BART Climate Resiliency Planning

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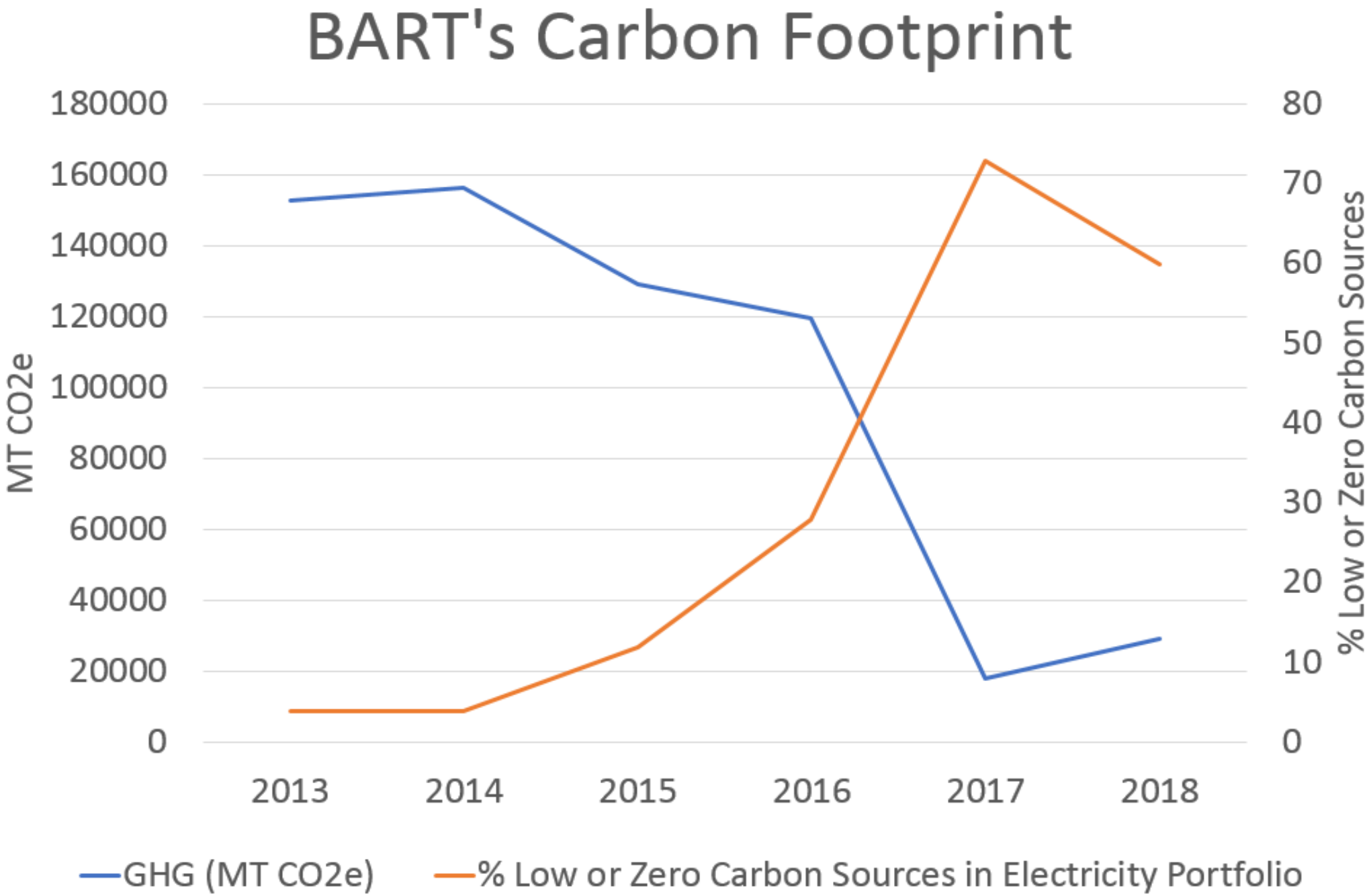
BART Climate Action: Land use

Cumulative TOD Projects

2020 is estimated based on projects under construction

BART Climate Action: GHG Reduction



BART Progress on Climate Resiliency

2012- Climate Change Adaptation Pilot

Transit specific, national context, FTA fund

2014 - Climate Change & Extreme Weather Adaptation

Transportation in scope, regional context, FHWA fund

2016 - Local Hazard Mitigation Plan

Agency specific, BART fund

2018 - BART Sea-level Rise & Storm Surge Resiliency

Transit specific but inter-agency, Caltrans fund

FTA Project: Developed Approach & Process

- **Element 1 – Climate Hazards in the Bay Area**
  - Sea Level Rise, Downpour & Flooding
- **Element 2 – Vulnerability and Risk Assessment**
- **Element 3 – Adaptation Strategies**
  - Global Rail Sector Climate Adaptation Strategies
  - Adaptation Strategies
  - Prioritizing Adaptation Strategies
- **Element 4 – Links to BART Organization and Practices**
- **Element 5 – Asset Management and Life-Cycle Cost Analysis**

FTA Project: Focus on BART's Critical Assets

FHWA Project: Regional Approach

- **Core Transportation Assets**
  - Drainage System Modifications
  - Update Emergency Management Plans
  - Relocation/Replacement/Enhancement
  - ITS Solutions
- **Focus Area**
  - Levees
  - Shoreline Protection (berms)
  - Natural and Engineered Solutions
- **Agency Specific**
  - Information Databases
  - Coordination
  - Strategies that can be integrated into normal maintenance

Team work of BART, MTC, BCDC, and Caltrans

Sites included Route 92, Bay Bridge Touch Down and Coliseum Area

Caltrans Project: SLR & Storm Surge Resiliency

YEAR 2050 (>5 ft)

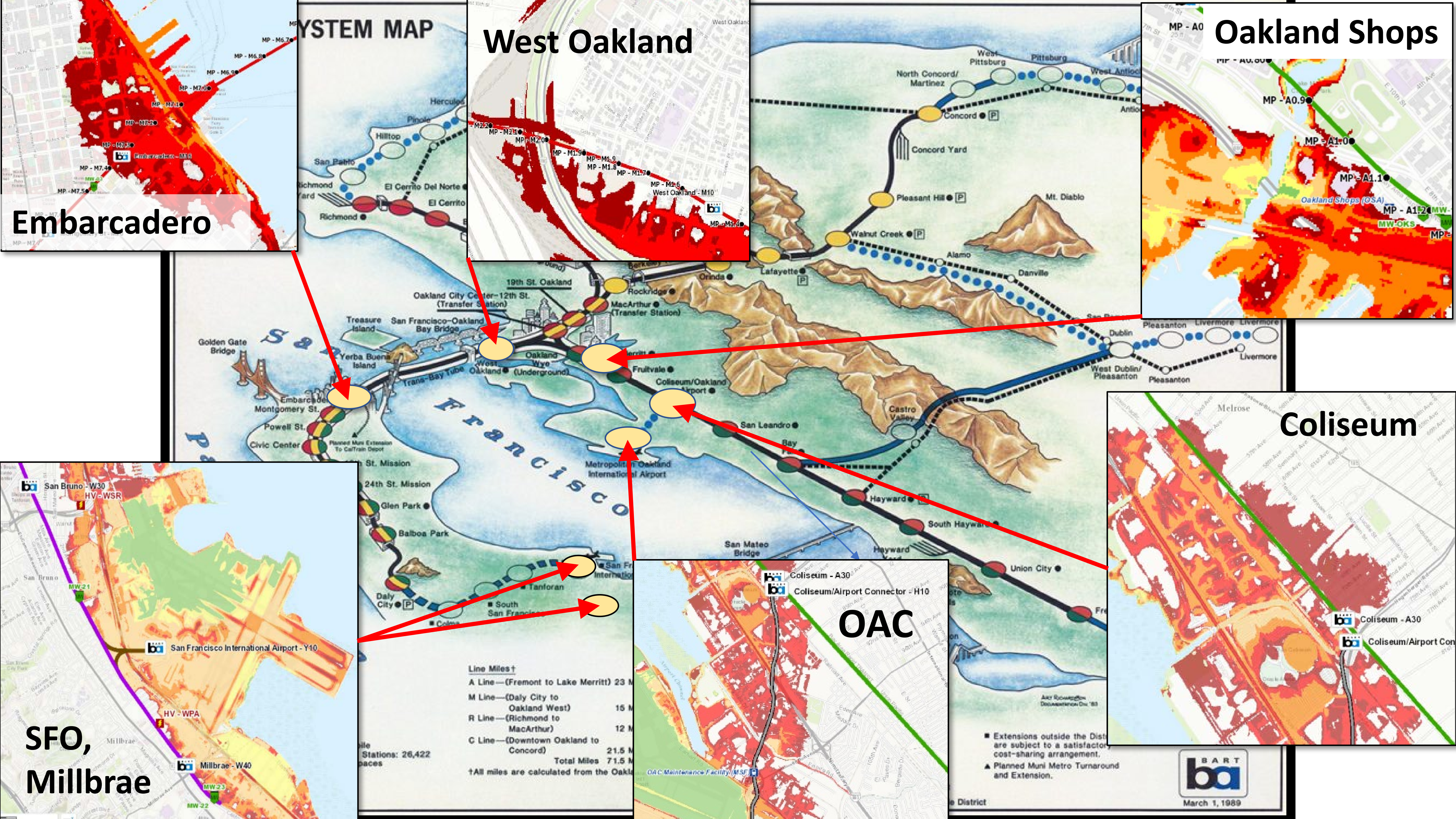
1.9 ft* + ~3.5 ft** = 5.4 ft

YEAR 2100 (10 ft)

82.8 inches + ~42 inches = 124.8 inches

Sea-level Rising (0.5% probability) + 100 year Storm = Water Level

- Project originally proposed using 50% probabilistic projection.
  Updated to 0.5 % based BART infrastructure's criticality.
  ** Based BCDC's Adapting To Rising Tide program



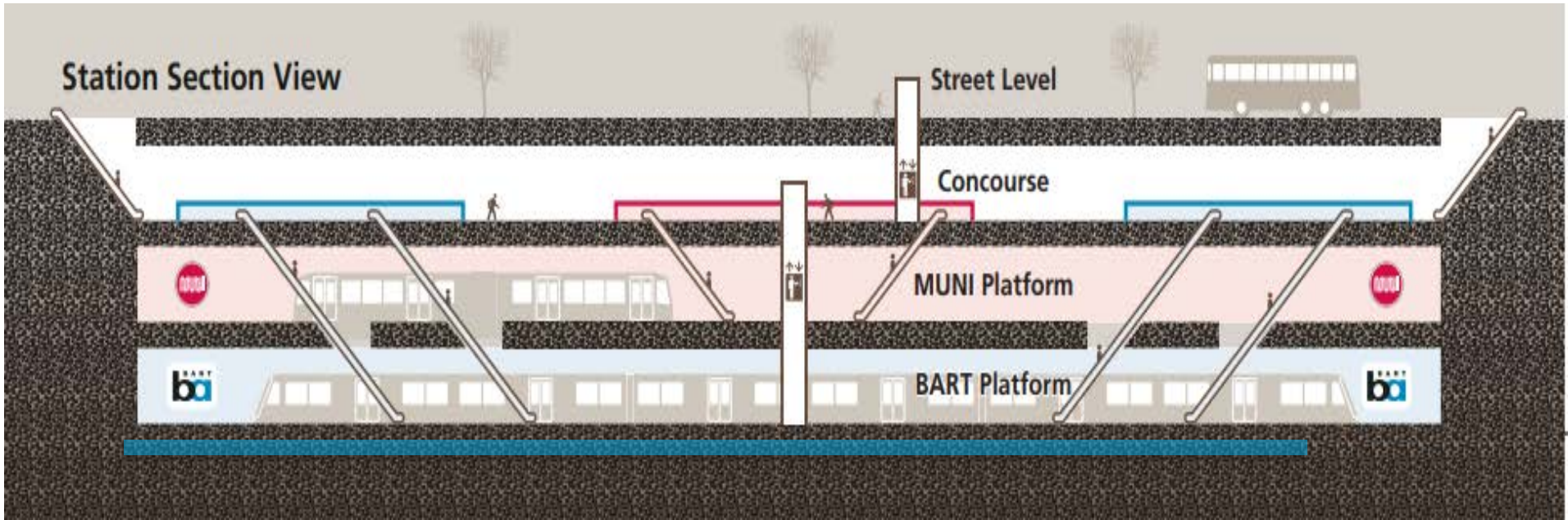
Embarcadero
West Oakland
Oakland Shops
Coliseum
OAC
SFO, Millbrae
SYSTEM MAP
Embarcadero - M16
West Oakland - M10
Oakland Shops (OSA)
Coliseum - A30
Coliseum/Airport Connector - H10
OAC Maintenance Facility (MSF)
San Bruno - W30
San Francisco International Airport - Y10
Millbrae - W40
Line Miles†
A Line—(Fremont to Lake Merritt) 23 M
M Line—(Daly City to Oakland West) 15 M
R Line—(Richmond to MacArthur) 12 M
C Line—(Downtown Oakland to Concord) 21.5 M
Total Miles 71.5 M
†All miles are calculated from the Oakla
Extensions outside the Dist are subject to a satisfactory cost-sharing arrangement.
Planned Muni Metro Turnaround and Extension.
March 1, 1989

Flooding Extent, 2050 (1-in-200) + 100yr

Note: Prior to catastrophic storm event, BART would evacuate and shutdown system.

~4 days

to pump out volume



Damage Assessment Approach

EXPOSURE

Exposure Choices	Description
Exposed	Asset comes in contact with water.
Not exposed	The asset does not come in contact with water. Some examples why this may occur: 1) asset is protected by a protective flood barrier or asset; 2) asset is elevated above the flood stage; 3) asset is not located in the flooding extent

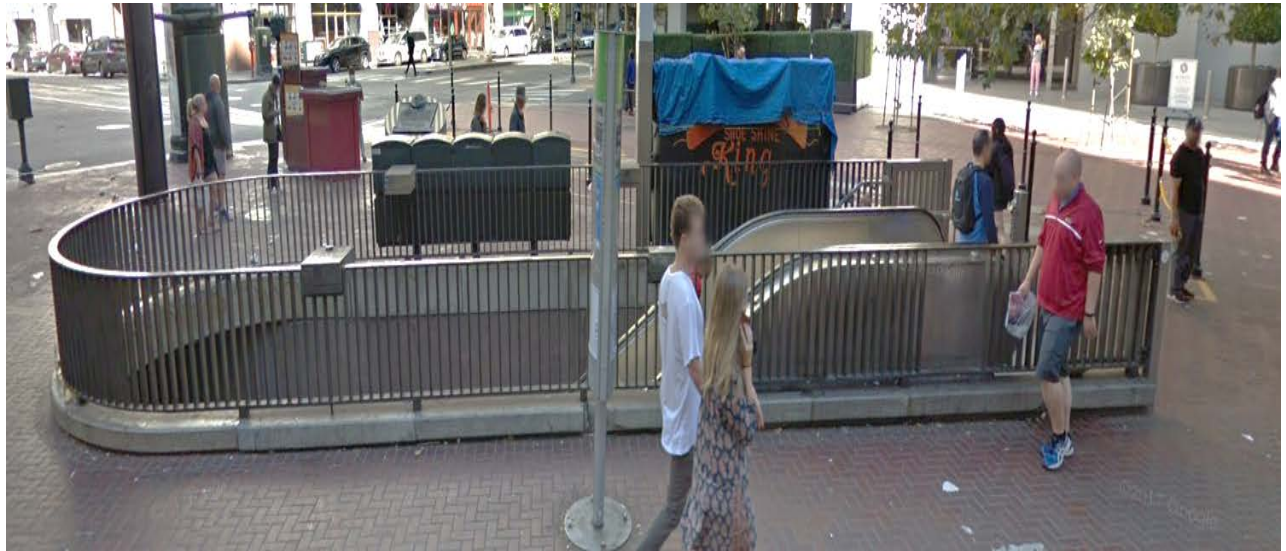
IMPACT

Impact Choices	Description
Need immediate repair/replacement	The asset is inundated in water or otherwise comes in contact with water. The asset is damaged requiring immediate repair or replacement in order for the asset to function. Repair/replacement may range from repair of a subcompent of an asset to wholesale replacement.
Functions but asset life shortened.	There are no immediate damages to the asset and can function after the event passes. However, the asset life is shorted and replacement of asset will be needed in the near term. An example of such an asset may be track due to the corrosive nature of the brackish water.
No impact	The asset is not damaged and can function immediately after the event after cleanup. Concrete structures for example may be resilient to flood impacts.

DAMAGE

Monetary Cost and Service Disruption

Embarcadero Station Site: Points of Water Entry



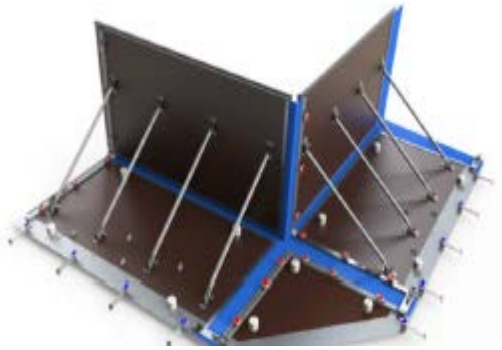
Embarcadero Station Site Adaptation Design

Deployable Cover

Tunnel Flood Shield

Raised entrance

Permanent flood wall with deployable shield



Temporary Flood Walls

BART Climate Resiliency Design

Powell Station Ceiling Water Intrusion Mitigation Project

Water intrusion through station box down into concourse level.

Pilot Repair

- Polyurethane Grout (Hydrophobic) – catalyst as agent
- Polyurethane Grout (Hydrophilic) – water as agent
- Elastomeric Polymer Rubber – suseptable to heat

Recommendation:

- Positive side curtain wall injection (Drill holes in pattern, inject till grout exits adjacent holes)
- Polyurethane Grout (Hydrophobic)

WMATA Station Water Intrusion

During

BART Facilities Standards BFS

Facility Design Criteria

Principles and recommendations for designing a functional facility based on good practices and BART's experience. Mandatory requirements for configurations and attributes required for facility safety, usability, operability and maintainability.

ARCHITECTURE

CIVIL

ELECTRICAL

- General
- Facilities Security
- Landscaping and Vegetation Control
- Maintenance and Engineering
- Passenger Stations
- Passenger Station Sites
- Police Department Facilities
- Resiliency Against Extreme Weather
- Revenue Processing Building