use zoning classification were also inconsistent predictors of whether a particular location was developed for urban purposes. The NEIGH70 variable controls for the natural "spread effect" of urban development pressure. The coefficient for this variable was positive in 6 of 9 cases for predicting the likelihood of land use change from 1970 to 1990. As also indicated by the spatial lag variable, as would be expected, the neighborhood variable suggests that land was more likely to be developed or become developed if surrounding properties were developed. The land use zoning variables were not consistent predictors of development patterns. In cases where the coefficient was significant, land zoned for single family residential and commercial land uses was more likely to be developed compared to land zoned as industrial or rural. This suggests that in some cases, rural and agricultural designations had generally inhibited development while growth accommodating commercial and residential zones was associated with increases in urban land use activities.

MEASUREMENT ERROR

The manual method of digitizing urbanized areas from aerial photographs involves a degree of error in a few different forms. Image distortion, edgematching errors, and image registration errors potentially contribute to either over- or under-estimation of total urbanized areas *(see Aronoff 1991, Tellez and Servigne 1997)*. Because the analysis was performed at a relatively small geographic scale and because general rates of development were being reported, it is likely that the overall level of error in estimates of urbanized areas does not significantly affect the outcomes of the analysis.

When many spatial measures are included within a single regression equation there was an increasing chance of multicollinearity. Undetected multicollinearity can bias regression results and potentially lead to unreliable regression coefficients *(Neter, Wasserman, and Kutner 1989)*. For this analysis, it is possible that there may be a high degree of correlation between the distance to nearest highway and distance to nearest highway project. In addition, it is possible that the measures of urban proximity; distance to UGB and distance to city center were correlated. If a UGB were a perfect circle, then the distance to the center of the city would have a significant negative correlation with the distance to the boundary. As would be expected, the correlation matrix for the pooled observations suggests that squared terms for spatial measures were collinear with their root measures. However, there does not appear to be an excessive amount of correlation among other distance measures with 1-tailed correlations generally around 0.40 or less. The correlation between distance to the nearest highway and distance to the nearest highway project being -0.048 means that there appears to be little relationship between the two distances measures.

Testing variance inflation factors proved to be problematic due to the inclusion of the squared terms of the spatial indicators *(see SPSS 1993, p.355 for discussion of variance inflation factors)*. As an alternative test, eleven iterations of an ordinary least squares regression predicting the percentage of land area within each grid cell that converted to urban uses were performed removing individual variables in succession. For example, first D_CENTER and D_C2 were excluded from the regression equation and the results were examined. Then, D_CENTER and D_C2 were returned to the equation and D_HIGHWAY and D_H2 were excluded, and so forth. In virtually all cases the sign of the coefficients remained constant, except for D_U2 and YEARS, which tended to be statistically insignificant variables in most models. Chi-square statistics for each of the regressions did not vary significantly. Based on the results of these tests, multicollinearity does not appear to be having a substantial influence on the regression results.

Along with multicollinearity it was suspected that there was a lack of independence in the spatial data. A test for spatial autocorrelation confirmed this suspicion. For this reason an autoregressive procedure using generalized least squares regression was used to fit the data. A spatially lagged variable was generated using a simultaneous spatial autoregression (SAR) model *(see Kaluzny, Vega, Cardoso, and Shelly 1998; Haining 1990)*. A second logit model was then fit that controlled for the spatial trend of residuals from the initial specification. In each case the spatially lagged model (including the variable SPATIAL) provided improved performance.

Measurement errors may also result from the method used to estimate accessibility measures. In this case the straight-line (Euclidean) distances from grid cell centroids to the nearest highway, highway project, and city center were used rather than the road network distance or travel time. In addition, the distances to the nearest highway and highway project were measured from the grid cell centroid to the nearest point along each line segment, rather than to the actual access point such as an on-ramp or interchange. This is significant because the ability to use a highway facility is influenced by the distance to an access point, which means that the variability of distance measures was affected by the type of highway (limited access, controlled access, unlimited access, etc.). It was probable that these measures did not have an adverse effect given the geographic scale of the analysis. More detailed network analysis would probably not add much variation to the relative accessibility measures for each of the grid cells.

CONCLUSIONS

The analytical method used in this study incorporated a set of commonly used data sources and techniques to assess highway impacts on urban development patterns. The results suggest that for 19 selected cities, the spatial measures have mixed performance in predicting the location of urban development from 1970 to 1990. This information provides a baseline for assessing the potential land use impacts of capacity increasing highway improvements.

Of most significance to this analysis, the results of the logit regression model indicated that controlling for other location factors, urban development has not clustered along state high project corridors. One possible explanation is that while growth occurred, these highway facilities provided the requisite accessibility for urban development to occur elsewhere in the area. With the exception of particular outliers (such as Troutdale and Hillsboro), city size and growth rates from 1970 to 1990 explain only a small amount of the variation in development occurring around specific highway improvements (see Table C.8 and Figures C.11 and C.12). It should be noted that the analysis did not account for intra-urban transportation network improvements administered by city or county jurisdictions. Non-highway transportation improvements may certainly improve circulation and congestion conditions, but not have the growth inducing impacts that major highway capacity increases tend to produce. In the case of the cities analyzed in this study, it appears that highway capacity increasing projects, which are typically a response to current or anticipated increases in travel demand, did not lead to direct and immediate land development activities.

Table C.8: Proportion of Grid Cell Changes by Population Size, Growth Rate, and Location

City	% Change < 1.61 km	% Change > 1.61 km	% Change City	1990 Pop.	% Pop. Change 1970-1990	Project Location(s)
Albany	52.3%	30.5%	35.3%	29,540	62.5%	CL/UGB
Aumsville	na	na	na	1,650	179.7%	na
Bend	43.5%	10.0%	24.5%	20,447	49.1%	CL/UGB
Canby	na	na	na	8,990	135.8%	na
Central Point	na	na	na	7,512	87.6%	na
Columbia City	9.6%	0.0%	6.5%	1,003	86.8%	CL/UGB
Corvallis	34.1%	16.6%	21.4%	44,757	27.7%	CL
Dallas	27.6%	9.6%	15.5%	9,422	48.1%	CL/UGB
Florence	11.6%	2.2%	6.9%	5,171	130.2%	CL/UGB
Grants Pass	45.2%	30.1%	35.6%	17,503	40.5%	CL
Hillsboro	50.5%	22.7%	31.5%	37,598	156.2%	CL
Klamath Falls	21.1%	9.3%	11.8%	17,737	12.4%	CL/UGB
Lincoln City	na	na	na	5,908	40.8%	na
Madras	32.6%	10.9%	16.7%	3,443	103.8%	CITY
McMinnville	30.2%	23.1%	24.9%	17,894	76.7%	CL/UGB
North Plains	29.6%	12.1%	24.5%	997	44.5%	CL
Redmond	27.2%	4.4%	14.2%	7,165	92.6%	CL/UGB
Sherwood	32.1%	28.4%	30.2%	3,093	121.6%	CL
Troutdale	42.4%	15.0%	22.9%	7,852	372.7%	CL
Woodburn	35.6%	16.4%	26.0%	13,404	78.8%	CL

Note: CL = near city limit, UGB = near urban growth boundary, CITY = within city limits

Comparing development rates around highway improvements by location of the improvement suggests that projects that were generally at or near city limit boundaries exhibit more land use conversion than do projects at or near UGBs. On average, 41.6% of grid cells within 1.61 km (1 mi) of highway projects converted to urban land uses for projects near city limits compared to 31.4% for projects near UGBs. This can be partly explained by the fact that projects near city limits were closer to previously developed land than were projects near UGBs. This is consistent with the logit regression results that suggest development had a higher likelihood to occur within city limits and contiguous to other land in urban uses.

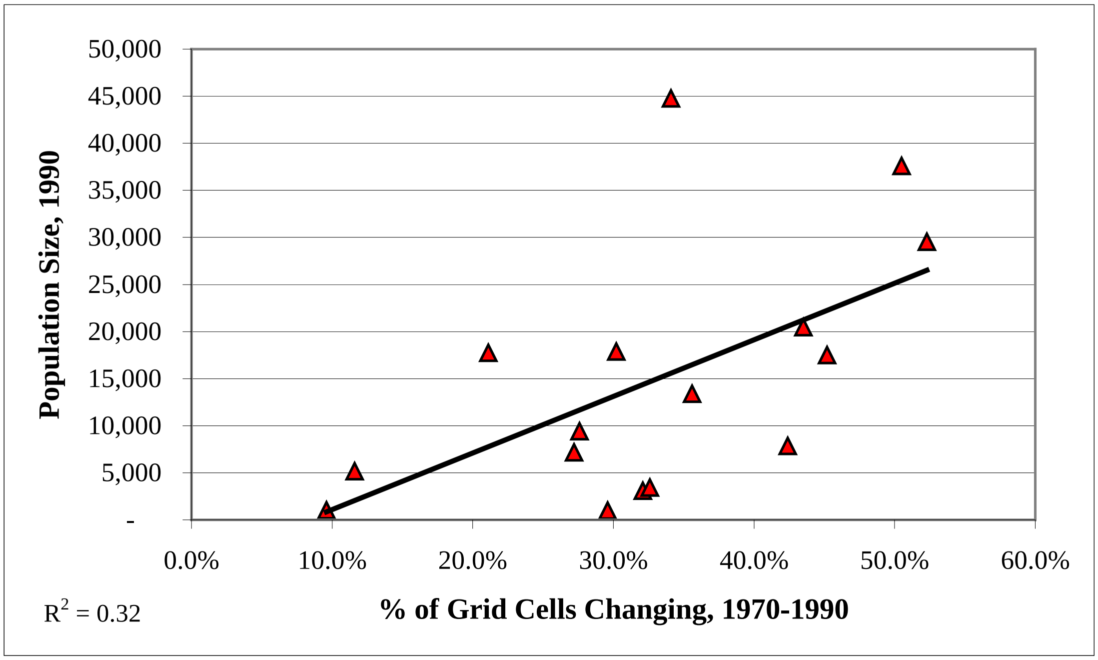


Figure C.11: Comparison of Grid Cell Changes within 1.61 km of Highway Project with City Size

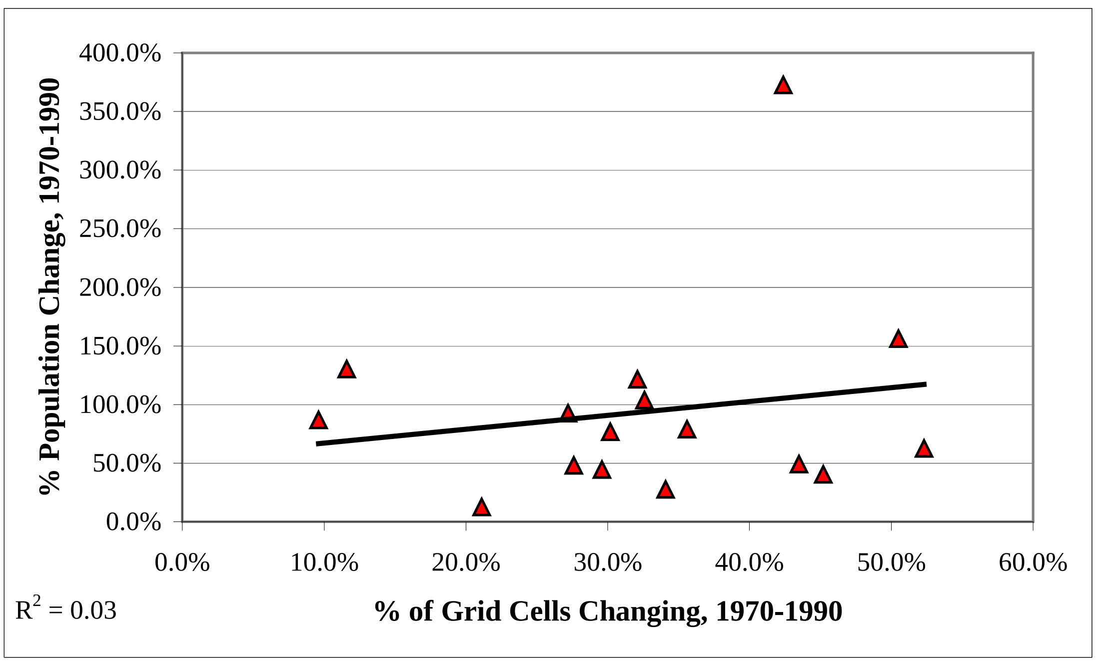


Figure C.12: Comparison of Grid Cell Changes within 1.61 km of Project with Population Change

The distance to the nearest highway project (D_PROJECT) coefficients were also compared, to determine if the pattern of land use impacts was related to city type – either by city size or by the population growth rate from 1970 to 1990. There were four cities with positive coefficients, five with negative coefficients, and seven with statistically insignificant coefficients (see Table C.7). On average, cities with negative coefficients (indicating more localized highway project impacts), cities with positive coefficients (indicating more dispersed project impacts), and cities with statistically insignificant coefficients for this variable did not differ significantly in terms of population size (see Figure C.13).

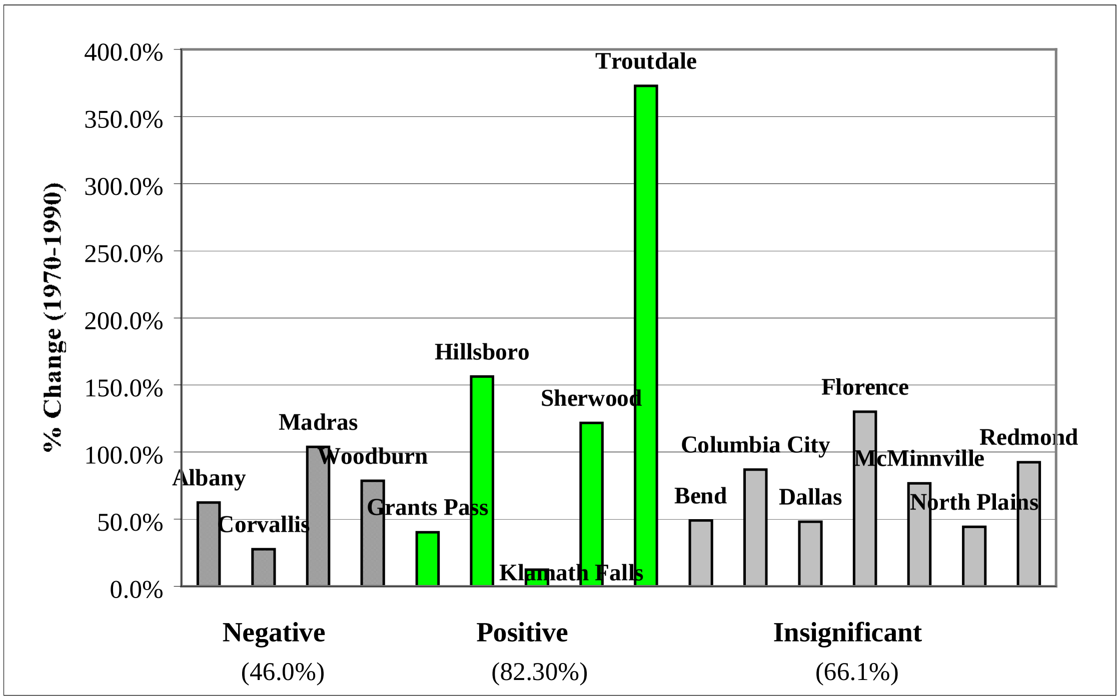


Figure C.13: D_PROJECT Coefficients by Percent Population Change, 1970-1990
(average change in parentheses)

The distance to the nearest highway project coefficients and the percent population change from 1970 to 1990 were also compared for the above groups of cities. Similar to the comparison by population size, the average rate of population change for cities with negative D_PROJECT coefficients, and statistically insignificant coefficients did not exhibit a strong or consistent pattern (see Figure C.14).

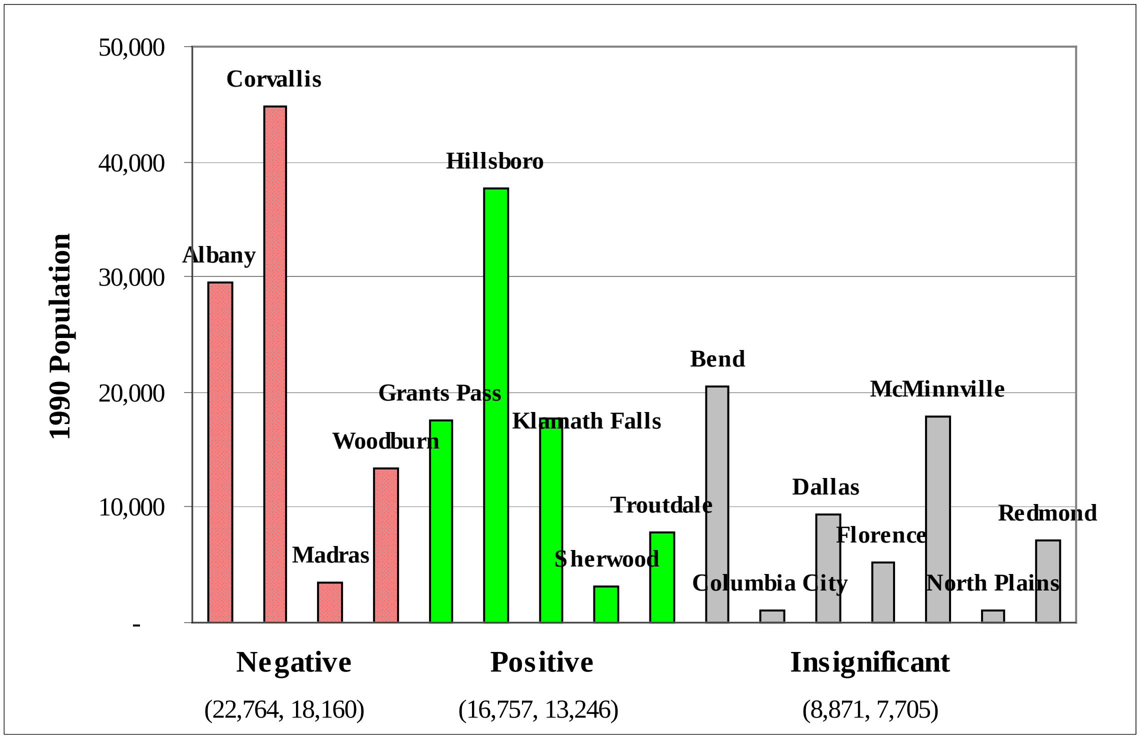


Figure C.14: D_PROJECT Coefficients by Population Size, 1990
(average and standard deviation in parentheses)

The following are the key findings of this research.

- The selected cities had experienced significant rates of urban development from 1970 to 1990. The average increase in urbanized area was approximately 72.2%.
- Urban development appeared to occur more rapidly during the period from 1970 to 1980 compared to the period from 1980 to 1990.
- While these cities grew in population size and geographic extent, most increased both in population density and housing density within their 1990 city limits.
- As would be expected, changes in physical size of cities were generally correlated with changes in population size and number of total housing units.
- Urban proximity measures were reasonable predictors of the extent and rate of urban development.
- The location of existing highways and capacity increasing highway improvements were somewhat correlated with urban development patterns.
- The correlation between land use change and highway project locations was inconsistently related to city size and city population growth trends.

Like other quantitative analyses of urban growth trends, this study could be enhanced with additional information about each of the urban areas. The study was limited by the availability and quality of the aerial photography, the precision of the urban area estimation techniques, the availability and reliability of the highway data, and the resolution and extent of city data. Additional information could also include the historic land use regulations and parcel information for each of the cities. Another important variable that should be included in subsequent analyses is the highway traffic volume. Additional vehicle traffic resulting from highway capacity increases is likely to be correlated with induced urban development demand. The location of other capital investments besides transportation facilities also influence development patterns. Many of these issues are addressed in Phase II and III (case studies) of this research project where specific highway improvement corridors are analyzed at a more localized level.

The analysis presented here provides useful information about trends in land use development. Similar analyses can be utilized for highway impact assessment purposes – especially during the environmental impact assessment phases of project design. However, such a model cannot anticipate changes in political or economic environment of an urban area.

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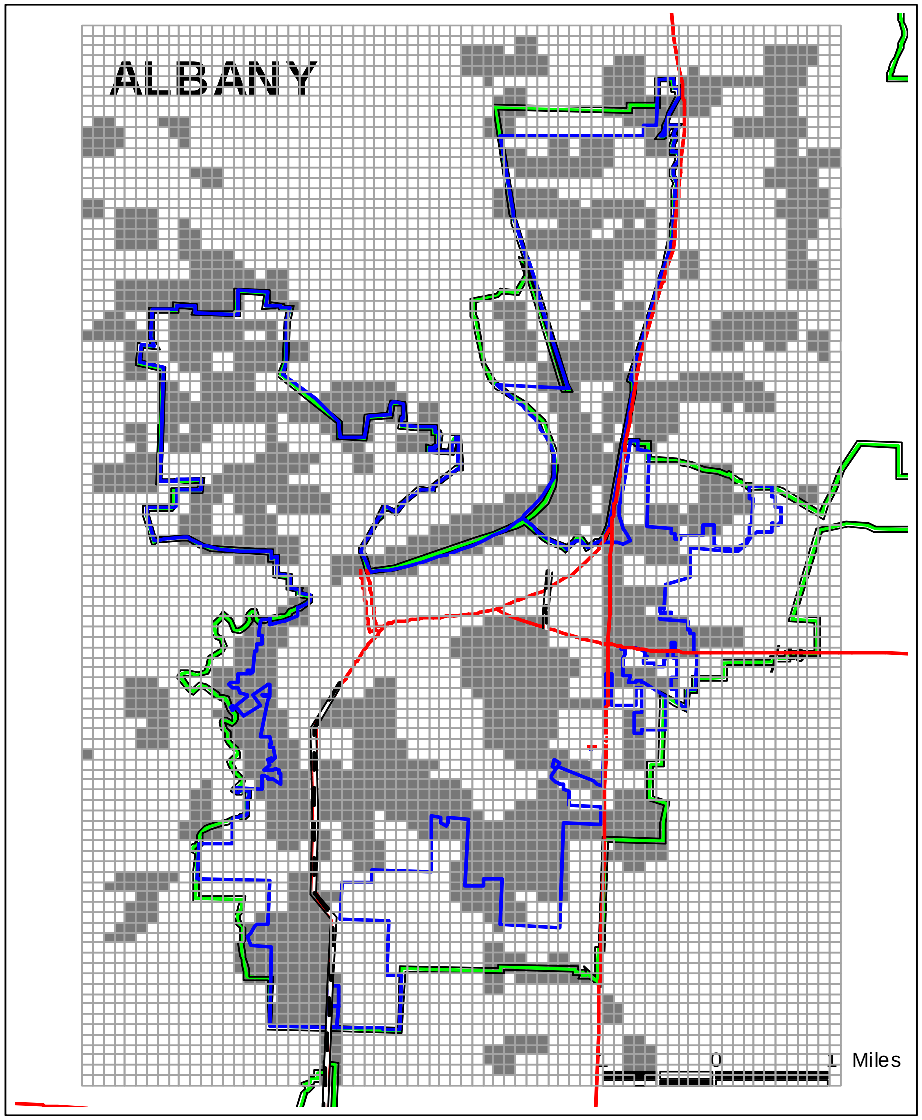
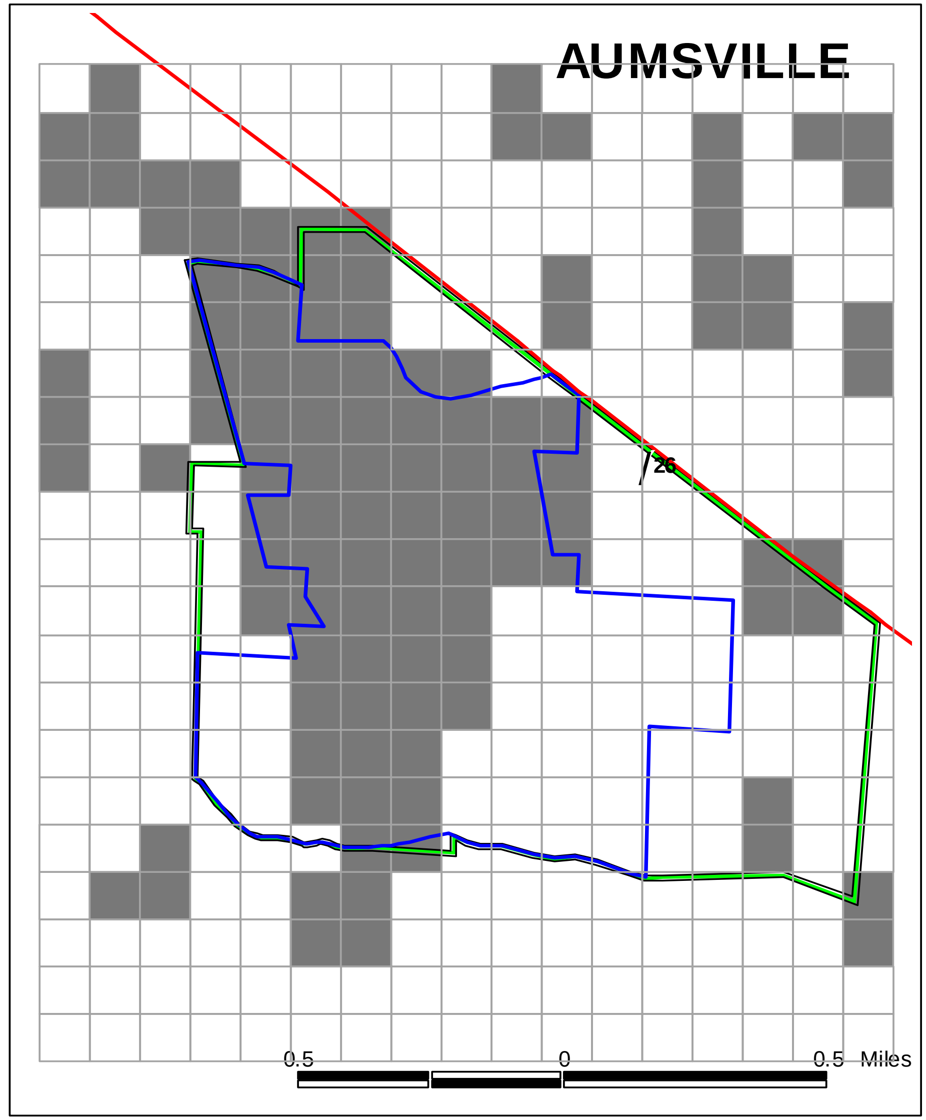
MAPS OF GROWTH TREND ANALYSIS CITIES





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City Limit

Urban Growth Boundary

Highways

Highway Project

1970-1990 Grid

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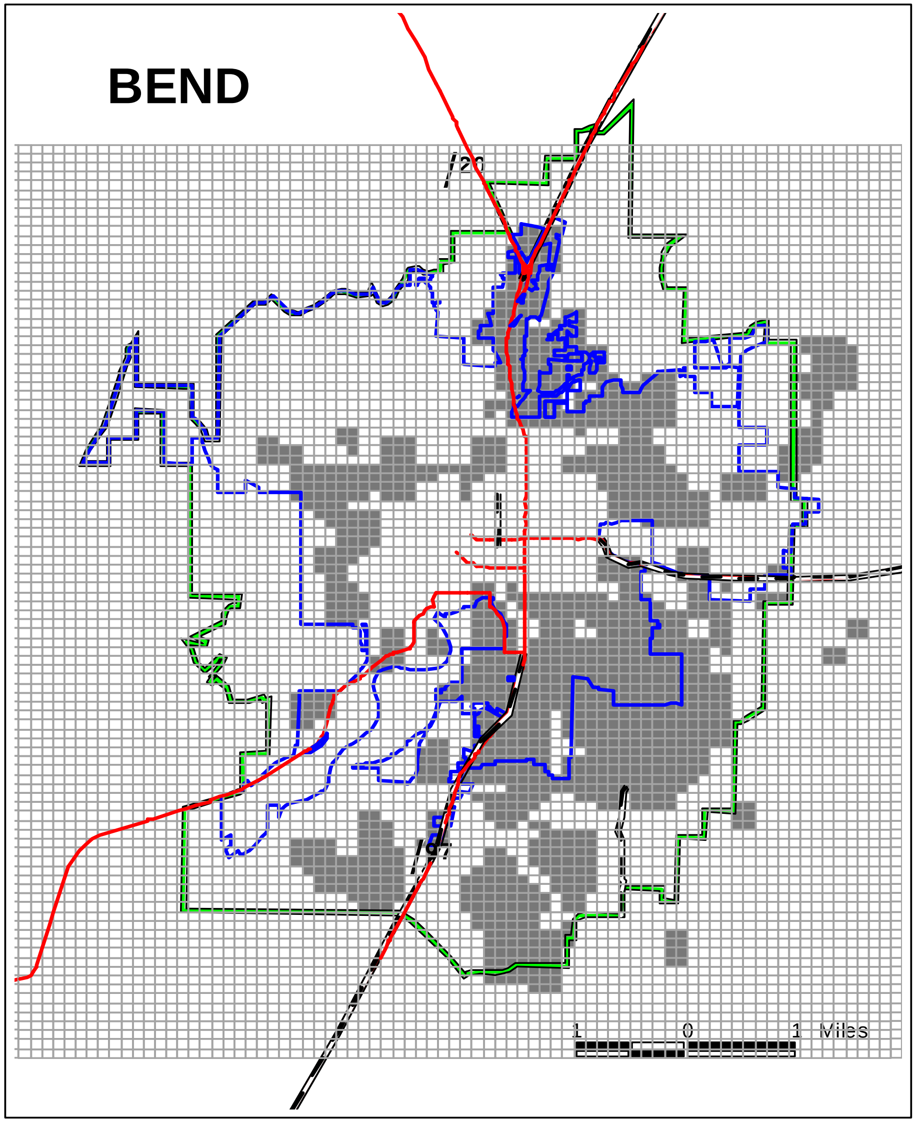
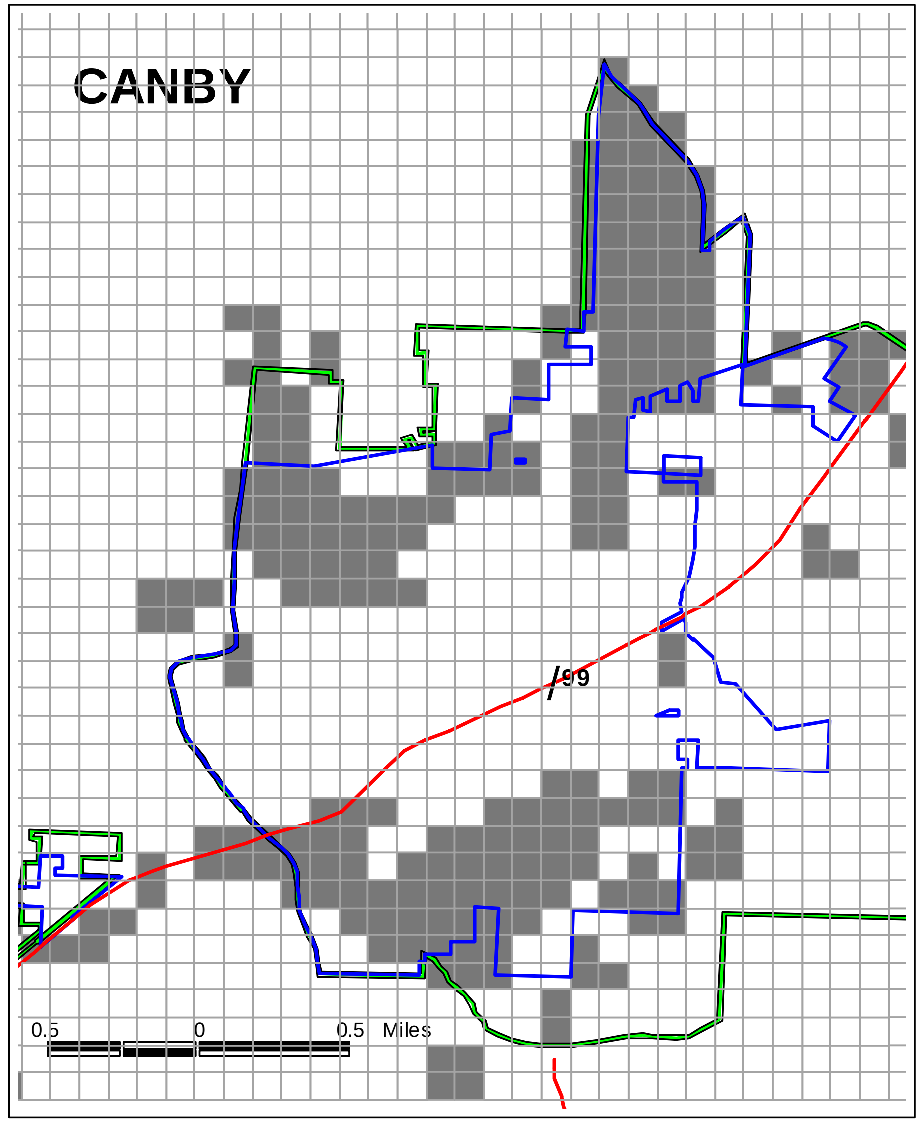
Indirect Land Use and Growth Impacts

prepared for the Oregon Department of Transportation
July 1999

Maps of Growth Trend Analysis Cities





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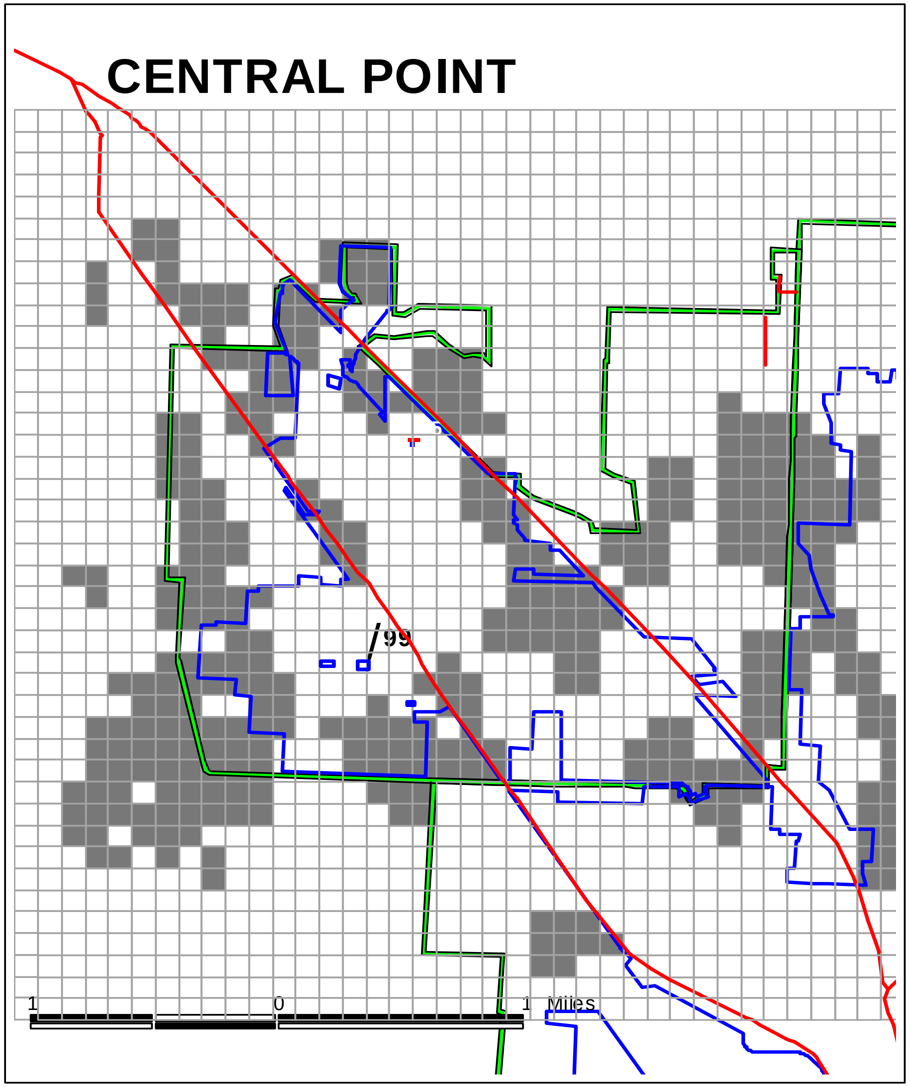

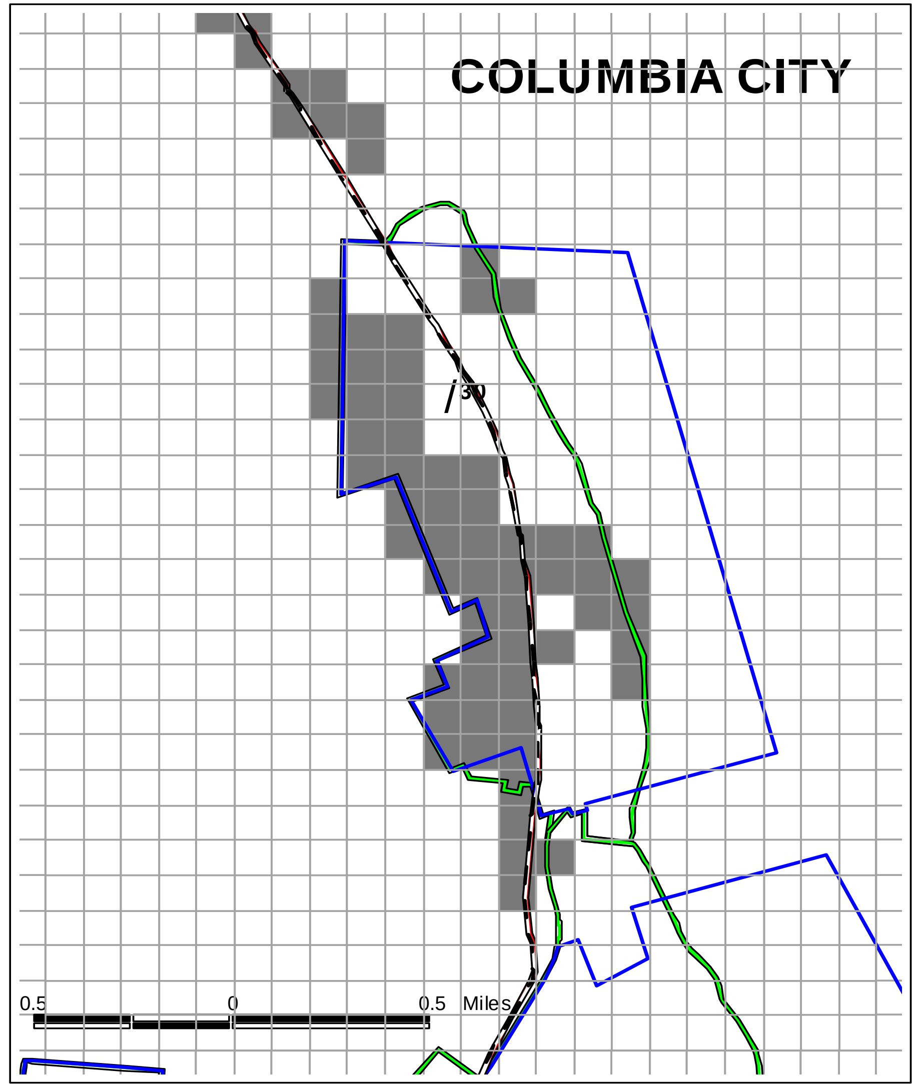

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City Limit

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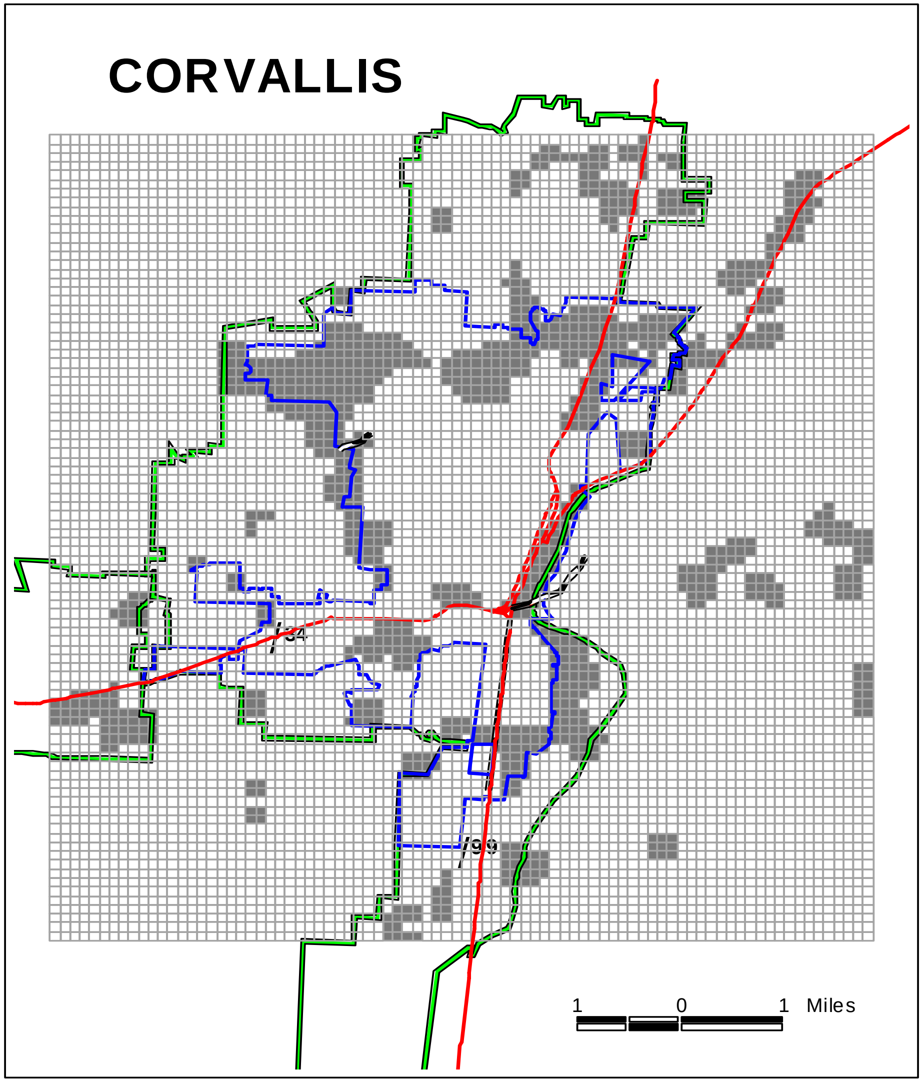

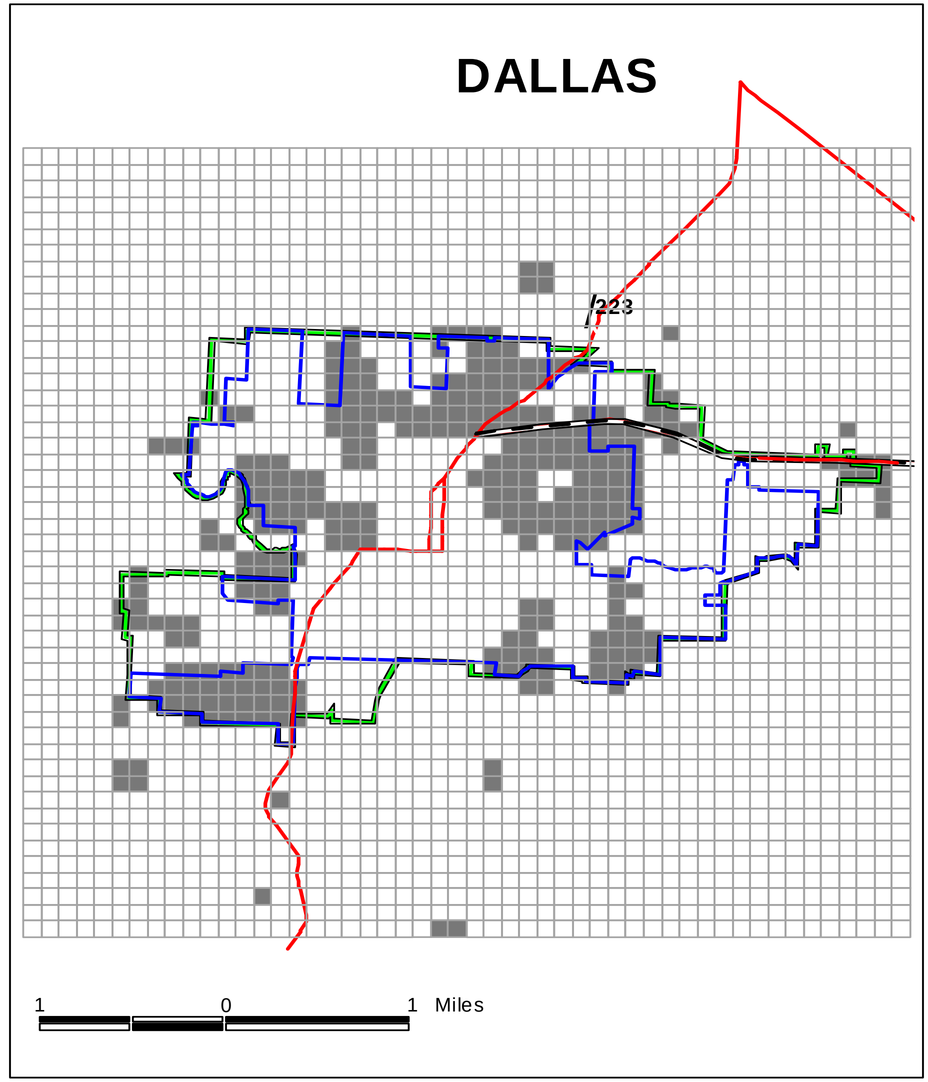

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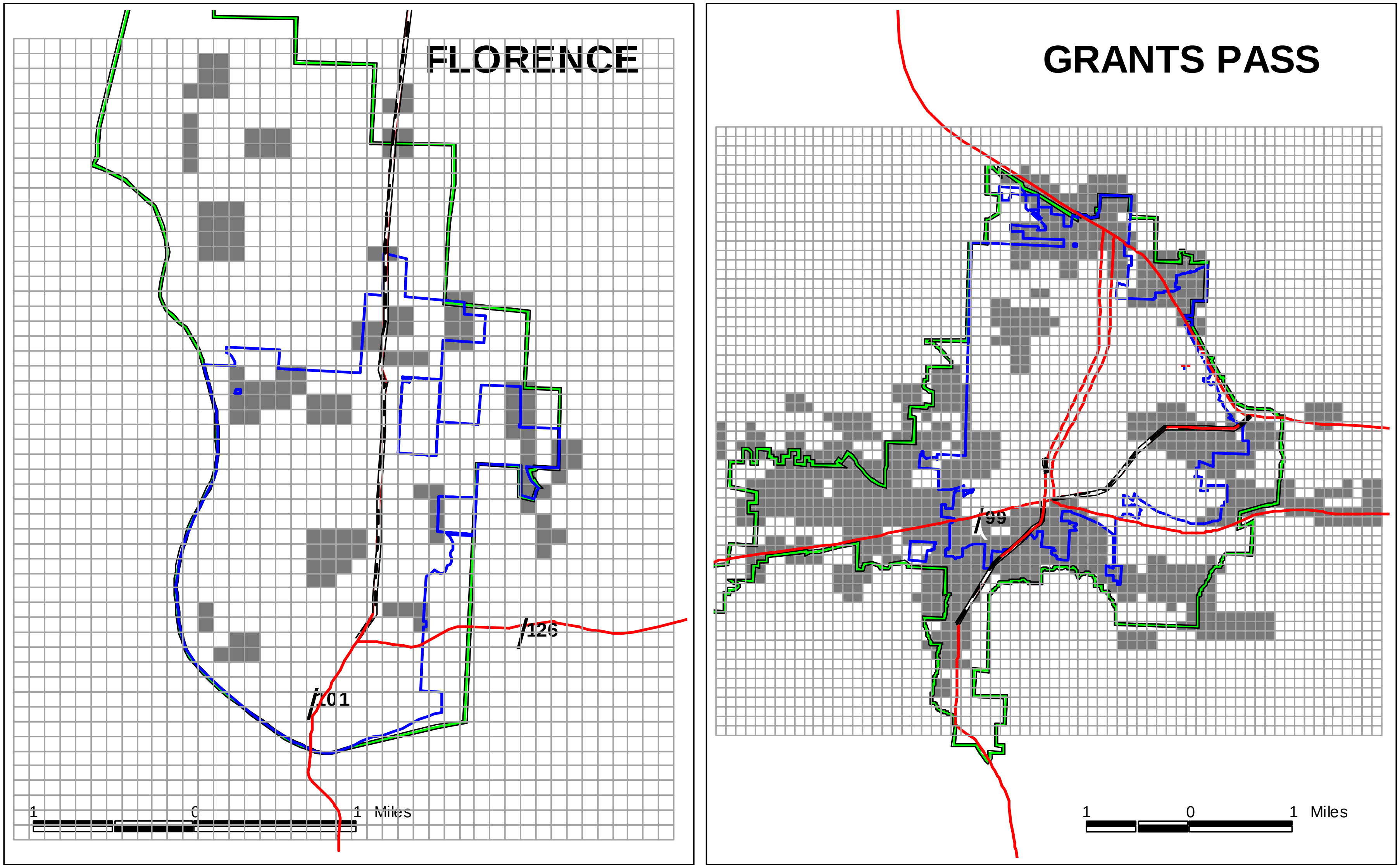

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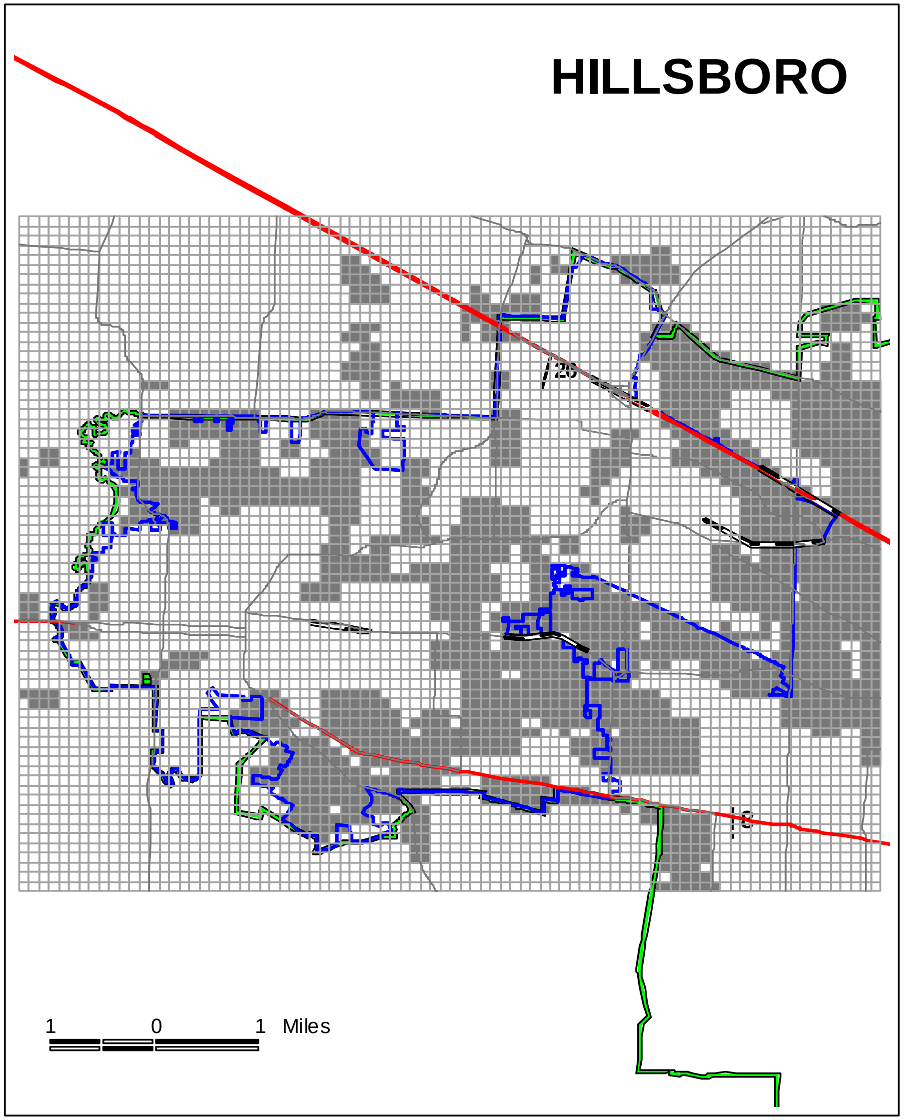

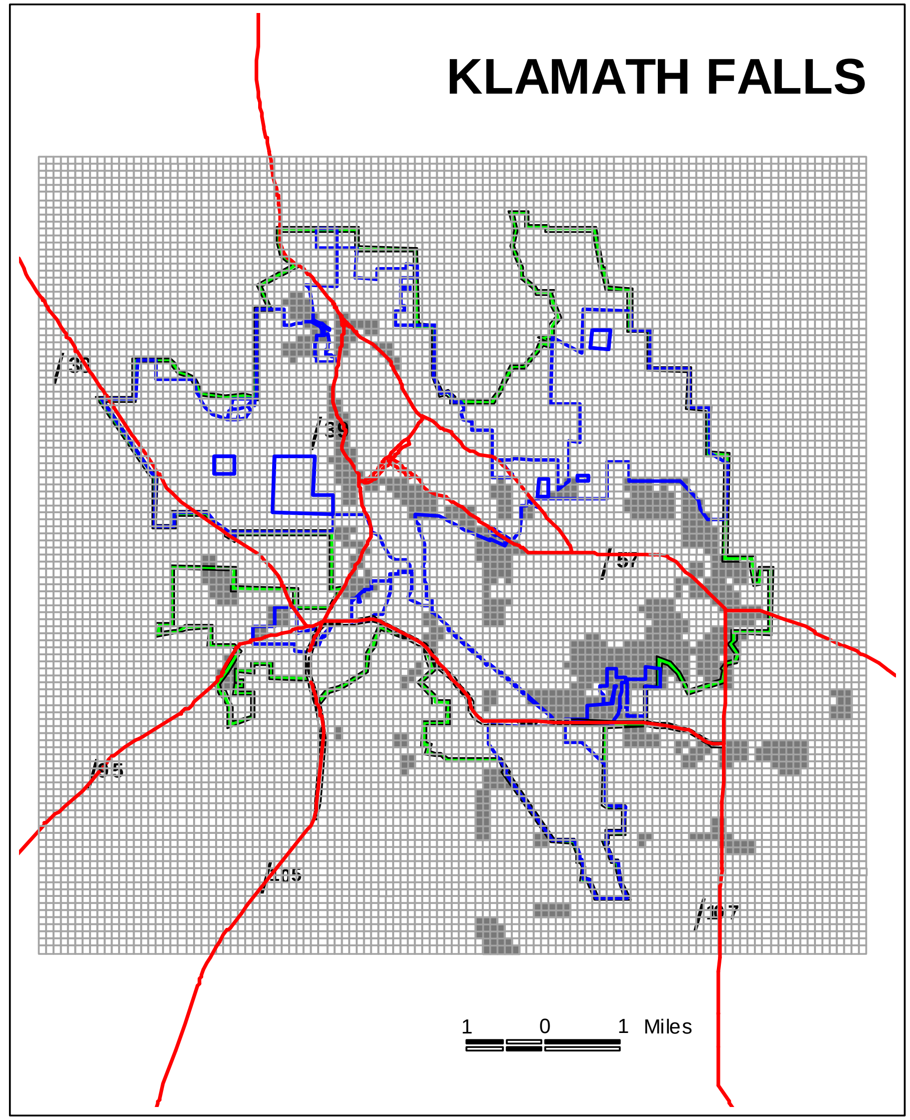

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Highways
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Indirect Land Use and Growth Impacts

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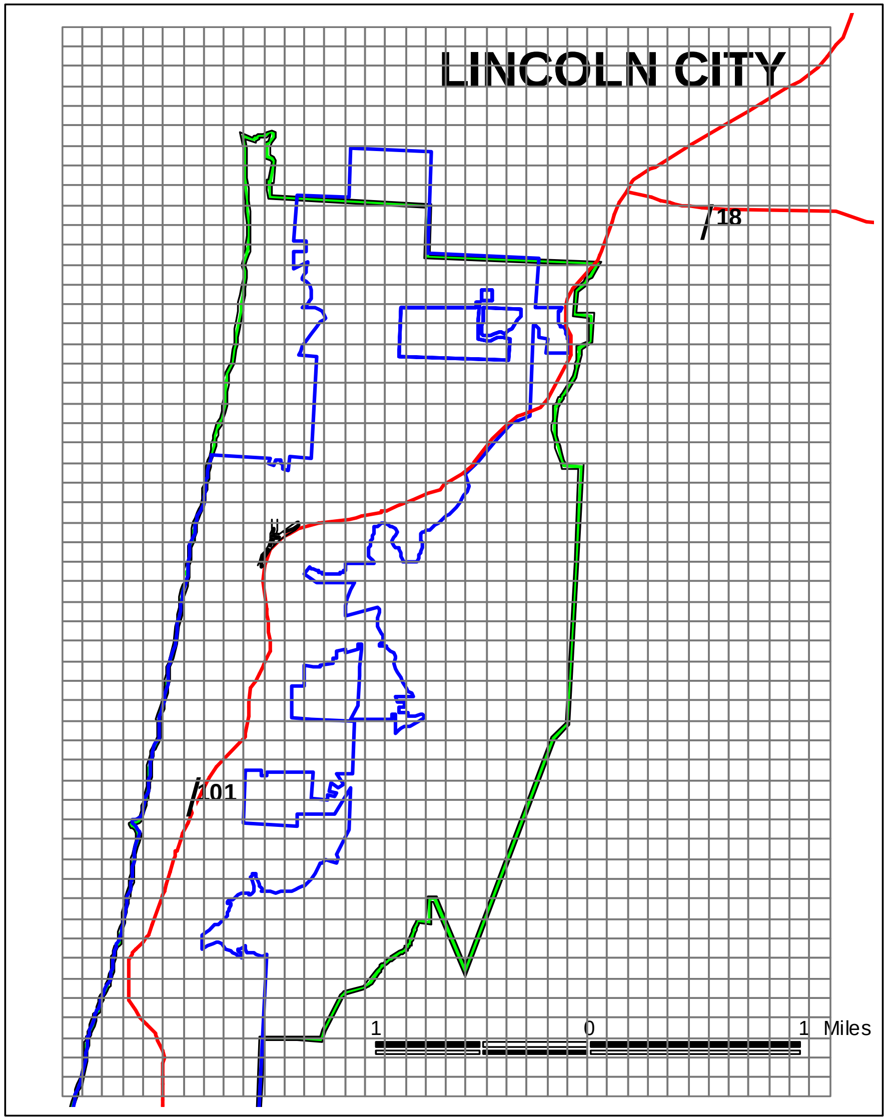
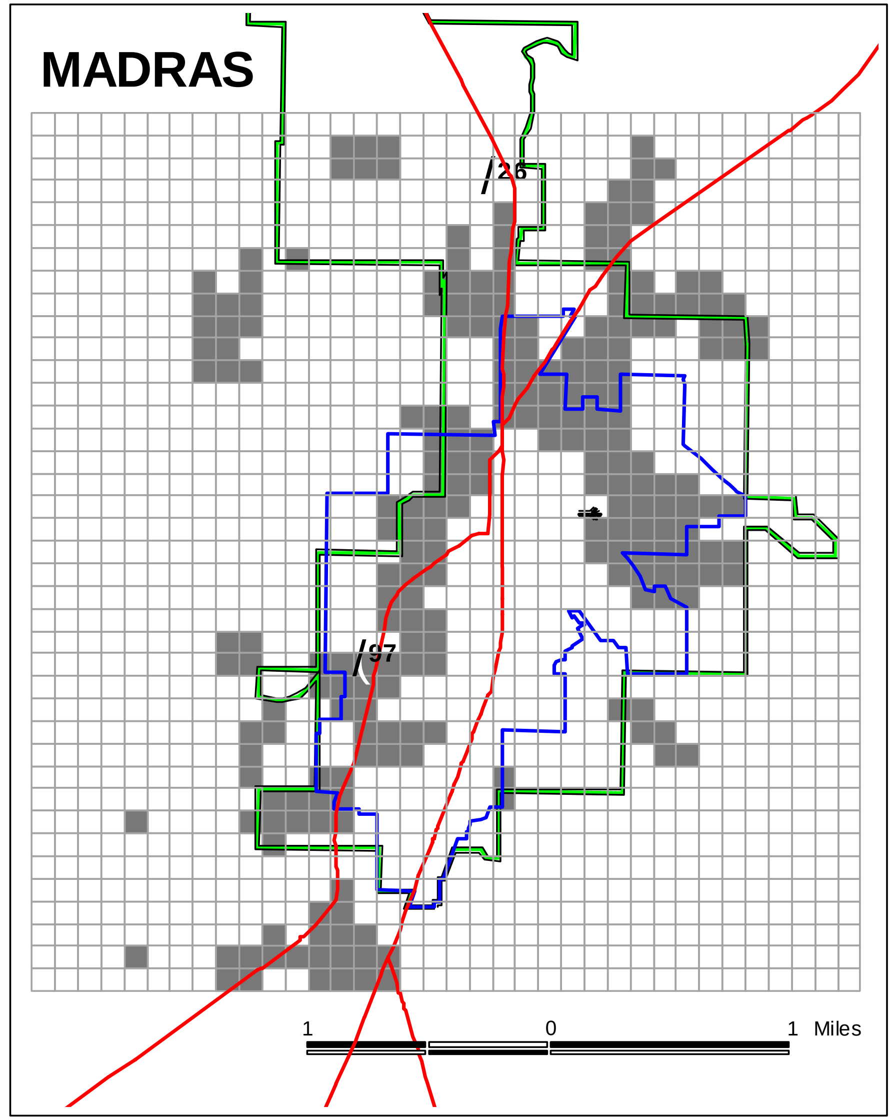
Maps of Growth Trend Analysis Cities





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City Limit

Urban Growth Boundary

Highways

Highway Project

1970-1990 Grid

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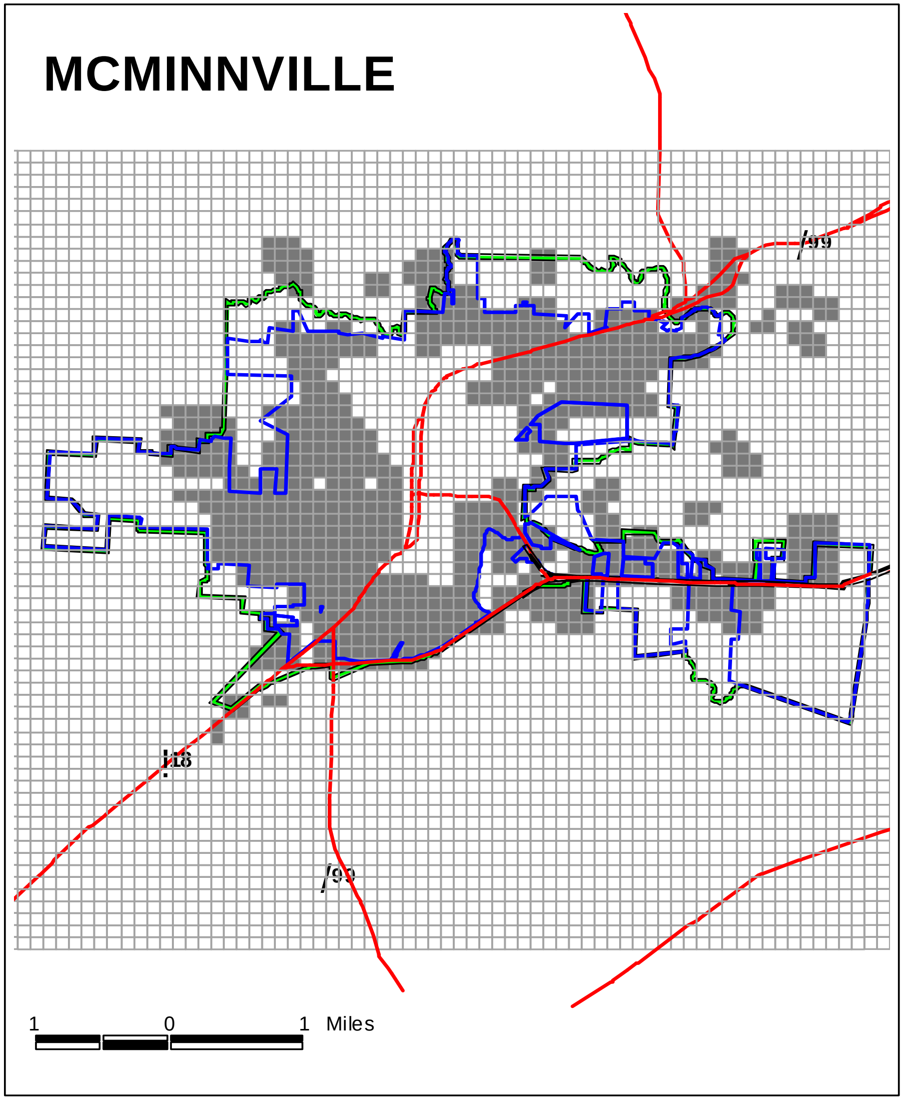

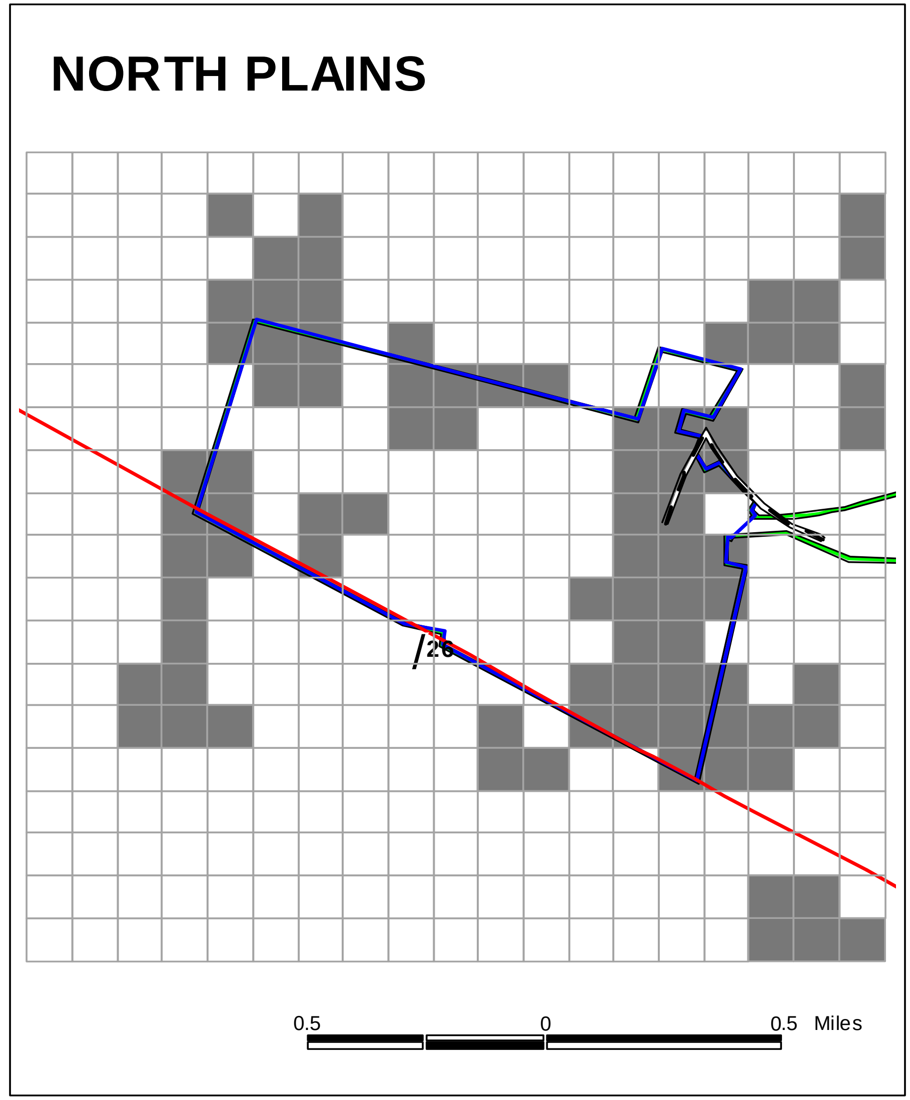

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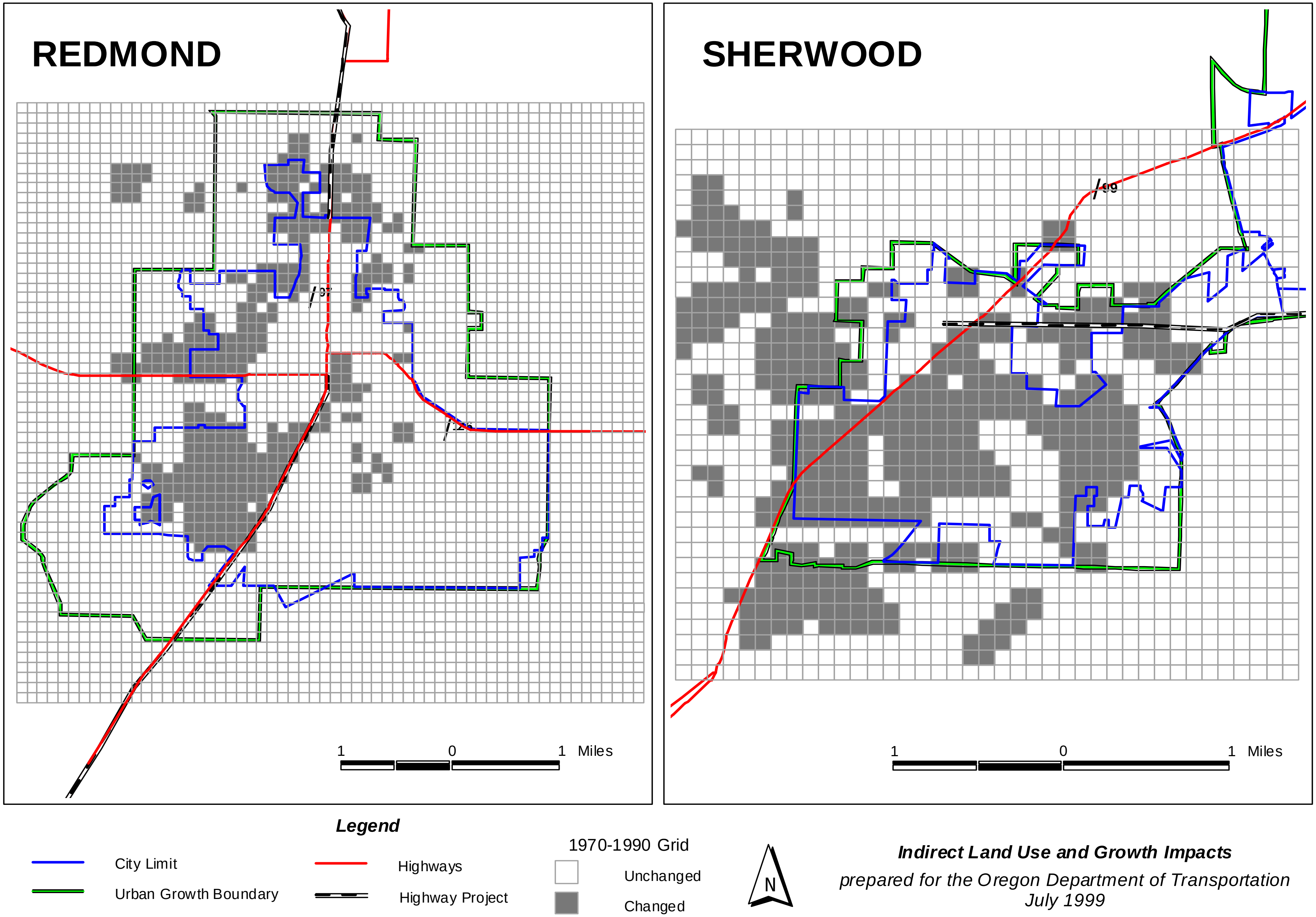
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97
126
1
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1 Miles
SHERWOOD
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Legend
City Limit
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Indirect Land Use and Growth Impacts
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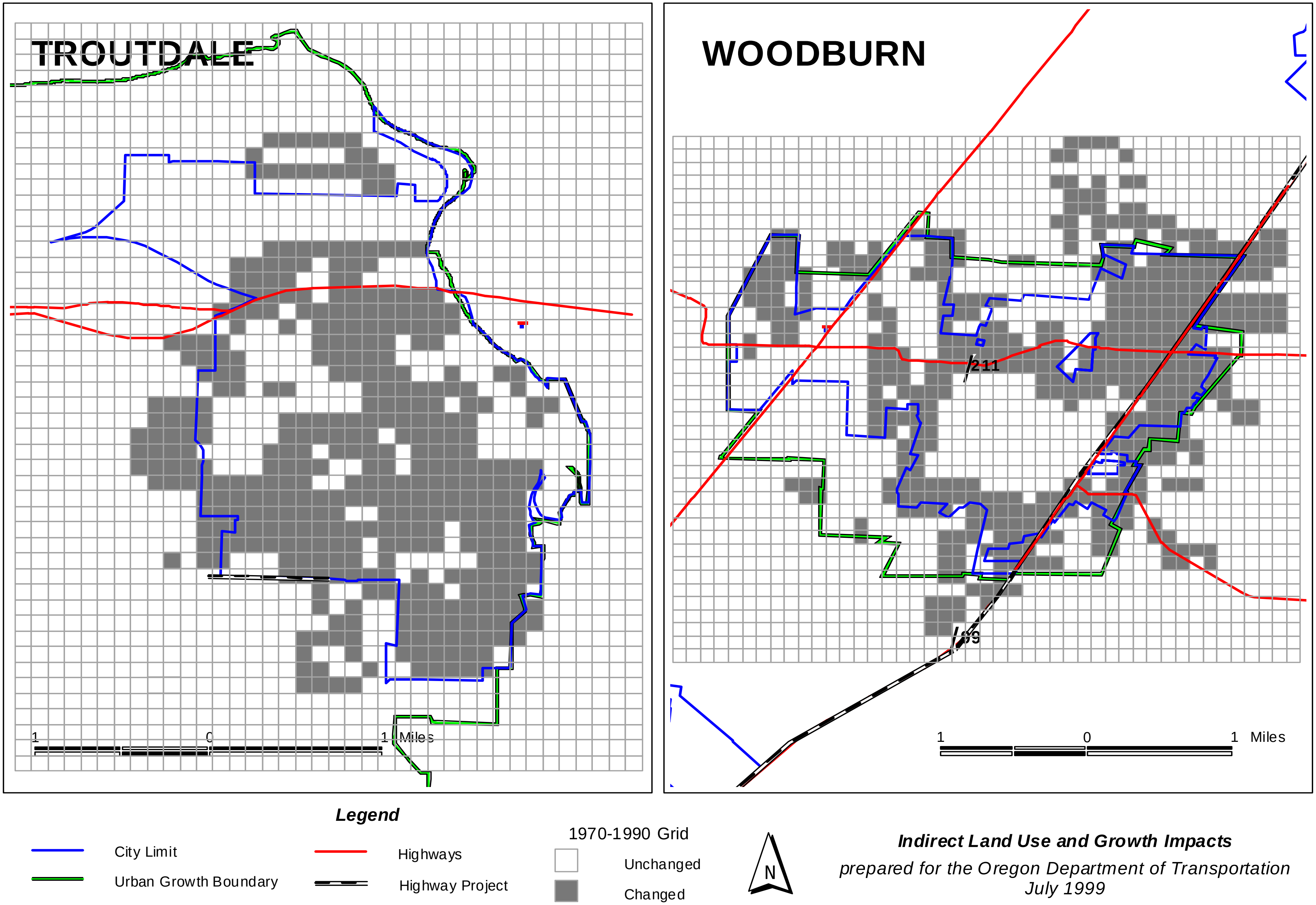
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City Limit
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Highways
Highway Project
1970-1990 Grid
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Indirect Land Use and Growth Impacts
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LIST OF HIGHWAY PROJECTS

Albany

Highway 99E (Queen Ave to Tangent Drive). Widen 5.5 miles from 2 lanes to 4 lanes with CLTL between I-5 and Corvallis. Construction completed 1988.

Lake Creek to I-5. Widen Highway 34 from 2 to 4 lanes outside UGB between I-5 and Corvallis. EIS 1984. Construction completed 1990.

Waverly Drive between Route 99E and U.S. 20 Road widening, improvement. EIS 1979. Estimated completion 1985.

Aumsville

None

Bend

Murphy Road to Lava Butte. Widen 9 miles of Highway 97 from 2 to 4 lanes with CLTL south of Bend UGB. EIS 1986. Construction completed 1989.

Highway 97 Bend SCL to Murphy Road 2 to 4 lanes with CLTL. FEIS 1977. Estimated completion 1985.

Highway 97 Bend to Redmond Section 10 miles 2 to 4 lanes with CLTL EIS 1986. Estimated completion 1990.

Greenwood Ave. Reconstruct .13 miles of Greenwood Ave. between Hill St. and First St. Elevation Lowered to provide clearance under railroad structure and Division St. to improve capacity of both Green wood Ave. and Division St. EIS 1981. Construction completed 1984.

Route 46 Oregon Forest Highway, Cascade Lakes Highway, beginning at Bachelor Butte in Deschutes County and extending west and southerly approximately 11.2 miles following the existing Cascade Highway to Elk Lake. Widen existing highway. EIS 1974. Estimated completion 1985.

Division St. improvement from Greenwood north to Deschutes Pl. to relieve congestion on Hwy 97. EIS 1981. Estimated completion 1985.

Rt. 20 Central Oregon Highway. East city limits extending 2.37 miles east. Realignment, increase lane and shoulder width. EIS 1971. Estimated completion 1980.

Canby

None

Central Point

None

Columbia City

U.S. 30 North of Columbia City to Bennett Rd. 6.96 miles, 2 to 5 lanes. EIS 1989. Estimated completion 1990.

Corvallis

Highway 34 (Lake Creek to I-5). Widen Highway 34 from 2 lanes to 4 lanes with CLTL between I-5 and Corvallis. EIS 1984. Construction completed 1990.

Corvallis Bypass. New alignment connecting Highway 34 to 99W on east side of Corvallis. EIS 1978. Construction completed 1989.

N.W. Circle Blvd, from N.W. Lantana Drive to N.W. Witham Hill Drive. New link, arterial, 2 lanes, 0.35 miles. EIS 1980. Estimated completion 1985.

Dallas

Rickreall to Independence Section toward Dallas. Widen Highway 22 5.3 miles to 4 lanes with CLTL. EIS 1971. Estimated completion 1980.

Florence

Highway 101 (Sutton Lake to NCL Florence). Widen 5.44 miles - 5 lanes between 37th and 10th in Florence, 3 lanes for the rest. EIS 1979. Construction completed in 1989.

Grants Pass

Highway 238 (Grants Pass to New Hope Road). Widen 1.5 miles from two lanes to four lanes with CLTL outside the urban area near the Redwood Highway Interchange. Construction completed 1975.

Third river crossing facility through urban area to serve both through traffic bound for I-5 to the north and highway 199 to the south and local traffic in the Grants Pass urban area. DEIS 1978. Estimated completion 1985.

Hillsboro

East Main Street to Hillsboro ECL; Cornell Road. Widen 2.4 miles from 2 lane to a 4 lane with a CLTL. (Connects to a state highway in developing area) FEIS 1982. Construction completed in 1985.

Hillsboro ECL to NW 185th. FEIS 1986. Estimated completion 1990.

Cornell Road from 242nd to Elam Young Parkway (west end). Widened to 4 lanes with continuous left-turn lane. Construction completed 1978.

Cornell from 242nd (Shute) to Cornelius Pass. Widened to 4 lanes with continuous left-turn lane. Construction completed 1988.

Cornell from 188th to 185th. Widened to 4 lanes with continuous left-turn lane. Construction completed 1989.

Cornell from Arrington to 34th. Widened to 4 lanes with continuous left-turn lane. Construction completed 1985.

Cornelius Pass/Highway 26 interchange - Northbound Cornelius Pass to eastbound Hwy. 26 on-ramp, and various signals. Construction completed 1987.

Klamath Falls

Highway 97 (Greensprings to Midland Junction). 2 to 4 lanes. Replace structures over Klamath River and railroad. Construction completed 1990.

Klamath Falls South Side Bypass south of urban area linking Highway 97 with highway 140. Segment 1. Linking Hwy 97 to Washburn Way and Johns Way. Two 12' lanes shoulder, 2.6 miles controlled access. Segment 2. Washburn Way to Highway 39. EIS 1978. Estimated completion 1985.

Lincoln City

Highway 101 and Logan Rd. intersection redesign. Additional travel lanes and signal. EIS 1984. Estimated completion 1990.

Madras

Replacement of "C" Street bridge across Willow Creek. Replace 17 foot wide bridge with 54 foot wide bridge. EIS 1974. Estimated completion 1985.

McMinnville

East McMinnville Interchange to Airport Road. Salmon River Highway Route 18. Widen 2.2 miles from 2 to 4 lanes with CLTL (Extended south of UGB) EIS 1984. Construction completed in 1984.

North Plains

Glencoe Rd and West Union Rd. realignment, replace rail crossing and bridge over McKay Creek. Estimated completion 1990.

Redmond

Highway 97 widen highway from 2 lanes to 4 lanes. Project extends north from one-way couplet to 0.1 miles north of O'Neil Junction where it ties into previously improved section of Hwy. 97 (2.07 miles). EIS 1986. Estimated completion 1990.

Sherwood

Tualatin- Sherwood Road/Eddy Road from I5 to Highway 99. Tualatin-Sherwood Road from Boons Ferry Road to Tenton Avenue, 3 to 5 lanes. Tenton Avenue to Highway 99, 2 to3 lanes. Estimated completion 1990.

Troutdale

SE Stark Street from 242nd Ave to 700' east of 257th Drive. Widen from 3 to 5 lanes. Estimated completion 1990.

Woodburn

Highway 99. Widen and improve highway from north city limits to south city limits (2.19 miles). Estimated completion 1990.

APPENDIX D

CASE STUDY SUMMARY

Indirect Land Use and Growth Impacts

CASE STUDY SUMMARY

This case study summary report is part of a larger study sponsored by the Oregon Department of Transportation (ODOT) to help it assess the land use impacts of future highway projects. Major highway improvement projects that ODOT undertakes require environmental analysis[3], which in turn require an assessment of the improvements on land use.[4] The study consists of three research components and a guidebook. The three research components are:

- *Literature Review.* Review of state and national studies to summarize empirical estimates of the relationship between highway and land use change, especially at the urban fringe. (Appendix B)

- *20-Site Analysis.* Analysis of historical aerial photographs and highway maps to show the association between highway improvements and land use changes over 20 years in 20 Oregon cities. (Appendix C)

- *Case Study Analysis.* More detailed analysis of highway projects and land use changes in six Oregon cities.

The case studies evaluate the impacts of major improvements to state highways at the urban fringe [primarily inside, secondarily outside, urban growth boundaries (UGBs)]. Six case studies were completed for this project: five for highway widenings (Albany, Bend, Corvallis, Island City/La Grande, and McMinnville) and one which was partially a widening project and partially construction of a new alignment (Grants Pass). Copies of individual case study reports of the detailed analysis for each case study are available from the ODOT Research Group.

Figure D.1 shows how the elements of this study fit together to address the study objectives.

PURPOSE OF THIS REPORT

There are many questions about the relationship between transportation improvements and land use change that ODOT or other transportation agencies might want answered. It is important to be clear about which ones this study addressed. The purpose of this report is to summarize the results of six case studies that researched whether there is any evidence that ODOT projects completed after 1985 caused land uses to change from what adopted plans at that time envisioned and apparently desired. That question is relatively narrow and ignores a number of broader questions that were outside of the scope of the case study research.

[3] Depending on the scale of the project, ODOT might prepare an Environmental Impact Statement (EIS) or an Environmental Assessment (EA). Larger projects generally require a more detailed EIS

[4] In addition, of course, to other environmental and socioeconomic impacts.

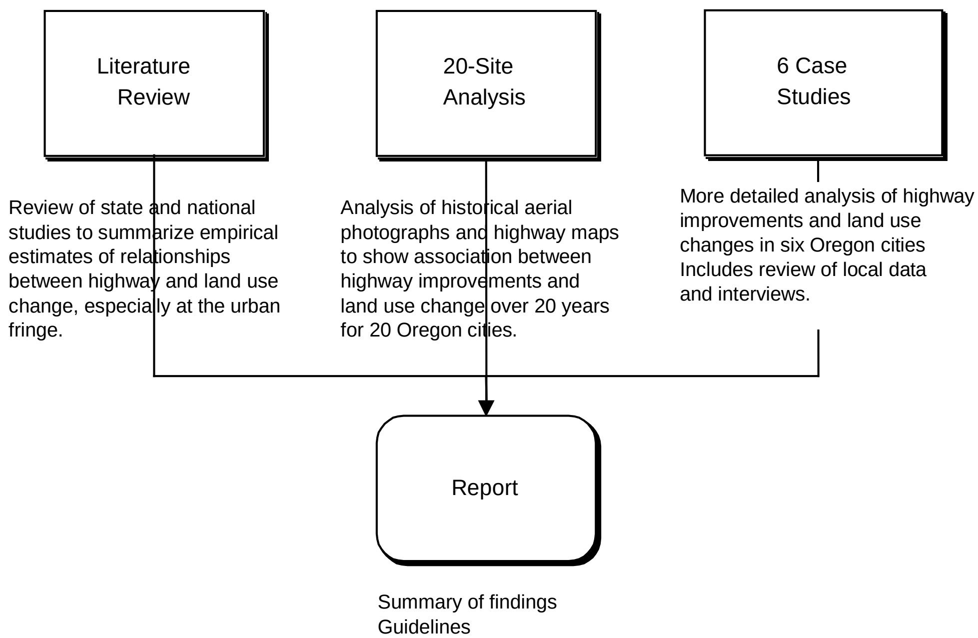

Figure D.1: Structure of the Research

Two general questions that were *not* the focus of the case studies but help establish context:

- Is there any evidence that highway projects in the United States, anywhere at any time, have had impacts on land use? The professional literature clearly answers "yes."
- Is there any evidence that that highway projects in Oregon, anywhere at any time, have had impacts on land use? Observation indicates the answer to this question is also "yes."

The fact that at some time in the past, in some places, for some type and scale of projects, highways have had impacts on land use, does not provide a basis for assessing the extent of the effects of a specific project. Today's transportation projects are usually small improvements to part of a large and ubiquitous network of highways and streets. Fifty (or even 30) years ago one could find new highways (e.g., the interstate system) that vastly increased access to large areas of land. Today, large projects opening up new areas to development are rare. Projects are typically improvements to existing paved highways; improvements that are usually less than a couple of miles long, providing marginal improvements in safety and travel time, and no new access.

The two preceding questions contrast with the ones that follow, which focus on the case study projects which occurred after 1985. The contrast is critical for at least two reasons: (1) most of the urban areas and highways in Oregon were well established by 1985; interstates and state highways had been completed – any single highway project would have had a proportionately smaller effect on travel, congestion, and land use; and (2) local land use plans based on statewide goals were all in place as of 1985; the desired/predicted pattern of growth through the year 2000 (what we see today) may have already been on the comprehensive plan and/or zoning map in 1985. Thus, three more specific questions were posed for the case study analysis; only the first one (in bold) was addressed by the research:

- **Is there any evidence that ODOT projects completed after 1985 caused land uses to change from what adopted plans at that time envisioned?** This question was the focus of the study. The ODOT Environmental Services Section is responsible for the preparation of Environmental Assessments (EAs) and Environmental Impact Statements (EISs), which must include an analysis of land use impacts, and more specifically, indirect land use impacts.[5] The analysis of indirect (secondary) impacts is often framed this way. It is particularly important in Oregon, where state land use law requires state transportation improvements to be identified in local land use plans. If the improvements are likely to facilitate land use change different from what the plan envisions, then either the improvement or the plan must be changed.[6]

  A related question is whether ODOT projects completed after 1985 caused development to occur <u>faster</u> than they would have without the project or faster than planned rates.

- Is there any evidence that prior ODOT highway investments influenced the land use plans that were adopted in the 1970s and 1980s in response to state mandates? While interesting, this question is outside the scope of the case study analysis. When adopting and updating their land use plans, local governments certainly look at where roads are and where they are able and likely to go. In that sense, the prior and expected investments of ODOT influenced the *plan* for future land development. If the plan then influenced development, as Oregon law says it should and most planners believe it does, then the logical inference is that land use in Oregon today would be different if ODOT and local governments had made different highway investments. This conclusion is not much help to planners who need to describe the impacts of improvements to existing highways.

- Is there any evidence that ODOT's recent and new highway improvements allow (and are a necessary condition for at least some of) the development envisioned in local land use plans? While this question is not the focus of the case studies, some data and analysis on this topic is included.

As described above, a *marginal* analysis was conducted to evaluate how land use changes associated with a highway improvement are different from changes that would otherwise occur, given the rest of the transportation network and the public sector expectations and desires for land use development as embodied in their required comprehensive plans.

METHODS

As with most policy research, the intent of this case study is to be able to isolate the impacts (the effects) that are uniquely attributable to a change in public policy. Figure D.2 illustrates the

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[5] See Guidebook for more discussion on National Environmental Policy Act (NEPA) and Council on Environmental Quality (CEQ) requirements for environmental analysis.

[6] For example, this question was the one of concern on the Sunrise Corridor EIS (Clackamas County) about 10 years ago: if ODOT were to widen Highway 212 or build a new alignment for it, should it expect growth beyond what plans envisioned; should it expect local governments to change their plans, in particular, to change agriculturally zoned and urban reserve land to more intensive uses? And would anticipated growth occur faster with the improvement than it would otherwise?

concept. The shaded box represents a world that does not exist but one that an analyst must somehow describe. It is a world that *would have* existed but for the introduction of the new policy. As it relates to the case studies, the highway improvement was the policy. The case studies document, to the extent the data allow, what happened after that policy (box on bottom right). Describing what *would have happened* without the improvement (the shaded box) is more speculative. As applied to the case studies, the method does not formally define a hypothetical world and compare it to an actual one. Rather, it relies on expert opinion about the contribution of the project to the changes observed between "Existing Conditions" (at the time the EIS or EA was completed) and the "Actual World" (2000). The methods we used were consistent with a case study approach, which is an *ex post* evaluation of indirect land use effects.

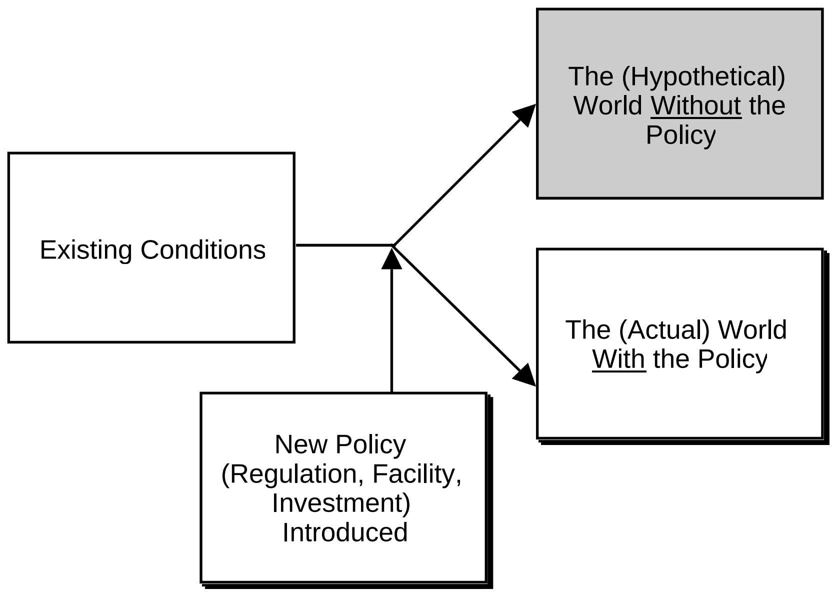

Figure D.2: Case Study Method, in Concept

The Council on Environmental Quality (CEQ) regulations describe requirements of the National Environmental Policy Act (NEPA). The CEQ defines indirect land use effects as follows:

> Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.[7]

The methods used for the case studies were both quantitative and qualitative. Sources for the description of existing conditions before the highway improvement include:

- EISs or EAs for the case study project;

[7] 3; 40 CFR 1508.8

- Local Comprehensive Plans and zoning ordinances;
- Transportation system plans;
- Interviews with city/county staff and other knowledgeable persons; and
- Other planning-related documents.

The case study methods used the following sources to describe changes in land use:

- County property tax assessment data to identify the location, timing and value of residential development;
- Building permit and development data;
- Maps showing city limits, urban growth boundaries (UGBs), and zoning/land use designations at various times; and
- Planning documents that show changes in land use and public policy.

Each case study included a focus group to assist with a qualitative assessment of changes associated with the transportation project. The focus groups generally consisted of city staff, county staff, ODOT staff, and local developers or realtors. The purpose of the focus group session was to get comments on the preliminary conclusions made from review of secondary data sources, and to gain insights into the public policy decisions and market factors that contributed to the observed development patterns. Table D.1 summarizes the projects analyzed in the case studies.

Table D.1: Summary of Case Study Projects

CITY	DATES	TYPE OF PROJECT	DESCRIPTION
Albany	Draft EIS–1983 Final EIS–1985 Project completion– Phase I: 1988 Phase II: 1994	Widening	Widening of OR Highway 99E (Albany–Junction City Highway) from Queen Avenue on the north to OR Highway 34 (at Tangent) to the south. The project improved a 5.5 mile section from two to four lanes, with a continuous left-turn median.
Bend	EA–1987 Project completion–1991	Widening	Widening from two to four lanes of a 2.2 mile stretch of US Highway 97 (The Dalles-California Highway) from milepost 132.6 on the North (about 0.5 miles north of the Smalley Road/US 97 intersection) to the Highway 97/Highway 20 connection at milepost 134.8. The project was called the Bend-Redmond South Unit.
Corvallis	EA–1985 Project completion–1992	Widening	Widening of a 2.2 mile section of OR Highway 99W (Pacific Highway West) from the Mary’s River on the north to Kiger Island Drive on the south (this stretch is also known as South Third Street).
Grants Pass	Draft EIS–1978 Final EIS–1979 Project completion–1991	Widening/new alignment for third Rogue River bridge	Construction of a third Rogue River crossing in the Grants Pass area. The project is a 2.1 mile section of highway known as the Grants Pass Parkway.

CITY	DATES	TYPE OF PROJECT	DESCRIPTION
Island City/ La Grande	EA–1986 Revised EA–1987 Project completion–1992	Widening	Widening a 1.42 mile section of OR Highway 82 (Wallowa Lake Highway) from approximately 1/4 mile east of the I-84 interchange (M.P. 1.20) to the Grande Ronde River bridge at the northern city limits of Island City (M.P. 2.62). The project widened an existing two-lane highway to five lanes from the beginning of the project to the intersection with the Cove Highway (Hwy. 237) in Island City, and to a three-lane roadway from that point to the Grande Ronde bridge.
McMinnville	EIS–1985 Project completion–1993	Widening	Widening of OR Highway 18 (Salmon River Highway) from the East McMinnville Interchange on the west to Airport Road on the east (this stretch is also known as Three Mile Lane). The project improved a 2.2 mile section from two to four lanes, with a continuous left-turn median.

Source: Case Study Reports, ECONorthwest, 2000

General Patterns and Trends from the Six Case Studies

There are only six case studies, so any generalizations have to be made cautiously. But the small sample is remarkably similar on a few key points.

- **All the case studies illustrate that the development that occurred after the highway improvement was generally consistent with the development envisioned in local plans before the improvement.** In other words, the highway improvements, at most, facilitated making the expectations or hopes about future development a reality.

  The one exception to this finding is that the Wal-Mart built in Island City required several infrastructure improvements not identified in local plans, or not included in capital improvement programs. While the site adjacent to Highway 82 was designated for commercial uses, the plan did not anticipate a development of this magnitude. The cities of La Grande and Island City partnered with Union County and ODOT to make needed transportation and infrastructure improvements.

- **All the case studies illustrate that interactive, iterative, and incremental nature of most urban development.** The plan says what kind of development is wanted or acceptable; the highway improvement facilitates that development. But the plan may be what it is in response to past highway improvements, and future plans may change in response to the way that current plan gets implemented. The case studies all paint a picture of incremental and iterative decisions: small changes in land use plans and highway improvements, each responding to previous changes in land use and transportation.

  In all of the case studies, the land use pattern in the study area was established prior to the highway improvements. Moreover, all of the jurisdictions had plans or policies that recognized and supported the case study highway improvements.

- **The case studies support the hypothesis that the scale of land use change will correlate with the scale of the improvement to accessibility.** Where access already existed (as in all of the case studies), widenings did not cause any obvious changes in the type of development.

  None of the highway improvements could be directly correlated with annexations or UGB expansions. Moreover, with two exceptions (in Bend and Island City), no zone or plan designation changes occurred in the study areas.[8]

  In two of the case studies, however, evidence was found that suggest that the improvements may have influenced the rate of development. In Bend and Corvallis we found increased rates of development in the study areas after the improvements were completed. It appears, however, that a strong economy and other site specific factors (availability of infrastructure, visibility) were significant factors in the rate of growth. In other words, we were unable to attribute the increased rates of growth directly or completely to the highway improvements.[9]

Other important findings from the case studies include:

- **Good accessibility is a necessary but not sufficient condition for local development.** Some of the case studies illustrate what is common knowledge among planners and developers: the amount development responds to the availability of other key public facilities (especially water and sewer) and their costs (including how such facilities will be funded and who will pay for them).

  This was particularly important in Albany and Island City. In Albany, the lack of sewer and water capacity south of Oak Creek was a major limiting factor on development. In Island City, the four jurisdictions (LaGrande, Island City, Union County, and ODOT) worked together to develop infrastructure needed to accommodate the Wal-Mart store.

- **In all of the case studies, development of all types was dispersed throughout the communities.** Those development patterns were also envisioned by local comprehensive plans.

  While some of the study areas contained the majority of commercial or industrial land, in all of the case studies all types of development were dispersed among the appropriate zones.

[8] One plan designation change from light industrial to commercial occurred within the Bend study area. This land use change was consistent with the development pattern of the area. In Island City, a plan designation change from residential to commercial was made to facilitate development of the Wal-Mart store.

[9] Another issue in assessing indirect impacts is the time period for analysis as it relates to when project construction began and was completed. All of the case study projects were completed between 1988 and 1993. It may be possible that indirect impacts would be more noticeable if evaluated over a longer period of time than was covered by the case studies. For example, growth that is more rapid than anticipated may contribute to pressures to annex adjacent land, expand urban growth boundaries, and/or rezone to more intensive land uses. The time period for when the effects of this become noticeable may be longer than the periods evaluated in the case studies.

- **All of the case study highway improvements were completed in the late 1980s or early 1990s, mostly before Oregon's economic boom in the 1990s.** All of the case study communities had higher growth rates in the 1990s than in the 1980s. Thus, while substantial development occurred after the highway improvements, the growth cannot be solely attributed to the influence of the improvements.

- **As implemented by counties, state policies that restrict development of resource lands have been effective in limiting development associated with highway improvements outside UGBs.** The case studies did not identify any major new developments outside UGBs.

Finally, a few words of advice with respect to the study objective to create information that ODOT could use when assessing the potential indirect impacts of proposed highway improvements on land use. One caution is the potential for confusion caused by saying that a highway project "creates or causes changes in land use." As noted before, development will likely occur in areas now served by ODOT highways whether ODOT improves those highways or not. Plans allow and even desire those changes inside city limits and UGBs; other public policies sometimes provide incentives for that growth. Even without the encouragement, market demand could encourage land use change. So the fact that change occurs, by itself, is not evidence that new ODOT improvements significantly contributed to that change.[10]

Thus, “change in land use” must be about some notion of how future land use will be different from what it would have been without the highway improvement. But as the case studies show, ODOT projects were consistent with local plans for development.

A term commonly found in EISs and EAs is that highway improvements may “create pressure for land use change.” The bigger the improvement, access benefits, and travel-time savings, the greater the pressure. But when does the pressure become an impact? Apparently, when a comprehensive plan is changed to allow different (probably more intensive) development than the plan previously allowed. Still, pressure is hard to measure. The case studies did not find a lot of petitions for changing plan designations or rezoning. While several annexations and UGB expansions were found in the study areas of the case study cities, it was difficult to directly attribute those actions to the highway improvements. The presence or absence of adequate water and sewer infrastructure, however, played a significant role in whether development occurred in the case study areas.

Moreover, the “pressure” is not that important in and of itself: what matters is whether plans or boundaries are actually changed in response to that pressure. The evidence from the case studies (with the exception of Island City, and the possible exception of Bend) is that they were not. Particularly important is that we found no evidence outside of UGBs of land development that was not allowed by existing plans. Finally, there is the question of whether any change that does occur is, by definition, undesirable. Local plans change frequently; planners and citizens making those changes often believe they are making things better. Plan changes to allow more intense

[10] Not addressed in this report is a larger question of whether ODOT improvements made 20 to 50 years ago and more affected land use. They certainly did, but their big effect was a result of the substantial travel time savings that new, paved roads and limited access highways afforded.

development in areas where public investments have provided facilities to accommodate it may make sense. Growth that occurs sooner or more intensively than forecast, however, may make lead to premature obsolescence of highway improvements.

These six case studies support the conclusion that highway widening projects, by themselves, are not likely to cause changes in land use from what they would have been in the absence of those improvements. The highway improvements may contribute to such changes in land use, but it is difficult to determine the extent of their influence. Local governments have ample tools to plan and control land use changes with or without highway improvements. The market will respond to the available accessibility. Given sufficient market demand and reasonable land prices, development will occur if public services like sewer and water, and some minimal level of access (i.e., there is a paved road to a site with a curb cut) are available. Highway widenings are unlikely to change what gets developed, but will likely to facilitate whatever development is already allowed. That is not to say that plan designations or zoning will not change in a corridor where a widening has occurred, but based on the six case studies, highway widenings are neither a necessary or sufficient condition to predict whether such policy changes will occur.

The case studies *did* show that land use changes generally were consistent with zoning and comprehensive plan designations. It could not be determined if the growth occurred slower, faster, or at the same rate as envisioned in plans, because few comprehensive land use plans get to that level of specificity. The evidence could be interpreted to suggest that in Island City and Corvallis (and maybe some of the other jurisdictions), growth occurred faster with the projects than it would have without the projects. For example, OR 82 (Island City) and OR 99W (Corvallis) traffic volume increases (which occurred faster than forecast in the environmental documentation), annexations, and/or UGB expansions *may* suggest changes that were greater or faster than expected.

Accepted economic theory for land use and transportation is clear that travel time changes are an impetus for land uses, i.e., the greater the travel time savings, the greater the accessibility, and the greater the propensity for land use changes. Unfortunately, such an evaluation implies analysis of the larger regional context, further complicating the analysis. The changes in a particular corridor may be relatively minor but the increases in congestion on other routes may be so pronounced that minor travel time improvements or even maintaining travel time may result in large changes in regional accessibility for the particular highway improvement. The environmental documentation of the case study projects was generally insufficient to make such determinations.

The evidence from the case studies shows that small ODOT projects will generally have minimal, if any, effects on land use that can be measured and uniquely attributed to those projects.

Each of the six case studies is reported in a separate document, recording the extensive analysis completed as part of this research. These reports were written to stand alone as well as to support the development of the Guidebook for Evaluating Indirect Land Use and Growth Impacts of Highway Improvements. The key findings for each case study are summarized below. Copies of the full reports for each case study are available from the ODOT Research Group.

SUMMARY FINDINGS FOR EACH CASE STUDY CITY

ALBANY

The Albany case study evaluated the land use impacts of improvements to a section of Oregon Highway 99E (the Albany-Junction City Highway) from Queen Avenue on the north to Oregon Highway 34 (at Tangent) to the south. The project improved an 8.85 km (5.5 mi) section from two to four lanes, with a continuous left-turn median.

The Draft Environmental Impact Statement (DEIS) was completed in 1983, and the Final EIS in 1985. The project was built in two phases. Phase I, completed in 1988, included improvements from Queen Avenue to Linn-Benton Community College (LBCC). Phase II was completed in 1994 and included improvements south of LBCC to the 99E/34 intersection. According to the Draft Environmental Impact Statement, the purpose of the project was to accommodate increases in traffic and provide greater highway safety. The DEIS explains that the need for the project resulted from commercial and residential development, as well as rapid growth of LBCC.

FINDINGS

It is easy to conclude that ODOT's improvement of Highway 99E did not cause substantial land use changes in Albany, because one can observe that little land use change occurred. Since 1988, growth in Albany has been distributed throughout the City; it has not concentrated along Highway 99.

The research found several reasons for the development patterns observed:

- Planning and public policy encouraged growth not only in the study area, but in other parts of Albany as well. On that basis alone, one should expect land use changes in the study area even in the absence of an ODOT improvement.
- The improvement to Highway 99 did not create new access: it improved safety, convenience, and travel by alternative modes, and kept congestion from increasing as quickly as it would have otherwise. Its impacts on existing travel times were probably small.
- Economic conditions had a profound impact on the area. Little development occurred on vacant commercial and industrial property during the recession of the early 1980s. Moreover, much of the existing commercial and industrial space became vacant. The reabsorption of that space during the 1990s decreased demand for new construction.
- Land must be available at market prices for development to occur. Focus group participants pointed out several key sites they felt would have developed had the owners made them available.
- The availability and cost of water and sewer infrastructure was a limiting factor for sites south of Oak Creek. Albany policies would require looping of the water system for any major development south of Oak Creek. It is difficult for any one development to absorb the costs of extending services across the Oak Creek flood plain.

BEND

The Bend case study evaluated the land use impacts of improvements to a section of US Highway 97 (the Dalles-California Highway) from milepost 132.6 on the North (about 0.8 km or 0.5 miles north of the Smalley Road/US 97 intersection) to the Highway 97/Highway 20 connection at milepost 134.8. Parts of the improvement were inside, and parts outside, the Bend urban growth boundary at the time of project construction. The project was called the Bend-Redmond South Unit. The project improved a 3.5 km (2.2 mi) section from two to four lanes.

A full Environmental Impact Statement (EIS) was not completed for the Bend-Redmond South Project. ODOT completed an Environmental Assessment (EA) for the project in 1987. Construction was completed in 1991. According to the EA, the purpose of the project was to increase the capacity and level of service of the facility and to improve safety along this stretch of Highway 97. The EA explained that the need for the project resulted from operational problems due to heavy traffic volumes.

FINDINGS

The evidence is mixed that ODOT's improvement of Highway 97 induced land use changes in Bend, and more specifically, in the Highway 97 corridor. Development has certainly occurred in the corridor but (1) it has not accounted for a large amount of growth relative to the rest of Bend, and (2) it has been generally consistent with the types of development plans and policies called for.

While a commercial development pattern had begun to emerge on the east side of Highway 97 prior to completion of the EA, the redesignation of lands slated for light industrial use to highway commercial use was consistent with the commercial land use pattern in the area. City planning staff suggested that the plan designation change was a “housekeeping” matter to get the plan designation consistent with existing uses. Focus group participants suggested that commercial use was the “highest and best” use of the land, and that the initial plan designation should have been commercial. Moreover, a considerable amount of vacant land exists east of the highway. Many factors affect the functionality of land in the corridor, including highway capacity, access, and visibility. But without the improvement level of service would have been lower and congestion greater. Commercial property in the project area may have developed sooner with the highway improvement than it otherwise would have.[11]

The research found several reasons for the development patterns observed:

- Planning and public policy allowed growth not only in the study area, but in other parts of Bend as well.
- The improvement to Highway 97 did not create new access: it improved safety, convenience, and travel by alternative modes (bicycle lanes were part of the project), and kept congestion

[11] Note that this statement does not comment on whether such changes were desirable or not. The improvement may have contributed to change that was suitable for Bend as a growing urban area with an economy strongly influenced by second homes, recreation, and tourism.

from increasing as quickly as it would have otherwise. Reductions in travel times have probably been small for the majority of days, but may have been significant for many periods during the more congested summer months.

- Economic conditions and population growth impacted the rate of development in the corridor. Rapid population growth, coupled with a strong economy made Bend attractive to large discount retailers. Some of those retailers chose to locate in areas designated for commercial use in the project corridor.
- According to focus group participants, few large sites designated for commercial use existed in Bend outside the project area. The only other suitable sites were in the southern portions of Bend along the Highway 97 corridor. Sites in the study area had better access and visibility than many other sites, providing them with a comparative advantage to commercial sites in other areas of Bend.
- In 1998, Bend expanded its city limit to the entire extent of its UGB. The annexation was due to rapid population increases, an expected doubling of population by 2015, and the City's desire to have more oversight over land use decisions in the UGB.
- Field observation and conversations with Deschutes County Planning staff indicate that little development has occurred in the project corridor outside the Bend UGB since 1987. This is consistent with the agricultural zoning that existed in the area in 1987 and still exists.

GRANTS PASS

The Grants Pass case study evaluated the land use impacts of the construction of a third Rogue River crossing in the Grants Pass area. The project is a 3.4 km (2.1 mi) section of highway known as the Grants Pass Parkway. The Parkway provides a southeast bypass of downtown Grants Pass for traffic travelling between Interstate 5 and Highways 199 (Redwood Highway), 99 (Rogue River Highway), and 238 (Jacksonville/Williams Highway).

The Draft Environmental Impact Statement (DEIS) was completed in 1978, and the Final Environmental Impact Statement (FEIS) in 1979. The project construction began in 1989 and was completed in 1991.

FINDINGS

On the one hand, ODOT's construction of the Grants Pass Parkway has not caused substantial land use changes in Grants Pass, in the sense the City has planned for the development patterns that exist in the study area since the possibility of a third bridge was initially identified in 1961. On the other hand, some of the development envisioned by the City's plan may not have occurred at the same rate and may have been a different mix, if the improvement had not been made.

Commercial development along the Redwood Spur in the study area has been strong; a land use trend that had begun before the FEIS was issued. Industrial development in the study area has not been as extensive as expected despite public expenditures in infrastructure and roads specifically aimed at attracting this type of development.

The research found several reasons for the development patterns observed:

- Planning and public policy have consistently supported the development patterns and type of development that occurred in the study area. Moreover, the City adopted land use ordinances and provided economic development incentives for development to follow patterns established prior to issuance of the FEIS in 1979.
- Economic conditions (such as overall decline of manufacturing in the Oregon economy as a percentage of total employment) and the price of industrially-zoned land in the study area compared to that in nearby communities (such as Merlin) may have affected industrial development in the Riverside Industrial Area.
- Increased traffic volumes along the Redwood Spur portion of the Parkway may have enhanced its attractiveness to commercial development. Commercial development, however, is partially responsible for the increased traffic volumes. If the project had not been built, persons living south of the Rogue River may have been less willing to cross the river to shop along the Redwood Spur. Moreover, according to focus group participants, the types of commercial development found along the Redwood Spur may have been duplicated south of the Rogue River without the Parkway. This last point raises the interesting possibility rarely talked about in the debate about the impact of transportation improvements on land use: if growth gravitates to where improvements are made, then highway improvements in one area may have effects on land use in areas that are competing locations for that development.

MCMINNVILLE

The McMinnville case study evaluated the land use impacts of improvements to a section of Oregon Highway 18 (the Salmon River Highway) from the East McMinnville Interchange on the west to Airport Road on the east (this stretch is also known as Three Mile Lane). The project improved a 3.5 km (2.2 mi) section from two to four lanes, with a continuous left-turn median.

The EIS for the project was completed in 1985. Construction was initiated in 1991 and completed in 1993. According to the Draft Environmental Impact Statement, the purpose of the project was to accommodate increases in traffic and provide greater highway safety.

FINDINGS

It is easy to conclude that ODOT's expansion of Three-Mile Lane has not caused substantial land use changes in the study area or McMinnville because one can observe that little land use change occurred. Prior to the highway widening, the study area was located within the City's UGB and contained a mix of residential, commercial, industrial, institutional and agricultural activities and designations. No changes to the city limit or UGB in the study area have occurred since the highway improvement.

Non-residential development in the study area began to pick up in 1994 with the construction of the Tanger Outlet Center. Several business establishments settled in the study area within several years of Tanger: McDonalds, the Willamette Valley Medical Center, Sun Retirement Assisted Living Home and Vineyard Inn Suites. Although the PUD overlay was designed to deter "strip" development, the Tanger Outlet Center and the McDonalds can be considered to be this style. Meanwhile, with the exception of the hospital[12], relatively little industrial development in the study area has occurred.

The research found several reasons for the development patterns observed:

- Since 1981, planning and public policy have consistently supported the development patterns and type of development that occurred in the study area. The City designated a Planned Unit Development overlay affecting much of the study area. This PUD created conditions that were attractive to a number of businesses that have located along Three Mile Lane since 1994, primarily large lot sizes and flexible zoning provisions. In the case of the Willamette Valley Medical Center, the City modified its zoning laws to allow the hospital in a limited light industrial zone.
- The City of McMinnville does not heavily promote development of any type. Instead, the City developed land use and infrastructure policies for the area decades ago and lets the developers or businesses choose their locations based on these established conditions (rather than offer additional incentives, etc.).
- McMinnville residents and developers are not particularly attracted to Three Mile Lane for residential use. Residents continue to see Three Mile Lane as geographically and culturally separate from the City. The Three Mile Lane area juts out from the southeastern edge of the City and lies on the eastern side of the South Yamhill River, a river with high banks north of Three Mile Lane. The land is flat and still has an agricultural character with the exception of the airport to the east and commercial/institutional development near the western end of Three Mile Lane.
- Water and sewer services existed in the study area. Both services existed prior to the highway improvement.

ISLAND CITY

The Island City case study evaluated the land use impacts of improvements to a 2.3 km (1.42 mi) section of Oregon Highway 82 (the Wallowa Lake Highway) from approximately 0.4 km (¼-mi) east of the I-84 interchange (M.P. 1.20) to the Grande Ronde River bridge at the northern city limits of Island City (M.P. 2.62). The project widened an existing two-lane highway to five lanes from the beginning of the project (near the I-84 interchange) to the intersection with the Cove Highway (Hwy. 237) in downtown Island City, and to a three-lane roadway from that point to the Grande Ronde bridge. An at-grade railroad crossing was maintained and bicycle lanes were included on the shoulders of the roadway over the entire length of the project.

An Environmental Assessment (EA) for the Island City portion of the project was completed in 1986, and a Revised EA was issued in 1987. Project construction was completed in 1992.

[12] The hospital is institutional in nature and is located in a limited light industrial zone.

According to the EA, the purpose of the project was to provide a safer and more efficient highway by widening the existing two-lane facility to four travel lanes with a left turn median. Average daily traffic volume on the existing highway had exceeded design capacity and was approaching 10,000 average daily traffic (ADT) in 1984, with a Level of Service rating "D."

FINDINGS

While the data showed a significant increase in development activity after the completion of the highway project, there is evidence that ODOT's expansion of the Wallowa Lake Highway was not the only factor that affected the type or rate of development in the study area or in the La Grande/Island City urban area. The evidence in this case study suggests that the development pattern observed in the study area today would be substantially the same without the highway project. This conclusion is based on several findings from our research:

- All of the development activity that occurred in the study area is located within the Urban Growth Boundary of La Grande and Island City.
- Before the highway widening, Island Avenue was already developing into a commercial strip, with auto-oriented uses such as a shopping center, fast-food restaurants, and service stations from Adams Avenue east to the area around the I-84 interchange. La Grande's 1983 Comprehensive Plan acknowledged the strip development pattern between downtown La Grande and Island City.
- The existing strip development pattern on Island Avenue was primarily due to the I-84/Island Avenue interchange, high traffic levels on Island Avenue, and adjacent vacant land designated for commercial development. Island Avenue was the most likely location in the La Grande/Island City urban area for continued auto-oriented commercial development because the I-84/Island Avenue interchange is the only full-access interchange in the urban area, Island Avenue had higher traffic counts than other major arterials, and the availability of vacant land designated for commercial development. This mix of conditions did not exist anywhere else in the La Grande/Island City urban area.
- The most significant development in the study area was Wal-Mart. Focus group participants indicated that Wal-Mart's primary reason for locating along Island Avenue was their need for a large parcel, access, and visibility from I-84. No other sites in the La Grande/Island City urban area met these criteria, and all focus group participants speculated that Wal-Mart would have selected the site in the absence of the improvements to Island Avenue.
- The construction of Walton Road, the rezoning of surrounding land for commercial uses, and the extension of water and sewer services to the area allowed the development clustered around Wal-Mart. This development may be located to take advantage of the traffic and visibility generated by Wal-Mart, but there is no evidence that the highway widening was the sole factor, or even a major factor, in these businesses' location decision.
- Land use and public service plans did not explicitly foresee retail development at the scale of Wal-Mart and did not specifically include Walton Road or the extension of water and sewer service to the area. However, the area where Wal-Mart located was within

Island City's UGB. Focus group participants indicated that local jurisdictions recognized the long-term need for new roads to provide access to the area, and for extension of water and sewer service to serve future development in the area. Focus group participants indicated that Wal-Mart's decision to locate in the study area created the need for local jurisdictions to engage in more detailed planning for the surrounding area.

- According to the Environmental Assessment for the case study project, construction was expected to stimulate commercial development in the project area, but this would be a continuation of existing trends. Local land use controls, particularly local comprehensive plans, were cited as the "chief ingredient" in controlling or mitigating the potential for future land use and economic impacts as a result of the highway project.
- The public policies of La Grande and Island City encouraged commercial development in the study area, and both cities worked to facilitate the development of Wal-Mart in the study area. According to focus group participants, little resistance to the development was encountered in either community.
- The widening of Highway 82 was justified by deteriorating level of service and safety conditions on the existing roadway, and the expectation that these conditions would worsen over time with additional development in the study area. While the plans for this project did not explicitly foresee retail development on the scale of Wal-Mart, they did recognize that future development would occur in the study area that would create the need for additional roadway capacity to maintain an adequate level of service and to reduce accident rates.
- Focus group participants agreed that Wal-Mart would have located in its current location even if the highway widening had not occurred. However, without the highway project, Wal-Mart may have needed to make improvements to the highway, such as turn lanes, to mitigate traffic impacts. According to focus group participants, there is no evidence that, in the absence of the highway widening, increased traffic generated by Wal-Mart would have altered the development or prevented the development from locating near Island Avenue.[13]
- Increased traffic in the study area, whether from the highway widening or the development of Wal-Mart, may have spurred renovation and new business location in downtown Island City. However, this activity occurred in structures that were developed before completion of the highway project, so this activity did not alter the pattern of development in the study area.

CORVALLIS

The Corvallis case study evaluated the land use impacts of improvements to a 3.5 km (2.2 mi) section of Oregon Highway 99W (Pacific Highway West)[14] from the Mary's River on the north to Kiger Island Drive on the south (this stretch is also known as South Third Street). Highway 99W is a major north-south highway and connects Corvallis to Eugene to the south and Salem to

[13] Planning for the Wal-Mart development did not need to comply with the Transportation Planning Rule (TPR) because Island City has a population of less than 2,500.

[14] The original roadway was built in 1920.

the north. This section of highway serves as the southern entrance to Corvallis and is the only arterial serving this section of town known as South Corvallis. Highways 34 and 20 are the major east-west routes.

The initial form of the project was proposed in 1974 and consisted of four travel lanes with center left-turn lane between the end of the Third/Fourth Street couplet and what was then the south city limits just past Goodnight Avenue. Funding limitations and research indicating development needs caused the project scope to undergo several changes. After 1981, the project was extended further south to just past Kiger Island Drive to address the recent subdivisions and planned industrial uses inside the city's UGB.

A full Environmental Impact Statement (EIS) was not completed for the Mary's River to Kiger Island Drive Project. The Environmental Assessment (EA) for the South Third Street improvement was completed in 1985. Project construction began in 1990 and was completed in 1992. The EA had described a staged construction for funding purposes, but the actual project construction occurred as a whole.

According to the EA, the purpose of the project was to improve vehicle, pedestrian (particularly school children), and bicycle safety, improve levels of service, and improve the facility's appearance. At the time the EA was written (1985), numerous, small commercial establishments and residential neighborhoods along the highway generated traffic and turn movements, and industrial uses were designated near the south end of the project. Turning and rear-end collisions were the main type of accidents occurring, and the EA expected that as the project area developed, traffic volume would increase 50% by the year 2000.

FINDINGS

ODOT's expansion of South Third Street did not cause substantial land use changes in the study area or Corvallis. Prior to the highway widening, the study area was located within the City's UGB and contained a mix of residential, commercial, industrial, institutional, and agricultural activities and designations. The pre-existing development has been very stable with little business turnover or redevelopment. Residential development in the study area since 1985 has occurred in the areas originally designated to receive housing and has had assessed values consistently lower than the citywide median. Non-residential development in the study area since 1985 consisted of infill and some light industrial operations near the airport on land that has been designated for these uses since 1985. The South Corvallis Area Refinement Plan (1997) made minor adjustments to the land use designations in the study area by creating new classifications to be more restrictive with the type of nonresidential development desired and to allow mixed use development.

Although the study area has not seen substantial changes in land use type or designation since the EA was issued, it has seen a rise in the rate of both residential and nonresidential development, especially since the project was completed in 1992. About 90 dwelling units were built in the study area between 1992 and 1999. Some of the nonresidential development has occurred on industrial land that received utility service extensions in 1997 and some on land that received industrial park subdivision approval in 1998. Favorable economic conditions in 1990s as well as the availability of vacant residential land appear to have played a role in the increased rate of development. A local law requiring voter approval of annexations may help reduce or minimize the indirect effects as they relate to annexations and expansions of the UGB.

Without the project, it is likely that the study area would have more traffic congestion and higher accident rates, would be slightly less developed, especially with regard to the light industrial operations, and might not have received the same recommendations in the South Corvallis Area Refinement Plan.

Our research found several reasons for the development patterns we observed:

- Since 1984, planning and public policy have consistently supported the development patterns and type of development that occurred in the study area. These patterns were largely fixed by 1984 by the geographic nature of the study area (bound by two rivers and flat) and the pre-existing development that included mixed development in the northern portion of the study area, a rail line to the west, and the airport to the south. Parks, open space areas, and wetlands have restricted development in and transportation access to the study area. The location of the airport over one mile south of the city limits in 1984 and the inclusion of the airport in the Corvallis UGB created a large amount of vacant land within the South Corvallis urban fringe. This land included the majority (74%) of the Corvallis urban area's vacant industrial land. The Willamette River provided a natural eastern boundary for the UGB and thus land to allow extensions of existing residential neighborhoods.

  Compatibility issues between different land uses (such as between industries or the airport and residential) have strongly influenced City land use policies, and thus development in South Corvallis. As the study area developed, compatibility issues became more relevant and were addressed by the South Corvallis Area Refinement Plan (1997). The focus group participants believed that the annexations in the study area were approved by voters because the character, isolation, and geography (flat) of South Corvallis made the annexations less contentious (the voter annexation law may help to reduce or minimize the indirect effects as they relate to annexation and expansion of the UGB). The nature of the study area as a major entrance to the City has contributed to the City paying special attention to planning and public policy in the area.

  The character of South Corvallis matched the City's need for affordable housing, including lower-priced single family homes and apartment units. This type of residential development occurred in the study area.

- Current planning trends emphasize mixed use, multimodal development. Thus, the South Corvallis Area Refinement Plan (1997), funded by agencies supporting this philosophy, emphasized these design elements and led to zoning modifications in the study area.

- The Corvallis area economy went through a cycle with a recession in the early 1980s and growth in the 1990s, thus resulting in an increase in the rate of population growth and all types of development in the 1990s. According to the focus group participants, this economic expansion had a large influence over the rate of development (especially the light industrial) within the study area.

- A few property owners control the pace of large-scale development in South Corvallis. Thus, the rate of development of these properties depends on the property owners' personal interests and finances. The best example of this is the Rivergreen Estates residential developments from 1993 to 1998 by a single property owner.
- Drainage issues and lack of water and sewer lines may have limited industrial development in the study area. The focus group participants stated that the absence of site utilities prior to 1997 greatly inhibited industrial development in the study area. Once this was resolved, development began occurring on these lots.
- The widening of South Third Street and the construction of the Corvallis Bypass were generally seen as a positive by businesses and residents for reasons of accessibility, capacity, safety, and appearance. The project did not create new access. The improvements created a better transportation facility connecting the study area with the Corvallis central business district and Highway 34 which leads to Albany and Interstate 5 eleven miles to the east. Although the improvements addressed the most congested portion of South Third Street, a mile of Highway 99W between Kiger Island Drive and Airport Avenue remains a two-lane road. The focus group participants said that some businesses might not have located in the study area if these transportation improvements had not occurred, but that this effect was minor and one of many factors affecting development.

APPENDIX E

POPULATION AND EMPLOYMENT FORECASTING ISSUES

POPULATION AND EMPLOYMENT FORECASTING ISSUES

In Oregon, all land use and transportation planning is driven by population and employment forecasts. Sources for those forecasts are: (1) official forecasts, consolidated by county and consistent with state population forecasts from the Department of Administrative Services as required by state law;[15] (2) forecasts in a comprehensive plan that may not yet have been updated to comply with requirements for a consolidated forecast; (3) forecasts in the traffic model. Ideally, all these forecasts should be the same.

If the proposed project is a large one that substantially changes access, accessibility, and travel time, then the amount or rate of growth of population and employment should be expected to be different with and without the project.[16] In that case, the project may (or should) have different forecasts of population and employment – at least at the sub-area level – for the no-build and build alternatives. Different amounts of population and employment imply different amounts of built space and land development to accommodate them. If there is only a single forecast, the implication is that the project makes no difference in the amount or rate of growth at whatever level of geography the forecast has been conducted. The alternative forecasts should be at a sub-area level, preferably transportation analysis zones (TAZs).

Of key importance is the determination of whether the project is large enough to warrant different forecasts of population and employment for the no-build and build alternatives. Because no empirical method exists to make this determination, the analyst must rely on professional judgment. As an alternative, the analyst might consider convening an expert panel to assist with this determination.

Such a determination is not common practice, at least in any formal sense. It is not uncommon in the evaluation of highway projects to have a single set of population and employment forecasts (in the aggregate, and perhaps by sub-area) that are applied to all alternatives, including the "no-build" alternative. This single set of forecasts can create a major problem for an analyst trying to estimate indirect land use impacts. Here's why.

The type of indirect land use impact of concern for this study is one which contributes to a change in land use. If the uses that could develop as a result of a transportation project are roughly the same (in type and intensity) as those envisioned by the comprehensive plan, there is typically less concern by local and state planners. The plan is still being implemented; it may be

[15] DAS forecasts are available online at http://www.oea.das.state.or.us/

[16] The weight of professional opinion, and common practice, is that local highway projects do not change the aggregate economic growth of a region (population, employment, income), but they can change the distribution of that growth (e.g., more population growth and development may occur around a highway improvement than would have occurred in the absence of the improvement), or can cause growth and development to occur more quickly then it would have without the improvement.

primarily the rate of implementation that is changing. A plan designation, because of its generality, could allow two, qualitatively different types of development, which could lead to different estimates of indirect land use impacts. Thus, consistency with a comprehensive plan suggests fewer indirect land use impacts, but it is not definitive.

If the transportation improvement causes changes in the plan that would not have otherwise occurred, or if the rate of development increases enough to put pressure on public services and finances, the impacts will be of more concern. For example, a new interchange on a limited access highway that passes through what the Oregon planning system terms Resource Land (farm and forest land) may contribute to developers' requests for zone changes around the interchange to allow commercial development. This is clearly the kind of indirect land use impact that federal requirements, state law and many citizens are concerned about.

Now consider population and employment forecasts in the context of the previous example. If there is only one set of forecasts for both the no-build and build alternatives, then the population and employment would be similar around the area of the hypothetical interchange, whether it is built or not. But the concern is how the population and employment distributions would be different if the interchange is built: that difference would be evidence of an indirect land use impact. An analyst trying to evaluate indirect land use impacts may assert that land use development could be substantially different even though there is no difference in area population and employment forecasts.

One solution is to acknowledge that population and employment would (or may) differ if the project is built, and that difference may result in changes in land use. In other words, the solution is to have different population and employment forecasts (at least for sub-areas of the study area, if not for the larger jurisdiction as a whole) for the no-build and build alternatives. Transportation models are capable of handling such differences. The point is simply that in many project evaluations no differences are forecasted, which makes any assessment of land use impacts more subjective. Under any circumstance, the land use analyst should work closely with traffic analyst to ensure they are making the same assumptions about future land uses, employment, population, and so on.

The documentation for most forecasting that has been reviewed for large-scale transportation projects is poor to non-existent on this issue. The forecasts of population and employment are driven primarily by assumptions about the continuation of, or changes in, demographic and economic trends. They usually give some consideration to existing land use, land use plans, and public facility constraints and planned expansions, especially for transportation. It is often difficult to determine the extent to which the base forecasts have already considered indirect or cumulative impacts. If an analyst believes that a build alternative will cause indirect impacts, the analyst should address whether those impacts suggest that population, employment and traffic forecasts for the build alternatives should be different from the forecasts for the no-build alternative.

Moreover, the analyst must be clear about the grain of the analysis: what is the size of the sub-area for which population and growth are being forecast? If it is for a large area (e.g., an entire city), then the analyst has the flexibility to argue that the project may contribute to redistribution of population and employment at a finer grain, and that such a shift would be consistent with a finding of potential indirect land use impacts (i.e., development patterns could be different if the improvement is built). But if the forecasts of population and employment are at the relatively fine grain of a Transportation Analysis Zone (TAZ) typical of urban transportation models, then it is harder (but not impossible) to argue that redistribution within the TAZ will occur and result in indirect land use impacts.

The advice here is to make sure that any evaluation of indirect land use impacts is clear about what assumptions were made in the forecasting of traffic volumes as related to population and employment, including assumptions about changes in land use plans or development patterns.

Even if there is only a single forecast of population and employment for all alternatives at the sub-area level (e.g., TAZ), there may still be variation of the distribution of population and employment, and the details of land use and design, in each sub-area. For example, ODOT could make improvements to an arterial in different ways: one that would emphasize arterial speeds, and another that would emphasize main street development. From a strict travel-time perspective, the travel demand model might be relatively insensitive to that level of specificity and show little difference between the alternatives. If the model does make forecasts at that level of detail, then the through-traffic alternative might show a decrease in travel time, which (for the reasons presented earlier in this report) could contribute to greater land use change. Conversely, main street development might show an increase in travel time depending on design features incorporated into the “build” alternative.

Many analysts would argue, with ample justification, that the main-street alternative would have an impact on land use at the sub-area level even though (1) the population and employment forecast is identical under both alternatives (because the land uses just get rearranged); and (2) the travel demand model shows either no difference or better performance for the through-traffic alternative. In some instances, performance may even be worse for through traffic (e.g., special transportation areas).

Thus, even though change in transportation system performance is the key way that transportation improvements affect land use, at a small scale both highway design and the ancillary improvements that accompany it (parking, auto access via turn lanes and curb cuts, bike paths, pedestrian access, signage) can contribute to changes in development patterns and the rate of development. A description of indirect land use impacts should include a description of those effects.

Common responses to the issues raised in this appendix are (a) they are too academic, (b) even if they are logically correct, they are not the way federal and state policy requirements have typically been expressed, so they just make the evaluation process more confusing, and (c) they would require more work. If EIS-type analysis is ignorant of, or unclear about, what assumptions about transportation improvements and land use are already embedded in the forecasts of population and employment that are being used to drive estimates of transportation and land use impacts, then its conclusions about indirect land use impacts in the no-build and build alternatives will be hard to interpret.

APPENDIX F

ODOT PROCESS FOR PROJECT EVALUATION

Indirect Land Use and Growth Impacts

ODOT PROCESS FOR PROJECT EVALUATION

The project development and review process ODOT uses has many steps. The process begins with the Oregon Highway Plan and other statewide transportation planning policies. Goal 12 and the Transportation Planning Rule (OAR 660-012) require incorporated cities over 2,500 to develop local transportation system plans (TSPs). TSPs must include a local road plan for a system of arterials and collectors and a capital improvement component that identifies local project priorities as well as funding sources.

The various plans provide guidance in the identification of potential projects. Once a specific project is identified, ODOT conducts a preliminary assessment of project impacts at the time projects are identified. Regional offices complete a "project prospectus" that provides a preliminary assessment of the project's impacts, as well as a recommended project classification (the specific form is attached: Part 3 – Project Environmental Classification). Following is a typical scenario for a project prospectus:

- Regional Environmental Coordinator (REC) tours project area, usually with a group on a formal scoping trip, and prepares the Part 3 Project Environmental Classification.
- The REC passes the Part 3 Project Environmental Classification on to someone in the Region who packages it together with the other parts of the prospectus. Part 1 is Project Request which includes a justification for the project as well as the existing conditions and proposed solution. Part 2 is Project Details and gives detailed information about the existing and planned roadway.
- The three-part prospectus gets sent to a person in Environmental Services (ES) who then submits it to FHWA for concurrence on the environmental classification of the project (see below).
- FHWA signs Part 3 and sends it back to ES.
- The prospectus is circulated to the lead staff people in ES who use it as a basis for determining whether work is needed in their resource area (land use, biology, archaeology, etc), for developing a budget estimate, and for assigning work.
- ES sends the prospectus, with the assessment of work needed and budget estimate, to the Region.
- The Region gives the prospectus package to the project team leader and REC for use during project development. (If it is a Class 1 or 3 project, the environmental project manager in ES assigned to the project would also get a copy)

The Part 3 Environmental Classification assigns the project to one of three classes of action that prescribe the level of environmental documentation required. A Class 1 Action is one judged likely to have significant environmental impacts. It requires the preparation of a Draft

Environmental Impact Statement (DEIS), a Final Environmental Impact Statement (FEIS), and a Record of Decision (ROD). A Class 2 Action is one judged unlikely to individually or cumulatively have a significant effect on the human environment. It is given a Categorical Exclusion (CE). This action does not normally require additional environmental documentation. A Class 3 Action is one for which the significance of the impact on the environment is not clearly established. All actions that are not Class 1 or 2 default to Class 3 and require the preparation of an Environmental Assessment (EA) and a Revised Environmental Assessment (REA).

The EA determines whether a Finding of No Significant Impact (FONSI) is appropriate or whether the preparation of a DEIS and a FEIS is required. The decision to reclassify the Class 3 Action as a Class 1 Action (which would then require additional analysis) or to prepare a FONSI (which, effectively reclassifies the Class 3 Action as a Class 2 Action, which requires no additional analysis) depends on the impacts identified and the comments received on the EA. Regardless of what the classification of the document is, it does not limit and should not limit the exploration of impacts. It is the requirement of the National Environmental Policy Act (NEPA) that all impacts be identified. Federal Highway Administration (FHWA) makes the final determination as to appropriateness of the classification.

An EIS is written when there is potential for significant impacts as described by the National Environmental Policy Act (NEPA). If there are impacts that are major but not "significant," (as defined by NEPA), then an EA is prepared. In general, in impact is "significant" if it is large and that cannot be mitigated. Projects that require an EIS would include a major realignment of a highway, a new highway on a new location, a facility that allowed access to a large area for development that was not before accessible, or a new facility in a natural area that forever commits those resources to a new use.

This guidebook is primarily intended to assist analysts in projects classified as Class 1 or Class 3 decisions (i.e., projects that require an EIS or an EA). As described above, ODOT makes a determination of how to classify individual projects based on a preliminary evaluation. The Project Prospectus: Part 3 – Preliminary Environmental Evaluation that ODOT uses includes a preliminary assessment of land use impacts (see attached form, pages 1-4). The form, however, is very brief, and focuses on direct land use impacts and consistency with local land use plans (items 3 and 32-46 on the prospectus form).

ODOT staff asked that the final Guidebook include a brief description of how the techniques could be simplified for use in the preliminary evaluation that occurs as part of the ODOT Project Prospectus process. Based on the full analytical process in the Guidebook, an abbreviated version is proposed to aid ODOT staff in conducting a preliminary assessment of indirect land use impacts. That brief process is presented of page 16 of the Guidebook and at the end of this appendix as a proposed form that could become part of the Part 3 Project Prospectus.

The form is intended to indicate whether the project increases the probability of land use change to an extent that warrants a detailed evaluation of indirect land use impacts. In that sense, it can help ODOT staff determine the project's Action Class (1 2, or 3), which determines how much research ODOT will conduct to evaluate its impacts.

Oregon Department of Transportation

PROJECT PROSPECTUS

Part 3--Project Environmental Classification

Key ID #
00000

Section	Bridge No.	Region	County

1) ESTIMATED RIGHT-OF-WAY IMPACTS (INCLUDING EASEMENTS, NUMBER OF PARCELS, ACREAGE, AND IMPROVEMENTS)

2) ESTIMATED TRAFFIC VOLUME, FLOW PATTERN, AND SAFETY IMPACTS (INCLUDING CONSTRUCTION IMPACTS, DETOURS, ETC.)

3) ESTIMATED LAND USE AND SOCIOECONOMIC IMPACT (INCLUDING CONSISTENCY WITH COMPREHENSIVE PLAN)

4) ESTIMATED WETLANDS, WATERWAYS, AND WATER QUALITY IMPACTS

5) ESTIMATED BIOLOGICAL AND THREATENED & ENDANGERED SPECIES IMPACTS

6) ESTIMATED ARCHEOLOGICAL AND HISTORICAL IMPACTS

7) ESTIMATED PARK AND VISUAL IMPACTS

8) ESTIMATED AIR, NOISE, AND ENERGY IMPACTS

9) ESTIMATED HAZMAT IMPACTS

10) PRELIMINARY IDENTIFICATION OF POTENTIAL AREAS OF CRITICAL CONCERN AND CONTROVERSIAL ISSUES

RECOMMENDED PROJECT CLASSIFICATION

- ☐ CLASS 1 DRAFT & FINAL ENVIRONMENTAL IMPACT STATEMENT
- ☐ CLASS 2 CATEGORICAL EXCLUSION
- ☐ CLASS 3 ENVIRONMENTAL ASSESSMENT & REVISED ENVIRONMENTAL ASSESSMENT
- ☐ RECONNAISSANCE
- ☐ PROGRAMMATIC CATEGORICAL EXCLUSION

PREPARED BY		FHWA OR STATE OFFICIAL APPROVAL	
DATE	TELEPHONE NUMBER	DATE	TELEPHONE NUMBER

REGION ENVIRONMENTAL CHECKLIST
ATTACHMENT TO PART 3, (PROJECT ENVIRONMENTAL CLASSIFICATION)

Project	**Key No.**
Name of Project	00000

Instructions:
This checklist should be completed and attached to the Part 3. It will provide information to assist in appropriately classifying projects. A "Yes" answer indicates areas of concern, a "No" answer indicates no concerns, and UNK indicates that you didn't check into that area. The primary intent of the checklist is to ensure these items have been considered, and where appropriate, researched. When something of potential impact is found, explain in the appropriate section of the Part 3. If you have any questions, please call (503) 986-3477. The receptionist will transfer you to the appropriate resource person for assistance.

AIR
1 ☐ YES ☐ NO ☐ UNK Is project in an air quality non-attainment area: ☐ CO; ☐ ozone; ☐ PM10
2 ☐ YES ☐ NO ☐ UNK Is project missing from: ☐ STIP; ☐ OTP; ☐ TIP? ____________
3 ☐ YES ☐ NO ☐ UNK Does the project involve adding lanes, signalization, channelization, and/or alignment changes? ____________

ARCHAEOLOGY
4 ☐ YES ☐ NO ☐ UNK Are archaeologically sensitive areas potentially affected (confluence of rivers, headlands, coves, overlooks, etc.)? ______
5 ☐ YES ☐ NO ☐ UNK Does local city/county Comprehensive Plan indicate potential Goal 5 resources? ____________
6 ☐ YES ☐ NO ☐ UNK Does contact with local USFS or BLM archaeologist indicate any problems? ____________
7 Extent and cause of previous ground disturbance (minor, major)? ____________

BIOLOGY
8 Please provide: USGS Quad Name ____________ Township____________ Range____________ Section____________
9 ☐ YES ☐ NO ☐ UNK Does contact with local ODFW (District Fish/Game/Habitat/Non-game biologists) indicate any problems? ____________
10 ☐ YES ☐ NO ☐ UNK Any local knowledge of T&E or sensitive (candidate) species in area? ____________
11 ☐ YES ☐ NO ☐ UNK Does contact with local BLM or USFS biologists indicate any problems? ____________
12 What are the results from a Natural Heritage Data Base check? ____________
13 Confirmed ODFW in-water preferred work periods for project area? (List if applicable) ____________
14 List any streams impacted by project ____________

ENERGY
15 ☐ YES ☐ NO ☐ UNK Does project affect traffic patterns, volumes, or involve speed zone changes? ____________

GEOLOGY
16 ☐ YES ☐ NO ☐ UNK Discussions with Region Geologist indicate any major concerns?____________
17 ☐ YES ☐ NO ☐ UNK Drilling/exploration anticipated? ____________

HAZARDOUS MATERIALS
18 ☐ YES ☐ NO ☐ UNK Does contact with local DEQ office indicate any concerns? ____________
19 ☐ YES ☐ NO ☐ UNK Does contact with State Fire Marshal's office indicate any concerns? ____________
20 ☐ YES ☐ NO ☐ UNK Does contact with local fire department indicate any concerns? ____________
21 ☐ YES ☐ NO ☐ UNK Does contact with PUC indicate any highway spills/incidents? ____________
22 ☐ YES ☐ NO ☐ UNK R/W acquisition impacts gas stations/repair shops/industrial sites/landfills? ____________
23 ☐ YES ☐ NO ☐ UNK Ground disturbance anticipated (excavation/drilling etc.) near known hazmat sites? ____________
24 Checked DEQ lists: UST ☐ Release incident ☐ RCRA ☐ Solid Waste ☐ TSD ☐ Leaking UST ☐ Confirmed release ☐ Other ☐
25 (List any occurrence on the above lists) ____________

HISTORIC
26 ☐ YES ☐ NO ☐ UNK Does city/county comp plan list any impacted buildings/items as Goal 5 resources? ____________
27 ☐ YES ☐ NO ☐ UNK Any impacted sites on nominated/listed as eligible for National Register? ____________
28 ☐ YES ☐ NO ☐ UNK Does contact with city/county Historical Society indicate potential resources? ____________
29 ☐ YES ☐ NO ☐ UNK Any impacted buildings thought to be 50 years or older? ____________
30 ☐ YES ☐ NO ☐ UNK Any apparent/unique/suspect structures of possible historical interest? ____________
31 ☐ YES ☐ NO ☐ UNK Historic district/trails/bridges? ____________

LAND USE/PLANNING
32 ☐ YES ☐ NO ☐ UNK Project not identified in local transportation system plan? ____________
33 ☐ YES ☐ NO ☐ UNK Does contact with local jurisdiction planning department indicate any concerns? ____________
34 ☐ YES ☐ NO ☐ UNK Is project outside of UGB? ____________
35 ☐ YES ☐ NO ☐ UNK Does project cross or touch UGB? ____________
36 ☐ YES ☐ NO ☐ UNK Does Coastal Zone Management Act apply?____________
37 ☐ YES ☐ NO ☐ UNK Is it zoned forest or EFU? ____________
38 ☐ YES ☐ NO ☐ UNK Are there other protected resources (i.e., estuary, wetlands, greenways, etc.)? If yes, list ____________
39 ☐ YES ☐ NO ☐ UNK Does contact with local NRCS indicate "High Value" farmland concerns? ____________
40 ☐ YES ☐ NO ☐ UNK Farmland Conversion Impact Rating applicable? ____________
41 List Comprehensive Plan designations being impacted:____________
42 List zoning designations being impacted ____________
43 Region Planner's opinion that the project conforms with (If not, why not?):
44 o Transportation Planning Rule ____________
45 o Statewide Planning Goals ____________
46 o Comprehensive Plan (county/city or both)____________

Project Name of Project	Key No. 00000

NOISE
47 ☐ YES ☐ NO ☐ UNK Any shift in horizontal or vertical alignment? Amount of shift: Horizontal _____________ m (ft.); Vertical __________m (ft.)
48 ☐ YES ☐ NO ☐ UNK Does project increase the number of travel lanes? Existing number of lanes ____________ Proposed number of lanes ______
49 ☐ YES ☐ NO ☐ UNK Any known noise problems/complaints? ____
50 Approximate number of buildings/activity areas within 61 meters (200-feet) of proposed R/W line: Commercial_________ Industrial__________ Public__________
51 Residences_________ Schools ____________ Churches _________ Parks ________

SECTION 4(f) POTENTIAL
52 ☐ YES ☐ NO ☐ UNK Parks, wildlife refuges, historic properties, public recreational areas, etc. impacted? (explain)____________________________

SECTION 6(f) POTENTIAL
53 ☐ YES ☐ NO ☐ UNK Land & Water Conservation Funds used to acquire parks, etc.? ____

SOCIOECONOMICS
54 ☐ YES ☐ NO ☐ UNK Do building displacements appear key to economy/neighborhood? ____
55 Number of building displacements: ____
56 General use of adjacent land: Residential ☐ Commercial ☐ Farmland/Range ☐ Public ☐ Other ☐ (explain)___________________________________
57 Estimate of number of people living adjacent to project: 0-30 ☐ ; 31-100 ☐; 100+ ☐
58 Estimate of number of people working adjacent to project: 0-30 ☐ ; 31-100 ☐; 100+ ☐
59 ☐ YES ☐ NO ☐ UNK Divide or disrupt an established community, or affect neighborhood character or stability? ______________________________
60 ☐ YES ☐ NO ☐ UNK Affect minority, elderly, handicapped, low income, transit-dependent, or other specific interest group? ___________________

VISUAL
61 ☐ YES ☐ NO ☐ UNK Designated Scenic Highway? ____
62 ☐ YES ☐ NO ☐ UNK Oregon Forest Practices Act restrictions apply?____
63 ☐ YES ☐ NO ☐ UNK Major cut/fills? ____
64 ☐ YES ☐ NO ☐ UNK Bridges or large retaining walls anticipated? ____
65 ☐ YES ☐ NO ☐ UNK Any rivers on the Oregon Scenic Waterway listing? ____
66 ☐ YES ☐ NO ☐ UNK Any rivers on the Federal Wild and Scenic River Listing? ____

WATER WAYS/WATER QUALITY
67 ☐ YES ☐ NO ☐ UNK Does city/county comp plan list any water resources as Goal 5 resources?____
68 ☐ YES ☐ NO ☐ UNK Within FEMA 100-year flood plain?____
69 ☐ YES ☐ NO ☐ UNK Within FEMA regulated floodway? ____
70 ☐ YES ☐ NO ☐ UNK Water quality limited stream impacted? ____
71 ☐ YES ☐ NO ☐ UNK Any active wells impacted? ____
72 ☐ YES ☐ NO ☐ UNK ADT of 10,000 or greater? ____
73 ☐ YES ☐ NO ☐ UNK Navigable waterways? ____
74 ☐ YES ☐ NO ☐ UNK Is stream on ODFW Rivers Information System database? ____
75 ☐ YES ☐ NO ☐ UNK Any irrigation districts impacted? ____
76 If streams affected what is the fisheries stream classification? ____

WETLANDS
77 ☐ YES ☐ NO ☐ UNK National wetlands inventory maps indicate any potential concerns? ____
78 ☐ YES ☐ NO ☐ UNK Soil conservation maps indicate hydric soils in project area?____
79 ☐ YES ☐ NO ☐ UNK Local Comprehensive Plan show any wetlands as protected resources? ____
80 ☐ YES ☐ NO ☐ UNK Riparian or wetland vegetation evident from visual inspection? ____

****

PERMITS
81 ☐ YES ☐ NO US Corps of Engineers Section 404
82 ☐ YES ☐ NO DSL Removal and Fill
83 ☐ YES ☐ NO DEQ Indirect Source (Air)
84 ☐ YES ☐ NO PUC (railroad)
85 ☐ YES ☐ NO DOGAMI
86 ☐ YES ☐ NO Coast Guard
87 ☐ YES ☐ NO Local Jurisdiction National Pollutant Discharge Elimination System (NPDES)
88 ☐ YES ☐ NO Other ____

CLEARANCES
89 ☐ YES ☐ NO State and/or federal Endangered Species Act
90 ☐ YES ☐ NO State Historic Preservation Office (Historic)
91 ☐ YES ☐ NO State Historic Preservation Office (Archaeological)
92 ☐ YES ☐ NO FHWA Noise
93 ☐ YES ☐ NO Air Conformity
94 ☐ YES ☐ NO DEQ Commercial/Industrial Noise Regulation
95 ☐ YES ☐ NO Hazmat Clearance
96 ☐ YES ☐ NO ODOT Erosion Control Plan

Prepared by	**Phone Number**	**Date**

REGION ENVIRONMENTAL CHECKLIST
GUIDELINES

INTRODUCTION

This guideline supplements the Part 3 Checklist to help the preparer consider potential project impacts and provides resource agency phone numbers. The guideline is organized to correlate with the number sequencing on the Part 3 Checklist.

CLASSIFICATION

There are three classes of action which prescribe the level of environmental documentation required. A Class 1 Action will have significant environmental impacts and requires the preparation of a Draft Environmental Impact Statement (DEIS), a Final Environmental Impact Statement (FEIS), and a Record of Decision (ROD). The Class 2 Action does not individually or cumulatively have a significant effect on the human environment and constitutes a Categorical Exclusion (CE). This action does not normally require additional environmental documentation. A Class 3 Action is required when the significance of the impact on the environment is not clearly established. All actions that are not Class 1 or 2 are Class 3 and require the preparation of an Environmental Assessment (EA) and a Revised Environmental Assessment (REA).

The EA determines whether a Finding of No Significant Impact (FONSI) is appropriate or whether the preparation of a DEIS and a FEIS is required. The decision to proceed with a Class 1 Action or the preparation of a FONSI is dependent on the impacts identified and the comments received on the EA. Regardless of what the classification of the document is, it does not limit and should not limit the exploration of impacts. It is the requirement of the National Environmental Policy Act (NEPA) that all impacts be identified. Federal Highway Administration (FHWA) makes the final determination as to appropriateness of the classification.

An EIS is written when there is potential for significant impacts in a National Environmental Policy Act (NEPA) context. If there are impacts, that are major, but may not fall under the understanding of SIGNIFICANT, then an EA is prepared. You can think about SIGNIFICANT as basically being a large impact which can not be mitigated for. Projects that require an EIS would be a major realignment of a highway, a new highway on a new location, a facility that allowed access to a large area for development that was not before accessible, a new facility in a natural area that forever commits those resources to a new use, etc.

Contact your local Oregon Department of Transportation (ODOT) Region Environmentalist for more information on the project development and/or environmental process, Salem (northwest area) (503) 986-2652, Portland (503) 731-8240, Roseburg (southwest Oregon) (503) 957-3519, Bend (503) 388-6386, or LaGrande (503) 963-4972.

AIR

The Department of Environmental Quality (DEQ) has designated areas of Oregon as in non-attainment of the National Ambient Air Quality Standards for the criteria pollutants carbon monoxide, ozone, and particulate matter (PM-10). Areas designated as in non-attainment of the standard for any criteria pollutant are required by the Clean Air Act to implement a plan which demonstrates how the area will achieve attainment and maintain the standard.

1. Non-attainment areas for carbon monoxide (CO) are Klamath Falls, Grants Pass, Salem, Medford, and Portland-Vancouver. Eugene-Springfield was designated as in non-attainment for CO, but has been redesignated to attainment with a maintenance plan. Ozone non-attainment areas are Portland-Vancouver and Salem. PM-10 is fine particulate of less than 10 microns in diameter. Non-attainment areas for PM-10 are Eugene-Springfield, Medford-Ashland, Grants Pass, LaGrande, Oakridge, Lakeview, and Klamath Falls. Contact the Department of Environmental Quality (DEQ), Air Quality Division (503) 229-5581 for more information.

2. The Statewide Transportation Improvement Program (STIP) is a yearly schedule of projects on various highways. The STIP contains construction estimates, scheduling by the year of implementation, and is a required document by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). Contact ODOT Public Affairs (503) 986-3434 for a copy.

The Oregon Transportation Plan (OTP) is a planning document that summarizes transportation goals, priorities of the ODOT Transportation Commission, and estimates future transportation trends. Contact ODOT Planning Section (503) 986-4254 for a copy.

A Transportation Improvement Plan (TIP) must be developed for each metropolitan area by the Metropolitan Planning Organization (MPO). The four MPO's in Oregon are the Portland region, Salem area, Eugene area, and the Medford area. The TIP must include all projects funded by Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) or with Federal Transit Act funds (FTA). Contact your local MPO for a copy.

3. Applicable to all projects including safety, bridge, etc.

ARCHAEOLOGY

4. Archaeological resources are locations of prehistoric and historic human activity that contain artifacts or distinct features. Paleontological resources (dinosaur bones) are also covered in this field. These sites are covered by both State and Federal Laws. Certain areas within the state have a greater potential for having archaeological resources than others. These areas include the Coast, Columbia River Gorge, major river basins, and other areas where the accessibility to fish and water is high, such as perennial streams and lakes.

5. City/County Comprehensive Plans are available from your local Planner; refer to the Land Use Section of this Guide for further explanation. Goal 5 resources are open spaces, scenic and historic areas, and natural resources.

6. Contact the U.S. Forest Service (USFS), Pacific Northwest Regional Office (503) 326-3644 to identify your local District office, if the project is on USFS lands. Contact the Bureau of Land Management (BLM), Salem office (503) 375-5646 to identify your local District office, if the project is on BLM lands.

7. Significant archaeological resources exist in undisturbed ground. Minor ground disturbance is defined as caused by farming, lawns, dirt tracks, and the like. Examples of major ground disturbance would be extensive cut and fill, presence of structures, parking lots, etc. Contact ODOT Cultural Resources (503) 986-3508, or Parks and Recreation Department (503) 378-6508 Ext. 232 for more information.

BIOLOGY

Federally funded transportation projects require ODOT to comply with several federal environmental regulations in regard to biological resources, most importantly the National Environmental Policy Act (NEPA), the Fish and Wildlife Coordination Act, and Section 7 of the Endangered Species Act (ESA). When projects are not federally funded, Section 7 (i.e. preparation of a biological assessment) responsibilities may be replaced by Sections 9 and 10 of the federal Endangered Species Act. State regulations including the Oregon Endangered Species Act would apply in either case. If there is a threatened species, an endangered species, designated critical habitat, or if a species has been proposed for either status, and has been located in or near the project area, then impacts will need to be formally assessed.

8. Contact the Department of Geology and Mineral Industries (DOGAMI), Nature of the Northwest (503) 872-2750 for a U.S. Geological Survey (USGS) Quad Map Index.

9/10. Contact the Oregon Department of Fish and Wildlife (ODFW) (503) 229-5403 to identify your local District office for natural resource problems. Typical concerns are rare species, critical habitat, in-water work provisions (timing), fish/game passage issues, etc. ODFW have different biologists by district for fish issues versus wildlife issues. You may have to coordinate with both biologists depending upon the project. Federally or State Listed Threatened and Endangered (T&E) (animal and plant) species may also be referenced in the Natural Resource Section of the local Comprehensive Plan.

11. Contact the Bureau of Land Management (BLM), Resources (503) 952-6068 to identify your local District office, if the project is on BLM land. Contact U.S. Forest Service (USFS), Pacific Northwest Regional Office, Natural Resources (503) 326-2954 to identify your local District office, if the project is on USFS lands.

12. To check the Natural Heritage Data Base contact the Oregon Natural Heritage Program (503) 229-5078. Have available the Range, Township, and Section information of the project area. There is a fee to use the Natural Heritage Data Base.

13/14. Fish passage is required on any stream, regardless of size or whether perennial or intermittent, that is used by anadromous or resident fish during any period of the year. Bridge or structure construction usually involves in-water work periods. Request in-water work periods (range of dates for construction to occur) from Oregon Department of Fish and Wildlife (ODFW), Habitat Conservation (503) 229-6967 Ext. 463, if project area is in a river/stream.

ENERGY

15. Energy will be used in the construction of the build alternatives and for the operation of vehicles on a proposed project. For projects that significantly affect operational energy consumption, an energy analysis is required according to Oregon Transportation Planning Rule, National Environmental Protection Act (NEPA), and/or the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). Contact ODOT Environmental (503) 986-3489 for more information.

GEOLOGY

16/17. All highway projects have their ultimate foundations in natural earth materials. Slope stability and subgrade are assessed by geologic and geotechnical work. Contact your local ODOT Region Geologist for a preliminary determination on the need for drilling/exploration, Salem (northwest area) (503) 986-2644, Portland (503) 731-8302, Roseburg (southwest Oregon) (503) 957-3595, Bend (503) 388-6251, or LaGrande (503) 963-3177. Typical concerns are soft soil conditions, embankment drainage (seepage), land slides, and earthquake hazards.

Aggregate resources are required for highway subgrade and structural materials. The Oregon Department of Geology and Mineral Industries (DOGAMI) (503) 731-4100 has information on rock and gravel mining resources, and is in charge of issuing mining permits.

HAZARDOUS MATERIALS

18. Hazardous materials and the problems associated with them are an important concern in the location of transportation facilities. Contaminated sites should be avoided if at all possible. Site investigations and cleanups have significant impacts on budgets and project schedules. Typical concerns are the history of hazardous spills in the area, known and potential hazardous material sites, etc. When hazardous sites are encountered, some level of action is required. Construction activities that generate hazardous materials, such as waste water or lead paint from rehabilitation bridge projects require hazardous materials handling and disposal. Contact the Department of Environmental Quality (DEQ), Headquarters office (503) 229-5733 to identify your local Region office.

19. Contact the State Fire Marshal, Community Right-to-Know Program (503) 373-1540 Ext. 262 to obtain data base information on companies that store hazardous materials, quantities, etc.

20/21. Contact the Public Utility Commission (PUC), Transportation Safety (503) 378-5916 for historical data on highway spills.

22. Known sites or "red flags" indicating possible sites (such as historically the site was an industrial facility or gas station) should be listed. To determine the right of way (r/w) needs for the proposed project, contact the designer. R/w acquisition refers to property to be acquired to construct the proposed project.

24/25. Underground Storage Tank (UST),Resource Conservation Recovery Act (RCRA), Transportation Storage Disposal Facility (TSD),
Confirmed release is for a site on DEQ's UST Clean Up List.

HISTORIC

26. Section 106 of the National Historic Preservation Act applies to projects that are likely to affect properties which are listed, nominated, or determined to be eligible for the National Register. Historic resources, such as famous and well-preserved pioneer houses, train depots, and picturesque covered bridges are usually National Register eligible. If the National Register does not indicate the presence of any historical resources, it just may not have been identified yet-- which is frequently the case. Contact your local Planner for a copy of the city/county Comprehensive Plan.

27. Contact the State Historic Preservation Office (SHPO) (503) 378-6508 Ext. 228 for general guidance. To request a National Register and Statewide Inventory Data Base search contact ODOT Cultural Resources (503) 986-3514.

28-30. To obtain a listing of city/county Historical Societies contact Oregon Historical Society (503) 222-1741.

31. Proposals to retrofit, upgrade, or replace a bridge listed in or eligible for the National Register are subject to the requirements of Section 106 and a Section 4(f).

LAND USE/PLANNING

32. The Land Conservation and Development Commission (LCDC) has developed 19 goals, which constitute the framework for a statewide program of land use planning. Oregon law requires every city and county to have a Comprehensive Plan, which is acknowledged by the LCDC. Acknowledged plans are consistent with the statewide planning goals. In addition, each jurisdiction is to prepare a Transportation System Plan (TSP) which when acknowledged will be considered consistent with the Comprehensive Plan and Statewide Planning Goals. Metropolitan Planning Organizations (MPO's) are preparing the TSP for Portland region, Salem area, Eugene area, and the Medford area. Contact your local MPO for a copy.

33. City/County Comprehensive Plans are available from your local Planner. Typical concerns are points of conflict with the Comprehensive Plan or Zoning Ordinance.

34/35. Urban Growth Boundary (UGB) delineates the rural lands from the urban lands. Some transportation improvements are not allowed on rural lands. Urban fringe is the area 2-5 miles outside the UGB. Some projects are not allowed in the urban fringe. Contact the local planner for identification of the UGB.

36-38. Contact your local Planner, or Department of Land Conservation and Development (DLCD) (503) 373-0096 for information on the Coastal Zone Management Act, forest zoning, Exclusive Farm Use (EFU), and to identify other protected resources.

39/40. Contact U.S. Agricultural Department, Natural Resources Conservation Service (NRCS), (formerly Soil Conservation Service (SCS)) (503) 414-3200 to identify your local Field office for information on High Value Farmland and Farmland Conversion applicability.

41/42. City/County Comprehensive Plans are available from your local Planner.

43-46. Contact your local ODOT Region Planner, Salem (northwest area) (503) 986-2653, Portland (503) 731-8200, Roseburg (southwest Oregon) 957-3521, Bend (503) 388-6342, or LaGrande (503) 963-4972.

44. Transportation Planning Rule (TPR) (OAR 660-12-000).

45. Statewide Planning Goals are listed in your Comprehensive Plan; contact the local Planner, or the Department of Land Conservation and Development (DLCD) (503) 378-2332 for a copy.

NOISE

47/48. For highway projects, the existing noise level at representative sites along the project is measured. Then based on projected traffic, anticipated changes to topography, buildings, and other characteristics of the project, the Federal Highway Administration (FHWA) Noise Prediction Model is used to predict noise levels along the project. Contact the designer for the proposed project alignment (design specifications).

49. Contact the local city/county Traffic Engineer for information on known noise issues.

50/51. The right of way (r/w) line is the existing and proposed r/w lines for the project. An industrial building/activity is distinguished from a commercial building/activity by its function as a manufacturer.

SECTION 4(f) POTENTIAL

52. Section 4(f) of the Department of Transportation Act of 1966 refers to any effect on a historic property, historic bridge, park, wildlife and waterfowl refuge, or public recreation area, if the project includes federal funds. Contact your local ODOT Region Environmentalist for general guidance.

SECTION 6(f) POTENTIAL

53. Section 6(f) refers to the rules and regulations of the Land and Water Conservation Fund (L&WCF) Act and associated property acquired or developed for public outdoor recreation with those funds. To determine if Land & Water Conservation Funds are involved contact Parks and Recreation Department (503) 378-6378 Ext. 241.

SOCIOECONOMICS

54-60. Socioeconomics refers to the social and economic impacts of a proposed project. Contact your local Planner for information on neighborhoods, community cohesion, demographic data, census, and economic reports.

VISUAL

61. This area of interest was formerly referred to as scenic or aesthetics resources. Visual Resource Management (VRM) is the management of the visual resource elements of an area or project for a specific purpose, such as capturing significant views or building upon a particular thematic concept (like Sisters, Or.). Visual resources are the actual elements of an area or project, including the viewshed, landmarks, aesthetic quality and continuity between the project and the context (elements such as Haystack Rock or Mt. Hood in the viewshed of Portland, for example). Particularly sensitive areas are tour routes, historic or scenic highway sections, state entrance, national forest, or along a scenic river. A Listing of Scenic Highways is available from the ODOT Scenic Byways Program (503) 986-4261.

62. For information on the Oregon Forest Practices Act contact the Oregon Forestry Department (503) 945-7470.

63/64. Contact the designer to determine if major cut/fills, bridges, or large retaining walls are proposed for the project.

65/66. For an Oregon Scenic Waterways Listing and a Federal Wild and Scenic River Listing contact the Parks and Recreation Department (503) 378-6305.

WATERWAYS/WATER QUALITY

The major types of water resources are streams and rivers, lakes and ponds, wetlands, and groundwater. Navigable waters include the Columbia River, the Willamette River, coastal rivers in areas subject to tidal influence, and any river presently used for commerce. Any filling in the river, removing of soil and gravel from the river or changing the river bank in any way, regardless of the amount of material involved, requires further analysis. Mitigation measures will be addressed for a project where there is a potential for hazmat spills into waterways. Impacts from construction activities, such as erosion of exposed soils, waste water from rehabilitation bridge projects, and other effects on streams are evaluated.

67. Contact your local Planner for a copy of the city/county Comprehensive Plan.

68/69. For Federal Emergency Management Agency (FEMA) 100-year floodplain and regulated floodway information contact the Department of Land Conservation and Development (DLCD) (503) 378-2332, or FEMA 206-481-8800.

70. For a listing of water quality limited streams contact the Department of Environmental Quality (DEQ), Water Quality 1-800-452-4011 or 229-6121.

71. Contact the local County Watermaster for records on wells.

72. Roadway runoff can be assumed to have no impact on surface waters if the roadway area is both less than 1% of the drainage basin, and the Average Daily Traffic (ADT) is less than 10,000 or all runoff flows through 90 m (200 ft) of vegetated swale. To obtain a copy of the Traffic Volume Tables contact ODOT Systems Monitoring (503) 986-4147. The table shows monthly ADT at permanent recorders for the reporting year, 10 years of historical data at permanent counting stations, and a vehicle classification breakdown.

73. For a Navigable Waterway listing contact the U.S. Corps of Engineers, Regulatory Division (503) 326-6995.

74. Contact the Oregon Department Fish and Wildlife (ODFW), Habitat Conservation Division (503) 229-6967 Ext. 521 to access the Rivers Information System Data Base.

75. Obtain information on irrigation districts from your local County Watermaster.

76. For a fisheries stream classification contact Oregon Department of Fish and Wildlife (ODFW), Habitat Conservation (503) 229-6967 Ext. 463.

WETLANDS

Wetlands generally include wet meadows, swamps, marshes, bogs, vernal pools and similar areas. Wetlands filter water, trap sediments, provide flood and erosion protection, provide diverse wildlife and fisheries habitats, and naturally replenish surface waters. Wetlands form a transition between aquatic and terrestrial systems. Wetlands are characterized by their unique combination of cyclical inundation, hydric soils, and vegetation adapted to growth in these areas.

77. National Wetland Inventory maps display wetland areas identified by the U.S. Fish and Wildlife Service by wetland type and are referenced similar to USGS maps. Contact the Oregon Division of State Lands (DSL) (503) 378-3805 Ext. 233 for more information.

78. Soil conservation maps data are listed on County Soil Surveys. Request a hydric soils list from U.S. Agricultural Department, Natural Resources Conservation Service (NRCS) (503) 414-3270.

79. For a listing of protected resources refer to the Goal 5 Resources Section of the Comprehensive Plan.

80. Riparian vegetation occurs along water sources (stream edge). Many species of riparian vegetation are indicative of the existence of wetland conditions at that site. Establishing riparian vegetation as mitigation is frequently used for bank stabilization on bridge construction projects.

PERMITS/CLEARANCES

There are a number of permits and/or clearances required from various agencies prior to construction of a project.

81. Contact U.S. Corps of Engineers (503) 326-6995 for a Section 404 Permit determination.

82. For a DSL Removal and Fill Permit contact Division of State Lands (DSL), Western Region (Westside Cascades) (503) 378-3805, or Eastern Region (Eastside Cascades) (503) 388-6112.

83. For an Indirect Source (Air) Permit contact Department of Environmental Quality (DEQ) (503) 229-6086. For Lane County projects contact the Lane Region Air Pollution Authority (LRAPA) (503) 726-2514 also.

84. Contact the Public Utility Commission (PUC) (503) 378-6217 for railroad permit issues.

85. Department of Geology and Mineral Industries (DOGAMI) (503) 967-2039.

86. Coast Guard (206) 220-7282.

87. For a Local Jurisdiction National Pollutant Discharge Elimination System (NPDES) Permit determination contact your local Public Works Director, or Department of Environmental Quality (DEQ) (503) 229-5437.

88. For information on other permits contact ODOT Permits (503) 986-3783.

89. Contact Oregon Department of Agriculture (ODA) (503) 986-4716 for state threatened or endangered plants. For federally proposed or listed threatened or endangered plants, animals or resident fish contact U.S. Fish and Wildlife (503) 231-6179. For federally proposed or listed threatened or endangered anadromous fish or marine mammals, contact National Marine Fisheries Service (503) 230-3388. Most state listed fish and wildlife species are also federally listed so complying with the federal regulations for these species will suffice for compliance with the state regulations.

90. State Historic Preservation Office (SHPO), Historic (503) 378-6508 Ext. 228.

91. State Historic Preservation Office (SHPO), Archaeological (503) 378-6508 Ext. 232.

92. Contact ODOT Acoustical (503) 986-3488, or FHWA (503) 399-5749 for Noise Clearance.

93. For State Air Conformity contact DEQ (503) 229-6086 and the local MPO. For Federal Air Conformity contact ODOT Air Quality (503) 986-3485, or FHWA (503) 399-5749.

94. Contact Department of Environmental Quality (DEQ) (503) 229-6086 for Commercial/ Industrial Noise Regulation.

95. Contact Department of Environmental Quality (DEQ (503) 229-5733 for a Hazmat Clearance determination.

96. For an ODOT Erosion Control Plan determination contact ODOT Geotechnical (503) 986-5782, or ODOT National Pollutant Discharge Elimination System (NPDES) (503) 731-8309.

CJS

PROPOSED PROSPECTUS ADDENDUM

Part 3--Project Environmental Classification
Indirect Land Use Supplement

<u>Form is for Illustration Only: This is NOT an official ODOT Form</u>

		Key ID # 00000	
Section	**Bridge No.**	**Region**	**County**

Instructions:

This form is intended to assist in a preliminary analysis of indirect land use impacts for proposed projects. The form supplements information on the Part 3--Project Environmental Classification form, specifically items 3, and 33-46.

The steps that follow are designed for cursory analysis, but more detail could easily be added to the answers to the questions posed. An analysts can answer the questions based only on personal knowledge and judgment, or based on research. Sources of information include:

- Field visit/evaluation of proposed study area.
  - Existing land use in the corridor.
  - Amount of vacant land by plan designation within 1/2 mile of the project.
  - Capacity of vacant land in the study area in terms of population and employment.
- Project description (Part 1 of the Prospectus) and preliminary traffic analysis.
- Local plans and policies: land use, water and sewer, transportation. Do the policies support the project? Are services available for development in the project area?
- Interviews with local government staff, realtors, developers and others with knowledge of the study area. Ask how they think the improvement will affect land use in the area.

The following questions allow a preliminary evaluation of indirect impacts based on a number of variables that increase the possibility of land use changes in the project vicinity. The responses are on a scale of 1 to 5 with 1 being less or smaller affects, and 5 being larger affects. More specific guidance can be found in the *Draft Guidebook for Evaluating Indirect Land Use Impacts*.

ESTIMATED INDIRECT LAND USE IMPACTS

1) How big is the transportation improvement? [Review project description (Part 1 of the Prospectus)preliminary traffic analysis. Pay close attention to travel time savings and changes in access. Larger travel time savings, new transportation corridors, and significant amounts of vacant land within 1/2 to one mile of the project suggest a larger potential for indirect impacts. Aggregate change in travel time is the best indicator (travel time savings times number of vehicles). The bigger it is, both absolutely and relative to existing transportation capacity in the study area, the more likely it is to have indirect land use impacts.]

a) Aggregate change in travel time (absolute and relative)

<u>Little change Considerable change</u>

1 2 3 4 5

b) Estimated project cost

<u>Lower Higher</u>

1 2 3 4 5

c) Length

<u>Shorter, more localized Longer</u>

1 2 3 4 5

d) Number of vehicles/trips affected

<u>Lower Higher</u>

1 2 3 4 5

e) Capacity of project relative to existing capacity in the study area. A project in a developed downtown may have a small relative impact; a project at the urban fringe may have a large one.

<u>Small percentage Large percentage</u>

1 2 3 4 5

2) Review local plans and policies: land use, water and sewer, transportation.

a) Do the policies support the project?

Policies do not support project — Policies completely support project

1	2	3	4	5

b) Are services (i.e., water, sewer, electricity, telecommunications) available for development in the project area?

No services are available — All services available

1	2	3	4	5

c) Strength of market demand for development around the project

Weak — Strong

1	2	3	4	5

d) Opinions of local government staff, realtors, developers and others with knowledge of the study area regarding how the improvement will affect land use in the area.

Little impact — Considerable impact

1	2	3	4	5

3) Given the responses to items 1 and 2, how big are the potential indirect land use impacts? The potential magnitude will depend on the size, type, configuration, and location of the transportation improvement, on market forces, and on public policy (land use plans and public facility capacity).

Little impact — Considerable impact

1	2	3	4	5

For a more detailed evaluation of indirect impacts, see the Guidebook, particularly Table 3.2 on page 35.

The answer to item 3, by itself, is not definitive regarding whether a project should be classified as an Action of Type Class 1, 2, or 3. That determination depends on combining the analysis of many different categories of impacts (See the previous Worksheet for Part 3).