ECONorthwest
ECONOMICS • FINANCE • PLANNING

Phone • (503) 222-6060
FAX • (503) 222-1504
info@econw.com

Suite 1600
222 SW Columbia
Portland, Oregon 97201-6616

Other Offices
Eugene • (541) 687-0051
Seattle • (206) 622-2403

19 August 2010 Project #: 20282

TO: **Southeast Corridor Project grant applicants**
FROM: **Terry Moore and Steven Carter**
SUBJECT: **TECHNICAL MEMORANDUM ON BENEFITS AND COSTS SOUTHEAST CORRIDOR PROJECT: CONNECTING COMMUNITIES**

1 INTRODUCTION

Several agencies in the Portland metropolitan area are jointly pursuing a TIGER II Discretionary Grant from the U.S. Department of Transportation (USDOT). The partnering agencies are TriMet, Portland Development Commission (PDC), City of Portland Bureau of Transportation (PBOT), City of Milwaukie, and Portland Metro (Metro).

The "Southeast Corridor Project: Connecting Communities" proposal has five elements. They are varied in their scope, but they are mainly not traditional road projects:

- **Relocation of S.E. Water Ave**. Constructs 1,300 feet of roadway to realign a major intersection, improve freight movement, and facilitate intermodal transit access.
- **Oregon Pacific Railroad and Yard Improvements**. Facilitates the S.E. Water project above, and creates safer routes for cyclists.
- **Clinton Multi-use Path**. Creates 2,000 feet of new bicycle and pedestrian pathway connecting to other existing multi-use pathways.
- **Rhine Pedestrian Bridge**. Reconstructs pedestrian bridge crossing over the freight and passenger railways.
- **Kellogg Lake Bridge.** Constructs a pedestrian and bicycle bridge as an addition to a planned light-rail bridge spanning Kellogg Lake.

The USDOT has defined the long-term outcomes it expects from projects using TIGER II funding:[1]

[1] See Federal Register Vol. 75 No. 104 pgs 30463-30464

- **Economic Competitiveness**. The nation, region, or metropolitan area will become more competitive economically, mainly by reducing transportation costs of economic activity.
- **Livability**. A transportation project may better connect people and increase a sense of community.
- **Safety**. Measurable safety benefits come from the reduction of collisions by vehicles (including bicycles) and pedestrians.
- **State of Good Repair**. This benefit derives from the reduction of future maintenance costs of the facility, and improved reliability due to reduced maintenance service activities. These benefits can be capitalized into the future via reduced costs of operation, maintenance, and travel time.
- **Sustainability**. This category could have a large number of potential effects, but the grant application guidance defines it narrowly to cover air emissions. By reducing VMT and congestion, and changing the emission characteristics of vehicles, emissions of pollutants and greenhouse gases can be reduced.

Applications must show how proposed projects address these outcomes. In addition to being long-term outcome goals, these five points are also in Appendix A of the notice of funding availability (NOFA) as benefit categories. The NOFA requires that applications present a benefit-cost analysis for proposed projects.

To assist in addressing this requirement, the partner agencies hired ECONorthwest (ECO), a consulting firm with substantial experience in the application of the principles and techniques of benefit-cost analysis (BCA) to transportation investments.

This memorandum describes the principles, methods, data, and analysis used to address these requirements for economic evaluation. It has three additional sections:

- **Section 2, Framework**, describes the theory, principles, and methods relevant to an evaluation of the benefits and costs of the types of projects being proposed (e.g. alternative transit). It addresses the assumptions made within and limitations of each methodology used, as well as how it relates to the categories of TIGER II.
- **Section 3, Context for the Evaluation,** summarizes (1) how the proposed projects fit into a vision and capital facility program for a larger area that comprises them, and (2) demographic and socioeconomic data about that area.
- **Section 4, Analysis of the Proposed Project**, applies the principles and methods described in Section 2 to make estimates of the projects benefits and costs. It documents assumptions and calculations.
- **Section 5, Synthesis**, comments on how to interpret the results of each project into the context of the entire portfolio of projects.

2 FRAMEWORK

Staff at ECONorthwest are well informed about state-of-the-practice techniques for benefit-cost analysis in transportation, and the difficulties and inherent limitations in applying them. We were primary authors of recent guidebooks for the Transportation Research Board of the National Academies on how to do BCA for highway projects and for transit projects.[2]

Benefit-cost analysis (BCA) seeks to measure and compare benefits and costs of a particular action, and to compare them across alternative actions. For most complicated decisions about public investment and policy, benefits and costs are numerous and measured in different units. For transportation projects, for example, they might be measured as travel-time saving, vehicle-hours of delay, crashes, parts per million of pollutants, and so on. Thus, a comparison of benefits and costs always includes some attempt to convert tangible or intangible benefits into a common unit of measure. That common unit is typically dollars, and that conversion is referred to as “monetizing“impacts.

In transportation planning in the U.S., BCA is talked about much more than it is applied. There is no debate that transportation projects create both benefits and costs, and there is not much disagreement about what the broad categories into which those impacts might be categorized. But the measurement and standardized analysis per the theory of full benefit-cost analysis is hard work conceptually, takes a lot of time, and is often dismissed by policymakers who prefer what they consider a more intuitive approach to project analysis and selection (e.g., a description of impacts they care about, brought together into a matrix that they can discuss).

The relatively few cases where BCA techniques have been rigorously applied have addressed mainly **highway transportation projects** (e.g., a new highway, road, or bridge; additional lanes; improved signalization). For these projects, the main benefits are usually reductions in travel time, travel costs, and crashes for motor vehicle users. Standard practice in computing these benefits involves assigning each user-vehicle class a value of time (in dollars per hour). These value-of-time figures are well established by USDOT. Then, total travel costs are estimated before a project and after a project using vehicle volumes, total travel time, and value of time. The difference in total travel costs of the before and after case is a partial estimate of the monetary benefits of a highway project.

Other impacts (which may be costs or benefits, depending on how a project performs) included those on safety (the number of crashes and resulting fatalities, injuries, and property damage), the environment (especially in air emissions: both pollutants and

---

[2] ECONorthwest is the primary author of AASHTO *Redbook Manual for Highway User Benefit Analysis* (2004, with third edition forthcoming in 2010) and TCRP *Report 78: Estimating the Benefits and Costs of Public Transit Projects: A Guidebook for Practitioners* (2003).

carbon), the economy (often, but not always, a different way of enumerating the basic transportation benefits and costs), and the municipal fiscal situation.

BCA evaluation of **alternative transportation projects** is similar in concept, but the techniques are less well developed. In concept, the impact categories are similar: there are direct transportation benefits, obtained by making investments in a project (i.e., by incurring monetary costs), and the construction and operation of the project then has secondary impacts[3] on the environment, land use, the economy, and other things people care about. But while travel-demand models are well developed for auto and truck trips, they are less well developed for transit, and relatively new and undeveloped for bike and pedestrian trips. Thus, the benefits of those projects are not primarily about decreases in travel time for the users of alternative modes. Proponents of alternative modes point to secondary benefits like reduced air emissions, increased livability, and health benefits from the increased exercise associated with non-motorized travel.

The complications of rigorous BCA are many and apply to both highway and alternative modes. Increasing attention is being paid to "sustainability," which reinforces the need to fully evaluate life-cycle costs, to consider and quantify effects that occur even farther in the future, and to weigh the tradeoffs of projects that might have higher capital costs now but lower operating costs in the future. If the project has, as part of its scope, a potential to improve the state of repair of the facility, the future reduced maintenance costs can, together with the present construction costs, be compared to the "do nothing" case of continued repair of the existing facility. Using reliable forecasts of future costs, these figures can be discounted (following standard discounting guidelines) and compared in present dollars. Standard issues about proper discount rates, quantifying and monetizing externalities, avoiding double counts, weighting non-monetizable effects, incorporating distributional impacts, dealing with interdependent projects: all of these and more are still around and will never be definitively resolved.

Given those points, we concluded that our analysis should (1) conform to the principles of BCA, (2) list the full range of potential categories of benefits and costs that might be generated by transportation projects, (3) identify which of those categories of impacts are most likely to be significant for any of the five proposed projects, and (4) try to quantify those impacts approximately but in a consistent way. The rest of this section addresses items 1 and 2. Section 3 addresses items 3 and 4.

Most BCA guidebooks for transportation categorize benefits and costs using some variation of the following:

[3] Secondary in the sense of subsequent, not necessarily less important.

- **User impacts**. These are the ones that accrue directly to travelers and shippers as they use transportation facilities. The benefits are that trips are faster, more reliable, safer, more convenient, more comfortable, or cheaper. To get those new benefits, there are direct costs for new facilities, vehicles, and programs. Some of those costs are paid via taxes and fees; others are paid privately (e.g., the purchase of vehicles; time spent driving). The direct costs may be up-front for capital construction, or paid over time for operation and maintenance. A key tradeoff here relates to life-cycle cost: does paying more now for a better facility payoff over the long-run with reduced maintenance?
- **Non-user impacts**. The construction and operation of new facilities can affect people who do not use them. Those impacts many benefits (e.g., better travel brings more customers to a retail store) or costs (e.g., highway noise and pollution). Critical to any benefit cost analysis is the attempt to identify, describe, quantify, and monetize *externalities* (impacts that are external to normal market transactions), especially negative ones: for example, carbon emissions and the resulting impacts on climate and, ultimately, on human well-being. In other studies, ECONorthwest has subcategorized these impacts as those relating to the economy, the environment, land use, and other amenities and social objectives.

Many of these benefits and costs are embedded in the five evaluation criteria in the TIGER II grant process—three primarily address user benefits; two primarily non-user benefits and disbenefits (though there is overlap in many places, especially between Economic Competitiveness and Livability regarding transportation benefits):

User impacts

- **Economic Competitiveness.** Does the proposed transportation improvement deliver travel benefits that exceed its costs? If so, there are, by definition, gains in economic efficiency and competitiveness is improved. Consistent with theory, FHWA notes that projects that have more than *local* effects (e.g., regional, national, or international ones) will, all else being equal, have a greater effect on economic competitiveness.
- **Safety**. Measurable safety benefits from the reduction of collisions (and therefore, of fatalities, injuries, property damage, and delay) are typically included in a full BCA.
- **State of Good Repair**. In the context of BCA, this criterion would be handled as a current expenditure that is judged to more than offset future expenditures on operation, maintenance, and preservation (OMP). This is a "life-cycle cost" idea.

Non-user impacts

- **Livability.** This category is a broad one that could cover everything that listed above as non-user impacts. It could also double count user impacts, since a subset of livability is more walkable and bikeable neighborhoods. The TIGER II grant application material appears to have a narrower definition in mind: a project should better connect people (double count on user benefits) and increase a sense of community (very hard to quantify, much less monetize). It specifies addressing the distribution of benefits and costs across income groups.

- **(Environmental) Sustainability.** Though sustainability could cover many benefits and costs,[4] the guidance in the Notice of Funding Availability limits its discussion to air emissions: pollutants and carbon dioxide (CO_2, greenhouse gas).

Guidelines for the TIGER II grant applications note the interest in transparent BCA calculations that can be easily followed and replicated. Each step in the calculation must be justifiable through best practices, or justify reasonable assumptions regarding any subjective adjustments to existing data. We try to meet those standards, consistent with the framework we have described, in the Section 4.

3 Context for the Evaluation

The five elements that the proposed project comprises fit into a larger context of development plans and local demographics. This section describes both to provide a basis for evaluation the benefits and costs of the projects in Section 4.

3.1 Development and public facilities

Oregon and Portland have a justified national reputation for being leaders in comprehensive planning. Independent of whether that planning leads to greater net benefits for the region's residents than they would have enjoyed in the absence of that planning (the agencies making this grant application strongly believe that it does), the undeniable facts are (1) the Portland region does orient its public investment and economic development strategies around these plans, and (2) the Southeast Corridor—which extends from central Portland to central Milwaukie, and is where the project is located—is expected to accommodate growth.

The promotion of growth and infrastructure development in the Southeast Corridor is consistent with Metro's 2040 Growth Concept, which hopes to promote compact development for efficient use, non-automotive trips, and reductions in air and water pollution. It supports the City of Portland's Economic Development Strategy to create 10,000 jobs in the next five years, provide employment opportunities for neighborhood residents, and provide successful neighborhood-based businesses with access to national and international markets. Embedded in these broad goals are more specific policies aimed at helping existing and new businesses, creating jobs, encouraging redevelopment and increased density, and providing affordable housing in well-established neighborhoods.

[4] Many of the potential benefits and costs are already covered under other headings: e.g., life-cycle costs, state of good repair, and various aspects of livability.

Portland has made "green" and "livability" part of its economic development strategy. It is hoping to attract and expand businesses that can make Portland work for them because it works for an important part of its labor force: relatively young, creative, and attracted to the greenness and urban amenity of Portland's close-in neighborhoods.

To accommodate growth consistent with these objectives, the region has planned significant investments in public facilities:

- The 3.3-mile Portland Eastside Streetcar Loop project is under construction on the Broadway Bridge and along the Martin Luther King Jr. Boulevard-Grand Avenue couplet. Further tracks are planned to extend south on the couplet to the Oregon Museum of Science and Industry (OMSI) and across a planned transit bridge to the South Waterfront, connecting to the existing streetcar line.
- The 7.3-mile Portland-Milwaukie Light Rail is planned to connect the downtown University District to the Central Eastside, Milwaukie and north Clackamas County.
- More and better bike and pedestrian facilities.
- A six-mile Trolley Trail is planned to connect with other trails in the area to form a 20-mile loop in East Portland, Milwaukie, Gladstone, Oregon City, and Gresham.

That is the context into which the proposed project must be placed. None of the project's five elements, by itself, makes or breaks the plan for quality development in the Southeast Corridor. But collectively these improvements and others like them are essential infrastructure for the kinds of livable neighborhoods and economic development that Portland is trying to create.

3.2 DEMOGRAPHICS

The five elements of the proposal affect different areas of the Southeast Corridor and the Central Eastside depending on the mode of transportation and the scope of the improvement. For the purpose of demographic analysis, Metro summarized the impact area for each project using Multnomah and Clackamas County census tracts.[5] The census tracts approximating each impact area for each project are as follows:

- **Relocation of SE Water Avenue** and **Oregon Pacific Railroad and Yard Improvements**: Multnomah County tracts 10, 11.01, 11.02, 12.01, and 12.02. The SE Water Avenue and Oregon Pacific Railroad projects have the same projected area of impact, so they are treated as the same area for demographic analysis.
- **Clinton Multi-use Path**: Multnomah County tracts 1, 2, 3.01, 3.02, 4.01, 4.02, 5.01, 5.02, 7.01, 7.02, 8.01, 8.02, 9.01, 9.02, 10, 11.01, 11.02, 12.01, 12.02, 13.01, 13.02, 14, 15, 16.01, 86, 87, and 88

[5] All relevant Multnomah County tracts are numbered 88 or below; Clackamas County tracts are 208 or above.

- **Rhine Pedestrian Bridge**. Multnomah County tracts 9.01, 9.02, and 10
- **Kellogg Lake Bridge**. Clackamas County tracts 208, 212, 213, and 214
- **Southeast Corridor.** Every tract listed above plus Clackamas County tracts 9, 10, 11, 15, 16.01, and 16.02

Table 1 shows Metro's Household Forecast for 2005 and 2030 for segments of the Southeast corridor.

Table 1. Household forecast, corridor segments, 2005 and 2030

Metro Household Forecast, 2005 and 2030			
District	**2005**	**2030**	**Change**
Lloyd District/Central Eastside	6,100	11,670	91%
South Portland	2,250	7,210	221%
Inner SE Portland	14,050	14,500	3%
Milwaukie	18,180	20,480	13%

Source: South Corridor Portland-Milwaukie Light Rail Project
Supplemental Draft Environmental Impact Statement

Table 2 shows population for the Water/OPR, Clinton, Rhine, Kellogg, and SE Corridor Project areas in 1990, 2000, 2008, and projected 2013, as projected by Claritas.

Table 2. Population, various project areas, 1990, 2000, 2008, and 2013

					Change 2000-2008		
Project Area	**1990**	**2000**	**2008**	**2013**	**Number**	**Percent**	**AAGR**
Water/OPR	16,402	16,037	15,028	14,485	-1,009	-6%	-0.81%
Clinton	110,262	111,257	109,795	109,500	-1,462	-1%	-0.17%
Rhine	13,596	13,459	12,717	12,333	-742	-6%	-0.71%
Kellogg	17,188	18,001	17,605	17,541	-396	-2%	-0.28%
SE Corridor	153,445	158,355	157,386	157,874	-969	-1%	-0.08%

Source: Claritas, 2008

While the Claritas model projects a declining population, regional land use plans and local policy call for accommodating growth as projected by Metro within the existing urbanized area, particularly areas designated for increased intensity such as the central city, town centers (Milwaukie) and light rail station areas.

Table 3 shows per capita income in the five project areas and the Portland Metro Area in 2000 and 2008. Only the Water/OPR area has a higher per capita income than average in the Portland Metro Area. Income in the Rhine area was the lowest by a significant amount despite growing faster than in any other from 2000 to 2008.

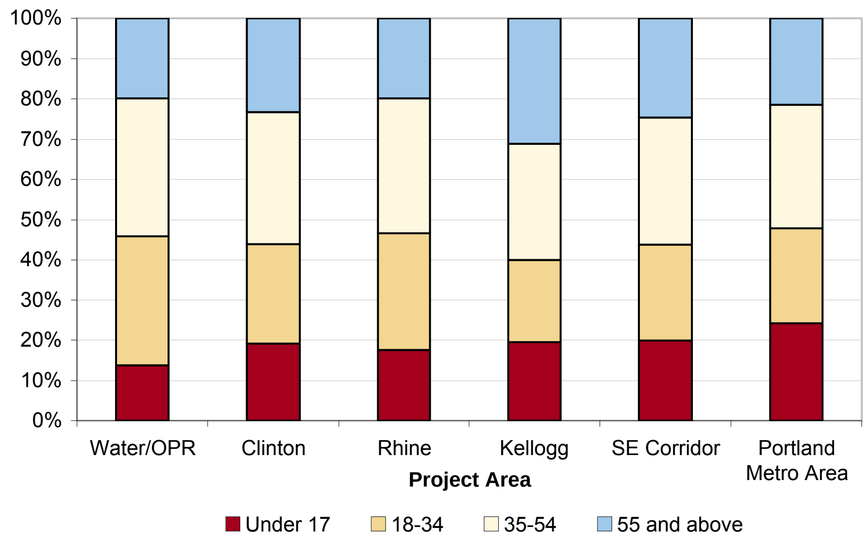
Table 3. Per capita income, various project areas, 2000 and 2008

Project Area	2000	2008	Change 2000-2008 Number	Percent	AAGR
Water/OPR	$23,129	$28,473	$5,344	23%	2.63%
Clinton	$21,466	$26,281	$4,815	22%	2.56%
Rhine	$19,183	$24,499	$5,315	28%	3.10%
Kellogg	$24,192	$27,221	$3,029	13%	1.49%
Corridor	$21,462	$25,702	$4,240	20%	2.28%
Portland Metro Area	**$23,298**	**$27,355**	**$4,057**	**17%**	**2.03%**

Source: Claritas, 2008
Note: Portland Metro Area consists of Multnomah, Washington, Clackamas, Columbia, Yamhill, Clark, and Skamania Counties

Figure 1 shows age in the five project-element areas and the Portland Metro Area in 2008. Kellogg had the highest proportion of residents above the age of 55 at 31% compared to just 21% in the Portland Metro Area. Every project area had a lower proportion of residents under the age of 17 than the Portland Metro Area at 24%.

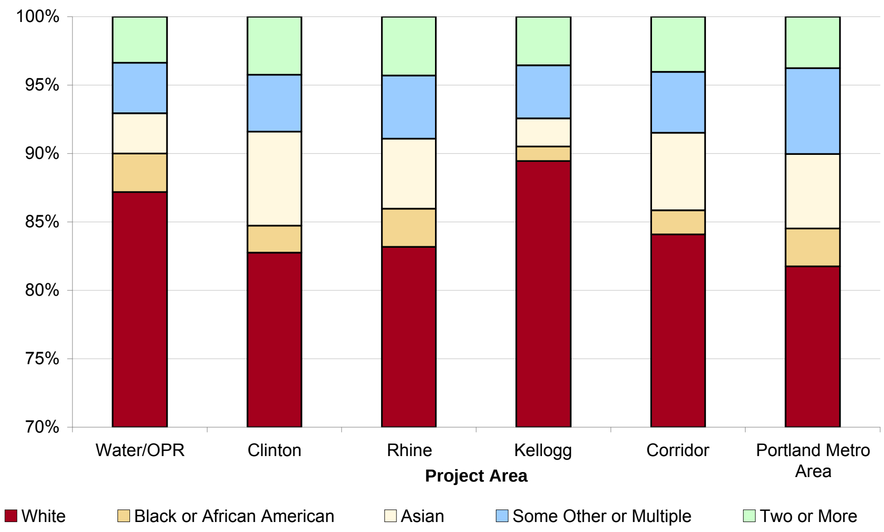
Figure 1. Age, various project areas, 2008



Source: Claritas, 2008
Note: Portland Metro Area consists of Multnomah, Washington, Clackamas, Columbia, Yamhill, Clark, and Skamania Counties

Figure 2 shows race for residents of the project-element areas and the Portland Metro Area. Kellogg (86%) and Water/OPR (87%) had the highest proportions of white residents, compared to 83% in Clinton and Rhine and 82% in the Portland Metro Area. The proportion of the population who were Black or African American was below 3% in all geographies.

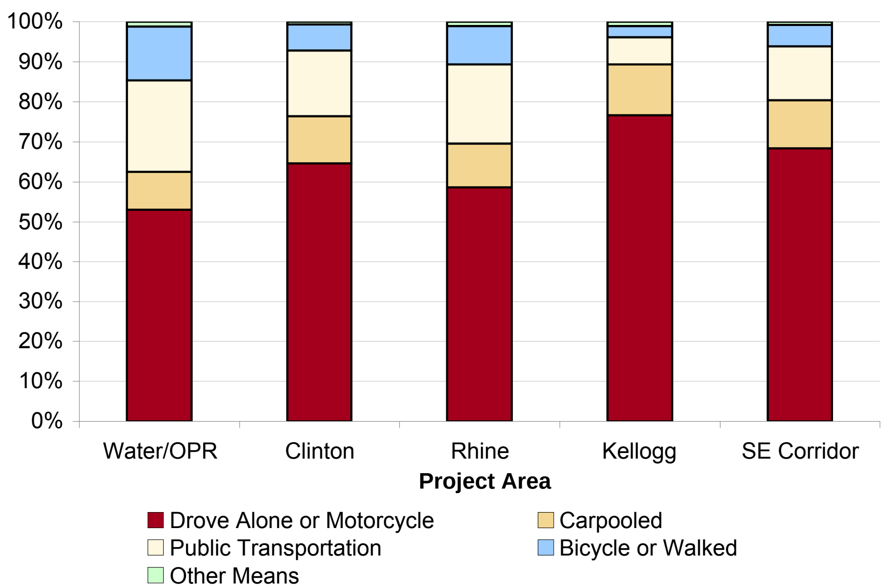
Figure 2. Race, various project areas, 2008



Source: Claritas, 2008
Note: Y-axis truncated to improve readability

Figure 3 shows method of transportation to work for commuting residents of the project-element areas in 2008. Just 53% of commuting workers in the Water/OPR area drove alone or rode a motorcycle to work, compared to 77% in Kellogg and 68% in the Southeast Corridor. Instead, these residents walked and used public transportation and bicycles in greater numbers.

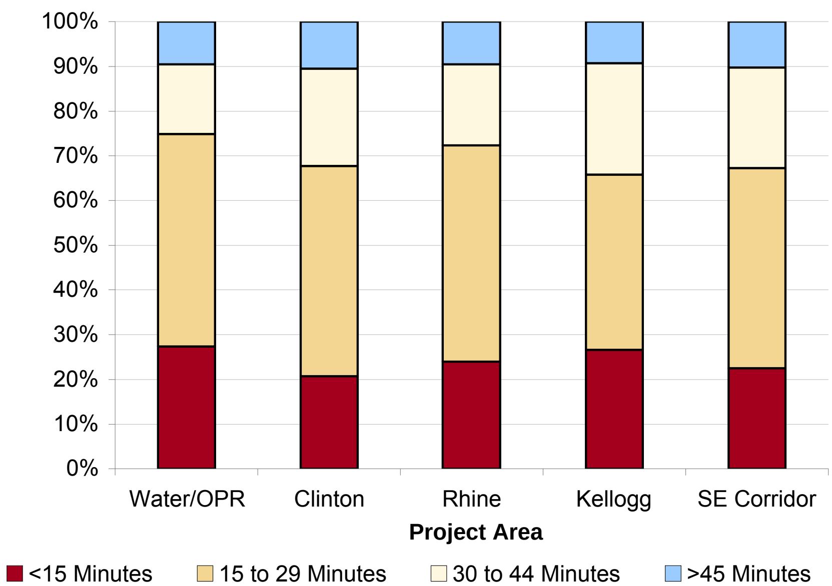
Figure 3. Method of transportation to work, various project areas, 2008



Source: Claritas, 2008

Figure 4 shows travel time to work for commuting residents of the project-element areas in 2008. Commute times were fairly similar for all project areas, though slightly more residents had commutes less than 15 minutes in the Water/OPR and Kellogg areas (27%) than in Rhine (24%), Southeast Corridor (22%), and Clinton (21%). Despite a higher than average proportion of residents with short commutes, residents of Kellogg were the most likely to have a commute of 30 minutes or more.

Figure 4. Travel time to work, various project areas, 2008



Source: Claritas 2008

In summary, the main points about the demography of the Southeast Corridor relevant to this analysis:

- It is mainly an inner-city area that is largely developed with a mix of employment and residential uses. It is not forecasted (by Claritas) to grow much in population over the next five years, though other sources (including those used by the regional agency) forecast more growth. If the light rail projects and other public investments consistent with public policy occur, then more growth is certainly possible. Per capita income is lower in the Corridor (and in three of the five project areas) than in the metropolitan region. Thus, the projects generally meet local goals to provide services to areas where households have relatively fewer economic resources.
- Age profiles can be hard to interpret because the percent differences in age cohorts often relatively small. But we will risk a few observations. Water / OPR (and to a lesser extent Rhine) has a large cohort in 18 -34 age bracket, is also relatively high in the 35 – 54 age bracket, and is relative low in the under 17 bracket. The 18 – 34 bracket is a prime cohort for bike and walk travel (because of physical abilities, lower average income, and lower rates of family formation). The lower percentage under 17 supports the same conclusion.

- Four of the five project areas (the exception is Kellogg) have higher rates of work trips by alternative modes than the Corridor has a whole. Thus, it appears that the projects are located in places where they are most likely to be used.

4 ANALYSIS OF THE PROPOSED PROJECTS

In concept, each of the five project elements could have impacts (positive or negative) in any of the five categories of evaluation criteria. To focus ECONorthwest's analysis, agency staff made a preliminary judgment about whether the impacts of each project would be high, moderate, or low for a given criterion. Table 3 shows those judgments.

Table 3. Preliminary judgments about potential project impacts.

	Economic Competitivene	Safety	State of Good	Livability	Sustainability
SE Water Ave.	medium	medium	medium	high	medium
OPR and Yard	medium	medium	low	low	low
Clinton Multi-Use Path	low	high	low	high	medium
Rhine Pedestrian Bridge	low	high	medium	high	low
Kellogg Lake Bridge	low	high	low	high	low

In the analysis that follows we focus primarily on the benefit areas that that project aims at: economic competitiveness, safety and livability.

4.1 OVERVIEW OF METHODS

There are too many types of impacts to be able to address all of them for each of five elements the proposed project comprises. Thus, we consolidate in this report as follows:

- **Economic Competitiveness.** The primary focus on is on travel benefits to transportation users (especially more capacity and decreased travel time), and agency construction costs. We do not address work zone disbenefits during construction (e.g., *increases* in travel time) or life-cycle maintenance costs (which we address, mainly qualitatively, under *State of Good Repair)*. The secondary focus is on indirect benefits to land development and economic development: is a project likely to increase either in ways that local policy desires and might have broader state or national effects on economic competitiveness? Regarding costs, we do not provide analysis project by project, but summarize our estimates for all projects in Section 5.
- **Safety**. The focus is on reduction of collisions (and therefore, of fatalities, injuries, property damage, and delay).
- **State of Good Repair**. The analysis here depends on the project. For a new facility that does not replace an existing facility, the focus is whether the project will create a new facility whose design, technologies and materials will make the investment more efficient over the long run. The analysis would include a consideration, at least qualitative, of life-cycle costs: for a given amount of benefits, is the present discounted value of construction, operation, maintenance, preservation (OMP), and decommissioning cost low relative to other options? For

a new facility that replaces a similar facility, an additional question is whether the old facility was at a point in its lifecycle where replacement is efficient. Will the replacement or improvement reduce long-run maintenance and operating costs (including private operating costs)? We do not have data on operation, maintenance, and preservation costs, so the analysis is mainly qualitative, though we do make some ballpark estimates of OMP costs in Section 5.

- **Livability.** Many of the benefits of expanding facilities for alternative modes of travel fall into this category. The TIGER II grant application material suggests that a project should better connect people and increase a sense of community, and that such connections are more valuable if they accrue to groups identified as deserving of special consideration (e.g., low-income households).
- **(Environmental) Sustainability**. The focus of the guidance in the NOFA is on air emissions: pollutants and carbon dioxide (CO_2, greenhouse gas). These may be benefits or costs (disbenefits) depending on whether a project causes them to decrease or increase, either absolutely or relative to alternatives.

For each category of effect there are many possible effects (positive and negative) and multiple ways to try to measure each effect. An initial description of effects is typical in "natural units": the units that one naturally thinks of when discussing the effects (e.g., minutes of delay, miles per hour, crashes per year, miles, jobs, square feet of built space, parts per million). We describe those effects—to the extent that data and theory allow—for each project. But for even a cursory benefit-cost evaluation, one must take a next step: converting where possible the natural units to a monetary (dollar value).

Thus, our methods, and the organization that follows, do the following for each category of effects, for each project:

- Describe the type of effect and the reason to expect it
- Where possible, try to estimate the size of the effect in natural units
- Describe the values being used to monetize the effects. We provide more detail about the methods for monetization for the first project (Water Avenue) and then simply apply the factors we have documented to the subsequent projects.

4.2 SE WATER AVE REALIGNMENT

Realigning SE Water Avenue would consist of about 1,300 feet of two-lane roadway with bicycle lanes and sidewalks. Currently, SE Water Avenue intersects property owned by OMSI and the Portland Opera, and its removal allows expansion of the institutions and redevelopment of others in the area. Expansion of OMSI and the Portland Opera would be centered on a pedestrian and bicycle plaza with access to the streetcar and MAX. The relocation would protect and enhance freight mobility and would connect to local and regional bike and pedestrian routes, supporting new multi-modal connections to jobs and cultural and educational opportunities.

4.2.1 Economic Competiveness

The SE Water Avenue realignment would be expected to have some impacts on economic competitiveness. It has those effects by:

- Decreasing travel time. The project improves the intersection. Estimates are that all vehicles, during peak travel periods, using Water Avenue will reduce travel time for motor vehicles by 31 seconds per vehicle. We have counts for Water Avenue for the three morning and three evening peak hours, for cars (total: 2,263) and trucks (251). From other sources we can observe that the six peak hours in urban areas account, on average for about 50% of the trips: we assume that ratio for Water Avenue. All these assumptions lead to an average daily time savings for cars of about 40 hours and for trucks of about 4 hours. We assume that because of the retail, community college, and museum, weekend travel volume is somewhat different from weekday travel for cars, but significant less for trucks (we assume 30 hours of savings per day for cars and 1 hour for trucks). Thus, cars save about 13,500 hours per year and trucks save about 1,200 hours per year. Using guidelines suggested in the Federal Register for values of time ($24.04 per hour for trucks, $14.32 per hour for cars), the total monetized benefit of travel time savings is about $222,000 per year (assuming 250 working days in the year). Assuming a 3% annual growth rate of the benefits, a 30-year facility life, and a real discount rate of 7% (per guidelines in the Federal Register),[6] the total discounted benefit is about $4 million for vehicle time savings.

- In addition to motor vehicle benefits, cyclists will experience a reduction in travel time of 91 seconds and pedestrians will experience a reduction of 102 seconds. The SE Water Avenue project includes safer bike facilities as well as improvements in travel time for bicycle trips, which might lead to a shift in mode split from automobile trips to bicycle trips. We lack baseline data, however, for making any firm projections of the shift in trips. Counts done by Kittelson in January 2009[7] showed, effectively, no bike or pedestrian traffic at Water and Clay during the AM peak: obviously we cannot generalize from those data to assume no trips by those modes, but the numbers are probably small and the value of the travel-time savings is probably on the order of a few tens of thousands of annually. Over the life of the project it might add a few hundred thousand dollars in present discounted value of travel-time savings to our admittedly crude estimate of $4 million for motorized vehicles.

---

[6] 7% seems high to us for a *real* discount rate for public projects; we have typically used (based on ample documentation) something closer to 3%. The effect of using 7% is to reduce the present value of a future stream of benefits or costs. For example, a 30-year stream of benefits in real dollars of $1 million per year has a present discounted value of about $12 at 7%, and $19 at 3%. Nonetheless, the federal guidance is clear: we use 7%.

[7] Kittelson and Associates, 25 January 2009, "Portland Central Eastside Street Plan, Existing Transportation Conditions Analysis." Attachments.

- Facilitating development on adjacent lands. The project provides new access and allows for the consolidation of key parcels. The current route of SE Water Avenue bisects both the OMSI and Portland Opera properties. Its removal allows for expansion of both facilities to be centered on an inviting pedestrian and bicycle plaza serviced by streetcar and light rail transit. OMSI plans about 1.3 million gross leasable square feet (mainly office, with some retail) and the Portland Opera plans to use a brownfield site for an opera house (1,800 seats) and offices (50,000 square feet); 24 short-stay apartments; 350,000 gross leasable square feet of office; 15,000 gross leasable square feet of retail. Their master planning to date assumes that Water Avenue will move to the east. The estimated employment of just these two projects has been estimated at around 3,500 at build out, and the development investment at around $400 million. Portland Community College is also in the immediate area. The rerouting also allows the retention of parcels zoned for heavy industrial uses south of SE Caruthers Street which might otherwise be cut by the extension of the current SE Water Avenue alignment.

The grant guidance is clear, however, that many of the economic impacts described in the previous paragraph are not necessarily (or even likely) economic benefits, and they are certainly not net benefits.[8] Counting the cost of labor as a benefit, and then compounding the error by referencing multiplier effects is not the kind of analysis that the guidance wants.

Quantitatively disentangling net benefits from all the various measures used in economic impact analysis is beyond our scope and budget. But one can get a sense of productivity increases by looking at rates of return, which for real estate development are probably now in the range of 7% to 15%. If all the profits of a development were a net gain to the national economy (i.e., but for the building a development here, it would not have been built elsewhere in the US), then the net benefit might be approximated as 10% of the value of the development. But since most developments are not strictly bound to a site and will develop elsewhere in the region or the nation if a particular local transportation project does not unlock them, the net benefits are even less. We assume that the expected value might be on the order of one tenth of the rate of return, which means that, as a broad average, about 1% of the total development value might be an estimate of net benefit. Given other projects besides OMSI and the Portland Opera that the Water Avenue project might help facilitate, and the facts that even those developments are still just plans and may not occur at all, we would put the net benefits of development in the range of $1 to $10 million.

Beyond the monetized benefits are the real but hard-to-quantify benefits of "achieving the plan." Oregon and the Portland region take their planning

---

[8] Federal Register/Vol. 75, No. 104/Tuesday, June 1, 2010/Notices page 30475

seriously. Though not always or completely successful, they try to focus their public investments in infrastructure where they want development to occur. The efficiency of such a focus can lead to real efficiencies and gains in productivity. Portland clearly has made Southeast Corridor one of several foci for development.

4.2.2 Safety

The SE Water Avenue realignment aids safety by:

- Giving non-drivers dedicated space (bicycle land and sidewalks) adjacent to vehicle lanes
- Aligning the intersection which means drivers no longer need to cross lanes of traffic
- Reducing conflicts with industrial freight movement around OMSI, which has about 1 million visitors per year, and the Portland Opera, where there will be a lot of foot traffic, and a disproportionate amount by groups more at risk: children and seniors.

It is easy to make the case that safety will be improved. But to monetize the value of such improvement, one needs some baseline notion about the number of crashes. A recent report[9] found that “Reported crashes have been relatively rare and typically not severe. Few large tractor□trailer type trucks appear to be entering or leaving the area’s key portals during peak traffic periods, but there is a significant percentage of smaller single□unit trucks.”

Thus, the project might reduce a risk that is rather small, empirically. The problem with high-value, low-probability events is that though the expected value may be small, the consequences of an event were it to occur, are high. The typical value of the loss of a life (the statistical, average value from a societal point of view, not the value to the person killed, family, or friends) is on the order of $ 6 million.[10] Injuries are typically valued as a percent of a fatality and range from Minor (0.2%), to Moderate (2%), to Serious (6%), to Severe (19%), to Critical (76%). We can only guess at the probabilities. If the project were to eliminate one fatality, a few severe injuries, and several (say 10) moderate ones over the course of a 30-year life, it might deliver a present value of benefits on the order of $5 million (because of discounting, the farther out the event, the lower its present value, so the total present value of a fatality and other injuries can easily be less than the value of just a fatality that occurs today).

---

[9] Kittelson and Associates, 25 January 2009, “Portland Central Eastside Street Plan, Existing Transportation Conditions Analysis.” page 25

[10] Per USDOT Guidance, the value of a statistical life is $5.8 million in 2007 dollars, and advise that a reasonable range is $3.2 to $8.4 million: http://ostpxweb.dot.gov/policy/reports/080205.htm

Crashes also cause property damage. A severe crash with two motor vehicles might do on the order of $20,000 to $40,000 of damage; lesser collisions might do only 10% of that. Given the assumptions in the previous paragraph, the damage would be on the order of $50,000 over the thirty-year life of the project: 1% of the value of fatalities and injuries. Given the crudeness of our estimate for fatalities and injuries, the property damage effects are just part of the error in the estimate.

If project planners have reasons to believe that the rate of fatalities and injuries will be different, they can scale off of that estimate.

4.2.3 State of Good Repair

The SE Water Avenue realignment increases the state of good repair by constructing new streets, sidewalks, and bike lanes to replace the existing street. The new alignment would be built to standards and with materials and technologies not common when the old Water Avenue was built about 15 years ago. Since the old Water Avenue is not rebuilt or abandoned, its investment gets to live out its expected useful life.

4.2.4 Livability

The SE Water Avenue realignment increases livability because a main intersection will be more attractive and better aligned (which will allow easier crossing), and noise (especially truck noise) will be moved off of the old Water Avenue alignment which will now be used for bicycles and pedestrians. Bicyclists and pedestrians will have dedicated space and direct routes, and the direct routes will lead to more users. The transportation in the area around the old and new Water Avenues will be improved—a hierarchy of streets will improve connectivity (including to the new light rail and streetcar stops), wayfinding, and amenity for different modes, and reduce conflicts among them.

Hundreds of studies have addressed and tried to estimate the economic value of increased urban amenity. Hedonic pricing studies have tried to isolate the value of reduced noise, proximity to parks and bike paths, and so forth. The assumption, supported by theory and empirical work, is that the value of the amenities get capitalized into property values

For example, the effect of increased noise levels on property value is well-researched, and the relationship is strongly established as negative. The difficulty in assessing such impacts comes from the multitude of interfering forces pushing property values in different directions. A freeway through a more rural area would bring an increase in traffic noise, but it would also bring benefits of improved accessibility that would have a positive effect on property value. A new freeway in an urban area increases traffic noise and at the same time increases pollution and exposure to it for a large number of people. Separating these impacts, regardless of whether they push property values in the same direction or have opposite effects, is difficult. Among the studies we reviewed on noise was one on the impacts of noise from road traffic on property values that included 18 reports covering 28 study areas. The study found a simple mean of a 0.55% decrease in property value per decibel of noise.[11] But we lack any detailed noise studies for these projects. Moreover, any effects will be localized: they will be smaller than the project study area (which is defined to include larger travel-time benefits) and are not tied to any standard reporting units.

Similarly, studies of parks and open space have tried to isolate their value.[12] One study found that homes within 1,500 feet of urban parks sold for 2% more than those that were not, holding all else constant.

An alternative to using observed behavior ("revealed preference") is to use "stated preference" for valuation: what do people say they would pay for the amenity? Here too we lack the data, but it is a little easier to hypothesize values that would allow crude estimates. Consider this thought experiment.

Assume that people nearest to the improvements benefit the most. Assume that they might be willing to pay some amount per month to enjoy all the non-travel benefits that the project delivers (the travel benefits are already covered under Economic Competitiveness). Think of it like a homeowner or property owner association: what would they pay for the additional amenity. Note that they are already paying a lot for amenities that they probably consider more valuable: water, electricity, sewerage, telecommunications, and most of them already feel financially burdened. In that context, what might they be willing to pay per year to get the new value?

Among the problems is that many of the beneficiaries are not local property owners: they are visitors to the area. So one could, for example, try to estimate what each of the 1 million visitors to OMSI might pay for a safer, more walkable area. But they think of their trip in terms of total experience and admission and parking costs. Arguably, OMSI and other businesses are capturing the value of the amenity in the price and amount of ticket sales. That reasoning suggests asking businesses what the value of the amenity is—their answer would be based in an assessment of net revenue (profits).

In summary, we do not feel that we have the data or budget to estimate the value of the livability effects. Even if we were to estimate them, it would take extensive work to isolate their net benefits, since many of the beneficiaries are paying, at least in theory, for the value of those amenities in higher land prices, rents, and retail prices. Basic theory in land economics is relatively well established that ultimately the beneficiaries

---

[11] Bateman, I., B. Day, I. Lake, and A. Lovett. 2001. "The Effect of Road Traffic on Residential Property Values: A Literature Review and Hedonic Pricing Study." Scottish Executive Development Department. January.

[12] Bolitzer, B. and N.R. Netusil. 2000. "The Impact of Open Spaces on Property Values in Portland, Oregon." *Journal of Environmental Management*. 59: 185-193. Lutzenhiser, M. and N.R. Netusil. 2001. "The Effect of Open Spaces on a Home's Sale Price." *Contemporary Economic Policy*. 19(3): 291-298.

of those amenity improvements should be the landowners as the value of the amenities gets capitalized into the price of land (and, thus, into sales price and rent).

4.2.5 Sustainability

The SE Water Avenue realignment aids environmental sustainability by reducing the tailpipe emissions of pollutants and greenhouse gases as a result of (1) travel time savings, and (2) a shift from single-occupant auto trips to walking, biking, and using public transportation.

While we do not have modeled estimates of the mode split effect of the realignment, some back-of-the-envelop calculations suggest that the monetized benefits of emissions reductions are small. We start with the same assumptions used for calculating the value of travel time to calculate that there are about 1.8 million trips by car per year[13] and about 140,000 by truck. The distance reduced by the new alignment is 450 feet (.085 miles). Total reduction in VMT is about 150,000 miles per year for cars and about 12,000 miles for trucks. The reduced miles will be traversed at an average speed of 15 miles per hour, which produces approximately 644 grams of CO_2 per mile for cars, and 2,733 grams per mile for trucks. [14] There are 1,000,000 grams per metric ton, so given the VMT and average speed, 96.6 tons of CO2 are reduced from vehicle travel and 32.7 tons are reduced from truck travel. Department of Energy guidelines[15] suggest that the social value of carbon reduction is $35.10 per ton. Thus, the total annual benefit of carbon reduction is $4,541. Assuming benefits grow at 3%, discounted benefits through the year 2040 amount to $81,000.

It is also possible that some drivers will switch to other modes because of the new alignment. But (1) we have no estimates, and (2) as described above, walk and bike trips are a relatively small share of total trips, so the effect will be a small percentage of that shown for trip length reduction, which is already small relative to other benefits and costs.

4.3 Oregon Pacific Railroad and Yard Improvements

The Oregon Pacific Railroad (OPR) and Yard Improvements project would relocate the OPR Yard and rail track and allow for the proposed realignment of SE Water Avenue and bike lanes. The project would reconstruct 3,700 feet of short-line freight rail and accommodate improvements to the rail yard.

---

[13] 2263 in AM peak x 2 = 4426 per week; weekend at 75% of week day = 3,320.

[14] These values 644 and 2,733 are linearly extrapolated from the speed block emissions guidelines used in the Puget Sound Regional Council travel benefits model.

[15] http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/sem_finalrule_appendix15a.pdf

The new configuration would also benefit the Portland-Milwaukie Light Rail project, streetcar lines, and the new Willamette River bridge, as well as make room for the Oregon Rail Heritage Foundation museum.

4.3.1 Economic Competiveness

This project element has two different types of effects on economic competitiveness:

- Direct effects on freight movement. By using the land in Brooklyn Yard more efficiently, the land has more capacity to handle multimodal freight activity. Operators estimate that they can increase their capacity by 20%. However, because baseline capacity was not available for use in this analysis, we are unable to monetize the value of this increased efficiency.
- Indirect effects on development in the area. The amount of potential development in the Water Avenue area was described above in section 4.2.1. Light rail obviously increases the potential, but the realignment of Water Avenue is also critical to getting various parcels consolidated into sizes conducive to development and redevelopment. In that sense, this project can claim some of credit for those land development benefits. But since (1) the general contribution of the realignment of SE Water Avenue is already estimated in section 4.2.1, and (2) all five project elements are part of a coordinated project, we think that the value of these indirect effects is already covered in section 4.2.

4.3.2 Safety

The Oregon Pacific Railroad and Yard Improvements would aid safety by:

- Eliminating at-grade railroad crossings
- Reducing conflicts during switching operations.

As for other safety issues, we have no historical data on fatalities, injuries, or property damage and presume that there have be few, if any, incidents. Thus, the present discounted value of expected future reductions in incidents over the life of the project is probably small.

4.3.3 State of Good Repair

This project element would improve the state of good repair by:

- Replacing the older, existing rail yard with a new one
- Accommodating roadway improvements.

4.3.4 Livability

The project's effects on livability come primarily from making land available for transportation improvements (SE Water, and related improvements on the existing alignment for bicycle and pedestrian improvements), which in turn provide access and land configurations conducive to the development of high-value projects that will make the area around the streetcar and rail stations more livable. As for other goals, the benefits for livability are already being described and estimated (to the extent we can) in section 4.2.4: valuing them again here would be a double count.

4.3.5 Sustainability

The Oregon Pacific Railroad and Yard Improvements would not significantly impact motor vehicle travel and emissions, except to the extent that it facilitates the SE Water Avenue realignment, whose travel and emissions benefits have been estimated separately above.

4.4 CLINTON TO RIVER MULTI-USE PATH

The existing route from Clinton Street to the Willamette River is confusing and dangerous to cyclists and pedestrians who must use at-grade railroad crossings and roads built for industrial truck traffic. Many of the streets do not have sidewalks. The Clinton to the River project would construct a 2,000 foot multi-use path for bicycle and pedestrian uses. The path would provide safe connections to other five other bicycle and pedestrian routes including the proposed Willamette River bridge.

4.4.1 Economic Competiveness

The project aims at providing benefits to bicyclists and pedestrians, not to motorized vehicles. For a project of this size aimed at those modes, one would not expect large impacts on travel time.

The planning agencies calculated the travel-time improvements for bikes. The existing route for bikes through the study area is about 3800 feet (0.72 miles). The proposed new route is about 2650 feet, (0.5 miles). At an average bike speed of 10 mph, a bicyclist would save about a minute and 15 seconds per trip, not counting savings from fewer stop signs and less traffic. There are six west-bound stop signs and five east-bound stop signs on the existing route: assume that their absence on the new route saves another minute. Thus, for every trip on the new route, bicyclists are saving about two minutes and 15 seconds compared to the old route. Roughly, every 25 trips saves an hour; every one hundred trips, four hours. At around 2,500 trips per day, that equates to a travel-time savings of about 100 hours per day. Those estimates will grow over time to approximately 12,500 trips per day by year 2030, especially after the new Willamette River transit/bike/pedestrian bridge is built. Using this metric (every 25 trips saves 1 hour), a $10 value of time,[16] an assumption of straight-line growth in bicycle trips over time, and a facility life of 30 years, the present discounted value of travel time savings for bicyclists is about $9.3 million (Table 4).

---

[16] NCHRP Report 552. 2006. *Guidelines for Analysis of Investment in Bicycle Facilities.*

Table 4. Value of travel time savings for cyclists (in 2010 $)

Year	Trips per Day	Hours Saved (1 hour=25 trips)	Total Value ($10 per hour, 250 Days)	Total Value (7% Discount)
2010	2500	100	$250,000	$250,000
2011	3000	120	$300,000	$279,000
2012	3500	140	$350,000	$302,715
2013	4000	160	$400,000	$321,743
2014	4500	180	$450,000	$336,623
2015	5000	200	$500,000	$347,844
2016	5500	220	$550,000	$355,845
2017	6000	240	$600,000	$361,021
2018	6500	260	$650,000	$363,728
2019	7000	280	$700,000	$364,288
2020	7500	300	$750,000	$362,987
2021	8000	320	$800,000	$360,083
2022	8500	340	$850,000	$355,807
2023	9000	360	$900,000	$350,365
2024	9500	380	$950,000	$343,942
2025	10000	400	$1,000,000	$336,701
2026	10500	420	$1,050,000	$328,788
2027	11000	440	$1,100,000	$320,334
2028	11500	460	$1,150,000	$311,452
2029	12000	480	$1,200,000	$302,244
2030	12500	500	$1,250,000	$292,799
2031	13000	520	$1,300,000	$283,195
2032	13500	540	$1,350,000	$273,501
2033	14000	560	$1,400,000	$263,776
2034	14500	580	$1,450,000	$254,073
2035	15000	600	$1,500,000	$244,436
2036	15500	620	$1,550,000	$234,903
2037	16000	640	$1,600,000	$225,507
2038	16500	660	$1,650,000	$216,275
2039	17000	680	$1,700,000	$207,231
2040	17500	700	$1,750,000	$198,393
Total				**$9,349,597**

4.4.2 Safety

The project increases safety by giving non-drivers dedicated space away from rail and freight traffic, and reduces the number of intersections that are the main locations for bicycle and motor vehicle crashes. However, we have neither adequate baseline data nor a means to accurately project a reduction in accidents to monetize the value of the proposed improvement to safety. Absent other information, we refer to our simulated calculations in section 4.2.2 above for an idea about the order of magnitude of the monetary benefits.

4.4.3 State of Good Repair

The project increases the state of good repair by constructing a new, more easily maintained route.

4.4.4 Livability

Improvements in travel time are addressed above under Economic Competitiveness. The travel-time savings are one measure of the increased connectivity this project provides. It connects five different bike paths to each other and to a new light rail /

bicycle / pedestrian bridge across the Willamette River. It will reduce congestion modestly by attracting some automobile drivers to switch modes, and by reducing conflicts with bicyclists and pedestrians are several street intersections and the resulting delay.

As noted above in the analysis for Water Avenue, "Livability" is hard to measure and even harder to monetize. But it is, nonetheless, the fundamental goal of this project. Connecting the various bike paths just makes sense and should be a high priority for a City that has made a reputation for itself on livability and bicycle friendliness.

4.4.5 Sustainability

The project will reduce emissions relative to existing conditions to the extent that the new bike or pedestrian trips are substitutes for motor-vehicle trips. Some will be, but others will be additional trips made because of the improved facility. In theory, there may also be benefits from improved traffic at intersections that bikes are no longer using, but those improvements are not modeled and very small.

For the purposes of this estimate, we assume that of the daily bicycle trips listed in Table 5, two percent are replacing car trips. Also, in this area, trips in motorized vehicles are likely to be approximately four miles long at an average speed of 15 miles per hour. At this speed, vehicles emit approximately 707.913 grams of CO_2 per mile, valued at $35.10 dollars per ton. Table 5 shows the present discounted value of the benefit of reduced CO_2 for the 30-year life of the facility: $46,463.48.

Table 5. Value of CO_2 reduction (2010 $)

Year	Trips per Day	Reduced Vehicle Miles (4 miles per trip)	CO2 Output (Tons per Year)	Benefit of Reduced CO2	Total Value (7% Discount)
2010	2500	200	35.396	$1,242.39	$1,242.39
2011	3000	240	42.475	$1,490.87	$1,386.51
2012	3500	280	49.554	$1,739.35	$1,504.36
2013	4000	320	56.633	$1,987.83	$1,598.92
2014	4500	360	63.712	$2,236.31	$1,672.87
2015	5000	400	70.792	$2,484.79	$1,728.64
2016	5500	440	77.871	$2,733.26	$1,768.39
2017	6000	480	84.950	$2,981.74	$1,794.12
2018	6500	520	92.029	$3,230.22	$1,807.57
2019	7000	560	99.108	$3,478.70	$1,810.35
2020	7500	600	106.187	$3,727.18	$1,803.89
2021	8000	640	113.267	$3,975.66	$1,789.46
2022	8500	680	120.346	$4,224.13	$1,768.21
2023	9000	720	127.425	$4,472.61	$1,741.16
2024	9500	760	134.504	$4,721.09	$1,709.24
2025	10000	800	141.583	$4,969.57	$1,673.26
2026	10500	840	148.662	$5,218.05	$1,633.94
2027	11000	880	155.742	$5,466.53	$1,591.92
2028	11500	920	162.821	$5,715.01	$1,547.78
2029	12000	960	169.900	$5,963.48	$1,502.02
2030	12500	1000	176.979	$6,211.96	$1,455.08
2031	13000	1040	184.058	$6,460.44	$1,407.36
2032	13500	1080	191.137	$6,708.92	$1,359.18
2033	14000	1120	198.216	$6,957.40	$1,310.86
2034	14500	1160	205.296	$7,205.88	$1,262.63
2035	15000	1200	212.375	$7,454.36	$1,214.74
2036	15500	1240	219.454	$7,702.83	$1,167.37
2037	16000	1280	226.533	$7,951.31	$1,120.67
2038	16500	1320	233.612	$8,199.79	$1,074.79
2039	17000	1360	240.691	$8,448.27	$1,029.85
2040	17500	1400	247.771	$8,696.75	$985.93
Total					**$46,463.48**

4.5 RHINE PEDESTRIAN BRIDGE

The Rhine Pedestrian Bridge project would replace the existing pedestrian bridge over the Union Pacific and Amtrak mainlines. The nearest track crossing to the north is a quarter mile, at Powell; to the south, a half mile at Holgate. The existing bridge, located at SE 20th and Lafayette, is in poor repair and is frequently ignored by potential users in favor of walking across the tracks or driving. The new bridge would be one block north of the existing one, connecting pedestrians to SE Rhine Street instead of SE Lafayette.

The bridge would connect pedestrians from the Brooklyn neighborhood to Cleveland High School and the employment-heavy area nearby. Additionally, users would have easy access to Brooklyn and Powell parks and Milwaukie Avenue.

4.5.1 Economic Competiveness

The project's impacts on various travel measures that contribute to economic competitiveness are low. A bridge already exists (the project is a replacement), the existing bridge is not used much (many people choose to cross without using the bridge, trading off safety for travel time), no modeling on change in travel behavior is available: these are all reasons to expect that, at the margin, the new bridge will not have much effect on travel patterns or, consequently, on economic activity.

4.5.2 Safety

The project would improve safety by giving pedestrians and cyclists a dedicated path over the rail yard as opposed to crossing the tracks or going north to the busier Powell Boulevard. There is an open question, however, relevant to all pedestrian overpasses: will people choose the safety benefits given the additional climb, distance, and time that a new bridge would provide?

We have no data regarding injuries or fatalities to pedestrians or cyclist crossing at grade. We presume that there are none. Thus, the project might reduce a risk that is already small, empirically. Everything described in section 4.2.2 above applies here for a hypothetical calculation. If the project eliminate one fatality, a few severe injuries, and several (say 10) moderate ones over the course of a 30-year life, it might deliver a present value of benefits on the order of $5 million (because of discounting, the farther out the event, the lower its present value, so the total present value of a fatality and other injuries can easily be less than the value of just a fatality that occurs today).

4.5.3 State of Good Repair

The project contributes to the state of good repair by:

- Replacing a bridge that was of rudimentary design and now old, unsightly and perceived to be dangerous, with a new, safe, attractive bridge
- Doing value engineering to ensure that the bridge uses a design and materials that give among the lowest present value of life-cycle cost for the benefits delivered of all the alternatives considered.

4.5.4 Livability

The main livability benefit is retaining connectivity, and doing so in a way that improves safety and aesthetics. Travel-time and safety benefits are already covered elsewhere.

It seems to us that the main livability benefit of the bridge is distributional: (1) it is located in the sub-area with the lowest per capita income of any of the five project study areas, and (2) it is a connection that exists now and is in poor repair.

4.5.5 Sustainability

Given (1) sustainability is defined for TIGER II grants as changes in emissions, (2) emissions are a function of changes in VMT, and (3) and our assessment that the limited new bicycle and pedestrian access provided by the bridge would not have much of an effect on VMT, we do not expect the bridge to cause much of a reduction in air emissions from motor vehicles.

4.6 KELLOGG LAKE BIKE/PEDESTRIAN BRIDGE

Kellogg Lake divides north and south passage through Milwaukie for cyclists and pedestrians, and leaves McLoughlin Boulevard, a busy 4-lane arterial road, as the fastest route for these travelers. The Kellogg Lake Bike/Pedestrian Bridge project would construct a 1,400 foot bicycle and pedestrian connection, including a 550-foot multi-use path on the lower level of the planned LRT bridge across Kellogg Lake (which was originally built to accommodate this type of improvement). In addition trail connection 14-feet wide would be provided between a funded regional trail adjacent to McLoughlin Blvd (the Trolley Trail). The bridge would provide a connection between the Island Station neighborhood, downtown Milwaukie, Milwaukie High School, and a planned light rail station at Lake Road.

4.6.1 Economic Competiveness

The bridge would reduce travel distances for cyclists and pedestrians by up to 0.15 miles (if they are traveling to or from the east or southeast of the eastern bridgehead). But as origins or destination move to the north, the distance become more similar: travel from the downtown Milwaukie to the Island Station neighborhood is effectively the same distance whether one takes the bridge or existing roads. Given that we are talking about travel by bike and foot, it seems likely that a large portion of the beneficiaries of the bridge would be high school students at Milwaukie High School traveling to and from the Island Station neighborhood, and users of light rail traveling to and from the new station near the northeast bridgehead and the Island Station neighborhood. The approximately 500 households in the Island Station neighborhood might have more attractive and safer access by bicycle and foot to the downtown, but not necessarily much faster, since the distance is about the same. Since the Trolley Trail, which is funded, would take them to the downtown along the west side of McLoughlin, the advantages of the Kellogg Bridge over the Trolley Trail in terms of attractiveness, speed, or safety for trips to the downtown are likely to be small.

There are, however, several hundred multi-family units on the east side of McLoughlin that would have to make an out-of-direction crossing of McLoughlin to get to the downtown, and would have a circuitous route to get the light rail station. They benefit from the Kellogg Lake Bridge even if the Trolley Trail exists.

Modeling of the bridge estimated that the bridge would have 170 bicycle trips and 30 pedestrian trips daily.[17] The situation as we have described it suggests travel-time savings a maximum of 3 minutes for a pedestrian, and 1 minute for a bicyclist, with the average being lower. Ideally, we would want estimates of the amount of recreational biking (where travel time savings is not the main point), but to keep things simple we assuming that their lower value of travel-time savings is offset by their higher value of

---

[17] In our preliminary calculations, before the modeling was complete we had assumed 150 bike trips and 100 walk trips, so the model results comport with our intuitions.

the recreational features of the bridge. Assuming the estimates are an annual average (rather than a weekday average, which is more likely) we get travel-time savings on the order of 1,500 hours per year. Given that the demographic of the trips is weighted toward high-school students, a value of $10 per hour is high, but we will use it to estimate a reasonable upper bound on the benefit: the annual value of the savings is on the order of $15,000. Using assumption we have described previously about growth rates in usage, discount rates, and facility live, the present value (in 2010 dollars) of the 30-year stream of benefits is on the order of $300,000.

It seems unlikely that the bridge will provide access characteristics that would unlock development that would not otherwise occur but for the bridge.

4.6.2 Safety

The Kellogg Lake Bike/Pedestrian Path will improve safety by providing a direct route across the lake for pedestrians and cyclists. Some pedestrians have been unsafely using the active freight train trestle to access downtown Milwaukie and Milwaukie High School.

As for other projects described above, (1) we have no data on fatalities or injuries, (2) we assume they are small to nonexistent, (3) nonetheless, there is always the possibility that they could occur in the future, (4) if the bridge reduces future fatalities by one, and future injuries by a dozen or two over its lifetime, then the present discounted value of the benefit is on the order of $5 million.[18]

4.6.3 State of Good Repair

The Kellogg Lake Bike/Pedestrian Path would not significantly impact state of good repair.

4.6.4 Livability

With few commercial services located within the Island Station neighborhood—this project improves connections to those services in the downtown. But as noted in section 4.6.1, the multi-use path connection to the downtown is large redundant to the funded Trolley Trail, which will be essentially the same distance. The bigger advantage is for people in the Island Station neighborhood and in the area southwest of the lake and east of McLoughlin who want to get to the LRT station. So the main trips that will benefit are those to and from these neighborhoods to the high school and LRT station, and social / recreational trips.

A bridge over a lake provides amenity value. The benefits are real, though the extent to which they are capitalized and who ultimately captures them can be difficult to sort

[18] We note again: one must be very careful in using estimates like these. It is possible that by putting meandering pedestrians and faster moving bicyclists and on a narrow bridge will *increase* injuries.

out. Here is a back-of-the-envelop calculation to get an order-of-magnitude estimate of the amenity value:

- South of the Lake there are on the order of 700 to 800 households in walking distance of the bridge. Many are apartments.
- Assume (1) an average value of $200,000 to $250,000 per dwelling unit; (2) an increase in property value of 0.5% for properties near the bridge; and (3) the property-value impact of the bridge falls linearly with distance to zero at the farthest housing unit.
- Those assumptions lead to an increase in property value of about $420,000.
- But other beneficiaries include households northeast of the Lake, businesses in the downtown, and tourists (whose gains are unlikely to be completely capitalized into commercial land values.
- Thus, a reasonable order-of-magnitude estimate of the amenity value is $0.5 to $1 million in present value (2010 dollars).

4.6.5 Sustainability

Given the relatively low present discounted value of emissions reductions for Water Avenue, which had substantial changes in VMT, the calculations for the Kellogg Bridge project at not worth doing: the present discounted value of the savings will be on the order of a few thousand dollars.

5 SYNTHESIS

Section 4 describes benefits and costs for each project element and for each evaluation criterion. In this section we summarize benefits and costs by evaluation criterion, for all project elements together to capture impact of the project on the Southeast Corridor. All estimates are of present discounted value in 2010 dollars.

User impacts

- **Economic Competitiveness.** The total cost (including planning, design, right of way acquisition, and construction) of the project is $12.8 million. Given that we made no estimate of work-zone costs during construction to travelers (as they are delayed and re-routed) and residents and businesses (from noise and dust), we think $14 million is a reasonable round number for construction costs. For lifecycle operation, maintenance, and preservation (OMP) costs (costs that occur after construction for the 30-year evaluation period), we can bound the number by noting that (1) all the projects are capital facilities designed to have a long life, and (2) to enjoy that life they will require annual maintenance and periodic major maintenance. Based on other fiscal work we have done, we are relatively confident that the average, annual amortized OMP costs will be in the range of 1% to 10% of capital costs; 2% to 5% is a tighter range. At a 7% real discount rate, an annual stream of real OMP costs at 2% to 4% of construction value for a 30-year planning period add roughly 25% to 50% the present value of construction costs. We think a reasonable estimate of the present discounted value of **lifecycle costs** for a 30-year planning period for all the projects is about $19 to $20 million.

Regarding monetizable benefits to travelers, our estimates, summed for all projects and rounded, are on the order of $15 million in present discounted value.

Regarding land and economic development benefits that might result from real productivity gains and are net of costs, the only project likely to be able to claim credit for significant differences in development is SE Water Avenue (combined with OPR, which allows the Water realignment to occur. We estimated the value of the incremental contribution to profitability at $1 million to $10 million.

- **Safety**. We have only simulations here, and the values are not risk adjusted. If one assumes that the projects will reduce fatalities and injuries as we simulated, then the present discounted value of those reductions is on the order of $15 million. The uncertainty is large: our intuitive 90% confidence interval is about $1 million to $30 million.
- **State of Good Repair**. To some extent, this category is about lifecycle costs, estimates of which we report above under the heading "Economic Competitiveness." It is also about improvements in operating costs by reducing congestion or potholes: those benefits also, to the extent that they have been quantified for these projects, are captured in the travel-time calculations under Economic Competitiveness. Otherwise, State of Good Repair is qualitative assessment that long-lasting projects are being built using efficient design, technology, and materials. Agency staff believe that (1) current and future value engineering will deliver efficient projects, and (2) such projects are not occurring at the expense of removing existing infrastructure that still would have a substantial productive life. All projects have a positive value for State of Good Repair; the strongest positive is for Rhine Bridge, which replaces a substandard bridge.

Non-user impacts

- **Livability.** A key goal of all five projects is better quality of life, urban amenity, and livability. They all deliver on that goal, but putting their expected results into dollars is very difficult in general, and almost impossible given the data and budget for this evaluation. We can save with confidence that the projects deliver user and non-user benefits that improve connectivity, especially for bike and pedestrian trips, and create amenity that people value. For the Kellogg Lake project, which clearly connected some discrete areas, we had enough information to make an order-of-magnitude estimate of the capitalization of the amenity value into property values: on the order of a present value of $1 million. The Rhine

Bridge would probably be less (the access is already provided by the existing bridge, though it is inadequate), and OPR would be counted as part of Water Avenue. Values at Water Avenue would be much bigger than at Kellogg ($5 to $20 million), and for Clinton they would be between the two ($2 to $10 million). We do not have much confidence in these estimates, but they are probably the right order of magnitude.

- **(Environmental) Sustainability**. The focus of the guidance in the Notice of Funding Availability is on air emissions: pollutants and carbon dioxide (CO_2, greenhouse gas). For our analysis, we calculated changes in emissions as a function of changes in the amount and type of travel. The total present discounted value of CO_2 reduction is on the order of $0.1 million for all projects combined. The low values derive directly from the amount of VMT that the projects are likely to reduce. We did not do calculations for pollutants: typical values of $0.01 to $0.02 per mile mean that the present discounted value of their reduction would be in the range of $0.5 million.

5.1 Benefits Exceed Costs

Our estimate of lifecycle costs seems relatively solid at $19 to $20 million (PDV in 2010 dollars). Similarly, our estimate of the present discounted value of travel-time savings seems reasonable at $15 million. In addition we have provided a range of estimates for other benefits: net value of more productive land use, $1 to $10 million; value of reduced accidents, injuries, and property damage, $1 to $30 million; value of livability based on increases in property value, $8 to $30 million; value of reduced pollution and CO_2, $0.5 million. Even if we take the low end of all our estimates, the value of these additional benefits sums to about $10 million. Add that to the $15 million value of the travel-time savings and the project's monetizable benefits come to $25 million, about $5 million greater than the costs. If we use a mid range of our estimates (and cap safety values at $ 6 million total, instead of 50% of $30 million) we get total monetized benefits of $35 million.

Based on our reading of the guidance in the NOFA, we have not attempted to claim the benefits of the larger transit investments in the South Corridor. Those benefits have already been claimed in prior grant applications and should not be counted again here.

At the margin, however, it is very likely that the project evaluated here will contribute to the overall success of the larger transit projects in the Southeast Corridor, and that they might be credited with some percentage of the overall benefits of those larger projects. We have not attempt to do that in this report, though the planning agencies may choose to do so in their application.

Moreover, as part of this synthesis it is legitimate to note that a balance, integrated transportation system requires balance and integration. There are legitimate reasons to do each of these five projects. It is easy to imagine how they would improve both transportation and land use in the areas they would serve.

But budgets are constrained. Other projects also have value. FHWA must have some way of judging whether its scarce funding is going to the best projects. If it were evaluating alternative implementations of a specific modal project at a specific locations, comparisons would be easier. But for national competition for grant funds, FHWA will have to compare projects for all modes, of all types and scales, at different places around the country, with different data and analysis generated and reported in different ways by different agencies: comparisons will be very difficult.

Benefit-cost analysis, as described in the FHWA guidance, can help. At a minimum, it can eliminate the worst of the double counting and get project proponents to use similar evaluation principles, even if their methods to implement those principles differ. It can put some reasonable bounds on many benefits and costs, but it can never hope to monetize them all. Benefit-cost analysis should be a decision-aiding technique, not a decision-making technique. We think that idea is reflected at several points in the federal guidance, and we hope that FHWA in its review of the analysis here will give credit to the applicants for allowing ECONorthwest to do an independent analysis that tries to honestly apply the principles of benefit-cost analysis, rather than inflate the estimated values by ignoring costs, inflating benefits, counting costs as benefits (and then counting them again as multiplier effects), and counting transfers as benefits.