

Rail Industry Spotlight

Digital Tools and Immersive Experience Technology

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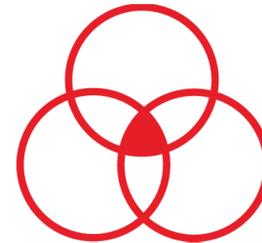
Major projects face unique challenges



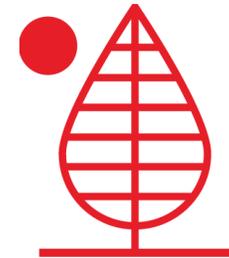
**Budget and schedule
overrun risk**



**Managing multiple
stakeholders and
contractors**



**Ensuring compliance and
quality of work**



**Positive contribution to
communities and climate**

Digital solutions enable faster and better outcomes through centralized, efficient access to accurate, timely information to align stakeholders and support decision making.

Digital toolkit evolves over time

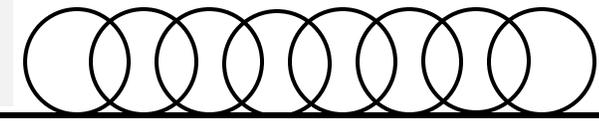
Eglinton Crosstown West Extension

- Extends Eglinton Crosstown LRT approx. 9.2km with 7 new stations.
- Arup serving as Technical Advisor including preliminary engineering, procurement support, and design and construction oversight.



Digital Inception Workshop
 Collaborative workshop including all stakeholders to identify pain points and priorities for digital solutions.

Digital Strategy Check Ins
 Monthly or quarterly meeting between client and Arup digital team to review work done and align on priorities



Project Start

Project Drivers

Automating and optimizing current processes for document submission and tracking

There is an opportunity to automate processes and leverage the current tools such as Excel Sheets or ProjectWise that are currently done manually.

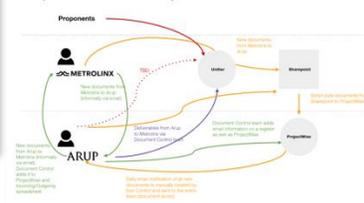
Responding to a large number of incoming documents or submittals in a timely fashion

Arup is preparing to enter a phase of procurement that will entail the reception of a large number of documents from proponents including RFIs and submittals.

Developing ways of working that are compatible with client systems

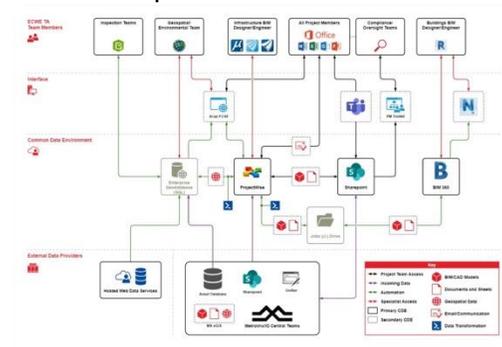
The Arup team has had experience in the design role, serving as a consultant to Metrolinx and using internal systems for tracking internal performance. With the start of a new role as Procurement and Construction Advisors, Arup will work "on the client side" and will need to understand how to integrate the systems that the client has made available for submittals and RFIs, namely Unifer.

Project Information Management Workflow



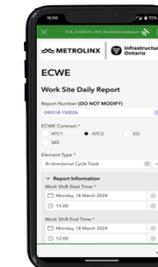
Current state, pain points, and opportunities

Day 1 Digital Tools

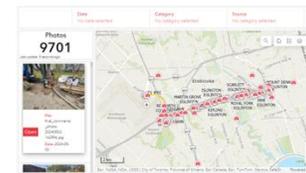


Common Data Environment, existing conditions, automations

Timely Release of New Functionality



Tunnel Boring Machine position



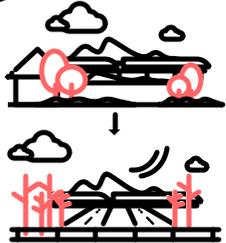
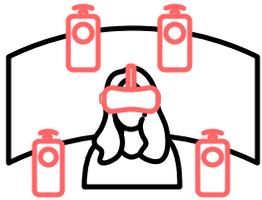
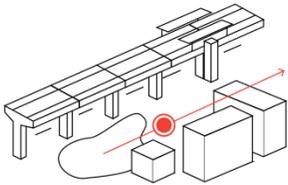
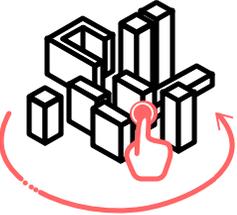
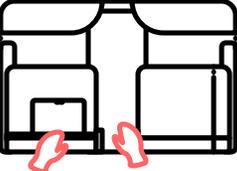
In Progress Site photos

Digital strategy revisited to meet project needs as new pain points are identified

Goals + KPIs

Immersive Experience technology

Supporting client and stakeholder engagement

<p>1</p>  <p>Architectural Rendering</p> <ul style="list-style-type: none"> Architectural renders 	<p>2</p>  <p>Verified Photographic Views</p> <ul style="list-style-type: none"> Existing conditions Construction operations 	<p>3</p>  <p>Photographic Aerial Route Animation</p> <ul style="list-style-type: none"> Clear Route and Contextual Communications Broadcast Media Communication 	<p>4</p>  <p>Verified Immersive experience</p> <ul style="list-style-type: none"> View & Acoustics SoundLab Experience Lab 	<p>5</p>  <p>Verified Kinetic experience</p> <ul style="list-style-type: none"> Station & Route Experience <ul style="list-style-type: none"> Stations Travel along Elevated Guideway through Eglinton Flats 	<p>6</p>  <p>3D Route & Context Interactive Model</p> <ul style="list-style-type: none"> Interactive Bird Height Collaboration Toolsets Embed Other Media from Toolkit 	<p>7</p>  <p>Passenger Experience</p> <ul style="list-style-type: none"> Station & Route Experience <ul style="list-style-type: none"> Stations Travel along Elevated Guideway through Eglinton Flats
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Community Engagement

Yonge North Subway Extension

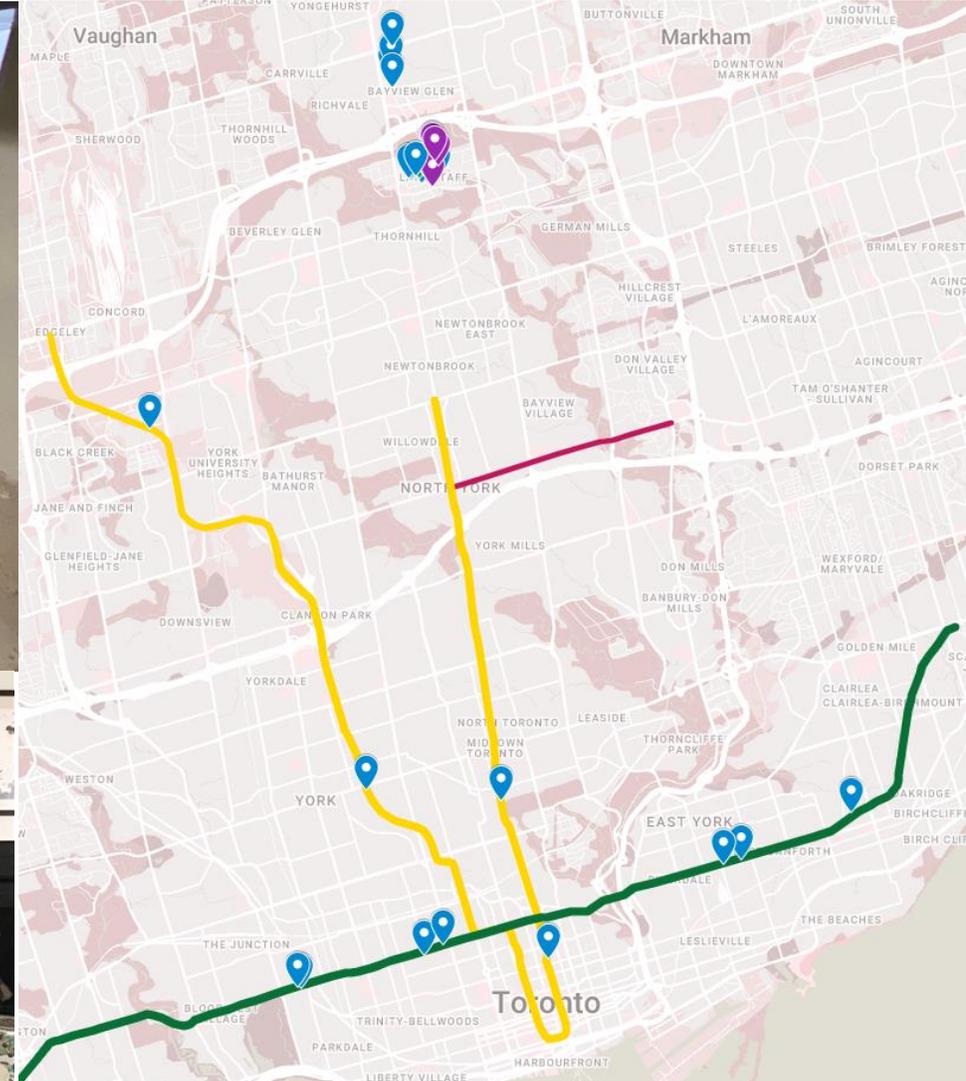
- Community engagement is critical to gain project support and minimize opposition
- Public was concerned about noise and vibration that subways operating beneath their homes may cause
- Providing advanced research and transparency was used to help educate public on actual impacts expected



Community Engagement

Data Driven and Informative

- Arup collected extensive audio and vibration measurements at various locations across Toronto
- Enabled technical assessment of the actual impact from an operating subway at proposed locations



Community Engagement

Immersive and Informative

- Collected data and analysis was then made accessible to the public
- Outreach centers enable concerned citizens an opportunity to experience what the future subway would feel like

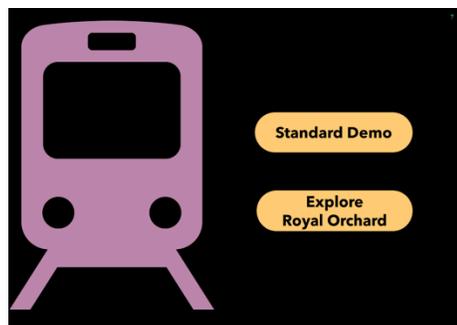
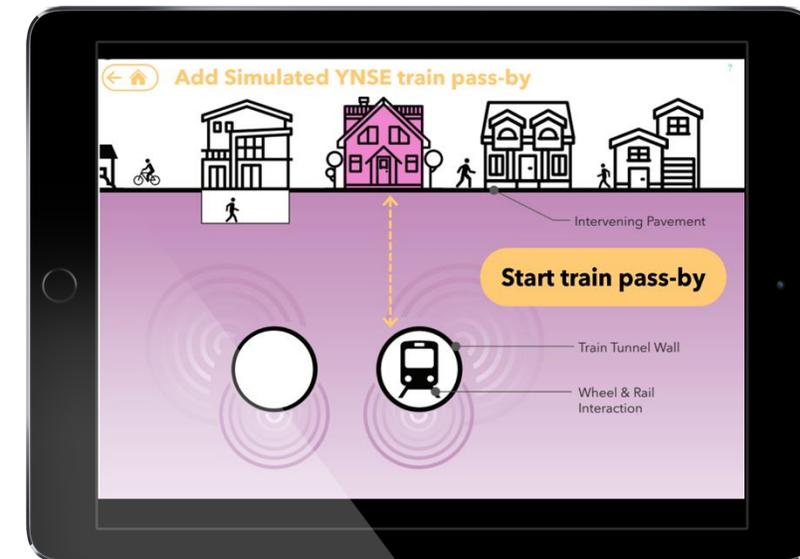
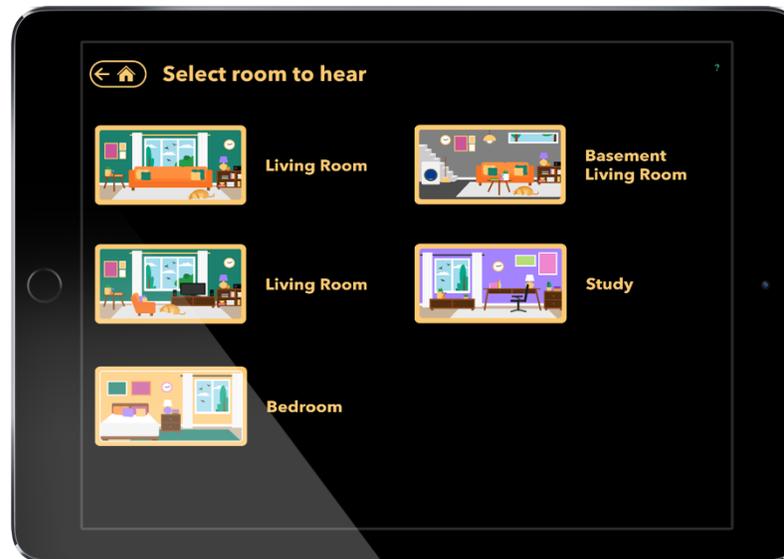
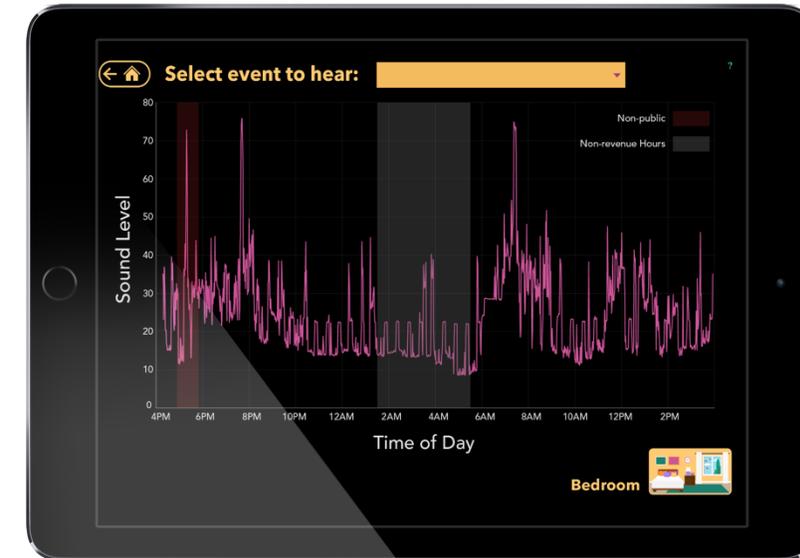
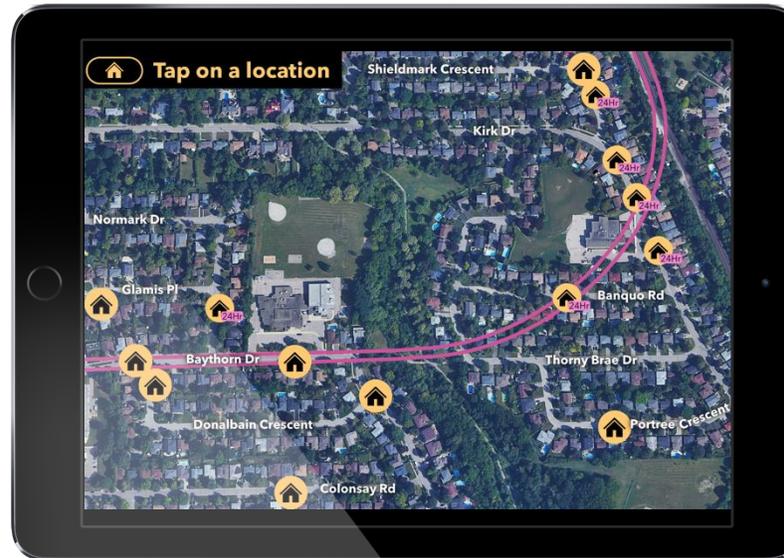


Stereo camera, 360 field acoustic recording, and Leica Total Station for geo positioning

Community Engagement

Interactive iPad demonstrations

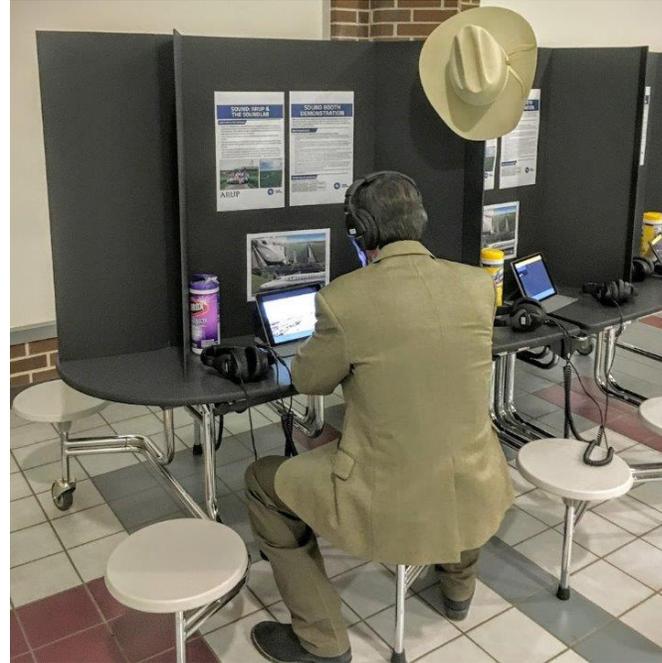
- iPad demonstrations
- High quality headsets
- Multiple locations of interest



Community Engagement

Immersive audio experience - Texas HSR

- Education is the best method to ensure public and private buy-in.
- Outreach must reach public in a variety of formats, from executive board meetings to government agencies or public forums.
- Mobile Sound Labs for public meetings along corridor based on recordings in Japan and Texas



ARUP



Community Engagement

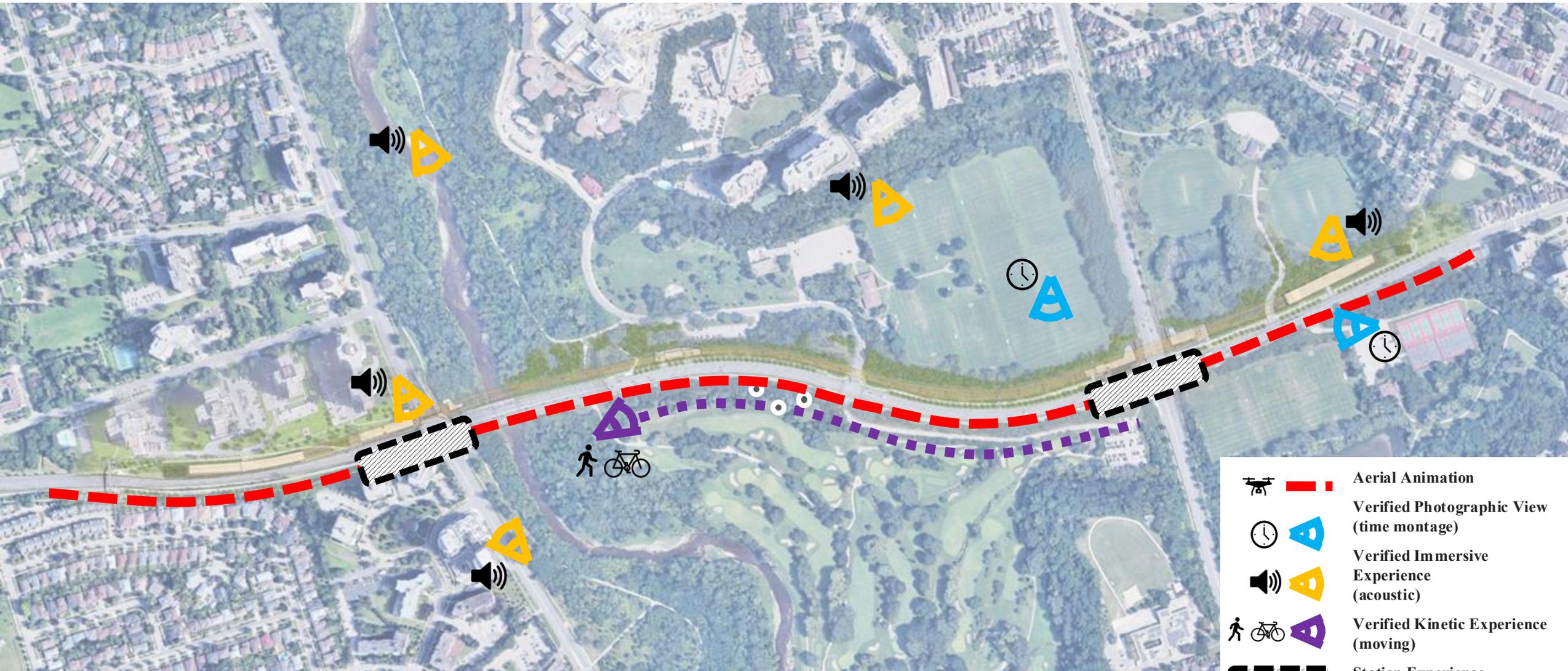
Full Immersive Experience for HS2 in London

- Advanced mobile sound and vibration labs
- Bringing it all together with a virtual train with vibration/motion platform integration
- Demonstrating the experience and ride quality to people inside with full immersion



Immersive Experiences

Eglinton Crosstown West Extension - Toronto



-   Aerial Animation
-   Verified Photographic View (time montage)
-   Verified Immersive Experience (acoustic)
-   Verified Kinetic Experience (moving)
-  Station Experience (for SRS)



1000

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EXPERIENCE ECWE

You are about to experience simulations of the Eglinton Crosstown West Extension over 4 timeframes: today, during construction, 5 years, and 30 years in the future.

These simulations were produced by acoustics and visualization professionals using data collected from existing rail lines. Pay attention and listen closely to the changes in landscape and soundscape.

ARUP



“I have deep respect and appreciation for Arup as a firm...Really impressed with the acoustics work you are doing with us. Loved the SoundLab and want it to be central to our stakeholder engagement.”

Phil Verster, Former President & Chief Executive Officer, Metrolinx.