I-90 Allston Intermodal Project

Technical Report Addendum

Prepared for
Massachusetts Department of Transportation

Prepared by
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Table of Contents

List of Figures

List of Tables

Appendices

1 Executive Summary

The Secretary of the Massachusetts Department of Transportation (MassDOT) charged the Independent Review Team (IRT) for the Allston I-90 Intermodal Project with evaluating the three design alternatives presented in the Draft Environmental Impact Report (DEIR) for the Throat portion of the project. The IRT was tasked with attempting to optimize each DEIR Alternative in order to address flaws that could impact the ultimate viability of each. The team was narrowly focused only on design issues related to the Throat. The IRT is reporting directly to the Secretary of Transportation, not to the design team that developed the DEIR. In this Addendum, the use of "MassDOT" is meant to indicate this reporting relationship.

After the Technical Report, which analyzed the DEIR Alternatives and three new IRT Variants, was published and presented to MassDOT and the Task Force, A Better City (ABC) presented a new concept to the IRT, MassDOT, and the Task Force that placed the Paul Dudley White Path on a viaduct over Soldiers Field Road. This Addendum has been created as a supplement to the Technical Report, providing an equivalent level of analysis of ABC's new concept, referred to in this document as the Elevated Shared Use Path Hybrid Variant. A list of acronyms used throughout this document can be found in Appendix A of the Technical Report.

The Addendum process took place throughout the 54 days following the original 90-day review period. Tables 1.1 – 1.8 summarize the combined findings of both the 90-day and 54-day periods. These tables can be found at the end of this section. As with the Technical Report, this Addendum does not draw conclusions about how to move forward with the Throat area; ***the IRT has still not been tasked with making a recommendation to MassDOT or the public. Rather, this document is meant to further inform MassDOT's decision-making process.***

The IRT Technical Report summarizes the findings over this process. This section, Section 1, is an executive summary highlighting major findings. Section 2 summarizes the new Variant, including its history, design details, and design evolution. Section 3 summarize the IRT's scope and process. Sections 4 and 5 discuss the DEIR Alternatives, while Section 6 describes the evolution of concepts into IRT Variants. Finally, Section 7 evaluates the IRT Variants.

1.1 Families and Evaluation Criteria

The DEIR presented three different approaches for positioning the transportation infrastructure within the Throat, referred to as the three 'Families:'

- At-Grade (all elements at-grade);
- Highway Viaduct (I-90 elevated); and

- Hybrid (some elements elevated, one at-grade).

Each Family has a set of two designs:

- DEIR Alternative – the design as it was contained within the DEIR of the project.
- IRT Variant – the design as optimized by the IRT that would, as much as possible, address flaws that could challenge the viability of that Alternative.

Within this Addendum, only the Hybrid family is described in any detail, as the Elevated Shared Use Path Hybrid Variant falls within that family.

1.2 Hybrid Family

The Hybrid Family provides all five of the existing transportation elements in the Throat by elevating an element that is not I-90 above other uses. The intention of this design concept is to offer an option that provides an intermediate between a high viaduct and a fully at-grade option. The DEIR Alternative and the IRT Variant for this family have been evaluated in the Technical Report. Because the Paul Dudley White Path is elevated but all other elements are at-grade in the Elevated Shared Use Path Hybrid Variant, it has been adopted into the Hybrid Family.

1.2.1 ELEVATED SHARED USE PATH

In developing the Elevated Shared Use Path Hybrid Variant, ABC proposed multiple concepts that would allow most elements to remain at-grade, while exploring whether permitting issues could be reduced by moving the Paul Dudley White Path over Soldiers Field Road and away from the Charles River. Key questions posed by ABC and the IRT included:

- Can the path structure be adequately supported by columns that are narrow enough to avoid pushing Soldiers Field Road into wetland areas?
- Could the path structure be robust enough to accommodate separated modes of travel and the load of a planter?

To answer these questions, the IRT developed several concepts for the path, including a more minimal structure with 1.5-foot-wide columns and no planters and a more robust structure with 2-foot columns and planters. In order to try to maintain a cross-section with minimal intrusion into the Charles River, the IRT maintained the narrow lanes and shoulders on I-90 as in the At-Grade family in the hope of minimizing permitting implications.

An elevated Paul Dudley White Path will have a similar construction cost to a viaduct constructed for Soldiers Field Road or I-90; however, the load requirements are significantly reduced if a planter is not included as part of the elevated path. A direct connection from Agganis Way will be nearly flat

for this Variant, and the elevation of the Paul Dudley White Path allows a clearer connection from Commonwealth Avenue.

The history, design, and evolution of the Elevated Shared Use Path Hybrid Variant can be found in Sections 2.1, 2.2, and 2.3.

1.2.2 DETAILED EVALUATION

Across the eight evaluation criteria categories, the IRT has the following major findings about the Elevated Shared Use Path Hybrid. More detailed findings are found the in the matrix, Addendum, and Technical Report.

- Constructability
  - This Family has the longest projected construction timeframe.
  - The construction timeframe for the Elevated Shared Use Path Hybrid Variant is like the IRT Hybrid. However, construction timeframe may be elongated due to riverfront activity and impact.
- Cost
  - Construction cost ranges from $1,195 Million for the DEIR Hybrid Alternative to $1,126 Million for the IRT Hybrid Variant (decrease of 7%).
  - The construction cost for the Elevated Shared Use Path Hybrid Variant is $1,165 Million (increase of 3% over IRT Hybrid).
  - Life cycle costs for Elevated Share Use Path Hybrid Variant increase by 4% from IRT Hybrid Variant.
- Environment
  - The DEIR Hybrid Alternative and the IRT Hybrid Variant have limited permanent and temporary impacts to open space, historic resources, wetland and tidelands.
  - The Elevated Shared Use Path Hybrid Variant poses the most significant impacts to open space, historic resources, wetlands, and tidelands compared to the other members of the Hybrid Family, with more substantial temporary impacts than the other Hybrid Family members.
- Permitting
  - The DEIR Hybrid Alternative and IRT Hybrid Variant have relatively low permitting risk.
  - The Elevated Shared Use Path Hybrid Variant has relatively high permitting risk.
- Multimodal Connectivity
  - Elevated Shared Use Path Hybrid Variant improves north-south connections compared to the other members of the hybrid family.
  - New connections may be possible in the IRT Hybrid Variant and the Elevated Shared Use Path Hybrid Variant.

- Public Realm
  - The IRT Hybrid Variant provides the greatest amount of additional open space.
  - The Elevated Shared Use Path Hybrid Variant provides more usable open space than the existing condition. The new usable space contained within the Elevated Shared Use Path Viaduct and therefore separated from the river.
  - Riverfront open space along the throat becomes inaccessible from land in the Elevated Shared Use Path Hybrid Variant.
- Resiliency
  - Ample space for stormwater management can be provided by the Hybrid family.
  - The IRT Hybrid Variant significantly reduces overall impervious surface, compared with all other Variants.
  - The Elevated Shared Use Path Hybrid creates more impervious surface than the IRT Hybrid Variant.
  - However, Elevated Shared Use Path Hybrid creates less impervious surface than the DEIR Hybrid Alternative. This is due to the retained, but inaccessible, river front edge along the throat.
- Safety and Operations
  - The Family provides for 2-foot shoulders on I-90, which help improve operations.
  - The Family has moderate predicted crash rates due to the vertical and horizontal curves.
  - The Elevated Shared Use Path Alternative roadway alignments are like the At-Grade Family. Therefore, safety and operations are comparable in both alternatives.

1.3 Synopsis

1.3.1 EVALUATION CRITERIA

The IRT examined 54 evaluation sub-criteria over eight categories for all three DEIR Alternative Families and IRT Variant Families. Most evaluation criteria determinations were seen as roughly equivalent – there was not a significant variation between different Families or between DEIR Alternatives and IRT Variants. This helped the IRT focus evaluation onto categories where differences were more apparent. For additional discussion of how the evaluation matrix was developed, see Section 3.2 of the Technical Report.

1.3.2 EVALUATION MATRIX

This matrix serves as a fact sheet to inform MassDOT as it decides on which Throat alternative will move forward at the conclusion of the independent review process. The IRT has not been tasked with making a recommendation to MassDOT or the public. The Technical Report, Addendum, and matrices contain the results of the IRT's evaluation of the alternatives for the Throat and are meant

to inform MassDOT's decision-making process. The results are intended to be a factual review of the alternatives, without providing an opinion as to a preferred alternative. It is left to MassDOT to determine an outcome. The matrices are comprised of **Tables 1.1 – 1.8**.

Table 1.1. ***Constructability Criteria Matrix***

Constructability		DEIR Alternatives			IRT Alternatives			
Criteria	**Measures**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**Elevated Shared Use Path Hybrid**
Construction time frame	# Years and months	6 years 6 months	6 years 6 months	8 years	6 years 6 months	6 years 6 months	7 years 6 months	8 years
Effects on ramp connections for I-90 and SFR	Y/N / Service interruption duration / User delays (hours)	Yes; Maintains ramps for I-90 and SFR through all phases of construction	Yes; Maintains ramps for I-90 and SFR through all phases of construction	Yes; Maintains ramps for I-90 and SFR through all phases of construction	Yes; Maintains ramps for I-90 and SFR through all phases of construction	Yes; Maintains ramps for I-90 and SFR through all phases of construction	Yes; Maintains ramps for I-90 and SFR through all phases of construction	Yes; Maintains ramps for I-90 and SFR through all phases of construction
Effects on current rail service to Grand Junction	Service interruption duration / User delays (hours)	Significant interruption	Minor/moderate interruption	Significant interruption	Signifcant interruption, reduced from DEIR Alternative	Minor/moderate interruption	Moderate interruption	Moderate Interruption
Effects on current rail service to Framingham/ Worcester	Single v. double track operation / Service interruption duration / User delays (hours)	Minor interruption; primarily 2 track operation	Moderate interruption; primarily 1 track operation	Minor interruption; primarily 2 track operation	Minor interruption; primarily 2 track operation	Moderate interruption; primarily 1 track operation	Minor interruption; primarily 2 track operation	Minor interruption; primarily 2 track operation
Effects on access to PDW during construction	Yes/No / Service interruption duration / User delays (hours)	Yes; Temporary during construction of path in river, detour delay of 5 minutes via two detour routes	No; Unless there are any planned improvements to PDW	Yes; During construction of SFR, detour delay of 5 minutes via two detour routes	Yes; Temporary during construction of path in river, detour delay of 5 minutes via two detour routes	No; Unless there are any planned improvements to PDW	Yes; During construction of SFR, detour delay of 5 minutes via two detour routes	Yes; During construction of SFR, detour delay of 5 minutes via two detour routes
Complexity of staging	# Stages / Duration / Interruptions to service / Temporary structures required	6 stages, 3 year Grand Junction closure, 2 years impacted Worcester Line operations, temporary viaduct structure to bring I-90 to grade at western edge	6 stages, 3 year Grand Junction closure, 2 years impacted Worcester Line operations, temporary viaduct structure to bring I-90 to grade at western edge	7 stages, 4 year Grand Junction closure, 5 year PDW closure or detour, temporary structure limited to viaduct	6 stages, 3 year Grand Junction closure, 2 years impacted Worcester, temporary support limited to viaduct supports during demolition	6 stages, Grand Junction operational, Worcester Line single track, PDW in service without temporary structure, temporary columns and foundations required for viaduct	6 stages, 3.75 year Grand Junction closure, 5 year PDW closure or detour, temporary structure limited to viaduct	6 stages, 3.75 year Grand Junction closure, 5 year PDW closure or detour, temporary structure limited to viaduct
Risk of delay / Cost increase due to uncertainty / Complexity	High / Medium / Low	Medium - High	Medium	Medium - High	Slightly less than DEIR Highway At-Grade Alternative	Slightly less than DEIR Highway Viaduct Alternative	Slightly less than DEIR Hybrid Alternative	Slightly less than DEIR Hybrid Alternative

Table 1.2. ***Cost Criteria Matrix***

Cost		DEIR Alternatives			IRT Alternatives			
Criteria	**Measures**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**Elevated Shared Use Path Hybrid**
Construction cost	Estimated construction costs (including non-capital construction costs such as rail detours during construction)	$987,942,174	$1,039,947,429	$1,195,395,979	$1,133,017,000	$1,202,458,000	$1,126,265,000	$1,165,772,000
Life-cycle cost	Estimated life-cycle cost for each option	$54,329,465	$71,814,241	$81,549,196	$57,811,000	$83,331,000	$60,506,000	$63,180,000
Need to acquire/take property	Estimated cost of acquisition	11,860 SF	0 SF	9,605 SF	3,245 SF	0 SF	0 SF	3,245 SF
Mitigation costs	Estimated cost range of required mitigation for permitting	Relatively greater risk of mitigation costs	Relatively lesser risk of mitigation costs	Relatively lesser risk of mitigation costs	Relatively greater risk of mitigation costs	Relatively lesser risk of mitigation costs	Relatively lesser risk of mitigation costs	Relatively moderate risk of mitigation costs

Table 1.3. *Environment Criteria Matrix*

Environment		DEIR Alternatives			IRT Alternatives			
Criteria	**Measures**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**Elevated Shared Use Path Hybrid**
Permanent effects on designated historic resources	Amount of impacts / benefits	41,430 SF of CRBHD land used -6,044 SF net loss of accessible open space Narrower PDW than existing Eliminate viaduct visual, shadow impacts; cause river impacts N-S ped/bike connections feasible Reconstructed LGJ Bridge/improved PDW east end	11,640 SF of CRBHD land used 16,942 SF net gain of accessible open space Wider PDW than existing Maintain viaduct visual, shadow impacts N-S ped/bike connections infeasible No reconstructed LGJ for improved PDW east	19,420 SF of CRBHD land used 12,422 SF net gain of accessible open space Wider PDW than existing Reduce viaduct visual, shadow impacts N-S ped/bike connections feasible Reconstructed LGJ Bridge/improved PDW east end	46,950 SF of CRBHD land used -10,251 SF net loss of accessible open space Narrower PDW than existing Eliminated viaduct visual, shadow impacts; cause river impacts N-S ped/bike connections feasible Reconstructed LGJ Bridge/improved PDW east end	8,353 SF of CRBHD land used 38,722 SF net gain of accessible open space Considerably wider PDW than existing Maintain viaduct visual, shadow impacts N-S ped/bike connections infeasible No reconstructed LGJ for improved PDW east	47,290 SF of CRHBD land used 47,242 SF net gain of accessible open space Considerably wider PDW than existing Viaduct visual, shadow impacts differ from existing; better landscape screening N-S ped/bike connections feasible Reconstructed LGJ Bridge/improved PDW east end	45,610 SF CRBHD land used 24,172 SF net gain of accessible open space (elevated structure, limited landscaping) Considerably wider PDW than existing Viaduct visual impacts differ from existing; no landscape screening N-S ped/bike connection feasible Reconstructed LGJ Bridge/improved PDW east end
Temporary effects on designated historic resources	Amount of impacts	Assumed that all alternatives will occupy throat during full construction period	Assumed that all alternatives will occupy throat during full construction period	Assumed that all alternatives will occupy throat during full construction period	Assumed that all alternatives will occupy throat during full construction period	Assumed that all alternatives will occupy throat during full construction period	Assumed that all alternatives will occupy throat during full construction period	Assumed that all alternatives will occupy throat during full construction period
Permanent effects on parks/open space	Amount of impacts / benefits	For Article 97, project-wide open space benefits compensate For 4(f) review, see historic resource impacts/benefits	For Article 97, project-wide open space benefits compensate For 4(f) review, see historic impacts/benefits	For Article 97, project-wide open space benefits compensate For 4(f) review, see historic impacts/benefits	For Article 97, project-wide open space benefits compensate For 4(f) review, see historic impacts/benefits	For Article 97, project-wide open space benefits compensate For 4(f) review, see historic impacts/benefits	For Article 97, project wide open space benefits compensate For 4(f) review, see historic impacts/benefits	For Article 97, project wide open space benefits compensate For 4(f) review, see historic impacts/benefits
Temporary effects on parks/open space	Amount of impacts	Assumed that all alternatives will occupy throat during full construction period, and that PDW path will be closed and relocated, with route to be determined	Assumed that all alternatives will occupy throat during full construction period, and that PDW path will be closed and relocated, with route to be determined	Assumed that all alternatives will occupy throat during full construction period, and that PDW path will be closed and relocated, with route to be determined	Assumed that all alternatives will occupy throat during full construction period, and that PDW path will be closed and relocated, with route to be determined	Assumed that all alternatives will occupy throat during full construction period, and that PDW path will be closed and relocated, with route to be determined	Assumed that all alternatives will occupy throat during full construction period, and that PDW path will be closed and relocated, with route to be determined	Assumed that all alternatives will occupy throat during full construction period, and that PDW path will be closed and relocated, with route to be determined
Permanent effects on wetlands	Amount of impacts / benefits	330 LF Bank 420 SF of LUW 1,100 SF Waters of the U.S. In addition to stormwater outfall work, common to all alternatives	Stormwater outfall work, common to all alternatives: 10 LF Bank 40 SF of LUW 60 SF Waters of the U.S.	Stormwater outfall work, common to all alternatives: 10 LF Bank 40 SF of LUW 60 SF Waters of the U.S.	400 / 670 LF Bank 1,100 / 4,310 SF LUW In addition to stormwater outfall work, common to all alternatives	Stormwater outfall work, common to all alternatives: 10 LF Bank 40 SF of LUW 60 SF Waters of the U.S.	Stormwater outfall work, common to all alternatives: 10 LF Bank 40 SF of LUW 60 SF Waters of the U.S.	Stormwater outfall work, common to all alternatives: 10 LF Bank 40 SF of LUW 60 SF Waters of the U.S. Potential bank shadow impact
Temporary effects on wetlands	Amount of impacts	Additional 20 LF of Bank 3,300 SF of LUW In addition to temporary impacts for stormwater installation, common to all alternatives: 90 LF of Bank 240 SF of LUW	Additional temporary impacts for stormwater installation, common to all alternatives: 90 LF of Bank 240 SF of LUW	Additional temporary impacts for stormwater installation, common to all alternatives: 90 LF of Bank 240 SF of LUW	Additional temporary impacts for stormwater installation, common to all alternatives: 90 LF of Bank 240 SF of LUW	Additional temporary impacts for stormwater installation, common to all alternatives: 90 LF of Bank 240 SF of LUW	Additional temporary impacts for stormwater installation, common to all alternatives: 90 LF of Bank 240 SF of LUW	Additional 300 LF of Bank 190 SF of LUW In addition to temporary impacts for stormwater installation, common to all alternatives: 90 LF of Bank 240 SF of LUW

Table 1.3. ***Environment Criteria Matrix (continued)***

Environment		DEIR Alternatives			IRT Alternatives			
Criteria	**Measures**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**Elevated Shared Use Path Hybrid**
Permanent effects on tidelands	Amount of impacts / benefits	Fill 1,100 SF of flowed tidelands NWDIF impacts on filled tidelands -6,044 net loss accessible open space Narrower PDW than existing	NWDIF impacts on filled tidelands 16,942 SF net gain accessible open space Wider PDW than existing	NWDIF impacts on filled tidelands 12,422 SF net gain accessible open space Wider PDW than existing	NWDIF impacts on filled tidelands -10,251 SF net loss accessible open space Narrower PDW than existing	NWDIF impacts on filled tidelands 38,722 SF net gain accessible open space Wider PDW than existing	NWDIF impacts on filled tidelands 47,242 SF net gain accessible open space Wider PDW than existing	NWDIF impacts on filled tidelands 24,172 SF net gain accessible open space Wider PDW than existing, on elevated structure, not adjacent to riverbank No permanent fill on flowed tidelands
Temporary effects on tidelands	Amount of impacts	Temporary impact on 3,000 SF of flowed tidelands Assumed that PDW path closed and relocated during construction for all alternatives	Assumed that PDW path closed and relocated during construction for all alternatives	Assumed that PDW path closed and relocated during construction for all alternatives	Assumed that PDW path closed and relocated during construction for all alternatives	Assumed that PDW path closed and relocated during construction for all alternatives	Assumed that PDW path closed and relocated during construction for all alternatives	Temporary impact of 600 SF of flowed tidelands Assumed that PDW path closed and relocated during construction for all alternatives
Effects on air quality	Roadway congestion / Stopped traffic / Active ventilation	All alternatives expected to produce greater emissions than no build due to more efficient roadway attracting more trips, 3 DEIR alternatives very similar	All alternatives expected to produce greater emissions than no build due to more efficient roadway attracting more trips, 3 DEIR alternatives very similar	All alternatives expected to produce greater emissions than no build due to more efficient roadway attracting more trips, 3 DEIR alternatives very similar	All alternatives expected to produce greater emissions than no build due to more efficient roadway attracting more trips Alternative expected to have air quality impacts in keeping with DEIR alternatives	All alternatives expected to produce greater emissions than no build due to more efficient roadway attracting more trips Alternative expected to have air quality impacts in keeping with DEIR alternatives	All alternatives expected to produce greater emissions than no build due to more efficient roadway attracting more trips Alternative expected to have air quality impacts in keeping with DEIR alternatives	All alternatives expected to produce greater emissions than no build due to more efficient roadway attracting more trips Alternative expected to have air quality impacts in keeping with DEIR alternatives

Table 1.4. ***Permitting Criteria Matrix***

Permitting		DEIR Alternatives			IRT Alternatives			
Criteria	**Measures**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**Elevated Shared Use Path Hybrid**
Risk of not receiving necessary permit(s)	High / Medium / Low	High See Table 5.7 in the Technical Report	Low - Medium See Table 5.8 in the Technical Report	Low - Medium See Table 5.9 in the Technical Report	High See Table 7.9 in the Technical Report	Low - Medium See Table 7.10 in the Technical Report	Low - Medium See Table 7.11 in the Technical Report	High See Table 3.5 in the Addendum
Risk of permitting delay	High / Medium / Low	High See Table 5.10 in the Technical Report	Low - Medium See Table 5.11 in the Technical Report	Low - Medium See Table 5.12 in the Technical Report	Medium - High See Table 7.12 in the Technical Report	Low - Medium See Table 7.13 in the Technical Report	Low - Medium See Table 7.14 in the Technical Report	High See Table 3.6 in the Addendum
Able to meet all state wetlands regulatory requirements without variances	Y/ Variance required	Variance required, would not be granted due to other reasonable alternatives without these impacts	Yes	Yes	Variance likely required, would not be granted due to other reasonable alternatives without these impacts	Yes	Yes	Variance likely required, would not be granted due to other reasonable alternatives without these impacts
Able to meet all state tidelands regulatory requirements without variances	Y/ Variance required	Variance required, would not be obtained due to other reasonable alternatives without these impacts	Yes	Yes	Yes	Yes	Yes	Yes
Existence of alternative with lesser impact to wetlands, tidelands, parklands or historic resources	Y/N, as applicable to specific permit	Yes for wetlands and tidelands, potentially for parklands or historic resources	No for wetland and tidelands, Potentially for parklands or historic resources	No for wetlands and tidelands, Potentially for parklands or historic resources	Yes for wetlands, No for tidelands, Potentially for parklands or historic resources	No for wetland and tidelands, Potentially for parklands or historic resources	No for wetland and tidelands, Potentially for parklands or historic resources	Yes for wetlands, No for tidelands, Potentially for parklands or historic resources
4(f) parkland impacts	Amount of impacts, potential mitigation	Medium risk - outcome depends on whether another alternative is judged superior. This alternative has lesser area of riverfront open space	Low - Medium risk - outcome depends on whether another alternative is judged superior. This alternative has greater area of riverfront open space	Low - Medium risk - outcome depends on whether another alternative is judged superior. This alternative has greater area of riverfront open space	Medium risk - outcome depends on whether another alternative is judged superior. This alternative has lesser area of riverfront open space	Low - Medium risk - outcome depends on whether another alternative is judged superior. This alternative has greater area of riverfront open space	Low - Medium risk - outcome depends on whether another alternative is judged superior. This alternative has greater area of riverfront open space	Medium risk - outcome depends on whether another alternative is judged superior. This alternative has lesser area of riverfront open space
Sect. 106 historic resource impacts	Amount of impacts, potential mitigation	Medium risk - outcome depends on whether another alternative is judged superior; This alternative has lesser area of riverfront open space	Low - Medium risk - outcome depends on whether another alternative is judged superior; This alternative has greater area of riverfront open space	Low - Medium risk - outcome depends on whether another alternative is judged superior; This alternative has greater area of riverfront open space	Medium risk - outcome depends on whether another alternative is judged superior; This alternative has lesser area of riverfront open space	Low - Medium risk - outcome depends on whether another alternative is judged superior; This alternative has greater area of riverfront open space	Low - Medium risk - outcome depends on whether another alternative is judged superior; This alternative has greater area of riverfront open space	Medium risk - outcome depends on whether another alternative is judged superior; This alternative has lesser area of riverfront open space
Risk of I-90 inundation by 50-year flood	Y/N / Amount of risk	No	No	No	No	No	No	No

Table 1.5. ***Multimodal Connectivity Criteria Matrix***

Multimodal Connectivity		DEIR Alternatives			IRT Alternatives			
Criteria	**Measures**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**Elevated Shared Use Path Hybrid**
Impact (if any) on West Station constructability/ expandability	Impact Y/N	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Number of N-S access points to river for peds/bikes	# Connections / Travel time to destinations	Multiple; likely 2 including west end	None	Potentially at west end	Multiple; likely 2	None	Multiple; likely 2 including west end	Multiple; likely 2
Provides minimum 50 mph railroad design speed	Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Provides desired 79 mph railroad design speed	Y/N	No; requires spreading of track and West Station relocation	No; requires spreading of track and West Station relocation	No; requires spreading of track and West Station relocation	No; requires spreading of track and West Station relocation	No; requires spreading of track and West Station relocation	No; requires spreading of track and West Station relocation	No; requires spreading of track and West Station relocation
Maintains desired clearance (18'-6") over train operations	Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Allows future 2- or 3-track operation on Grand Junction	Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Effect on future multimodal connectivity	Potential for multi-use path connection to Grand Junction railroad and N-S connections for bus/transit	No	Yes	No	No	Yes	Yes	Yes

Table 1.6. ***Public Realm Criteria Matrix***

Public Realm		DEIR Alternatives			IRT Alternatives			
Criteria	**Measures**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**Elevated Shared Use Path Hybrid**
Accommodates filed land use plans for project area (including any air rights development plans)	Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Effects on noise (both sides of river)	Change in noise impacts on receptors / Mitigation feasibility	Noise increases over existing conditions, especially for receptors close to the highway (BU). Rail viaduct shields PDW and noise decreases. Noise wall near Nickerson Field feasible. No feasible mitigation for PDW because of physical constraints. Magazine Beach noise reduced but mitigation not feasible or cost effective. Rail noise mitigated with special track turnout or relocating turnout away from receptors.	Noise increases over existing conditions, especially for receptors close to the highway (BU). Noise decreases some along PDW and at Magazine Beach. Noise wall near Nickerson Field feasible. No feasible mitigation for PDW because of physical constraints. Magazine Beach noise reduced but mitigation not feasible or cost effective. Rail noise mitigated with special track turnout or relocating turnout away from receptors.	Noise increases over existing conditions, especially for receptors close to the highway (BU). Rail viaduct shields PDW and noise decreases. Noise wall near Nickerson Field feasible. No feasible mitigation for PDW because of physical constraints. Magazine Beach noise reduced but mitigation not feasible or cost effective. Rail noise mitigated with special track turnout or relocating turnout away from receptors.	Noise levels at BU receptors should be similar to DEIR alternatives because of proximity to the highway and rail traffic. A noise wall along Nickerson Field would be feasible. Noise from SFR traffic and I-90 will continue to impact receptors along PDW, although constructing the trail on structure along SFR with a profile that is higher than the roadways would reduce noise levels along a portion of PDW. Magazine Beach noise levels would be similar as existing conditions. Noise mitigation is not likely to benefit this area.	Noise levels at BU receptors should be similar to DEIR alternatives because of proximity to the highway and rail traffic. A noise wall along Nickerson Field would be feasible. Shifting SFR traffic away from the Charles River (partially under I-90 viaduct) should reduce noise at PDW receptors, and created green space could support a noise wall along a portion of the length. Magazine Beach noise levels should also be reduced. No further mitigation is likely.	Noise levels at BU receptors should be similar to DEIR alternatives because of proximity to the highway and rail traffic. A noise wall along Nickerson Field would be feasible. Depressing I-90 westbound traffic into a boat section and shifting SFR traffic away from the Charles River and on top of the I-90 boat section should reduce noise at PDW receptors, and created green space could support a noise wall along a portion of the length. Magazine Beach noise levels should also be reduced. No further mitigation is likely.	Noise levels at BU receptors should be similar to DEIR alternatives because of proximity to the highway and rail traffic. A noise wall along Nickerson Field would be feasible. Noise from SFR traffic and I-90 will continue to impact receptors along PDW, although constructing the trail on structure above SFR would reduce noise levels along a portion of PDW. Magazine Beach noise levels would be similar as existing conditions. Noise mitigation is not likely to benefit this area.
Effects on visual quality of the riverfront and other open spaces	Vegetation coverage / Vegetation types / Positive or negative man-made elements	"Wall" effect of viaduct is eliminated All vegetation is removed and replaced with retained fill	"Wall" effect of highway Slightly increased space for landscaping between SFR and PDW Little to no change in man-made elements with potential for improved path	"Wall" effect of rail viaduct is shorter than existing No change to river's edge No added vegetation	"Wall" effect of viaduct is eliminated All vegetation is removed and replaced with paved area or cantilevered paved path	"Wall" effect of highway Increased space for landscaping between SFR and PDW Reduced presence of man-made roads in existing parkland area	"Wall" effect reduced with lower viaduct Large increase in space for landscaping between SFR and PDW Increased presence of man-made elements with multiple roads adjacent to parkland Potential for improved PDW man-made facilities	"Wall" effect reduced with lower viaduct Potential for landscaping on PDW PDW above roadway Potential for improved PDW man-made facilities
Increases/decreases navigable water sheet area available	Amount of increase/ decrease	Decreases by 481 SF	No Change	No Change	Decreases by 1,760 SF	No Change	No Change	No Change
Effects on physical quality of open space and PDW through amenities	Shade / Surface / Furniture	This option does not provide any additional open space. Due to the narrowness of the PDW and with no additional space, furniture or green space is not an option.	Due to the distance between the viaduct and the PDW, shade is not anticipated to be a issue. This option provides the most space for the PDW and green space/buffer.	Shade is not anticipated to be a factor. This option does not provide any additional open space. Due to the narrowness, there is only an opportunity to increase the PDW width by 2 feet.	This option does not provide any additional open space. Due to the narrowness of the PDW and with no additional space, furniture or green space is not an option.	Due to the distance between the viaduct and the PDW, shade is not anticipated to be an issue. This option provides additional space compared to the DEIR Option for the PDW and green space/buffer.	This option is anticipated to have shading impacts due to the proximity of the SFR over I-90 WB viaduct to the PDW. The imapcts should not encorach on the PDW but rather the green space from the rasied structure to the path. This option provides additional space for expanding the PDW or for green space/buffer	Elevated PDW may provide new open space, depending on size of viaduct

Table 1.6. ***Public Realm Criteria Matrix (continued)***

Public Realm		DEIR Alternatives			IRT Alternatives			
Criteria	**Measures**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**Elevated Shared Use Path Hybrid**
Effects on amount of open space in area	# Acres added	Decreases by .14 acres	Increases by .39 acres	Increases by .29 acres	Decreases by .24 acres	Increases by .89 acres	Increases by 1.08 Acres	Increases by 0.55 acres
Effect on quality of riverfront access points	Width / Material / Continuity of neighborhood feel	Low, gradual access across throat. Requires additional space for landing stairs/ramps along river. Barriers along edges.	Very high access across throat with stairs and ramps at both ends. Barriers along edges.	Very high access across throat with stairs and ramps at both ends. Barriers along edges.	Low, gradual access across throat. Requires additional space for landing stairs/ramps along river. Barriers along edges.	Very high access across throat with stairs and ramps at both ends. Barriers along edges.	Medium-high access with stairs and ramps required only along river. Barriers along edges	Medium height access that meets path, but must ramp to ground level for continued access

Table 1.7. ***Resiliency Criteria Matrix***

Resiliency		DEIR Alternatives			IRT Alternatives			
Criteria	**Measures**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**Elevated Shared Use Path Hybrid**
Protects key components of project from flood impacts	# Facilities impacted / Mapping of key components relative to flood elevations	2070 1% flood: Grand Junction Rail and Commuter Rail are not vulnerable. PDW path is vulnerable. 2070 0.1% flood: Grand Junction Rail and Commuter Rail are not vulnerable.	2070 1% flood: Grand Junction Rail and Commuter Rail are not vulnerable. PDW path is vulnerable. 2070 0.1% flood: Grand Junction Rail and Commuter Rail are vulnerable.	2070 1% flood: Grand Junction Rail and Commuter Rail are not vulnerable. PDW path is vulnerable. 2070 0.1% flood: Grand Junction Rail is not vulnerable. Commuter Rail is vulnerable.	2070 1% flood: Grand Junction Rail and Commuter Rail are not vulnerable. PDW path is vulnerable. 2070 0.1% flood: Grand Junction Rail and Commuter Rail are not vulnerable.	2070 1% flood: Grand Junction Rail and Commuter Rail are not vulnerable. PDW path is vulnerable. 2070 0.1% flood: Grand Junction Rail and Commuter Rail are vulnerable.	2070 1% flood: Grand Junction Rail and Commuter Rail are not vulnerable. PDW path is vulnerable. 2070 0.1% flood: Grand Junction Rail and Commuter Rail are not vulnerable.	2070 1% flood: Grand Junction Rail and Commuter Rail are not vulnerable. PDW path is vulnerable. 2070 0.1% flood: Grand Junction Rail and Commuter Rail are not vulnerable.
Addresses stormwater runoff impacts from future rainfall projections	BMPs included / Amount of space available for BMPs / Drainage sized for future projections	BMPs provide 59% phosphorus removal / Constrained space for BMPs / Limited capacity to address future rainfall	BMPs provide 66% phosphorus removal / Substantial space for BMPs / Sufficient capacity to address future rainfall	BMPs provide 59% phosphorus removal / Moderate space for BMPs / Limited capacity to address future rainfall	BMPs anticipated to provide 59% phosphorus removal / Constrained space for BMPs / Limited capacity to address future rainfall	BMPs anticipated to exceed 59% phosphorus removal / Moderate space for BMPs / Sufficient capacity to address future rainfall	BMPs anticipated to exceed 59% phosphorus removal / Moderate space for BMPs / Limited capacity to address future rainfall	BMPs anticipated to provide 59% phosphorus removal / Constrained space for BMPs / Limited capacity to address future rainfall
Protects highway infrastructure from flood impacts	% Roadway inundated based on future flood projections	2030 1% flood: I-90 and SFR not vulnerable. 2070 1% flood: I-90 is not vulnerable; SFR at BU Bridge and outside the throat is vulnerable 2070 0.1% flood: Large sections of I-90 and SFR (Throat and at BU Bridge) are vulnerable.	2030 1% flood: I-90 and SFR not vulnerable 2070 1% flood: I-90 is not vulnerable; SFR at BU Bridge and outside the throat is vulnerable 2070 0.1% flood: I-90 at BU Bridge Underpass and large sections of SFR (Throat and at BU Bridge) are vulnerable.	2030 1% flood: I-90 and SFR not vulnerable 2070 1% flood: I-90 is not vulnerable; SFR at BU Bridge and outside the throat is vulnerable 2070 0.1% flood: Large sections of I-90 and SFR (Throat and at BU Bridge) are vulnerable.	2030 1% flood: I-90 and SFR not vulnerable 2070 1% flood: I-90 is not vulnerable; SFR at BU Bridge and outside the throat is vulnerable 2070 0.1% flood: Large sections of I-90 and SFR (Throat and at BU Bridge) are vulnerable.	2030 1% flood: I-90 and SFR not vulnerable 2070 1% flood: I-90 is not vulnerable; SFR at BU Bridge and outside the throat is vulnerable 2070 0.1% flood: I-90 at BU Bridge Underpass and large sections of SFR (Throat and at BU Bridge) are vulnerable.	2030 1% flood: I-90 and SFR not vulnerable 2070 1% flood: I-90 is not vulnerable; SFR at BU Bridge and outside the throat is vulnerable 2070 0.1% flood: SFR at BU Bridge Underpass and large sections of I-90 (Throat and at BU Bridge) are vulnerable.	2030 1% flood: I-90 and SFR not vulnerable 2070 1% flood: I-90 is not vulnerable; SFR at BU Bridge and outside the throat is vulnerable 2070 0.1% flood: SFR at BU Bridge Underpass and large sections of I-90 (Throat and at BU Bridge) are vulnerable.
Accommodates FHWA guidance on building of interstate highway in flood plain	Yes/No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Amount of impervious surface created	Amount (acres)	4.90	5.90	5.39	4.95	5.56	3.56	4.56

Table 1.8. ***Safety and Operations Criteria Matrix***

Safety and Operations		DEIR Alternatives			IRT Alternatives			
Criteria	**Measures**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**At-Grade**	**Highway Viaduct**	**Hybrid**	**Elevated Shared Use Path Hybrid**
Effects on safety for I-90	Presence of safety elements per lane mile / Safety model analysis	10 crashes 0.86 crashes/MVMT No safe place for vehicles to pull out of traffic	11 crashes 0.94 crashes/MVMT	11 crashes 0.94 crashes/MVMT No safe place for vehicles to pull out of traffic	11 crashes 0.94 crashes/MVMT No safe place for vehicles to pull out of traffic	10 crashes 0.86 crashes/MVMT	11 crashes 0.94 crashes/MVMT No safe place for vehicles to pull out of traffic	11 crashes 0.94 crashes/MVMT No safe place for vehicles to pull out of traffic
Effects on safety for SFR	Presence of safety elements per lane mile / Safety model analysis	16 crashes 1.60 crashes/MVMT	13 crashes 1.30 crashes/MVMT	16 crashes 1.60 crashes/MVMT	15 crashes 1.50 crashes/MVMT	17 crashes 1.70 crashes/MVMT	15 crashes 1.50 crashes/MVMT	15 crashes 1.50 crashes/MVMT
Effects on operations and maintenance on I-90	Shoulder width / Lane width	Substandard shoulders result in impact to traffic operations and worker safety issues when there is a breakdown or accident; Trench drains full length of throat area or drain inlets every 5-10 feet are required to prevent 10-year storm gutter flow spreading into travel lanes	8-foot shoulders provide safe refuge area for breakdowns and responders; Drain inlets every 190 feet are required to prevent 10-year storm gutter flow spreading into travel lanes	Substandard shoulders result in impact to traffic operations and worker safety issues when there is a breakdown or accident; Drain inlets every 15-20 feet are required to prevent 10-year storm gutter flow spreading into travel lanes	Substandard shoulders result in impact to traffic operations and worker safety issues when there is a breakdown or accident; Trench drains full length of throat area or drain inlets every 5-10 feet are required to prevent 10-year storm gutter flow spreading into travel lanes	8-foot shoulder provides safe refuge area; Drain inlets every 350 feet are required to prevent 10-year storm gutter flow spreading into travel lanes	Substandard shoulders result in impact to traffic operations and worker safety issues when there is a breakdown or accident; Trench drains full length of throat area or drain inlets every 5-10 feet are required to prevent 10-year storm gutter flow spreading into travel lanes	Substandard shoulders result in impact to traffic operations and worker safety issues when there is a breakdown or accident; Trench drains full length of throat area or drain inlets every 5-10 feet are required to prevent 10-year storm gutter flow spreading into travel lanes
Effects on operations and maintenance on SFR	Shoulder width / Lane width	No opportunity for maintenance vehicles to pull over. Limited snow storage.	Opportunity for maintenance vehicles to pull over. More snow storage.	No opportunity for maintenance vehicles to pull over. Limited snow storage.	No opportunity for maintenance vehicles to pull over. Limited snow storage.	Opportunity for maintenance vehicles to pull over. More snow storage.	No opportunity for maintenance vehicles to pull over. Limited snow storage.	No opportunity for maintenance vehicles to pull over. Limited snow storage.
Requires design exception from NHS Design Standards	Y/N	Yes - shoulder, lane	Yes - shoulder	Yes - shoulder, lane	Yes - shoulder, lane	Yes - shoulder, lane, vertical clearance	Yes - shoulder, lane, vertical clearance	Yes - shoulder, lane
Accommodates addition of outside shoulders on I-90	Y/N	2-foot shoulder	8-foot shoulder	2-3-foot shoulder	2-foot shoulder	8-foot shoulder	2-foot shoulder	2-foot shoulder
Allows separation of modes on PDW Path	Level of comfort (width of path / buffer or physical barrier / width of shoulder)	No separation of modes (8.5'). Concrete barrier separation from traffic. Edge of path is 2.5' from travel lane.	No separation of modes (12'). Guard rail and landscaped buffer separation from traffic. Edge of path is 11.5' from travel lane.	No separation of modes (12'). Guard rail separation from traffic. Edge of path is 3' from travel lane.	No separation of modes (8.5' - 12'). Various separation alternatives from traffic (vertical and horizontal). Edge of path is 2.5' from travel lane or vertically separated.	Room for separation of modes (26'). Various option for separation from traffic including guard rail and landscaped buffer. Edge of path is 8'-18' from travel lane.	Room for separation of modes (26'). Various option for separation from traffic including guard rail and landscaped buffer. Edge of path is 20-'30' from travel lane.	Room for separation of modes (34"). Separated from traffic vertically, but separation from traffic will require anti-missile fencing for safety. Landscaped buffer is possible between pedestrian and bike facilities in more robust version

2 Variant Design

2.1 History

The IRT worked with ABC, the primary proponent of the At-Grade Alternative, throughout the 90-day review. This collaboration included five meetings, numerous phone calls, and the frequent exchange of materials and design concepts. Throughout the period of the 90-day review, the permitting obstacles posed by the At-Grade Alternative – due to its anticipated impacts upon the Charles River and the associated state and federal permitting requirements for construction in or near wetlands – were a continued topic of discussion between the IRT and ABC staff. To attempt to mitigate potential permitting challenges, ABC staff and the IRT worked to develop variants of the core At-Grade concept that might be able to avoid wetlands-related impacts (those that were understood to most likely trigger impediments to permitting).

The majority of the At-Grade design concepts considered by the IRT included a Paul Dudley White Path that was roughly level with the roadway elements. However, ABC proposed at least one design concept that explored elevating the Paul Dudley White Path over either the Charles River or Soldiers Field Road westbound. Following the Task Force meeting on September 26, 2018, ABC developed an additional option for consideration. This was followed by additional details provided to the IRT on October 5 and October 17.

However, ABC noted that these design solutions still may not be permittable by state regulators under the Wetlands Protection Act (WPA) due to the Paul Dudley White Path being placed above a 'resource area' (the Charles River). ABC requested an examination of the various options, which the IRT has titled the Elevated Multi-Use Path Concept, to reduce the permitting risk of the At-Grade Alternative. ABC provided MassDOT and the IRT with a memorandum in which it described and provided sketches of possible configurations for the Elevated Multi-Use Path Concept. Through coordination with ABC, it was decided that the IRT would proceed with concept design and evaluation of Option 1.5. ABC's memo and materials can be found in the Appendices.

The IRT worked to independently verify the design, connectivity, and permitting assertions made by ABC about the Elevated Multi-Use Path concept by analyzing the selected path option and evaluating it through the previously-used process. Through collaboration and discussion with ABC, the selected path option for further design development included the Paul Dudley White Path elevated primarily over Soldiers Field Road eastbound, with a cantilever over part of the westbound roadway. This Addendum summarizes the IRT's review of this Concept in a manner similar to the analysis done for the earlier variants.

2.2 Design Details

The Elevated Shared Use Path concept moves I-90 from the existing deteriorating elevated viaduct and in the final condition relocates I-90 at grade with Soldiers Field Road to its north, the Grand Junction and Worcester Rail Lines to its south, and the pedestrian path elevated on viaduct structure stacked above Soldiers Field Road. To the IRT, the apparent benefits of this concept as compared to the IRT At-Grade Variant include minimized permanent impacts to wetlands, and its enhanced potential for connectivity between the Paul Dudley White Path and local roads such as Agganis Way. The stacked path elevation is closer to that of the local roads across the Throat, enabling connections from local roads with minimal ramps at their intersections. Some apparent shortfalls of this scheme as compared to the IRT At-Grade and Hybrid Variants include the Paul Dudley White Path viaduct maintenance and operation costs, and the tradeoff between quality of green space on the viaduct, and the cost of its construction, as compared to the quality of park space that can be created at grade. The Elevated Shared Use Path Hybrid Variant would also cause greater temporary wetlands impacts than other Variants.

A configuration which has a 36-foot-wide path spanning over the full width of Soldiers Field Road eastbound and cantilevering over Soldiers Field Road westbound has been studied in this Addendum. The study included the possible options for plantings, corresponding beam depths, and column widths, to ensure that the weight of structure did not become so great that its column support widths pushed the overall infrastructure cross section into the wetlands threshold.

Due to construction staging considerations the viaduct path construction will have to occur during a stage after the construction of permanent Soldiers Field Road. This will not reserve space to maintain the Paul Dudley White Path until after the new viaduct path is completed. One of the first phases of construction may be to construct the permanent Soldiers Field Road alignment through the Throat with path viaduct prior to I-90 viaduct demolition. This will likely result in very small laydown areas which complicate the construction. Construction of this path cannot wait until a later stage because then the construction will need to occur with either no laydown area or over an active Soldiers Field Road.

Figure 2.1 shows the plan view of the Elevated Shared Use Path Hybrid Variant, **Figure 2.2** shows the narrowest cross section of the Elevated Shared Use Path Hybrid Variant, **Figure 2.3** shows the western cross section of the Elevated Shared Use Path Hybrid Variant, and **Figure 2.4** shows the profile of the Grand Junction Railroad. **Figures 2.5, 2.6, 2.7, and 2.8** show renderings of the Elevated Shared Use Path Hybrid Variant.

Figure 2.1. ***Plan View of Elevated Shared Use Path Hybrid Variant***

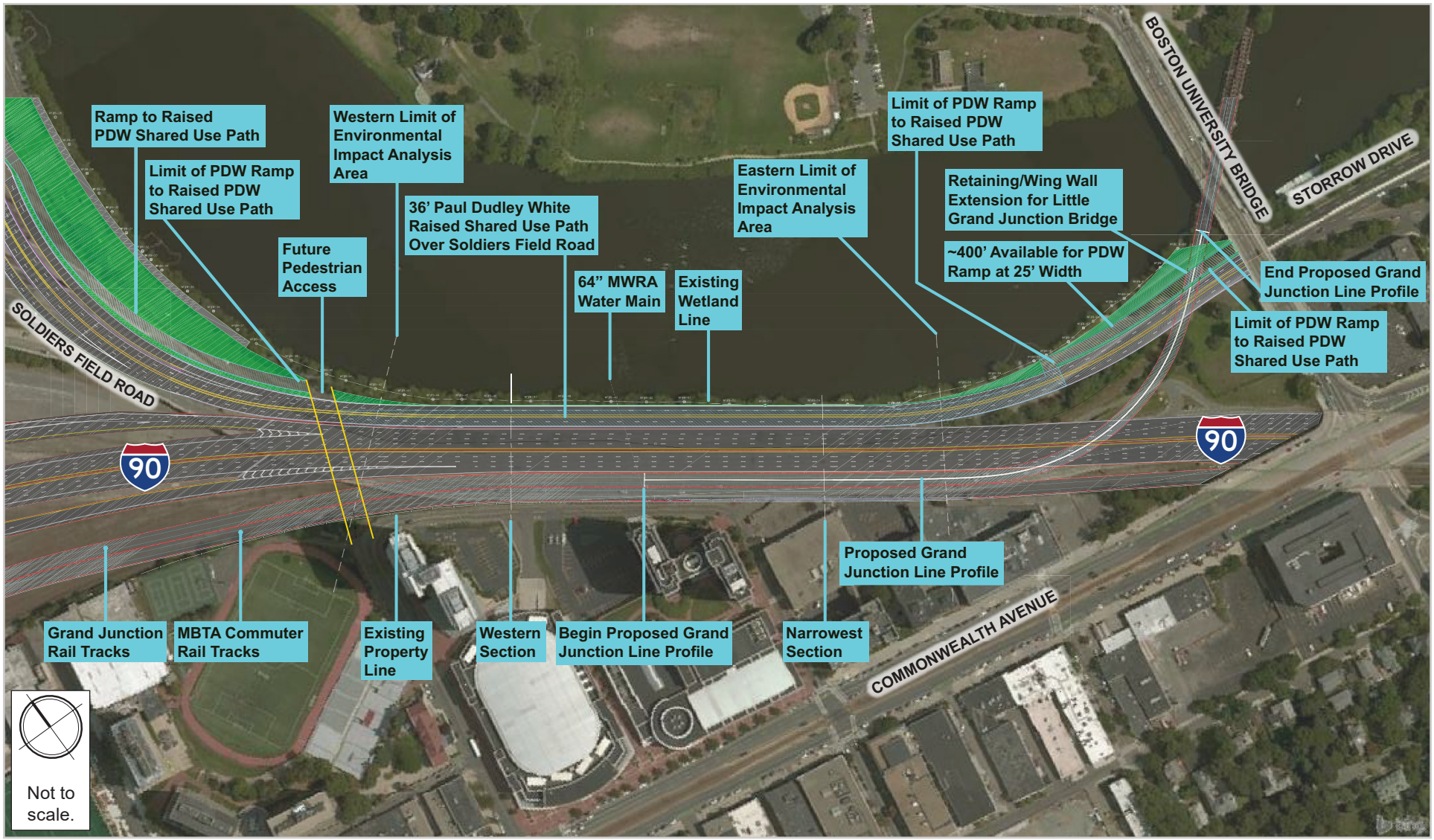
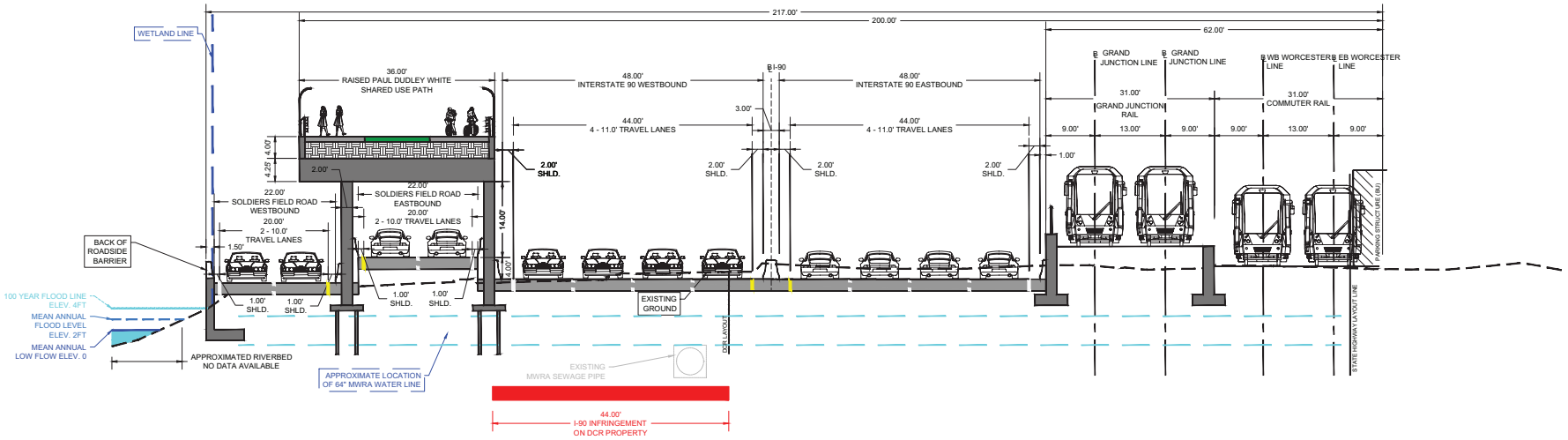
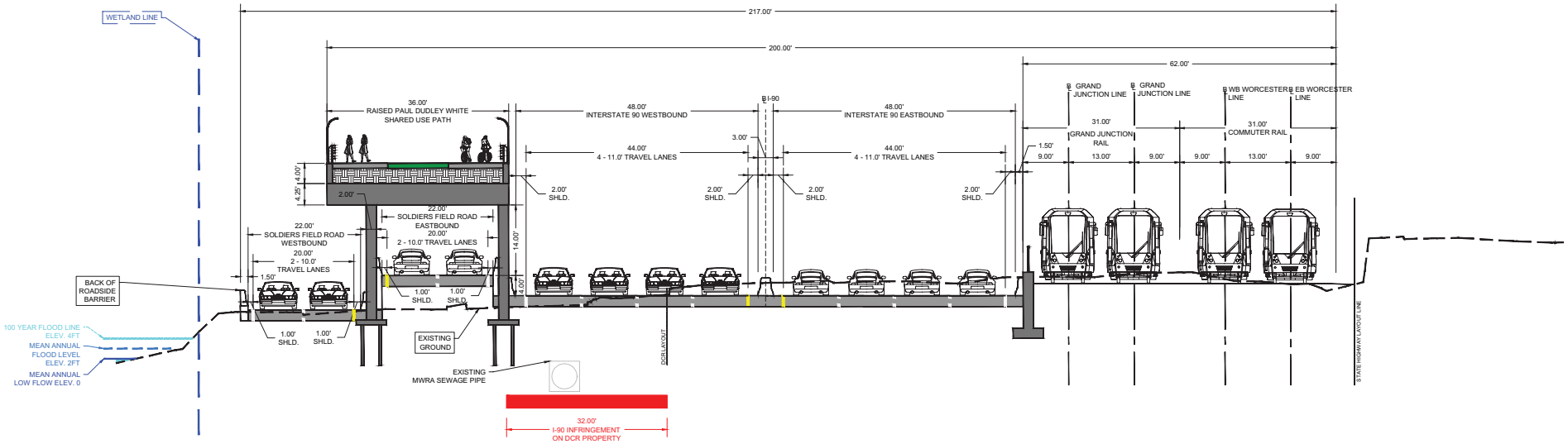


Figure 2.2. ***Narrowest Cross Section of Elevated Shared Use Path Hybrid Variant***



CONCEPT ABC 10-29-2018 REDUCED LANE WIDTH
ELEVATED SHARED USE PATH HYBRID VARIANT
SECTION AT NARROWEST POINT ALONG CHARLES RIVER

Figure 2.3. ***Western Cross Section of Elevated Shared Use Path Hybrid Variant***



CONCEPT ABC 10-29-2018 REDUCED LANE WIDTH
ELEVATED SHARED USE PATH HYBRID VARIANT
WESTERN SECTION ALONG CHARLES RIVER

Figure 2.4. ***Profile of Grand Junction Railroad***

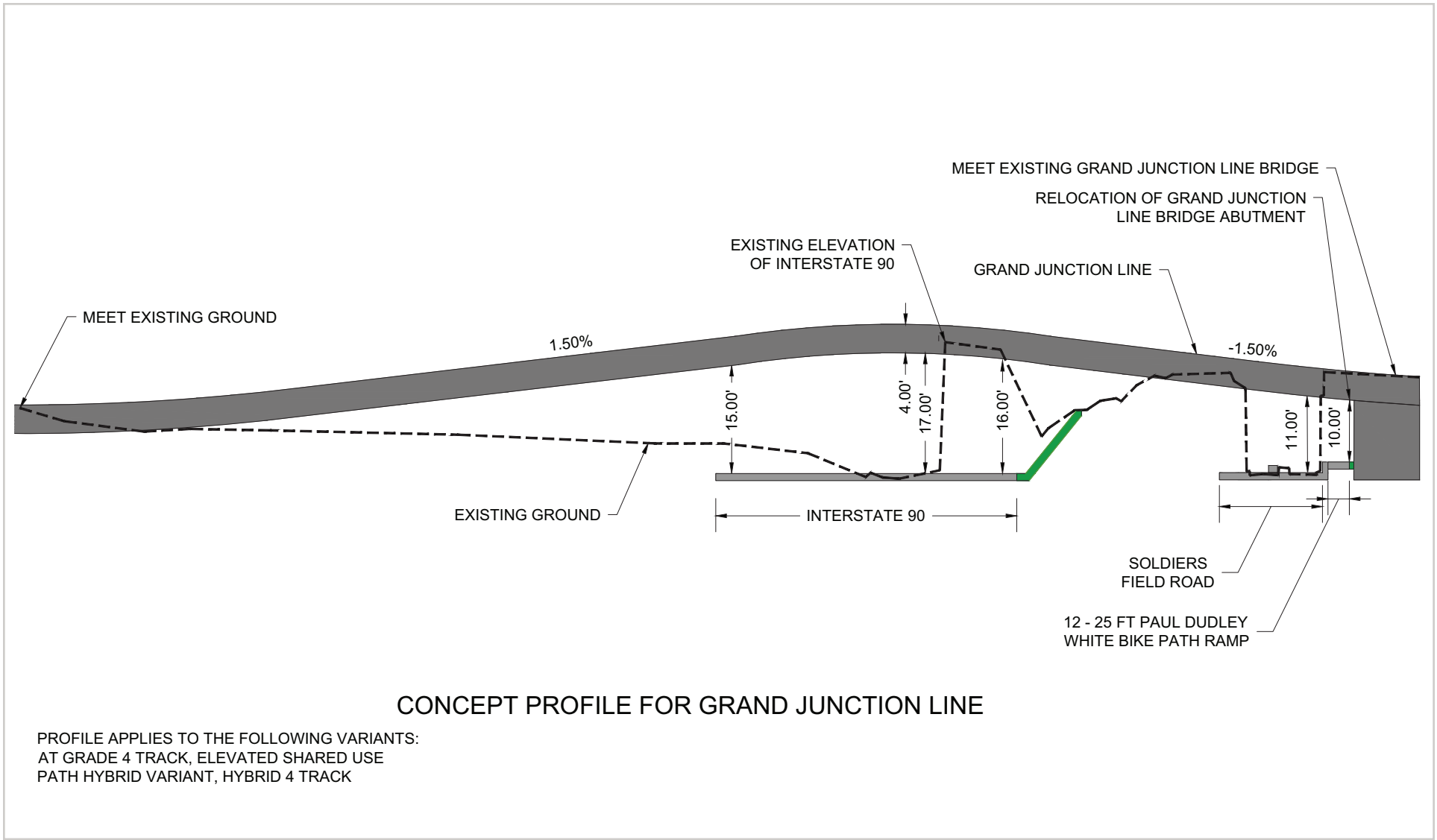
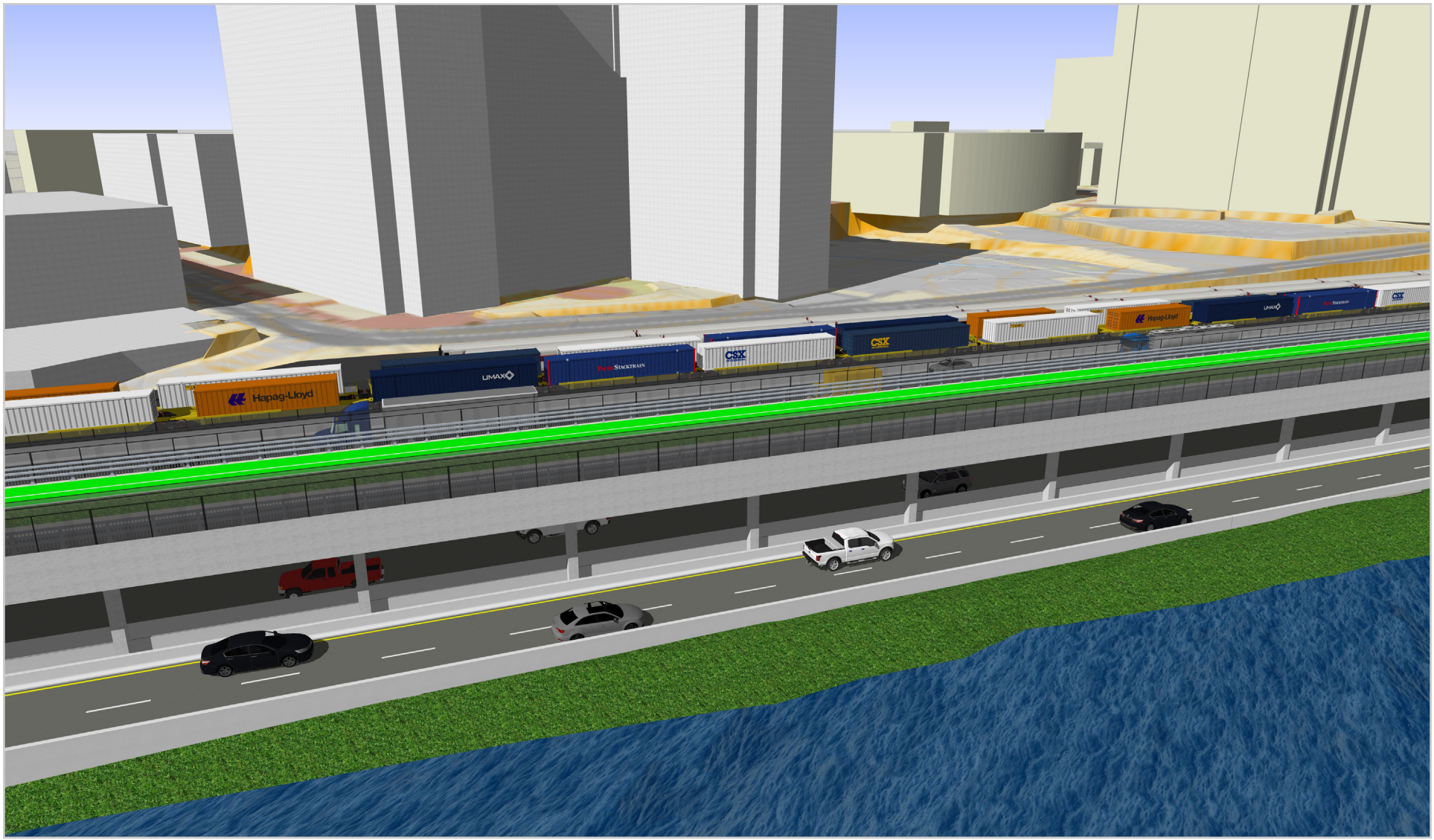


Figure 2.5. ***Rendering of Elevated Shared Use Path Hybrid Variant Looking South from Magazine Beach***

Figure 2.6. ***Rendering of Elevated Shared Use Path Hybrid Variant Looking Northeast from Buick Street***

Figure 2.7. ***Rendering of Elevated Shared Use Path Hybrid Variant Looking West from the Paul Dudley White Path***

Figure 2.8. ***Rendering of Elevated Shared Use Path Hybrid Variant Bird's Eye View***



2.3 Design Evolution

The At-Grade IRT Variant with the Paul Dudley White Path at-grade extends into the Charles River because the Throat area is narrow considering the amount of parkway, interstate, and rail being reconstructed adjacent to one another. This did not leave room for the Paul Dudley White Path to be constructed at-grade without extending into wetlands. This was a significant permitting risk identified by the IRT with the At-Grade Variant.

Both during and following task force meetings, the Massachusetts Department of Transportation (MassDOT) received stakeholder feedback for the investigation of another variant, which shifts the Paul Dudley White Path out of the wetlands and stacks it upon Soldiers Field Road, in an effort to lessen permitting risk and improve the size of the available pathway. This is consistent with other options and variants developed to date, where at least one piece of infrastructure gets stacked upon another to more efficiently use the available space. This is the study of Paul Dudley White Path, the last of the four pieces, being stacked where Rail upon I-90 was stacked in the DEIR Hybrid, I-90 was stacked upon rail in the DEIR and IRT Variant Highway Viaduct, and Soldiers Field Road was stacked upon I-90 in the IRT Variant Hybrid.

3 Evaluation of Variant

3.1 Constructability

3.1.1 TIMEFRAME

Depending on the precise sequencing, an elevated Paul Dudley White Path would likely increase the construction timeframe of the revised path in comparison to an at-grade path. With the very basic sketch plans developed for this exercise, it is not possible to provide a precise estimate of the duration of the revised work to elevate the Paul Dudley White Path.

Ground investigation and site survey work would have an impact of the design decisions, such as the number of pilings, and this would be used to optimize the design as well as the construction methodology. Utilizing experience from other projects where elevated pathways have been built with roadways beneath, it is reasonable to anticipate anywhere from 18-24 months of additional work, compared to the At-Grade IRT Variant within the master schedule, to erect the elevated path. This may be mitigated by other changes to the overall schedule.

3.1.2 EFFECTS ON RAMP CONNECTIONS

Moving Soldiers Field Road closer to the Charles River and placing an elevated path over the top may create new complications related to the duration and sequencing of the work, and how the ramps to and from the Soldiers Field Road area are constructed in relation to the other roadways. The actual impacts, or rather the mitigation of possible impacts, depends very much so on the sequencing of the work as to whether Soldiers Field Road or the interstate ramp connections and movements would be impacted more then with the other options.

As described in the Technical Report, maintaining ramp movements and connectivity throughout the project is not impossible; however, the Elevated Multi-Use Path Concept does come with added complications for more elevated work closer to the Charles River, which will lead to longer activity durations. The differing design and the anticipated longer durations could shift some work in to different time periods. These items would need to be studied in a more detail scheduling of the work which has not been undertaken at this stage.

Effects on the ramp connections for Soldiers Field Road and I-90 will need to be measured assessing whether the scheme to enclose Soldiers Field Road requires a temporary ramp closure during a construction stage. If so, then the approximate duration of the ramp closure will need to be estimated with the hours of user delays assessed against the impact of working around a temporary ramp connection sequence.

3.1.3 EFFECTS ON RAIL SERVICE TO GRAND JUNCTION

Despite changes to elevated infrastructure, this concept does not differ from the IRT Hybrid Variant in regard to design or construction impacts on the Grand Junction Railroad. The elevated Shared Use Path would be at-grade in the location of any interface with the Grand Junction, allowing a similar construction staging approach and interaction to what is described in Section 7.1.3 of the Technical Report.

3.1.4 EFFECTS ON RAIL SERVICE TO FRAMINGHAM/ WORCESTER

As this Concept does not differ from the IRT Hybrid Variant in regards to service or design of the Worcester Main Line, the evaluation of this Concept is identical to that described in Section 7.1.4 of the Technical Report.

3.1.5 EFFECTS ON PAUL DUDLEY WHITE PATH

As described in Section 7.1.5 of the Technical Report, the IRT assumed that the Paul Dudley White Path would be closed substantially during the entire construction period for all new variants.

3.1.6 STAGING COMPLEXITY

Constructing approximately 2,600 feet of elevated structure and ramps will require significantly more quantity consumption for the project as well as greater temporary shoring in the Charles River while the elevated Paul Dudley White Path and Soldiers Field Road beneath is constructed. In comparison to previous IRT Variants, there will be more in work within and near the river, as well as more foundations piling, column erection, and beam lifts overall and closer to the river than in the At-Grade IRT Variant. Thereafter, decking and barrier installation would complete the superstructure. Much of this work would be offline from the Throat and outside the existing Soldiers Field Road. Ideally, the existing Paul Dudley White Path would not be open to the public during construction.

There will be a need for larger staging/landing areas to store and prepare these additional structural items that will be used to construct 2,600 feet of ramp and elevated structure as compared to the At-Grade IRT Variant. The DEIR impacts for construction air quality and noise, as well as marine impacts, would need to account for the overall increases to the scope of work and ensure that adequate mitigations are in place to avoid adverse and lasting impact to the Charles River.

It is possible to prepare a sequencing plan where the elevated Paul Dudley White Path and the realigned Soldiers Field Road beneath could be constructed ahead of the work on I-90. This could be accomplished by closing and diverting the Paul Dudley White Path for the early part of the project and moving Soldiers Field Road early in the schedule. This would help create more space for the realignment of the I-90 and the Worcester Commuter Rail Line in the Throat.

3.1.7 DELAY/COST INCREASE FROM UNCERTAINTY/COMPLEXITY

Building foundations so close to the shoreline can be more time consuming due to water levels and season conditions as well as applied environmental constraints, such as limitations on piling energy or duration of work. Couple this with the very limited concept level design at this stage introduces greater uncertainty when comparing this Concept to the other options noted in the Technical Report.

The elevated Paul Dudley White Path will require foundations for over 2,000 feet along the river and increase the number of interactions with buried utilities when compared to the At-Grade IRT Variant.

3.2 Cost

3.2.1 CONSTRUCTION COST

The IRT developed the rough order of magnitude construction costs for the Elevated Shared Use Path Hybrid Variant taking as a baseline the At-Grade IRT Variant and Hybrid IRT Variant, and the unit costs updates that had been made in section 7 of the Technical Report. The main differences in scope with the At-Grade IRT Variant are as follows:

- Increase in excavation quantities (additional 5,200 CY) due to the need to sink Soldiers Field Road westbound to accommodate Paul Dudley White viaduct above it;
- Removal of the cantilevered structure bike path along the Charles River for the Paul Dudley White Path;
- Additional 1,750 feet long viaduct, 400 feet of retained sections, and 400 feet of bridge sections on both ends of the viaduct;
- Inclusion of additional staging and laydown areas to support the construction of the viaduct;
- Inclusion of an allowance for additional environmental monitoring and mitigation measures given the proximity to the river which may be an issue during foundation installation.

These scope differences translate into a 3% construction cost increase compared to the At-Grade IRT Variant. **Table 3.1** shows the costs presented in Section 7.2.1.1 of the Technical Report for the At-Grade IRT Variant, and the new Elevated Shared Use Path Hybrid Variant.

Table 3.1. Comparison of Construction Costs, At-Grade Variant and Elevated Shared Use Path Hybrid Variant

Description	At-Grade Variant	Elevated Shared Use Path Hybrid Variant	Difference (%)
HIGHWAY WORK	$ 305,027,333	$ 318,852,333	+4%
I-90/Street Grid	$ 225,699,149	$ 225,699,149	
Civil Work	$ 124,969,317	$ 124,969,317	
Structural Work	$ 100,729,832	$ 100,729,832	
Soldiers Field Road	$ 79,328,184	$ 93,153,184	
Civil Work	$ 19,105,848	$ 19,105,848	
Structural Work	$ 60,222,336	$ 74,047,336	+23%
BEACON YARD	$ 173,189,986	$ 173,189,986	
TOTAL CONSTRUCTION	$ 478,217,319	$ 492,042,319	+4%
Indirects, OH, Profit, Bonds (%)	$ 167,376,100	$ 172,214,900	
Subtotal Incl. Indirects, etc.	$ 645,596,419	$ 664,257,219	
Escalation (%)	$ 193,678,100	$ 199,277,200	
Subtotal Incl. Escalation	$ 839,271,519	$ 863,534,419	
Contingency	$ 293,745,100	$ 302,237,100	
Total Construction Costs	$ 1,133,016,619	$ 1,165,771,519	+3%

When compared to the Hybrid IRT Variant, the Elevated Shared Use Path Hybrid Variant has a similar cost increase, as shown in **Table 3.2.**

Table 3.2. Comparison of Construction Costs, At-Grade Variant and Elevated Shared Use Path Hybrid Variant

Description	Hybrid Variant	Elevated Shared Use Path Hybrid Variant	Difference (%)
HIGHWAY WORK	**$298,636,367**	**$ 318,852,333**	**+7%**
I-90/Street Grid	$196,511,290	$ 225,699,149	+15%
Civil Work	$119,908,683	$ 124,969,317	+4%
Structural Work	$76,602,607	$ 100,729,832	+31%

Description	Hybrid Variant	Elevated Shared Use Path Hybrid Variant	Difference (%)
Soldiers Field Road	$108,257,578	$ 93,153,184	-14%
Civil Work	$17,993,634	$ 19,105,848	+6%
Structural Work	$90,263,944	$ 74,047,336	-18%
BEACON YARD	**$170,598,980**	**$173,189,986**	**+2%**
TOTAL CONSTRUCTION	**$475,367,847**	**$492,042,319**	**+4%**
Indirects, OH, Profit, Bonds (%)	$166,378,800	$ 172,214,900	
Subtotal Incl. Indirects, etc.	$641,746,647	$ 664,257,219	
Escalation (%)	$192,524,000	$ 199,277,200	
Subtotal Incl. Escalation	$834,270,647	$ 863,534,419	
Contingency	$291,994,800	$ 302,237,100	
Total Construction Costs (2023USD)	**$1,126,265,447**	**$ 1,165,771,519**	**+3%**

3.2.2 LIFE CYCLE COST

The IRT reviewed the life-cycle costs of the Elevated Shared Use Path Hybrid Variant and compared them with both the At-Grade IRT Variant and the Hybrid IRT Variant. The methodology to develop the life-cycle costs remains the same as the one presented in the Technical Report. The life-cycle costs are based on the construction costs for the Concept and the scope changes described above.

Given the inclusion of some planters/trees on the superstructure of the Elevated Shared Use Path, it is anticipated that its life-cycle costs will behave in a similar way to a railroad elevated structure lifecycle costs, due to the dead loads of the structure.

The main differences between the At-Grade IRT Variant life-cycle costs and the Elevated Shared Use Path are:

- Savings in the life-cycle costs as the cantilevered Paul Dudley White Path is no longer needed;
- Increase in costs for the additional elevated Paul Dudley White Path, including approaches/ramps (additional 76,500 sf of path).

The overall increase in life-cycle costs of the Elevated Shared Use Path over the 50 years of analysis is less than 10% for both options (At-Grade and Hybrid IRT Variants).

Table 3.3 shows the comparison between the Elevated Shared Use Path Hybrid Variant and the At-Grade IRT Variant.

Table 3.3. Comparison of Life Cycle Costs, At-Grade Variant and Elevated Shared Use Path Hybrid Variant

	At-Grade Variant	Elevated Shared Use Path Hybrid Variant	Difference (%)
HIGHWAY WORK	$45,757,300	$51,126,214	+12%
I-90/Street Grid	$23,311,853	$23,311,853	
CIVIL WORK	$17,972,348	$17,972,348	
Drainage	$ 2,768,094	$ 2,768,094	
Waterworks	$ 137,668	$ 137,668	
HMA Pavement – Surface Roads	$ 7,615,711	$ 7,615,711	
Curb	$ 226,854	$ 226,854	
Concrete Barrier	$ 1,372,344	$ 1,372,344	
Concrete Sidewalk	$ 589,862	$ 589,862	
HMA Separated Bike Lane	$ 98,119	$ 98,119	
Traffic Signals	$ 397,181	$ 397,181	
Lighting	$ 1,264,101	$ 1,264,101	
Pavement Markings	$ 122,689	$ 122,689	
Traffic Maintenance (5%)	$ 538,123	$ 538,123	
Pump Station Operation Costs	$ 2,841,600	$ 2,841,600	
STRUCTURAL WORK	$ 5,339,505	$ 5,339,505	
Retaining Wall at Buick Street	$ 311,018	$ 311,018	
STRUCTURE - MSE WALL	$ 319,604	$ 319,604	
I-90 BRIDGE STRUCTURES	$	$	
Traffic Maintenance (5%)	$	$	
I-90 BOAT SECTION	$ 4,484,650	$ 4,484,650	
Traffic Maintenance (5%)	$ 224,232	$ 224,232	
Soldiers Field Road	$22,445,447	$27,814,361	+23%
Drainage	$ 1,408,613	$ 1,408,613	
HMA Pavement	$ 1,009,583	$ 1,009,583	
Pavement Markings	$ 21,752	$ 21,752	
Curb	$ 30,600	$ 30,600	

	At-Grade Variant	Elevated Shared Use Path Hybrid Variant	Difference (%)
Concrete Barrier	$ 891,492	$ 891,492	
Concrete Median	$ 9,284	$ 9,284	
HMA Multiuse Path			
Lighting	$ 496,179	$ 496,179	
Traffic Maintenance (5%)	$ 233,749	$ 233,749	
Pump Operation Costs	$ 2,490,176	$ 2,490,176	
Soldiers Field Road Boat, Bridge, and Bike Path	$ 15,854,017	$ 21,222,931	+33%
ELEVATED TRACK VIADUCTS	$ 12,053,681	$ 12,053,681	
Elevated Rail Viaduct over I-90	$ 6,903,854	$ 6,903,854	
Traffic Maintenance (5%)	$ 345,193	$ 345,193	
Elevated Rail Viaduct over Soldiers Field Road	$ 4,575,841	$ 4,575,841	
Traffic Maintenance (5%)	$ 228,792	$ 228,792	
Total REPEX Costs (50Y)	$57,810,981	$63,179,895	+9%

Table 3.4 shows the comparison between the Elevated Shared Use Path Hybrid Variant and the Hybrid IRT Variant:

Table 3.4. Comparison of Life Cycle Costs, Hybrid Variant and Elevated Shared Use Path Hybrid Variant

	Hybrid Variant	Elevated Shared Use Path Hybrid Variant	Difference %
HIGHWAY WORK	$49,762,559	$51,126,214	+3%
I-90/Street Grid	$25,058,978	$23,311,853	-7%
CIVIL WORK	$19,542,203	$17,972,348	-9%
Drainage	$ 3,785,662	$ 2,768,094	-27%
Waterworks	$ 134,319	$ 137,668	+2%
HMA Pavement – Surface Roads	$ 7,910,119	$ 7,615,711	-4%

	Hybrid Variant	Elevated Shared Use Path Hybrid Variant	Difference %
Curb	$ 237,115	$ 226,854	-5%
Concrete Barrier	$ 1,392,730	$ 1,372,344	-2%
Concrete Sidewalk	$ 608,239	$ 589,862	-4%
HMA Separated Bike Lane	$ 101,162	$ 98,119	-3%
Traffic Signals	$ 408,786	$ 397,181	-3%
Lighting	$ 1,311,047	$ 1,264,101	-4%
Pavement Markings	$ 126,705	$ 122,689	-4%
Traffic Maintenance (5%)	$ 684,717	$ 538,123	-22%
Pump Station Operation Costs	$ 2,841,600	$ 2,841,600	
STRUCTURE WORK	$ 5,516,775	$ 5,339,505	-4%
Retaining Wall at Buick Street	$ 320,660	$ 311,018	-3%
Structure – MSE Wall	$ 739,935	$ 319,604	-57%
I-90 Bridge Structures	$	$	
Traffic Maintenance (5%)	$	$	
I-90 Boat Section	$4,243,981	$ 4,484,650	+6%
Traffic Maintenance (5%)	$212,199	$ 224,232	+6%
Soldiers Field Road	$24,703,581	$27,814,361	+12%
Drainage	$ 1,165,052	$ 1,408,613	+20%
HMA Pavement	$ 863,440	$ 1,009,583	+17%
Pavement Markings	$ 23,170	$ 21,752	-7%
Curb	$ 35,587	$ 30,600	-14%
Concrete Barrier	$ 660,212	$ 891,492	+35%
Concrete Median	$ 15,311	$ 9,284	-40%
HMA Multiuse Path	$ 133,650		
Lighting	$ 522,077	$ 496,179	-5%
Traffic Maintenance (5%)	$ 180,081	$ 233,749	+29%
Pump Operation Costs	$ 2,490,176	$ 2,490,176	
Soldiers Field Road Boat, Bridge, and Bike Path	$ 18,614,824	$ 21,222,931	+14%
Elevated Track Viaducts	$ 10,743,581	$ 12,053,681	+12%

	Hybrid Variant	Elevated Shared Use Path Hybrid Variant	Difference %
Elevated Rail Viaducts	$6,154,157	$ 6,903,854	+12%
Traffic Maintenance (5%)	$ 307,708	$ 345,193	+12%
Elevated Rail Viaducts over Soldiers Field Road	$ 4,077,824	$ 4,575,841	+12%
Traffic Maintenance (5%)	$ 203,891	$ 228,792	+12%
Total REPEX Costs (50Y)	$ 60,506,140	$63,179,895	+4%

3.2.3 NEED TO ACQUIRE OR TAKE PROPERTY

As this Concept does not differ from the IRT Hybrid Variant in regards to acquiring or taking property, the evaluation of this Concept is identical to that described in Section 7.2.3 of the Technical Report.

3.2.4 MITIGATION COSTS

The mitigation costs for the Elevated Shared Use Path Hybrid Variant are similar to those for the IRT At-Grade Variant; refer to section 7.2.4 in the Technical Report.

3.3 Environment

3.3.1 PERMANENT EFFECTS ON DESIGNATED HISTORIC RESOURCES

3.3.1.1 COMMON TO ALL VARIANTS

Within the Throat, this variant, like all the other variants, is assumed to involve the complete reconstruction of Soldiers Field Road and the Paul Dudley White Path, both of which are contributory elements in the Charles River Basin Historic District (CRBHD). These will constitute direct adverse effects upon the State Register of Historic Places (SR) resource. Therefore, an alternatives analysis under Section 106 would be required by Massachusetts Historical Commission (MHC) and Federal Highway Administration (FHWA) to determine which variation will have the least effect on the characteristics which make the CRBHD eligible for listing in the National Register of Historic Places (NR). The review will consider both direct and indirect effects (visual, shadow, and noise) upon the CRBHD.

Outside of the Throat, the project will involve the relocation of Soldiers Field Road further from the river and the creation of new Department of Conservation and Recreation (DCR) -controlled parkland along the river. See Section 7.3.3.1 of the Technical Report for further details.

3.3.1.2 ELEVATED SHARED USE PATH HYBRID VARIANT

As discussed in Section 3.2.3.1.3 of the Technical Report, evaluation of effects upon historic resources involves a complex weighing of multiple factors. The following summary of direct and indirect impacts, benefits, and potential mitigation measures for this variant, within the Throat only, is based upon multiple sections of this Addendum.

Direct adverse effects and potential mitigation:

- Involves complete demolition of existing Soldiers Field Road and Paul Dudley White Path (common to all variants).
- Occupation of land within the CRBHD, due to shifting northern lanes of I-90 into the historic district, of 45,610 SF (1.05 acre).
- Increased area of accessible open space. The total area of 46,180 SF (1.06 acres), which is located on an elevated structure over Soldiers Field Road with limited opportunity for landscaping, yields a net increase in accessible open space of 24,172 SF (0.55 acres), compared with current conditions. This variant also includes 9,800 SF of inaccessible open space between the riverbank and Soldiers Field Road and a small area of inaccessible open space (520 SF) south of Soldiers Field Road. The total net increase in open space, taking into account the reduced area of the inaccessible strip between Soldiers Field Road and I-90, equals 8,244 SF (0.19 acres). This variant does less to preserve and enhance the parkway character of Soldiers Field Road, or to mitigate the loss of the inaccessible existing open space strip between Soldiers Field Road and I-90.
- Narrower riverbank than current conditions, which would not be publicly accessible under this variant. The top of the bank would have an average width of 9 feet (compared with the current average of 20 feet) and a narrowest condition of 0 feet, with the edge of the Soldiers Field Road infringing on Bordering Land Subject to Flooding (BLSF) areas (compared with the current narrowest condition of 14 feet). This would negatively affect opportunities for trees and other landscaping, for flood storage, and for potential ecological restoration of the bank. Because of the narrowness and incompleteness of this vestigial open space between Soldiers Field Road and the riverbank, it would be treated as inaccessible, comparable to the strip south of Soldiers Field Road.
- As a project benefit/mitigation, this variant provides an expanded Paul Dudley White Path, compared to current conditions. The elevated structure would have a continuous width of 36 feet, compared with the current average width of 20 feet for the existing riverbank (which reduces further to a narrowest condition of 14 feet). However, relative to the Hybrid Variant, the average width of open space is less. See Section 3.6 of this Addendum for a further discussion of the open space character of the elevated structure, including the reduced opportunity for landscaping, and for a discussion of the user experience for pedestrians and bicyclists.

- As a project benefit/mitigation, this variant preserves the possibility for pedestrian/bicycle bridges across the Throat to the riverfront, enhancing public access to historic resource.
- As a project benefit/mitigation, reconstruction of Little Grand Junction Bridge (presumed to be a non-contributory structure) permits a continuous, widened Paul Dudley White Path connection at the eastern end of Throat. This enhances public access to the historic resource, and it permits removal of the existing boardwalk under the Boston University (BU) Bridge, restoring the historic character of the bridge and the river.

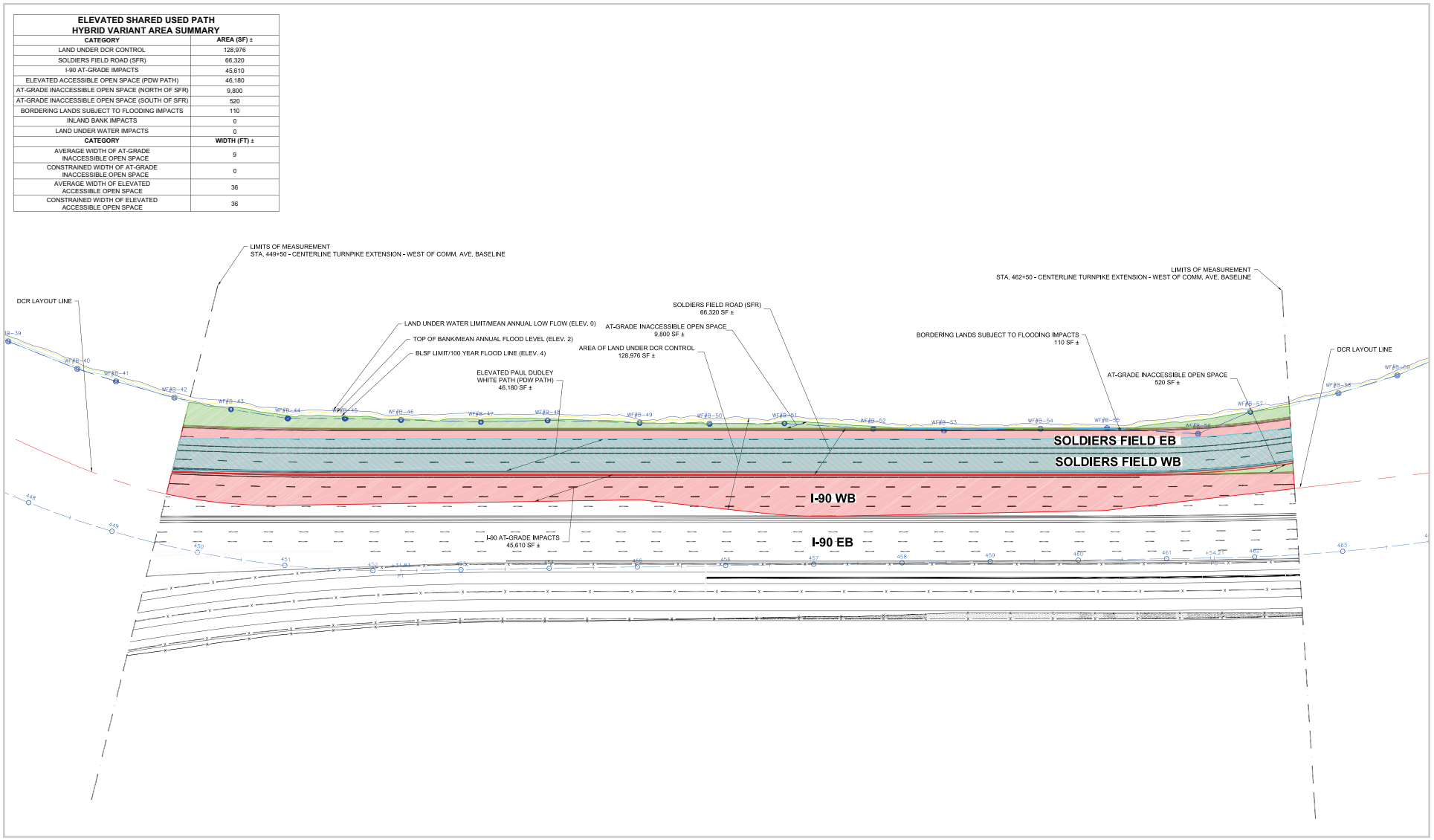
Indirect adverse effects and potential mitigation:

- This variant introduces different types of visual impacts upon Soldiers Field Road and the CRBHD, compared with current conditions. The current highway viaduct will be removed, but a new elevated structure for the Paul Dudley White will be constructed over Soldiers Field Road. The elevated structure will be closer to the river than the viaduct structure in the Hybrid Variant. Also, unlike the Hybrid Variant, there will be little or no opportunity for visual screening of the elevated structure by trees along the riverbank, due to the severely reduced width of available open space between the river and Soldiers Field Road.
- As a project benefit/mitigation, this variant reduces shadow impacts on Paul Dudley White Path compared with the existing highway viaduct. If this alternative is chosen, this can be quantified in design development.
- Relative noise impacts on Paul Dudley White should be comparable to the DEIR alternative (see Section 7.6.2 of the Technical Report).

Figure 3.1 shows the parkland impacts for this variant.

Figure 3.1. ***Parkland Impacts of Elevated Shared Use Path Hybrid Variant***

ELEVATED SHARED USED PATH HYBRID VARIANT AREA SUMMARY	
CATEGORY	**AREA (SF) ±**
LAND UNDER DCR CONTROL	128,976
SOLDIERS FIELD ROAD (SFR)	66,320
I-90 AT-GRADE IMPACTS	45,610
ELEVATED ACCESSIBLE OPEN SPACE (PDW PATH)	46,180
AT-GRADE INACCESSIBLE OPEN SPACE (NORTH OF SFR)	9,800
AT-GRADE INACCESSIBLE OPEN SPACE (SOUTH OF SFR)	520
BORDERING LANDS SUBJECT TO FLOODING IMPACTS	110
INLAND BANK IMPACTS	0
LAND UNDER WATER IMPACTS	0
CATEGORY	**WIDTH (FT) ±**
AVERAGE WIDTH OF AT-GRADE INACCESSIBLE OPEN SPACE	9
CONSTRAINED WIDTH OF AT-GRADE INACCESSIBLE OPEN SPACE	0
AVERAGE WIDTH OF ELEVATED ACCESSIBLE OPEN SPACE	36
CONSTRAINED WIDTH OF ELEVATED ACCESSIBLE OPEN SPACE	36



3.3.2 TEMPORARY EFFECTS ON DESIGNATED HISTORIC RESOURCES

For temporary construction period impacts common to all variants, see Section 7.3.2.1 of the Technical Report.

3.3.3 PERMANENT EFFECTS ON PARKS AND OPEN SPACE

3.3.3.1 STATE (ARTICLE 97) REVIEW

It is assumed that this variant, like all of the other variants and DEIR alternatives, will have unavoidable use of Article 97 protected open space. For all variants, the project design to the west of the Throat relocates Soldiers Field Road further back from the river than the current alignment. This will create a net gain of approximately 3.6 acres of new land to be transferred to DCR control for both parkland and Soldiers Field Road, and a net gain of approximately 4.7 acres of additional landscaped open space usable for recreation. See Section 7.3.3.1 of the Technical Report for further details.

As described above in Section 3.3.1, within the Throat, the relocation of I-90 will decrease the amount of DCR land. As further described above, for this as for other variants, this will be offset by net gains in land under DCR control, and in landscaped open space usable for recreation. From a project-wide perspective, this net increase in DCR-controlled open space outside the Throat will offset any variations in impacts on DCR-controlled open space within the Throat among the variants. Thus, this variant should be able to satisfy the EEA Article 97 Policy.

3.3.3.2 FEDERAL (SECTION 4(F)) REVIEW

It is assumed that this variant, like all of the other variants and DEIR alternatives, will have unavoidable use of Section 4(f) protected open space/historic resources. As described previously, the project design to the west of the Throat relocates Soldiers Field Road further back from the river than the current alignment, creating a net project-wide increase in open space. See Section 7.3.3.1 of the Technical Report for further details.

The scope of federal open space review under Section 4(f) is broader than state open space review under Article 97; it encompasses substantially the same factors that are considered in federal historic review under Section 106. Therefore, the analysis in this Addendum considers the same direct and indirect impacts for this variant that are listed above for Section 106. To avoid repetition, the reader should refer to the previous Section 106 discussion. However, because of subtle differences in the governing laws and regulations, these factors may be weighted differently by FHWA during the course of review, and the outcome, particularly in terms of required mitigation, will not necessarily be the same.

3.3.4 TEMPORARY EFFECTS ON PARKS AND OPEN SPACE

For temporary construction period impacts common to all variants, see Section 7.3.4.1 of the Technical Report.

3.3.5 PERMANENT EFFECTS ON WETLANDS

3.3.5.1 ALL VARIANTS

For impacts common to all variants, relating to the installation of one new stormwater discharge pipe, removal of six outfall pipes, and replacement of three stormwater discharge pipes in the Charles River, see Section 7.3.5.1 of the Technical Report.

3.3.5.2 ELEVATED SHARED USE PATH HYBRID VARIANT

3.3.5.2.1 *State Wetlands Permitting*

There are potential permanent adverse impacts to the bank habitat given the proximity of the proposed footing structure to the bank. Shadow and wildlife impacts would have to be carefully considered in permitting, and the existence of alternatives that do not raise such issues create permitting uncertainty. The clearer permitting problem, however, pertains to temporary impacts described in Section 3.3.6.2.1 below.

3.3.5.2.2 *Federal Section 404 Wetlands Permitting*

Provided that under this variant there is no fill placed in the river or no structure extending over the river, then there should be no need for additional ACOE permit compliance in the Throat section beyond that explained in Section 7.3.5.1.2 and Chapter 3 of the Technical Report.

3.3.5.2.3 *Federal/State Section 401 Water Quality Certification:*

If no Army Corps of Engineers (ACOE) individual permit is required for this variant, it does not appear that a 401 Water Quality Certification (WQC) would be triggered either, as discussed in Section 7.3.5.1.3 and Chapter 3 of the Technical Report.

3.3.6 TEMPORARY EFFECTS ON WETLANDS

3.3.6.1 COMMON TO ALL VARIANTS

For temporary construction period impacts common to all variants, see Section 7.3.6.1 of the Technical Report.

3.3.6.2 ELEVATED SHARED USE PATH HYBRID VARIANT

3.3.6.2.1 *State Wetlands Permitting*

It has been determined that to construct required footings for the northern edge of Soldiers Field Road under this variant would require that approximately 300 linear feet of bank be temporarily

altered. As the state wetlands regulations do not distinguish between temporary and permanent impacts, this variant, like the At-Grade Variant, would not meet the bank performance standard. As there are other alternatives being considered that do meet the bank performance standard, for the reasons set forth in Section 5.3.5.2 of the Technical Report, a variance would not be granted where there are reasonable alternatives that comply with the state wetlands regulations.

3.3.6.2.2 *Federal Wetlands Permitting/Federal/State Section 401 Water Quality Certification*

If the construction of this variant does not involve work in or over the river, then it does not appear that the ACOE permitting, or 401 WQC, would be implicated beyond the need to comply with the General Permit (GP)/ Preconstruction Notification (PCN) requirements with respect to the stormwater related work set forth above.

3.3.7 PERMANENT EFFECTS ON TIDELANDS

As noted in Section 3.2.3.7 of the Technical Report, with respect to development on filled tidelands, beneficial factors included the provision of open space, in particular, publicly accessible open space, as well providing access to open space. This is consistent with 310 CMR 9.55, which provides that in developing non-water dependent infrastructure facilities (NWDIFs), water-related interests of the public include recreation, public access, and the "protection and enhancement of public views and visual quality in the natural and built environment of the shoreline" under Sect. 9.55. Stormwater discharge pipes associated with all the variants may be licensed under Sect. 9.32(2)(b).

With regards to Floodplain Storage Impacts, the raised Grand Junction Railroad and lowered I-90 elevations relative to existing grade will be roughly offset but are anticipated to result in slight decrease in floodplain storage volume. The raised Soldiers Field Road may create a local barrier to floodpaths during the 2070 1% flood event, causing a reduction in floodplain storage volume. This effect becomes less significant once the Soldiers Field Road is overtopped, such as during the 2070 0.1% flood.

It is assumed that the construction of Soldiers Field Road and the elevated walkway, including any footings, can be placed outside of flowed tidelands. In that case, this variant would avoid the permitting challenge faced by the DEIR At-Grade Alternative, which involved the placement of fill or piles within flowed tidelands. With respect to the standards of Section 9.55 of the regulations, this variant would provide less open space in the filled tidelands area, relative to the other variants. Further, in this variant the open space would be placed on an elevated structure with limited opportunities for landscaping, rather than being located at grade within a landscaped park area, immediately adjacent to the river's edge. Like the Hybrid Variant, this variant has the potential to provide more convenient north-south public access connections to the Throat.

3.3.8 TEMPORARY EFFECTS ON TIDELANDS

For temporary construction period impacts common to all variants, see Section 7.3.8.1 of the Technical Report.

3.3.9 AIR QUALITY

Comparing air quality for the Elevated Shared Use Path Throat Variant to those proposed in the DEIR, the results should be similar. This variant has similar characteristics to those in the DEIR. The analysis used the same vehicle miles traveled (VMT) and travel speeds and presumed that there is no difference in congestion among the alternatives. As with the DEIR alternatives, future mode shifts to higher use of transit, bicycling, and walking could also provide reduced emissions over time.

3.4 Permitting

3.4.1 RISK OF NOT RECEIVING NECESSARY PERMITS

Based upon the analysis contained in Section 3.3, **Table 3.5** shows a summary of the permitting risks for the different permits and approvals examined in this Addendum. Because permits are typically issued to address both permanent and temporary (construction) effects, this analysis addresses all effects collectively for each permitting program.

Table 3.5. Permitting Risk Assessment Summary, Elevated Shared Use Path Hybrid Variant

Permitting Program	Risk of Not Receiving Necessary Permit
MassDEP state wetlands permit	High (unlikely to receive variance)
ACOE federal wetlands permit	Low (may not require individual permit)
MassDEP Section 401 water quality certification	Low (may not require certification)
MassDEP state tidelands (Chapter 91) permit	Low-Medium (no variance required; but outcome depends upon whether another alternative is judged superior on grounds of public access)
EEA Article 97 Land Disposition Policy	Low
FHWA / MHC Section 106 historic review	Medium (outcome depends upon whether another alternative is judged superior – this variant has lesser area of riverfront open space, which is placed on elevated structure)
FHWA Section 4(f) open space/historic review	Medium (outcome depends upon whether another alternative is judged superior – this variant has lesser area of riverfront open space, which is placed on elevated structure)

Permitting Program	Risk of Not Receiving Necessary Permit
Overall permitting risk for Elevated Shared Use Path Variant	High

3.4.2 PERMITTING DELAY

Based upon the analysis contained in Section 3.3, **Table 3.6** shows a summary of the risk of permitting delays for the different permits and approvals examined in this Addendum. Because permits are typically issued to address both permanent and temporary (construction) effects, this analysis addresses all effects collectively for each permitting program.

Table 3.6. Permitting Delay Assessment Summary, Elevated Shared Use Path Hybrid Variant

Permitting Program	Risk of Permitting Delay
MassDEP state wetlands permit	Medium - High (due to extended length of variance process)
ACOE federal wetlands permit	Low (likely not to require individual permit)
MassDEP Section 401 water quality certification	Low (likely not to require certification)
MassDEP state tidelands (Chapter 91) permit	Low (no variance process)
EEA Article 97 Land Disposition Policy	Low
FHWA/MHC Section 106 historic review	Medium (greater likelihood of additional information and reviews being required, due to lesser area of riverfront open space, which is placed on elevated structure)
FHWA Section 4(f) open space/historic review	Medium (greater likelihood of additional information and reviews being required, due to lesser area of riverfront open space, which is placed on elevated structure)
Overall risk of permitting delay for Elevated Shared Use Path Variant	Medium - High

3.4.3 STATE WETLANDS REGULATORY REQUIREMENTS MET WITHOUT VARIANCES

As described in Section 3.3.6 above, the temporary wetlands impacts of this variant exceed the performance standard for impacts to Inland Bank, and because this variant would not qualify as a limited project, it would require a variance under the MassDEP wetlands regulations. And as discussed in the Technical Report, a variance will not be granted if there are reasonable alternatives

that comply with the regulation. As there are such reasonable alternatives, it does not appear that a permit can be obtained for this variant under the wetlands regulations. Furthermore, as described in Section 3.3.5 above, it is also not clear whether the permanent wetlands impacts of this variant would satisfy the performance standards due to shadow impacts/alteration of habitat.

3.4.4 STATE TIDELANDS REGULATORY REQUIREMENTS MET WITHOUT VARIANCES

Based upon the analysis in Section 3.3, if this variant can maintain all foundations for Soldiers Field Road and the Paul Dudley White Path structure outside of filled tidelands, a variance would not be required under the regulations. The remaining permanent and temporary tidelands impacts, which are common to all variants, satisfy the standards of the MassDEP regulations for all three variants. In that case the outcome of the MassDEP tidelands licensing process with respect to impacts on filled tidelands will require MassDOT to demonstrate that its preferred alternative "ensures that all feasible measures are taken to avoid or minimize detriments to the water-related interests of the public" and may include mitigation. See 310 CMR 9.55.

The different variants, as well as the three DEIR alternatives, satisfy different water-related interests of the public to different degrees. The Hybrid Variant and the Highway Viaduct Variant significantly increase the width and area of accessible landscaped riverfront open space and the width of the Paul Dudley White Path within the Throat beyond existing conditions, and beyond what is provided in the DEIR alternatives. The Elevated Shared Use Path Hybrid Variant also increases the width and total area of open space and the Paul Dudley White Path; but since most of the open space within the Throat would be on an elevated structure, with limited opportunities for landscaping, there would be a net decrease in the width and area of accessible landscaped riverfront open space within the Throat, compared to existing conditions, and significantly less than in the Hybrid and Highway Viaduct Variants.

The Elevated Shared Use Path Hybrid Variant, like the Hybrid and At-Grade variants, provides better public access to the riverfront open space. It offers the best opportunity for a north-south pedestrian/bicycle bridge at the western end of the Throat, and improved connection to the Paul Dudley White Path at the eastern end of the Throat (through replacement of the Little Grand Junction Railroad Bridge); the Highway Viaduct Variant does not provide either of these benefits/mitigations. Based on our discussions with MassDEP Tidelands staff, it does not appear that the requirements of 310 CMR 9.55 will be determinative with respect to which alternate can receive a license for filled tidelands impacts.

3.4.5 EXISTENCE OF ALTERNATIVE WITH LESSER IMPACTS

See sections 7.4.3 and 7.4.4 of the Technical Report and Section 3.3.5 and 3.3.7 of the Addendum, with respect to the alternatives analyses as applicable to the MassDEP wetlands and tidelands

regulations. See sections 7.4.5 and 7.4.6 of the Technical Report and Section 3.3.1 and 3.3.3 of the Addendum, with respect to the alternatives analyses as applicable to the FHWA Section 4(f) and Section 106 reviews for open space and historic resources.

3.4.6 SECTION 4(F) PARKLAND IMPACTS

As described previously, all variants, like all of the DEIR alternatives, will incorporate significant net increases in parkland outside of the Throat, totaling approximately 4.7 acres of new usable open space. This benefit will be incorporated into the project-wide review, along with the relative impacts and mitigation measures within the Throat for each of the variants, as described here.

In terms of direct impacts and mitigation on open space, the Hybrid Variant and the Highway Viaduct Variant significantly increase the width and area of accessible landscaped riverfront open space and the width of the Paul Dudley White Path within the Throat beyond existing conditions, and beyond what is provided in the DEIR alternatives. The Elevated Shared Use Path Hybrid Variant also increases the width and total area of open space and the Paul Dudley White Path; but since most of the open space within the Throat would be on an elevated structure, with limited opportunities for landscaping, there would be a net decrease in the width and area of accessible landscaped riverfront open space within the Throat, compared to existing conditions, and significantly less than in the Hybrid and Highway Viaduct Variants.

In terms of direct impacts and mitigation on historic resources, the Highway Viaduct variant may be considered to better preserve the historic parkway character of Soldiers Field Road, relative to the other variants. If the Little Grand Junction Railroad Bridge were found to be a contributory structure to the CRBHD, that would increase the impacts of the Elevated Shared Use Path Hybrid Variant and the Hybrid Variant, and would require additional mitigation (such as the improved connection to the Paul Dudley White Path that replacement of the Little Grand Junction Railroad Bridge makes possible).

In terms of indirect impacts and mitigation, the Elevated Shared Use Path Hybrid Variant, like the Hybrid and At-Grade variants, provides better public access to the riverfront open space. It offers the best opportunity for a north-south pedestrian/bicycle bridge at the western end of the Throat, and improved connection to the Paul Dudley White Path at the eastern end of the Throat (through replacement of the Little Grand Junction Railroad Bridge); the Highway Viaduct Variant does not provide either of these benefits/mitigations.

The Elevated Shared Use Path Hybrid Variant introduces different types of visual impacts upon Soldiers Field Road and the CRBHD, compared with current conditions. The current highway viaduct will be removed, but a new elevated structure for the Paul Dudley White Path will be constructed over Soldiers Field Road. The elevated structure will be closer to the river than the

viaduct structure in the Hybrid Variant. Also, unlike the Hybrid Variant, there will be little or no opportunity for visual screening of the elevated structure by trees along the riverbank, due to the severely reduced width of available open space between the river and Soldiers Field Road.

As this discussion shows, there is no single variant that ranks highest on all of the factors to be considered. If the width and total area of accessible landscaped riverfront open space were considered the single most important factor, the Hybrid Variant would rank higher than this and the other variants. If the width and continuity of the Paul Dudley White Path within the Throat were considered the single most important factor, the Elevated Shared Use Path Hybrid Variant and the Hybrid Variant would rank higher than the other variants.

3.4.7 SECTION 106 HISTORIC RESOURCE IMPACTS

As noted above, the scope of federal historic review under Section 106 encompasses substantially the same factors that are considered in federal open space review under Section 4(f). Therefore, the analysis in this Addendum considers the same direct and indirect impacts for this variant that are listed above for Section 4(f). However, because of subtle differences in the governing laws and regulations, these factors may be weighted differently by FHWA during the course of review, and the outcome, particularly in terms of required mitigation, will not necessarily be the same.

To avoid repetition, please refer to Section 3.4.6 above for a discussion of these factors. As that discussion shows, there is no single variant that ranks highest on all of the factors to be considered. If the width and total area of accessible landscaped riverfront open space were considered the single most important factor, the Hybrid Variant would rank higher than this and the other variants. If the width and continuity of the Paul Dudley White Path within the Throat were considered the single most important factor, the Elevated Shared Use Path Hybrid Variant and the Hybrid Variant would rank higher than the other variants.

3.4.8 RISK OF I-90 INUNDATION BY 50-YEAR FLOOD

An existing pump station located below the viaduct currently pumps water from the BU Bridge underpass area to a Boston Water and Sewer Commission (BWSC) outfall pipe to the Charles River. All alternatives will continue to require pumping for the 50-year storm event as the BU Bridge underpass is below the surrounding ground level and cannot be drained by gravity to the Charles River.

The existing pump station will need to be replaced to accommodate the lowered I-90 elevation through the Throat area. The existing pumping capacity will also need to be increased to accommodate the increased contributing area. The pump station and drain system in the underpass will need to accommodate flows from the present-date 50-year rainfall event.

Additionally, this alternative proposes 2-foot wide shoulders. To prevent stormwater gutter flow spread into the I-90 travel lanes during the 10-year storm event, drain inlets will need to be spaced approximately every five to ten feet along the shoulders, or trench drains provided along the full length of the throat section. There are limited opportunities for stormwater Best Management Practices (BMPs) to provide storage and water quality treatment on the Paul Dudley White Path, but these BMPs will provide negligible runoff volume reduction and will have no impact on stormwater runoff from the roadways and railroad Right of Ways.

3.5 Multimodal Connectivity

3.5.1 WEST STATION CONSTRUCTABILITY AND EXPANDABILITY

As this Concept does not differ from the IRT Hybrid Variant in regards to design of any railroad infrastructure, the evaluation of this Concept is identical to that described in Section 7.5.1 of the Technical Report.

3.5.2 NUMBER OF NORTH-SOUTH PEDESTRIAN/BICYCLE ACCESS POINTS TO RIVER

This alternative does not preclude the potential to construct a new north-south riverfront access point. One location where this is feasible is between Agganis Way and the Charles Riverbank via a pedestrian bridge spanning the railroad, I-90, and Soldiers Field Road. In addition to providing direct access to the riverfront, it could tie in to the elevated Paul Dudley White Path over Soldiers Field Road and augment the future pedestrian and bicycle circulation system along the river.

3.5.3 PROVIDES DESIRED 79-MPH RAILROAD DESIGN SPEED

As this Concept does not differ from the IRT Hybrid Variant regarding design of any railroad infrastructure, the evaluation of this Concept is identical to that described in Section 7.5.3 of the Technical Report.

3.5.4 PROVIDES MINIMUM 50-MPH RAILROAD DESIGN

As this Concept does not differ from the IRT Hybrid Variant regarding design of any railroad infrastructure, the evaluation of this Concept is identical to that described in Section 7.5.4 of the Technical Report.

3.5.5 MAINTAINS DESIRED RAILROAD VERTICAL CLEARANCE

As this Concept does not differ from the IRT Hybrid Variant in regards to design of any railroad infrastructure, the evaluation of this Concept is identical to that described in Section 7.5.5.3 of the Technical Report.

3.5.6 GRAND JUNCTION CONNECTIONS

As this Concept does not differ from the IRT Hybrid Variant in regards to design of any railroad infrastructure, the evaluation of this Concept is identical to that described in Section 7.5.6.3 of the Technical Report.

3.5.7 EFFECTS ON FUTURE MULTIMODAL CONNECTIVITY

Similar to the IRT Hybrid Variant, in this Concept, it is presumed that the Little Grand Junction Bridge over Soldiers Field Road would be replaced; therefore, the connections from the Paul Dudley White Path within the Throat to the path east of the BU Bridge can be made much more directly. The Elevated Multi-Use Path would need to return to grade in order to get underneath the Little Grand Junction Bridge, thus making this connection very similar to the IRT Hybrid Variant. However, the location of ramp structures for the Elevated Path may impinge upon or force a change in the interface between the two Grand Junction bridges (over Soldiers Field Road and over the Charles River), which may add cost or complexity to that area. Connections from the Paul Dudley White Path to the Grand Junction Railroad Bridge and the BU Bridge can be similarly to made, as described in the Technical Report. North-south bus connections within the Throat are not currently proposed.

3.6 Public Realm

3.6.1 FILED LAND USE PLANS

As described in Section 3 of the Technical Report, the focus of evaluation of development potential was on the combination of air rights and terra firma at the northwestern corner of Commonwealth Avenue and the BU Bridge, or Site 1.

Similar to the previous three alternatives identified, the development on Site 1 is possible with the Elevated Multi-Use Path Concept and is subject to similar constraints and challenges. This alternative may also require additional study to investigate the impact for potential development.

3.6.2 EFFECTS ON NOISE

The Elevated Shared Use Path Hybrid Variant should have the least noise impact of any of the build alternatives on noise sensitive receptors in the vicinity of the Throat area. By carrying the shared use path on structure above the travelway of Soldiers Field Road and I-90, noise level reductions, especially along the Paul Dudley White Path, should be lower than the other alternatives; at Magazine Beach, noise levels would also be reduced by moving Soldiers Field Road away from the Beach along with carrying I-90 traffic mostly in a boat section as the structure wall would shield much of the area from noise. The traffic volumes on Soldiers Field Road, which excludes truck traffic, will be operating at slower speeds and carried on top of the I-90 traffic. Green space created between the Paul Dudley White Path and the stacked Soldiers Field Road/I-90 traffic should create

opportunity for a noise wall to be sited to reduce noise levels further. At Boston University, the Elevated Shared Use Path Hybrid Variant will shield I-90 traffic noise but still would warrant a noise wall along Nickerson Field.

Table 3.7 summarizes noise levels for Throat Area sensitive receptors as presented in the DEIR and includes existing conditions and future design year conditions. It also includes a qualitative comparison of the options, with minus signs indicating an increase in noise, plus signs a decrease in noise, and equal signs as effectively no difference relative to existing conditions. Again, noise modeling and evaluation of engineering and acoustic feasibility would need to be done.

Table 3.7. Noise Effects by Alternative and Variant

Rec.	Existing (dBA)	DEIR Highway Viaduct (dBA)	DEIR At-Grade (dBA)	DEIR Hybrid (dBA)	DEIR Highway Viaduct	DEIR At-Grade	DEIR Hybrid	Highway Viaduct Variant	At-Grade Variant	Hybrid Variant	El. Shared Path Hybrid Variant
BU-1	79.4	87.5	83.8	84.6	--	-	-	--	-	-	-
BU-2	73.1	79.4	81.8	79.3	-	--	-	-	--	-	-
BU-3	72.5	74.9	78.1	77.6	-	--	--	-	--	--	--
BU-4	75.2	72.4	78.2	74.7	+	-	=	+	-	=	=
BU-5	74.6	74.0	79.8	74.2	=	-	=	=	-	=	=
PD-1	76.5	75.7	76.0	75.2	=	=	=	+	=	+	+
PD-2	78.7	76.8	78.1	77.7	+	=	=	+	=	+	+
PD-3	78.9	76.1	78.1	76.8	+	=	+	+	=	+	+
PD-4	78.3	75.8	77.1	77.2	+	=	=	+	=	+	+
PD-5	78.4	67.0	68.3	69.1	++	++	++	++	++	++	++
MB-1	66.6	65.4	67.6	65.8	=	=	=	=	=	+	+
MB-2	67.0	64.7	66.7	65.3	+	=	=	+	=	+	+
MB-3	63.3	61.2	62.7	61.3	+	=	+	+	=	+	+

3.6.3 VISUAL QUALITY OF OPEN SPACE AND PAUL DUDLEY WHITE PATH

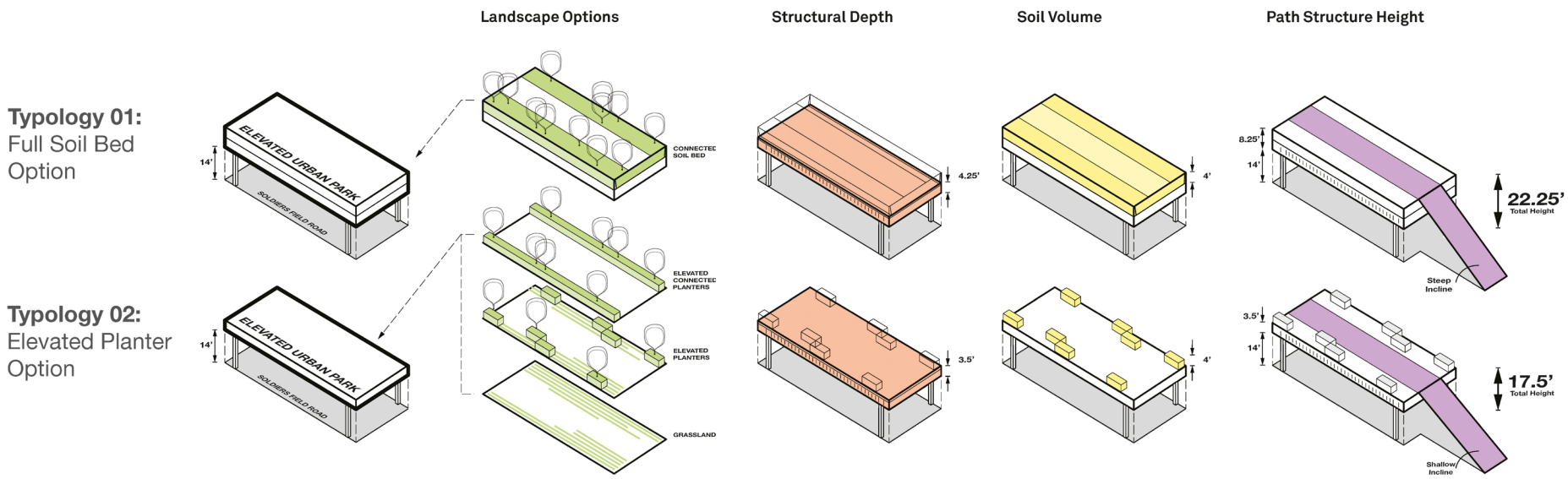
The Elevated Shared Use Path Hybrid Variant alters the visual experience of the riverfront and open space by providing a lower viaduct than currently exists. A lower viaduct reduces shade

impacts that effect the path during afternoon hours in winter months, while also clearing the view looking inland towards Boston.

The Elevated Shared Use Path Hybrid Variant features an elevated Paul Dudley White Path built on a 36-foot wide platform with the potential for installation of green space and trees. It is located directly over the eastbound alignment of Soldiers Field Road. This provides elevated pedestrian and bicycle paths with an unobstructed view shed along the Charles River and to Back Bay, downtown Boston, and Cambridge. The provision of design features along the elevated Paul Dudley White Path, such as overlooks, trees, seating amenities, and wayfinding signage, can be incorporated within the 36-foot wide corridor and may enhance the user experience.

The potential new vegetation along the elevated Paul Dudley White Path, combined with the existing vegetation along the river, will soften the visual impact of the viaduct structure from the Cambridge side of the river. The two structural types for the elevated Paul Dudley White Path that were tested as part of this analysis (see **Figure 3.2**) have a 4-foot difference in elevation.

Figure 3.2. ***Elevated Shared Use Path Typology Comparison***



3.6.4 NAVIGABLE WATER SHEET AREA

Refer to section 7.6.4.3 in the Technical Report; the navigable water sheet area will be indifferent to that of the IRT Hybrid Variant.

3.6.5 PHYSICAL QUALITY OF OPEN SPACE AND PAUL DUDLEY WHITE PATH

The Elevated Shared Use Path Hybrid Variant features an elevated Paul Dudley White Path built on a 36-foot wide platform with the potential, if enhances structure is provided, for installation of green space and landscaping. It is located directly over the eastbound alignment of Soldiers Field Road.

The 36-foot wide corridor contains new, useable open space and can accommodate the dimensional requirements for either a separated bicycle track and pedestrian path or a combined shared used path. The remaining space, of up to 24 feet, can accommodate design features that may enhance the user experience such as small trees, landscape, pedestrian and cycle amenities, public art, and facilities for performance and programming.

A primary structural constraint is supporting the dead load of the heavy soil volumes required to sustain substantial landscaping on the elevated Paul Dudley White Path. Landscaping vegetation and their accompanying soil volumes should be located near the vertical structural supports to provide a direct path of load to the foundation. The trees located along the southern edge of the corridor provides a much-preferred vegetation buffer from the vehicular traffic of I-90.

3.6.6 AMOUNT OF OPEN SPACE

The Elevated Shared Use Path Hybrid Variant provides a large amount of accessible open space by using a 36-foot-wide structure to elevate the Paul Dudley White Path above Soldiers Field Road. The elevated Paul Dudley White Path creates 46,180 SF (1.06 acres) of elevated accessible open space on the structure, while an additional 9,800 SF (0.22 acres) of inaccessible open space is created at-grade, between the edge of Soldiers Field Road and the Charles River. The at-grade inaccessible open space is not continually connected from the east to west as the edge of Soldiers Field Road goes past the limit of the bordering lanes subject to flooding. Additionally, the accessible open space created on the elevated structure does not provide a direct physical connection to the river as there is a vertical separation in addition to horizontal separation through anti-missile fences, snow fences, and a horizontal offset away from the river's edge. There is a net increase of accessible open space of 24,172 SF (.55 acres) through this alternative.

As noted, the accessible open space on top of the elevated structure is proposed to be 36-feet-wide throughout the entire area of measurement. The inaccessible open space at-grade between Soldiers

Field Road and the Charles River is on average, approximately 9-feet-wide, but at several locations, the narrowest width will be 0 feet.

3.6.7 QUALITY OF RIVERFRONT ACCESS POINTS

The Elevated Shared Use Path Hybrid Variant features an elevated Paul Dudley White Path built on a 36-foot wide platform with the potential for installation of green space and trees. It is located directly over the eastbound alignment of Soldiers Field Road. In addition to the elevated Paul Dudley White Path, a pedestrian bridge is feasible between Agganis Way and the riverfront, potentially providing a new north-south riverfront access point. This connection could physically link the activity of Commonwealth Avenue to the recreational uses along the waterfront and is an opportunity to provide an additional neighborhood gateway to the Charles River.

The Paul Dudley White Path elevates in the Throat area and incorporates ADA-accessible ramping to accommodate the change in height (see **Figure 3.3**). However, due to spatial limitation, only ramps with 4-5% percent grade of slope are possible. While this is still a steep climb for cycle commuters, it is an acceptable trade-off when considering its important role in the regional cycle network. The elevated path would form a small segment of a larger cycle journey and the relatively steep ramp slope can be easily anticipated by regular commuters. Ramping should run adjacent to Soldiers Field Road, where possible, to maximize the programmable area of open space along the riverfront.

Figure 3.3. ***Pedestrian and Bicycle Ramp Design Standards***

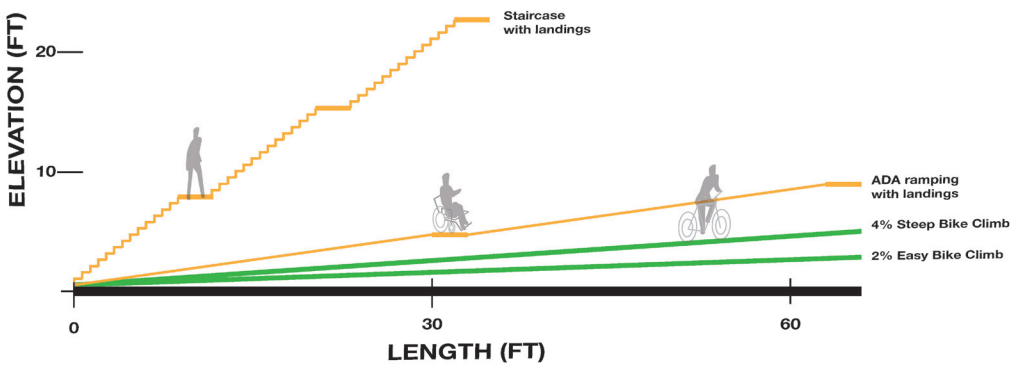


Figure 1 - A diagram of bike and pedestrian vertical circulation

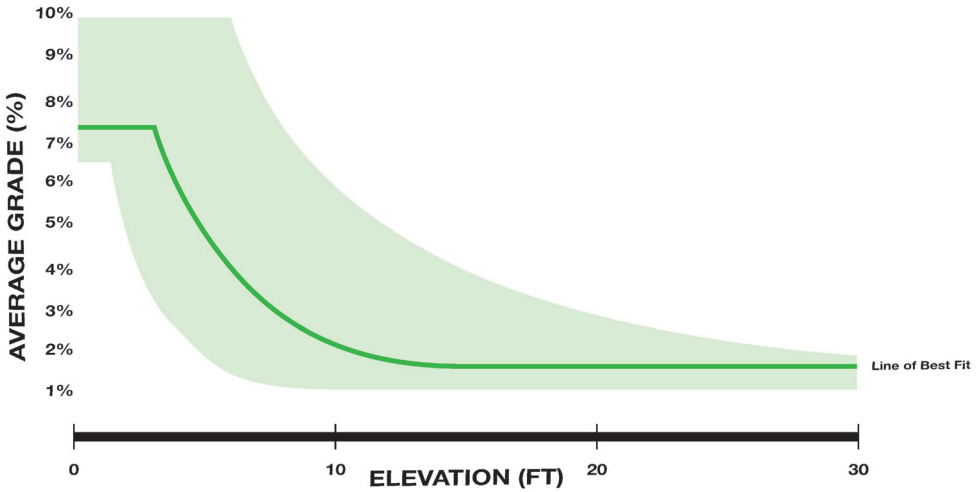


Figure 2 - A line-of-best-fit diagram based on several previously published Dutch studies on bicycle grades. Source: Brief Dutch Design Manual for Bicycle and Pedestrian Bridges (2015), ipv Delft,

3.7 Resiliency

3.7.1 PROTECTS KEY COMPONENTS OF PROJECT FROM FLOOD IMPACTS

No key components of the project are vulnerable to the Federal Emergency Management Agency (FEMA) 1% flood. A portion of the Paul Dudley White Path, where the ramp begins at the BU Bridge, may be vulnerable to flood impacts beginning at the 2030 1% flood event. The Grand Junction Railroad and MBTA Commuter Rail are not expected to be vulnerable to the 1% flood for present-day, 2030, or 2070 conditions. Additionally, the Grand Junction Railroad and Worcester Main Line are not expected to be vulnerable up to and including the 2070 0.1% flood due to the raised Grand Junction Railroad elevating it above the floodplain and cutting off the flow path from the Charles River to the MBTA Commuter Rail.

It is important to note that the area outside the Throat is also vulnerable to flood impacts in the 2070 1% storm event. Additionally, the risk to the area outside the Throat increases significantly under the 2070 0.1% storm event.

3.7.2 STORMWATER RUNOFF IMPACTS

This alternative has limited capacity to address current and future projected risk from increased precipitation events due to the narrow shoulders. Extensive use of drain inlets or continuous trench drains will likely be necessary to handle runoff during precipitation events to prevent gutter flow spread in the travel lanes. This alternative has constrained areas for installing BMPs due to insufficient unoccupied ground area. While there are limited opportunities for stormwater BMPs placed on the Paul Dudley White Path high line to provide moderate water quality treatment and stormwater attenuation of stormwater runoff from the Paul Dudley White Path high line, these BMPs will provide little to no runoff volume reduction and will have no impact on stormwater runoff from the roadways and railroad Right of Ways. This alternative will require construction-phase groundwater and an increase in permanent stormwater pumping, as the drainage system will be below the water elevation of the Charles River.

3.7.3 PROTECTS HIGHWAY INFRASTRUCTURE

There is limited future flood risk to the road infrastructure under this alternative. There are no anticipated flood impacts to the roadways under any of the alternatives during the present-day or 2030 1% storm event. A small portion of Soldiers Field Road, near the BU Bridge, is vulnerable to flooding under the 2070 1% storm event. A portion of Soldiers Field Road in the area outside the Throat is also vulnerable to flood impacts in the 2070 1% storm event. I-90 is not expected to be vulnerable to flooding for the 2070 1% storm event. It is important to note that the area outside the Throat is also vulnerable to flood impacts in the 2070 1% storm event.

Large sections of I-90 and Soldiers Field Road through the Throat area and BU Bridge underpass will be vulnerable to flooding during the 2070 0.1% flood. Additionally, the risk to the area outside the Throat increases significantly under the 2070 0.1% storm event.

3.7.4 FLOODPLAIN STORAGE VOLUME IMPACTS

The raised Soldiers Field Road eastbound and lowered I-90 elevations relative to existing grade will roughly offset but are anticipated to result in slight decrease in floodplain storage volume. The raised Grand Junction Railroad, the fill associated with Soldiers Field Road West, and the Paul Dudley White Path high line support columns will result in a loss of flood storage volume that will negatively impact the floodplain for all flood events. The raised Soldiers Field Road may also create a local barrier to floodpaths during the 2070 1% flood event, causing a reduction in floodplain storage volume. This effect becomes less significant once the Soldiers Field Road is overtopped, such as during the 2070 0.1% flood.

3.7.5 FHWA GUIDANCE

This alternative meets the FHWA guidance. Relocation of the existing pump station and an increase to the existing pumping capacity is required to convey the 50-year storm rainfall. The 2-foot shoulder widths will require extensive use of drain inlets to keep stormwater out of travel lanes. Space for stormwater storage is constrained.

3.7.6 IMPERVIOUS SURFACE CREATED

The Elevated Shared Use Path Hybrid Variant creates a total of 4.56 acres of impervious surface. The amount of impervious surface created is similar to the IRT At-Grade Variant, but the Paul Dudley White Path is directly over Soldiers Field Road rather than extended over the surface of the Charles River. Because of this change, the amount of impervious surface created slightly decreases. By placing the impervious surface created by the Paul Dudley White Path above the impervious surface of Soldiers Field Road, the portion of Soldiers Field Road covered by the elevated structure is not included as part of the calculated area of impervious area created. While the elevated structure has the potential for plantings, the structure below any proposed landscaped area is also an impervious surface.

3.8 Safety and Operations

3.8.1 SAFETY FOR I-90 AND SOLDIERS FIELD ROAD

Safety measures remain unchanged from the IRT At-Grade Variant; refer to section 7.8.1.1 in the Technical Report.

3.8.2 OPERATIONS AND MAINTENANCE ON I-90

Safety measures remain unchanged from the IRT At-Grade Variant; refer to section 7.8.2.1 in the Technical Report.

3.8.3 OPERATIONS AND MAINTENANCE ON SOLDIERS FIELD ROAD

Refer to section 7.8.3.1 in the Technical Report.

3.8.4 DESIGN EXCEPTION FROM NATIONAL HIGHWAY SYSTEM (NHS) DESIGN STANDARDS

Refer to section 7.8.4 in the Technical Report.

3.8.5 ACCOMMODATES ADDITION OF SHOULDERS

Refer to section 7.8.5.1 in the Technical Report.

3.8.6 SEPARATION OF MODES ON PAUL DUDLEY WHITE PATH

Refer to section 7.8.6.1 in the Technical Report.

4 Continued Review Process

4.1 Outreach

The IRT began meeting with ABC to coordinate the addendum process immediately after the Task Force meeting on October 17, 2018. Meetings and calls allowed the IRT to receive and consider ABC's input through the working period. We met with ABC on the following dates:

- A Better City – October 19, 2018
- A Better City – October 23, 2018
- A Better City – November 8, 2018

Notes from all meetings can be found in **Appendix B.**

5 Additional Concerns

5.1 Additional Cross Sections

At the request of the Task Force, the IRT worked to develop an additional cross section for each variant at the easternmost end of the Throat near the BU Bridge. However, it was established that a profile view could provide a clearer understanding of the various Throat elements and how they differ between Variants. **Figure 2.4** shows a profile view of the Grand Junction Railroad, which is the same for the Elevated Shared Use Path Hybrid Variant, the IRT At-Grade Variant, and the IRT Hybrid Variant. The profile view for the IRT Highway Viaduct Variant is the same as the existing highway viaduct.

5.2 Replacement Costs

The IRT evaluated the Lifecycle or Replacement CAPEX (REPEX) for the considered alternatives. It corresponds to an analysis of the replacement of the structural/civil components of each alternative, over a specified period of time (50 years in this case). As such, lifecycle costs (or replacement costs) are meant to capture the long-term capital investments required to maintain a functional asset, considering the useful lives of asset components (asphalt pavement, concrete pavement, concrete and steel structural elements, retained structures, and others).

Given the fact that all the options contain multiple types of components (elevated structures, retaining walls, different pavement structures) but similar total cost allocation within components, a 50-year analysis period was chosen. However, a 100-year lifecycle cost scenario was calculated to incorporate the end-of-life replacement costs for all the alternatives.

Table 5.1 summarizes the projected useful life of the key infrastructure components, as included in the 100-year model:

Table 5.1. Projected Useful Life by Component

	Projected Useful Life (years)
Pavement (at-grade)	80
Elevated Structures	75
Drainage - RCP pipes	75
Retaining Walls	100

Table 5.2 provides an approximation of the total construction cost percentage per component type in all the considered alternatives:

Table 5.2. Cost Percentage by Component

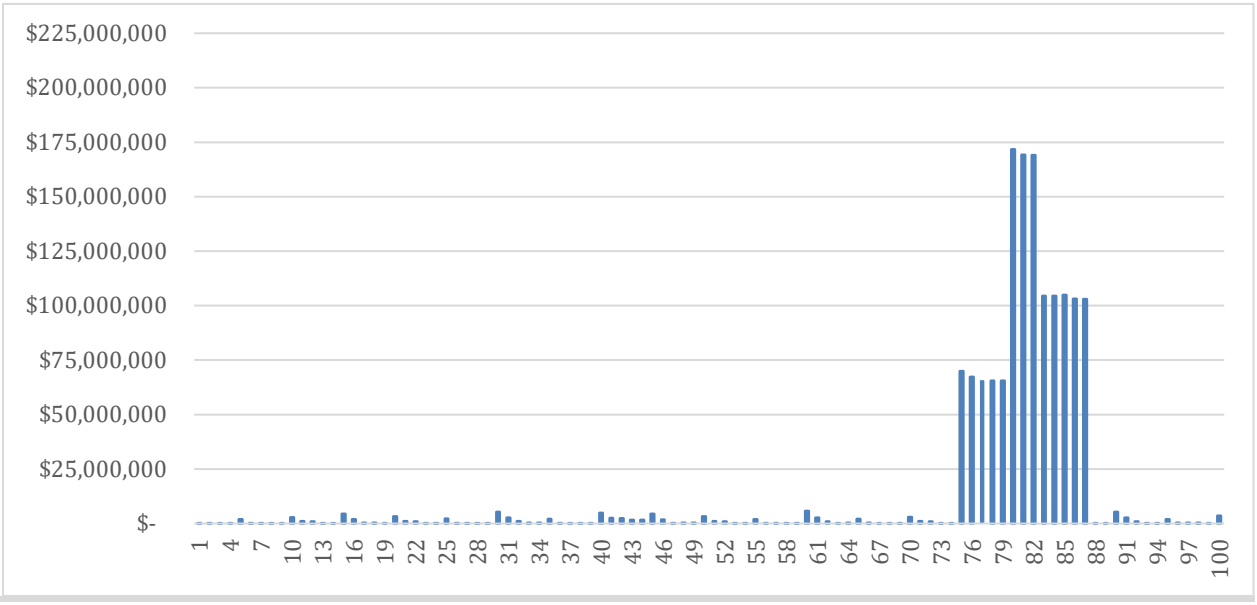
	At-Grade	Highway Viaduct	Hybrid	Elevated Shared-Use Path Hybrid
Elevated Structures	37%	50%	41%	41%
Pavement - Civil Works	30%	24%	29%	30%
Retaining Walls - Civil Works	4%	0	1%	0%
Beacon Yard	29%	27%	29%	29%
	100%	100%	100%	100%

Based on **Table 5.2**, it can be seen how all alternatives have a significant elevated structure component, which is not limited to the I-90 Viaduct, but it also includes the Grand Junction Railroad, Little Grand Junction Bridge, I-90 ramps, Elevated Shared-Use Path, and Soldiers Field Road elevated viaduct/bridge sections.

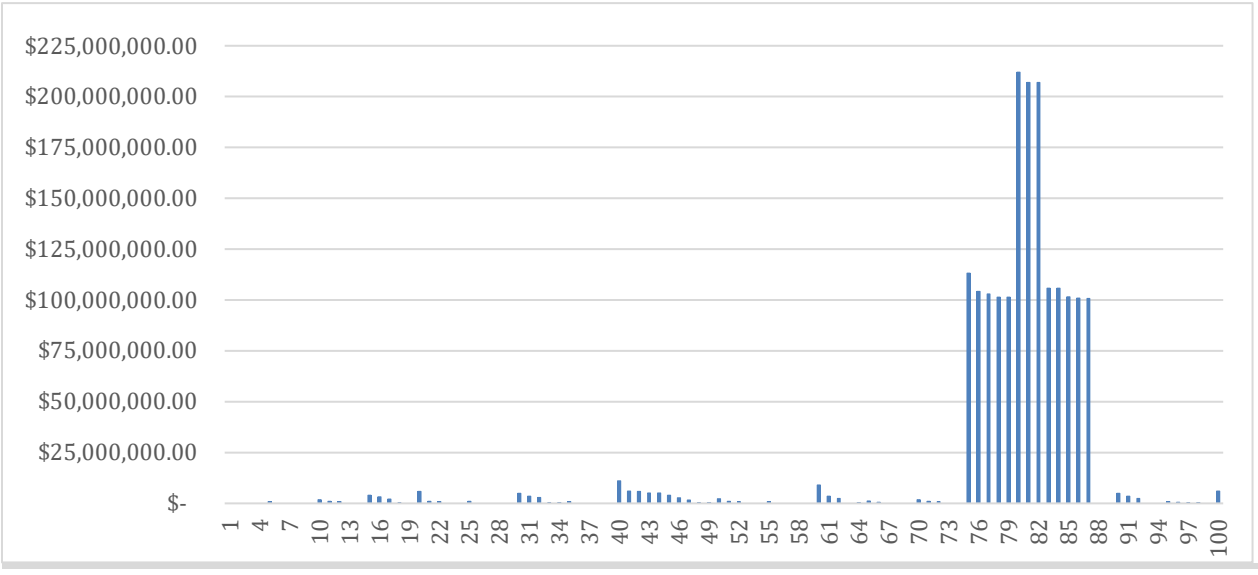
The following graphs represent the 100-year lifecycle costs for all alternatives based on the following assumptions:

- Full replacement of all elevated structures in year 75, with a construction duration of 8 years
- Full replacement of all other civil elements (pavement, drainage, etc.) in year 80 with a construction duration of 8 years.
- Replacement costs based on the alternative's construction costs, including an allowance of 15% for demolition costs.
- Replacement cycles based on Chapter 5 of the Technical Report.
- The approximate lifecycle costs exclude soft costs (design, agency involvement, ROW considerations, or others).
- All costs presented in 2023 USD.

The first graph below represents the 100-year lifecycle cost for the At-Grade IRT Variant, with a total lifecycle/replacement cost of approximately $1.45bn in 2023USD. The second graph shows the Highway Viaduct IRT Variant 100-year lifecycle replacement costs, with a total of $1.8bn in 2023USD.

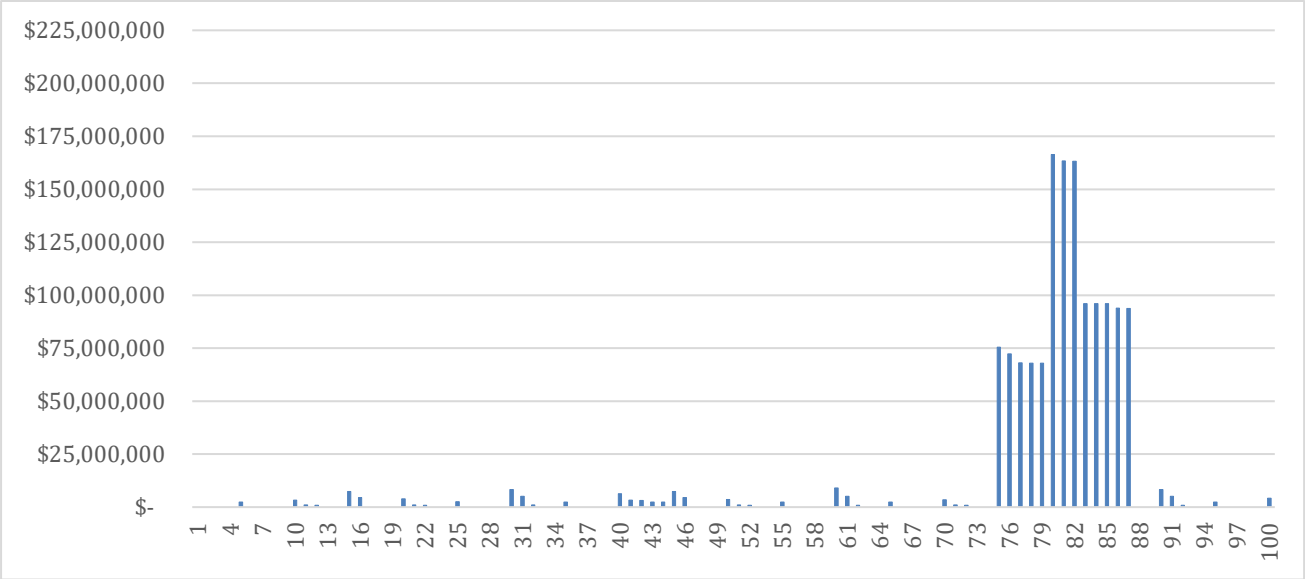


IRT At-Grade Variant 100-year Lifecycle Cost

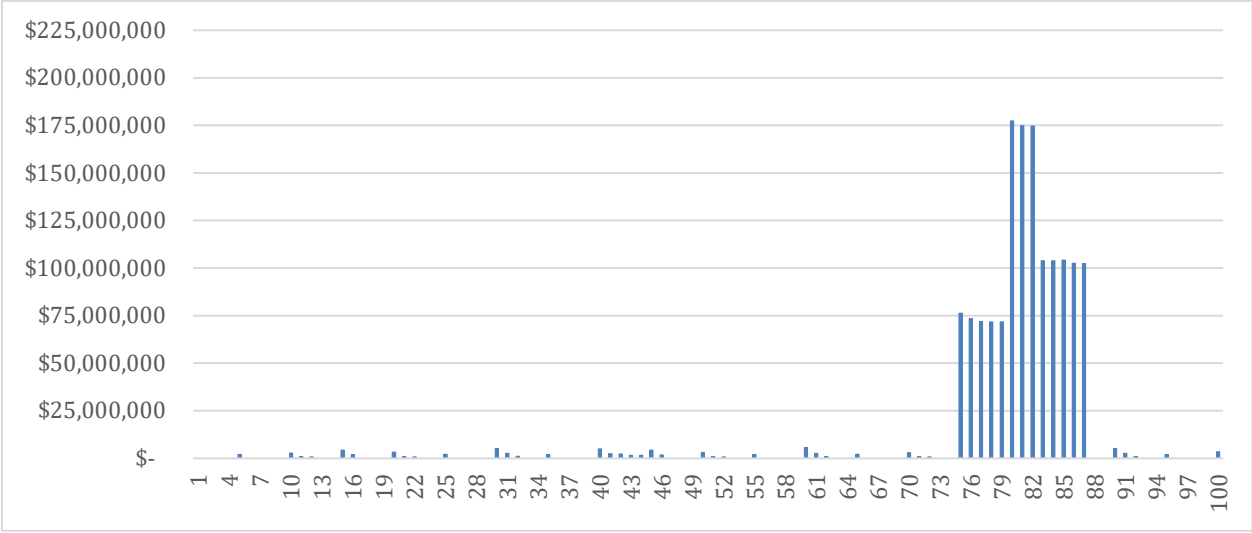


IRT Highway Viaduct Variant 100-year Lifecycle Costs

The following graph below represents the 100-year lifecycle cost for the Hybrid IRT Variant, with a total lifecycle/replacement cost of approximately $1.45bn in 2023USD. The final graph shows the Elevated Shared Use Path Hybrid IRT Variant 100-year lifecycle replacement costs, with a total of $1.5bn in 2023USD.



IRT Hybrid Variant 100-year Lifecycle Costs



Elevated Shared Use Path Hybrid Variant 100-year Lifecycle Costs

5.3 Cost of the Little Grand Junction Bridge

The IRT evaluated the cost of replacing the Little Grand Junction Bridge (over Soldiers Field Road), in the Alternatives and Variants in which it was required (Hybrid and At-Grade Alternatives and Variants). These costs were included in the summary tables show in Section 7.2 of the Technical Report.

The DEIR included two costs for the Little Grand Junction Bridge construction cost, as described in Sections 5.2.1.1 and 5.2.1.3 of the Technical Report. These costs were approximately $9.5M in the Hybrid Alternative, and $6.9M in the At-Grade Alternative; however, the IRT could find no explanation for this difference in costs. When evaluating these costs, the IRT applied different factors for unit prices, as well as adding escalation, indirect costs, and contingency as described in Section 5.2.1 of the Technical Report. This brings the total cost of the Little Grand Junction Bridge to roughly $16.8M - $23.2M depending on the Alternative. The life-cycle costs of the bridge would range from $4.1M - $4.6M. The IRT feels that these costs would accurately capture the cost of rebuilding the Little Grand Junction Bridge in any Alternative, Variant, or Concept.

5.4 Bicycle Stress Level

With great interest expressed in understanding the comfort level of the Paul Dudley White Path for each Variant, the stress level has been broken down into three components for each Alternative and Variant: nearest roadway, distance to roadway, and roadway speed. See **Table 5.3**, **Table 5.4**, and **Table 5.5** for bicycle stress level evaluations of the Highway At-Grade Family, Highway Viaduct Family, and Hybrid Family, respectively.

Table 5.3. Bicycle Stress Level Evaluation for the Highway At-Grade Family

	DEIR Highway At-Grade Alternative	IRT Highway At-Grade Variant
Nearest Roadway	Soldiers Field Road	Soldiers Field Road
Distance to Roadway (at narrowest cross section)	1.5 feet (with 8.5-foot shared use path)	1.5 feet
Roadway Speed	40 mph	40 mph

Table 5.4. Bicycle Stress Level Evaluation for the Highway Viaduct Family

	DEIR Highway Viaduct Alternative	IRT Highway Viaduct Variant
Nearest Roadway	Soldiers Field Road	Soldiers Field Road
Distance to Roadway	9 feet (with 12-foot shared use path)	16 feet (with 16-foot shared use path)
Roadway Speed	40 mph	40 mph

Table 5.5. Bicycle Stress Level Evaluation for the Hybrid Family

	DEIR Hybrid Alternative	IRT Hybrid Variant	Elevated Shared Use Path Hybrid Variant
Nearest Roadway	Soldiers Field Road	I-90	I-90 and Soldiers Field Road
Distance to Roadway (at narrowest cross section)	2 feet (with 12-foot wide path)	26 feet (with 16-foot shared use path)	2 horizontal feet, 18-20 vertical feet
Roadway Speed	40 mph	55 mph	40-55 mph

5.5 Crash Data on the Paul Dudley White Path

Bicycle crash data was requested by project stakeholders during Task Force Meetings, so the IRT searched to find relevant data. However, it was concluded that there is insufficient data for analysis purposes. While the City of Boston maintains an interactive Vision Zero crash tracking map, it does not include details of crashes or precise incident locations. Alternate sources checked for crash data included the Boston Cyclists Union, MassDOT Crash Portal, and the Metropolitan Area Planning Council.

6 Errata

After the completion and publication of the Technical Report by the IRT, further analysis revealed several corrections needed to the original document. Those corrections are summarized in **Table 6.1** below.

Table 6.1. Corrections to the Technical Report

Page, Section	For	Replacement
Page 19, Section 1.8	Table 1.3	Table 1.2, which is in Section 1.3 of this Addendum
Page 19, Section 1.8	Table 1.3	Table 1.2, which is in Section 1.3 of this Addendum
Page 23, Section 1.8	Table 1.7	Table 1.6, which is in Section 1 of this Addendum
Page 237, Section 7.2.1	Table 7.2	Table 6.2, which follows this errata list
Page 240, Section 7.2.2	Table 7.4	Table 6.3, which follows this errata list

Table 6.2 serves as a replacement for Table 7.2 in the Technical Report and **Table 6.3** serves as a replacement for Table 7.4 in the Technical Report.

Table 6.2. Comparison of Construction Costs, Highway Viaduct Family of Alternatives

Description	DEIR Highway Viaduct Alternative	Highway Viaduct Variant	Difference (%)
HIGHWAY WORK	$344,710,573	$ 384,890,547	+ 13%
I-90/Street Grid	$ 285,391,934	$ 323,276,755	+ 13%
Civil Work	$ 104,037,675	$ 105,818,912	
Structural Work	$ 181,354,259	$ 217,457,843	
Soldiers Field Road	$ 59,318,639	$ 62,423,022	+ 5%
Civil Work	$ 15,243,639	$ 18,348,022	
Structural Work	$ 44,075,000	$ 44,075,000	
BEACON YARD	$ 139,439,508	$ 139,439,508	
RAILYARD	$ 68,016,761	$ 68,016,761	
WEST STATION	$ 71,422,748	$ 71,422,748	
TOTAL CONSTRUCTION	$ 484,150,081	$ 525,139,300	+8%

Description	DEIR Highway Viaduct Alternative	Highway Viaduct Variant	Difference (%)
Indirects, OH, Profit, Bonds (%)	$ 127,030,044	$ 183,798,800	
Subtotal Incl. Indirects, etc.	$ 611,180,125	$ 708,938,800	
Escalation (%)	$ 159,151,304	$ 181,771,800	
Subtotal Incl. Escalation	$ 770,331,429	$ 890,709,900	
Contingency	$ 269,616,000	$ 311,748,500	
Total Construction Costs (2023USD)	$ 1,039,947,429	$ 1,202,458,400	+15%

Table 6.3. Comparison of Replacement Costs, At-Grade Family of Alternatives

	DEIR At-Grade Alternative	At-Grade Variant	Difference (%)
HIGHWAY WORK	$42,892,263	$45,757,300	+7%
I-90/Street Grid	$18,689,017	$23,311,853	+25%
CIVIL WORK	$15,508,873	$17,972,348	+15%
Drainage	$ 2,214,476	$ 2,768,094	+25%
Waterworks	$ 137,668	$ 137,668	
HMA Pavement – Surface Roads	$ 6,291,240	$ 7,615,711	+21%
Curb	$ 226,854	$ 226,854	
Concrete Barrier	$ 1,372,344	$ 1,372,344	
Concrete Sidewalk	$ 589,862	$ 589,862	
HMA Separated Bike Lane	$ 81,056	$ 98,119	+21%
Traffic Signals	$ 397,181	$ 397,181	
Lighting	$ 1,264,101	$ 1,264,101	
Pavement Markings	$ 122,689	$ 122,689	
Traffic Maintenance (5%)	$ 538,123	$ 538,123	
Pump Station Operation Costs	$ 2,273,280	$ 2,841,600	+25%
STRUCTURAL WORK	$ 5,453,423	$ 5,339,505	-2%
Retaining Wall at Buick Street	$ 311,018	$ 311,018	
STRUCTURE - MSE WALL	$ 433,523	$ 319,604	+26%
I-90 BRIDGE STRUCTURES	$	$	
Traffic Maintenance (5%)	$	$	

	DEIR At-Grade Alternative	At-Grade Variant	Difference (%)
I-90 BOAT SECTION	$ 4,484,650	$ 4,484,650	
Traffic Maintenance (5%)	$ 224,232	$ 224,232	
Soldiers Field Road	$21,929,966	$22,445,447	+9%
Drainage	$ 1,408,613	$ 1,408,613	
HMA Pavement	$ 834,061	$ 1,009,583	+21%
Pavement Markings	$ 21,752	$ 21,752	
Curb	$ 30,600	$ 30,600	
Concrete Barrier	$ 891,492	$ 891,492	
Concrete Median	$ 9,284	$ 9,284	
HMA Multiuse Path	$ 127,199		
Lighting	$ 496,179	$ 496,179	
Traffic Maintenance (5%)	$ 233,749	$ 233,749	
Pump Operation Costs	$ 2,490,176	$ 2,490,176	
Soldiers Field Road Boat, Bridge, and Bike Path	$ 14,059,244	$ 15,854,017	+15%
ELEVATED TRACK VIADUCTS	$ 11,437,203	$ 12,053,681	+5%
Elevated Rail Viaduct over I-90	$ 6,575,742	$ 6,903,854	+5%
Traffic Maintenance (5%)	$ 328,787	$ 345,193	+5%
Elevated Rail Viaduct over Soldiers Field Road	$ 4,316,832	$ 4,575,841	+6%
Traffic Maintenance (5%)	$ 215,842	$ 228,792	+5%
Total REPEX Costs (50Y)	$54,329,465	$57,810,981	+6%

APPENDIX A

Meeting Notes

Meeting Notes—I-90 Allston Independent Review Team

DATE: October 19, 2018
ATTENDEES: Tom Nally, A Better City
Jack Wright, Weston & Sampson
Keri Pyke, Howard Stein Hudson (HSH)
Sarah Davis, HSH

Meeting with A Better City

On October 19, 2018, members of the I-90 Allston Independent Review Team (IRT) met with A Better City over the phone to mark the start of the IRT Addendum Period.

General Notes

- Jack opened the call by stating his intention of accelerating the concept selection process in order to allow more time for analysis by the IRT.
- Tom expressed support for "Concept 1.5" and noted that the Task Force had also expressed support for the concept. Tom emphasized that the cross sections need further work to ensure that the new elevated Paul Dudley White Path Variant does not intrude into any wetlands.
- Jack pointed out that the elevated pedestrian path will require a significant support structure, especially if a planter is placed along the length of the elevated Paul Dudley White Path. A planter increases the load of the structure, requiring columns of a greater diameter. Tom agreed with this assessment.
- Tom further noted that the Department of Conservation and Recreation (DCR) had not expressed concern about the path's overhang of westbound Soldiers Field Road. Jack noted that DCR had expressed concerned about overhang issues – particularly in the winter.
- Tom pushed to receive some feedback from the IRT prior to deciding on a path concept; however, Jack and Keri were clear that only one concept could be analyzed in the allotted time. The group decided that the IRT would begin analyzing and created a cross section for Concept 1.5; it was agreed that ABC would notify the IRT if their preferred concept was changed.

Meeting notes prepared by Sarah Davis, HSH. Please send any corrections and/or additions within one week of receipt.

Meeting Notes—I-90 Allston Independent Review Team

DATE: October 23, 2018
ATTENDEES: Tom Nally, A Better City (ABC)
Glen Berkowitz, ABC
Rick Dimino, ABC
Ryan McNeill, MassDOT
Jack Wright, Weston & Sampson
Matthew Ciborowski, Arup
Keri Pyke, Howard Stein Hudson (HSH)
David Matton, HSH
Mark Gravallese, HSH
Doug Johnson, HSH

Meeting with A Better City

On October 23, 2018, members of the I-90 Allston Independent Review Team (IRT) met with A Better City (ABC) to discuss the new Elevated Paul Dudley White Path alternatives.

General Notes

- ABC pushed the IRT to assist in identifying the most permittable and feasible concept for the elevated Paul Dudley White Path; however, the IRT was clear that they could not make assumptions or predictions about any concept without doing time-consuming calculations and assessments. The IRT reiterated that they would only provide analysis for one concept, and that concept needs to be selected so that the IRT's engineers can move forward with creating cross sections, plans, calculations, and analysis. It was acknowledged that all three concepts – 1, 1.5, and 2 – have some positives and some negatives.
- ABC expressed desire to create a viable alternative with the elevated path that would not be dismissed immediately. The IRT was clear that they would put time and work into the new variant; however, the team was clear that they were uncertain about characterizing an elevated, paved path as open space, and that permitting implications of the designs were unclear.
- When pushed by ABC to share further thoughts on the specific designs, the IRT specified that larger columns would be required for a larger structure, impacting wetlands further. Additionally, the IRT acknowledged that any structure would create shadow impacts, and

that structures outside of the wetlands could still require foundations that intrude into the wetlands.

- ABC clarified that their intent in creating three separate concepts was to find an alternative that is viable, and to maximize the opportunity to create walking and biking amenities. They explained their process of analyzing a 25-foot wide elevated path, which limited the ability to separate modes, and then analyzing a 50-foot wide elevated path, which was popular with advocates. ABC came to a 36-foot design as a mid-point between the two widths, allowing for adequate path separation and some planters. To this point, the IRT was clear that planters add significant weight to the structure, referencing previous similar projects.
- ABC implied that the structure for the elevated shared use path may be less sizeable and significant than the viaduct in the IRT Hybrid Variant; however; the IRT was uncertain as to how accurate that was, noting that pedestrian loads can be massive. The IRT also pointed out that emergency response access as an issue for the elevated path.
- Another concern was brought up by the IRT regarding the potential elevated path planters; while MassDOT would be responsible for maintaining the elevated shared use path structure, MassDOT would not want responsibility for maintaining planters. However, all parties agreed that the decision would likely be made further in the design process as to which entity is responsible for the maintenance of the elevated shared use path structure and potential planters.
- The two teams discussed alternate support systems for the elevated shared use path; however, any central support system would likely require wider columns and lead to further wetlands infringement.
- In conversation about the installation of planters on the path, the IRT brought up the issue of width, length, and total soil load. The IRT agreed to investigate this issue further as they developed cross sections for the new variant, and further discussed the potential quality of the path regarding planters and other amenities.
- ABC proposed a meeting after the IRT has further developed a realistic cross section for the new variant, and the IRT agreed. Meeting details were to be established at a later date.

Meeting notes prepared by Doug Johnson and Sarah Davis, HSH. Please send any corrections and/or additions within one week of receipt.

Meeting Notes—I-90 Allston Independent Review Team

DATE: November 9, 2018
ATTENDEES: Tom Nally, A Better City (ABC)
Glen Berkowitz, ABC
Rick Dimino, ABC
Jack Wright, Weston & Sampson
Keri Pyke, Howard Stein Hudson (HSH)
Sarah Davis, HSH

Meeting with A Better City

On November 9, 2018, members of the I-90 Allston Independent Review Team (IRT) met with A Better City (ABC).

General Notes

- The IRT clarified that no Alternative or Variant would be embellished in renderings and cross sections, as that was specified by the Task Force as an issue with the DEIR renderings.
- The IRT presented their developed plan view and cross sections for two concepts: one with two-foot columns supporting the elevated shared use path with a planter, and another with 1.5-foot columns supporting the elevated shared use path without a planter. The IRT suspected that, though the path with wider columns would be approximately one foot beyond the wetland line at the narrowest cross sections, the intrusion would not be a fatal flaw. However, the IRT further noted that the temporary impacts would be so substantial that they may be a more significant permitting issue than previously thought.
- ABC pushed to learn more about the potential to reduce column width by altering the spacing, which the IRT discussed. Alterations to spacing and column width have been explored by the IRT, but the existing load would need to be altered in order to allow significant change. Overall, ABC expressed satisfaction with the 1.5-foot and 2-foot column width options.
- The IRT also specified that the team's engineers were working to reduce the linear impact to the bank, as that can have significant permitting implications.
- ABC expressed concern for the length of the ramps, noting that ramps previously shown for north-south pedestrian and bike connections in the Throat have been shown with switchbacks, rather than just straight ramps.

- ABC proposed designing an elevated shared use path with the thinner, more minimal design through the narrow eastern part of the throat and expanding the path structure to be more substantial after clearing the narrow section to ease permitting issues.
- Also pertaining to permitting, the IRT has noted a distinction between open space at ground level and open space on the elevated path; the IRT is unclear what permitting implications this distinction will have.

Meeting notes prepared by Sarah Davis, HSH. Please send any corrections and/or additions within one week of receipt.

APPENDIX B

Related Documents

October 17, 2018

Jonathan Gulliver
Highway Administrator
Massachusetts Department of Transportation
Suite 7410
10 Park Plaza
Boston, MA 02116

Subject: I-90 Allston Interchange Project
Highway At-Grade Hybrid
Paul Dudley White High Line Updates

Dear Mr. Gulliver:

A Better City appreciates the opportunity to continue our dialogue with MassDOT and members of the Independent Review Team (IRT) focused on the Throat area of the I-90 Allston Interchange Project. As you are aware, we have developed several new options for accommodating the Paul Dudley White pedestrian and bicycle paths along the Charles River. The "High Line" concept that was suggested and supported in the September 26 Task Force meeting is the basis for these new options. The idea is modeled after the very popular "High Line" park in Lower Manhattan.

We have had conversations and received good ideas from members of the Task Force since that meeting, and we look forward to sharing these new options with the Task Force when it meets on Wednesday night.

By elevating and relocating the Paul Dudley White path stacking it over portion(s) of Soldiers Field Road in the Throat Area, we are able to remove any structures overhanging the Charles River. We believe that this concept will minimize or even eliminate any wetlands and waterways permitting risk.

Attached are three options for the Paul Dudley White High Line. All three directly connect to the proposed Agganis Promenade to provide a pedestrian and bicycle connection between Commonwealth Avenue and the Charles River. That connection has been supported as a priority by Task Force members and other stakeholders such as the Town of Brookline. All three options provide a 4% ADA compliant ramp at the ends of the High Line to the ground along the river. And all three options provide 14 feet of clearance above Soldiers Field Road that matches the clear height of the recently opened bridge at Charles Circle. All options are compatible with any additional river edge improvements or environmental restoration implemented by this project or a subsequent project by others.

Each of the options considers different assumptions to explore a range of possible priorities:

Option 1 provides a 25-foot wide deck over the westbound lanes of Soldiers Field Road to provide separated pedestrian and bicycle paths that will connect to dual treadway paths along the edge of the river at either end of the Throat, assuming reconstruction of the "Little Grand Junction" bridge over Soldiers Field Road.

Option 2 provides a 50-foot wide deck that covers both westbound and eastbound lanes of Soldiers Field Road to accommodate ample separated pedestrian and bicycle paths as well as opportunities for planting, seating areas, and other pedestrian scale amenities that could resemble the well-known "High Line" elevated deck in New York City. While creating more open space on the deck has a great deal of appeal, the deck itself may be more visually intrusive, and more expensive to build and maintain.

Option 1.5 provides a 36-foot wide deck covering the eastbound lanes of Soldiers Field Road and a cantilever partially covering the westbound lanes. The deck and cantilever is supported by more robust columns. Benefits of this option include ample space for planting and pedestrian amenities and additional sunlight and reduced visual impact at the edge of the river.

There are trade-offs and choices associated with each of these options, and understanding of those trade-offs would benefit from further discussion with MassDOT, members of the IRT, and the Task Force.

We look forward to sharing these options with the I-90 Allston Task Force on Wednesday night and discussing with you on Thursday how we can work with members of the Review Team to further develop these options and incorporate them into the Team's final report and the evaluation matrix.

Sincerely,

Richard A. Dimino
President and CEO

Attachment

cc: Jack Wright, Keri Pyke

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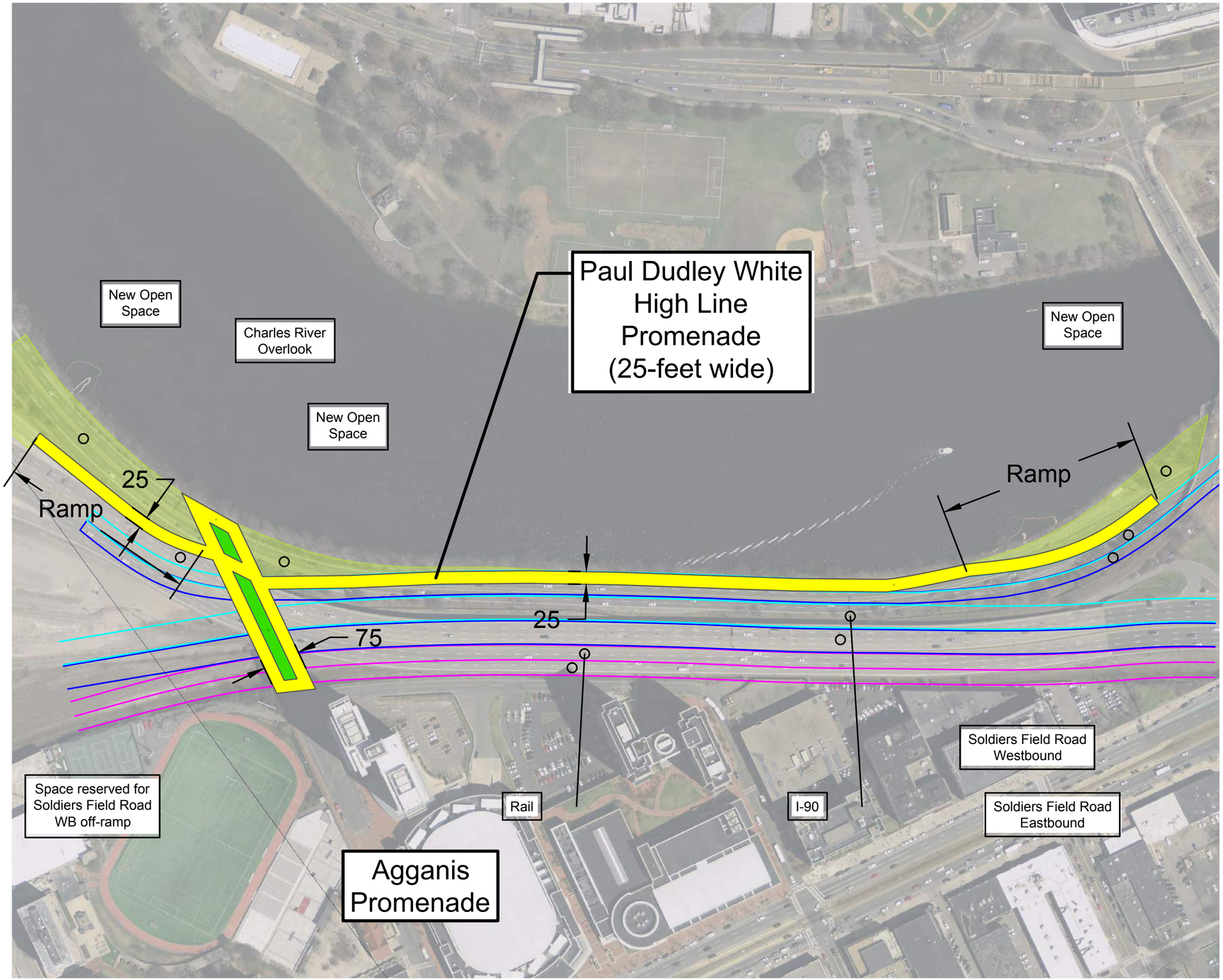
2013 10:15:18 hybrid Working r2j.dwg



neral No~

1. Preliminary schematic sketch, for initial discussion purposes only.
2. Option 1: Paul Dudley White High Line above Soldiers Field Road WB.
3. High Line ramps depicted @ 4% grade = 425 feet long.
4. Please note generous landscape opportunities on the:
   - 4.1. High Line
   - 4.2. Agganis Promenade

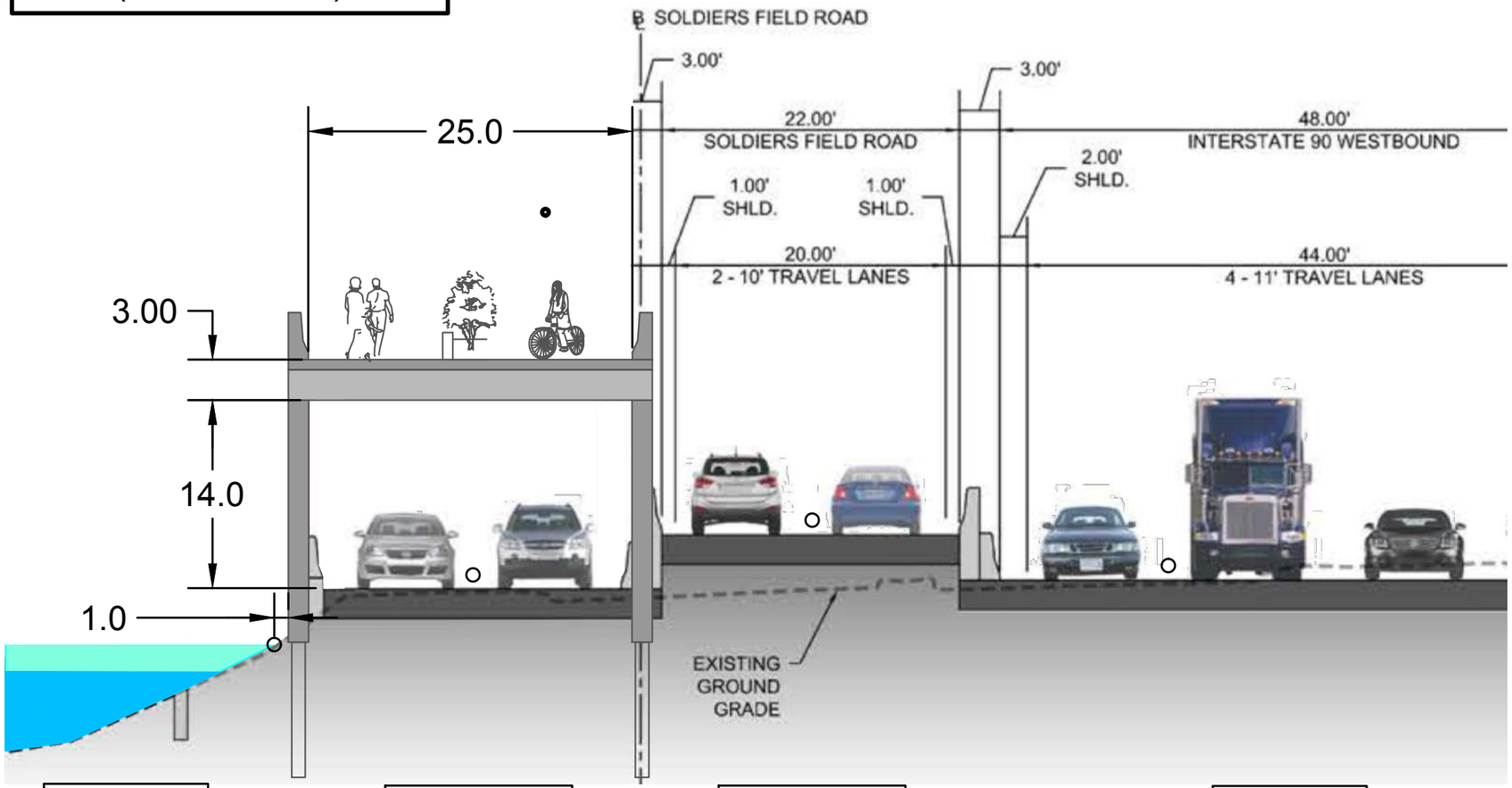
   Total amount of Open Space = 91,335 ft^2 or 2.1 acres.
5. All dimensions in feet

Shee~ Ti~le:
Highway At-Grade Hybrid,
Paul Dudley White High Line
Plan: Option 1

Prepared by	GAB
Drawn by	GAB
Da~	/5/18, rev. 10/17/18
Scale	1" = 200'

Shee~
PDW HL–1

Highway At-grade Hybrid
Paul Dudley White
High Line
(25-feet wide)



Top of Bank (elevation 2-feet)

Soldiers Field Road Westbound

Soldiers Field Road Eastbound

I-90 Westbound

neral No-

1. Preliminary schematic sketch, for initial discussion purposes only.
2. Structure to be designed for plantings with appropriate depths of soils.
3. Background (DEIR) sketch needs to be revised with appropriate lateral clearances roadways from High Line columns.
4. Column to Bank setback calculation based on DEIR and IRT materials.
5. All dimensions in Feet
6. x

Shee- Ti-le:
Highway At-Grade Hybrid, Paul Dudley White High Line: Cross Section, Option 1

Prepared by	GAB
Drawn by	GAB
Da-	/5/18, rev. 10/17/18
Scale	1" = 10'

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PDW HL–XS-Option 1

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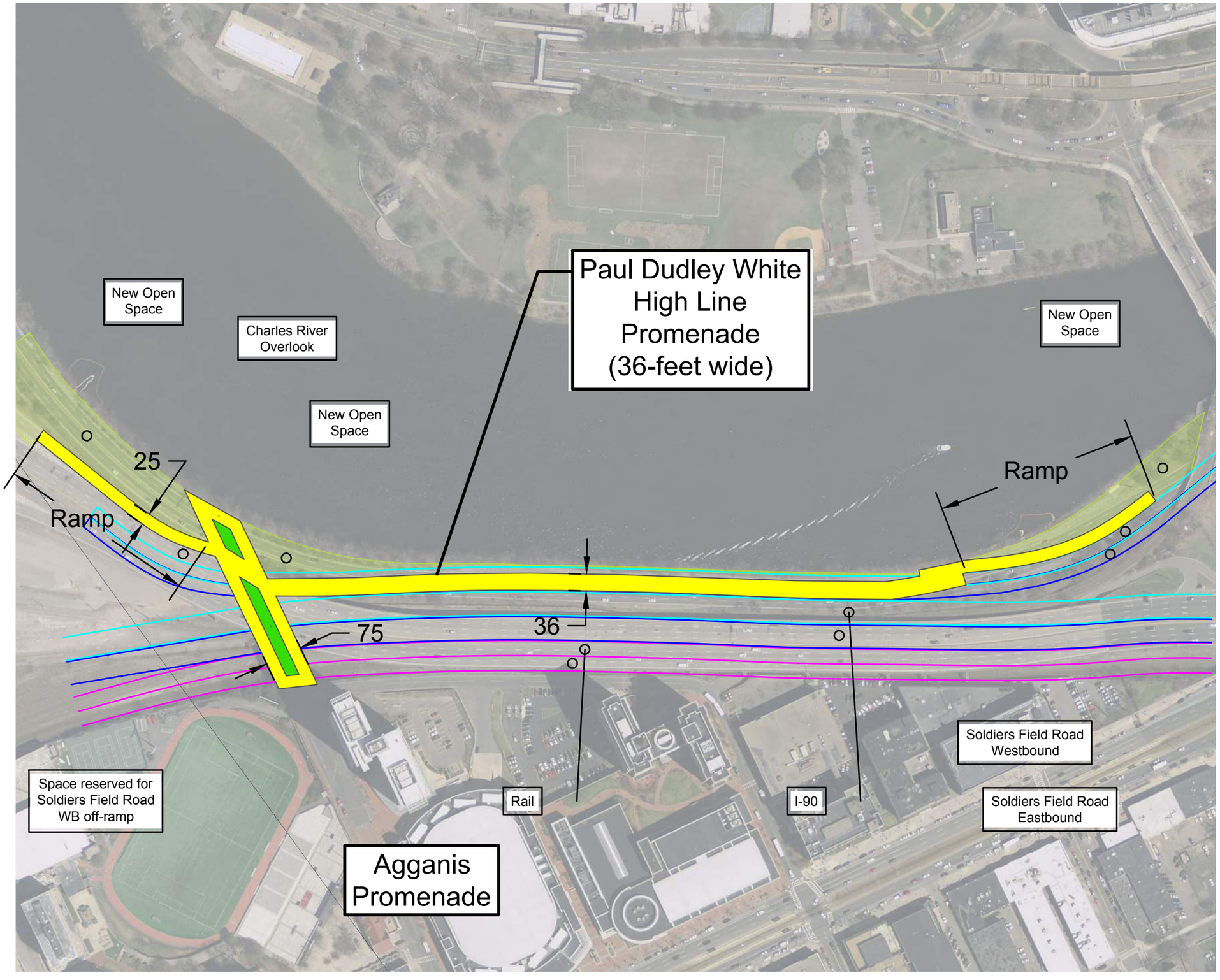


neral No~

1. Preliminary schematic sketch, based on concept by ATO, for initial discussion purposes only.
2. Option 1.5: Paul Dudley White High Line above Soldiers Field Road EB and cantilevered half-way over WB.
3. High Line ramps depicted @ 4% grade = 425 feet long.
4. Please note generous landscape opportunities on the:
   - 4.1. High Line
   - 4.2. Agganis Promenade

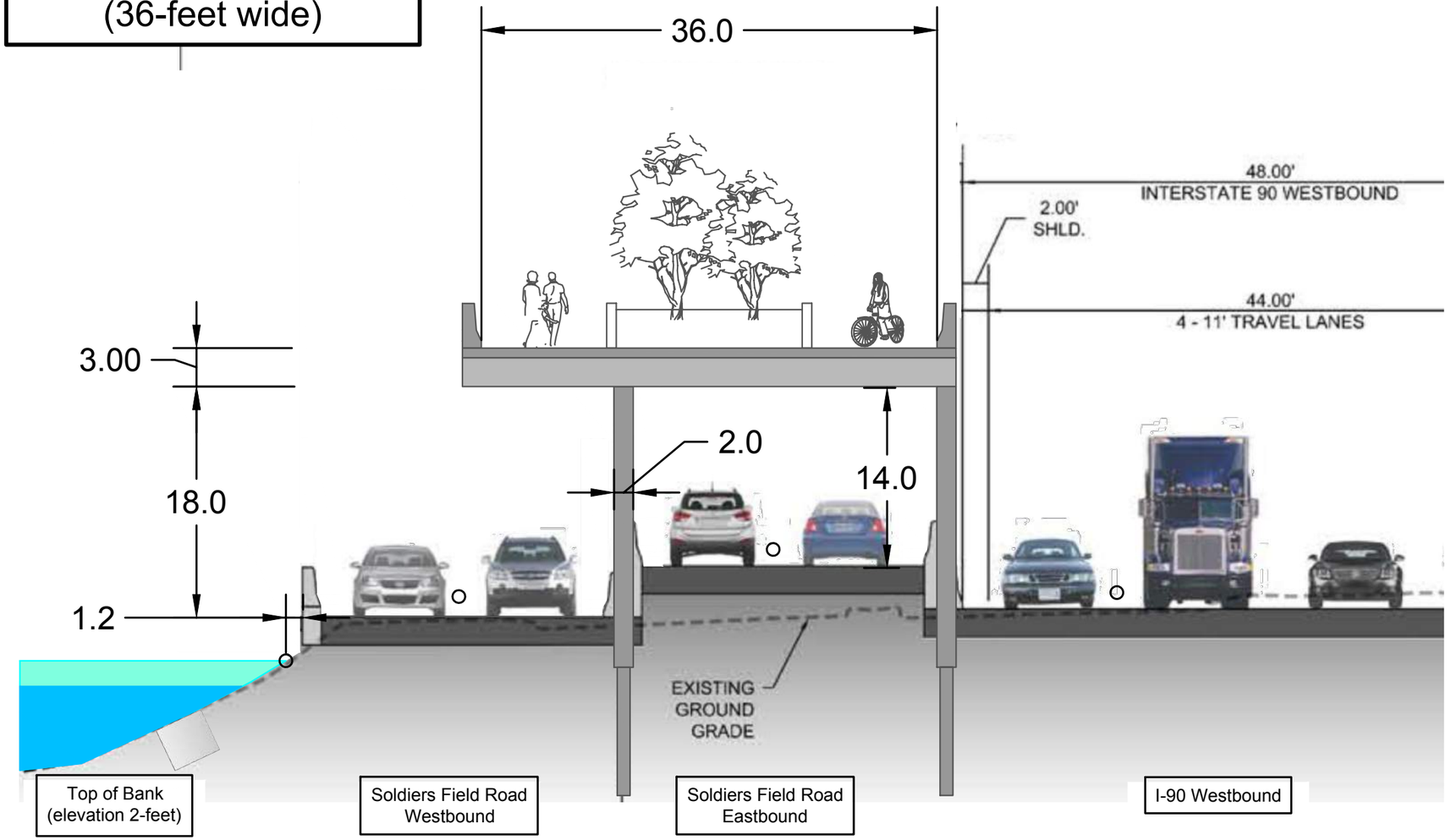
   Total amount of Open Space = 106,666 ft^2 or 2.4 acres.
5. All dimensions in feet

Shee~ Ti~le:
Highway At-Grade Hybrid, Paul Dudley White High Line Plan: Option 1.5

Prepared by	GAB
Drawn by	GAB
Da~	/17/18
Scale	1" = 200'

Shee~
PDW HL–1.5

Highway At-grade Hybrid
Paul Dudley White
High Line
(36-feet wide)



neral No-

1. Preliminary schematic sketch, based on concept by ATO, for initial discussion purposes only.
2. Structure to be designed for plantings with appropriate depths of soils.
3. Background (DEIR) sketch needs to be revised with appropriate lateral clearances roadways from High Line columns.
4. All dimensions in Feet
5. x

Shee- Ti-le:
Highway At-Grade Hybrid,
Paul Dudley White High Line:
Cross Section,
Option 1.5

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Drawn by	GAB
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Scale	1” = 10’

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PDW HL–XS-
Option 1.5

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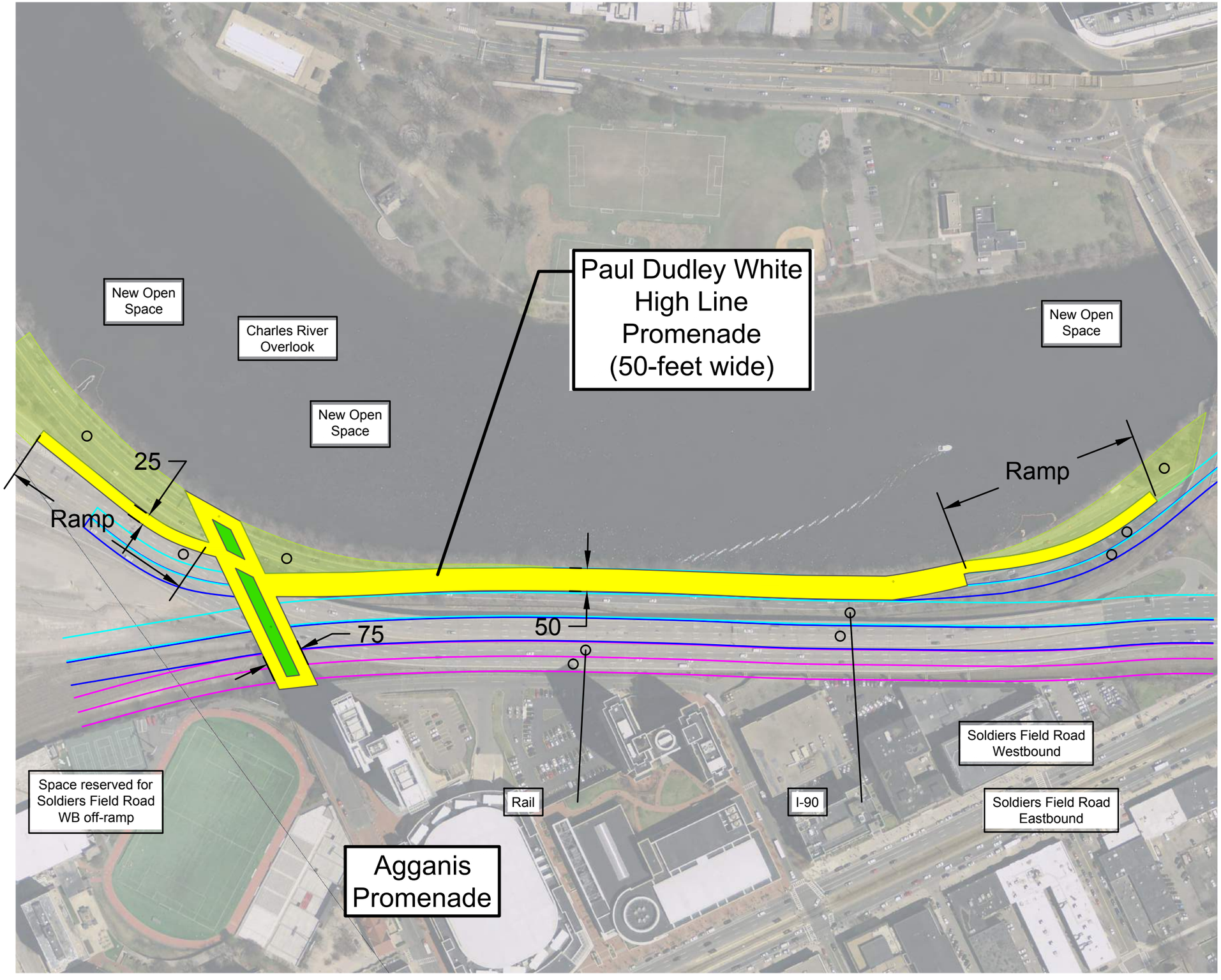

neral No~

1. Preliminary schematic sketch, for initial discussion purposes only.
2. Option 1: Paul Dudley White High Line above Soldiers Field Road WB.
3. High Line ramps depicted @ 4% grade = 425 feet long.
4. Please note generous landscape opportunities on the:
   - 4.1. High Line
   - 4.2. Agganis Promenade

   Total amount of Open Space = 123,587 ft^2 or 2.8 acres.
5. All dimensions in feet

Shee~ Ti~le:
Highway At-Grade Hybrid, Paul Dudley White High Line Plan: Option 2

Prepared by	GAB
Drawn by	GAB
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Scale	1" = 200'

Shee~
PDW HL–2

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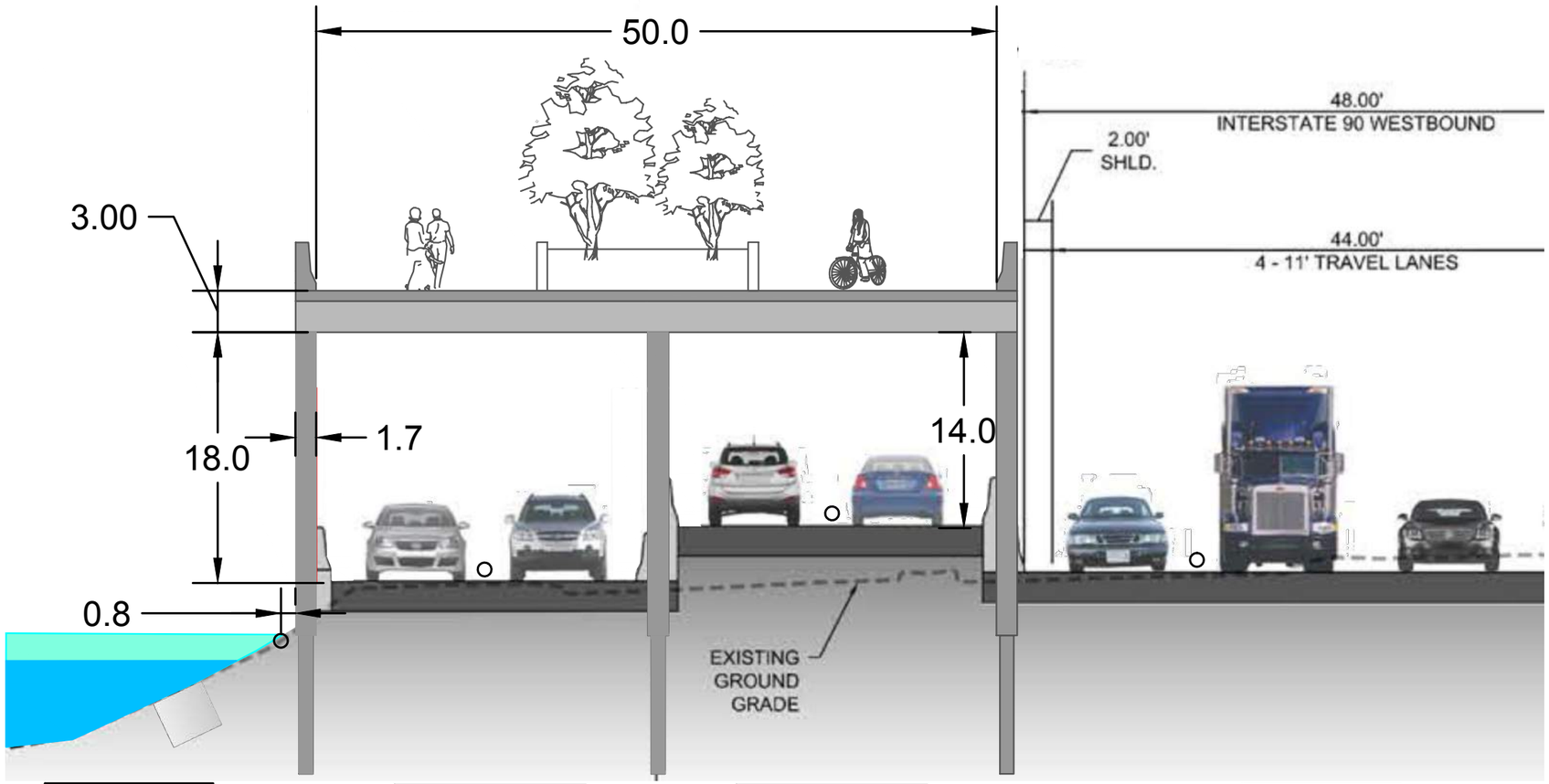
Highway At-grade Hybrid
Paul Dudley White
High Line
(50-feet wide)



neral No-

1. Preliminary schematic sketch, for initial discussion purposes only.
2. Structure to be designed for plantings with appropriate depths of soils.
3. Background (DEIR) sketch needs to be revised with appropriate lateral clearances roadways from High Line columns.
4. All dimensions in Feet
5. x

Shee- Ti-le:
Highway At-Grade Hybrid, Paul Dudley White High Line: Cross Section, Option 2

Prepared by	GAB
Drawn by	GAB
Da-	/5/18, rev. 10/17/18
Scale	1" = 10'

Shee-
PDW HL–XS-Option 2

APPENDIX C

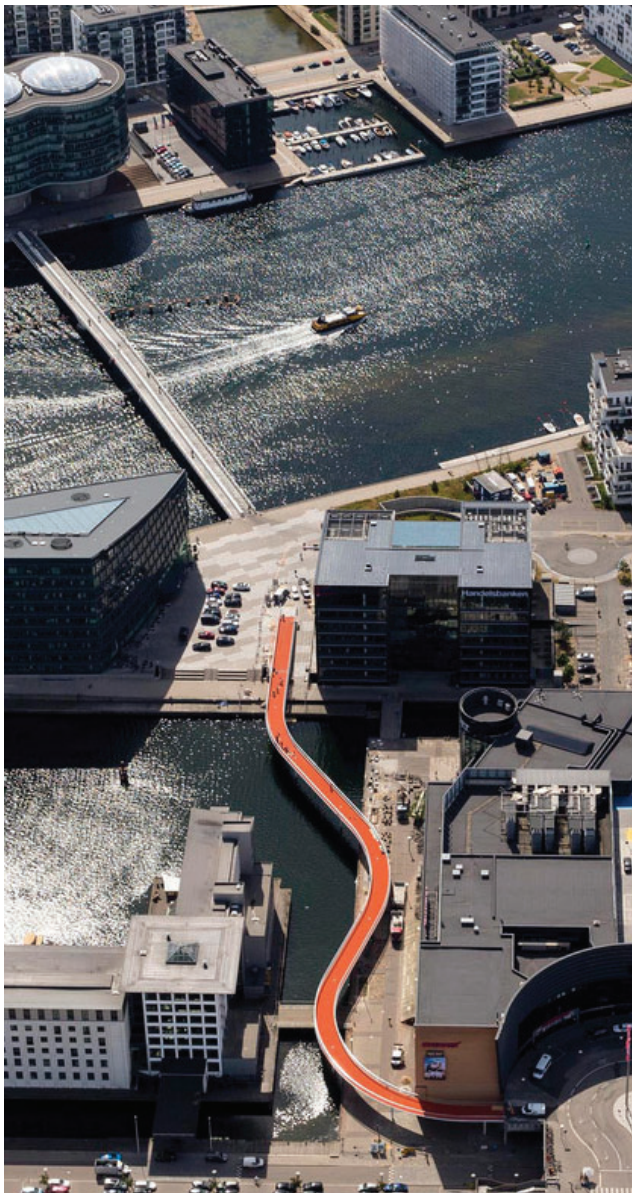
Benchmarks of Elevated Path

An Elevated Paul Dudley White Path in the Throat Area:
Benchmarking Study and Concepts

ARUP

©Dissing + Weitling Architecture

©Adrià Goula Sardà



©Dissing + Weitling Architecture

©NYC Parks

©Flickr - John Zacherle

Various images of elevated active mobility corridors.

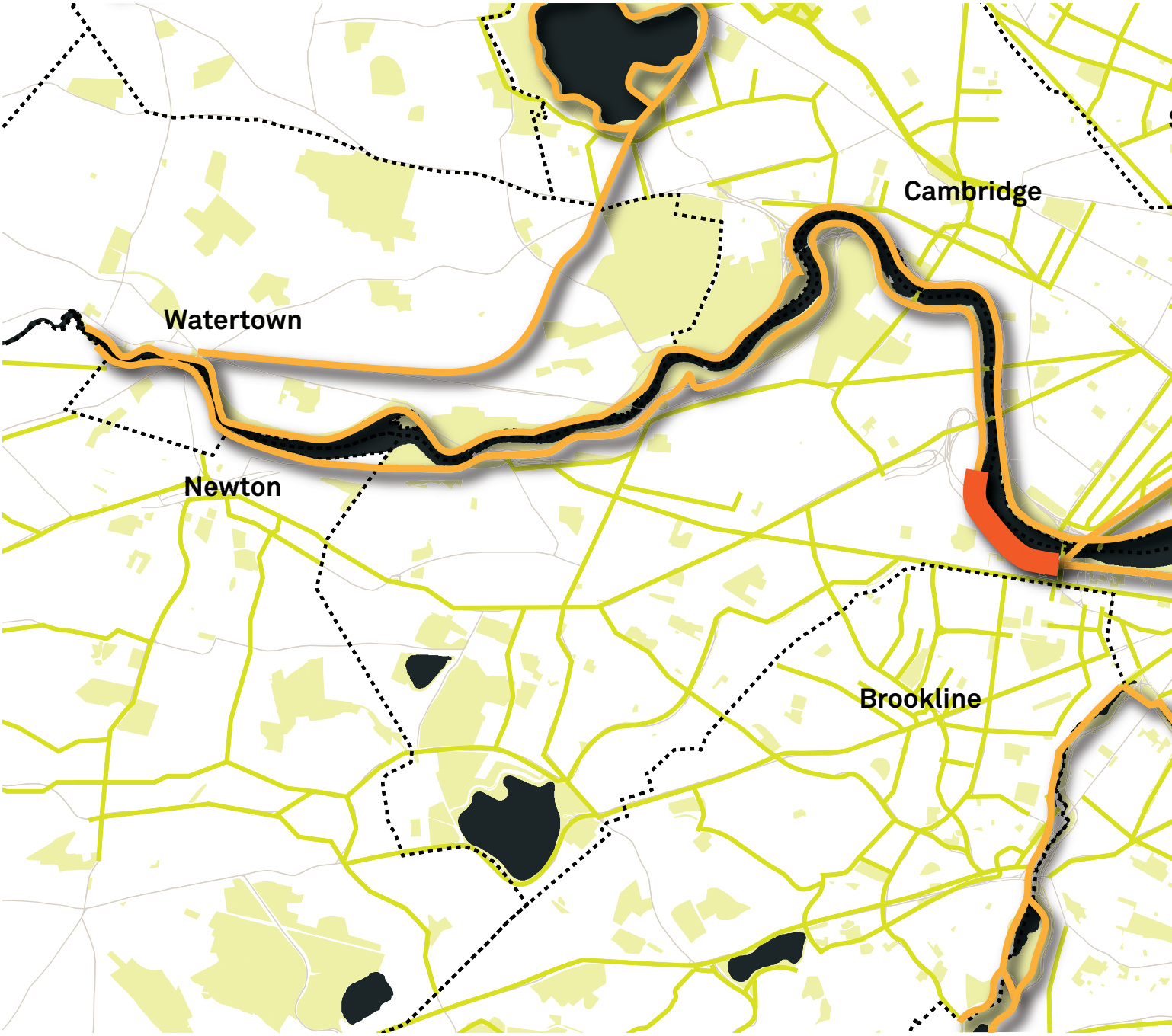
Introduction

The Paul Dudley White Path is a corridor that allows for nonmotorized, active mobility in the city and region. It is an important active mobility corridor along the Charles River that connects commuters and recreational users to downtown Boston.

This report examines the opportunity to elevate a section of the Paul Dudley White Path at the 'Throat Area', located at the convergence of Soldiers Field Road, I-90 and the Worcester Main Line. This elevated path has the potential to be a new public space that features scenic views of the waterfront, trees and vegetation, seating, and recreational activity.

This report documents the guidelines that underlie the elevated path concept, provides context to its role within the City of Boston, and identifies commonalities and lessons learned from similar projects around the globe. It is organized into five sections.

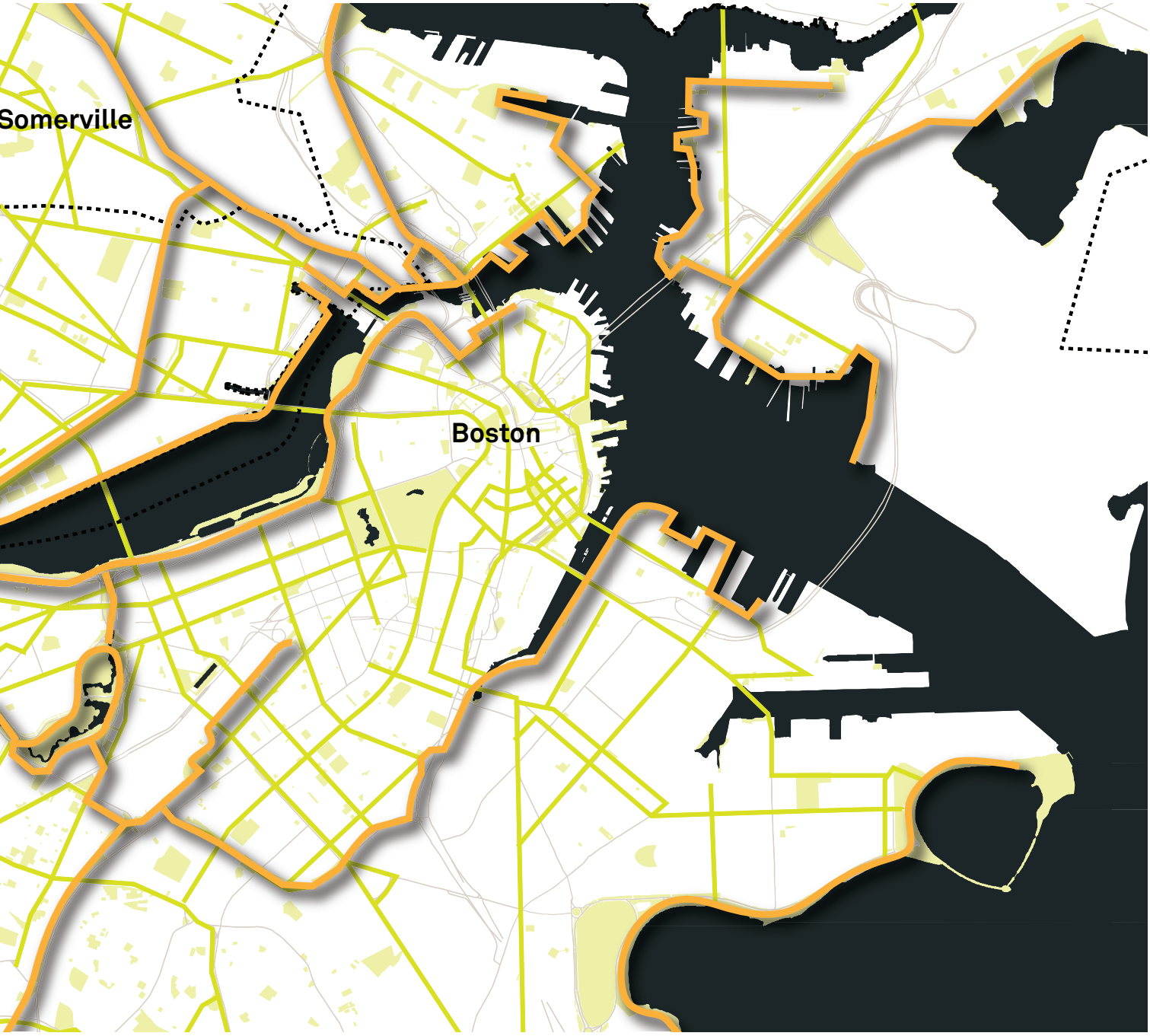
Table of Contents



City Context

The study area is one link in a larger, complex network of active mobility corridors that connect several green spaces and traverses several jurisdictions along the Charles River. It is a critical link in a wider network that is utilized by visitors, local residents, recreational users and commuters alike.

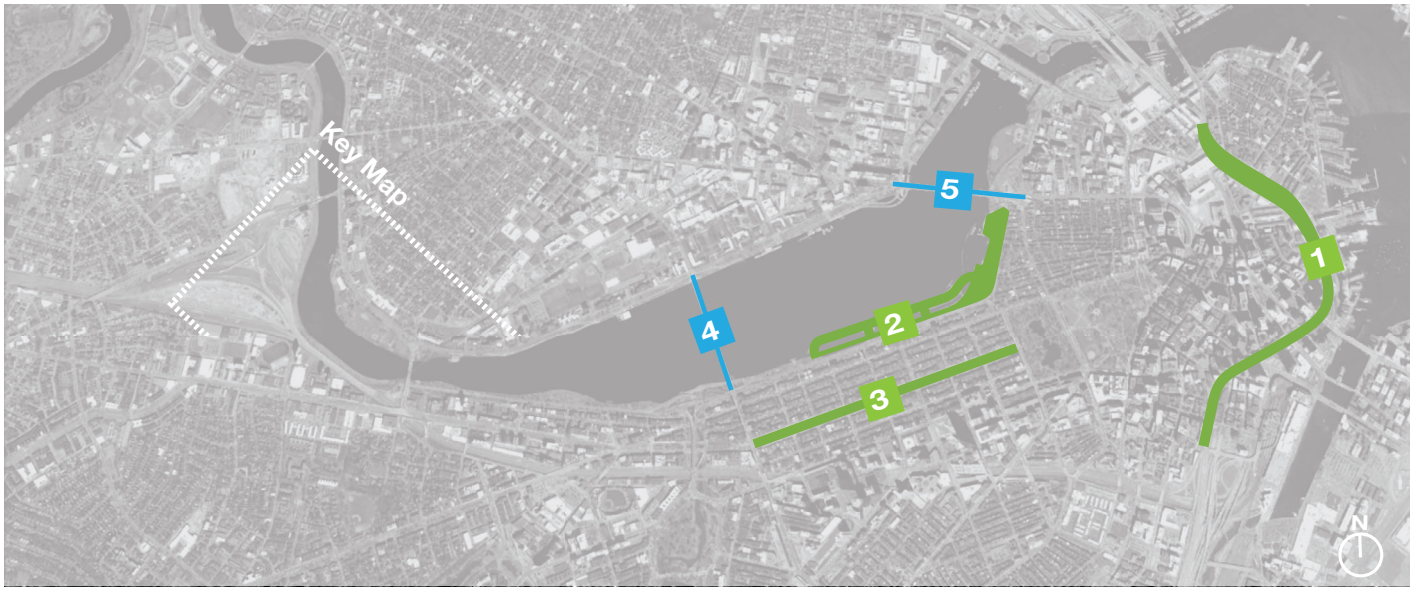
The above map is a composite of existing and planned cycle network as depicted in various guidance documents of the Cities of Boston, Cambridge, Newton and Somerville; and the Towns of Brookline and Watertown.



Legend

- **Study Area**
- **Key Existing / Proposed Bikeways**
  Off-Street Path, Off-Road Path, Bike Path, Multi-use Path, Cycle Track, Greenway
- **Existing / Proposed Cycle Network**
  Bike Lane, Protected Lane, Shared Lane, Shared Road, Contraflow Lane
- **Green Space**
- **Water Bodies**
- **Boundary**

Sources: Boston Bike Network Plan; Brookline Green Routes Bicycle Network Plan; Cambridge Bicycle Network Plan; Newton Bicycle Network Plan; Somerville Bike Map; Watertown Bike and Pedestrian Trails Map.



The following is a scale study of key urban parks and elevated structures within the City of Boston. The purpose is to give contextual and scale references to existing pedestrian and cycle corridors.

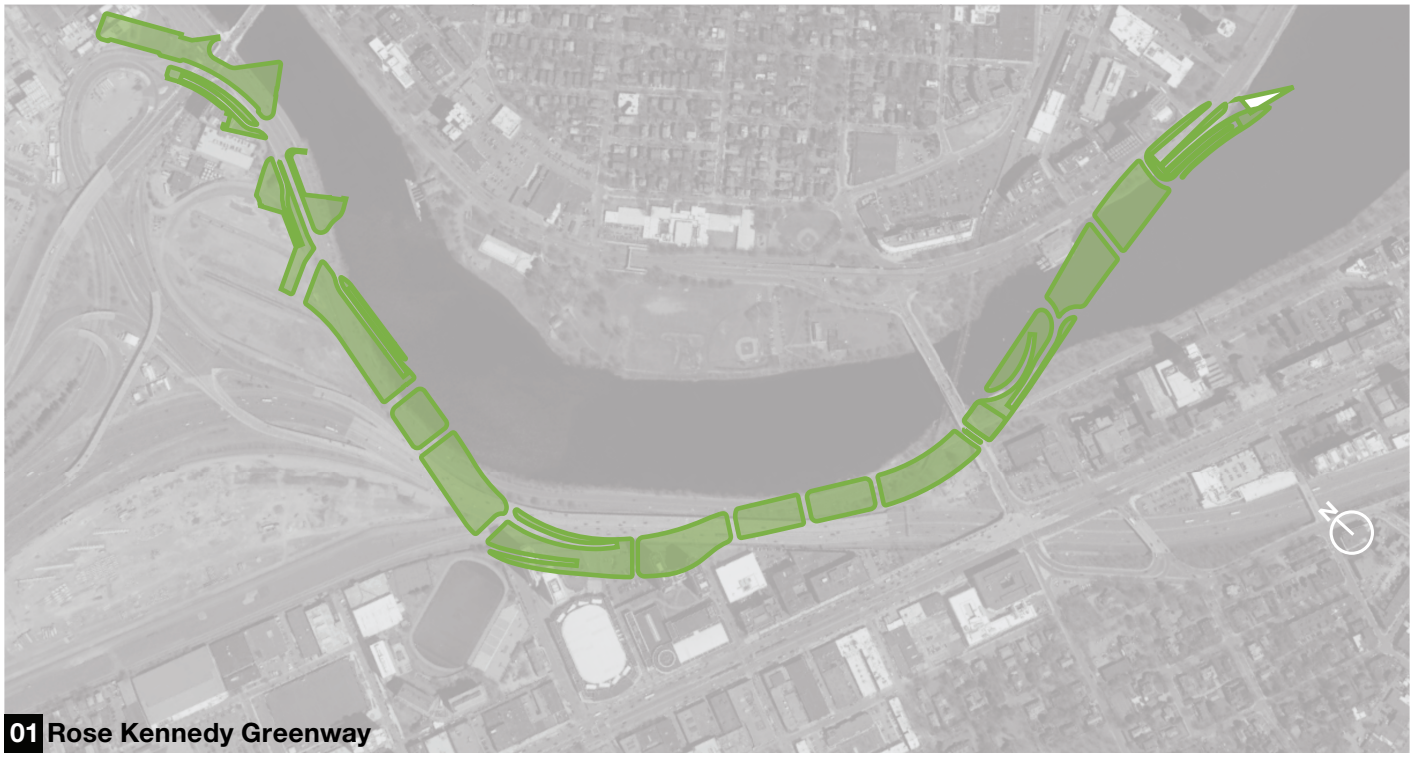
The following corridors have been superimposed onto an aerial photograph of the study area:

1. Rose Kennedy Greenway
2. Charles River Esplanade
3. Commonwealth Ave. Mall
4. Mass. Ave. Bridge
5. Longfellow Bridge

Commonwealth Ave.

Rose Kennedy

Charles River



01 Rose Kennedy Greenway

02 Charles River Esplanade

03 Commonwealth Ave. Mall

04 Mass. Ave. Bridge

05 Longfellow Bridge

Elevated Path Design Guidelines

The following are guidelines that informed the concepts for the Elevated Paul Dudley White Path in the Throat Area. Whether for recreational use or commuting these guidelines prioritize the user-experience and draw from best practices to create a functional, comfortable, and welcoming place.

1. Recreation and Leisure

Recreational users include pedestrians, joggers, local residents, and students from nearby institutions. This is a diverse profile of the community with users of different levels of ability. The following guidelines should be considered when designing for this user group:

- Best practice limits the incline to a 8.3% percent grade and requires regularly spaced landings to provide respite for mobility impaired users. As a rule of thumb, 5 foot landings are needed at 30 foot intervals. This is illustrated in Figure 1, along with other acceptable forms of vertical circulation.
- Provisions for seating at regular intervals should be considered, especially to provide for the elderly community.
- Pedestrian lighting, anti-climb fences and screening increase the perception of safety and encourage a 24 hour use of the facility.

2. Commuting

Within the Throat Area, 4-5% is the shallowest possible grade given the lack of linear space available for ramps and supporting infrastructure. While this is a steep climb for cyclists it is an acceptable trade-off when considering its important role in the regional cycle network. The Elevated Paul Dudley White Path in the Throat Area forms a small segment of a larger cycle journey and the relatively steep incline can be easily anticipated by regular commuters.

The following guidelines should be considered when designing for this user group:

- 2-3% grade is an acceptable incline for most pedestrians and cycle commuters,
- Ramps of a 3-4% percent grade (and above) feel like a formidable climb, however are permissible in short intervals. Both are illustrated in Figure 1, along with other acceptable forms of vertical circulation. Figure 2 illustrates a line-of-best-fit for the ideal grade and the range of acceptable upper and lower limits.
- On-deck space provisions for bikes and pedestrians should be clearly marked and have a combined width of at least 12 feet.

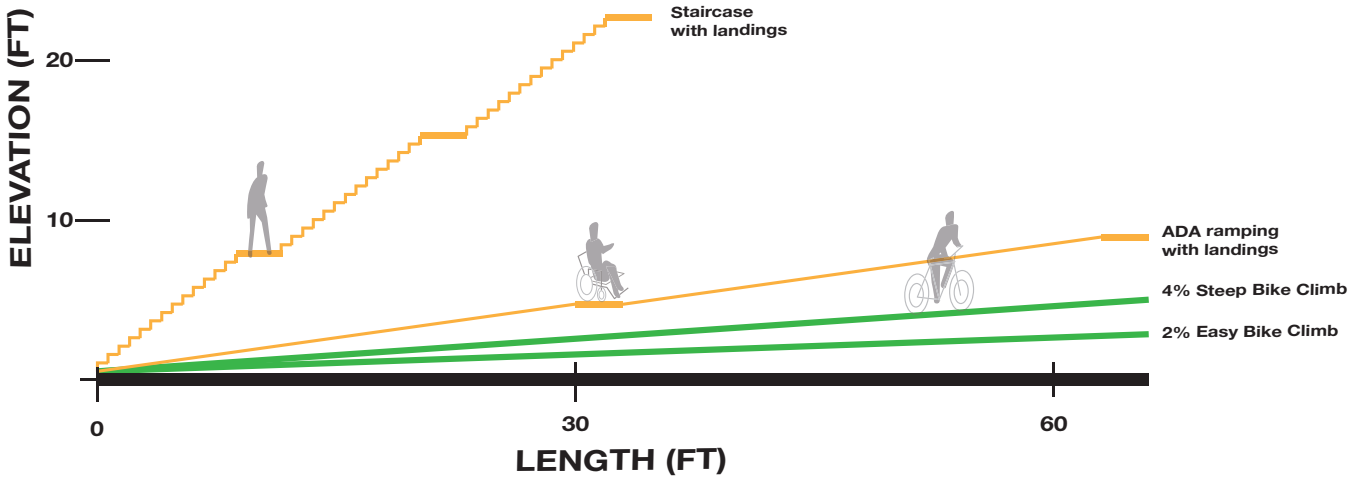


Figure 1 - A diagram of bike and pedestrian vertical circulation

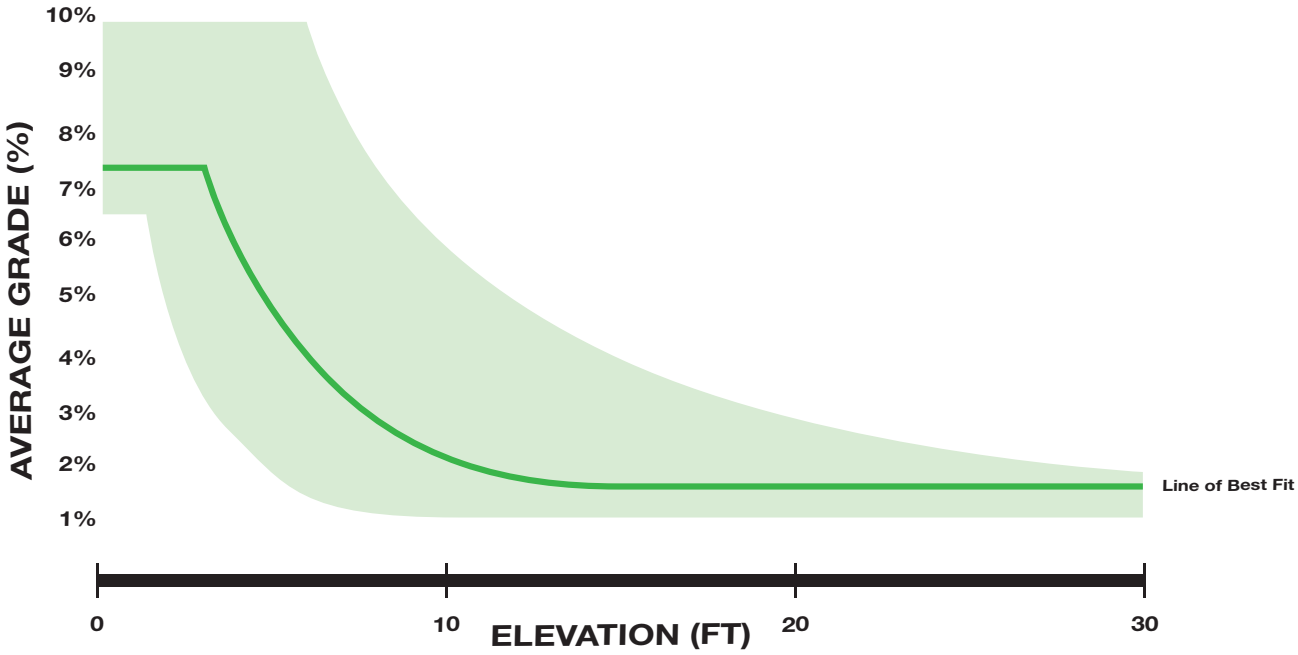


Figure 2 - A line-of-best-fit diagram based on several previously published Dutch studies on bicycle grades. Source: Brief Dutch Design Manual for Bicycle and Pedestrian Bridges (2015), ipv Delft,

Structural Design Driven by Desired User Experience

At this early concept stage, the design team was driven by the idea of an elevated urban park that supported healthy trees. Trees and vegetation provide many benefits such as shade, screening, air quality improvement, micro-climate control, and improved quality of user experience.

The need to support trees drove structural design. Trees require substantial soil volumes, which when saturated with water, become heavy and must be accounted in the structural design. The structural design had additional requirements, such as:

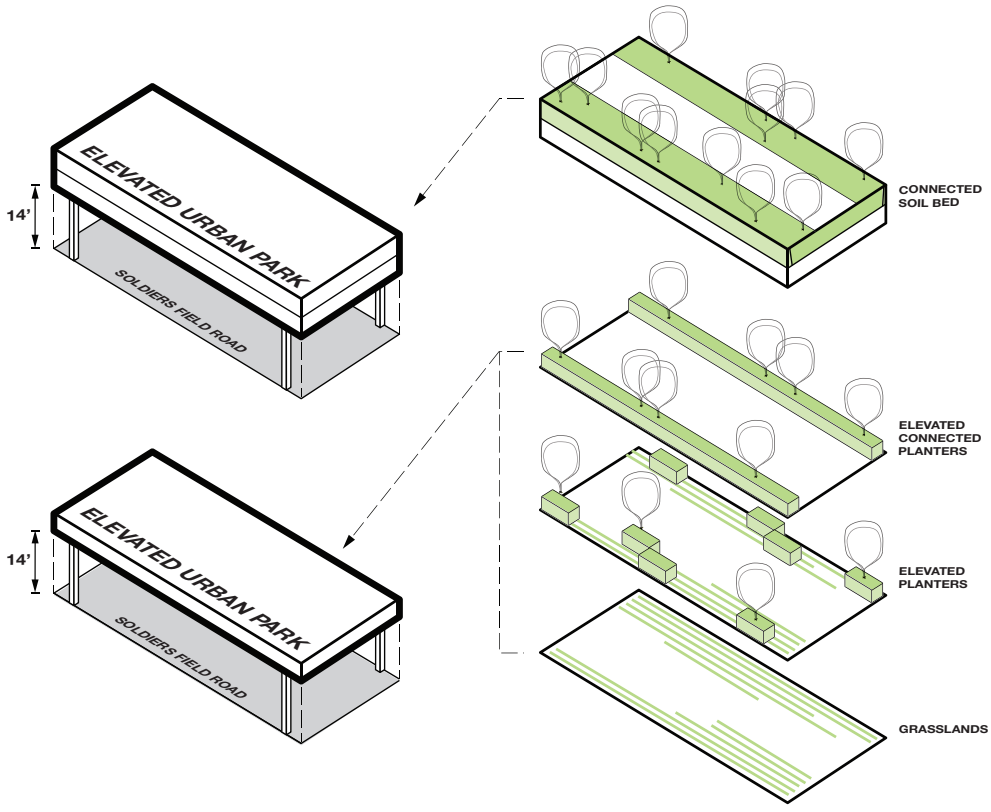
- Provide adequate vertical clearance above Soldiers Field Road, and
- Minimize path structure height to lessen visual impact and reduce the length of ramp run and grade at vertical circulation points.

The team developed two design typologies to study the feasibility of two elevated path scenarios: one that can support a full soil bed for planting trees and vegetation across the deck, and the other that supports trees and vegetation in elevated planters.

The first typology supports a full soil bed and allows the most flexibility in landscape design. This typology allows for connected root networks and denser vegetation that boosts local biodiversity. The added weight results in an

Typology 01:
Full Soil Bed Option

Typology 02:
Elevated Planter Option



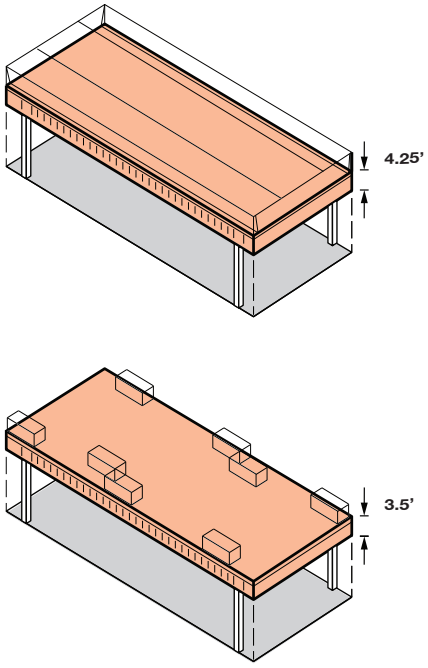
increase of structure depth, with a path structure height of 22.25 feet.

The second typology supports landscaping in elevated planters and has some flexibility in landscape design. Design options include linear tree canopies of connected planters, trees within individual planters, and grassland schemes.

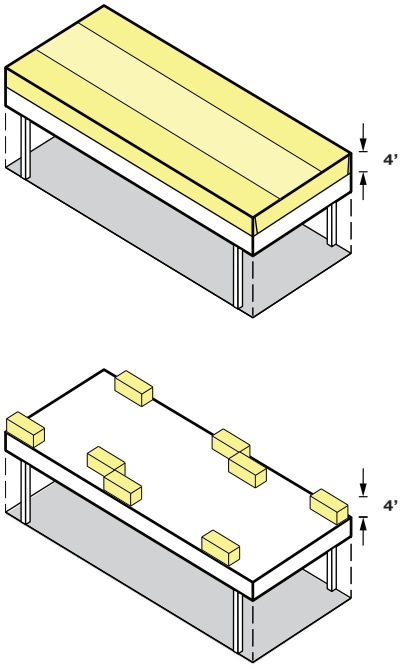
By distributing the weight at distinct points, the supporting structure may be reduced to a depth of 3.5' and have a path structure height of 17.5 feet. The lower height reduces the length of ramp run and grade at vertical circulation points.

There is a 4.75' difference in total path structure height between the two design typologies.

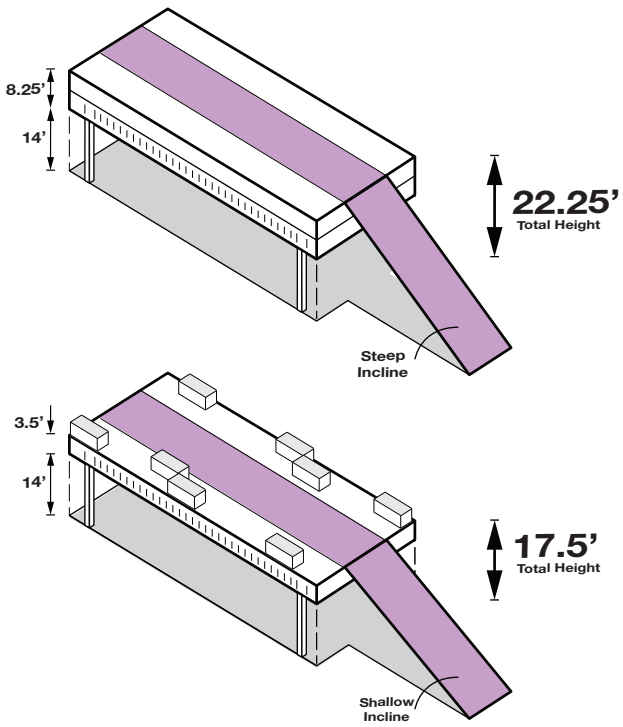
Structural Depth



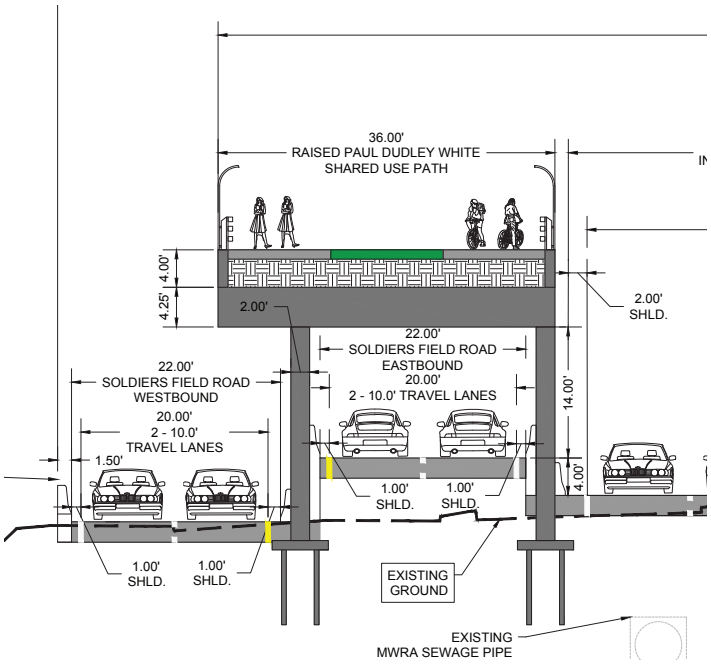
Soil Volume



Path Structure Height

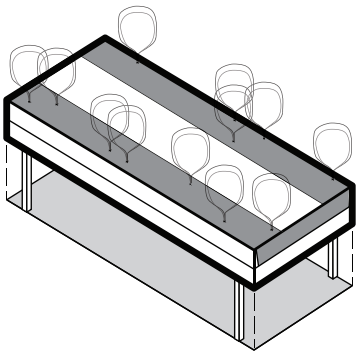


Typology 01: Full Soil Bed Option

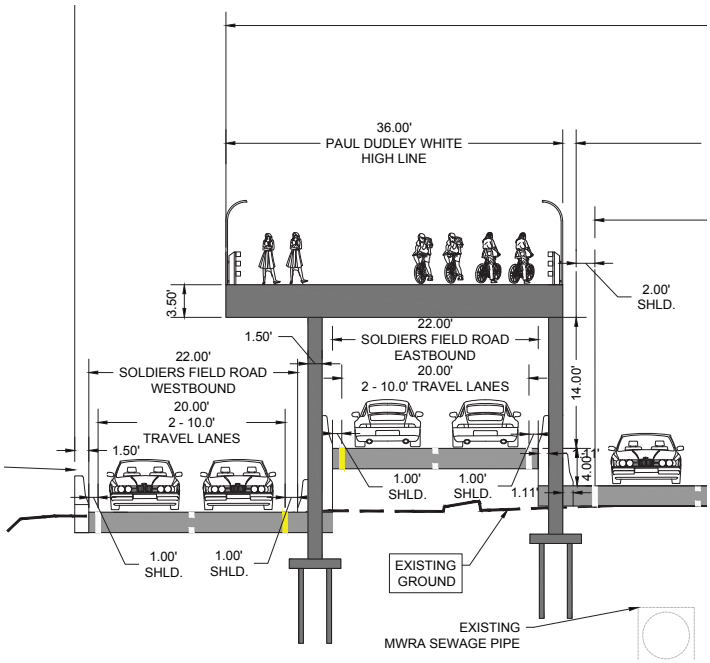


The concept was inspired by Barcelona's Raised Gardens in Sants (pictured below) and has the following key features:

- Utilizes a full soil bed that runs along the span.
- Provides most flexibility for landscape design can accommodate denser vegetation.
- Increased height which impacts the vertical circulation design.

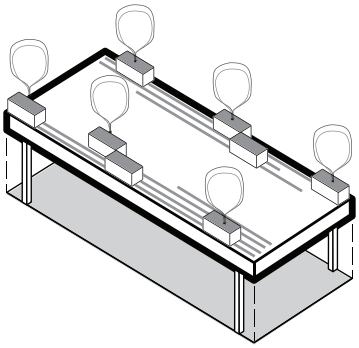


Typology 02: Elevated Planter Option



The concept was inspired by New York City's High Line (pictured below) and has the following key features:

- Utilizes elevated planters.
- Provides some flexibility for landscape design with continuous planter or intermittent planter options.
- Lower height which reduces the length of ramp run and grade at vertical circulation points.



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Benchmarking Study

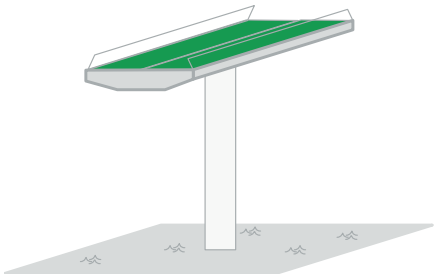
More than half of the global population lives in urban environments. As our cities continue to densify, cycling and walking networks are fast becoming critical transportation infrastructure, as they connect compact destinations in an engaged manner, promote physical activity, and reduce auto-dependence.

This benchmarking study investigates six world-class active mobility infrastructure projects. The team reviewed projects that had similar physical characteristics and use requirements as the Elevated Paul Dudley White Path in the Throat Area; the projects are elevated structures and support active mobility users.

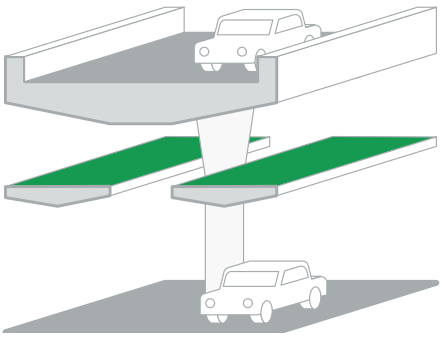
The projects show a spectrum of elevated active mobility corridor typologies. They range from dedicated cycle viaducts, walking and cycling structures underneath transportation viaducts, urban parks created from repurposed infrastructure, and decked open spaces above transit routes.

The following are the six global benchmarking projects featured in this section:

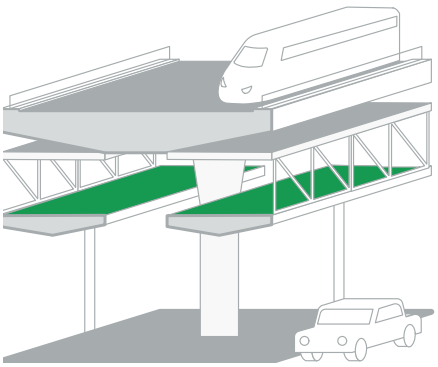
- **Cykelslangen**, Copenhagen, Denmark
- **Xiamen Bicycle Skyway**, Xiamen, China
- **Bangkok Elevated Skyway**, Bangkok, Thailand
- **The High Line**, New York, New York
- **The 606 Park**, Chicago, Illinois
- **Raised Garden of Sants**, Barcelona, Spain



Cycle Viaduct

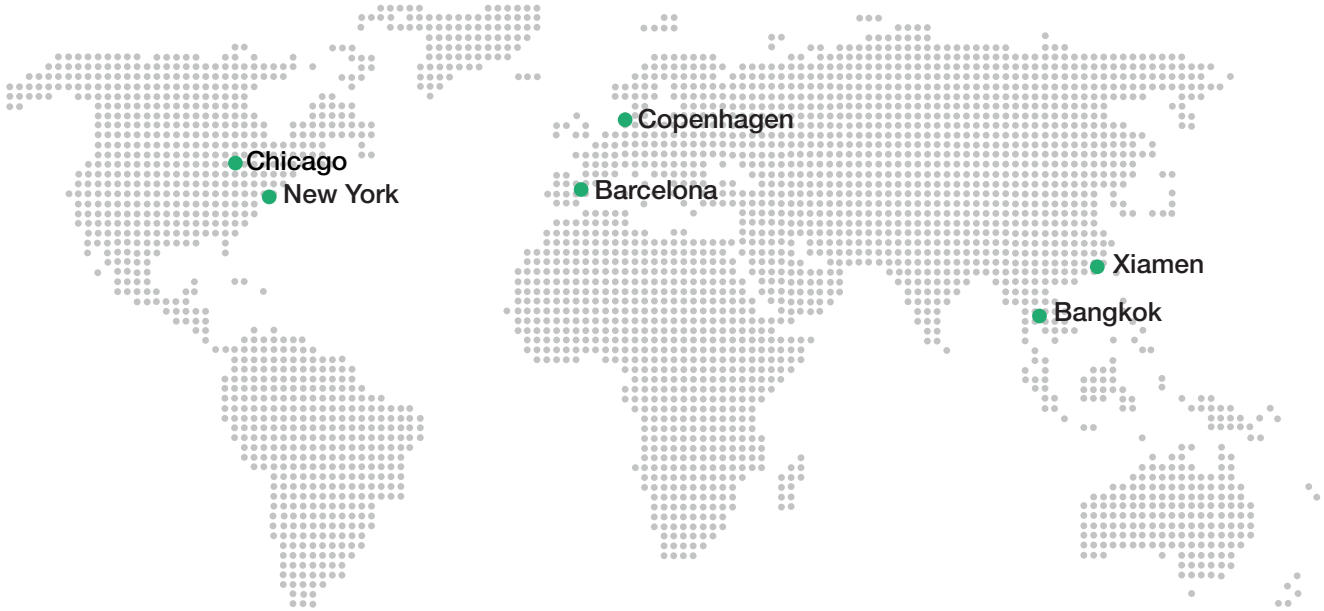


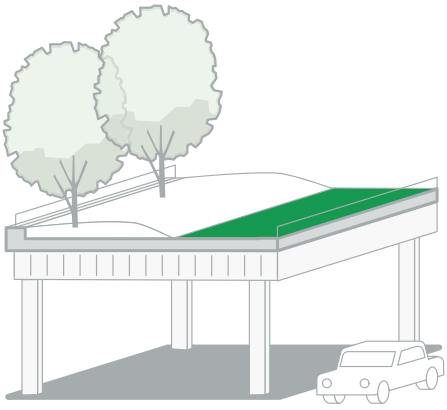
Elevated Cycleway



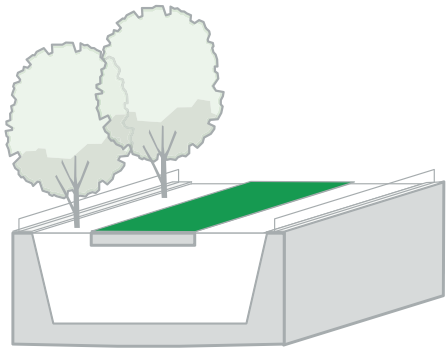
Elevated Walkway

Typologies of elevated structures that support active mobility users

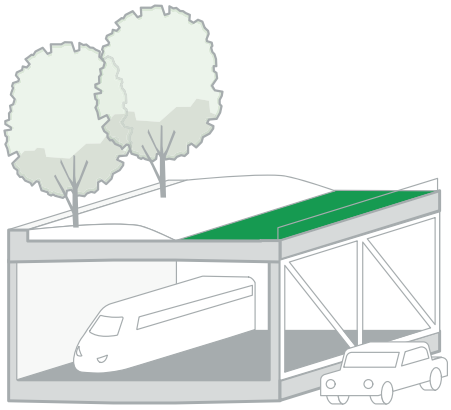




Urban Park & Walkway



Urban Park, Cycle & Walkway



Urban Park above Transit

1 Cykelslangen Bicycle Snake

An elevated cycle viaduct over water.

Location

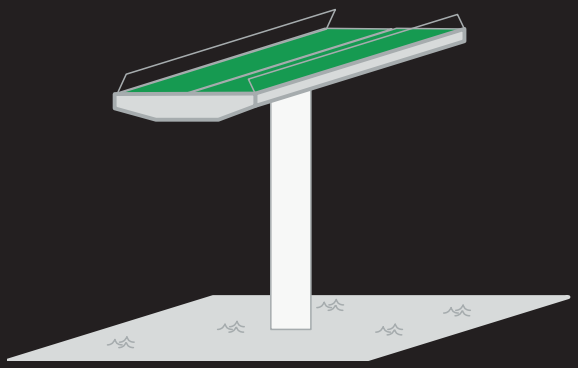
Copenhagen, Denmark

Metrics

Length: 0.1 miles
Profile Width: 15 ft
Elevated Height: 20-24 ft

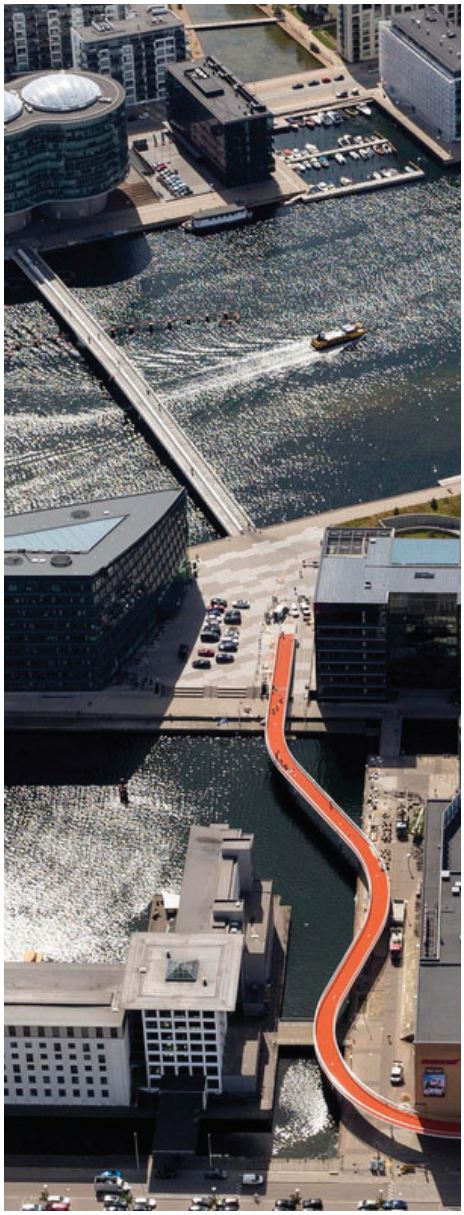
Structure

Prefab concrete structure



Project Description

The elevated Cykelslangen or 'Bicycle Snake' is a two-lane, dedicated cycle viaduct structure located in Copenhagen's inner harbor. It is a crucial link in the 'super bikeway' network providing a direct cycle route above pedestrian plazas, rail corridors, highway infrastructure, and the canal.



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2 Xiamen Bicycle Skyway

An elevated cycle network in the heart of the Xiamen city.

Location

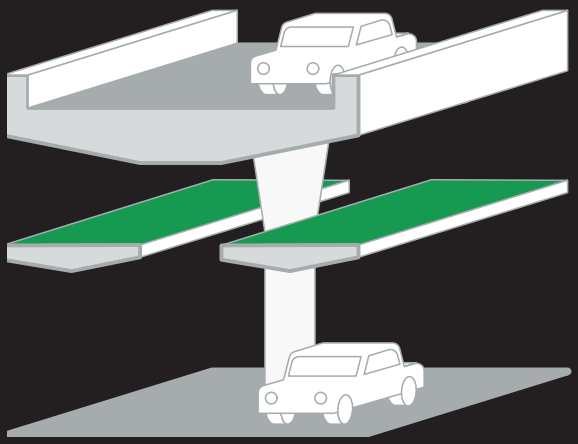
Xiamen, China

Metrics

Length: 5 miles
Profile Width: 10 ft
Elevated Height: 22 ft

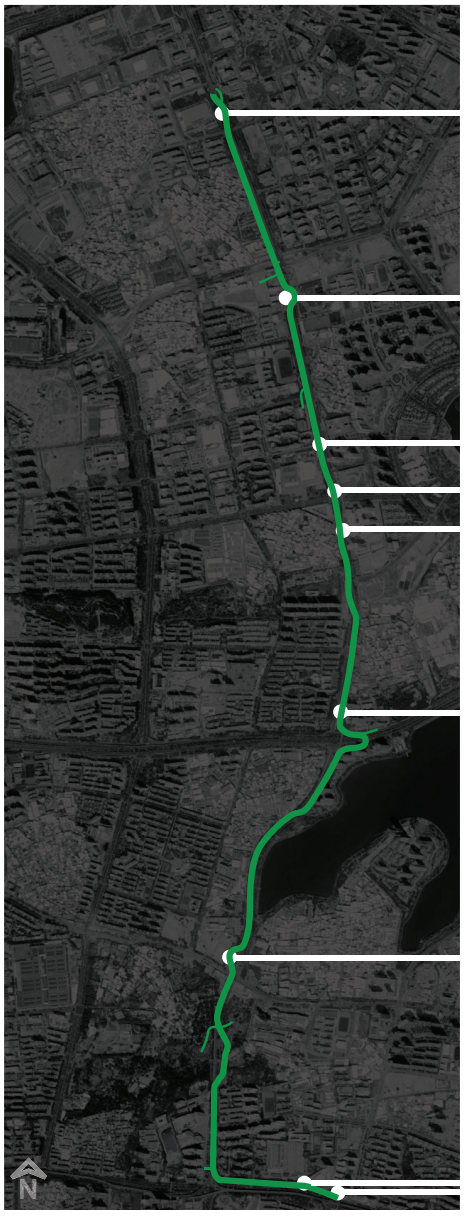
Structure

Prefab concrete structure



Project Description

The Xiamen Bicycle Skyway is the longest elevated cycle structure in the world, and routes alongside the BRT corridor that connects major residential and business districts. Utilizing a series of pedestrian bridges, and curved ramping the path joins 11 BRT stations, two subway stations, as well as bike share and bike parking facilities.



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3 Bangkok Elevated Skyway

An elevated pedestrian walkway underneath the metro viaduct.

Location

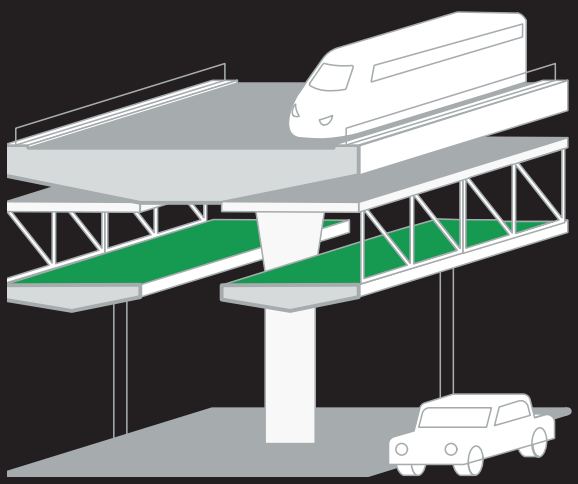
Bangkok, Thailand

Metrics

Length: 0.7 mile

Structure

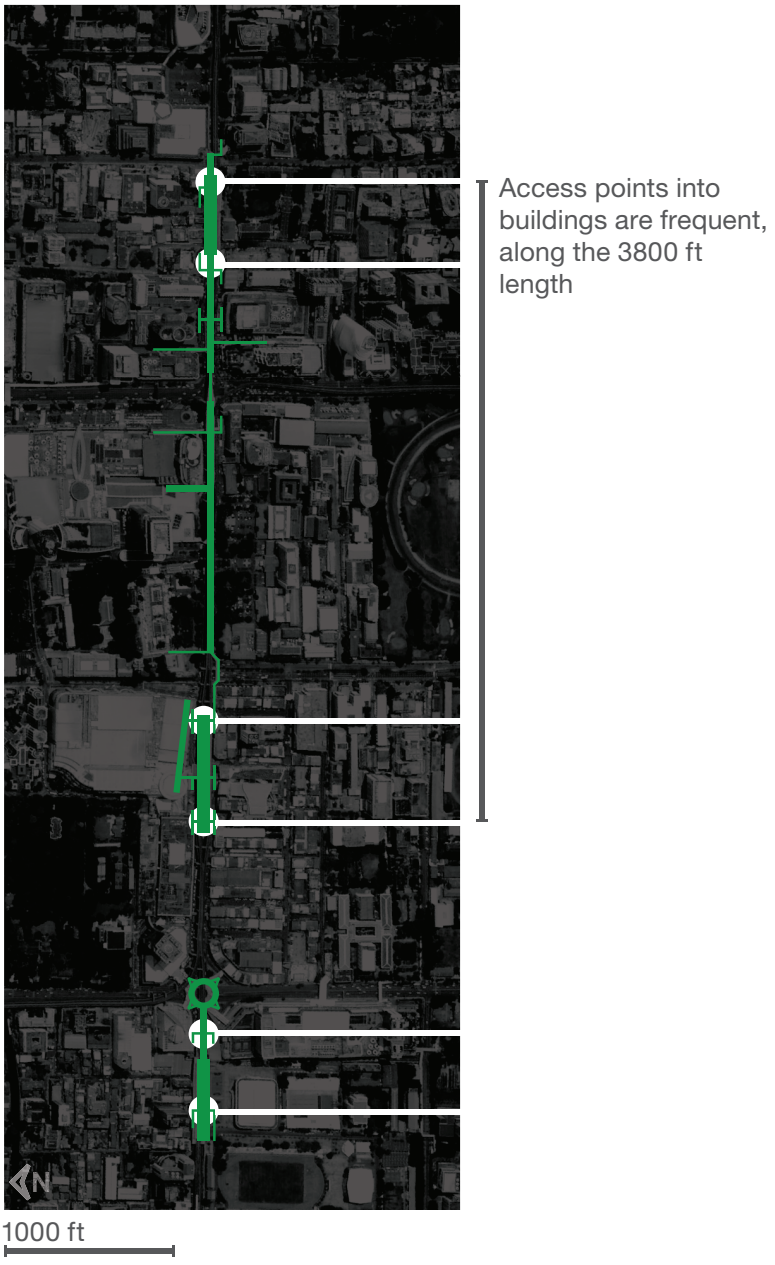
Prefab concrete structure



Project Description

The Bangkok Elevated Skyway is a series of pedestrian walkways located above street level, and underneath the Bangkok Mass Transit System (BTS) viaduct.

Pedestrian bridges and elevated public plazas connect shopping malls and public institutions to the transit stations.



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4 The High Line

An elevated urban park created from a repurposed freight rail line.

Location

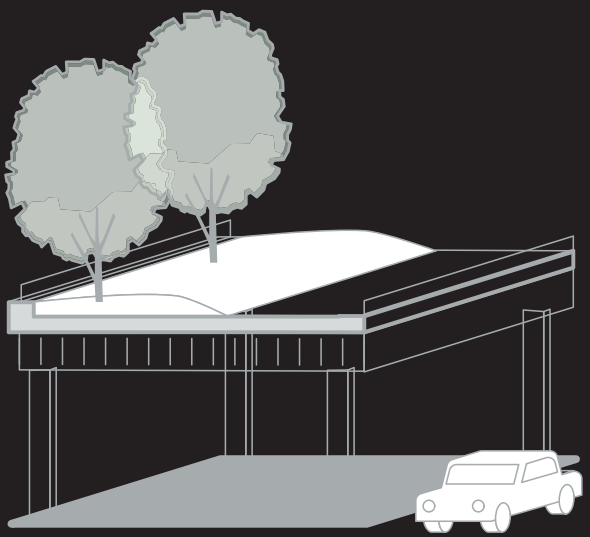
New York, New York

Metrics

Length: 1.45 miles
Profile Width: 30-50 ft
Elevated Height: 18-30 ft

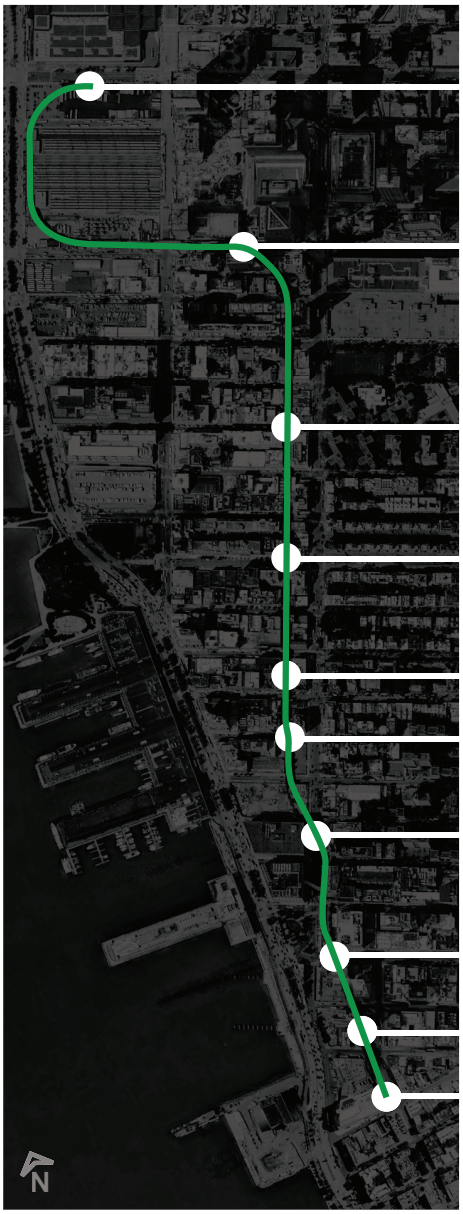
Structure

Riveted-steel structure



Project Description

The High Line is an urban park created from a repurposed elevated freight rail structure. Along with rezoning frameworks, it catalyzed urban renewal and intensified development in Manhattan. The park is designed for local residents and visitors alike; providing areas for recreational activity, events, performances, and public art.



Access points located at approx. 200 ft intervals

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5 The 606 Park

An elevated shared space created from a repurposed rail line.

Location

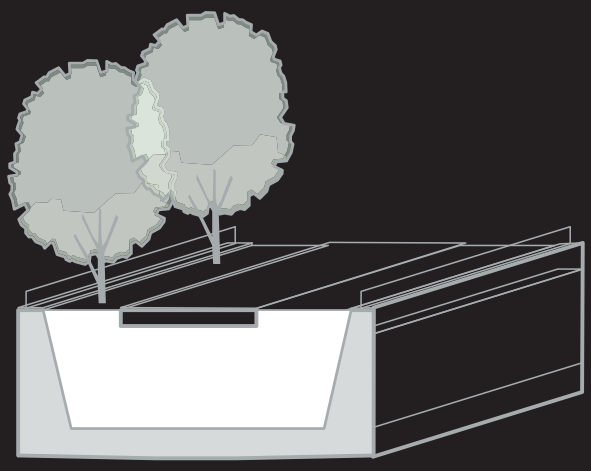
Chicago, Illinois

Metrics

Length: 2.7 miles

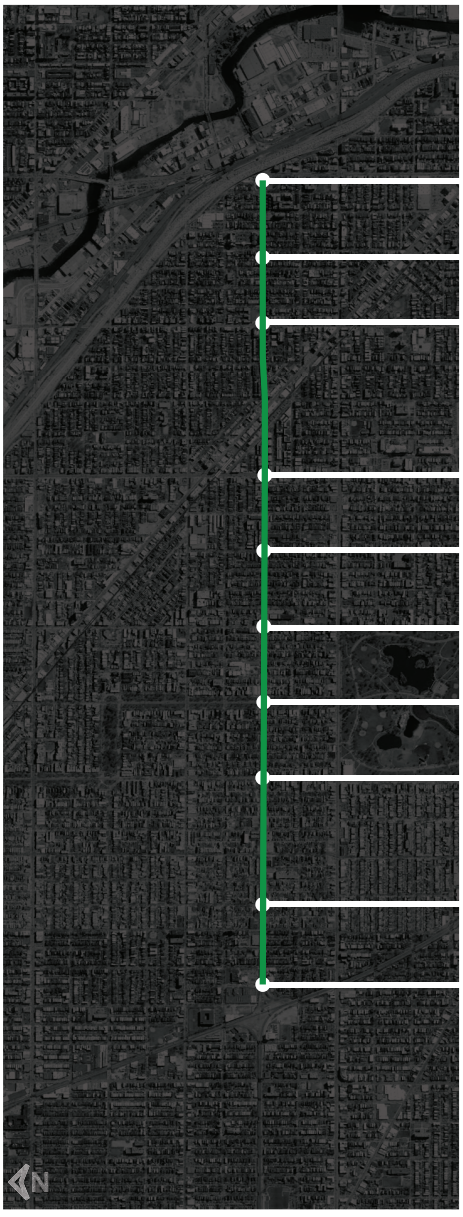
Structure

Mounded earth with prefab retaining walls



Project Description

The 606 is a landscaped urban park for pedestrians and cyclists that connects six smaller parks, and supports neighborhood activities and events. Built on a former elevated freight line, the park serves to connect and revitalize several residential neighborhoods in northwestern Chicago.



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6 Raised Gardens of Sants

An elevated urban park built above a commuter rail and metroline.

Location

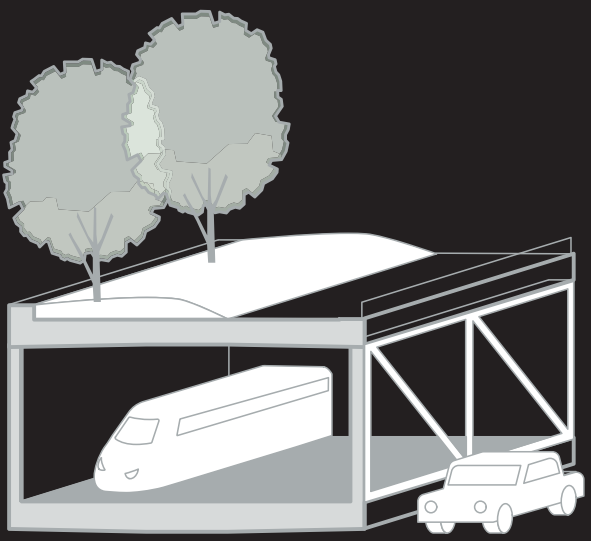
Barcelona, Spain

Metrics

Length: 0.5 miles
Profile Width: 30-40 ft
Elevated Height: 12-20 ft

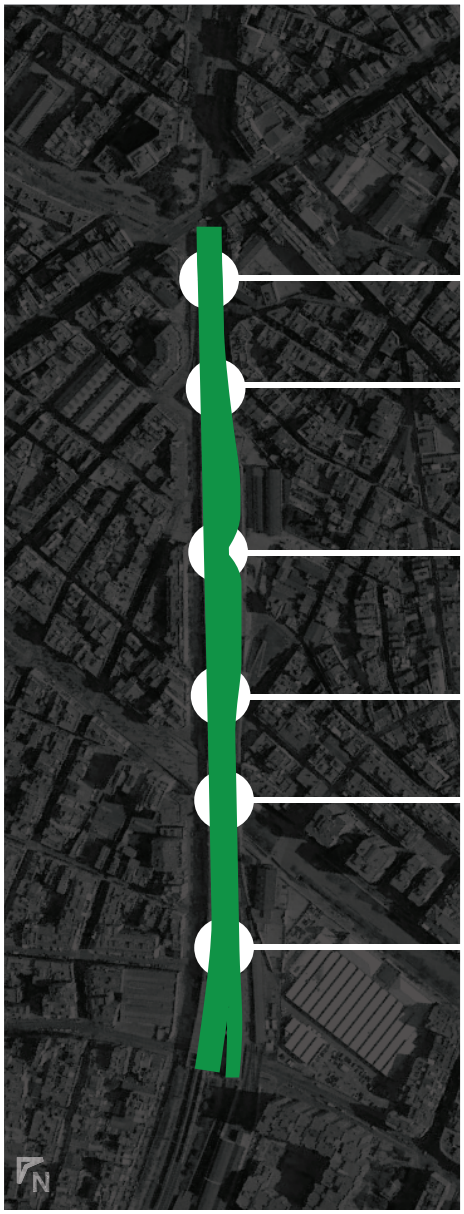
Structure

Prefab concrete structure



Project Description

The Raised Gardens of Sants, is an elevated urban park above a segment of the metro corridor, located in Barcelona's Sants neighborhood. It forms part of a larger 3 mile active mobility corridor, and utilizes elevators, ramps, staircases and escalators to connect into the neighborhood.



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