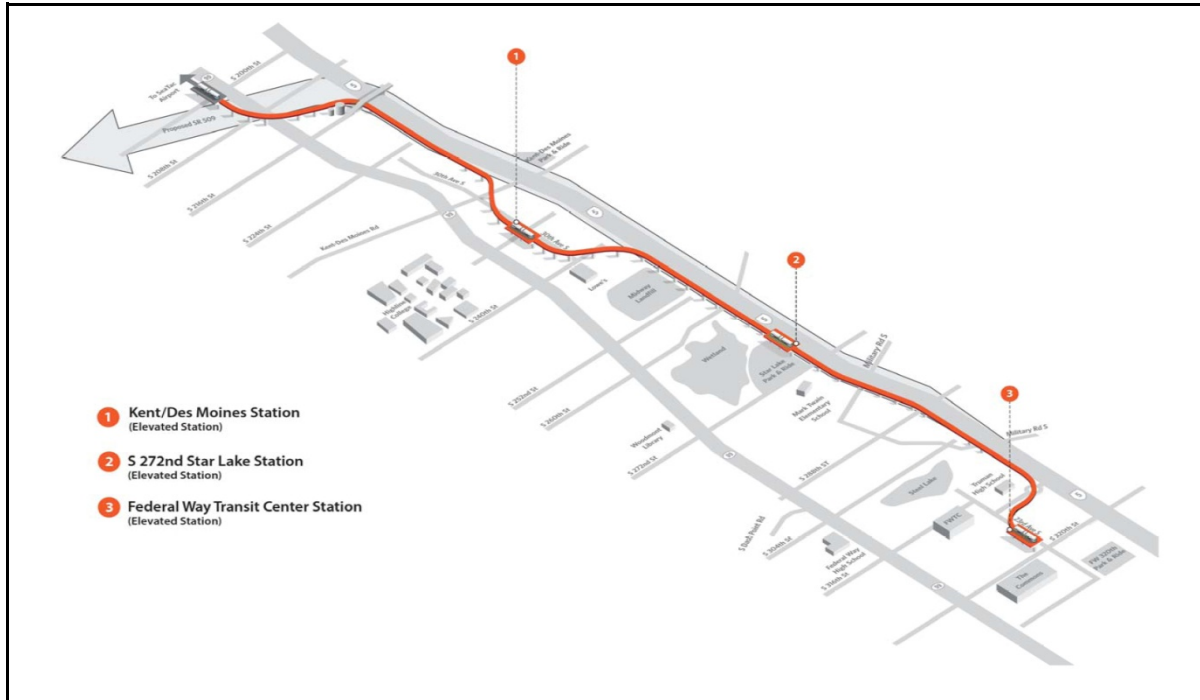


Federal Way Link Extension Seattle, USA



The Zofnass Program at Harvard

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Prof. Spiro N. Pollalis prepared this case study with researcher Dimosthenis Lappas at the Zofnass Program as the basis for research and class discussion rather than to illustrate either effective or ineffective handling of the design, the construction, or an administrative situation.

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Abstract

The Sound Transit Federal Way Link light rail extension in the cities of SeaTac, Des Moines, Kent and Federal Way, WA, showcases how a sustainability rating tool, such as Envision®, can contribute to and determine the sustainability performance of a design-build project.

In much of the Puget Sound region, congested roadways increase travel times. Sound Transit’s Link light rail system offers a high-quality alternative form of transportation, and the Federal Way Link Extension (FWLE) will bring light rail to 36,500 riders per day by 2035. When complete, the Federal Way Link Extension will not only offer an alternative to driving or riding the bus, it will also accelerate development of the new activity centers surrounding each station.

Sound Transit, the Central Puget Sound’s Regional Transit Agency, develops and operates the regional light rail network and is promoting a cultural change in how sustainability can be embedded in a design-build mass transit project. From the early planning phase to the bidding process and construction, sustainability is intended to be a key component of decision-making. One major challenge is how to raise awareness and communicate the sustainability vision through the entire process and to all stakeholders involved. The FWLE has the potential to set an example for ensuring sustainability in a design-build project for Sound Transit, as well as other agencies.

Table 1. Project data

Project Name:	<u>Federal Way Link Extension</u>
Project Type:	Light rail
Location:	South King County , Seattle metropolitan area, USA
Area / Length:	7.8 miles, 3 stations
Capacity:	36,500 daily riders by 2035
Owner / Client :	Sound Transit
Project Team:	Contractor: Kiewit Infrastructure
	Engineer/Designer: Kiewit Infrastructure / Parsons
	Facility/Project Manager: Sound Transit
	Consultants: HDR
Project Lifespan	100 years
Current Status:	Pre-construction, opens 2024
Funding model:	Public funding – Local tax revenues, federal funds, fares, bonds
Delivery Method:	Design-build
Overall investment cost:	\$2.55 billion
Design & Construction cost:	\$1.7 billion

Introduction

The FWLE project is a 7.8-mile light rail project in the cities of SeaTac, Des Moines, Kent and Federal Way, WA all located near the Seattle and Tacoma metropolitan areas. The extension begins at the existing Angle Lake Station in the City of SeaTac and will terminate near the existing Federal Way Transit Center in the City of Federal Way. It includes three new stations: (a) Kent/Des Moines, (b) South 272nd Street, and (c) the Federal Way Transit Center. Two of the three stations will incorporate transit-oriented development opportunities when construction is complete. All stations will have improved non-motorized and transit access and add parking for a total of 3,200 spaces along the route.

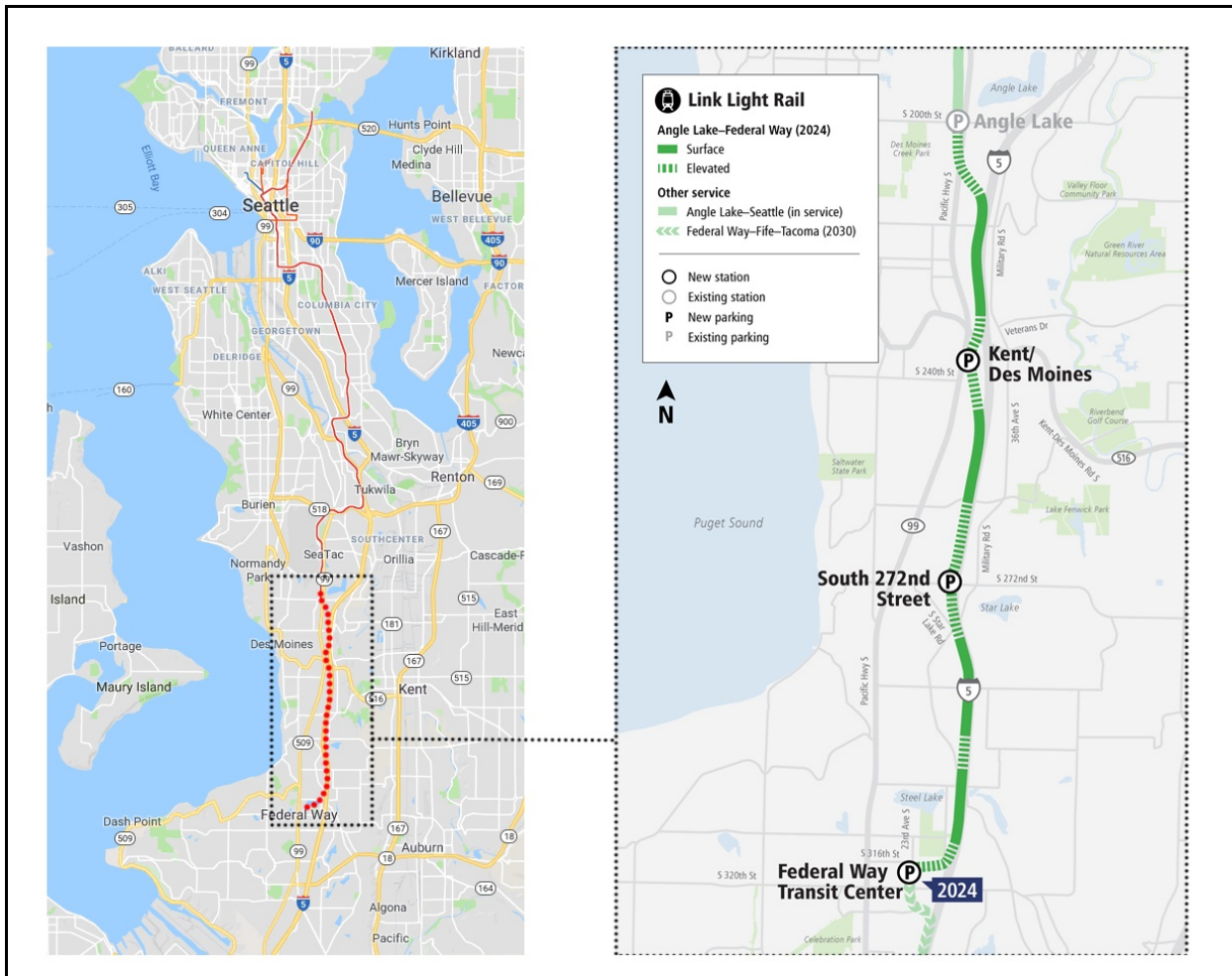


Fig. 1. Federal Way Link Extension alignment

The project is managed and will be operated by Sound Transit (ST). Sound Transit is the Regional Transit Authority for the majority of Pierce, King, and Snohomish Counties. This area includes 52 cities and a population of 3 million, almost 40% of the whole population of Washington State. Sound Transit operates two existing lines of Link light rail (Tacoma Link and Link light rail), the Sounder commuter trains, ST Express bus lines, and will soon be operating bus rapid transit (BRT) lines. With voter approval, Sound Transit is in the process of planning and building one of the most ambitious transit expansion projects in the country. The \$53.8 billion Sound Transit 3 (ST3) expansion plan proposes adding 62 new miles of light rail to create a 116-mile regional system, as well as expanded

commuter train service, BRT, and other express bus improvements. ST3 would complete major mass transit extensions every few years over a 25-year period, with the last parts of the system to be delivered in 2041 (Fig. 2).

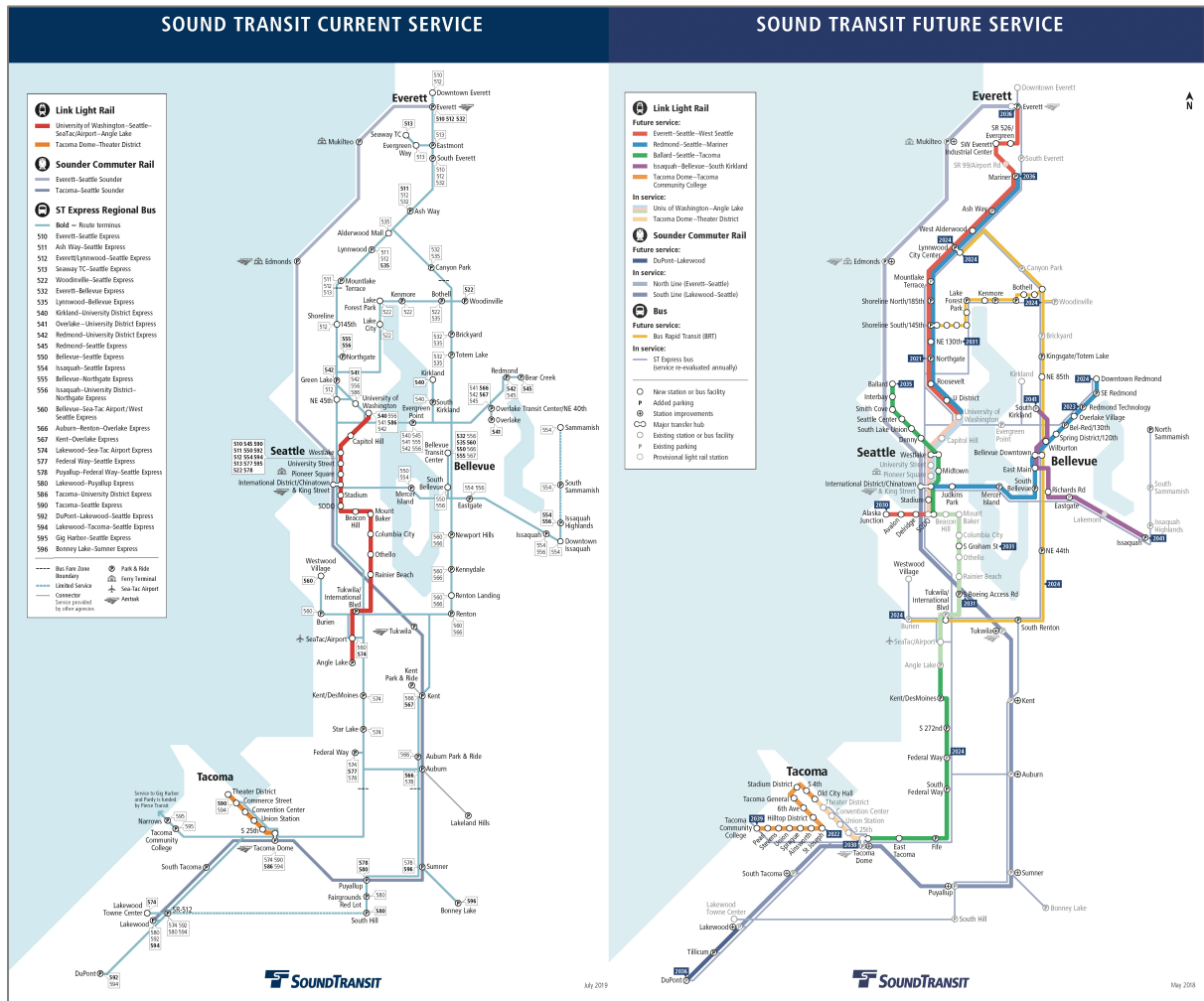


Fig. 2. Sound Transit 3 expansion program

About half of Sound Transit 3's \$53.8 billion total budget, or \$27.7 billion, would be funded by new taxes that the voters have already approved. These are: a sales tax increase of 0.5 percent; a motor vehicle excise tax (MVET) of 0.8 percent; and a property tax of 25 cents for each \$1,000 of assessed valuation. In addition to new revenues, the other primary funding sources supporting ST3 would include federal funds, bonds, existing taxes, and fares.¹

Project development

The planning process for the extension began in late 2012 and was completed in May 2019 with the selection of Kiewit Infrastructure (Kiewit) as the design-build contractor. Kiewit will conduct final design and construction of the project. The construction is expected to last 5 years, with the line opening for revenue service in 2024.

¹ <http://soundtransit3.org/calculator> (ST3 Funding Factsheet)

In 2012, Sound Transit selected HDR² as the prime consultant for the planning process and the preparation of the specifications for the design-build contract. The first task for HDR was to conduct an analysis of the alternative routes. To arrive at the final alignment and the locations of the three stations, HDR collaborated with the communities to be served by the extension and produced a Transit-Oriented Development Study. They started with 20 potential station locations and shortened the list based on data and frequent stakeholder outreach. Then the consultant looked for opportunities to avoid bisecting candidate parcels that could be used for higher-density and mixed-use development and ranked each location's merits in four categories: multimodal access; existing land use and land use plans and policies; market support for development and redevelopment; and land availability.³ Findings were presented at numerous community outreach events, educating the public and elected officials to foster support.

In 2013, the route alternatives were narrowed and selected for the Environmental Impact Statement, a draft version of which was published for comments in early 2015. HDR developed an innovative spreadsheet to evaluate the more than 400 design combinations – showing both a cost estimate and a graphic to illustrate the various options.⁴ The spreadsheet simplified the presentation of the 400 potential combinations for Sound Transit and stakeholders and helped the decision-making.

In November 2016, voters approved the funding of the project, and in January 2017 with the completion of the Final Environmental Impact Statement by HDR, the Sound Transit Board of Directors selected the final route alignment.

In mid-2018, Sound Transit requested proposals for the final design-build contract. Among the firms which responded to the RFQ, three were selected to continue in the competitive phase. Each of the three competitors was given \$1 million and had 5 months to prepare their final proposals. The selection was based on a point system of performance project requirements, although as Denis Martynowych, Sustainability Planner and Designer at Sound Transit, pinpoints, “in design-build there is always a creative tension between specifying exactly what is you want and using performance oriented language that allows for innovative solutions.”⁵ The process ended on 23 May 2019 when the Sound Transit Board awarded the contract to Kiewit Infrastructure West Company.

² <https://www.hdrinc.com/>

³ <https://www.hdrinc.com/portfolio/federal-way-link-extension>

⁴ <https://www.hdrinc.com/insights/keeping-transit-moving-leveraging-our-strengths>

⁵ Interview with Prof. Spiro N. Pollalis in June 2019.

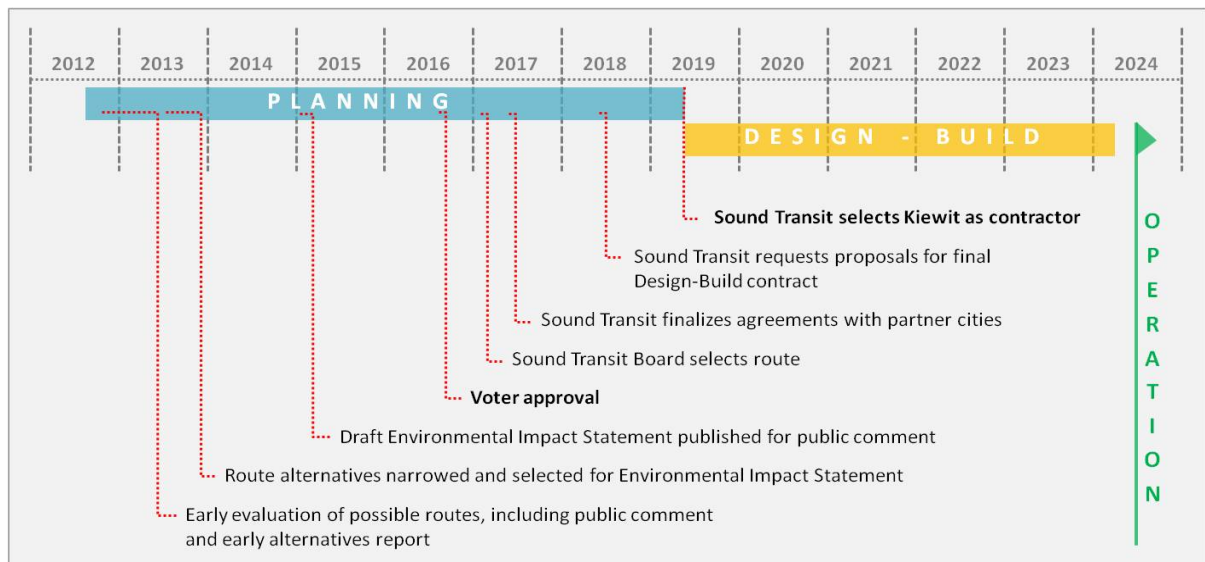


Fig. 3. Timeline and milestones (data source: Sound Transit)

In parallel to the bidding process and after the final route approval, Sound Transit started acquiring land. Since the approved alignment follows the Interstate 5 highway right-of-way, most of the required land was property of the Washington State Department of Transportation (WSDOT). ST collaborated closely with WSDOT, with employees of the latter embedded in the ST team to further increase collaboration and efficiency. ST had to acquire private land around the three stations, at market prices.

There was also an internal debate regarding the evaluation of the sustainability part of the proposals: Should sustainability be evaluated independently, or should it be part of “design excellence”? It was decided that sustainability would get better attention from the design-build teams if it was part of overall design excellence which is heavily weighted in the comparative analysis.

It was decided that the design-build contract would be lump sum. Bidders knew the maximum not-to-exceed sum for construction, and as part of their submittal had to provide a guarantee maximum price for the project. The selection process was based on a point structure to guarantee that the agency would get the better quality, rather than focusing only on lowest price. Actually, the bid that was chosen for FWLE was not the lowest bid just in terms of cost. As Martynowych mentions, “Kiewit scored the most overall points for their whole package.” After it was awarded the contract, Kiewit hired Parsons⁶ as the lead designer of the project.

The construction period is expected to last 4 years. More than 9 months alone will be needed for testing the system, so the line will be revenue-ready after 5 years, in 2024. There is already an existing central train maintenance yard, and Sound Transit is building another yard to better facilitate the needs of the expanded system. The trains are expected to arrive two years before the completion of the project so there will be adequate time for testing and the final assembly and delivery. The acquisition of the rolling stock is part of another contract, not connected with the design-build process.

⁶ <https://www.parsons.com/>

Main sustainability features of the project

As many mass-transit projects demonstrate, the Federal Way Link Extension project brings significant environmental, social, and economic benefits for the region. It is estimated that the service will be used by up to 36,500 daily riders by 2035, notably reducing greenhouse emissions and improving the environmental performance of the area while boosting the local economy's competitiveness by shortening trip times and increasing accessibility.

Regarding sustainability, this is the “right project.”⁷ Nevertheless, in terms of sustainability, in a project of that scale it is also challenging to “do the project right.” FWLE is one of the first design-build projects to consider sustainability and the use of sustainability rating tools such as Envision® from the beginning and to embed sustainable thinking into its decision-making.

Early in the design process, HDR prepared a Sustainability Technical Memorandum. The memorandum documented the sustainability assessment completed for the project before the final design phase. Based on the results of the assessment, several sustainable design options were considered by Sound Transit while preparing the sustainability project requirements for the design-build request for qualifications (RFQ) and request for proposals (RFP) documents.

Regarding renewable energy, the use of solar energy was chosen. Sound Transit's Design Criteria Manual requires analyzing all projects for opportunities to use renewable energy like using solar panels.). All possible installation locations were thoroughly examined and parameters of cost, design, visibility, and ease of maintenance were analyzed.

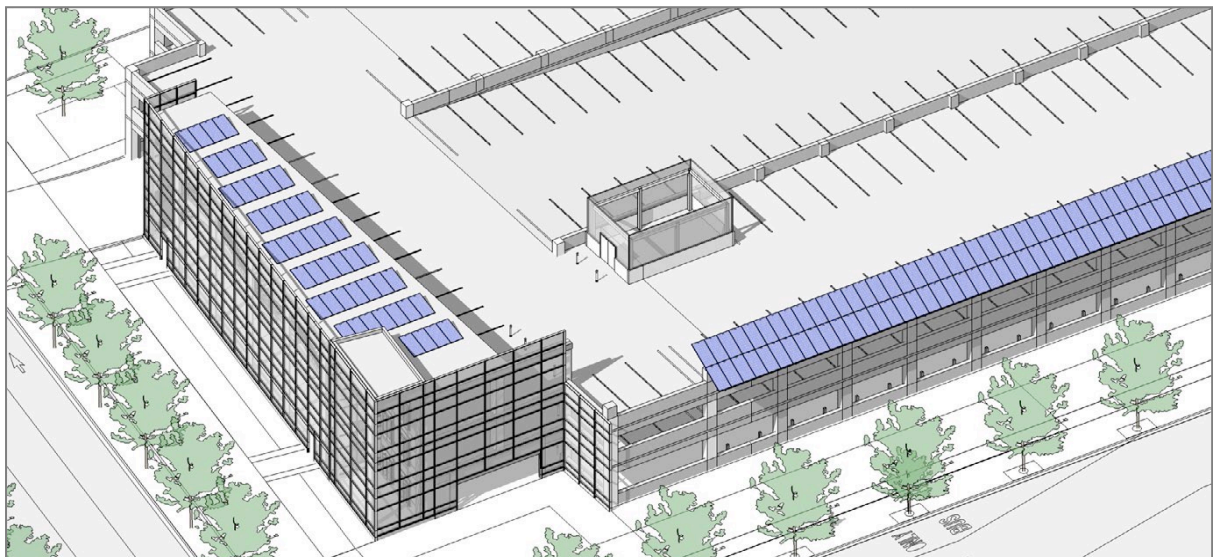


Fig. 4. Solar array concept for panels on the garage of KDM Station (source: Sound Transit)

Sound Transit's Design Criteria Manual includes a Sustainability Chapter that requires low-impact development (LID) best management practices (BMPs) to be evaluated and incorporated in the agency's projects where applicable and feasible. In the FWLE project, bioretention, native vegetated surface restoration, vegetated filter strips and dispersion have been incorporated in the design, while permeable pavement has also been considered but needs to be evaluated by the design-build

⁷ Envision assesses not only individual project performance, but how well the infrastructure project contributes to the efficiency and long-term sustainability of the communities it serves. Envision not only asks, “Are we doing the project right?” but also “Are we doing the right project?”

contractor based on additional geotechnical exploration during final design.⁸ Potential locations for LID BMPs include stations areas, adjacent-to-roadway improvements, and along the guideway (elevated and at grade).

For energy efficiency, station design should consistently use LED lights and dimmers. Sound Transit intends to work with the design/contractor team to evaluate and select lighting features that perhaps go beyond the current requirements in the agency's Design Criteria Manual. The team would need to show how energy consumption is reduced through design changes and provide calculations demonstrating that the lighting features reduce energy consumption beyond the benchmarked industry norm.

The installation of rainwater harvesting cisterns for irrigation purposes was also examined. However, after maximizing water reduction strategies like optimal soil mixes and drought-tolerant plants the team concluded that irrigation will not be needed after a two year establishment period. Therefore cisterns were not needed. Only the installation of green facades and/or collaboration with local councils to supply irrigation water to adjacent parks or developments will make the rainwater harvesting system cost-effective. More detailed research on the use of green facades is needed during the final design to determine the feasibility of this option.

Other sustainability features were also examined for FWLE but not finally recommended for implementation. For the investment in wayside power storage to utilize the train car's existing regenerative braking technology, the cost-benefit analysis showed that the payback period exceeded the life of the system. Also, the agency already is committed to purchasing all renewable energy from the utilities serving light rail. No feasible locations were identified for green roofs and vegetated "green" tracks. Finally, Sound Transit currently does not require a life cycle carbon assessment for light rail projects, but it is under consideration for the FWLE project for better Envision[®] performance.

HDR also completed a detailed evaluation of transit-oriented development (TOD) potential for the station areas. The new stations are expected to create significant opportunities for urban TOD and help the cities achieve their sustainability and community development goals. Sound Transit aims for a holistic and multimodal planning. Martynowych mentions: "from a sustainability perspective we were mostly interested in how TOD can stimulate and encourage high-density development around the stations," thus providing new low-carbon footprint lifestyle opportunities in areas where the suburban low-density urban typology is predominant. Access is also important, how people are traveling the final mile, as is encouraging low-carbon transportation. Bolstering connections through planning for multimodal access was a priority during station planning. The design includes specifications for new and rerouted roadways, new and widened sidewalks, bike lanes, landscaping and street trees, and traffic signals. Station areas will support higher density development and include new infrastructure such as easy access for transfers to existing and planned bus routes. The result will be greater mobility, greater access, and new and vibrant social and economic centers.

The design-build contract requires the sustainability of the project to be assessed with the Envision[®] Rating Tool for the entire corridor and all three stations, while LEED certification is additionally

⁸ Sound Transit, "Sustainability Technical Memorandum," March 2017.

required for the terminus station which has office space for security personnel and train operators. The design-build team suggested that only Envision would be sufficient for the assessment of the project, but the client insisted on the additional use of LEED certification of the terminus station for further value and recognition. Kiewit as part of its contractual agreement has to present a Sustainability Management Plan at the 30%, 60%, 90%, and 100% design milestones.

Envision® rating

Sound Transit with the consulting services of HDR piloted the Envision tool during the preliminary engineering phase of the Federal Way Link Extension project. HDR completed a preliminary evaluation of how Envision could apply to FWLE, what credits might be applicable to the project, and a range of points that might be earned for each credit based on the concept design. As Kim Sosalla-Bahr of HDR underlines, “we went through each Envision credit and identified which ones can help the project progress further in sustainability... for the team this was not just a light rail project with stations along the way, we were interested on the impact it has and how it affects the area around it, we were looking at the big picture.”⁹

The main scope of this preliminary evaluation was to help Sound Transit consider how using Envision could add value to the design process, better understand the sustainability challenges of the project, and give the opportunity to identify at this early stage additional sustainable features and innovations that could be included in the design-build contract requirements. It also provided a better understanding of the additional cost some of the sustainability features might have and the overall cost to implement the rating system.

The early Envision application process was also seen as an opportunity for Sound Transit to expand staff experience and skills to integrate sustainability considerations into its planning, design, construction, and maintenance of transit infrastructure. For that reason, HDR’s ISI-approved staff conducted onsite training in the Envision rating system. Furthermore, Sound Transit encouraged its staff to become Envision Sustainability Professionals (ENV-SP), with 22 people already accredited and as Martynowych says, “with a goal for another 30 to be accredited”.

Prior to adopting the use of Envision, Sound Transit had developed its own Sustainability Checklist to assist in integrating sustainability into the agency’s projects and tracking the sustainability measures that are integrated into them. The first task the project team completed was a comparison between the ST checklist and Envision, identifying what is covered in each independently, where the gaps are, and where an Envision credit might be addressed by other ST policies and practices if not necessarily captured in the ST checklist itself.¹⁰

An in-depth analysis of all Envision credits followed. Each credit was examined and categorized through several variables. Credits were initially categorized regarding the level of effort needed to complete documentation and reach the targeted Envision Level of Achievement. As part of this study, each credit was categorized by its estimated level of effort to achieve points based on current

⁹ Teleconference with Prof. Spiro N. Pollalis in September 2019.

¹⁰ Sound Transit, “Sustainability Technical Memorandum,” March 2017. See Appendix A for the comparison table.

design plans or what could be incorporated in the design-build contract (Appendix B).

Of the 55 Envision credits, 18 were identified as falling in the “Low Level of Effort” category. These credits were thought to be less time-consuming for the sustainability team to document since they are already business-as-usual for ST and the required documentation should be easier to collect/compile than for other credits. 24 credits were identified as “Medium Level of Effort.” These credits might be easy to achieve without major changes to the design or scope of services, but might require additional documentation to support the credit, or might require advancing the preliminary design minimally beyond what was already included in the project definition. Finally, 13 credits go above and beyond the practices Sound Transit currently uses on its projects. A “High Level of Effort” would be needed for these credits that might require a significant change in the project design, or the credits might have very detailed documentation requirements beyond the standard procedures and the ways the data is typically tracked on similar projects.

Afterwards, the team drew a distinction between “Planning Phase/Process-Related Credits” and “Design and Construction Phase/Physical infrastructure – Design Opportunities Credits.” The credits in the former category are process-related, meaning they have no direct impact on design but rely on the National Environmental Policy Act (NEPA) process, public engagement, agency programs/commitments, etc. These credits offer opportunities to go beyond current best practices and the ST checklist design criteria, particularly in outreach, agency policies, energy, and climate change. The credits in the latter category relate to physical infrastructure or design opportunities. They could apply to preliminary engineering, final design, or design-build. These credits also offer opportunities to go beyond current best practices and the ST checklist design criteria, particularly in environmental resources, materials, and construction.¹¹ For credits in both categories, the lowest and highest possible Envision Level of Achievement were estimated, followed by a description of how the credit could apply to the project and a brief summary of actions needed to achieve the level and relative points.

Finally, the team specified who would be responsible for the documentation of each credit. Sound Transit will mostly be responsible for and compile documentation for the credits related to leadership, agency policies, and community outreach. The design-build contractor will be responsible for providing documentation for the credits related to infrastructure design and construction practices. For several credits, ST and the contractor will share the responsibility. For consistency, the design-build contract requires a sustainability point of contact, a sustainability manager who would oversee the documentation and submittal of the credits.

This following section examines the sustainability performance of the project after a self-assessment application of the Envision® Rating System. During conceptual engineering, HDR in coordination with Sound Transit did the self-assessment using Envision v2. Results are presented through Envision’s main five categories of impact: Quality of Life, Leadership, Resource Allocation, Natural World, and Climate and Risk. This early assessment will be updated during the design-build process which will be using Envision v3.

¹¹ Sound Transit, “Sustainability Technical Memorandum,” March 2017.

Quality of Life

The Quality of Life category addresses a project’s impact on host and affected communities, from the health and wellbeing of individuals to the wellbeing of the larger social fabric as a whole. These impacts may be physical, economic, or social. Quality of Life focuses on assessing whether infrastructure projects align with community goals, are incorporated into existing community networks, and will benefit the community in the long term. Community members affected by the project are considered important stakeholders in the decision-making process.¹² The Quality of Life category is divided into three subcategories: Purpose, Wellbeing, and Community.

		Must provide a clear justification if a credit is identified as not applicable to a project for exclusion.			Excluded	None	Improved	Enhanced	Superior	Outstanding	Exemplary	
CATEGORY	SUB-CATEGORY	NUMBER	CREDIT NAME		LEVEL OF ACHIEVEMENT							
1	QUALITY OF LIFE	PURPOSE	QL1.1	Improve Community Quality of Life	0	0	2	5	10	20	25	
2			QL1.2	Stimulate sustainable growth and development	0	0	1	2	5	13	16	
3			QL1.3	Develop local skills and capabilities	0	0	1	2	5	12	15	
4	QUALITY OF LIFE	WELLBEING	QL2.1	Enhance public health and safety	0	0	2	-	-	16	-	
5			QL2.2	Minimize noise and vibration	0	0	1	-	-	8	11	
6			QL2.3	Minimize light pollution	0	0	1	2	4	8	11	
7			QL2.4	Improve community mobility and access	0	0	1	4	7	14	-	
8			QL2.5	Encourage alternative modes of transportation	0	0	1	3	6	12	15	
9			QL2.6	Improve site accessibility, safety and wayfinding	0	0	-	3	6	12	15	
10	QUALITY OF LIFE	COMMUNITY	QL3.1	Preserve historic and cultural resources	0	0	1	-	7	13	16	
11			QL3.2	Preserve views and local character	0	0	1	3	6	11	14	
12			QL3.3	Enhance public space	0	0	1	3	6	11	13	
13	QL0.0			Innovation (earn 1 through 8 pts)								
								Maximum QL Points (w/o Innovation)		181		
								Excluded (n/a)		0		
								High		125		69.1%
								Low		79		43.6%

Fig. 5. Potential lower and higher score in the Quality of Life category

The project is expected to perform very well in the Quality of Life category. Out of the maximum 181 total points, it is expected to achieve 79 in the worst-case scenario and up to 125 points in the best-case scenario, or a percentage of 43.6% up to 69.1% respectively.

The project is expected to achieve high scores in all credits of the Purpose subcategory as well as all the credits of the Wellbeing subcategory except for credit QL2.3 Minimize Light Pollution. In the Community subcategory credits, an average to low score is most likely anticipated.

Leadership

Successful sustainable projects require a new way of thinking about how they are developed and delivered. Project teams are most successful if they communicate and collaborate early on, involve a wide variety of people in creating ideas for the project, and take a long-term, holistic view of the project and its life cycle. This category encourages and rewards these actions on the view that, together with traditional sustainability actions such as reducing energy and water use, effective and collaborative leadership produces a truly sustainable project that contributes positively to the world around it. This category is divided into the three subcategories of Collaboration, Management, and Planning.

¹² Envision® manual.

14	LEADERSHIP	COLLABORATION	LD1.1	Provide effective leadership and commitment	0	0	2	4	9	17	-
15			LD1.2	Establish a sustainability management system	0	0	1	4	7	14	-
16			LD1.3	Foster collaboration and teamwork	0	0	1	4	8	15	-
17			LD1.4	Provide for stakeholder involvement	0	0	1	5	9	14	-
18		MANAGEMENT	LD2.1	Pursue by-product synergy opportunities	0	0	1	3	6	12	15
19			LD2.2	Improve infrastructure integration	0	0	1	3	7	13	16
20		PLANNING	LD3.1	Plan for long-term monitoring and maintenance	0	0	1	3	-	10	-
21			LD3.2	Address conflicting regulations and policies	0	0	1	2	4	8	-
22			LD3.3	Extend useful life	0	0	1	3	6	12	-
23			LD0.0	Innovation (earn 1 through 6 pts)							
									Maximum LD Points (w/o Innovation)	121	
									Excluded (n/a)	0	
									High	90	74.4%
									Low	47	38.8%

Fig. 6. Potential lower and higher score in the Leadership category

Of the five Envision categories, the project seems to have one of its best performances in the Leadership category. It can accumulate 47 to 90 points out of a total of 121 points, or a percentage ranging from 38.8% to 74.4% respectively. The project performs very well in all the credits of the Collaboration subcategory, in part because of Sound Transit’s commitment to stakeholder outreach and engagement. In the Management subcategory it is doing very well in the credit LD2.2 Improve Infrastructure Integration but has a poor performance in the credit LD2.1 Pursue By-Product Synergy Opportunities. In the Planning subcategory it has the potential to do very well with the exception of the credit LD3.3 Extend Useful Life where the possible score is low.

Resource Allocation

Resources are the assets that are needed to build infrastructure and keep it running. This category is broadly concerned with the quantity, source, and characteristics of these resources and their impacts on the overall sustainability of the project. Resources addressed include physical materials (both those that are consumed and that leave the project), energy, and water. These resources are finite and should be treated as assets to use respectfully. Materials, Energy, and Water comprise the three subcategories of Resource Allocation.

24	RESOURCE ALLOCATION	MATERIALS	RA.1.1	Reduce net embodied energy	0	0	2	6	12	18	-
25			RA.1.2	Support sustainable procurement practices	0	0	2	3	6	9	-
26			RA.1.3	Use recycled materials	0	0	2	5	11	14	-
27			RA.1.4	Use regional materials	0	0	3	6	9	10	-
28			RA.1.5	Divert waste from landfills	0	0	3	6	8	11	-
29			RA.1.6	Reduce excavated materials taken off site	0	0	2	4	5	6	-
30			RA.1.7	Provide for deconstruction and recycling	0	0	1	4	8	12	-
31		ENERGY	RA.2.1	Reduce energy consumption	0	0	3	7	12	18	-
32			RA.2.2	Use renewable energy	0	0	4	6	13	16	20
33			RA.2.3	Commission and monitor energy systems	0	0	-	3	-	11	-
34	WATER	RA.3.1	Protect fresh water availability	0	0	2	4	9	17	21	
35		RA.3.2	Reduce potable water consumption	0	0	4	9	13	17	21	
36		RA.3.3	Monitor water systems	0	0	1	3	6	11	-	
37		RA.0.0	Innovation (earn 1 through 9 pts)								
									Maximum RA Points (w/o Innovation)	182	
									Excluded (n/a)	0	
									High	58	31.9%
									Low	25	13.7%

Fig. 7. Potential lower and higher score in the Resource Allocation category

The project has its weakest performance in the Resource Allocation category. It can achieve only 25 to 58 points out of a maximum total of 182 points, which means a percentage ranging from 13.7% to 31.9%. The project has an average-to-poor performance in all credits of the Materials subcategory, indicating that the procurement practices and waste/excavated materials management need improvement or a more innovative approach. In the Energy subcategory it is doing very well in the credit RA2.2 Use Renewable Energy, while in the Water subcategory the possible points to be earned in all three credits indicate a relatively poor performance. After this initial assessment in the early conceptual engineering phase, steps were taken to help ensure better performance especially in reducing potable water consumption. The agency is currently studying ways to reduce embodied energy and the use of recycled materials, especially in the concrete which is by far the largest single material by weight used in its projects.

Natural World

Infrastructure projects have an impact on the natural world around them, including habitats, species, and nonliving natural systems. The way a project is located within these systems and the new elements it may introduce to a system can create unwanted impacts. This category addresses how to understand and minimize negative impacts while considering ways in which the infrastructure can interact with natural systems in a synergistic, positive way. These types of interactions and impacts have been divided into three subcategories: Siting, Land and Water, and Biodiversity.

The project performs relatively well in the Natural World category, with a possible score between 50 and 84 out of a maximum total of 154 applicable points. This category has three nonapplicable credits: NW1.1 Preserve Prime Habitat, NW1.3 Preserve Prime Farmland, and NW3.1 Preserve Species Biodiversity. The majority of the applicable credits range in terms of level of achievement between Improved and Superior, indicating that the decisions made during the design-build process will determine to a vast degree the performance of the project in this category.

			Must provide a clear justification if a credit is identified as not applicable to a project for exclusion.								
			Excluded	None	Improved	Enhanced	Superior	Consistently Superior	Relative		
CATEGORY	SUB-CATEGORY	NUMBER	CREDIT NAME		LEVEL OF ACHIEVEMENT						
38	NATURAL WORLD	SITING	NW1.1	Preserve prime habitat	-18	0	-	-	9	14	18
39			NW1.2	Protect wetlands and surface water	0	0	1	4	9	14	18
40			NW1.3	Preserve prime farmland	-15	0	-	-	6	12	15
41			NW1.4	Avoid adverse geology	0	0	1	2	3	5	-
42			NW1.5	Preserve floodplain functions	0	0	2	5	8	14	-
43			NW1.6	Avoid unsuitable development on steep slopes	0	0	1	-	4	6	-
44			NW1.7	Preserve greenfields	0	0	3	6	10	15	23
45	LAND & WATER	NW2.1	Manage stormwater	0	0	-	4	9	17	21	
46		NW2.2	Reduce pesticide and fertilizer impacts	0	0	1	2	5	9	-	
47		NW2.3	Prevent surface and groundwater contamination	0	0	1	4	9	14	18	
48	BIODIVERSITY	NW3.1	Preserve species biodiversity	-16	0	2	-	-	13	16	
49		NW3.2	Control invasive species	0	0	-	-	5	9	11	
50		NW3.3	Restore disturbed soils	0	0	-	-	-	8	10	
51		NW3.4	Maintain wetland and surface water functions	0	0	3	6	9	15	19	
52	NW0.0		Innovation (earn 1 through 8 pts)								
					Maximum NW Points (w/o Innovation)		203				
					Excluded (n/a)		-49				
					High		84		54.5%		
					Low		50		24.6%		

Fig. 8. Potential lower and higher score in the Natural World category

Climate and Risk

The general scope of the Climate and Risk category is twofold: minimizing emissions that may contribute to increased short- and long-term risks, and ensuring that infrastructure projects are resilient to short-term hazards or can adapt to altered long-term future conditions. The Climate and Risk category is divided into two subcategories: Emissions and Resilience.

53	CLIMATE & RISK	EMISSIONS	CR1.1	Reduce greenhouse gas emissions	0	0	4	7	13	18	25	
54			CR1.2	Reduce air pollutant emissions	0	0	2	6	-	12	15	
55		RESILIENCE	CR2.1	Assess climate threat	0	0	-	-	-	15	-	
56			CR2.2	Avoid traps and vulnerabilities	0	0	2	6	12	16	20	
57			CR2.3	Prepare for long-term adaptability	0	0	-	-	-	16	20	
58			CR2.4	Prepare for short-terms hazards	0	0	3	-	10	17	21	
59			CR2.5	Manage heat island effects	0	0	1	2	4	6	-	
60		CR0.0			Innovation (<i>earn 1 through 5 pts</i>)							
									Maximum CR Points (w/o Innovation)		122	
									Excluded (n/a)		0	
									High		68	55.7%
									Low		20	16.4%

Fig. 9. Potential lower and higher score in the Climate and Risk category

The Climate and Risk category features the largest variation between the worst- and best-case scenarios. In the worst-case scenario, the project will achieve 20 out of a maximum 122 points or just 16.4%, but in the best-case scenario it has the potential to score 68 points or 55.7%. The credit in this category on which the project has the weakest performance is CR2.5 Manage Heat Island Effects, while the largest amount of points can be achieved on the credits CR2.1 Assess Climate Threat, CR2.2 Avoid Traps and Vulnerabilities, and CR2.3 Prepare for Long-Term Adaptability.

To receive Envision recognition, projects must achieve a minimum percentage of the total applicable Envision points. Projects can be recognized at four award levels:

- Verified: 20%
- Silver: 30%
- Gold: 40%
- Platinum: 50%

The projected award level for the FWLE project after the Envision pre-evaluation is Verified (27.3% of total applicable points) in the worst-case scenario and Platinum (56% of total applicable points) in the best-case scenario. The design-build contract requires that the contractor achieve at least a Silver award, but as Catherine Sheane Sustainability and Resilience Practice Lead of Parsons, mentions, “there is already optimism in the team that the Platinum level is achievable.”¹³

¹³ Teleconference with Prof. Spiro N. Pollalis in September 2019.

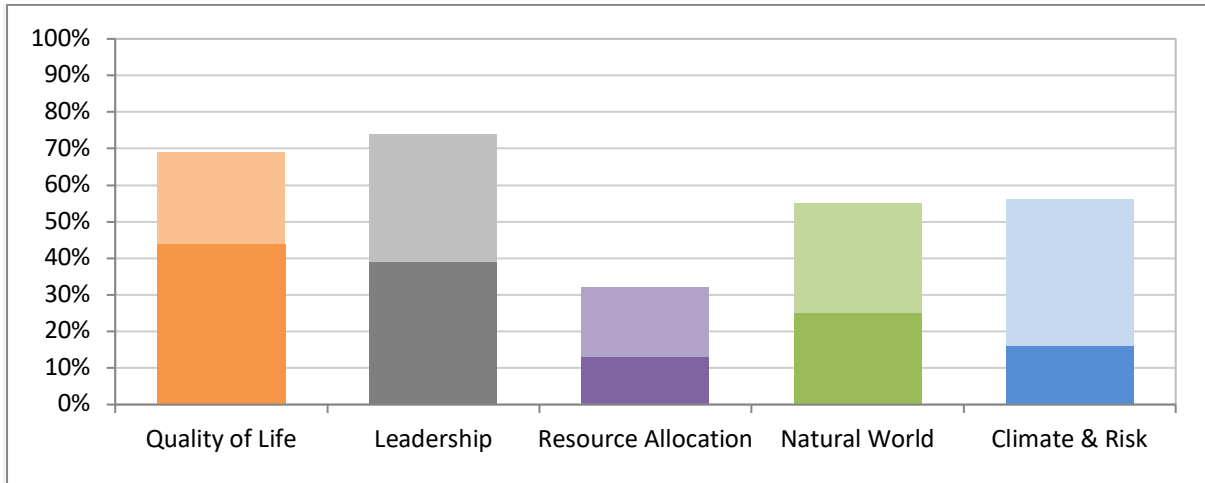


Fig. 10. Summary of potential lower and higher scores in the 5 Envision categories

Economic performance

The overall investment cost for the FWLE project is \$2.55 billion, and the construction is expected to cost \$1.7 billion. Embedded in the budget are three allowances with protected funds for sustainability, transit-oriented development, and for access. As Martynowych notes, “especially for access there is a partnership with the local municipal agencies to ensure pedestrian and cycling infrastructure and enhancements to municipal bus routes for improved connectivity.”

The sustainability allowance for the project is \$5.6 million, 0.33% of the \$1.7 billion construction budget. The allowance is mostly for driving innovation and supporting the Envision and LEED documentation process during all phases of the project. The Envision documentation and verification process is estimated to cost \$131,000 to \$196,000. As Kim Sosalla-Bahr, Senior Sustainability Consultant of HDR, adds: “from Envision point of view the cost is in documentation, pulling together and organizing the information it does have a cost, but in a big project that’s still a very small percentage of the overall project cost.”

Sound Transit considers many of the sustainability features of the project to be standard construction practices included in the standard project cost estimated, and they are therefore not counted as extra sustainability cost items. For instance, the use of LED lighting for energy saving, the low-impact development BMPs, and the restoration of disturbed soils are all considered standard construction practices for Sound Transit. On the other hand, an issue where Sound Transit wants to pay more attention and which can be funded by the sustainability allowance is research on the project’s embodied energy, specifically in its concrete. The agency wants to examine in collaboration with the design-build team what kind of documentation is involved in getting the Environmental Product Declarations (EPD) for all the concrete they use, and what extra effort or cost is needed to use greener concrete. Sound Transit wants to apply the results of that research on all its projects, and wants to test to what extent introducing new mixes can stimulate the market for green concrete and benefit the whole region in terms of sustainability.

Quantifying the benefits and the cost-effectiveness of sustainability is always a challenge, especially at this point for the FWLE project when the design hasn’t been finalized yet. A common belief shared

by the early planning consulting team of HDR and the design-built team of Kiewit/Parson is that the earlier you embed sustainability in the decision-making and the design process, the greater the potential for lower cost. As Sheane sums up regarding sustainability cost, “it always depends on whether the owner values sustainability in the first place. If they do, then that’s the way they write the RFP and their technical requirements, and usually when something is embedded and integrated in the design then there is not incremental cost, we just do the certification to prove that we did what the technical requirements said.” A better understanding of the correlation between sustainability benefits and cost will be possible towards the completion of the project.

Conclusion

With the use of Envision from a very early stage and through the entire process, Sound Transit is trying to build a culture of sustainability and innovation for design-build projects. The agency shows a remarkable commitment to sustainability and thus safeguards a sustainable outcome. It strongly believes that a third party certification process brings multiple benefits such as: resource savings, increased efficiency, easier permit granting process, continual improvement and a significant increase in brand equity. As Sosalla-Bahr mentions, “having a very passionate project team and organization behind the project really helps, because the tone and the expectation for sustainability are included from the beginning.” Martynowych explains that the agency wants to push things even further, “exploring opportunities to take Envision to the next step, in the sense of driving conversations even earlier during early planning phases.” The agency wants to obtain the know-how and be in control of the process, not entirely relying on external consultants.

Still, there are many areas for improvement, from the use of greener concrete up to implementing digital twin technology.¹⁴ The agency is open to innovation. Through the adoption of Envision, Sound Transit wants to create an internal culture to drive higher levels of accomplishment. The alignment of FWLE didn’t cross any areas of high environmental sensitivity, but that is not the case on other agency projects. The agency might need to raise the bar in sustainability even up to the restorative level in order to get approval from all stakeholders for other future extensions.

The main challenge for a design-build project, as both Kim Sosalla-Bahr of HDR and Catherine Sheane of Parsons mention, is how to educate the design and construction teams on sustainability and communicate to each member of the team how what they are already doing can contribute to the sustainability of the project, clarifying where each of the disciplines fits-in in the sustainability framework.

Regarding sustainability, this is the “right project.” Doing the project right, though, is always a challenge, as contractors in design-build projects are usually reluctant to adopt new approaches. They prefer tried and tested methods in order to avoid risk. Sound Transit with the use of Envision

¹⁴ For example the digital twin technology has been used by the Crossrail railway project in London, UK to facilitate design, construction and subsequent operation of the actual railway. Based on the digital version of the railway the design team came out with a simple but very innovative technique that will ensure the sustainable performance of the project in the long term. The sustainability rating tool information (BREEAM in that case) has been tagged to the relative parts of the digital twin, which will be handed to the operator. Every time the operator alters or replaces a component of the project, they will get a notification regarding the way it might affect credits and the overall BREEAM performance, prompting informed choices.
Harvard case study: https://research.gsd.harvard.edu/zofnass/files/2019/04/20190327_Crossrail-case-study.pdf

from a very early stage is changing that culture, and Kiewit already through the draft submission of the first Sustainability Management Plan seems ready to pursue innovation and aims to deliver a sustainable project.

Sources

The case study was based on:






- Interviews conducted by Prof. Pollalis in Seattle in June 2019 with Denis Martynowych, Sustainability Planner and Designer of Sound Transit.
- The presentation “Using Envision to Build a Culture of Sustainability, Innovation, and Efficiency at Sound Transit” by Denis Martynowych of Sound Transit, at the Zofnass Program for Sustainable Infrastructure workshop that took place at the Harvard Graduate School of Design on 17-18 April 2019.
- Teleconference with Kim Sosalla-Bahr, Senior Sustainability Consultant of HDR, in September 2019.
- Teleconference with Catherine Sheane, Sustainability and Resilience Practice Lead of Parsons, in September 2019.
- Online sources:
 - <http://soundtransit3.org/>
 - <https://www.soundtransit.org/system-expansion>
 - <https://www.soundtransit.org/system-expansion/federal-way-link-extension>
 - <https://www.hdrinc.com/insights/keeping-transit-moving-leveraging-our-strengths>
 - <https://www.hdrinc.com/portfolio/federal-way-link-extension>

Appendix A – Envision Credit and ST Checklist Comparison Chart

Envision Credits	PE/FEIS	FD / CN	ST- Wide	N/A	Is the topic included in ST Checklist ?		If not in checklist, addressed elsewhere?
					Yes	No	
QL1.1 Improve Community Quality of Life	●	●			●		
QL1.2 Stimulate Sustainable Growth and Development					●		Diversity/TOD/Access Program
QL1.3 Develop Local Skills and Capabilities		●				●	Diversity
QL2.1 Enhance Public Health and Safety		●				●	NEPA/Design/Operations
QL2.2 Minimize Noise and Vibration	●	●			●		NEPA/Compliance
QL2.3 Minimize Light Pollution	●	●			●		Design
QL2.4 Improve Community Mobility and Access	●	●			●		TOD/Access Program
QL2.5 Encourage Alternative Modes of Transportation	●				●		Inherent in agency business
QL2.6 Improve Site Accessibility, Safety and Wayfinding	●					●	Design/TOD/Access program
QL3.1 Preserve Historic and Cultural Resources	●					●	NEPA
QL3.2 Preserve Views and Local Character	●					●	NEPA
QL3.3 Enhance Public Space	●	●			●		TOD/Access Program
LD1.1 Provide Effective Leadership and Commitment	●		●		●		Board Initiative
LD1.2 Establish a Sustainability Management System			●			●	ISO 14001 ESMS
LD1.3 Foster Collaboration and Teamwork	●				●		*
LD1.4 Provide for Stakeholder Involvement	●					●	NEPA/Design/Outreach
LD2.1 Pursue By-Product Synergy Opportunities	●	●				●	* See also MP-2, MP-3, MP-4
LD2.2 Improve Infrastructure Integration	●					●	*
LD3.1 Plan for Long-Term Monitoring and Maintenance		●	●			●	*
LD3.2 Address Conflicting Regulations and Policies	●	●				●	*
LD3.3 Extend Useful Life		●			●		*Agency TCO Policy, more guidance
RA1.1 Reduce Net Embodied Energy						●	*
RA1.2 Support Sustainable Procurement Practices		●				●	Green Procurement Policy
RA1.3 Use Recycled Materials		●				●	*more guidance useful
RA1.4 Use Regional Materials		●			●		* more guidance useful
RA1.5 Divert Waste From Landfills	●	●			●	●	Specifications/Regional ordinances
RA1.6 Reduce Excavated Materials Taken Off Site	●	●			●		Design criteria
RA1.7 Provide for Deconstruction And Recycling		●			●		Compliance requirements
RA2.1 Reduce Energy Consumption		●			●		
RA2.2 Use Renewable Energy	●				●		*Encouraged; not required
RA2.3 Commission and Monitor Energy Systems		●			●		*Encouraged; not required
RA3.1 Protect Fresh Water Availability	●	●				●	NEPA
RA3.2 Reduce Potable Water Consumption		●			●		
RA3.3 Monitor Water Systems		●			●		*Encouraged; not required
NW1.1 Preserve Prime Habitat	●	●				●	NEPA
NW1.2 Protect Wetlands and Surface Water	●	●			●		
NW1.3 Preserve Prime Farmland		●				●	NEPA
NW1.4 Avoid Adverse Geology	●	●				●	NEPA/Design
NW1.5 Preserve Floodplain Functions	●	●			●		
NW1.6 Avoid Unsuitable Development On Steep Slopes	●	●				●	NEPA/Design
NW1.7 Preserve Greenfields				●		●	NEPA
NW2.1 Manage Stormwater	●	●			●		
NW2.2 Reduce Pesticide and Fertilizer Impacts		●			●		
NW2.3 Prevent Surface and Groundwater Contamination		●			●		
NW3.1 Preserve Species Biodiversity				●		●	NEPA
NW3.2 Control Invasive Species		●			●		
NW3.3 Restore Disturbed Soils		●			●		*Encouraged; not required
NW3.4 Maintain Wetland and Surface Water Functions		●			●		
CR1.1 Reduce Greenhouse Gas Emissions		●			●		*Encouraged; not required
CR1.2 Reduce Air Pollutant Emissions		●			●		*Encouraged; not required
CR2.1 Assess Climate Threat	●	●				●	*
CR2.2 Avoid Traps and Vulnerabilities	●	●				●	*
CR2.3 Prepare for Long-Term Adaptability	●	●				●	*
CR2.4 Prepare for Short-Term Hazards	●	●				●	*
CR2.5 Manage Heat Island Effects	●	●			●		
			If included, may not meet all documentation requirements for Envision.				* = opportunity for Envision to provide framework for a credit not currently addressed by ST checklist

Envision Credit and ST Checklist Comparison Chart (ST Sustainability Workshop, March 2016)

Appendix B – Envision V2 Credits and estimated level of effort¹⁵

		LEVEL OF EFFORT			
		LOW	MEDIUM	HIGH	
 Quality of Life	Purpose	QL1.1 Improve Community Quality of Life			
		QL1.2 Stimulate Sustainable Growth and Development			
		QL1.3 Develop Local Skills and Capabilities			
	Community	QL2.1 Enhance Public Health and Safety			
		QL2.2 Minimize Noise and Vibration			
		QL2.3 Minimize Light Pollution			
		QL2.4 Improve Community Mobility and Access			
		QL2.5 Encourage Alternative Modes of Transportation			
		QL2.6 Improve Site Accessibility, Safety and Wayfinding			
	Wellbeing	QL3.1 Preserve Historic and Cultural Resources			
QL3.2 Preserve Views and Local Character					
QL3.3 Enhance Public Space					
 Leadership	Collaboration	LD1.1 Provide Effective Leadership and Commitment			
		LD1.2 Establish a Sustainability Management System			
		LD1.3 Foster Collaboration and Teamwork			
		LD1.4 Provide for Stakeholder Involvement			
	Management	LD2.1 Pursue By-product Synergy Opportunities			
		LD2.2 Improve Infrastructure Integration			
	Planning	LD3.1 Plan for Long-term Monitoring and Maintenance			
		LD3.2 Address Conflicting Regulations and Policies			
		LD3.3 Extend Useful Life			
 Resource Allocation	Materials	RA1.1 Reduce Net Embodied Energy			
		RA1.2 Support Sustainable Procurement Practices			
		RA1.3 Use Recycled Materials			
		RA1.4 Use Regional Materials			
		RA1.5 Divert Waste from Landfills			
		RA1.6 Reduce Excavated Materials Taken off Site			
		RA1.7 Provide for Deconstruction and Recycling			
	Energy	RA2.1 Reduce Energy Consumption			
		RA2.2 Use Renewable Energy			
		RA2.3 Commission and Monitor Energy Systems			
	Water	RA3.1 Protect Fresh Water Availability			
		RA3.2 Reduce Potable Water Consumption			
		RA3.3 Monitor Water Systems			
 Natural World	Siting	NW1.1 Preserve Prime Habitat			
		NW1.2 Protect Wetlands and Surface Water			
		NW1.3 Preserve Prime Farmland			
		NW1.4 Avoid Adverse Geology			
		NW1.5 Preserve Floodplain Functions			
		NW1.6 Avoid Unsuitable Development on Steep Slopes			
		NW1.7 Preserve Greenfields			
	Land & Water	NW2.1 Manage Stormwater			
		NW2.2 Reduce Pesticide and Fertilizer Impacts			
		NW2.3 Prevent Surface and Groundwater Contamination			
	Biodiversity	NW3.1 Preserve Species Biodiversity			
		NW3.2 Control Invasive Species			
		NW3.3 Restore Disturbed Soils			
		NW3.4 Maintain Wetland and Surface Water Functions			
 Climate and Risk	Emissions	CR1.1 Reduce Greenhouse Gas Emissions			
		CR1.2 Reduce Air Pollutant Emissions			
	Resilience	CR2.1 Assess Climate Threat			
		CR2.2 Avoid Traps and Vulnerabilities			
		CR2.3 Prepare for Long-term Adaptability			
		CR2.4 Prepare for Short-term Hazards			
		CR2.5 Manage Heat Island Effects			
	TOTAL		18	24	13

¹⁵ This is an early planning analysis that will be updated in the design-build phase.