Draft as of 10/5/23

Prop L Sales Tax Program
Project Information Form (PIF) Template

San Francisco County Transportation Authority

Project Name and Sponsor			
Project Name:	Kirkland Yard Electrification		
Implementing Agency:	SFMTA		
Prop L Expenditure Plan Information			
Prop L Program:	06- Muni Transit Maintenance, Rehabilitation, and Replacement		
Prop L Sub-Program (if applicable):	N/A		
Second Prop L Program (if applicable):			
Project Information			
Brief Project Description for MyStreetSF (80 words max):	This project will undertake the design engineering and construction phases for the renovation and upgrade of the Kirkland bus maintenance facility and yard. The project plan involves retrofitting the Kirkland Facility to support the deployment of approximately 110 40-foot battery-electric buses by the end of 2027. This project is part of SFMTA's overall sustainable transportation plan in addressing climate change and environmental concerns.		
Project Location and Limits:	Kirkland Bus Yard is located located at 2301 Stockton Street and 151 Beach Street in the Fisherman's Wharf area adjacent to Pier 39. The site is bounded by Beach Street (to the north), Stockton Street (on its east), North Point Street (to the south) and Powell Street (to its west).		
Supervisorial District(s):	Citywide		
Is the project located on the 2022 Vision Zero High Injury Network ?	No	**Is the project located in an Equity Priority Community (EPC)?**	No
Which EPC(s) is the project located in?			
Detailed Scope (may attach Word document): Please describe in detail the project scope, any planned community engagement, benefits, considerations for climate adaptation and resilience (if relevant), and coordination with other projects in the area (e.g. paving, Vision Zero).	The Kirkland facility houses an aging diesel-hybrid fleet, which will be the first fleet scheduled to be entirely replaced with zero-emission vehicles. The project is part of SFMTA Strategic Plan to meet its goal to eliminate pollution and greenhouse gas emissions by moving away from diesel-hybrid buses and adopting zero emissions buses for Kirkland Facility. The project also meets another Strategic Plan goal by modernizing an aging facility which has outlived its intended useful life cycle and optimizing the Kirkland bus fleet with Battery-electric buses (BEBs) as well as facility infrastructure including the physical environment for its workforce of mechanics, operators, superintendents, and facility staff. The purpose of this project also is to meet the CARB (California Air Resource Board) Innovative Clean Transit (ICT) regulation to operate 100% zero transmission buses by 2040 and comply with the intent of the CARB ICT bus procurement requirements. See attached Detailed Scope for more information.		
Attachments: Please attach maps, drawings, photos of current conditions, etc. to support understanding of the project.	Attachment 1: Detailed Scope; Attachment 2: Pre-Development Report (PDR), April 2023; Attachment 3: Kirkland Project Information (short PPT); Attachment 4: SFMTA Battery Electric Bus Roll-Out Plan, July 2022; Attachment 5: SFMTA Zero Emission Transition Plan, May 2022		
Type of Environmental Clearance Required:	TBD		
Coordinating Agencies: Please list partner agencies and identify a staff contact at each agency.	SF Public Utility Commission (PUC); SF Port Waterfront Resiliency (Tim Doherty, SFMTA liaison); Pacific Gas & Electric (PG&E); SFMTA Environmental Review Team; SF Planning Department; NEPA Region 9 (environmental clearance); SF Department of Building Inspections (DBI); SF Fire Department (SFFD); SF Public Works - Site Assessment and Remediation (SAR); SF Department of the Environment (SFE)		

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San Francisco County Transportation Authority

Project Delivery Milestones	Status	Work	Start Date		End Date	
Phase	**% Complete**	**In-house - Contracted - Both**	**Quarter**	**Fiscal Year (starts July 1)**	**Quarter**	**Fiscal Year (starts July 1)**
Planning/Conceptual Engineering	30%	In-house and Contracted	Q2-Oct-Nov-Dec	2022/23	Q1-Jul-Aug-Sep	2026/27
Environmental Studies (PA&ED)	0%	Contracted	Q1-Jul-Aug-Sep	2023/24	Q1-Jul-Aug-Sep	2026/27
Right of Way	0%	TBD				
Design Engineering (PS&E)	0%	In-house and Contracted	Q4-Apr-May-Jun	2023/24	Q1-Jul-Aug-Sep	2025/26
Advertise Construction	0%	In-house	Q1-Jul-Aug-Sep	2025/26		
Start Construction (e.g. Award Contract)	0%	TBD	Q2-Oct-Nov-Dec	2025/26		
Operations (i.e. paratransit)	0%	TBD				
Open for Use	0%	TBD			Q3-Jan-Feb-Mar	2027/28
Project Completion (means last eligible expenditure)	0%	TBD			Q4-Apr-May-Jun	2027/28

Notes

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Project Information Form (PIF) Template

San Francisco County Transportation Authority

Project Name:	Kirkland Yard Electrification

Project Cost Estimate		**Funding Source**		
Phase	**Cost**	**Prop L**	**Other**	**Source of Cost Estimate**
Planning/Conceptual Engineering	$ 10,882,323	$ -	$ 10,882,323	Engineer's estimate
Environmental Studies (PA&ED)	$ -	$ -	$ -	
Right of Way	$ -	$ -	$ -	
Design Engineering (PS&E)	$ 12,821,322	$ 5,450,000	$ 7,371,322	Engineer's estimate
Construction	$ 155,063,912	$ 22,000,000	$ 133,063,912	Engineer's estimate
Operations (i.e. paratransit)	$ -	$ -	$ -	
Total Project Cost	$ 178,767,557	$ 27,450,000	$ 151,317,557	
Percent of Total		**15%**	**85%**	

Prop L Sales Tax Program
Project Information Form (PIF) Template

San Francisco County Transportation Authority

Funding Plan - All Phases - All Sources						**Cash Flow for Prop L Only (i.e. Fiscal Year of Reimbursement)**				
Fund Source	**Prop L Program**	**Phase**	**Fund Source Status**	**Fiscal Year of Allocation (Programming Year)**	**Total Funding**	**2023/24**	**2024/25**	**2025/26**	**2026/27**	**2027/28**
SB1 SGR		Planning/Conceptual Engineering	Allocated	2022/23	$ 668,225	$ -	$ -	$ -	$ -	$ -
Prop K		Planning/Conceptual Engineering	Allocated	2022/23	$ 1,073,196	$ -	$ -	$ -	$ -	$ -
FTA 5307		Planning/Conceptual Engineering	Programmed	2023/24	$ 265,902	$ -	$ -	$ -	$ -	$ -
RM3		Planning/Conceptual Engineering	Planned	2023/24	$ 8,875,000	$ -	$ -	$ -	$ -	$ -
Prop L	06- Muni Transit Maintenance, Rehabilitation, and Replacement	Design Engineering (PS&E)	Planned	2023/24	$ 5,450,000	$ -	$ 2,450,000	$ 3,000,000	$ -	$ -
FTA 5307		Design Engineering (PS&E)	Programmed	2024/25	$ 7,371,322	$ -	$ -	$ -	$ -	$ -
Prop L	06- Muni Transit Maintenance, Rehabilitation, and Replacement	Construction	Planned	2024/25	$ 22,000,000	$ -	$ -	$ -	$ 11,000,000	$ 11,000,000
FTA 5307		Construction	Programmed	2025/26	$ 17,611,860	$ -	$ -	$ -	$ -	$ -
RM3		Construction	Planned	2025/26	$ 15,000,000	$ -	$ -	$ -	$ -	$ -
FTA LowNo		Construction	Planned	2025/26	$ 60,179,701	$ -	$ -	$ -	$ -	$ -
Developer Fees		Construction	Programmed	2025/26	$ 4,921,078	$ -	$ -	$ -	$ -	$ -
General Fund Prop B Transit		Construction	Programmed	2025/26	$ 2,289,406	$ -	$ -	$ -	$ -	$ -
SB1 SGR		Construction	Programmed	2025/26	$ 4,749,596	$ -	$ -	$ -	$ -	$ -
FTA 5307		Construction	Programmed	2025/26	$ 6,312,271	$ -	$ -	$ -	$ -	$ -
General Fund Prop B Transit		Construction	Programmed	2025/26	$ 15,291,792	$ -	$ -	$ -	$ -	$ -
Developer Fees		Construction	Programmed	2026/27	$ 1,609,403	$ -	$ -	$ -	$ -	$ -
SB1 SGR		Construction	Programmed	2026/27	$ 4,749,596	$ -	$ -	$ -	$ -	$ -
SFMTA Capital Funds		Construction	Programmed	2026/27	$ 349,209	$ -	$ -	$ -	$ -	$ -
				Total By Fiscal Year	**$ 178,767,557**	**$ -**	**$ 2,450,000**	**$ 3,000,000**	**$11,000,000**	**$11,000,000**

Notes

Prop L Sales Tax Program
Project Information Form (PIF) Template

San Francisco County Transportation Authority

Prop L Supplemental Information Please fill out each question listed below (rows 2-8) for all projects.	
Project Name	***Kirkland Yard Electrification***
Relative Level of Need or Urgency (time sensitive)	See attached word document.
Prior Community Engagement/Level and Diversity of Community Support (may attach Word document):	Kirkland Yard in its location in the Fisherman's Wharf area of San Francisco is not located in the Equity Priority Community (EPC). The neighborhood has some of the highest levels of PM2.5 in the nation (93rd PCTL), high traffic volumes (93rd PCTL) and is overburdened by legacy pollution. The project will allow SFMTA to replace polluting diesel buses with zero-emission buses in support of our Climate Action Plan, dramatically reducing pollution in the community.
Benefits to Disadvantaged Populations and Equity Priority Communities	SFMTA is procuring the battery electric buses (BEBs) under a separate procurement contract (non-facilities). The procurement of BEBs requires Kirkland Bus Yard & Facility to be upgraded for the electrification of the new incoming bus fleet that is replacing the existing diesel hybrid buses. The new BEBs benefits the disadvantaged populations by improving bus vehicles and reducing greenhouse gas (GHG) emissions on the City's roads. The new BEBs will incorporate improvements for accessibility on-board and accessing the vehicles. Additionally, SFMTA's BEB Program will introduce new apprenticeship programs and hiring for technical training and jobs to operate and maintain this new vehicle type. For additional information, see attached Word document for "B5" Supplemental Information.
Compatability with Land Use, Design Standards, and Planned Growth	Yes
San Francisco Transportation Plan Alignment (SFTP)	Environmental Sustainability, Economic Vitality
	The conversion of Kirkland Bus Yard from a facility housing diesel hybrid buses (of approximately 81) to an all-battery electric bus (BEB) fleet of approx. 110 BEBs provide Muni zero emissions into the neighborhoods of the 17 routes serviced. The investment priority identified in SFTP 2050 advances economic vitality, transportation projects and Employment Training programs to provide employment opportunities benefitting disadvantaged individuals, more efficient transit and cleaner air. Vehicle miles traveled by the BEBs will be electrified helping cut greenhouse gases (GHG).

Prop L Sales Tax Program
Project Information Form (PIF) Template

San Francisco County Transportation Authority

The next section includes criteria that are specific to each Expenditure Plan program. The questions that are required to be filled out for each program will auto-populate once the Prop L program is selected on the Scope & Schedule tab.	
06- Muni Transit Maintenance, Rehabilitation, and Replacement	
Safety	As the existing diesel hybrid bus fleet arrives at its end of useful life, the buses will be retired and replaced by the next generation of buses that are more environmentally sustainable with less greenhouse gas (GHG) tailpipe emissions. With new vehicles, the BEB fleet will provide improved safety measures and accessibility improvements that are incorporated into the bus designs for bus operators and passengers. To electrify the new fleet of BEBs, Kirkland Yard and its facility must be fully rehabilitated to accommodate the conversion to bus electrification. An integral part of the facility conversion is to bring all related functions to a State of Good Repair (SoGR) and improve employee worker safety at the work site.
Need (Asset Useful Life) (Vehicles Sub-program)	N/A
Improves Efficiency of Transit Operations (Vehicles Sub-program)	N/A
Need (Asset Useful Life) (Facilities and Guideways Sub-program)	This project will replace Transit Operations Building housing operational offices and employee breakroom, electrical room (& switchgear equipment), bus wash and compound yard gate assets that are at/beyond the end of their useful life and enable the agency to proceed with a program to replace/upgrade several other facilties beyond their useful life. For additional information, see attached Word document for "B14".
Improves Efficiency of Transit Operations (Facilities and Guideways Sub-program)	This project is a necessary step in transitioning to SFMTA's existing diesel hybrid bus (DHB) bus fleet to battery electric buses (BEBs). It's construction will enable new BEB vehicles to be procured and eliminating greenhouse gas (GHG) emissions. In addition by bringing the facility to a better state of good repair, the project will improve work efficiency and safety by having updated, functioning equipment, more effective staff utilization, employee work safety and cleaner buses operating, dwelling and parked in the immediate Fisherman's Wharf area.

Prop L Supplemental Information
EP6 FC111 Kirkland Bus Electrification

Relative Leel of Need or Urgency
In accordance with the California Air Resource Board's (CARB) Innovative Clean Transit regulation (ICT regulation), the following report serves as the San Francisco Municipal Transportation Agency's (SFMTA) Rollout Plan to transition its bus fleet to 100% zero-emission (ZE) by 2040.

Effective October 1, 2019, the ICT regulation requires all public transit agencies in the state to transition from internal combustion engine buses (ICEBs) to zero-emission buses (ZEBs), such as battery-electric (BEB) or fuel cell electric (FCEB), by 2040. The regulation requires a progressive increase of an agency's new bus purchases to be ZEBs based on its fleet size. ICT regulation does not apply to overhead catenary trolley buses (ZETB), but they are a part of zero-emission vehicles.

To ensure that each agency has a strategy to comply with the 2040 requirement, the ICT regulation requires each agency, or a coalition of agencies, to submit a ZEB Rollout Plan before purchase requirements take effect. The Rollout Plan is considered a living document and is meant to guide the implementation of ZEB fleets and help transit agencies work through many of the potential challenges and explore solutions. Each Rollout Plan must include several required components and must be approved by the transit agency's governing body through the adoption of a resolution, prior to submission to CARB.

According to the ICT regulation, each agency's requirements are based on its classification as either a "Large" or "Small" transit agency. The SFMTA, as a Large Transit Agency must comply with the following requirements:
July 1, 2020 – Board of Directors (Board) approved Rollout Plan must be submitted to CARB
January 1, 2023 – 25% of all new bus purchases must be ZE
January 1, 2026 – 50% of all new bus purchases must be ZE
January 1, 2029 – 100% of all new bus purchases must be ZE
January 1, 2040 – 100% of fleet must be ZE
March 2021 – March 2050: Annual compliance report due to CARB

Due to the impacts of COVID-19, the SFMTA requested and was granted an extension for the submission of the Rollout Plan to March 31, 2021. The purpose of this request was to ensure that critical items such as the SFMTA's direction and decisions on trolley buses, yard rebuilds, stakeholder engagement, and future funding were included in the analysis to define the framework of its ZEB transition more accurately.

The SFMTA will renovate the Kirkland Bus Yard (Kirkland) to accommodate approx. 110 40 ft battery electric buses (BEBs), a critical step on the way to electrifying our entire fleet of over 900 buses. Kirkland is a functionally and physically deficient 70-year-old facility that currently houses 81 40 ft diesel-hybrid buses.

Kirkland Yard will now become the first SFMTA facility to be converted to a BEB electrified facility. Previously, in SFMTA's Facility Framework Plan (2017), Kirkland was to follow Potrero

Yard Modernization Project. Due to schedule and fiscal factors, the bus facility electrification conversion has prioritized Kirkland to be constructed first as well as to accommodate more than the originally planned 91 BEBs.

This project will include the installation of overhead and ground mounted charging equipment as well as replacing existing operations buildings with additional parking for BEBs.

The relative need and urgency is high. The BEB procurement is underway for the initial purchases of vehicles to comply with the 25% target. Very much related to the vehicle is the conversion of bus facilities such as Kirkland Yard to be ready by 2026-2027 to charge and store a fleet of BEB's as the SFMTA fleet is replacing its diesel hybrid buses.

Benefits to Disadvantaged Populations and Equity Priority Communities
Vehicles procured through this project will run in revenue service across 17 Muni routes that use 40' Motorcoach vehicles. Using ArcMap, SFMTA analyzed the alignment of 40' MC routes against Justice40 Disadvantaged Community Census Tracts to calculate the percent of Disadvantaged Community Census Tracts (DCCTs) served by intersecting routes resulting in 56% of San Francisco DCCTs (75) served by the project. To calculate the annual ridership served by this project, SFMTA used 2019 annual figures for all 40' bus routes serviced at Kirkland including those that serve equity neighborhoods. SFMTA used the results of our 2017 on-board survey, which captured passenger demographic information, to define the share of our ridership that is considered transit-dependent (low-income: 200% below the federal poverty line and no vehicle access) which equates to 23% of our ridership. Of the annual 30,853,000 riders this project would support, 7,096,190 are transit-dependent. (See attached list of CTs served)

SFMTA has 17 unions, and 3 employment opportunity elements to benefit disadvantaged individuals. The Employment Training Program requires consultants to hire trainees to provide technical training and jobs. The Construction Element ensures contractors make a good faith effort to employ minorities and women evenly on projects, and we offer the City Build apprenticeship program to meet hiring goals. The First Source Hiring Program gives workforce development participants the first chance at jobs.

Need *(Asset Useful Life)*
Upon completion of the designs, issuance of permits, NTP with the General Contractor (GC) executed, Phase I will begin. The GC will be mobilizing on site and performing site soils preparatory work to construct the project in one phase. Kirkland fleet operations and maintenance will be relocated offsite to either existing yards or new location TBD. The 1970's era Operations Building will be demolished and replaced with prefabricated, modular offices, the asphalt will be replaced with concrete or AC pavement to handle the BEB loadings, new raised equipment islands in the yard provided for the charging cabinets and new foundations for the steel frame gantry to support the electrical conduits and appurtenances connected to the overhead pantographs. 56 pantographs and 28 charging cabinets will be installed.

Prop L Supplemental Information
EP6 FC111 Kirkland Bus Electrification

The existing bus wash as well as the electrical equipment in the Electrical Room both have outlived their useful life. A new bus wash will be provided that will utilize a water reclamation system complying to SF Stormwater Management Ordinance (SMO). The electrical switchgear and infrastructure will all be upgraded for the increased electrical power demand to be submitted with the PG&E Service Application for Kirkland.

Existing perimeter gates along Stockton Street will be replaced to align with the BEB bus lane widths for bus circulation such as the morning peak "pullouts". Perimeter improvements will include the vehicle gates, upgraded yard and site lighting, CCTV cameras and addition of guard booths - TBD as part of the SoGR and security enhancement recommendations from SFMTA's security task force.

Prop L | Scope & Schedule
EP6 FC111 Kirkland Bus Electrification

Detailed Scope

The project is part of SFMTA Strategic Plan to meet its goal to eliminate pollution and greenhouse gas emissions by moving away from diesel-hybrid buses and adopting zero emissions buses for Kirkland Facility. The project also meets another Strategic Plan goal by modernizing an aging facility which has outlived its intended useful life cycle and optimizing the Kirkland bus fleet with BEBs as well as facility infrastructure including the physical environment for its workforce of mechanics, operators, superintendents, and facility staff. The purpose of this project also is to meet the CARB (California Air Resource Board) Innovative Clean Transit (ICT) regulation to operate 100% zero transmission buses by 2040 and comply with the intent of the CARB ICT bus procurement requirements.

The importance of Kirkland Bus Yard is the ability of accepting new BEB's and electric vehicle (EV) charging facilities by SFMTA to its fleet by Y2027. Y2027 is the target for first arrival of Battery-electric buses (BEB) to be received by SFMTA and placed into revenue service in Y2028. Kirkland Yard is on the critical path to retrofit the facility with electric vehicle (EV) charging infrastructure to have the BEB buses operational in the fleet. Kirkland will employ the overhead pantograph charging type system in a depot fleet charging and bus (stacking) storage configuration.

SFMTA has launched a project website for the Kirkland Yard Electrification Project as part of its commitment to public outreach and engagement. The website can be found here: https://www.sfmta.com/projects/kirkland-yard-electrification-project. Additional information will be continually provided by SFMTA Public Outreach and Engagement Team (POET) to external stakeholders with the inception of the design and through construction.

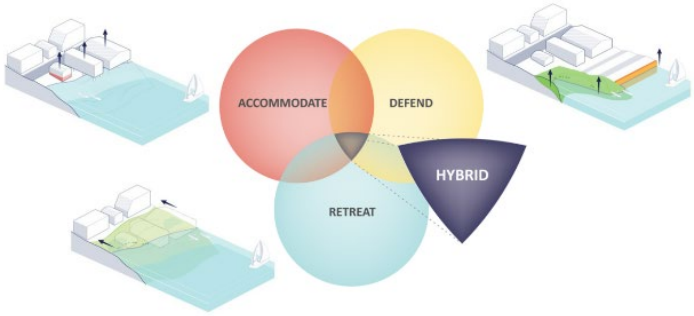
Kirkland Facility is situated in the Sea Level Rise Vulnerability Zone. Under the Port of San Francisco Resilient Program, the Port in partnership with SFMTA, U.S. Army Corps of Engineers, and other City agencies are developing a Draft Waterfront Adaptation Plan. The goal is to release the draft plan in summer of 2023. The plan will identify a preferred approach to reduce flood risks from sea level rise and extreme storms. Possible strategies in the plan could include raising the shoreline along roadways such as Embarcadero to address up to 7-feet of sea level rise expected 2100. Refer to the SF Port link for more information: https://sfport.com/wrp

These issues require a broader collaboration with the Port of San Francisco Resiliency Program. It requires a coordinated mitigation plan that is long in developing, hence the current plan is for this to be addressed when the Kirkland Facility is scheduled to be entirely re-built in 2040. Workshops are underway between the SFMTA and Port agencies in the discussion of the proposed strategies. The impact to Kirkland is indeterminant in the near-term, hence there is no impact to the project. The long term impact to Kirkland will be better understood when the Resiliency Program is adopted and will have far reaching not only to SFMTA's Kirkland Yard but all along the Embarcadero waterfront through Pier 39 and Fisherman's Wharf.

Kirkland Yard being the first yard facility to receive BEBs will advance through construction. Any modification to the yard or implementation of the sea level rise mitigation measures will be considered with the City's adoption of the Resiliency Program. The lines of defense (LOD) that have been discussed include the following:

- ~~**LOD E**: Defend~~
- ~~**LOD F**: Accommodate~~
- ~~**LOD G**: Retreat~~

~~**Vignette of LOD** E (Defend), F (Accommodate) and G (Retreat):~~



High-Level Draft Waterfront Adaptation Strategies

~~The planned SFCTA funds will go towards the Design Engineering (PS&E) and Construction of the Bus Electrification Project at Kirkland Bus Facility & Yard.~~

Attachment 2

Draft Review - Pre-Development Report
KIRKLAND YARD ELECTRIFICATION

CIP Project No.: 10037990

SFMTA

Developed By:
Capital Programs and Construction Unit (CP&C)
Date: March 2023

Revisions

Version	Date	Author(s)	Revision Notes
0.0	02/24/2023	Lang Huey, Project Engineer Quon Chin, Project Manager Chava Kronenberg, Project Planner	
1.0			
2.0			

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1.0 Summary

The purpose of this project is to retrofit Kirkland Yard to store, maintain and charge (91) 40-foot electric buses at the facility.

Kirkland Facility is in the Fisherman Wharf area at 2301 Stockton Street and 151 Beach Street. The Kirkland Facility currently stores, maintains, fuel and services (112) 40-foot diesel hybrid buses.

The California Air Resource Board's (CARB) Innovative Clean Transit (ICT) regulation requires all transit agencies to begin transition to 100 percent zero-emission bus (ZEB) fleet. Starting in 2029, 100% of new bus purchases must be ZEBs; and by 2040, transit agencies should fully operate with 100% ZEBs. SFMTA has a goal to operate all ZEBs by 2035.

Pursuant to SFMTA's electrification goals, in February 2020, SFMTA commissioned WSP to provide a roadmap for SFMTA's transition to an all-ZEB fleet replacement of existing fossil-fueled buses. With input and data from SFMTA staff, battery electric bus (BEB) industry stakeholders and SFPUC/PG&E sources, WSP developed the *Zero Emission Facility and Fleet Transition Plan* consisting of several task reports. This project will evaluate and implement several of WSP's reports recommendations to upgrade the Kirkland Facility for immediate "temporary" usage of the site to support the deployment of (91) 40-foot battery-electric buses (BEBs) by 2027.

The recommended Kirkland Yard Electrification project upgrades the bus yard infrastructure and increases the PG&E service capacity for BEB charging at the bus yard. To minimize service disruptions and operational impacts, the Kirkland Yard will undergo BEB upgrades in several construction phased stages. The improvements are expected to include the following:

1. Repaving the site.
2. Demolishing the existing operations building in addition to the adjacent trailer and utilizing a temporary building or temporary trailer facilities to house operations on the site. *The temporary facilities will be on the western side of the site along Powell Street.*
3. Installing charging infrastructure in a ground-mounted deployment to achieve the maximum number of charging positions to serve SFMTA's upcoming BEB procurement. *The BEB charging and electrical equipment will be located on a raised island between the bus bays.*

The existing diesel fuel tanks, fueling lanes, maintenance building, exterior outdoor wash facility, Parts & Office Building along Beach Street in addition to the Tire Storage will remain on site. South of this existing area, three-to-four bus lanes will undergo construction for a duration of roughly six-to-eight months. Buses usually occupying the lanes undergoing construction will be temporarily relocated to Islais Creek Facility. With reference to the underground diesel fuel tanks, it is envisioned this will remain in place throughout the construction phase. SFMTA stakeholders should confirm the continued long-term provision and function of diesel fueling at Kirkland Yard. However, it should be noted that Kirkland Facility is used for emergency diesel fueling by the City of-San Francisco due to its prime northernmost location along Fisherman's Wharf and the Embarcadero corridor.

After the Woods Facility is fully rebuilt (after 2040) to support BEBs, the Kirkland Facility is the next facility slated for an entire rebuild. When Kirkland is demolished and rebuilt, a new permanent maintenance and operations buildings will be provided with the reconfigured yard. The EV Charging equipment in addition to electrical service substation and cabinets are conceived to be on an elevated structure platform to optimize BEB bus storage on the ground.

SFMTA has launched a project website for the Kirkland Yard Electrification Project as part of its commitment to public outreach and engagement. The website can be found here: *https://www.sfmta.com/projects/kirkland-yard-electrification-project* Additional information will be continually provided by SFMTA Public Outreach and Engagement Team (POET) and the initial outline of the public outreach and engagement plan is also discussed herein Chapter 14 of the PDR.

2.0 Project Purpose

The purpose of this project is to upgrade Kirkland Yard to store, maintain and charge (91) 40-foot battery electric buses (BEBs) at the existing bus facility, and to meet the CARB Innovative Clean Transit (ICT) regulation to operate 100% zero transmission buses by 2040, and comply with the intent of the CARB ICT bus procurement requirements. In addition to the CARB goals, the SFMTA's Zero-Emission Bus Rollout Plan – see **Appendix B**- contributes to the City's Climate Action Strategy goals, eliminate San Francisco's carbon footprint by making SFMTA's transit fleet more sustainable and supports the City's voter-approved Transit-First Policy – established in 1973.

The CARB ICT states:

- Starting 2023: 25% of new buses purchased must be ZEBs
- Starting 2026: 50% of new buses purchased must be ZEBs
- Starting 2029: 100% of new buses purchased must be ZEBs

A fact sheet summarizing the ICT regulation is found in **Appendix A.**

It should be noted SFMTA has a self-imposed goal to operate all 100% zero greenhouse gas (GHG) emission buses by 2035 which is earlier than the CARB 2040 date. Therefore, the Kirkland, Potrero, Islais Creek, Flynn, Presidio, and Woods Facilities need to be operational for 100% of the BEB fleet by 2035. To meet the 2035 goal, WSP recommended the following:

- Kirkland, Islais Creek and Flynn Facilities infrastructure and yards be upgraded; and
- Potrero, Presidio and Woods Facilities be entirely rebuilt.

Kirkland is the first of the three SFMTA facilities to be upgraded for BEBs. The BEB facility transition will be a phased-approach starting with the temporary BEB modification to the Kirkland Facility, which is estimated to be completed end of 2027. The work at Kirkland Facility is phased to accommodate the charging, maintenance, and storage of the incoming procured ZEBs with a portion of the existing fleet operational in the yard during construction. Impacted buses that

cannot be stored at Kirkland will move to Islais Creek. SFMTA plans on operating and maintaining its existing trolley bus fleet and diesel hybrid fleet until the latter are retired.

After the Woods Facility is fully rebuilt to support BEBs (after 2040), the Kirkland Facility is expected to be entirely rebuilt with modernized maintenance building, permanent operations offices and back-of-house support spaces and reconfigured yard.

3.0 Project Objectives

The project is part of SFMTA Strategic Plan to meet our goal to eliminate pollution and greenhouse gas emissions by moving away from diesel-hybrid buses and adopting zero emissions buses for Kirkland Facility. The project also meets another Strategic Plan goal by modernizing an aging facility which has outlived its intended useful life cycle and optimizing the Kirkland bus fleet with BEBs as well as facility infrastructure including the physical environment for its workforce of mechanics, operators, superintendents, and facility staff.

4.0 Limits of Work

The project limit of work is mostly confined within the perimeter of Kirkland Facility, which is bordered by Beach Street (N) – to the North, Stockton Street (E), North Point Street (S) and Powell Street (W) as shown in **Figure A**. The Kirkland Facility mainly consists of a

Figure A: *Site Map of Kirkland Facility*

Maintenance Building, Operations Building, fuel dispensing area, storage tank areas, outdoor bus wash area, outdoor bus yard, non-revenue vehicle (NRV) and on-site employee parking and some small ancillary structures like tire storage.

The scope of street work that is expected outside of Kirkland Yard facility includes but not limited to modifying and providing connections of the utility services serving the yard such as new PG&E circuit feeders, fire service, domestic water, stormwater, and sanitary. Currently, there is no street re-paving and striping to the adjacent streets, sidewalk or cross walks improvements or traffic signalization anticipated at this juncture. However, the above is subject to change upon design advancement in Preliminary Engineering (PE). Trenching of the ductbank for the delivery of PG&E electrical service upgrades to Kirkland could trigger partial pavement of the street beyond the trench width in addition to ADA accessibility improvements for corner curb ramps by governance requirements. During PE phase the ADA accessibility compliance requirements will be identified, refined, and scoped and for further development in the following detail design (DD) phase.

The site is also constrained by height limits by zoning. The zoning requirements shall be further investigated during Preliminary Engineering.

The Stockton Street side of the yard is comprised mostly with overhead security grilles except where the fuel tank area and existing Operations Buildings are located. Buses enter from Stockton at the northeast corner of the yard and circulate in a counterclockwise movement within the yard through the fueling lanes. The existing diesel/hybrid buses are parked in tandem parking, or "nose-to-tail" pointed east towards Stockton Street and exit through the overhead security grilles onto Stockton Street when going into revenue service.

Figure B: *View of Kirkland Yard from Beach Street*

There is a vehicular sliding gate at the southwest corner of the yard at Powell and Northpoint Street mainly for SFMTA's NRV, operator's vehicles and employee vehicles. Other than the aforementioned security overhead grilles and existing Operations and Maintenance Buildings, the perimeter is comprised of a metal picketed fence with outward bent spikes at its top for perimeter security. A partial view of the fence is shown in Error! Reference source not found..

5.0 Scope of the Work

The scope of work involves evaluating and implementing several of WSP's recommendations outlined in the *Zero Emission Facility and Fleet Transition Plan* ("WSP Report"). The project plan involves upgrading the Kirkland Facility for immediate "temporary" usage of the site to support the deployment of (91) 40-foot battery-electric buses (BEBs) by 2027 construction completion. This WSP report was developed at the conceptual level only and did not identify key technical feasibility and requirements that will change the budget and scope of the overall project.

This Pre-Development Report is primarily based on the results and findings of the WSP Report for the conversion of the existing fossil-fueled bus fleet and yard operations into the new era of battery-electric bus fleet and associated with this new technology, the new operational and technical requirements to a bus yard for BEB buses. Hence, the general scope of the yard conversion is defined. However, in the planning phase there are options to review and validate from an environmental planning and external stakeholder perspectives, specifically how the visual impact and considerations of BEB electric vehicle (EV) charging apparatus and infrastructure is melded into the North Beach community. Below is a comparison matrix of EV charging options for the visual impact considerations in the environmental review process:

TYPE	EV Option Description	Environmental Impact Visual Assessment	Pros	Cons	Remarks
LOW	Plug-In Dispenser Chargers	Low Visual Impact	1. Low visibility of infrastructure. 2. Lower cost w/o gantry superstructure and foundation system. 3. Less invasive construction approach. 4. Potentially less cost.	1. Dispensers on islands - increase footprint impacts bus circulation. 2. Requires manual EV dispensing. 3. Adds time factor to operations. 4. Requires underground ductbank for EV feeder distribution. 5.Electrical Substation, Transformer, EV Power Blocks located at grade. 6. Electrical & EV equipment footprint trade-off to bus parking.	1. Low elevation of visible equipment at expense of taking footprint from bus parking. 2. Reduces bus parking size (91). 3. Revised parking configuration to be evaluated in PE Phase to determine level of reduction. 4. Not as conducive to depot parking.
HIGH	Overhead Inverted Pantograph Chargers	High Visual Impact	1. Automated EV Charging. 2. Optimizes bus operations - time. 3. Compact lanes - maximizes bus parking. 4. Minimum parking lane widths. 5. Optimizes bus storage (parking).	1. High visibility of infrastructure. 2. Increased costs. 3. Requires gantry superstructure and foundations. 4. New technology.	Designed for depot fleet parking.
HYBRID	Opportunity Charging - Single Pylon	Compromise between low visual & high visual impact	1. Single structure per bus - lower visual intrusion. 2. Combines single pylon w/inverted pantograph. 3. Reduction is heavy superstructure impact to site. 4. Visual appeal w/its industrial design factor.	1. Potentially increased costs with pylon and inverted pantograph. 2. Wider islands for footprint. 3. Impact to yard configuration and bus parking capacity. 4. Requires underground ductbank for EV feeder distribution. 5. Electrical Substation, Transformer, EV Power Blocks located at grade.	1. Hybrid of dispenser w/inverted pantograph 2. Elevates the form factor in design aesthetics and functionality. 3. Potential reduction in bus storage.
COMBO	Underground Infrastructure with Plug-in Dispenser or Single Pylon	Lowest Visual - Move Electrical Equipment Below Ground	1. Combines advantages of plug-in and pylon w/pantograph. 2. Option with no exposed exterior placed electrical equipment, substations and EV power block. 3. Maximizes open-yard environment.	1. High construction cost to excavate and construct underground level. 2. Requires MEP/FP systems to underground spaces. 3. Waterproofing of U/G structure and build-in flood resiliency	1. No electrical equipment at grade. Improves visual aesthetic of bus yard. 2. If combined with public parking, could provide a revenue stream to SFMTA.

Enlarged format of Parking Matrix along with photo examples of each EV option are found in ***Appendix C***

To support the 91 charging positions, a charging infrastructure island is required in the Kirkland Upgrade plan to be installed which will hold the charging cabinets and necessary transformers and switchgear at grade between bus lanes. The WSP plan proposes to utilize a temporary gantry system to support the 91 overhead inverted pantographs as shown in **Figure C**. In the figure, the yellow-colored buses are the locations of the new BEB buses; and the gray colored buses are 40' long indicate available spaces for potential bus parking during non-revenue hours. Note that these spaces are not EV-charging positions but provide additional parking capacity or open driving lanes.

***Figure C**: Axonometric View & Transverse Section*
Source: WSP Zero Emission Plan

The proposed project plan converts all the designated facility parking solely to BEB storage and adds additional bus parking to the facility by demolishing the existing Operation Building and trailer in the southeast corner of the site; provides temporary building/trailers along the western area of the site; and requires construction phasing to coordinate all the moves. Three-to-four lanes will undergo construction for a duration of roughly six-to-eight months. Buses occupying the lanes that are undergoing construction will be temporarily relocated to Islais Creek Facility and/or stored on site where there is available space. But space will be limited.

During design as well as in this PDR, SFMTA Transit Division will be consulted to determine the bus relocation area(s) and confirm the operations of the yard during construction. A concept of the layout with some buses stored on site is shown on **Figure D.**

For the yard plan showing the Kirkland Bus Electrification Y2040 rebuild, see **Figure M** in **Appendix D.**

The key deliverables in the various design phases of the facility upgrade for the Kirkland Bus Electrification Project are as follows:

1. **Pre-Development (Planning) Phase** include the Pre-Development Report (PDR).
2. **Preliminary Engineering Phase** include a Preliminary Engineering Report (PER) with the Preliminary Engineering (PE) or 30% Level Drawings, Specifications, Design Criteria, PE Schedule, and PE Estimated Construction Cost Estimate. Permit pre-applications will be prepared and submitted. AHJ and SFFD will be advised as the design progresses.
3. **Detailed Design Phase** – completed to construction document level with plans, specifications, updated design criteria, updated schedule and engineer's cost estimate. DBI and other permits will be obtained for construction.
4. **Contract Delivery**: Detailed Design will be subject to change depending upon the contract delivery method weighing factors such as bus procurement schedule, construction sequencing and duration, construction schedule, project cost and budget and overall project risk.
5. **Other Deliverables**: include the following but not limited to:
   a. CEQA Environmental - categorical exemption (CE),
   b. Department of Public Health (DPH) – Maher Ordinance,
   c. NEPA Environmental,
   d. SF Arts Commission (SFAC) - Art Enrichment,
   e. SF Arts Commission (SFAC) – Civic Design Review (CDR),
   f. SF Department of Building Inspections (DBI) – Permits,
   g. SF Fire Department (SFFD),
   h. SF Planning Department,
   i. SF Public Utility Commission (PUC) – water permits, and PG&E coordination,
   j. SF Water Quality Control Board (RWQCB),
   k. SFMTA Public Outreach Engagement (POE) Plan,
   l. PG&E Electrical Service Upgrades – System Impact Study (SIS) & Facility Study (FS) Reports and PG&E Engineering for the electrical upgrade to the site from its designated substation(s).

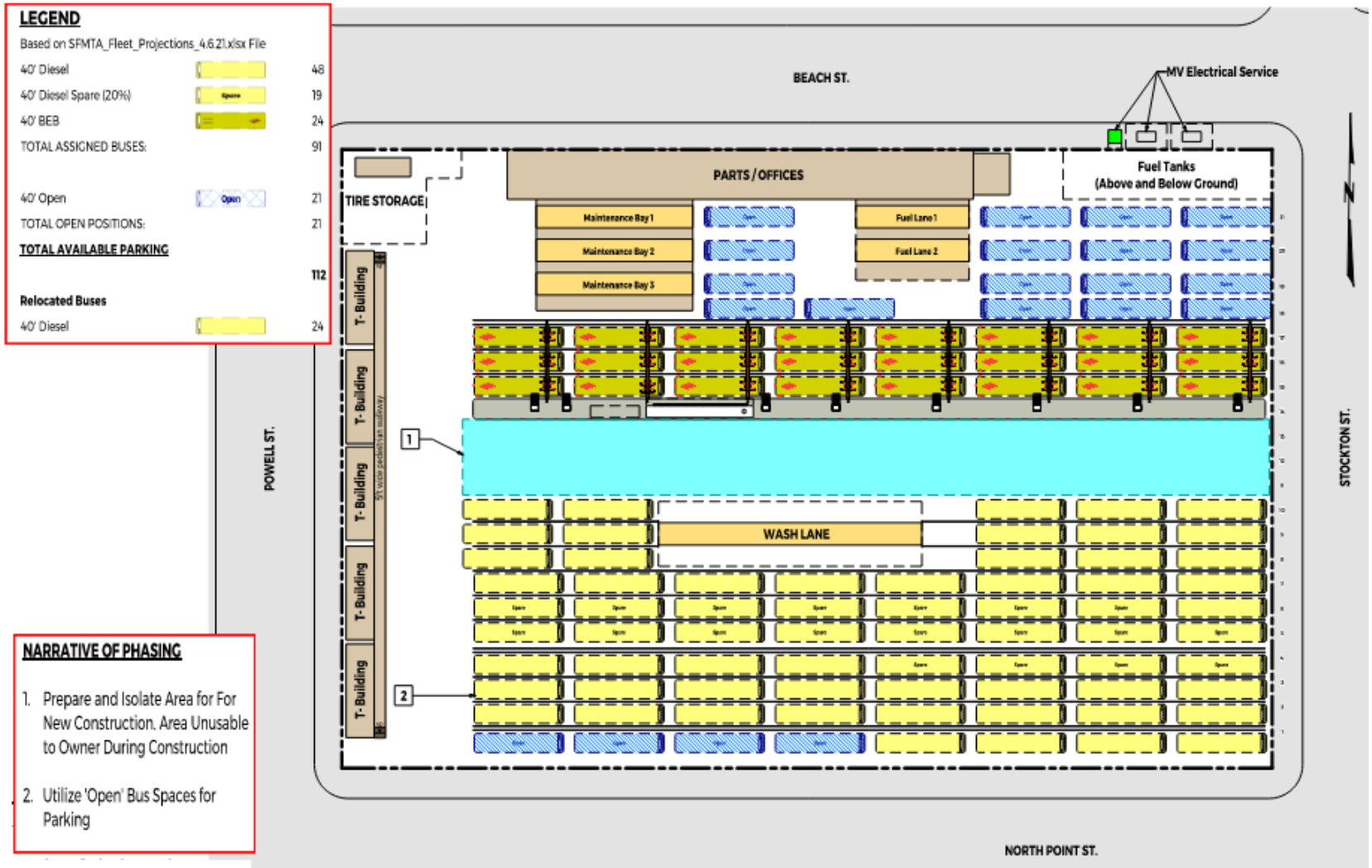


Figure D *Example Construction Phasing Configuration*
Source: WSP Zero Emission Plan

6.0 Key Issues, Risks, Constraints

The key issues, risks and constraints for the Kirkland Bus Electrification Project are many and includes and begins with:

A. SFPUC/PG&E energization timeline and cost;
B. Available funding for facility upgrade;
C. NEPA permitting review and approval process;
D. Building code compliance and fire/life safety measures with BEB emerging technologies;
E. Power for transit service resiliency;
F. Medium Voltage Electric Service;
G. Elimination of employee parking to maximize BEB bus storage and charging spaces;
H. Aesthetics and neighborhood concerns of the BEB infrastructure layout;
I. Retaining the existing above ground and underground storage tank throughout;
J. Demolition of existing Operations Building and adjacent trailer to maximize BEB bus storage;
K. Facility utility service connections;
L. Yard drainage;
M. Flooding risk;
N. Seismic risk; and
O. Other project considerations

The following paragraphs provide further detail into the key issues, risks and potential constraints in the order of highest to lowest risk, issues and constraints:

A. **PUC/PG&E** – *schedule impact from time of application to energization*

This is the number one risk to the Kirkland Bus Electrification Project. Approximately 7.6 MW of power is estimated based on 150 kW and 1:2 charging ratio to operate (maintain and charge) BEBs at Kirkland Facility. The assumptions are based on information and approach developed from the WSP Reports. The utility application process with PUC/PG&E for additional electrical service will take approximately three to five years. SFMTA can corroborate this timeline from current projects submitting electrical service upgrade applications as well new electrical service applications on Muni facility projects. Work on the PUC/PG&E application is in process and planned to be submitted prior start of Preliminary Engineering or earlier. If the overall application process goes on longer than three years, the initial bus procurement will be impacted by the delivery of the power to Kirkland. Hence, the impact could require the bus delivery delayed until power is available at Kirkland.

According to the CARB Innovative Clean Transit Regulations procurement goals, 50% of new bus purchases must be ZEB by 2026. Escalating the facility power requirements with SFPUC

and PG&E for the BEB Fleet program is critical to meeting schedule and receipt of the delivery of BEB buses procured by SFMTA. This is a huge risk to the Kirkland Bus Electrification Project if the facility is not energized by the project schedule's substantial completion date for testing and commissioning.

B. Available Funding

A significant facility upgrades to Kirkland along with new BEB infrastructure and EV technology come with significant investment for the capital improvement. Funding or their lack of is a significant risk to the project. See Chapter 10 Project Cost Estimate in this PDR for the pre-development (planning) phase level construction cost estimate as well as estimated total project cost.

If there is FTA funding for the project, this will influence the contract administration, terms of the contract and the RFQ/RFP in the contract delivery and solicitation.

C. Federal Environmental Review (NEPA)

Federal environmental assessment can be unknown in scope and especially in duration. Projects that receive federal funding, as this project may, will have to work with FTA to adequately complete studies and receive approvals. There is a history of untimely responses and long schedules associated with SFMTA projects that must complete NEPA to accept federal funding contributions. This risk is primarily related to budget and schedule.

D. **Limited Building Codes and Standards Available** – *related to BEB Facilities*

Currently, there are limited building codes, reference standards and related guidance standards for constructing or modifying existing bus maintenance facilities for the introduction of BEBs into the transit agency's fleets. There are codes and regulations for stationary energy storage systems, but none are specific to electric vehicles (EVs) such as for commercial and private BEBs, and the maintenance, parking such as depot charging and fleet vehicle storage, or service of EVs. This industry development and regulatory policy process is ongoing and will undoubtedly evolve as the technology expands with more fleet and non-fleet vehicles are placed into service not only in the City and County of San Francisco but also to other transit agencies across the country.

Codes and standards have traditionally been modified to address severe incidents, fatalities, and destruction of property after the fact. The goal and objective with BEB and EV charging is to assess causes and effects from in-use scientific sampling and monitoring in developing fire/life safety measures and lessons learned information. The limitation in BEB to current code enforcement and application will impact the design and permit phases of the project.

In the absence of BEB infrastructure-related codes that are written, the design and construction of BEB infrastructure and EV-Charging will be based upon available local, state and federal non-BEB infrastructure codes and regulations, including requirements that may be set forth by the Authorities Having Jurisdictions (AHJ) such as the San Francisco Fire

Department (SFFD) and San Francisco Department of Building Inspection (SFDBI). Relevant to the codes and applicable standards are the first responders to a fire or facility incident to minimize causalities and spread of fire. It is anticipated the building codes and national standards will be updated.

On October 11, 2022, SFMTA provided the SFFD an orientation session to the vehicles in SFMTA's Pilot BEBs (i.e., bus manufacturers represented by New Flyer, BYD, and Proterra) that are currently charged and in-use at the Woods Bus Facility. Nova, the fourth BEB manufacturer, was not present and its buses have not been delivered to SFMTA for testing as of the date of the site meeting with SFFD. See the meeting minutes of October 11, 2022 site meeting in the **Appendix E**.

SFMTA Woods fleet staff, SFMTA Zero-Emissions Bus (ZEB) Vehicle Program team, and the BEB bus manufacturers' representatives familiarized members of the SFFD with the battery electric buses components, on-board diagnostic monitoring instrumentation, shunt switch to cut off on-board power in an emergency, particularly with regards to the lithium-ion battery packs or modules for location and access points on the vehicles. In addition, SFMTA and the representatives from the bus manufacturers highlighted the differences between the battery electric buses and SFMTA's existing diesel hybrid and trolley bus fleet. **Figure E** shows an EMC representative explaining the functions of his electric-hybrid bus to SFFD.

SFMTA ZEB Team provided to the SFFD an informational packet of each bus manufacturer's OEM information, electrical diagrams of the BEB circuitry, plans and elevations of the prototype buses for SFFD to review and evaluate. No decision or recommendation was expected of SFFD from this orientation meeting. That is still to be discussed and requested of SFFD in the near future. One common point discussed verbally between the bus manufacturers and SFFD is to maintain a minimum clear distance of 20-ft around the BEB in the event the bus is on fire.

Figure E: *EMC-Electric Hybrid bus representative explaining the functions of his bus to members of SFFD*

Chemical foam suppression was not recommended by the bus manufacturers. It was said to allow the BEB to self-extinguish on its own. Surprisingly use of water was advised but primarily to bring the temperature of the batteries down while heated and/or on fire.

The project schedule and cost may be impacted during design and/or construction if new building codes and regulations for BEB infrastructure are enacted during the design and construction phase of the project. This is the challenge of new technology with unproven

fire/life safety measures and could lead to redesign and rework. With that said, obtaining permit approvals in this unprecedented and unchartered facility code design will be a challenge. The Code Official (DBI) will likely look to the first responder on the incident-side and authority having jurisdiction (SFFD) in providing a provisional permit.

E. Power Resiliency

Resiliency is the capacity to recover from power disruption. Currently, Kirkland Facility does not have an emergency electrical generator. Auxiliary battery storage can be implemented to reduce the effect of unexpected power outages. It should be emphasized that battery storage will not provide 100% redundant power for transit service resiliency.

From PG&E reliability data as highlighted in the WSP Report, there is an average one power outage every two years with an average outage of 78 minutes before service is restored.

Table 1 presents resiliency contingency based upon duration of power outage.

Table 1: *Power Resiliency Contingency*

Duration of Outage	Contingency
10 seconds to 15 minutes	On-Site Battery Storage System
15 minutes to 2 hours	Mobile Generator
	Permanent GenSet
More than 2 hours to multi-day outages	Redundant Utility Feed
	Mobile Generator

Source: WSP

The critical decision for power resiliency is in the SFMTA stakeholder's realm for their asset management and risk management decision-making. The WSP Report recommendation **is not to include** power resiliency in the upgrade phase of the (Y2028) bus electrification project, but to add resiliency after Y2040, when the entire Kirkland Facility is rebuilt. SFMTA stakeholders should comment and/or confirm this recommendation from the Report as the design progresses after PDR. In Y2040, it is estimated that 91 buses will be stored at Kirkland. For an emergency response, Kirkland is expected to maintain auxiliary power to charge a minimum of 10% of the buses stored at the Yard. This would require 9 buses to be available during an unexpected power loss. More than two hour resiliency will require a second PG&E power feed as a backup feed.

According to WSP Report, "The Kirkland Yard design plans include two 2,000 kWh (4,000KWh) of on-site battery storage to provide energy to charge buses during power outage. Realistically assuming that all buses are stored with 25% of their total capacity, the reserve systems would be able to charge 11 buses up to 100%. The designated on-site battery and generator would be able to meet the charging requirements of 12% of the fleet stored at Kirkland. Kirkland Yard is expected to use 255kW solar panels in the Y2040 rebuild to charge the on-site battery storage. It is estimated that the solar panels will generate an average of 1,000 KWh on a daily basis." Solar can only charge approximately 2 buses in the time period of 6 hour during daylight time only.

The Kirkland Bus Electrification Project will follow the WSP recommendations in regard to power resiliency unless informed otherwise through the PDR review and sign-off process.

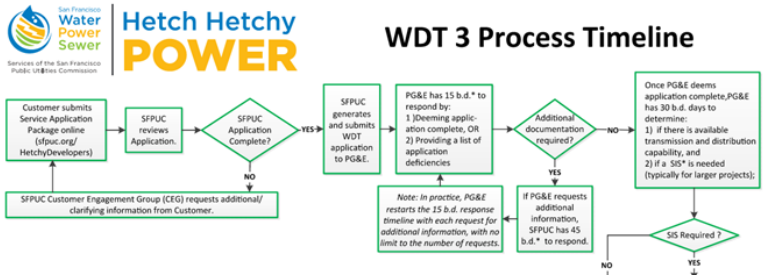
F. Medium Voltage Electric Service

There are four important issues under Medium Voltage Electric Service to highlight in this Pre-Development Report as follows:

1. PG&E WDT 3 (Wholesale Distribution Tariff) and PG&E energization timelines.
2. PG&E electrical upgrade to the existing service load – MW size - at Kirkland.
3. Location and routing of the PG&E feeder services to Kirkland Yard.
4. Horizontal clearance requirements around the electrical equipment and cabinets to be in code compliance. In this initial phase of the Kirkland Bus Electrification Project, the equipment and cabinets are on a raised concrete island located between bus bays.

F.1 PG&E Energization Timeline

SFMTA CP&C will submit the customer service application package on-line in Step 1 of the WDT 3 Process. The application goes through several SFPUC/PG&E processing steps. PG&E will determine if a System Impact Statement (SIS) is required. It typically is required for larger projects as SFMTA has experienced on recent Muni bus facility projects. PG&E drafts an SIS Agreement with request for payment on the SIS Final Report. The SIS Report will indicate the service feeder routing, substation source, location of service vault on site, and rough estimate of the electrical service infrastructure cost. After SIS is completed and received, PG&E will determine if a Facility Study (FS) is required. An FS agreement and request for payment to perform the draft and final FS is submitted to the customer. After SIS / FS are performed, PG&E provides a draft Service Agreement (SA) to the customer with a 20% Advance and Preliminary Design (APD). The SA is executed with a 20% payment of the estimated total PG&E costs. The workflow moves on through phases for pre-construction, construction, PG&E installation to energization. This is a simplified explanation of the process. See attached WDT 3 flow chart in **Appendix F.**



In SFMTA's recent facility projects, Muni Metro East (MME) Expansion and SFMTA Phelps Substation, the timeline from application to energization both averaged 5 to 5.5 years per PG&E's schedule to SFMTA. The cost to the MME Expansion Project for the Service Upgrade was estimated in the SIS Report to be approx. $10M excluding PG&E substation upgrades at its Potrero Substation (22nd Street & Illinois). In summary, the electrical service to essentially bring the required power for BEB electrification to Kirkland carries significant time and capital cost to the project. This is a significant project risk to the Kirkland Bus Electrification Project

(2028).

F.2 PG&E Electrical Service Upgrade

The existing PG&E electrical service to Kirkland Yard is inadequate to provide the required power for SFMTA's battery electric buses (BEB) which will replace the existing fossil-fuel bus fleet. Hence, an electrical service upgrade is required.

The WSP Report reported Kirkland receives its service loads from PG&E Mission Substation. WSP's report identified Circuit 1111 (12kV circuit) from Mission Substation which has approximately 5.5 MW of available capacity. While the Report estimates there is 5.5 MW of available capacity from PG&E Mission Substation, this will be confirmed with PG&E through SFMTA's monthly PG&E issues meeting that are convened with SFPUC. The service application that the Project Team submits will produce a Systems Impact Study (SIS) Report where PG&E will identify its substation for the source of power delivery to Kirkland.

The WSP Report estimates approximately 7.3 MW as shown on their single line diagram for the electrical service to power Kirkland's 91 BEB buses. As part of the PDR development, the report's finding was reviewed, and the Engineer's rough estimate is 7.6 MW based on the Report's 150 kW per charging cabinet. Taking into consideration, the BEB and EV-charging are new technologies, and the capital investment is high, the recommendation is to additionally evaluate the EV-charging load estimates using energy consumption-usage software such as Blu-Wave or equal in the following phase – Preliminary Engineering. The WSP Report states PG&E has a limit of 10MW for 12 kW feeder service for upgrade requests from customers.

A. Electrical design assumptions in the **WSP Report** proposes the following:

1. 36 DC charging cabinets to 72 pantographs from overhead pantographs[1]
2. 150 kW charging cabinets for 1:2 charging ratio
3. WSP Report also states charging for 91 BEB's
4. Overhead structural support columns configured every 3 or 4 bus bays
5. 1 medium voltage switchgear and 3 medium-low voltage transformers
6. Each 3,325 kVA Transformer feeds a max. 20 charging cabinets at 150 kW
7. Pantograph charging at 75 kW rate with assumed 1:2 charging ratio

[1] Task 2: Facility Power Needs and Technology Assessment, Page 69 (PDF #81 of 196)

B. Design discussions from **SFMTA ZEB Program Team[2]** provided the following new design assumptions for the PDR:

1. 46 DC charging cabinets to 92 pantographs with1:2 charging for 91 buses.
2. 150 kW charging cabinets for 1:2 charging ratio – *per WSP Report*.
   Note: SFMTA ZEB Program recommended recently to use 200 kW like at Woods. If this is the operational preference, the PG&E load request will increase greater than 7.6MW.
3. Utilizing a raised island to house electrical and EV charging cabinets – *width to be verified in PE Design Phase.*
4. 91 BEB Buses[3] - in early Y2028 for Construction Completion

5. Incorporating aspects of the WSP Master Plan with adjustments as required.

[2] SFMTA ZEB Program Team represented by Bhavin Khatri, ZEB Program Manager
[3] Task 3: BEB Implementation Facility Master Plan, Page 11 (PDF #19 of 88)

The SFMTA ZEB design assumption for the Kirkland Bus Electrification Project differs from the WSP design and planning approach of 1:2 charging at 75 kW rate. Proceeding with a larger kW charging rate such as the Wood eBus Charging Bus (1:2 charging at 200 kW rate before split) Pilot Project will realize a larger electrical load, hence a larger service application shall be submitted to SFPUC/PUC for the Kirkland Bus Electrification Project.

F.3 PG&E Service Vault Location & Routing

The WSP report recommends the medium voltage electric service and meter required to power the BEB buses be located outside the Kirkland Facility at the corner of Beach Street and Stockton Street. After a site visit, the existing site conditions show this northeast corner location to be constrained and not obstruction free.

Depending on how PG&E routes the incoming power and its requirements for the Type 7 underground vaults, actualizing the location for the service vault location in the right-of-way, the location and routing of the new service may negatively impact the existing SFMTA F-Line service trackway, mini-high boarding platform and ADA passenger ramp as shown in **Figure F**. This issue will have to be carried into the Preliminary Engineering Phase to review the constructability of this service location as well as coordination with SFPUC/PG&E.

Figure F: *Beach & Stockton Streets looking west)*

Work done near the overhead lines and trackway needs to be coordinated SFMTA Transit/Operations. Coordination will occur during detail design and construction phases of the project.

F.4 Horizontal Code Clearance Requirements

The third issue is clearance requirements to applicable codes. The National Electrical Code (NEC) defines the work clearance for electrical equipment. The actual distance depends on the voltage of the equipment and location. The minimum horizontal clearance requirement is 3 feet from face of the electrical panel or equipment door.

There are two key parts to the clearance issues here: (a) width of the equipment island housing the electrical equipment and EV charging cabinets, and (b) the underground vault size to comply to NEC and other applicable codes.

a. Electrical Island: The electrical equipment, switchgears, transformer and EV charging cabinets per the WSP Report are located on a continuous linear raised concrete island between bus bays. In a preliminary review of the dimensions, the equipment island may need to be wider in width, thus affecting the dimensional layout of the yard and shifting the bus charging lanes that are immediately adjacent. The island if increased in width will have a domino-effect relocating or shifting adjacent bus lanes to accommodate the increase in size by moving southward towards North Point Street and reducing the number of BEB buses stored and maintained at the facility. This requirement must be further studied along with the configuration of bus storage in Preliminary Engineering (PE) Phase.

b. PG&E Vault and Service Entrance Equipment Size: PG&E Green Book stipulates an 8-foot front and back work clearance requirements at the incoming pull and metering section. The depth of the pull and metering sections is 8-foot as well. The size of the PG&E vault (#7 box) is 4'-6" x 8'-6", sufficient clearance to remove covers, operate with hot stick, replace equipment and cables, etc., is required as 3' from the outside edge of the long side and 5' from the outside edge of the short side per PG&E Document 051122. During the Preliminary Engineering Phase, the size of the PG&E required vault and equipment shall be space-proofed to comply with NEC and other applicable codes as well as to PG&E design and construction guidelines. As indicated above in the early section of Medium Voltage Electric Service, constructability considerations, service impact to the existing F-Line station stop with its mini-high platform and potentially the Muni trackway are other key considerations with the underground vault excavation, existing utilities, and construction.

The project team assumes that the PG&E SIS Report will take this into consideration. At a minimum, the Preliminary Engineering shall coordinate this design and construction issue(s) with PG&E.

Another key agency integration that has been highlighted as a design criterion is flooding and sea level rise concerns. The site of Kirkland Yard is in the flood zone. The PG&E Vault while not a SFMTA property or asset is critical to service resiliency of the BEB fleet. In PE Phase, the flood criteria should also be discussed and coordinated with PG&E to provide flood resiliency to the service vault if that decision is mutually determined.

G. Elimination of Employee Parking

Under the WSP Report, the existing employee on-site parking is eliminated. Elimination of employee parking will be a major concern to the operation of the Kirkland Facility and its employees. The operators who operate the buses in the early A.M. morning of the shift currently park their vehicles in the yard. In addition, there are yard staff employees, Supervisors and non-revenue vehicles (NRV) parked in the existing yard. Given the site is constrained, the staff vehicles are not permanently parked in place and are moved accordingly to accommodate bus movements during the day. There is no free public parking near Kirkland Facility. According to Local 1414 - Automotive Machinists' Memorandum of Understanding

(Appendix A) for the period covering "July 1, 2022 – June 30, 2024" the following is cited "*Assigned parking provided at work locations where it is currently provided as available*." This is a key concern and risk to the project since parking is subject to a labor agreement with a local union. If parking is not resolved satisfactorily, this will severely constrain Kirkland Yard's bus service operations.

See **Appendix G** for the matrix evaluation on the impact of parking elimination and alternative options to providing employee parking which will be studied and analyzed in the Preliminary Engineering (PE) Phase.

H. Aesthetics and Neighborhood Concerns

Kirkland Yard is located in Fisherman's Wharf and proximate to many neighborhoods, atypical from a traditional bus yard. The proposed inverted pantographs, that will be able to reduce operational impacts and serve the greatest number of buses, are significantly sized in quantity and physicality, and may raise concerns about aesthetics with the surrounding community. Project may need to re-scope and/or mitigate the type of charging facility, and respectively the number of buses served, based on community feedback. This risk is primarily related to scope and governance approvals issued by various city elected boards and regulatory entities.

I. Existing Fluid Tanks

The existing fluid tanks are a key facility consideration to have maintained and serviceable to the electric-hybrid buses during project construction. Three aboveground storage tanks and two underground storage tanks are located on the north-east corner of the Kirkland Facility. The existing storage tanks consists of one 1,000 gallon waste oil above ground storage tank (AST), one 2,000 gallon lube oil AST, one 2,000 gallon automatic transmission fluid AST, and two 20,000 gallon biodiesel underground storage tanks (USTs). The biodiesel is used to fuel the electric hybrid buses at the Kirkland Facility and fueling generally occurs during the evening pull-in. The ASTs and USTs will remain in place and will continually be used by SFMTA during the construction and post-construction of Kirkland Bus Electrification Project.

Section 8.0 of this report includes additional information on the underground and above ground storage tanks on the site. According to WSP Zero-Emission Bus Fleet and Facility Needs Report, after Y2040 when the entire facility will be replaced, the existing tanks will be demolished. The issue is related to construction phase when contractors need to facilitate continued access to the fluid tanks.

J. Demolition of Existing Operations Building and Existing Trailer

A key issue during demolition of the existing Operation Building and existing trailer is the assurance the existing functions are programmed and provided to the temporary trailer facilities based on labor MOUs and employee expectations. From the WSP Report, the Operations Building and existing trailer will be demolished to accommodate additional BEB bus storage on site. The functions of the existing Operations Building and the existing adjacent trailer will be moved to new temporary trailers located on the west side of the Bus

Yard as shown in **Figure D.** In Preliminary Engineering Phase, the Project Team will conduct interviews to confirm the program functions and relocations status with the operations and maintenance stakeholders as well as delegated representative staff at Kirkland facility. This will be included in a space programming matrix as a design baseline for preliminary engineering.

The Kirkland Operations Building currently houses the dispatch room, receiving room, union office, superintendent offices, inspector offices, "Gillie Room" (employee lockers, rest area, and pool table), restrooms, and janitor closet. The existing trailer houses the operator's training area, fitness room, and storage room. There is a lack of organized and dedicated storage in the existing Operations Building.

K. Facility Utility Service Connections

Facilities utility service connections are key issues for design and construction. Based upon the existing conditions of the aboveground and subsurface conduits and piping in the Yard itself and at the new utility point of connection (POC), existing utilities may need to be relocated or replaced. The conditions will be evaluated in design and construction phases of the project.

When the existing Operations Building and trailer are demolished, the existing utilities (i.e., water, gas, sewer, and electricity) servicing the building and trailer will be capped; and new utility services will be provided at their new location on the west side of the yard along Powell Street. The new utility point-of-entry (POE) connections at Powell Street are premised on the future location of the Maintenance/Operations Building at this location.

A utility survey and coordination with utility agencies will be conducted in the Preliminary Engineering Phase of this project to determine the best location to tap into the new utility services, and best locations to cap the existing services. In PE Phase, any shared costs with other city agencies and utility agencies shall be identified and included in the Project Construction Cost.

L. Yard Drainage

Yard drainage is a key issue for the facility's long-term functionality that is non-existent at the existing yard. There is no storm water drainage connection to the storm/sewer system or catch basins in the bus storage area. The condition of the asphalt pavement in the yard is poor and subject to periodic depressions as shown in **Figure G** and **Figure H.**

Figure G: *Puddling in yard after recent rain.*

Figure H: *Potholes in pavement (looking west)*

During the initial phase of Kirkland Bus Electrification Project, new storm water drainage, catch basins, area drains, and pavement will be provided in the yard and coordinated with the structural foundations and elements of the gantry structure supporting the inverted pantographs. The new stormwater system needs to comply with Public Works Stormwater Water Management Ordinance (SMO), Public Works Code, Article 4.2 Sections 147-147.6. The SMO applies to all new and redevelopment projects that create and/or replace 5,000 square feet or more of impervious surface in combined sewer areas or 2,500 square feet or more in separate sewer areas. The SMO requires compliance with Stormwater Management Requirements and Design Guidelines, which outlines the mandatory requirements for managing post-construction stormwater runoff and provides guidance on how to incorporate green infrastructure into site design.

M. Flood Risk

As shown in **Figure I**, the Kirkland Facility is situated in the Sea Level Rise Vulnerability Zone.

Under the Port of San Francisco Resilient Program, the Port in partnership with SFMTA, U.S. Army Corps of Engineers, and other City agencies are developing a *Draft Waterfront Adaptation Plan*. The goal is to release the draft plan in summer of 2023. The plan will identify a preferred approach to reduce flood risks from sea level rise and extreme storms. Possible strategies in the plan could include raising the shoreline along roadways such as Embarcadero to address up to 7-feet of sea level rise expected 2100.

Figure I: *Future Flood Risk Area*

The flood risk issues are being identified in the PDR. These issues require a broader collaboration as mentioned in the Port of San Francisco Resiliency Program. It requires a coordinated mitigation plan that is long in developing, hence the current plan is for this to be addressed when the Kirkland Facility is scheduled to be entirely re-built in 2040. In summary, the initial phase of the Kirkland Bus Electrification Project will not include scope requirements for the long-term flood risks and sea level rise. See **Appendix H** for the *Draft Port of San Francisco Recommendations for City Coastal Flood Risk Reduction*, *September 29, 2021* for additional reference information.

However, the PDR and the PER can introduce a possible scenario option in pre-planning efforts such as placing the backup power systems on an elevated platform above the flood datum. This would reduce the operational risk during periods of flooding and/or rise of sea level during the useful life of the battery systems. If there are critical electrical components to maintain electrical power, penetrations, door openings and operable doors or gates can be designed for future installation of flood resilient doors and seals through wall and floor penetrations.

Additional information on the resilient program initiative is found in the following link: https://sfport.com/wrp/waterfront-adaptation.

N. Seismic Risk

The design and construction of Kirkland Electrification Project will be required to conform to seismic requirements listed in the latest edition of the San Francisco Building Code (SFBC) which comprises of the California Building Code (CBC) and the San Francisco Amendments. This is a key design issue and consideration.

O. Other Project Considerations

Figure J summarizes several of the key issues, risks, and constraints enumerated in text boxes on an aerial site plan. The overarching key component is the electrical upgrade work for the electrification of Kirkland Bus Yard Facility. Some key highlights of which are:

- ADA Upgrades along path of travel,
- Addressing site security of the facility such as CCTV, access control, intercom and vehicle gates – consulting with SFMTA Enforcement Task Force committee,
- New perimeter fencing around the facility,
- Ground condition, soil quality and site assessment remediation (SAR); and
- Bus Turning Radius (Note: Based upon the bus turning radius study, if a larger bus radius is needed to what is shown on the WSP report, the number of buses that can be stored and maintained at Kirkland Yard will be reduced).

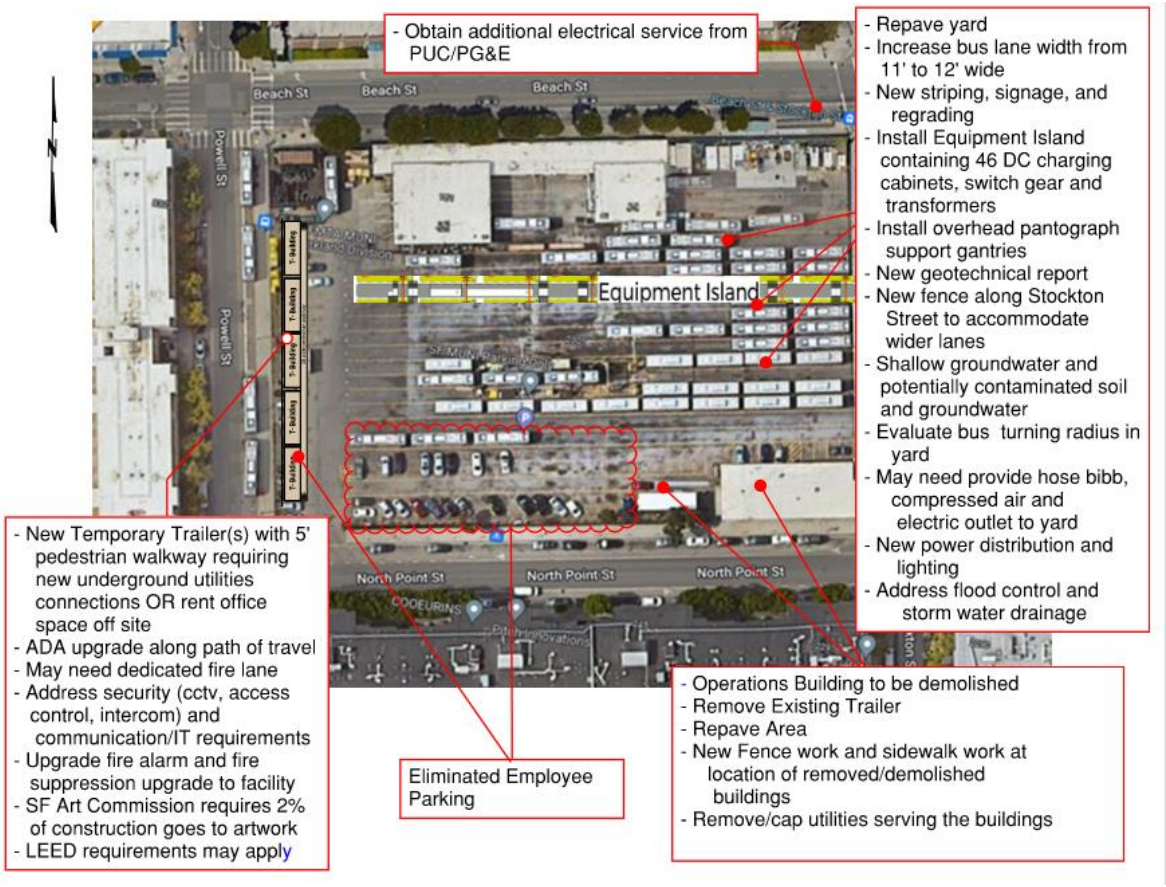


Figure J: *Issues, Risks and Constraints*

7.0 Contract Delivery Methods

The project is investigating and evaluating various contract delivery methods for the design and construction of the Kirkland Facility with critical BEB infrastructure. The uniqueness of this new emerging EV-charging technology for BEB depot charging is still evolving within the OEM (original equipment manufacturer) and BEB industry whereas the codes and standards (such as NFPA, SAE, APTA and building codes) have also not been formalized. The contracting evaluation process shall take this as a focus point in the procurement selection criteria.

Project delivery options that are under consideration include Design-Bid-Build (DBB), Design-Build (DB), Progressive Design Build (PDB), Construction Manager/General Contractor (CMGC), Construction Manager at Risk (CMR), and Turnkey. A simple matrix outlining the pros and cons of each alternative contract delivery method is included in this chapter for comparison and evaluation purposes.

Traditionally, the SFMTA has been involved principally on DBB projects for its capital program projects. The SFMTA is acquiring new exposure and experience to PDB on the current 1399 Marin Temporary Bus Facility which is in the RFQ/RFP procurement phase. The SFMTA has limited experience with CMGC but not in the typical framework of that project delivery method. That atypical CMGC experience should not dissuade SFMTA from CMGC. A resonating positive (pro)

consideration of CMGC is it allows the Owner, SFMTA, to work with its own selected design team and with the CMGC Contractor. The Owner is at the table with the CMGC to determine the design/construction scope, schedule & budget (SSB) as well as constructability issues. The Construction Manager collaborates with Owner throughout the design and construction phases of the project when they join the Project at the completion of 30% (Preliminary Engineering) level.

At Pre-Development Level, the objective is to identify all the viable options for contract delivery, enumerate the advantages and disadvantages in consideration to what is the most appropriate application for the Kirkland Facility taking into key factors such as schedule, budget, and cost. The matrix will be carried into the next phase, Preliminary Engineering, where it is anticipated a recommendation will be formulated and presented. This timeline would align with alternative project delivery methods such as design-build (DB), progressive design build (PDB) and CMGC. It probably will not preclude other options such Turnkey either as a well-defined scope, design criteria and reference documentation are positive elements in a set of bridging documents.

A summary of each contract delivery option is respectively described in **Appendix I.**

8.0 Other Projects to Consider/Integration

8.1 Utilities

Service utilities required for the project may include but not limited to: electrical (bus charging power-12KV/600V), electrical (building power-600V), sewer/stormwater connections, domestic water connection, fire water connection (sprinklers/site hydrants and/or public right-of-way hydrants), and communication connection. The utilities requirements for the Kirkland Electrification Project are identified in the PDR and will be determined for design in the Preliminary Engineering phase of the project.

A NOI (Notice of Intent) letter(s) will be used during the Preliminary Engineering Phase of the project to contact all utility companies within the project limit. The NOI will be uploaded to the City Utility Identification and Coordination platform (DotMaps).

The result of the utility composite map/plan or an underground utility matrix of general location and depth, will be included as part of the Preliminary Engineering Report.

8.2 Main Switchgear

The existing Kirkland Facility main switchgear is obsolete, and parts are difficult to procure. The replacement of the switchgear is not part of the Kirkland Yard Electrification Project and was not included in the WSP Zero Emission Reports, however a request has previously been made by Transit to replace the main switchgear. If the replacement of the switchgear is included in the Kirkland Electrification Yard Project prior to year 2040, more funding is needed for the project.

8.3 Past Environmental Projects

At Kirkland Yard site, SFMTA had another project in construction prior to the Bus Electrification Project. SFMTA had a project for tank replacements at the Yard and the design, construction, as-builts and environmental documents could be useful information for Preliminary Engineering Phase,

Figure K: *Exist. 20,000-gal. UST being removed from conc. vault*

MUNI has stored petroleum products in underground tanks at Kirkland Facility since 1950. Since then, the Kirkland Facility has undergone numerous environmental improvements and remediation activities. The more recent major activities are described herein. In 2017, two existing 20,000-gallon single-wall diesel underground storage tanks (USTs) stored in a concrete vault near the north-east corner of the facility, was replaced with two new 20,000-gallon double wall biodiesel USTs. The original USTs were installed in 1983, see **Figure K**.

In 2017, the existing underground vault and concrete pad were expanded to accommodate new double-wall biodiesel USTs. In addition, the three fuel dispensers, their under-dispenser containment system, and USTs underground piping systems were also replaced.

In 1998, a 2,000-gallon lubricating oil underground storage tank (UST), a 2,000 gallon automatic transmission fluid UST, and a 1,000-gallon waste fluid UST were removed and were replaced with three above ground storage tanks of the same capacity. The three above ground tanks are shown in **Figure L** and are situated in the north-east corner of the Kirkland Facility.

Figure L: *Existing Aboveground Tanks*

Free products containing hydrocarbons have been discovered in the latest edition of the San Francisco Building Code (SFBC) which comprises of the California Building Code (CBC) and the San Francisco Amendments. This is a key design issue and consideration groundwater on site in the mid-1980s. In March 1988, a free-product recovery system was installed and operated until December 1992. A replacement system was installed in 1995.

By 1998, the product skimming system was primarily pumping water, so the system was shut down in November 2000. The Kirkland Facility has been in the San Francisco Department of Public Health Local Oversight

Program (LOP) for USTs since 1994. The LOP at the San Francisco Department of Public Health has been discontinued as of July 1, 2021. All LOP cases have been transferred to the State Water Resources Control Board (WRCB).

The underground tank replacement project for Kirkland Yard is substantially completed and in operational use. Project close-out is in progress including completion of as-builts documents.

9.0 Project Team/Resources

This chapter introduces the members of the project team
starting with SFMTA and other Agency divisions. The various units, divisions, departments, and consultants are in the process of being contacted to confirm availability and resources to meet the proposed project scope. The proposed members of the project team are as follows:

SFMTA Capital Programs and Construction

- Project Manager: Quon Chin
- Project Engineer: Lang Huey
- Project Planner: Chava Kronenberg
- Electrical *(Lighting, Fire Alarm, Security, Power, Communications, Access Control, Conduits to IT equipment)*
- Mechanical: Plumbing, Fire Suppression, HVAC
- Quality Control

SFMTA FIT/ Real Estate/ Building Progress: Funding and Capital Program Management

SFMTA Transit Operations: Operational Staging and Approvals

SFMTA Planning *(Environmental Review & NEPA Support; (Seismic and Flood Issues)*

SFMTA Accessibility *(ADA Upgrade Requirements)*

SFMTA Communications *(Public Outreach and Engagement Team -POETS)*

SFMTA Government Affairs *(Community Relations)*

SFMTA Information Technology *(Fiber routing, Radio, Computer Aided Dispatching, IT equipment, WiFi, networks, Translink, Clipper, CCTV, Fleet Watch, Firetide Radio and server)*

SFMTA Construction Routing *(Traffic Control and Sidewalk Work)*

San Francisco Public Works

- Site Assessment and Remediation (SARs) *Handling of Hazardous Materials and Waste*
- Hydraulics *(sewer/stormwater)*

San Francisco Public Utilities Commission: Permits & Approvals *(water, sewer & streetlights and liaison to PG&E Additional Electrical Services)*

San Francisco Arts Commission *Art Enrichment & Civic Design Review*

San Francisco Environment *Green Halo Requirement Construction Debris Recycling*

San Francisco Department Building Inspection: DBI Permits & Approvals *(Building, Electrical, Sidewalk Improvement and Encroachment, Plumbing, Fire, etc.)*

A/E Consultants:

- Architectural, Structural (seismic, foundation, structural support), Geotechnical, Landscape Architect (fencing), and Civil (bus turning), Surveyor
- Code Consultant – *i.e., NFPA & ASCE for BEB fire life safety*
- Conduct utility investigation and prepare underground utility composite drawing; prepare utility risk assessment and recommended mitigations.
- Trenching Design for underground electrical connections to PG&E
- Prepare Geotechnical Report
- Prepare ADA Drawings and LEED documents
- Cost Estimator and Scheduler
- Prepare Design Criteria Report

Environmental Consultants

- Develop parameters and guidelines for environmental assessment and technical studies for NEPA and CEQA applications

10.0 Project Cost Estimate

Phase	Total Cost by Phase	Remarks
1.0 Planning	**$500,000**	
1.1 SFMTA Labor	$375,000	
1.2 Non-SFMTA Labor	$0	Work Orders/Work Authorizations
1.3 Environmental Consultant Costs	$125,000	
1.4 Contingency	$0	
2.0 Preliminary Engineering (Subtotal)	**$5,875,000**	
2.1 SFMTA Labor	1,175,000	
2.2 Non-SFMTA Labor	470,000	Work Orders/Work Authorizations
2.3 Environmental Consultation	1,880,000	
2.4 A/E Consultant Costs	1,175,000	
2.5 Contingency	1,175,000	25% Contingency on PE
3.0 Detailed Design	**$11,750,000**	
3.1 SFMTA Labor	3,760,000	
3.2 Non-SFMTA Labor	1,880,000	Work Orders/Work Authorizations
3.3 A/E Consultant Costs	3,760,000	
3.4 Contingency	2,350,000	25% Contingency on Design
4.0 Contracting	**$119,850,000**	
4.1 Construction Contract	$94,000,000	Year of Expenditure - 1Q 2026
4.2 Arts Commission Work	1,880,000	
4.3 Contingency	23,970,000	25% Contingency on Contracting
5.0 Construction Management	**$26,320,000**	
5.1 SFMTA Labor (CM+Engineering)	12,220,000	
5.2 Non-SFMTA Labor	14,100,000	Work Orders/Work Authorizations
5.3 Contingency	6,580,000	25% Contingency on CM
Total Project Cost	**$170,875,000**	

11.0 Project Funding Sources

Name in Ecosys	Kirkland Bus Electrification	
Name in CIP	Kirkland Bus Electrification	
Contributing Funding Sources	Prop K (in process)	$1,073,000
	SB-1 (State Gas Tax)	$ 668,125
	SFMTA Operating Funds	$ 450,000
	Low or No Emission Grant Program (tentative)	TBD
Total Funded	***Pre-Development & Partial (PE)*** *Preliminary Engineering Design Phase*	**$2,191,125**

12.0 Preliminary Project Schedule[0]

Task	Begin Date	End Date	Duration (Months)
Planning Phase			
Pre-Development Report Complete	11/1/22	4/28/23	6
Preliminary Engineering Phase			
Environmental Clearance	12/1/22	3/3/25	27
Preliminary Engineering Report Complete (30% design)	5/1/23	2/29/24	10
Detail Design Phase			
Detail Design (65% Design) *Inclusive of 1-month Comment/Response*	3/1/24	11/4/24	8
Detail Design (100% Design) *Inclusive of 1-month Comment/Response*	11/5/24	7/3/25[1]	8
Contracting Phase			
Advertise Construction *In lieu of DBB, then concurrent w/design*	7/5/25	10/30/25	4
Award Construction Contract *In lieu of DBB, then concurrent w/design*	11/4/25	12/30/25[2]	2
Construction Management Phase			
Construction with NTP	12/24/25	12/31/27	24
Substantial Completion	8/16/27	8/16/27	N/A
Commissioning and Certification	8/17/27	2/15/28	6
Administrative Closure Phase			
Close Out Activities	01/03/28	6/30/28	6

[0] Table (schedule) above is based on a traditional Design-Bid-Build Contract Delivery Method.

[1] In an alternative contract delivery method, the Detail Design Phase is concurrent with Advertising, Bid and Award e.g. w/PDB/CMGC but requires the overall 22 months for design w/Builder.

[2] Construction End Date will include continuation of design period to this end date.

13.0 POETS/Community Engagement

The Project Team working with the SFMTA POETS Team will engage with community members and key stakeholders in the problem-solving process to listen, address and communicate issues which affect them. This means involving community members in activities from identifying the relevant issues, working on decisions addressing the issues, to evaluating and sharing the results with the community. The objective is for the residents, businesses and other key stakeholders to feel involved with the community activities and decisions as the Kirkland Bus Electrification Project progresses, and they being able to explain or interpret them positively to others.

In the Pre-Development Phase, the Project Team has reached out to the POETS team providing the public outreach and engagement team with the scope of work and project objectives. The POETS having involvement on the SFMTA Kirkland Project to replace the underground diesel tank at the yard has project familiarity and the key community constituency. While this is essentially a planning phase, the POETS team has provided additional input the design team has initiated on the public outreach and engagement plan. It is in outline form to further advance and complete in the Preliminary Engineering Phase.

Reference Link*:* *SFMTA Public Outreach and Engagement Site*

The PDR has identified the following stakeholders who reside, work or travel through the Project Area include but are not limited to the following:

Residential
Telegraph Hill, North Beach

Business District
Fisherman's Wharf, Pier 39, Pier 45, North Point Shopping Mall, Hotel Riu Plaza and iHOP

People Who Drive
Big Bus Tours, Uber, Lyft, Private Vehicles

People Who Ride Bicycles
Blazing Saddles, Bay City Bike, Wheel Fun Rentals, Bay Wheels (bike share program) and local cyclists.

Neighborhood Organizations
Northern Waterfront Advisory Committee (NAC)

Merchant Group
Pier 39 & Pier 45
Longshoremen Lot 341

For additional information on the POETS Plan, see **Appendix K** for the outline of the public outreach and engagement plan.

14.0 Approvals

KIRKLAND BUS ELECTRIFICATION PROJECT PRE-DEVELOPMENT REPORT – APPROVAL SIGNATORY SHEET			
Role	**Name**	**Initials/Signature**	**Date**
Capital Programs & Construction **Facilities Project Manager**	Quon Chin		
Capital Programs & Construction **Acting Deputy Director of Engineering**	Jane Wang		
Capital Programs & Construction **Director CP&C** **Deputy Director of Project Delivery**	Aidin Sarabi		
SFMTA Fleet Maintenance **Chief Maintenance Officer**	Louis Guzzo		
SFMTA Transit Program Delivery **ZEB Bus Program Manager**	Bhavin Khatri		
SFMTA Transit Program Delivery **Chief Program Manager**	Janet Gallegos		
Capital Program Manager **Strategic Real Estate Manager**	Kerstin Magary		
Capital Program Manager **Chief Strategy Officer**	Jonathan Rewers		
SFMTA Transit Operations **Director of Transit**	Julie Kirschbaum		

15.0 Appendices

A. Innovative Clean Transit (ICT) Regulation Fact Sheet

CALIFORNIA
AIR RESOURCES BOARD

Innovative Clean Transit (ICT) Regulation Fact Sheet

DATE May 16, 2019

CONTACT
Email shirin.barjani@arb.ca.gov
Phone (916) 914-1031

CATEGORIES
Programs Innovative Clean Transit

What is the ICT regulation and to whom does it apply?

The ICT regulation was adopted in December 2018 and requires all public transit agencies to gradually transition to a 100 percent zero-emission bus (ZEB) fleet. Beginning in 2029, 100% of new purchases by transit agencies must be ZEBs, with a goal for full transition by 2040. It applies to all transit agencies that own, operate, or lease buses with a gross vehicle weight rating (GVWR) greater than 14,000 lbs. It includes standard, articulated, over-the-road, double-decker, and cutaway buses.

What are the ICT regulation requirements?

The ICT regulation includes the following elements:

- A ZEB Rollout Plan required from each transit agency, approved by its Board, to show how it is planning to achieve a full transition to zero-emission technologies by 2040. Large transit agencies have to submit their Rollout Plan by July 1, 2020, and small transit agencies by July 1, 2023;
- ZEB purchases with various exemptions and compliance options to provide safeguards and flexibility to transit agencies;
- Low NO_x engine purchases, unless the transit buses are dispatched from NO_x Exempt areas;
- Use of renewable diesel or renewable natural gas for large transit agencies, and
- Reporting and record keeping requirements.

Do the ICT requirements differ by transit agency fleet size?

Yes, the requirements differ for large and small transit agencies. A transit agency is considered large if it operates at least 100 buses in annual maximum service in an urbanized area with a population of at least 200,000. However, if it operates in either the South Coast or San Joaquin Valley Air Basins with more than 65 buses in annual maximum service, it is also considered a large transit agency. All others are small transit agencies. The number of buses in annual maximum service excludes demand response buses.

What are the ZEB purchase requirements?

As shown in the table, the ZEB purchase requirements begin in 2023 for large transit agencies and 2026 for small transit agencies, based on a percentage of new bus purchases each year that must be zero-emission.

The ZEB purchase requirements for articulated, over-the-road, double-decker, or cutaway buses do not start until 2026 or later. These bus types remain exempt from the ZEB purchase requirements until they pass the Altoona testing. Note the 2023 ZEB purchase requirement will be discharged (the requirement will be removed) if California transit agencies collectively purchase at least 850 ZEBs by December 31, 2020. The 2024 ZEB purchase requirement will be discharged if at least 1,250 ZEBs are purchased by December 31, 2021.

ZEB Purchase Schedule (ZEB Percentage of Total New Bus Purchases)

Year	Large Transit	Small Transit
2023	25%	-
2024	25%	-
2025	25%	-
2026	50%	25%
2027	50%	25%
2028	50%	25%
2029	100%	100%

Flexibility Options

Transit agencies may be able to take advantage of flexibility options to comply with the ZEB purchase requirements, including:

- Bonus credits for early ZEB purchases: to recognize transit agencies that took more risks by early purchases of innovative technologies; credit is based on each early acquisition of a zero-emission bus per the schedule in the regulation.
- Zero-emission mobility options: to encourage innovation in providing first- and last-mile connectivity and improved mobility for transit riders; and
- Formation of a joint ZEB group: to allow transit agencies to work together to collectively comply with the ZEB purchase requirements.

Note: To be eligible to form a joint ZEB group, two or more transit agencies must either share the use of infrastructure, be in the same air basin, be in the same air district, be under the same Metropolitan Planning Organization, or be under the same Regional Transportation Planning Organization.

Provisions for Exemptions of a ZEB Purchase

To ensure transit service is not adversely impacted, the regulation has exemptions for circumstances that are beyond a transit agency's control. Providing that all required information is correct and complete, exemptions will be granted upon request under the following circumstances:

- When the needed ZEB type is not available;
- When daily mileage needs cannot be met;
- When gradeability needs cannot be met;
- When incremental capital or electricity costs for depot-charging battery electric buses cannot be offset after applying for all available incentive and funding programs;
- When there is a delay in infrastructure construction; or

- When a transit agency declares a financial emergency.

More Information

For questions, please contact Yachun Chow at (279) 203-7449, or Shirin Barfjani at (916) 914-1031.

Source URL: *https://ww2.arb.ca.gov/resources/fact-sheets/innovative-clean-transit-ict-regulation-fact-sheet*

B. SFMTA BEB Rollout Plan, Final 2022

Zero-Emission Bus Rollout Plan

Prepared for:

CALIFORNIA AIR RESOURCES BOARD

Prepared By:

WSP

SFMTA

See Link below to view Rollout Plan *

*https://www.sfmta.com/sites/default/files/reports-and-documents/2022/07/sfmta_rollout_plan_final_2022.pdf

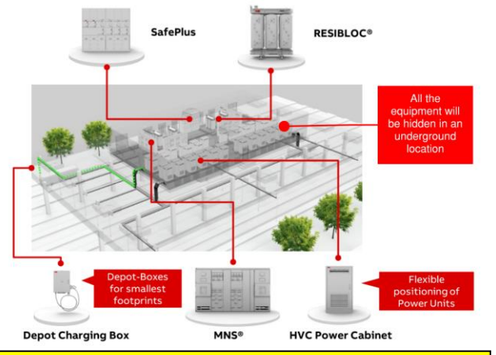
C. BEB Electric Vehicle Charging Option Comparison Matrix

BEB Electric Vehicle Charging Option Comparison Matrix

TYPE	EV Option Description	Environmental Impact Visual Assessment	Pros	Cons	Remarks
LOW	Plug-In Dispenser Chargers	Low Visual Impact	1. Low visibility of infrastructure. 2. Lower cost w/o gantry superstructure and foundation system. 3. Less invasive construction approach. 4. Potentially less cost.	1. Dispensers on islands - increase footprint impacts bus circulation. 2. Requires manual EV dispensing. 3. Adds time factor to operations. 4. Requires underground ductbank for EV feeder distribution. 5.Electrical Substation, Transformer, EV Power Blocks located at grade. 6. Electrical & EV equipment footprint trade-off to bus parking.	1. Low elevation of visible equipment at expense of taking footprint from bus parking. 2. Reduces bus parking size (91). 3. Revised parking configuration to be evaluated in PE Phase to determine level of reduction. 4. Not as conducive to depot parking.
HIGH	Overhead Inverted Pantograph Chargers	High Visual Impact	1. Automated EV Charging. 2. Optimizes bus operations - time. 3. Compact lanes - maximizes bus parking. 4. Minimum parking lane widths. 5. Optimizes bus storage (parking).	1. High visibility of infrastructure. 2. Increased costs. 3. Requires gantry superstructure and foundations. 4. New technology.	Designed for depot fleet parking.
HYBRID	Opportunity Charging - Single Pylon	Compromise between low visual & high visual impact	1. Single structure per bus - lower visual intrusion. 2. Combines single pylon w/inverted pantograph. 3. Reduction is heavy superstructure impact to site. 4. Visual appeal w/its industrial design factor.	1. Potentially increased costs with pylon and inverted pantograph. 2. Wider islands for footprint. 3. Impact to yard configuration and bus parking capacity. 4. Requires underground ductbank for EV feeder distribution. 5. Electrical Substation, Transformer, EV Power Blocks located at grade.	1. Hybrid of dispenser w/inverted pantograph 2. Elevates the form factor in design aesthetics and functionality. 3. Potential reduction in bus storage.
COMBO	Underground Infrastructure with Plug-in Dispenser or Single Pylon	Lowest Visual - Move Electrical Equipment Below Ground	1. Combines advantages of plug-in and pylon w/pantograph. 2. Option with no exposed exterior placed electrical equipment, substations and EV power block. 3. Maximizes open-yard environment.	1. High construction cost to excavate and construct underground level. 2. Requires MEP/FP systems to underground spaces. 3. Waterproofing of U/G structure and build-in flood resiliency	1. No electrical equipment at grade. Improves visual aesthetic of bus yard. 2. If combined with public parking, could provide a revenue stream to SFMTA.

or

+



(Plug-In Dispenser or Pylon Pantograph with Underground "Basement" Infrastructure Area) = **COMBO**

LOW Plug-In Dispenser

Source: ABB

HIGH Overhead Inverted Pantograph Charger

Source: ABB

HYBRID Opportunity Charging – Single Pylon

Source: ABB

D. Example of Proposed Future Buildout at Kirkland Facility

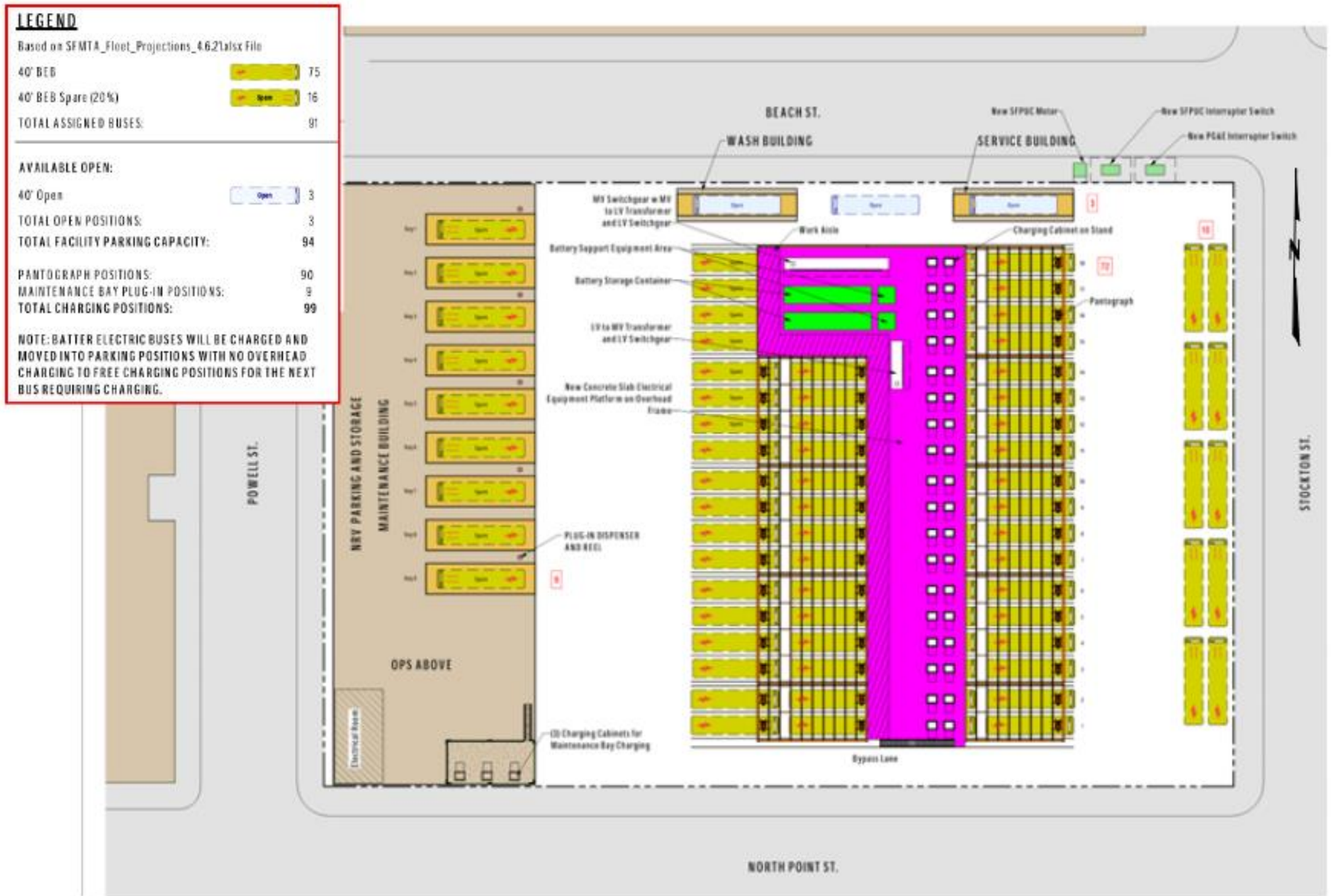


Figure M *Example of Kirkland Full Build-Out Plan (after 2040)*
Source: WSP Zero Emission Plan

E. BEB Orientation to SFFD at Woods Facility Meeting Minutes

Project Name:	SFMTA Kirkland Electrification (FC103)	**Date:**	10/11/2022
Location:	Site Visit 1059 Indiana St. (Woods Bus Facility)	**Time:**	9am to 11am
Report By:	Lang Huey, CP&C Project Engineer		
Present on Site:	SFMTA Fleet, SFMTA CP&C, SFFD, SFMTA Maintenance, Bus Manufacturer Representatives		

Subject: **SFMTA Battery Electric Bus (BEB) Orientation with SFFD**

Purpose:

The purpose of the meeting was to provide the San Francisco Fire Department (SFFD) an orientation session on SFMTA's battery electric buses (BEB) that are in the pilot program based at Woods Bus Facility. SFMTA fleet staff and bus manufacturer representatives familiarized members of the SFFD with the battery electric buses, particularly with regards to the lithium-ion battery packs on the vehicles and to the differences between the battery electric buses and our existing diesel hybrid and trolley bus fleet.

Notes from the Site Visit:

- All BEB have a charging rail on top of the bus. The location of the rail is standardized for all BEB buses. The pantograph (charging mechanism) comes down to the rail to charge the bus. This charging action is different from a trolley bus. In a trolley bus, the bus poles move to the pantograph.
- All BEB manufacturers (NF, BYD, Proterra) have the battery packs on the roof of the buses. They vary in the enclosures.
  - New Flyer (NF) uses a "pod" system. NF replaces the entire pod.
  - NF pods have (6) battery packs per pod. 82 cells per pack.
  - NF has the pods on a 1,000 mile inspection cycle.
- Typical to all BEB's tested, high voltage powers everything on the bus. The inverter stops down the high voltage to lower voltage current for on-board bus equipment. Orange signifies (to SFFD and bus maintainers) the cable/wiring is high voltage. This was consistent with the three BEB manufacturers.
- Proterra buses and BYD buses are different from New Flyer. The New Flyer does not have its own fire suppression system. The Proterra bus has a canister on the roof with water piped to nozzles in the rear compartment. Proterra BEB buses can be distinguished from the New Flyer BEB by a solid glass window.
- New Flyer has a stop actuator button to disable the bus.

Meeting Minutes: SFMTA Battery Electric Bus (BEB) Orientation to SFFD
11-October-2022

Left Pic: Proterra BEB
Right Pic: New Flyer BEB

- BYD manufacturers all electric buses. If there is a problem with one of the power modules, it will disconnect the power in the power pack. SFFD can utilize a hot stick to determine if the power is energized in the bus. It will be up to SFFD if they want to utilize a power stick during firefighting activities. The power stick is used by some authority having jurisdiction in other cities. 24V DC is considered high power. High voltage cables run along the length of the bus roof line and the rear of the bus. If a fire fighter wants gain access inside the bus, his/her best option is to break the side glass for entrance.

  BYD batteries have also been pierce tested to evaluate the impact conditions to the batteries.

  BYD's battery disconnect switch is located on the rear curbside of the bus. The disconnect switch controls high and low voltage. When the battery disconnect is turned off the high voltage is isolated to each batter pack. The 24V DC will cut off all power to the bus.

  Actually, all three (3) manufacturers have the battery disconnect switch on the rear of the curbside of the bus. It was noted the door panel is not locked secure like the access panel to the larger compartment.

- Proterra is considered a composite bus. The fire suppression cylinder is located on top of bus. Fire suppression nozzles are located at the back of the bus. The fire suppression system is activated by thermal sensors. The bus driver or first responder can activate the fire suppression system manually by pressing a button.

- For Hybrid Electric bus (30-ft), the high voltage battery is located on the roof. It has only one battery on the roof.

- For Trolley buses (40-ft and 60-ft), the high voltage battery is located on the back of the bus. It has only one battery on the roof.

- Nova bus and representative were not available during bus orientation.

Meeting Minutes: SFMTA Battery Electric Bus (BEB) Orientation to SFFD
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- Muni BEB numbering system:

    1. 5001-5003: New Flyer
    2. 5004-5006: BYD
    3. 5007-5009: Proterra
    4. 5010-5012: Nova

Site Meeting ended at 11:00am.

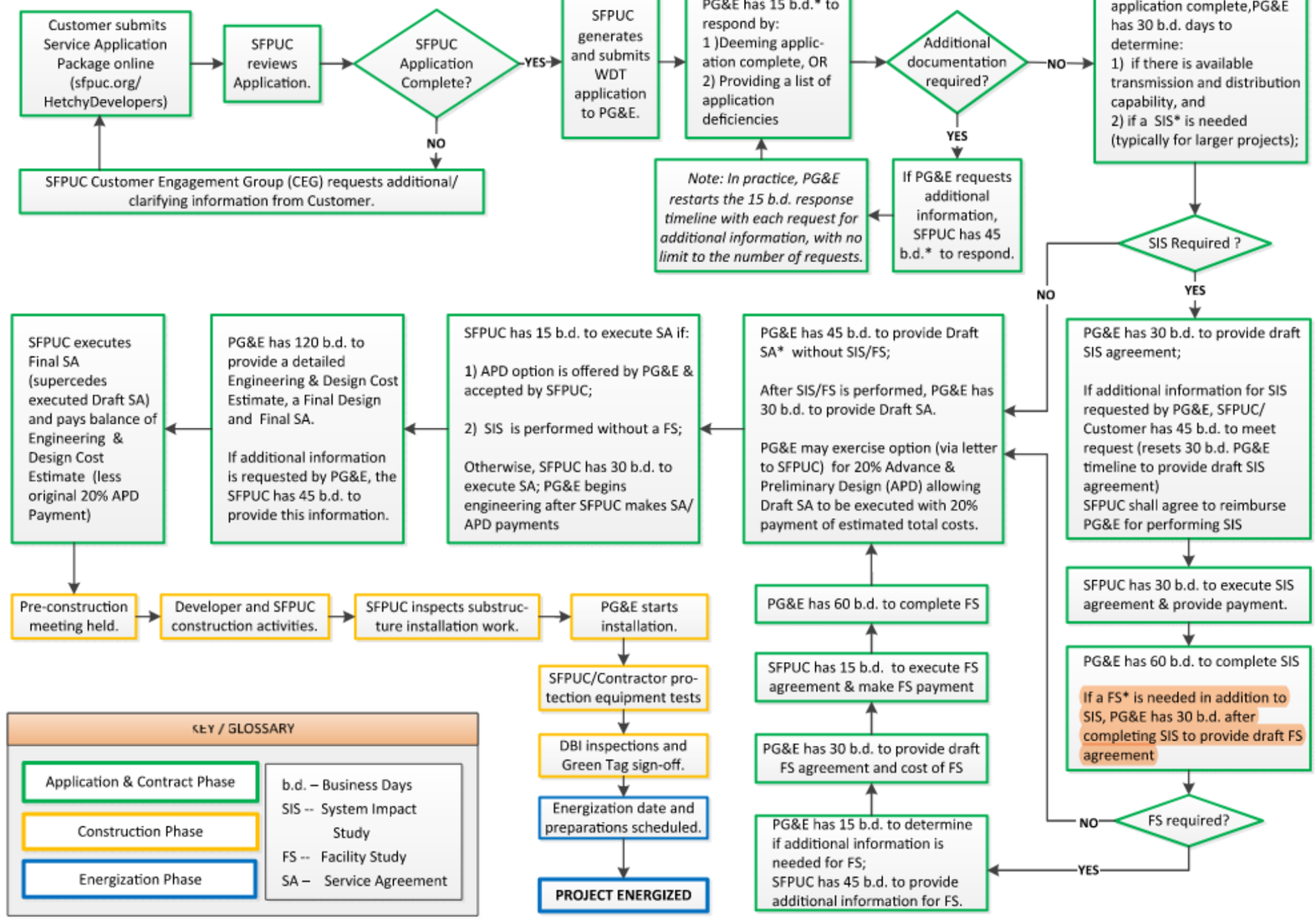
5

F. WDT 3.0 Process Timeline

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

Hetch Hetchy POWER

WDT 3 Process Timeline



G. Facility Parking Matrix

Facility Employee Parking Matrix

TYPE	Parking Option Description	Assessment of Options (High Level)	Pros	Cons	Remarks
No Provision	No Parking Provision for Employees, Supervisors and NRVs	No Parking Option High Risk to Project.	None	1. Elimination of parking impacts operations. 2. If unresolved, major risk to project.	Optimizes vacated employee's vehicular parking for BEB bus charging and storage.
On-Site At-Grade Alternative Mitigation	Elevate the temporary office trailers above grade level for cars to park below the trailers.	Mitigates parking constraint issue. Requires structural to go vertical for office trailers above retaining surface parking.	1. Retains *(% of the)* parking on site. *(may need to offset parking needs w/off-site).* 2. No loss of employee & NRV parking. 3. Maintains (91) BEB bus parking.	1. Elevated operations offices requires stairs and accessibility access w/elevator. 2. Support columns may impact # of parking. 3. Foundations and structural elements req'd.	1) Hybrid solution retains a plus-percentage of the parking on site. 2) Evaluate this hybrid option in more detail in PE Phase.
Off-Site (1) Parking Mitigation	Negotiate and rents parking from the City Parking garage across Beach Street.	Mitigates employee parking elimination w/off-site option.	1. Off-site parking is across Beach Street in the Pier 39 public parking facility. 2. Close proximity to Kirkland Yard.	1. Option to be discussed with garage operator to provide parking to SFMTA. 2. Lease/Rent Agreement to be negotiatied. 3. Additional operational cost to SFMTA.	1) Assumption long-term parking is available from Pier 39 garage operator. 2) Mitigating employee parking to an offsite option comes with additional cost to SFMTA. A business decision that is required.
Off-Site (2) Parking Mitigation	Negotiate and rent parking spaces from the unoccupied San Francisco Art Institute.	Mitigates employee parking elimination w/off-site option.	1. Off-site parking is across Stockton Street at SF Arts Institute parking lot. 2. Close proximity to Kirkland Yard.	1. Option to be discussed with SF Art Institute to provide parking to SFMTA. 2. Lease/Rent Agreement to be negotiatied. 3. Additional operational cost to SFMTA.	1) Assumption long-term parking is available and can be provided by SF Art Institute. 2) Assumption is based on the spaces Kirkland vehicles are currently parking at the closed SF Art Institute property.
Underground Facility Parking Mitigation	Excavate site as required to provide underground parking of essential operator, employee, supervisor and NRV maintenance vehicles.	High Cost. High Investment. Could be revenue generator if public parking included.	1. Site is constrained presently. With wider bus lanes for BEB buses, U/G option can accommodate the essential parking without going to off-site solutions. 2. Provides vehicles in close proximity to the bus yard and secure proximity to employees. 3. Provides highest level of surface area for BEB and bus operations. 4. Provides least visual impact of exposed electrical and EV infrastructure to the community. (Best in category for visual and aesthetics of the yard to neighbors)	1. Highest cost investment (budget) and schedule impact 2. Requires non-scoped excavation for underground parking. Additionally, soil handling, waterproofing and structural cost considerations to the overall schedule. 3. U/G facility will require MEP/FP and ventilatiion systems to comply with codes. 4. U/G facility will require exits and exit travel distances to nearest exit to comply w/codes.	1) if there is excavation of the ground for trenching, consider expanding scope to underground parking for employee vehicles. 2) Expanding scope further, relocated unoccupied BOH rooms: Electrical Switchgear Room, Electrical Distribution Room, Communications Room, Tire Storage to below ground - optimizing yard for bus charging, bus circulation and bus storage. 3) EV Charging infrastructure to the underground eliminates the visual impact to the neighborhood. 4) Expanding scope even further, extend the excavation to entire site to include pay-to-park public parking facility for revenue generation plus set aside facility parking.

H. Draft Port of San Francisco Recommendations for City Coastal Flood Risk Reductions

MEMORANDUM

Draft Port of San Francisco Recommendations for City Coastal Flood Risk Reduction

PREPARED FOR:	Sea Level Rise and Flood Hazards Coordinating Committee
COPY TO:	Darren Milsom, CH2M/Arcadis Team; Ramón Pérez-Zaragoza, CH2M/Arcadis Team
PREPARED BY:	Brad Benson, Port of San Francisco; Matthew Wickens, Port of San Francisco; Kris May, CH2M/Arcadis Team
DATE:	September 29, 2021
PROJECT NUMBER:	1.05.02.09

1 Introduction

The Port of San Francisco (Port) manages 7.5 miles of shoreline that includes a wide variety structures and infrastructure, including over water piers and wharves, buildings, bulkheads, marine terminals, roads, utilities, open space and parks, and historic resources. The Port's aging shoreline infrastructure has been very effective in preventing shoreline erosion and keeping San Francisco Bay (Bay) tides and storms from flooding Port and City and County of San Francisco (City) lands for more than a century. Over time, sea level rise and subsidence have reduced the level of coastal flood protection provided by the shoreline infrastructure. Without significant investment, coastal floodwaters will overtop the shoreline more and more frequently in the coming decades, flooding both Port and City land and causing damage and disruption.

The Port Waterfront Resilient Program is developing phased resilience actions to address both seismic and coastal flood risks along the Port-managed waterfront. The long-term goal of the program is to adapt the waterfront under its jurisdiction, including important regional and City-owned assets, and create a waterfront that is more resilient in the face of earthquakes, existing coastal flooding, and future coastal flooding that considers sea level rise. A foundational assumption for the program is the level of coastal flood risk reduction that should be provided for the inland areas of the City of San Francisco, including the residents and businesses within areas that could be flooded as sea level rises in the absence of a project.

This document presents:

- Relevant criteria and guidance documents that informed the recommendations
- Update to the sea level rise science considering the recent Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report
- Recommended City flood risk reduction guidance for both programwide planning and individual projects as they are designed
- Overview of initial elevation studies to assess the feasibility of the recommendations
- Consideration of Port and maritime assets that may have a higher flood risk tolerance
- Consideration of critical infrastructure assets that may have a lower flood risk tolerance

The Port is seeking concurrence from other City departments regarding the flood risk reduction guidance recommendations. Do these recommendations represent a level of flood risk reduction that is appropriate for the City? It is important to note that this document does not recommend a specific alignment for coastal flood defenses, nor does it recommend specific flood resilience structures or strategies. The alignment and the appropriate range of strategies will be selected and refined through a collaborative process with the City. Areas that remain outside of the alignment should have a higher flood risk tolerance or be able to accommodate temporary flooding and living with water.

Once agreement is reached among City departments on the level of flood risk reduction that should be provided, a series of conversations will begin regarding the long-term financial commitments and responsibility needed to properly build, maintain, and adapt this infrastructure in the future as sea levels continue to rise.

Full implementation of coastal flood risk reduction projects along 7.5 miles of the shoreline are likely to take several decades, with projects implemented in phases. Although each individual project will not provide citywide coastal flood risk reduction on its own, each project will be a building block toward achieving citywide flood risk reduction. It is therefore important that each building block uses a consistent approach when selecting flood risk reduction and sea level rise criteria – or be able to adapt to meet or exceed the criteria to reduce the likelihood of gaps in the coastal flood risk reduction system.

To promote cohesion across the city's shoreline, the Port recommends that coastal flood risk reduction projects implemented along the Bayside shoreline that are outside of the Port's jurisdiction adopt a similar approach as a best practice to provide a consistent level of coastal flood risk reduction for all San Francisco residents and businesses.[1]

2 Relevant Criteria and Guidance Documents

The Port recommends that coastal flood risk reduction projects meet or exceed the following federal criteria and state and local guidance. Note that these criteria and guidance documents are not necessarily additive.

- Federal Emergency Management Agency (FEMA) requirements for accredited coastal flood risk reduction structures. Flood resilience structures that are accredited by FEMA can remove protected areas from the special flood hazard areas on the FEMA Flood Insurance Rate Maps, thereby removing the mandatory requirement to purchase flood insurance. This requirement includes the greater of:
  - The 1 percent annual chance coastal stillwater elevation + 2 feet of freeboard
  - The 1 percent annual chance total water level (including wave runup) + 1 foot of freeboard

[1] This recommendation is not intended to apply to the San Francisco International Airport, which has developed its own flood risk reduction and sea level rise design criteria and is hydrologically and geographically separated from the Port of San Francisco property. This recommendation is also not intended to apply to the open Pacific Coast side of the city, which has a lesser coastal overtopping -related flood risk based on the findings in the Citywide Sea Level Rise Vulnerability and Consequence Assessment.

- The Federal Flood Risk Management Standard (Executive Order 13690) was adopted in 2015 to improve the resilience to current and future flood risk across the United States by creating a new (higher) flood risk reduction standard for federally funded projects. The executive order added an additional foot of freeboard to the FEMA criteria to account for climate change, including increasing storm intensity (that is, the 1 percent annual chance event based on the historical record may underestimate future storm events), and accelerated sea level rise. Although this executive order was revoked in 2017, the federal government is likely to reinstate this standard in one form or another during the lifetime of the Port Waterfront Resilience Program.

- California State Agencies "Principles for Aligned State Action" adopted in June 2020 by the San Francisco Bay Conservation and Development Commission recommending a planning assumption of 3.5 feet of sea level rise for all projects constructed prior to 2050, and a planning assumption of 7.0 feet of sea level rise by 2100 for roads, rail, ports, power plants, water and wastewater systems, and other critical infrastructure (California State Agencies 2020).

- California Ocean Protection Council (OPC) guidance, which recommends that projects consider a range of sea level rise values, including 3.4 feet (a likely value by 2100) and 6.9 feet (a lower-likelihood but plausible, high-impact value for 2100 that cannot be ruled out), and 10.2 feet (extreme sea level rise for 2100 resulting from loss of the West Antarctic ice sheet) along the sea level rise projection associated with the highest greenhouse gas emission scenario (Section 3) evaluated by IPCC in 2014 (OPC and CNRA 2018; Griggs et al. 2017; IPCC 2014). OPC guidance recommends consideration of the plausible, high-impact, and extreme sea level rise scenarios when adapting interrelated critical infrastructure, and for long-lasting projects with less adaptive capacity that would result in threats to public health and safety, natural resources, and critical infrastructure should sea level rise be underestimated. OPC guidance acknowledges the unique characteristics, constraints, and values of existing water-dependent infrastructure, ports, and Public Trust uses, particularly in densely developed coastal areas where managed retreat, nature-based solutions, and other space-dependent strategies may not be feasible (OPC and CNRA 2018).

- Capital Planning Committee (CPC) guidance adopted in 2014 and updated in 2020, "Guidance for Incorporating Sea Level Rise into Capital Planning," which recommends that projects consider the useful life of the structure when selecting the appropriate amount of sea level rise for planning and adaptation (CPC 2020).

3 Sea Level Rise Science

IPCC (2014) adopted a set of four greenhouse gas concentration trajectories scenarios known as "Representative Concentration Pathways," or RCPs, that have defined the range of possible future climate change projections and formed the basis of community climate mitigation and adaptation planning. The City, and the State of California, rely on sea level rise projections based on IPCC (2014). The recently released IPCC Sixth Assessment Report is generally consistent with the previous assessment, and the range of global sea level rise projections are presented with greater confidence (IPCC 2021). The National Oceanic and Atmospheric Administration (NOAA) is in the process of updating its sea level rise guidance with regional projections for the United States,

with an anticipated release date in early 2022. Updates to state guidance documents generally occur within a year of the NOAA updates. The RCP scenarios are as follows, ranging from the highest greenhouse gas scenario to lowest):

- RCP 8.5 assumes anthropogenic global greenhouse gas emissions continue to rise over the next century (that is, there are no significant efforts to limit or reduce emissions)
- RCP 6.0 assumes anthropogenic global greenhouse gas emissions peak in 2080 and then decline
- RCP 4.5 assumes anthropogenic global greenhouse gas emissions peak in 2040 and then decline
- RCP 2.6 assumes stringent emissions reductions, with anthropogenic global emissions declining by about 70 percent between 2015 and 2050, to 0 by 2080, and below thereafter (that is, humans would absorb more greenhouse gases from the atmosphere than they emit).

The City adopted RCP 8.5 for adaptation planning along the shoreline (CPC 2020).

IPCC (2014) global climate model projections were baselined to the year 2000 (that is, the model simulations were evaluated against historical observations prior to 2000, and all information from 2000 onward was considered a projection based on the RCP assumptions).

In 2021, IPCC released its latest report that builds upon the previous RCPs[2] with the inclusion of five Shared Socio-economic Pathways (SSPs) (SSP1 to SSP5). The SSPs include narratives that outline global and country-level future population, gross domestic product, urbanization projections (particularly for developing countries), and the successes and/or challenges associated with mitigation and adaptation. IPCC (2021) global climate simulations are baselined to 2015. Therefore, they include 15 additional years of historical data, observations, and global community actions compared to IPCC (2014), improving confidence in the near-term (such as 2030 to 2065) projections.

SSP5-8.5 (IPCC 2021) provides an update to RCP 8.5 (IPCC 2014). Therefore, SSP5-8.5 is considered within this guidance document. SSP5-8.5 represents a pairing of SSP5 with RCP 8.5. SSP5 (nicknamed "Taking the Highway") assumes that global communities remain fixated on innovation and rapid technological progress to support climate adaption, with a lesser emphasis on climate mitigation. RCP 8.5 remains the highest emission scenario evaluated by IPCC, representing a future with continued fossil-fuel development and dependency, and the adoption of resource and energy intensive lifestyles around the world.

SSP5-8.5 and RCP 8.5 both project a likely value of about 3.4 feet of sea level by 2100. The assessment focused on the likely range due to difficulties in estimating the distribution of deeply uncertain processes. However, the 83rd percentile of SSP5-8.5 projections include low-likelihood, high-impact ice sheet processes that cannot be

[2] IPPC (2021) added RCP 1.9 and RCP 7.0, and discontinued use of RCP 6.0. However, as with IPCC (2014) and many other guidance documents, most of the analysis focuses on RCP 2.6, RCP 4.5, and RCP 8.5.

ruled out. IPCC (2021) notes that global mean sea level rise above the likely value – approaching 6.2 feet by 2100 (approximately 2 meters) and 16.4 feet (5 meters) by 2150 could occur.

The State of California sea level rise guidance previously relied on a probabilistic analysis of the global climate model simulations (Griggs et al. 2017; Kopp et al. 2014; OPC and CNRA 2018). The individual global climate models, although guided by the same underlying physics and scenario assumptions, produce results that vary from model to model, with some models better representing certain regions of the globe better than other regions. The (Bayesian) probabilistic approach evaluated the sea level rise projections across the models and presented statistical estimates of sea level rise values, and sea level rise ranges. This approach led the state to adopt the upper end of the likely sea level rise range for RCP 8.5 (3.4 feet by 2100, or a value of sea level rise that was met or exceeded by 17 percent of the model simulations by 2100) and the 1-in-200 chance sea level rise value (6.9 feet, or a value of sea level rise that was met or exceeded by 0.5 percent, or 1 in 200, of the model simulations by 2100 – excluding the deeply uncertain ice sheet dynamics).

This probabilistic analysis has not yet been completed for the new SSPx-RCP scenarios presented in IPCC (2021). However, given the challenges inherent in communicating and using the Bayesian probabilities (Behar et al. 2017), and given the higher confidence in the IPCC (2021) projections, and the close similarity between the sea level rise values (Table 1), the Port recommends using the sea level rise projections adopted by the CPC (CPC 2020) with a reframing of the 1-in-200 chance sea level rise value for ease in public communication to "plausible, high-impact." When communicating the 2100 values, the recommendations from the state agencies in the Principles for Aligned State Action should be used.

Table 1. Sea Level Rise Comparisons for 2100

Source	2100 Likely	2100 Plausible, High-impact
State of California (local) (OPC and CNRA 2018)	3.4 feet	6.9 feet to 10.2 feet
City and County of San Francisco (local) (CPC 2020)	3.4 feet	6.9 feet
Stage Agencies (regional)[a] (California State Agencies 2020)	3.5 feet	7.0 feet
Intergovernmental Panel on Climate Change (global) (IPCC 2021)[b]	3.3 feet	6.2 feet

[a] Recommended for use to support this Coastal Flood Risk Reduction Guidance

[b] Global sea level rise projections do not consider all relevant local factors, and are generally lower than the San Francisco projected sea level rise values. NOAA is in the process of developing updated regional sea level rise projections (expected early 2022).

4 Recommended Flood Risk Reduction Guidance

The Port recommends using the following criteria for programwide planning (assuming a 2100 planning horizon). The programwide planning assumptions will allow the City to evaluate a range of adaptation strategies along the

shoreline and develop a reasonable range of alternatives for National Environmental Protection Agency/California Environmental Quality Act.

- FEMA criteria (for the 1 percent annual chance stillwater and total water levels, including wave runup) + 3.5 feet of sea level rise (likely scenario)
  - Recommended *minimum* criteria for coastal flood resilience projects
  - If the structure(s) are not readily adaptable to 7.0 feet of sea level rise (plausible/high-impact scenario), consider a sea level rise value greater than 3.5 feet
- FEMA criteria (for 1 percent annual chance stillwater and total water levels, including wave runup) + 7.0 feet of sea level rise (plausible/high-impact scenario)
  - Recommended adaptation criteria for coastal flood resilience projects

The Port recommends using the same criteria for the design of each coastal flood resilience project. However, the planning horizon should be set based on the planned construction completion year and useful life of structure, considering engineering best practices and judgement in assessing the structures useful life, consistent with the CPC (2020) guidance for asset- and facility-based sea level rise adaptation. For example, if a project will be completed in 2050 with a useful life of 80 years, the planning horizon would be 2130. Using best available sea level rise science at the time of project planning, sea level rise projections for 2130 would be selected. Figure 1 presents the process for translating the information into a flood resilience project elevation. The designed height of the structures may exceed this elevation to address settlement, continuity with adjacent structures, or other objectives that may come up during the design phase.

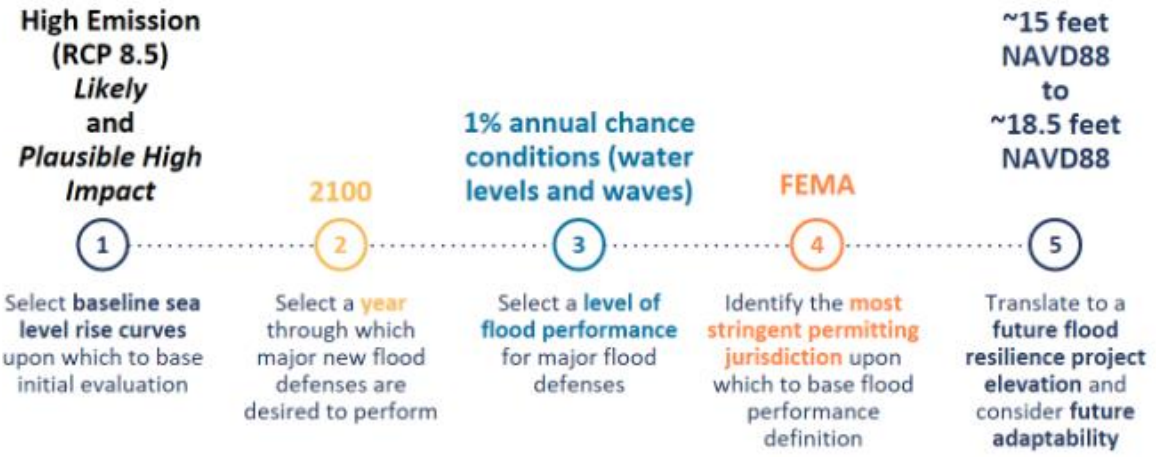


Figure 1. Example Process Diagram for Defining Flood Risk Reduction Elevation Criteria for each Coastal Flood Resilience Project

As each future phase is planned, designed, and implemented, the latest climate science, sea level rise projections, policies, and regulations should be reviewed to guide the selection of the appropriate sea level rise values and design criteria. Additional factors should also be considered when selecting design and future adaptation criteria, including historic preservation, public and water-based access, maritime use, public support, and other drivers that are likely to arise during project planning, design, and implementation.

Caveat: Interim (that is, temporary) projects are likely required to address existing and/or near-term flood risks before larger coastal flood resilience projects can be implemented. Interim projects are not required to achieve the flood risk reduction and sea level rise criteria outlined in this guidance document. However, interim projects must represent an initial step along an adaptation pathway that will ultimately achieve these criteria.

5 Initial Elevation Studies

The Port evaluated achieving FEMA criteria + sea level rise at 20 locations along the shoreline (Figure 2). The locations were chosen based on their complexity relative to the wave climate, roadway design (for example, grades, intersections, and bike paths), historic structures, and major utilities (for example, San Francisco Public Utility Commission wastewater infrastructure). Each location was also assessed against standard public realm assumptions (for example, maintaining Bay views and relationship to the water, sufficient promenade widths, and universal access in compliance with the Americans with Disabilities Act). The public realm considerations were a major factor in this assessment. Along much of the shoreline, a floodwall could potentially achieve the level of flood risk reduction desired, but a floodwall would not provide an enriching Bay connection or maintain the desired quality of public realm. A continuous floodwall along the shoreline is also extremely unlikely to garner public and political acceptance or support.

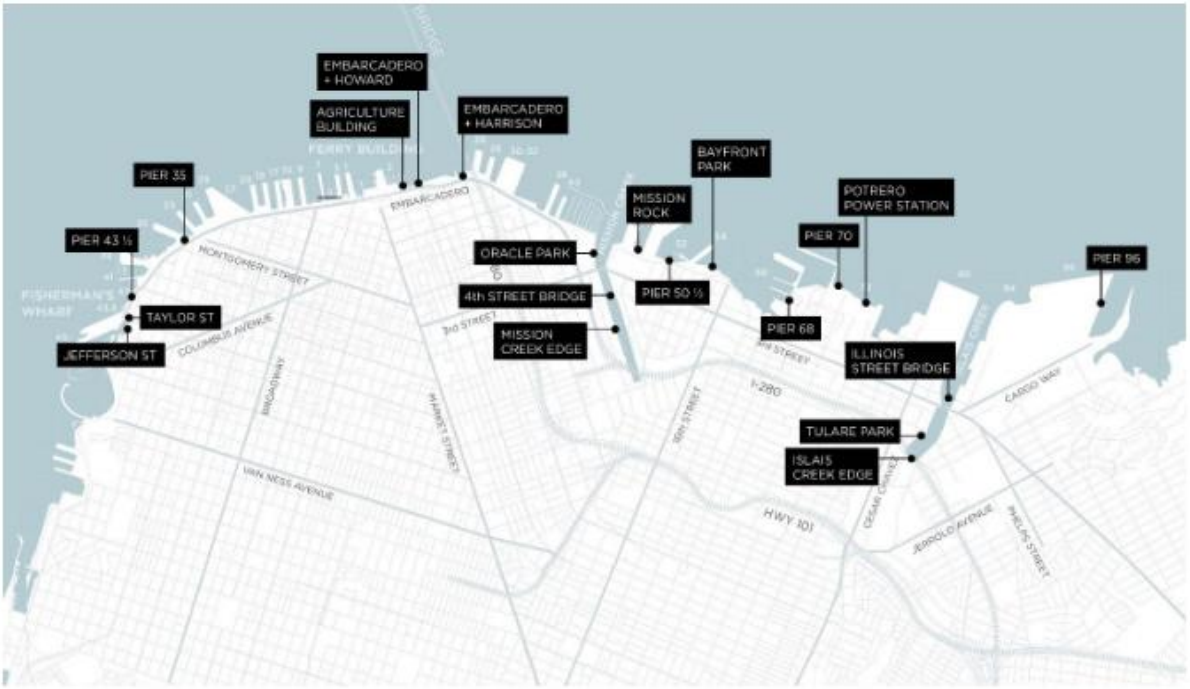


Figure 2. Locations Along the Shoreline Evaluated Relative to the Draft Flood Risk Reduction Guidance

This initial assessment was not intended to uncover every possible complication that could arise as the City attempts to adapt the shoreline to accommodate sea level rise and coastal flooding. Rather, the assessment was intended to assess the general feasibility from an urban realm perspective of raising the shoreline, and the extent of the "adaptation zone" that may be required if the City chooses to maintain the shoreline at its current location. The adaptation zone is the geographic area that would likely require modifications to accommodate the increase in shoreline height, but it may not capture the full area that would be disrupted during construction, or the full area that may require modifications such as maintaining or relocating utilities or utility connections, or maintaining grade connections with adjacent streets, sidewalks, or railways.

The assessment shows that the City can achieve existing FEMA criteria + 3.5 feet of sea level rise. This could be accomplished with a combination of floodwalls (with a maximum height of 3.5 feet to minimize public realm impact), elevating portions of adjacent roadway lanes, and extending the shoreline into the Bay (adding Bay fill) in some locations to minimize the potential of impacting the MUNI tracks along the Embarcadero roadway. The bridges and rail tracks across Islais Creek and Mission Creek, as well as the shoreline between Piers 54 and 48 in Mission Bay, will require additional detailed evaluation.

Achieving the FEMA criteria + 7.0 feet of sea level rise would require more extensive modifications to the Embarcadero roadway and other transportation infrastructure. Alternatively, these modifications could be minimized by extending the shoreline farther into the Bay (farther than needed for the 3.5 feet of sea level rise scenario outlined above), or through the addition of floodwalls with heights greater than 3.5 feet. The 20 selected locations served as a proxy for different conditions along the entire waterfront, thus it is understood

that the cumulative impacts of filling the Bay, modifying roadway and rail alignments, and modifying or relocating utilities along the entire 7.5 miles of waterfront would be significantly greater under this option. This would also require significant cross-department coordination across the entire shoreline (such as with San Francisco Municipal Transportation Agency, San Francisco Public Utilities Commission, and San Francisco Public Works).

In general, this initial assessment noted that shoreline could be modified and adapted to meet FEMA criteria + 3.5 feet of sea level rise without the need for extensive Bay fill. Therefore, this is recommended as the minimum criteria for coastal flood risk reduction. Achieving FEMA criteria + 7.0 feet of sea level rise would be more challenging and would likely require either significant amounts of Bay fill or significant modifications to the complex interrelated critical infrastructure along the shoreline (such as major roadways and lifeline routes, rail tracks, wastewater transport storage boxes, and disaster response infrastructure). However, although 7.0 feet of sea level rise may not happen by 2100, it is very likely to happen before 2150. The tradeoffs between achieving 3.5 feet and 7.0 feet of sea level rise should be closely evaluated as the alternatives are evaluated.

Although the general approaches to meet the FEMA criteria + 3.5 or 7.0 feet of sea level rise were considered feasible, this is not intended to imply that either approach would lead to a publicly and politically acceptable outcome. To avoid the perception that this initial analysis produced viable coastal flood resilience alignments or strategies, the specific details of the concept evaluated are not presented in this document. Robust City collaboration and public engagement will be required to develop publicly and politically acceptable outcomes.

6 Consideration of Port and Maritime Assets

The Port-owned over water piers and wharves, buildings, bulkheads, marine terminals, and maritime lands may have a higher flood risk tolerance than the inland city, its business and residents, and the city's critical infrastructure and lifelines. Therefore, the city's flood risk reduction alignment may, at times, be located inland of some Port assets or inland of the Port jurisdiction. In areas where Port lands are outside (that is, on the Bayside) of the city's flood risk reduction alignment, the Port will develop and maintain its own flood risk reduction policies and measures. The Port policies and measures will not reduce or impact the ability of the city's flood risk reduction structures from serving their intended purpose to reduce the likelihood of flood related damages, disruption, and loss of life.

7 Consideration of Critical City Infrastructure Assets

Some critical infrastructure assets may have a lower flood risk tolerance than the recommendations presented within this document. For example, the entrances to the underground MUNI/BART system may warrant flood risk reduction from a 0.2 percent annual chance flood event (500-year event). Other assets, such as electrical substations, wastewater pumpstation, hospitals, and fire stations may also require additional strategies, such as flood proofing and deployable flood barriers, to reduce the likelihood of significant consequences in the event flooding occurs. The recommendations presented in this document do not negate the need for a thorough evaluation of flood risk tolerance for individual critical infrastructure assets.

8 References

Behar, D., R. Kopp, R. DeConto, C. Weaver, K. White, and Bindschadler May, C.L. 2017. "Planning for Sea Level Rise: An AGU Talk in the Form of a Co-Production Experiment Exploring Recent Science." In *American Geophysical Union*.

California State Agencies. 2020. "Making California's Coast Resilient to Sea Level Rise: Principles for Aligned State Action." https://www.opc.ca.gov/webmaster/_media_library/2021/01/State-SLR-Principles-Doc_Oct2020.pdf.

Capital Planning Committee (CPC). 2020. "Guidance for Incorporating Sea Level Rise Into Capital Planning, Assessing Vulnerability and Risk to Support Adaptation." San Francisco, CA: Prepared by the Office of Resilience and Capital Planning. https://onesanfrancisco.org/sea-level-rise-guidance/.

Griggs, G., J. Arvai, D. Cayan, DeConto R, J. Fox, H.A. Fricker, R.E. Kopp, C. Tebaldi, and E.A. Whiteman. 2017. "Rising Seas in California: An Update on Sea-Level Rise Science." Sacramento, CA: California Ocean Science Trust.

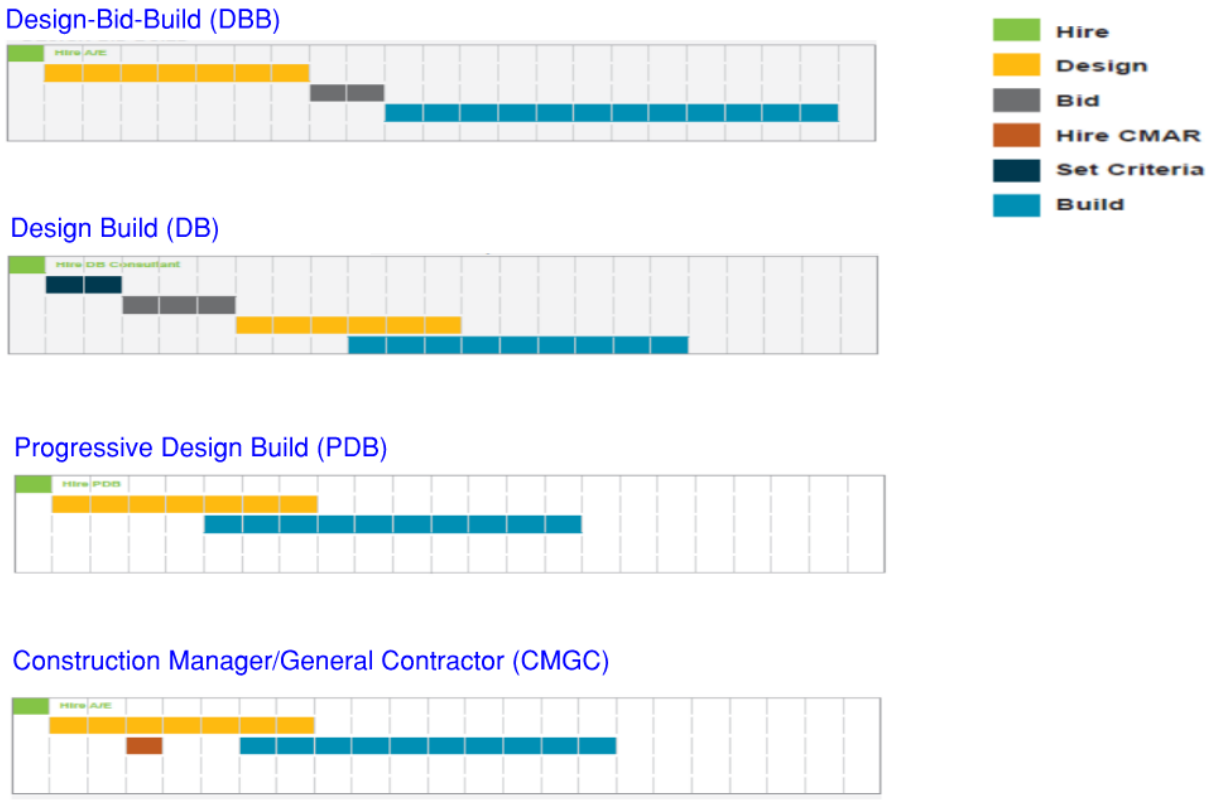
Intergovernmental Panel on Climate Change (IPCC). 2014. "AR5 Synthesis Report: Climate Change 2014." United Nations Intergovernmental Panel on Climate Change.

———. 2021. "Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan." https://www.ipcc.ch/report/ar6/wg1/.

Kopp, Robert E., Radley M. Horton Christopher M. Little, Jerry X. Mitrovica, Michael Oppenheimer, and D. J. Rasmussen Benjamin H. Strauss Claudia Tebaldi. 2014. "Probabilistic 21st and 22nd Century Sea-level Projections at a Global Network of Tide-gauge Sites." *Earth's Future* 2 (8): 383–406. https://doi.org/https://doi.org/10.1002/2014EF000239.

Ocean Protection Council (OPC) and California Natural Resources Agencuy (CNRA). 2018. "State of California Sea Level Rise Guidance." Prepared by the California Ocean Protection Council and the California National Resources Agency. http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf.

I. Contract Delivery Methods



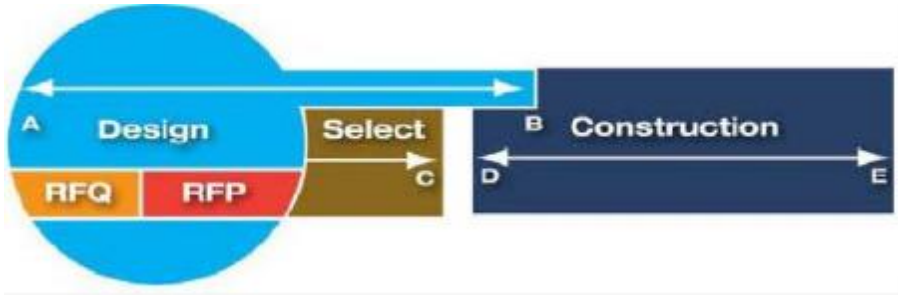
7.1 Design-Bid-Build (DBB)

A	Consultant NTP
B	Advertise/Bid Open
C	Contractor Selection
D	Construction NTP
E	Substantially Complete
A-B	Design Time
A-C	Selection Time
D-E	Construction Time
A-E	Project Time

Description: DBB	Pro	Con
• Designer team works directly with Owner and produces construction documents used for bidding. • Based upon "competitive bid" or "competitive sealed bid." • **Competitive Bid** – group of contractors (pre-qualified or not" submit bids for RFP, and lowest bidder usually get the project • **Competitive Sealed Bid** - group of contractors submit proposal includes fees and present their qualification. Lowest bidder gets the job provided their references and qualifications indicate they will do a good job.	• Lowest total construction cost. • Owner has more control. Owns more of the risk on SSB.	• Contractor primarily chosen on price with list of minimum qualifications, secondarily to qualifications. • General Contractor is not on board during design process. • Susceptible to change orders. • Timeline to the General Contractor (GC) onboard until construction documents are 100% complete poses longer transition to project. • Lowest bidder will meet the minimum qualifications but may not be the most qualified.

Sources:
(1) https://www.fgmarchitects.com/post/pros-cons-of-design-bid-build-vs-construction-manager-at-risk-vs-design-build ;
(2) A Guidebook for Construction Manager/General Contractor I(CMGC) for Contracting Highway Project by Texas A&M Transportation Institute

7.2 Design Build (DB)

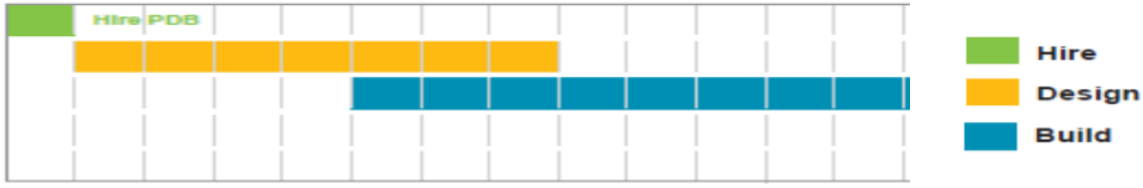


A	Consultant NTP
B	Advertise/Bid Open
C	Contractor Selection
D	Construction NTP
E	Substantially Complete
A-B	Design Time
A-C	Selection Time
D-E	Construction Time
A-E	Project Time

Description: DB	Pro	Con
• Single point of responsibility for whole construction process. • Design Builder (DB) is POC, who subcontracts various trades as well as entire scope of design services. • Depending upon contract T&C, DB has to self-perform a % of the contract work. • DB assumes all responsibility for design outcome, fixed cost, and staying on schedule.	• Minimal time and effort from Owner throughout process. • Shift responsibility of scope, schedule & budget (SSB) to DB Contractor. Shifts majority of risk to DB. • Gain quicker delivery time – to project completion. • Minimize Owner involvement if any conflict arises between Design Builder and design team. • Accelerated project delivery and completion with no or small non-schedule impacting changes.	• Owner gives up control of project to DB Contractor who now owns the risk on schedule and budget. • Design team working with Design Builder now works to the DB's expressed goals and cost drivers. *No longer the traditional process complying to Owner's end product & satisfaction.* • Design team is in difficult position advocating for Owner-Client since he reports directly to the Contractor. • Limits number of small and/or local contractors from submitting proposal. • Lack of competitive bidding may drive up cost.

Sources:
(1) https://www.fgmarchitects.com/post/pros-cons-of-design-bid-build-vs-construction-manager-at-risk-vs-design-build ;
(2) https://www.solutionsgc.com/benefits-of-construction-manager/ ;
(3) A Guidebook for Construction Manager/General Contractor I(CMGC) for Contracting Highway Project by Texas A&M Transportation Institute

7.3 Progressive Design Build (PDB)

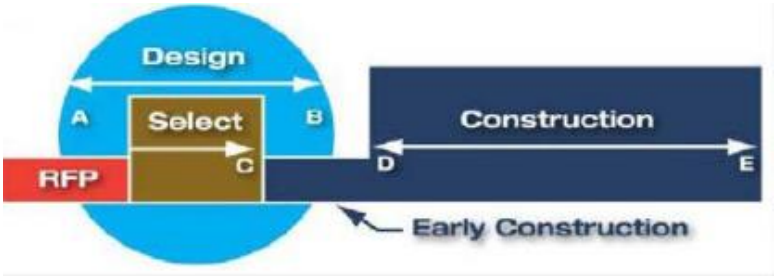


Description: PDB	Pro	Con
• Design is developed by Owner and Progressive Design-Build (PDB) entity. Design team is selected and works under the PDB entity. • Uses qualifications-based or best value selection. Design builder is retained by Owner early in the design and construction (build) process. • Progressive Design Builder (PDB) delivers in two phases: **Phase 1** includes budget level design development, preconstruction services, and a negotiated firm contract price or guaranteed maximum price (GMP). **Phase 2** includes final design, construction & commissioning.	• **One Contract**: PDB entity assumes the risk. Owner's risk for increased cost due to change orders and construction delay are eliminated for (base) contracted/scoped work. • Owner owns the budget because the Owner controls the design. PDB manages the GMP budget. • If any reason, parties cannot reach agreement on Phase 2, the Owner may consider **"off-ramp"** option- *where Owner can opt-out to use design and move forward with another Contract Strategy* • Flexibility and collaboration throughout design – to the Owner. • Some Phase 2 work can get started before proposal has been agreed upon.	• Qualification-Based Selection (QBS) may not be permissible under restrictive procurement regulation. • If QBS is used, may not have competitive pricing. • Procurement regulation may require the subcontractors to be procured competitively, thus limiting collaboration. • Owner may be uncomfortable using the "off-ramp" option.

Sources:
(1) https://www.performanceservices.com/resources/5-reasons-to-use-progressive-design-build-for-corrections-and-municipal-projects;
(2) DBIA Primer on Progressive Design-Build;
(3) https://dbia.org/wp-content/uploads/2018/05/Primer-Progressive-Design-Build.pdf;
(4) http://www.newea.org/wp-content/uploads/2018/06/Spr18_TMoline_5.pdf

7.4 Construction Manager/General Contractor (CMGC)

Also referred as "Construction Manager at Risk (CMAR)"



Description: CMGC	Pro	Con
• CMGC construction managers are professionals hired by Project Leader or Owner of construction project to provide feedback through all commercial construction phases – they oversee all project phases, including permits, sitework, commercial costs, and finishing). • Bring CM at beginning of the project. • **Design Phase**: CMGC works with project owner and Owner's designer early on to identify risk, provide estimated construction cost, and finalize project schedule. Both the Owner and CMGC negotiates Construction's total Contract Cost. If both parties agree, project proceeds to Construction Phase. • **Construction phase**: General Contractor (GC) oversees the construction. Construction Management (CM) is part of project from conception to completion.	• **Promotes innovation**: Encourages the Contractor and Owner to collaborate all possible options. • **Reduce Risk**: Contractor feedback in design can reduce construction cost because the Owner understand process and start to mitigate identified risk early. • **Constructability**: CMGC provides feedback by reviewing designs, answer questions so adjustment can be made, so cost and schedule are improved. • More time for Contractor to grasp SOW. • **Collaboration:** More time Owner, design team, and Contractor develop an understanding and trust. • Faster transition from design to construction. • CM**GC** chosen primarily on qualification, & next on price.	• Owner reluctant to choose CMGC before design since they have no idea of total construction cost. So, the Owner loses out Contractor experience in early design • Owner needs to cooperate and coordinate with CMGC manager on scope, schedule, and budget (SSB). • Requires multiple bids from subcontractor for all disciplines (to ensure competitive bidding). • Requires open-book policy from CMGC, so Owner can see line-item overhead cost, markups, and contingencies

Source:
(1) https://www.solutionsgc.com/benefits-of-construction-manager/ ;
(2) https://www.fgmarchitects.com/post/pros-cons-of-design-bid-build-vs-construction-manager-at-risk-vs-design-build ;
(3) A Guidebook for Construction Manager/General Contractor I(CMGC) for Contracting Highway Project by Texas A&M Transportation Institute

7.5 Turnkey

Description: Turnkey	Pro	Con
• **One Contract**: The Turnkey Contractor works with Owner under a single contract to complete all stages of a project from preliminary phases to construction at fixed price and fixed date. • **Combines** elements of project design, financing, procurement, subcontracts, and construction into a single, integrated project delivery with a single point of accountability.	• **Consistent Quality** expectation across phases. • **Reduced Change Management Challenges**: diminishes change orders and price increases throughout the project. • "***One Stop Shopping***" - One entity to contact. • **Reduced Cost Overruns**: Owner only liable for pre-determined project lump sum. • **Price Certainty**. Bid fixed cost. Owner is responsible for lump sum agreed amount during contract negotiation. • **Condensed Project Timelines** uses single design and construction firm for shorter timetable and fewer delays.	• **Firm Scope Definition**: Requires strong scope, design criteria and specification definitions by the Owner. • **Dependent on Trust:** Project Owner's confidence in Contractor is crucial to Turnkey approach. • **Design Cost** contingency: unforeseen changes in budget requirements. • **Risks Costs** are budgeted into the project cost. • **Scope Transference**: Owner shifts all control of scope to the Turnkey Contractor.

Sources:
(1) https://kibitec.com/turnkey-projects/advantages-and-disadvantages-of-turnkey-projects/ ;
(2) https://www.hm-ec.com/blog-posts/turnkey-project-advantages-and-disadvantages-what-to-know-before-signing-a-contract-hm#:~:text=Requires%20strong%20scope%20definition%3A%20The,the%20scope%20has%20been%20defined. ;
(3) https://wakefield.co.ke/turnkey-projects/;
(4) https://www.globalnegotiator.com/blog_en/turnkey-contract-construction-project-definition-epc/

J. Risk Register

Item #	Risk Category	Risk Item	Potential Likelihood Level (1-5)	Potential Impact Level (1-5)	RISK	Mitigation Strategy	Responsible Person	Schedule Impact (days)	Cost Impact ($)	Current Risk Status: Active/ Retired
1	**Safety**									
1.01	**Safety**	Safety issues associated with existing large, underground tank installation next to structures as well was surface tanks in the bus yard.	5	3	15	Construction sequencing of site work, information from as-built drawings from U/G Project.	CM / CON	7	$ -	Active
1.02	**Safety**	Waterproofing new underground vaults and sub-grade electrical structures - there could be leaks due to hydrostatic pressure to the new/existing structures.	5	3	15	Groundwater monitoring during construction, information from geotechnical reports.	CM / CON	14	$ -	Active
1.03	**Safety**	The worksite will need special barricades to prevent the public from accessing the site. The Kirkland Bus Yard may need to remain operational during construction work.	5	1	5	Special consideration to be given to blocking off work zones from the bus yard area. The bus yard and facilities to be maintained during work to allow employees to continue use of the facilities. Special shutdown periods to be coordinated with the site and public outreach to be conducted to notify prospective requests.	CON	0	$ 5,000	Active
1.04	**Safety**	A power shutdown may be required but not available, especially during revenue hours.	1	2	2	Schedule required shutdowns with a minimum 1 week notice.	CM / CON	7	$ -	Active
1.05	**Safety**	Contractors need additional safety training due to the proximity of the work to the Muni F-Line trackway and high voltage electrical equipment.	5	1	5	Include safety requirements in the project contract. Discuss project safety requirements in the pre-construction meeting.	CM / PM	14	$ -	Active
1.06	**Safety**	The storage location will need to be kept graffiti free and blocked off from bus yard employees and the general public.	3	2	6	Contractor to regularly remove graffiti from work equipment and materials per the contract documents.	CM / CON	0	$ 5,000	Active
1.07	**Safety**	Onsite construction injury due to negligence.	2	5	10	Contractor to hold safety tailgate or toolbox meetings at the start of the workday and when starting new tasks. Discuss safety at each construction meeting.	CON	30	$ -	Active
1.25	**Safety**				0				$ -	
2	**Contract**									
2.01	**Contract**	Contract procurement method is undetermined. Contract may be design-bid-build, DB, PDB, CMGC, CM/AR, Turn-Key or other. Contract determination NLT 30% Design Level.	5	2	10	Contracting method to be discussed with upper level management and project management team during preliminary engineering phase to determine the best method.	PM	0	$ -	Active
2.02	**Contract**				0				$ -	
2.03	**Contract**				0				$ -	
3	**Schedule**									
3.01	**Schedule**	The project design timeline is estimated. The project timeline needs to be revise during the next project phase to account for the detailed design work.	5	2	10	Discuss design requirements at the Preliminary Engineering and Detailed Design phases initiation. Revise the project schedule to match design proposals.	PM	0	$ -	Active
3.02	**Schedule**	Schedule considerations with PG&E facility energization aligned w/CON completion.	5	2	10	Escalate the milestone need for Kirkland Bus Yard with SFPUC/PG&E at their overall planning and project delivery sessions. SFMTA may need to be present at the table for escalation discussions.	PM	730	$ -	Active

Item #	Risk Category	Risk Item	Potential Likelihood Level (1-5)	Potential Impact Level (1-5)	RISK	Mitigation Strategy	Responsible Person	Schedule Impact (days)	Cost Impact ($)	Current Risk Status: Active/ Retired
3.03	**Schedule**	NEPA environmental review approval - lengthy process. CEQA/NEPA Clearance timelines are unknown dates.	5	5	25	Start CEQA/NEPA work early and anticipate a long duration for clearance. Engage with the ERO and Planning Department as soon as possible to start understanding the time needed to complete the tasks.	PM	365	$ -	Active
3.04	**Schedule**	Substantial complettion for BEB procurement and bus fleet delivery in 4Q 2027	5	5	25	Consider alternative project delivery methods which compress design and construction phases. And moves the responsibilities of long lead items to the alternative contract Contractor.	PM	90	$ -	Active
3.05	**Schedule**				0					
4	**Procurement**									
4.01	**Procurement**	SFMTA BEB Roll-Out Plan and delivery of BEB Fleet to Kirkland.	5	5	25	Close coordination with the BEB Procurement Team, BEB Fleet Management Team and Kirkland Yard Operations Team.			$ -	
4.02	**Procurement**	Long-lead procurement of items available for needed construction starts	3	3	9	Swift submittal review will help the contractor with ordering materials with enough float in the timeline to prevent project delays.	CM	0	$ -	Active
4.03	**Procurement**				0				$ -	
5	**Budget**									
5.01	**Budget**	Unidentified funding, inadequate budget, or budget approval timelines, to meet project needs	3	5	15	Obtain PDR and PER Approvals and obtain design phase approvals prior to commencement of work. Provide updated Total Construction Budget at PER to program remaining design and construction budgets.	PM	9	$ -	Active
5.02	**Budget**	The construction cost estimate is based on preliminary design details. The cost estimate requires update as the design is established. The work may become cost prohibitive.	2	2	4	Prepare revised project cost estimates at the start/end of each project phase, especially during the end of the Detailed Design phase.	PM	0	$ -	Active
5.03	**Budget**	Value engineering to be conducted to reduce extraneous costs if the cost estimate becomes too large.	3	2	6	Value engineering to be discussed during the detailed design phase of the project if the cost estimates are becoming larger than manageable. Value engineering may be established for later project phases that do not have REQUIRED improvements.	PM	0	$ -	Active
5.04	**Budget**	Federal funding is required to complete this project. Local funding may not be available to complete the project work due to the large volume of work and timeline to receive funding.	5	1	5	Discuss project funding with upper management, FIT, and project analysts early to understanding how funding will be established. Check the CIP for the funding projections.	PM	0	$ -	Active
5.05	**Budget**									
6	**Site/Logistics**									
6.01	**Site/Logistics**	Limited on-site laydown space for large material items while in construction on an active revenue service bus yard.	5	2	10	Contractor to review project documents and requirements. CM to discuss this during the pre-construction meeting.	CM / CON	0	$ -	Active

Item #	Risk Category	Risk Item	Potential Likelihood Level (1-5)	Potential Impact Level (1-5)	RISK	Mitigation Strategy	Responsible Person	Schedule Impact (days)	Cost Impact ($)	Current Risk Status: Active/ Retired
6.02	**Site/Logistics**	Kirkland Bus Yard will be active facility during construction. Work will need to be conducted around the bus pull-out/pull-in operations. Work will require coordination with the Yard Superintendent with bus circulation during the day.	5	1	5	Conduct pre-construction surveys of existing utilities. Discuss the work with stakeholders and the station maintenance team to protect utilities. Install proper facility projection and barricades.	CM / CON	0	$ -	Active
6.03	**Site/Logistics**				0				$ -	
7	**Environmental**									
7.01	**Environmental**	Force Majeure due to earthquake or other natural disaster.	1	1	1	Prepare emergency plans.	All	0	$ -	Active
7.02	**Environmental**	Remediation of existing hazardous soils and import of clean fill	1	3	3	SAR to conduct pre-construction hazardous materials survey to determine presence of hazardous materials. Prepare hazardous materials handling plan.	PM / PL	0	$ 50,000	Active
7.03	**Environmental**	CEQA/NEPA clearance timelines are unknown. CEQA/NEPA requirements are unknown.	5	3	15	Engage with ERO and Planning Department early to understand requirements. Prepare a realistic timeline of work during discussions.	PM / PL	365	$ -	Active
8	**3rd Party Impacts**									
8.01	**3rd Party Impacts**	Concern over AHJ plan check and permit timelines to meet schedule	5	5	25	Begin pre-application process earlier. Initiate pre-meetings with DBI to introduce new life safety code considerations and involve SFFD in the workshops.	PM / PE	190	$ -	Active
8.02	**3rd Party Impacts**	PG&E unresponsive to designer calls. Project needs PG&E to relocate facilities. Risk is the necessary relocation of the gas line in Kirkland Yard.	5	5	25	Deletable bid item for contractor to move the gas line.	CM / CON	0	$ 50,000	PG&E moved gas line on time! Closed.
8.03	**3rd Party Impacts**				0				$ -	
9	**Labor**									
9.01	**Labor**	Labor shortage in area local, use of Travelers, and impacts on production/costs	1	1	1				$ -	
9.02	**Labor**	Market uncertainty may change available contractors and vendors to support the project.	1	1	1	Advertise early and extend timeline for contractor bids to allow for as many contractors to view and bid on the project as possible.	PM	0	$ -	Active
9.03	**Labor**				0				$ -	
10	**Design**									
10.01	**Design**	One area of project not approved/fully designed and how to address	5	3	15	Identify and carry design element to regular design meetings and workshops to reach resolution. Escalate for resolution.	PM	30	$ -	Active
10.02	**Design**	Building code compliance with BEB EV Charging and bus storage.	5	5	25	Engage DBI and other AHJs to develop a consensus for fire/life safety solutions for a BEB facility. Tap into the Potrero Yard Modernization design progress for BEB bus charging and storage.	PM	180	$ -	Active
10.03	**Design**	Elimination of employee parking to maximize BEB bus storage.	5	5	25	Evaluate alternative options and develop a ROI if off-site parking is a necessary option.	PM	90	$ -	Active

Item #	Risk Category	Risk Item	Potential Likelihood Level (1-5)	Potential Impact Level (1-5)	RISK	Mitigation Strategy	Responsible Person	Schedule Impact (days)	Cost Impact ($)	Current Risk Status: Active/ Retired
10.04	**Design**	Aesthetic and visual impact of electrical & EV charging equipment.	5	5	25	Evaluate alternative options and engage POETS team to reach out to project community and stakeholders to reach reasonable, constructable solution.	PM	180	$ -	Active
10.05	**Design**	Soil excavation, sampling, handling, and trucking off-site disposal.	5	3	15	Retain SFPW SAR group to handle hazardous soil and develop a site assessment analysis before construction activities begin.	PM / CM	30	$ -	Active
10.06	**Design**	Yard drainage.	3	2	6	Conduct civil topographic survey working with utility mappings for drainage, comply with storm water management regulations.	PM / CM	0	$ -	Active
10.07	**Design**	Seismic risk.	3	2	6	Perform structural analysis. Refer to geotechnical report recommendations with the design.	PM	0	$ -	Active
10.08	**Design**	Flood risk.	3	5	15	Mitigating flood and sea level rise requires coordination with SF Port and other regulatory governing bodies. Long range planning and cost involved impacting the project.	PM / PL	365	$ -	Active
10.09	**Design**	Change orders will be requested during construction. The design drawings may need revisions by SFPW-BOA to resolve design issues.	3	2	6	Respond to RFIs as soon as possible and clarify design issues before they become debilitating. Conduct field meetings to discuss issues before resorting to change orders.	CM / PL	7	$ -	Active
10.10	**Design**	Design details are conceptual, and the details are not fully established. Design work may be conducted and found to be cost prohibitive in the future.	3	1	3	As designs change, the increasing cost of work would need to be discussed to prevent work from continuing that is fiscally unapproved.	PM	0	$ 50,000	Active
10.11	**Design**	Stakeholders change and may request different upgrades to the facility.	2	2	4	Engage stakeholders early and maintain engagement through the Preliminary Engineering and Detailed Design phases to keep the project on track. Maintain a comment resolution form to document changes and requests.	PM / PL	0	$ 50,000	Active
10.12	**Design**				0					
10.13	**Design**				0				$ -	
11	**QA/QC**									
11.01	**QA/QC & Comm**	3rd party testing is required for the project. The 3rd partner tester may not be available at the time of the required testing.	2	1	2	Testing to be scheduled 48 hours in advance.	CM / CON	0	$ -	Active
11.02	**QA/QC & Comm**				0				$ -	
11.03	**QA/QC & Comm**				0				$ -	
12	**Personnel**									
12.01	**Personnel**	Availability of staff to service project needs and timelines	1	2	2	Monitor project needs and milestones with a critical path schedule.			$ -	
12.02	**Personnel**	Onsite staff not available to shutdown equipment/power when needed.	1	3	3	Schedule required shutdowns with a minimum 48 hours' notice.	CM / CON	2	$ -	Active

Item #	Risk Category	Risk Item	Potential Likelihood Level (1-5)	Potential Impact Level (1-5)	RISK	Mitigation Strategy	Responsible Person	Schedule Impact (days)	Cost Impact ($)	Current Risk Status: Active/ Retired
12.03	**Personnel**	Safety requirements are not met by the contractor prior to attempting to start work. Subcontractors may not be aware of safety requirements.	1	2	2	Discuss safety requirements with the contractors during the pre-construction meeting and construction meetings. Safety tailgates to be conducted by the contractor.	CON	14	$ -	Active
12.04	**Personnel**	3rd party testing agency not available to conduct QAQC testing.	2	1	2	Testing to be scheduled 48 hours in advance.	CM / CON	2	$ -	Active
12.05	**Personnel**	Inspection personnel not available to conduct daily inspection of construction work.	1	5	5	Schedule testing personnel with a minimum 48 hours' notice.	CM / CON	2	$ -	Active
12.06	**Personnel**				0					
12.07	**Personnel**				0				$ -	
12.08	**Personnel**				0					
13	**Reputation**									
13.01	**Reputation**	If project requirements are not meet, it indirectly impacts on "project success"	3	1	3	Maintain a record of key requirements as well as integrating the needs into the CPM Schedule. Employ a 6 Week Look Ahead (6 WLA) schedule.	PM / CM	0	$ -	Active
13.02	**Reputation**	Construction delays may negatively impact SFMTA reputation in the eyes of the nearby public.	3	1	3	Maintain a record of project impacts and justification if there are changes to the project timeline. Ensure a public information officer is involved with public communication.	PM / CM	0	$ -	Active
13.03	**Reputation**	Storage around the site will need to be kept tidy. Otherwise, public complaints may result from unmanaged graffiti. Materials/Equipment may be vandalized.	5	1	5	Contractor to regularly remove graffiti from work equipment and materials per the contract documents.	CON / CM	0	$ 5,000	Active
13.04	**Reputation**	Interruption of the active Muni bus service at the bus yard will cause issues with the Muni and Maintenance of Way teams.	1	5	5	Contractor to be properly safety trained. Muni shutdowns and work that could impact Muni service to be scheduled to reduce potential impacts.	CON / CM	0	$ 50,000	Active
13.05	**Reputation**				0				$ -	
14	**Relationships**									
14.01	**Relationships**	Not having key alignment on most important project objectives, and then not achieving the objectives and goals.	1	2	2	At monthly management meetings, carry this as a typical agenda item opening the meeting to keep it in the forefront of the Project.	PM / CM / CON	0	$ -	Active
14.02	**Relationships**	The issue resolution ladder has not been setup.	1	2	2	Setup the issue resolution ladder during a partnering meeting, pre-construction meeting, or the first construction progress meeting.	PM / CM / CON	0	$ -	Active
14.03	**Relationships**	Conflict resolution to follow the resolution ladder and roles and responsibilities.	2	2	4	Prepare the issue resolution ladder with stakeholder involvement.	PM / CM / CON	0	$ -	Active
14.04	**Relationships**	Contractor does not take ownership of issues and instead blames the design or management team.	2	3	6	Ensure construction events and issues are well documented in daily reports and with photos.	CM / CON	0	$ -	Active
14.05	**Relationships**				0				$ -	
							Total Risk Provision $	2703	$ 265,000	
							Total Project Weeks / Value $	104	$ 265,000	
							% Risk Contingency	26.0	100%	

K. POETS Public Outreach and Engagement Plan

https://sfmta.sharepoint.com/:w:/s/KirklandYardElectrification/ESfWAFNR-8xIvDwHHBGahGsBaacO0oEIjtqT782LK5woZw?email=h.quon.chin%40sfmta.com&e=bELyjN

01.Predevelopment > 500 Pre-Development Package > **RP_230131_KRK_POE-Plan_PDR_REV00_CPC**

Public Outreach and Engagement Plan Template

Follow the steps below to create the Public Outreach and Engagement Plan for your project. See the Public Outreach and Engagement Plan Requirements for the standards that every plan must meet, and the Public Outreach and Engagement Plan Guide for more detailed support on completing each step of the plan. When you complete the plan, submit it to the POETS page on the SFMTA intranet here. **THIS STEP IS MANDATORY**. **Keep in mind that your plan is a public document and may be reviewed by SFMTA leadership and staff, city partners and members of the public.**

Project Overview

INSTRUCTIONS: Create an initial summary of the project scope, purpose, benefits and timeline. Based on an initial understanding of the project, state the anticipated decision space – the aspects of the project that the public might be able to influence and those that cannot be changed. Note that this is a very early step in project planning and should be revised based on the subsequent Project Needs Assessment. As a general rule, **the Project Overview should fit on one page**. Maps or other graphics can be included on the reverse side, but the Project Overview should be a single sheet when printed.

Project Description

Kirkland Facility (Kirkland Yard) is located within the Fisherman Wharf area at 2301 Stockton Street and 151 Beach Street. Kirkland Facility stores, maintains, fuels, and services (112) 40-foot diesel hybrid buses.

The Kirkland Yard interim retrofitting work includes upgrading the bus yard for battery electric bus (BEB) infrastructure and increasing the PG&E service to the yard for BEB charging. To minimize service disruptions and operational impacts, the Kirkland Yard will undergo BEB upgrades in several stages. Three to four lanes will undergo construction for a duration of roughly six to eight months. Buses usually occupying the lanes undergoing construction will be temporarily relocated to Islais Creek Facility. After the Woods Facility is fully rebuilt to support BEBs (after 2040), the Kirkland Facility is expected to be entirely rebuilt.

Project Purpose

The purpose of Kirkland Yard Electrification (Project) is to retrofit Kirkland Yard to store, maintain and charge (91) 40-foot electric buses at the facility to meet the California Air Resource Board's (CARB) Innovative Clean Transit (ICT) regulation to operate 100% zero transmission buses by 2040, and comply with the intent of CARB ICT bus procurement requirements.

Project Benefits

The California Air Resource Board's (CARB) Innovative Clean Transit (ICT) regulation requires all transit agencies to begin transition to 100 percent zero-emission bus (ZEB) fleet. Starting in 2029, 100% of new bus purchases must be ZEBs; and by 2040, transit agencies should fully operate with 100% ZEBs. The SFMTA has a goal to operate all ZEBs by 2035. Pursuant to the SFMTA's electrification goals, in February 2020, the SFMTA commissioned WSP to provide a roadmap for SFMTA's transition to all-ZEB fleet. With input and data from SFMTA staff, battery electric bus (BEB) industry stakeholders and PUC/PG&E sources, WSP developed Zero Emission Facility and Fleet Transition Plan consisting of several task reports. This PDR project involves evaluating and implementing several of WSP's reports recommendations to retrofit the

Kirkland Facility for immediate "temporary" usage of the site to support the deployment of (91) 40-foot battery-electric buses (BEBs) by 2027. A full rebuild of Kirkland is envisioned to take place in 2040 after other bus facilities have been upgraded for the BEB fleet.

Project Start and End Dates

November 2022 (PDR) Start Date and December 2027 (Construction) End Date

Decision Constraints (What has already been determined or decided?)

Y2027 SFMTA 50% New ZEB Bus Fleet Purchases and Y2030 100% New ZEB Bus Fleet Purchases. Y2040 CARB ICT 100% BEB Goal

Project Needs Assessment

STAKEHOLDER ANALYSIS

INSTRUCTIONS: Use this table to identify stakeholders – those who will be affected by, or interested in, the project. Check the categories of stakeholders who will be affected by the project, list specific individuals and groups, and classify each as either primary, secondary or partner audiences. Note that where boxes are already selected there is a presumption that these categories of stakeholders will be included in most plans. To the extent possible, classify each group as "primary," "secondary," or "partner." Primary stakeholders are *directly* impacted by the project and must be informed regularly (e.g., residents, merchants). Secondary stakeholders are *indirectly* or *temporarily* impacted by the project (e.g., delivery drivers, commuters, tourists). Partner stakeholders are *influential and interested* within the project area and/or community-at-large (e.g., transit riders, bicycle advocates). Partners can affect awareness and support and may be enlisted to assist with outreach to the primary and secondary audiences and/or to champion the project.

Stakeholders Who Reside, Work or Travel through the Project Area

	Category:	Names:	Classification:
ü	Type of Stakeholder	Specific Individuals or Groups	Primary, Secondary, Partner
☒	Residential Area	Telegraph Hill, North Beach	Choose an item.

☒	Business District	Fisherman's Wharf Pier 39, 45 North Point Shopping Mall Hotel Riu Plaza Williams-Sonoma IHOP	Choose an item.
☒	People who drive	Big Bus Tours	Choose an item.
☒	People who walk		Choose an item.
x	People who ride bicycles	Blazing Saddles, Bay City Bike, Wheel Fun Rentals, Bay Wheels (bike share program) and local cyclists	Choose an item.
☒	People who ride transit		Choose an item.
☐	Other		Choose an item.

Community Organizations Located in the Project Area

✓	**Category:** **Type of Stakeholder**	**Names:** **Specific Individuals or Groups**	**Classification:** **Primary, Secondary, Partner**
☒	Neighborhood Organizations	Embarcadero Fisherman's Wharf Northpoint Apartments Housing at Bay and Mason? Northern Waterfront Advisory Committee (NAC)	Choose an item.
☒	Merchant Groups	Pier 39 Pier 45	Choose an item.

☒	Community Groups	Longshoremen Lot 341	Choose an item.
☐	Interest/Advocacy Groups	WalkSF San Francisco Bicycle Coalition Pedicab Association	Choose an item.
☐	Faith-Based Groups	Click here to enter text.	Choose an item.
☐	Schools	Click here to enter text.	Choose an item.
☐	Senior Centers, Disabled Services	Click here to enter text.	Choose an item.
☐	Media (local and citywide)	Click here to enter text.	Choose an item.
☐	Other	Click here to enter text.	Choose an item.

Internal Stakeholders and Influencers

ü	**Category:** **Type of Stakeholder**	**Names:** **Specific Individuals or Groups**	**Classification:** **Primary, Secondary, Partner**
☒	SFMTA Internal Stakeholders (other projects that intersect with yours)	Embarcadero Enhancement Project	Choose an item.
☐	SFMTA Board of Directors	Click here to enter text.	Choose an item.
☐	San Francisco Board of Supervisors	District 3 Supervisor Aaron Peskin	Choose an item.
☐	Local Elected Officials (Supervisorial District)	District 3 Supervisor Aaron Peskin	Choose an item.

☐	City Agencies (Public Works, Public Utilities Commission, Planning, Police, etc.)	Port of San Francisco	Choose an item.
☒	SFMTA Committees (Citizens' Advisory Council, Multimodal Accessibility Advisory Council, Paratransit Coordinating Council)	Click here to enter text.	Choose an item.
☒	Planning/Funding Organizations (County Transportation Authority, Metropolitan Transportation Commission, etc.)	Click here to enter text.	Choose an item.
☐	State and Federal Elected Officials (Delegation offices)	Click here to enter text.	Choose an item.
☐	Local schools and district	Click here to enter text.	Choose an item.

IMPACT AND INTEREST ANALYSIS

INSTRUCTIONS: Think about the ways that the project will affect residents, merchants, those who ride transit, and those who walk and ride bicycles on city streets. List the main impacts anticipated throughout all phases of the project. Note that the impacts identified in your plan are distinct from those detailed in an Environmental Impact Report or Environmental Impact Statement. While those documents might inform your analysis, the focus here is impacts on the local community.

After listing the project impacts, use the following table

Impact and Interest Analysis Calculation

to calculate a score that represents the overall level of impact and interest. There is no hard and fast rule for translating the score into a particular plan, but it is an indicator of the public's likely expectations around outreach and engagement. It is intended to serve as a starting point for discussion among the project team in developing the Public Outreach and Engagement Plan.

To find your project score, answer each question by putting a number 1 in the appropriate box in each row. The table will add the numbers in each column and then multiply the total in each column by the column weight (very low = 1, low = 2, moderate = 3, high = 4, very high = 5). The table will then calculate an average score across all questions. Write the impact and interest analysis average score below.

Impact and Interest Analysis Average Score: Click here to enter text.

Project Impacts

List the main impacts anticipated from the project (service changes, traffic changes, parking changes, construction, etc.)

Click here to enter text.

DECISION SPACE ANALYSIS

INSTRUCTIONS: Describe the decision space of the project (the scope of potential public influence on the project or decision and the opportunities for public participation). Public participation requires the SFMTA to make a commitment to stakeholders about their involvement in the project. Defining the decision space gives the public clear expectations about their role in the planning and decision-making process. Complete the section below to identify the aspects of the project that the public can potentially influence, and the kind of public input that the project team will seek. See the Guide for a discussion of how the score on the impact and interest analysis can inform the decision space analysis.

What aspects of the project can potentially be influenced by public input?

Click here to enter text.

What aspects of the project are NOT open to change based on public input, and what are the constraints that limit public influence (financial, legal, legislative, etc.)?

Click here to enter text.

Goals and Objectives

INSTRUCTIONS: List the goals and objectives of the Public Outreach and Engagement Plan for each phase of the project that the plan covers. Goals should correspond to the levels of public participation on the Spectrum of Public Participation (Inform, Consult, Involve, Collaborate). Objectives should be measurable indicators of the extent to which the goals are met. Indicate the data sources that will be used to measure progress on the objectives.

PROJECT PHASE: Click here to enter text.

GOAL / OBJECTIVE	DATA SOURCES
Goal #1 **CARB 2040 100% ZEB Buses**	Click here to enter text.
Objective 1.1 **CARB ICT 2023: 25% BEB New Purchases**	Click here to enter text.
Objective 1.2 **CARB ICT 2026: 50% BEB New Purchases**	Click here to enter text.
Goal #2 **SFMTA Goal 100% ZEB Buses by 2035**	Click here to enter text.
Objective 2.1 **Kirkland Yard: Interim by 2027**	Click here to enter text.
Objective 2.2 **Woods, Presidio, Potrero entirely rebuilt**	Click here to enter text.

Key Messages

INSTRUCTIONS: List the key messages about the project for general and specific audiences. Be sure to include the purpose and benefits of the project, potential impacts, project timeline, opportunities for public input, and key contacts. Where relevant, indicate the intended purpose of communication in relation to the goals of the Public Outreach and Engagement Plan (to inform, to recruit participants, etc.).

Messages for General Audience:

Click here to enter text.

Specific Audience Messages (Stakeholder: Click here to enter text.)

Click here to enter text.

Specific Audience Messages (Stakeholder: Click here to enter text.)

Click here to enter text.

Specific Audience Messages (Stakeholder: Click here to enter text.)

Click here to enter text.

Specific Audience Messages (Stakeholder: Click here to enter text.)

Click here to enter text.

Outreach and Engagement Techniques

INSTRUCTIONS: List the outreach and engagement techniques and tools you will use to achieve the goals and objectives you established for the project. Include multi-channel communications tactics, community meetings, and other ways you will reach out to stakeholders given your goals for each project phase. This step is about how to inform and engage the public, including details about implementation. This is also the appropriate step for planning language access needs.

Project Phase: Click here to enter text.

ONGOING (For communication and relationship-building throughout the phase) Click here to enter text.
DISCRETE (At specific points to inform, compile feedback or convene people) Click here to enter text.

Project Phase: Click here to enter text.

ONGOING (For communication and relationship-building throughout the phase) Click here to enter text.
DISCRETE (At specific points to inform, compile feedback or convene people) Click here to enter text.

Project Phase: Click here to enter text.

ONGOING (For communication and relationship-building throughout the phase) Click here to enter text.
DISCRETE (At specific points to inform, compile feedback or convene people) Click here to enter text.

Schedule and Responsibilities

INSTRUCTIONS: Create an action plan – a summary of the schedule and responsibilities for public outreach and engagement activities and tasks.

PUBLIC OUTREACH & ENGAGEMENT ACTION PLAN

Date	Activities/Tasks	Person(s) Responsible
Click down arrow to enter a date; to enter approx. date or range, click inside cell, right click & choose "Remove Content Control".	Click here to enter text.	Click here to enter text.
Click down arrow to enter a date; to enter approx. date or range, click inside cell, right click & choose "Remove Content Control".	Click here to enter text.	Click here to enter text.
Click down arrow to enter a date; to enter approx. date or range, click inside cell, right click & choose "Remove Content Control".	Click here to enter text.	Click here to enter text.
Click down arrow to enter a date; to enter approx. date or range, click inside cell,	Click here to enter text.	Click here to enter text.

right click & choose "Remove Content Control".		
Click down arrow to enter a date; to enter approx. date or range, click inside cell, right click & choose "Remove Content Control".	Click here to enter text.	Click here to enter text.
Click down arrow to enter a date; to enter approx. date or range, click inside cell, right click & choose "Remove Content Control".	Click here to enter text.	Click here to enter text.

Budget

INSTRUCTIONS: Enter the estimated budget for public outreach and engagement for each project phase that the Public Outreach and Engagement Plan covers. Note: depending on the project, it might be necessary to complete this estimate before other steps in the planning process. If possible, however, the budget will be based on the Project Needs Assessment and a thorough understanding of the strategy for outreach and engagement. Note that the table below represents a budget summary which should be based on a more detailed estimate of budget line items for each phase. Note that budgeting for public outreach and engagement is more art than science and must be conducted on a project-by-project basis. Division Leads can provide support in developing your budget. The Appendix provides examples of line item budgets for other SFMTA projects.

PUBLIC OUTREACH & ENGAGEMENT PLAN BUDGET

Project Phase: Click here to enter text.	
Project Phase: Click here to enter text.	
Project Phase: Click here to enter text.	
Project Phase: Click here to enter text.	
TOTAL	**$ 0.00**
Enter cost for each phase; to total, click the $ sign and press F9. If you make changes to any of the costs, click the $ sign and press F9 to calculate the new total.	

Plan Review

INSTRUCTIONS: Check which of the following people and agencies need to be contacted and informed about your plan. Which SFMTA projects intersect with yours? What other agencies will you need to work with? Who needs to be kept informed within the City? Indicate in the Notes the nature of the relationship.

✓	Target:	Notes:
☒	SFMTA Public Relations Officer	Click here to enter text.
☒	Other SFMTA Projects in your Project Area	Click here to enter text.
☒	District Liaison for your Project Area	Click here to enter text.
☒	POETS Division Lead	Click here to enter text.

☐	Project Management Office	Click here to enter text.
☐	Other City Departments	Click here to enter text.
☐	Other non-City Agencies	Click here to enter text.

Plan Evaluation

INSTRUCTIONS: At the end of each phase of the project (or every six months, whichever comes first), answer the following questions and submit an updated version of your plan (one that includes the completed section below and any revisions to other parts of the plan for future phases of the project) to the POETS page on the SFMTA intranet here. If the Plan Evaluation along with any revisions to the Public Outreach and Engagement Plan.

Project Phase: Click here to enter text.

Was the plan implemented as intended? How did it change? Click here to enter text.
To what extent did the plan achieve its goals and objectives? Click here to enter text.
What were the main lessons learned during implementation? Click here to enter text.
How would you modify the plan as the project moves to the next phase? Click here to enter text.
How did you document public input and how it was considered (if applicable)? Click here to enter text.

Report Back to Stakeholders

INSTRUCTIONS: At the end of each phase of the project, complete the "feedback loop" with stakeholders who were contacted or engaged. Use the Template to provide the key information that will be provided to stakeholders, and to document when, how and to whom it was provided.

Project Phase: Click here to enter text.

What aspects of the project were open to public input? Click here to enter text.
What were the techniques used to receive public input? (meetings, website, surveys, etc.) Click here to enter text.
What input did the project team receive from the public? Click here to enter text.
How was public input conveyed to decision-makers (if applicable)? Click here to enter text.
How did public input influence the project? Click here to enter text.
What are next steps for the project and any opportunities for further public input? Click here to enter text.
List the stakeholders who received a follow-up report (written or verbal):

Stakeholder	Method	Date
Click here to enter text.	Click here to enter text.	Click down arrow to enter a date; to enter approx. date or range, click inside cell, right click & choose "Remove Content Control".
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Click here to enter text.	Click here to enter text.	Click down arrow to enter a date; to enter approx. date or range, click inside cell, right click & choose "Remove Content Control".

Attachment 3

Kirkland Yard Electrification
Pre-Development Report (PDR)

SFMTA Capital Programs & Construction

Stakeholders and End User Meeting

March 2023

Kirkland Yard

2301 Stockton Street, San Francisco, CA 94133

SFMTA Photo Archive

Agenda

- Introductions
- Walk-thru of PDR
- Hold Questions - *to end (at 4:30pm)*

Pre-Development (PLN) Project Team

Quon Chin *(Project Manager)*

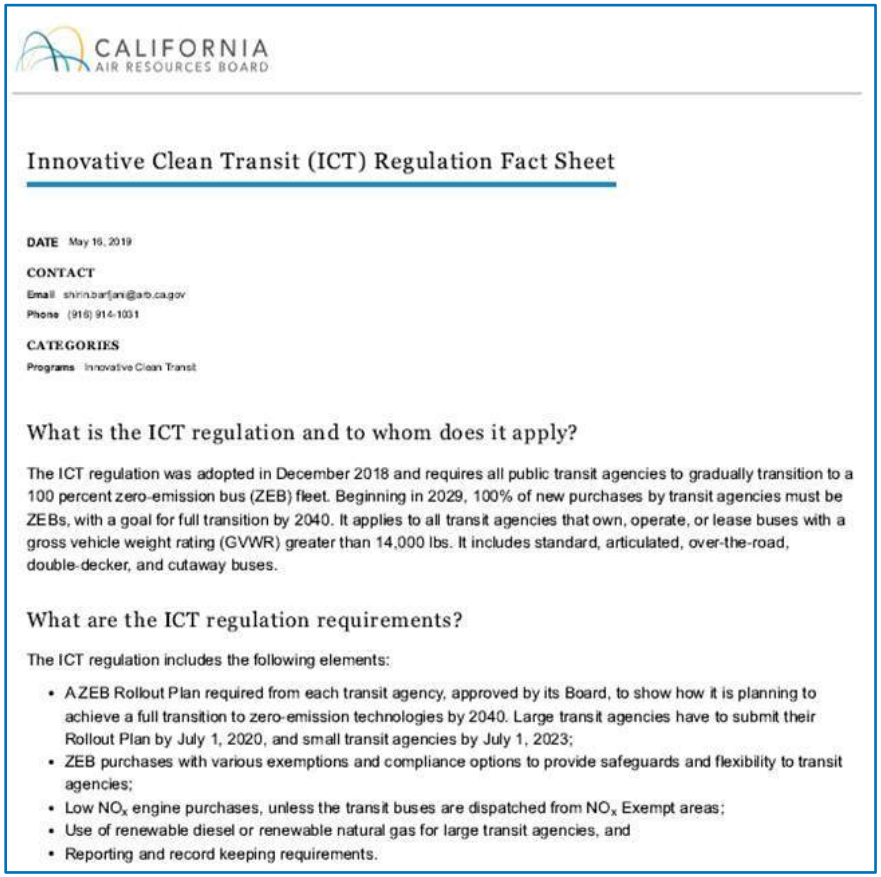
Lang Huey *(Project Engineer)*

Chava Kronenberg *(Project Planner)*

Qingwen Xi, *(Lead Electrical Engineer)*

Project Purpose

- Upgrade Kirkland Yard to store, maintain and charge **(91) 40-foot BEBs**.
- Meet the CARB Innovative Clean Transit (ICT) regulation to operate **100% zero emission buses (ZEB) by 2040**,
- Comply with the intent of the **CARB ICT bus procurement requirements**.
  - Starting 2023: 25% of new buses purchased must be ZEBs
  - Starting 2026: 50% of new buses purchased must be ZEBs
  - Starting 2029: 100% of new buses purchased must be ZEBs
- **SFMTA's Zero-Emission Bus Rollout Plan**:
  - **City's Climate Action Strategy** goals,
  - **Eliminating San Francisco's carbon footprint**,
  - **Making SFMTA's transit fleet more sustainable**, and
  - **Supports the City's voter-approved Transit-First Policy** – *established in 1973*.
- **SFMTA has a *self-imposed goal by 2035*** to operate all 100% zero greenhouse gas (GHG) emission buses - ***which is earlier than the CARB 2040 date***.



CALIFORNIA AIR RESOURCES BOARD

Innovative Clean Transit (ICT) Regulation Fact Sheet

DATE May 16, 2019

CONTACT

Email shirin.barjan@arb.ca.gov

Phone (916) 914-1031

CATEGORIES

Programs Innovative Clean Transit

What is the ICT regulation and to whom does it apply?

The ICT regulation was adopted in December 2018 and requires all public transit agencies to gradually transition to a 100 percent zero-emission bus (ZEB) fleet. Beginning in 2029, 100% of new purchases by transit agencies must be ZEBs, with a goal for full transition by 2040. It applies to all transit agencies that own, operate, or lease buses with a gross vehicle weight rating (GVWR) greater than 14,000 lbs. It includes standard, articulated, over-the-road, double-decker, and cutaway buses.

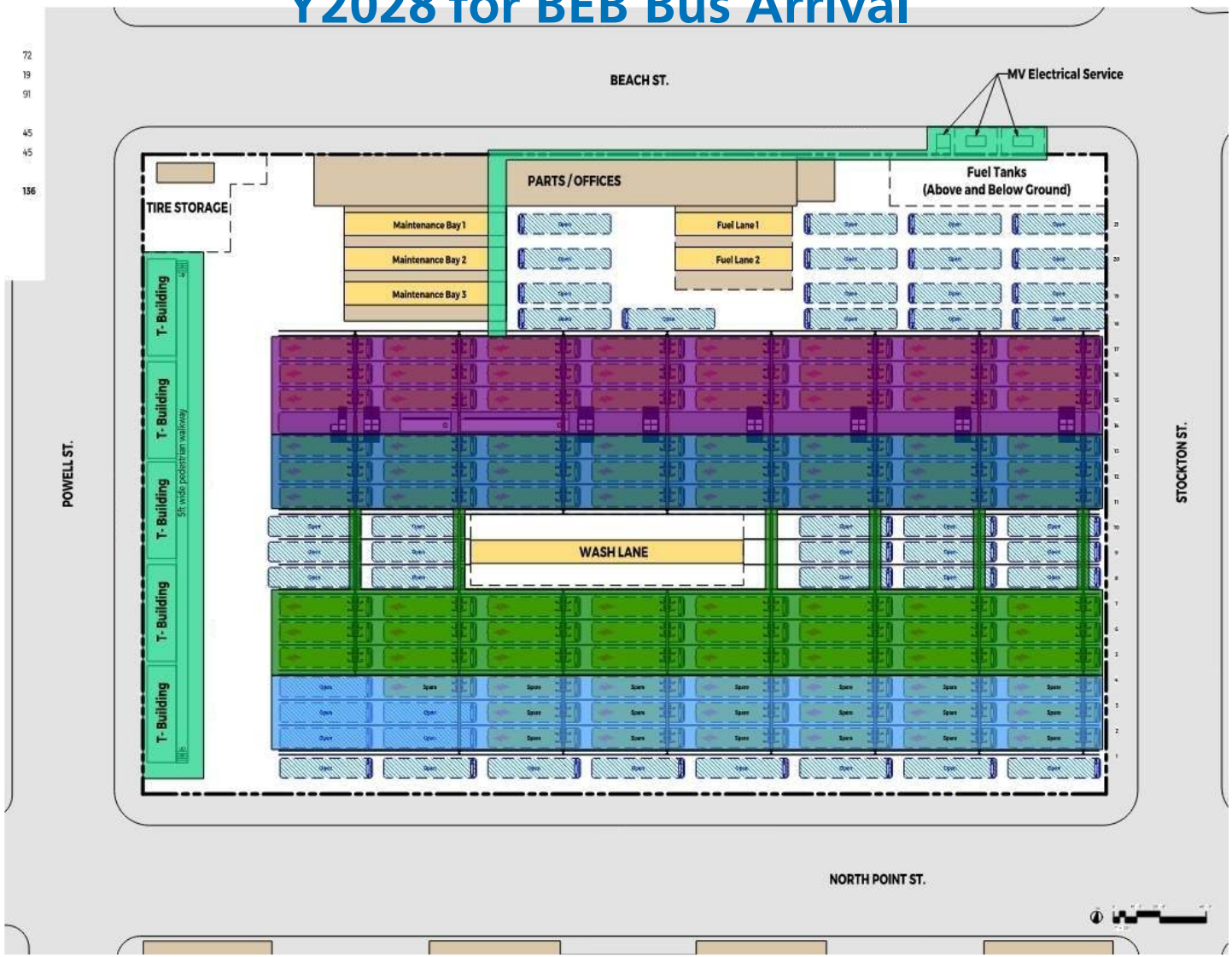
What are the ICT regulation requirements?

The ICT regulation includes the following elements:

- A ZEB Rollout Plan required from each transit agency, approved by its Board, to show how it is planning to achieve a full transition to zero-emission technologies by 2040. Large transit agencies have to submit their Rollout Plan by July 1, 2020, and small transit agencies by July 1, 2023;
- ZEB purchases with various exemptions and compliance options to provide safeguards and flexibility to transit agencies;
- Low NO_x engine purchases, unless the transit buses are dispatched from NO_x Exempt areas;
- Use of renewable diesel or renewable natural gas for large transit agencies, and
- Reporting and record keeping requirements.

Kirkland Yard – the Facility Today

Kirkland Yard: Configuration of Facility Upgrade Y2028 for BEB Bus Arrival



Existing Yard Facilities Stay:

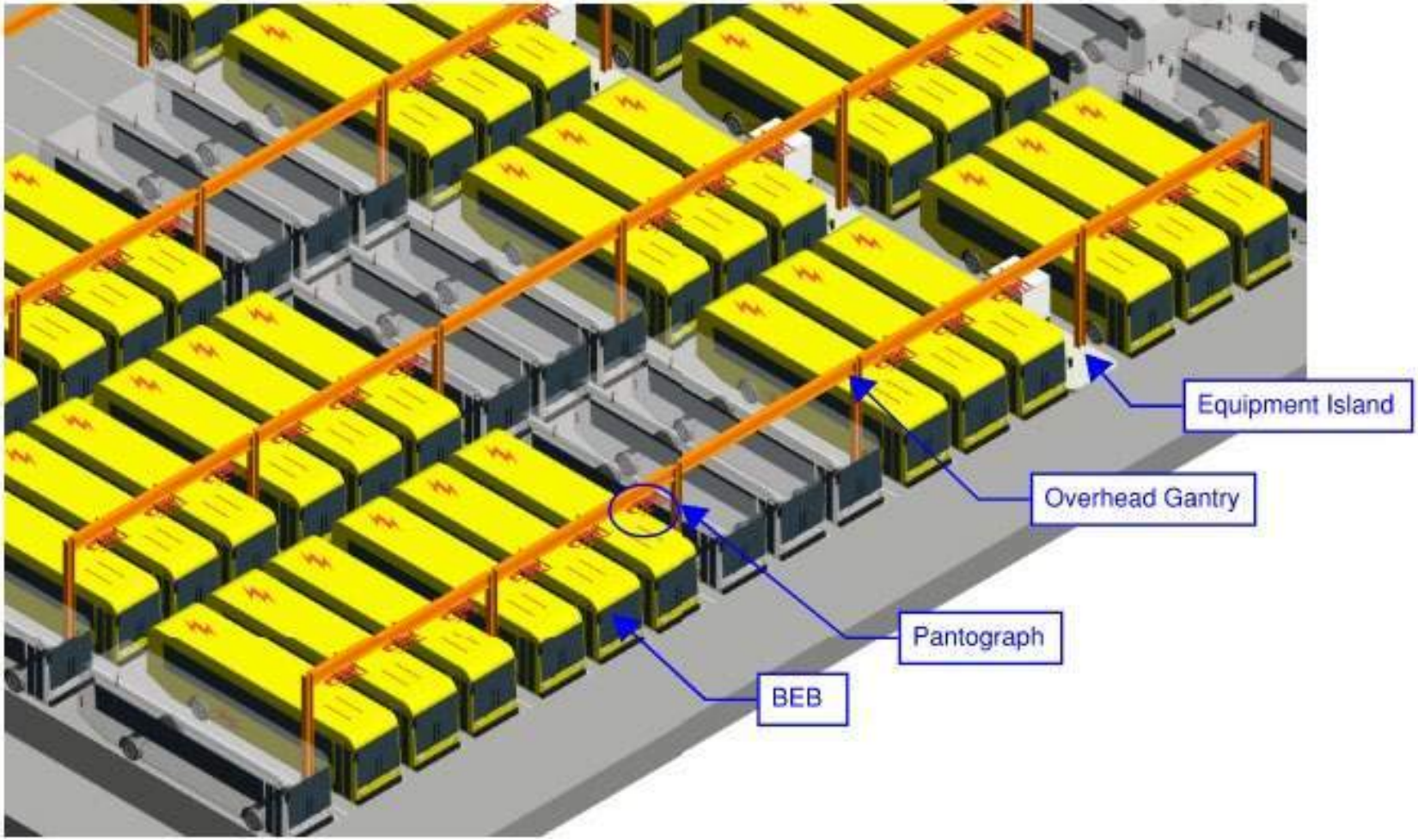
- Parts/Offices
- Electrical Rm
- Maintenance
- Fueling Area
- Tire Storage
- Bus Wash

New Facilities:

- Operations
- Locker Rooms
- Restrooms
- Gilly Room
- Exercise Room
- Training Room

Kirkland Yard: Components of the Upgrade

Depot Charging Elements



Kirkland Yard: Key Issues, Risks, Constraints

1. **SFPUC/PG&E Energization** *timeline and cost*;
2. **Available Funding** *for facility upgrade*;
3. **NEPA** *permitting process*;
4. **Building Code Compliance & Fire Life Safety** *regulation for BEBs*;
5. **Service Resiliency** *power to support transit operations*;

6. **Electric Service Upgrade & EV Charging**;
7. **Employee Parking** – *elimination to maximize BEB storage spaces*;
8. **Aesthetics of Gantry Infrastructure** – *to support pantographs*;
9. **Diesel Fueling** - *retaining the above ground and USTs*;
10. **Operations Building** – *impact of building demolition to operations*;

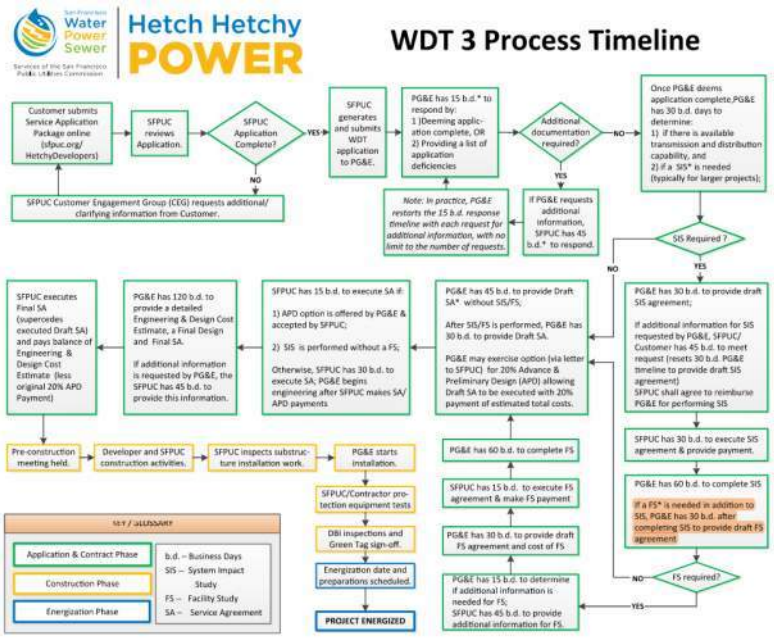
Other Considerations & Constraints

- Utility Service Connections – *not to be underestimated*;
- Yard Drainage – *with pavement design and regulatory compliance;*
- Bus Wash – *impact to yard and grade levelness for BEBs*
- Bus Maintenance Lift Area – *at bays w/concrete pads*
- Construction Sequencing – *conceptual approach*

Key Issue #1 PG&E Energization Timeline & Cost

PG&E Application Time Line – *WDT3 Process*

- **Application to SIS Report** **1 year**
- **SIS report to Service Agreement/Facility Study** **1 year**
- **PG&E Infrastructural Upgrade** *(ADP, ENG, CON, INSP)* **3 years**
- **Energization** *(Testing & Commissioning - to be included)*



PG&E Costs to the Project & Agency

- **System Impact Study** (SIS) **$ 50,000**
- **Facility Study** (FS Report) **$100,000**
- **PG&E Upgrade* Cost** **$12M**

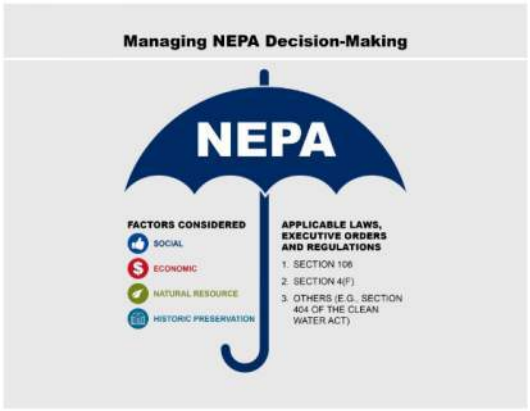
Based on information from Woods and MME projects

** PG&E infrastructure upgrade cost for engineering & construction*

Key Issue #3 NEPA Permitting Process

Federal Environmental Assessment

- **NEPA can be unknown in scope & time**.
- **Projects that receive federal funding have to complete studies** *in order to obtain FTA approval*.
- **History of untimely responses and long schedules** *associated with* SFMTA projects that must complete NEPA.
- **NEPA clearance required** to accept **federal funding contributions**.
- This **risk** is primarily **related to budget and schedule**.



The NEPA "umbrella" showing factors considered and applicable laws, executive orders, and regulations in the NEPA process.

Key Issue #4 Building Code & FLS Compliance

- **Limited Building Codes, Reference** (Code) **Standards and Regulations** *for construction or modification of maintenance facility for* **introduction BEB to Transit Fleet**
- **Utilize existing Non-BEB codes, Reference Standards,** and **Applicable Regulations**
- **Utilize requirements** *set forth by* **SFFD, SFDBI** and other **Authorities Having Jurisdiction (AHJ)**

SAN FRANCISCO DEPARTMENT OF BUILDING INSPECTION

Key Issue #5 Power for Service Resiliency

Resiliency is the capacity to recover from power disruption.

- Task Report **defers power resiliency to Future Kirkland Rebuild**.
- Kirkland does not have an emergency generator set.
- Auxiliary on-site battery storage can reduce effect of unexpected outages.
- Auxiliary battery storage will not provide 100% redundant power.

- **Critical Decision**: include Service Resiliency in the 2028 Kirkland Project?

Duration of Outage	Contingency	Charging Estimate[0]
10 seconds to 15 minutes	On Site: (2) 500 KWH Battery Storage System[1] *Only for Future configuration*	**Charges 9 Buses**[1] allocating 110 KW for each bus. *Assumes each bus at about SOC 20% capacity.*
15 minutes to 2 hours	On-site: 1MW Emergency GenSet *Only for Future configuration*	**Charges 9 Buses**[1] allocating 110 KW for each bus. *Takes about 6 hrs to charge from a SOC 10% to 100%*
More than 2 hours-to-Multi-day Outages	Redundant Utility Feed *Only for Future configuration*	100% backup with no impact to bus charging.
	On-site: 1MW Emergency GenSet *Only for Future configuration*	**Charges 9 Buses**[1] allocating 110 KW for each bus. *Takes about 6 hrs to charge from a SOC 10% to 100%*

Source: WSP and SFMTA

***SOC** = State of Charge*

[0] Assumes: 450 kW BEB Battery & 150 kW Charger Unit

[1] 10% of the Kirkland Fleet (91 Buses) or 9 BEBs are fully charged during an unanticipated power outage – *per Task Report Recommendation*

Key Issue #6 Electrical Service Delivery & EV Charging

Figure A: Beach & Stockton Streets looking west)

1. **Location of PG&E Pull & Metering Section**
   - *not constructable w/exist. F-Line ADA Boarding Platform*
2. **Inadequacy of Equipment Island**
   - *requires wider island & clearances between BEB lanes*
   - *may need more than one island for 46 power blocks*
   - *main electrical equipment infeasible on equipment island*
3. **Strategic Location of Enclosed Electrical Room Critical**
   - *locate main electrical room for 2028 and future build-out*
   - *PG&E will require another service application for new switchgear and any cut-over of 12kV power*

2028 Kirkland Yard Plan

- PG&E Incoming Service to new U/G equipment in vault at F-Line ADA boarding ramp.
- Location of MV & LV electrical equipment w/PG&E Pull and Metering Section – *TBD*
- EV charging cabinets (46) at ground level – *unidentified in Task Report. TBD*
- *Horizontal yard bus parking configuration (8 columns by 16 rows)*

Future Kirkland Yard Plan

- MV & LV electrical equipment w/on-site battery storage on an elevated platform (gantry)
- *Vertical yard bus parking configuration (4 columns by 18 rows)*

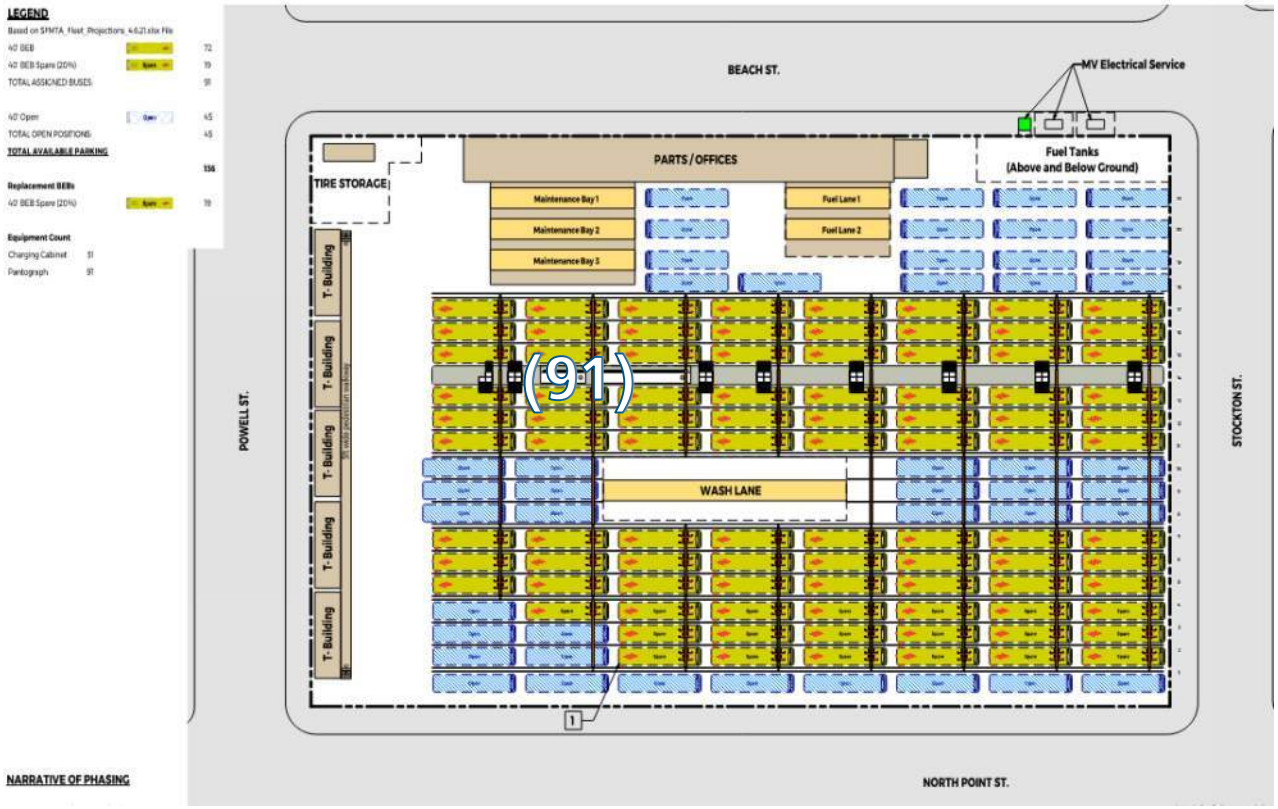
Key Issue #6 Electrical Service Delivery & EV Charging

Plan of 2028 (91 BEBs)

Horizontal Storage Yard

- **(91)** in **8 x 12** Stack
- **(28)** add'l infill parking
- **(17)** add'l infill parking

- *One circulation aisle*
- *One equipment aisle*
- ***EV Charging at grade***
- ***No Electrical Room***
- *No staff car parking*
- *Bus-Turning unproven*



Key Issue # 6 Power Capacity Rating vs Charge Time

Design Approach Set of Assumptions

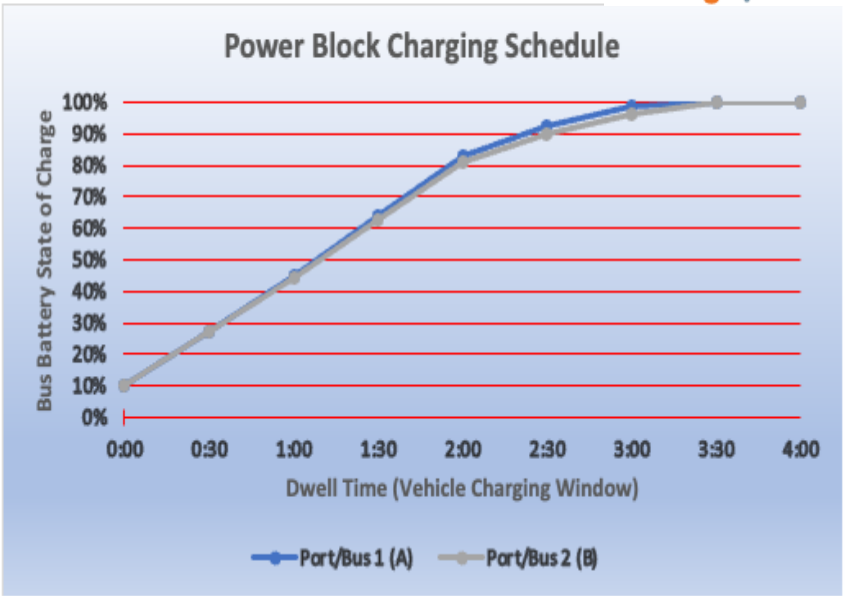
- ✓ **200 kW rated power blocks at 1:2 charging ratio** in lieu of 150kW power blocks & 1:2 charging
- ✓ 150 kW rated power blocks estimated 7.6 MW service request to PG&E
- ✓ 200 kW rated power blocks estimated 9.8 MW service request to PG&E

Critical Decision: incorporate the 200 kW power block with 1:2 ratio for depot charging.

Cluster Option 2

(2) 200kW Power Blocks connected to (2) single-port Power Links that have (1) pantograph connected each Power Link.
This solution can charge (2) buses in 3.5 hours from 10% to 100%. This option can deliver 250A to (2) buses simultaneously or up to 500A to a single bus (if it can take it). power levels.

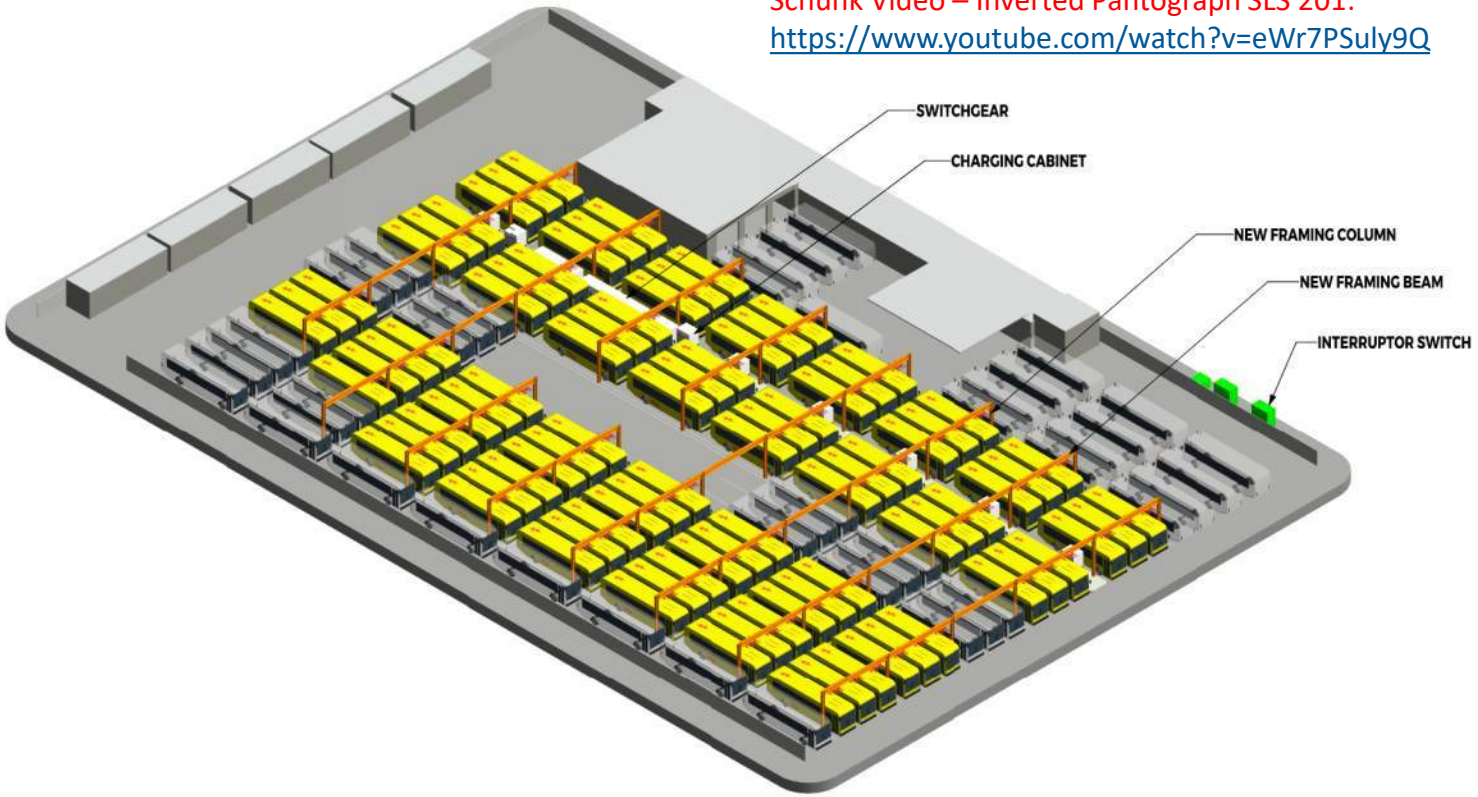
chargepoint



- It will take **3.5 hours for a 200 KW** rated power block to *charge a bus* from *10% to 100%.*
- *In a one power block to 2 dispenser* configuration, it will take approximately **7 hours to charge both buses** from 10% to 100%.
- Using ***200 KW rated*** *power blocks* will *charge* the buses *faster than 150 KW* units, but will **result in higher electrical power demand**.
- The **total energy usage KWH** will be the **same**.

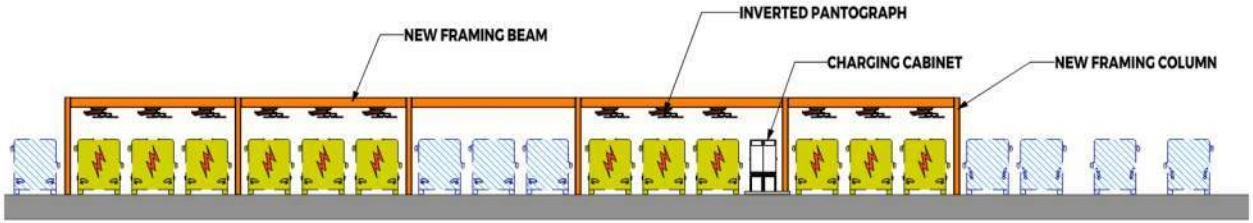
Key Issue # 6 Electrical Power Depot Charging

Schunk Video – Inverted Pantograph SLS 201:
https://www.youtube.com/watch?v=eWr7PSuly9Q



① MASTER PLAN OVERALL 3D

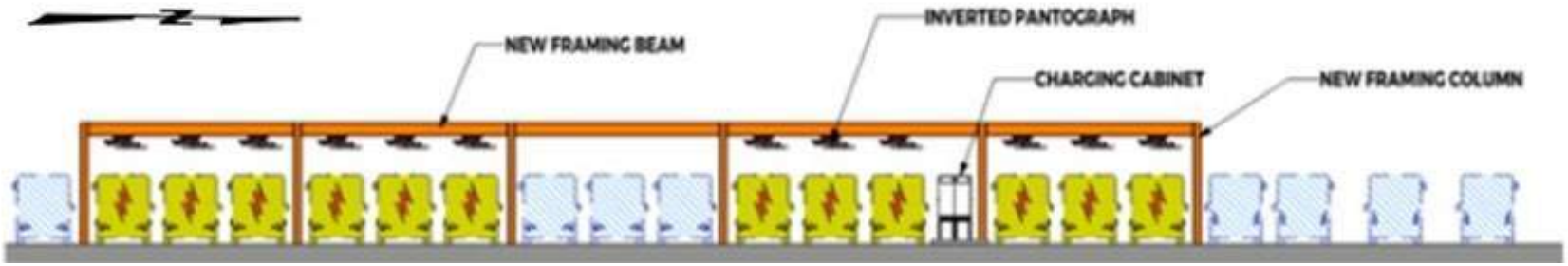
Axonometric View of Kirkland Y2028 Depot Charging w/Gantry Pantographs



Key Issue # 8 Aesthetics from Gantry

Images of Steel-Framed Gantry Structure *supporting depot pantograph charging system*

ABB



Transverse Section of Steel-Framed Gantry Structure *supporting depot pantographs*

Key Issue #9 Fueling Station

SFMTA Photo IMG_2396, January 18, 2023

SFMTA Photo IMG_2317, January 18, 2023

Kirkland Fueling Station

- **Emergency Fueling by City of San Francisco**
  - Due to northernmost location at Fisherman's Wharf & Embarcadero Corridor
- **Renewable Diesel Fueling System** *assumed to remain place*
- **Function:** *to fuel existing Kirkland diesel hybrid buses*

Key Issue #10 Impact to Operations Building

Kirkland Operations Building

- **Disruption and phasing** to the transit operators, Gilly Room, Locker & Restroom Facilities as well as yard staff personnel.
- **Phasing Critical**: must have new trailers in place before demolition.
- **Account for all program spaces and sizes** with Yard Maintenance Supervisor and Fleet Operations Manager before demolition.

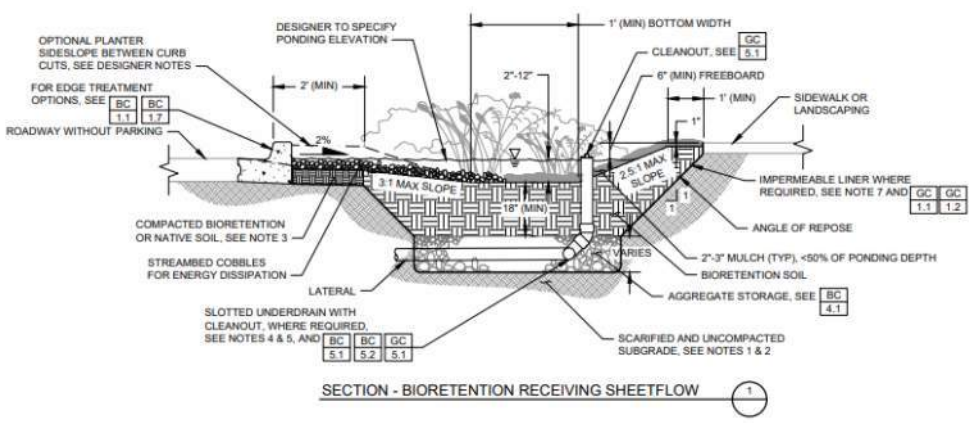
Key Issue #11 Facility Utility Connections

- **Existing underground and aboveground utilities across yard**
  - Serves Bus Wash (e.g., compressed air, electrical conduits)
  - Conduits feeding Operations Building and Trailer
  - Conduits feeding perimeter security fences, gates, lighting
- **File "NOI" Letter** to all utility companies within project limit.
- **Obtain "DotMaps"** composite utility map & underground utility matrix
- **Need disconnect and cap existing utilities** to Operations Building and nearby trailer (operator training, fitness room and storage room)
- **Install new utilities connections** to New Trailers on west side of yard (Powell Street) and New BEB Electrification System
- **Install new and additional connections** from on-site stormwater retention (bio-swales) to ROW street sewer connections

Key Issue #12 Yard Drainage & Pavement

Kirkland Bus Yard – Existing Conditions

- **No stormwater drainage** system in the existing bus yard – ***non-compliant***
- **Regulatory** requirements will require stormwater management as well as ***for permitting***
- On-Site stormwater management by **retention** or ***bio-swales***



Key Issue #15b - Maintenance Lift Bay

SFMTA Archive 171027_Kirk_Shops_106

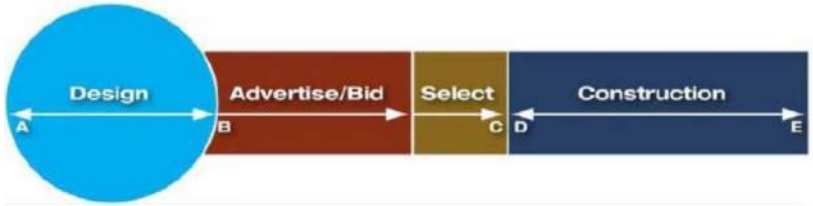
SFMTA Archive 171027_Kirk_Shops_051

Maintenance Lift Bay

- Inadequate Clearance to Lift Buses *inside existing Maintenance Building*
- Inadequate Width for portable lifts or in-place lifts *inside existing Building*
- Service pit in each bay *of existing Maintenance Building*
- Exterior concrete pad for portable lifts in outdoor area – *no canopy cover*
- Maintenance area is given to Gantry & BEB charging - *in the WSP Report*

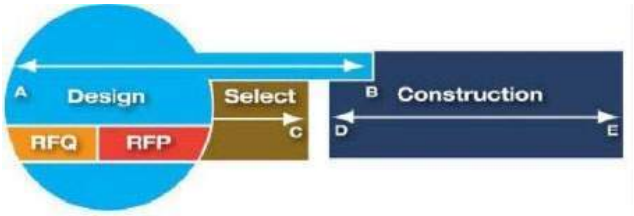
PDR Chapter 7 - Contract Delivery Methods

Design-Bid-Build

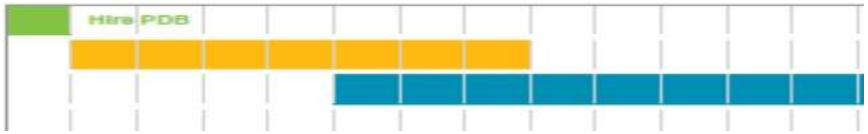


A	Consultant NTP
B	Advertise/Bid Open
C	Contractor Selection
D	Construction NTP
E	Substantially Complete
A-B	Design Time
A-C	Selection Time
D-E	Construction Time
A-E	Project Time

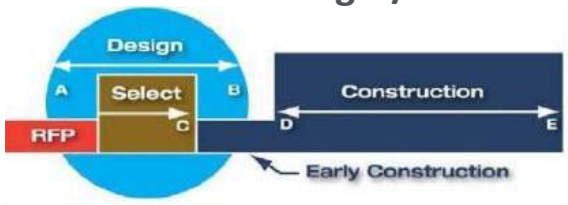
Design-Build



Progressive Design Build



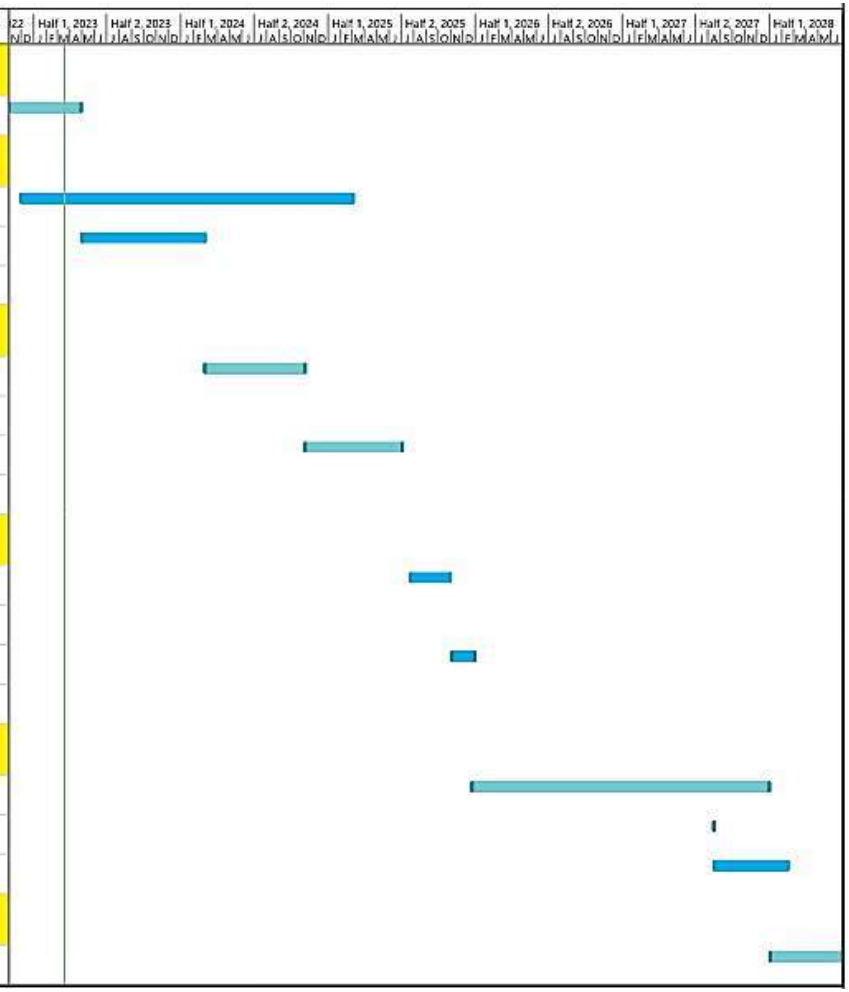
Construction Manager/General Contractor (CMGC)



Turn Key

PDR Chapter 12 - Preliminary Project Schedule[0]

ID	Task Name	Start	Finish	Duration (Months)
1	**Planning Phase**			
2	Pre-Development Report Complete	11/1/22	4/28/23	6
3	**Preliminary Engineering Phase**			
4	Environmental Clearance	12/1/22	3/3/25	27
5	Preliminary Engineering Report Complete	5/1/23	2/29/24	10
6	(30% Design)			
7	**Detail Design Phase**			
8	Detail Design (65% Design)	3/1/24	11/4/24	8
9	*Inclusive of 1-month Comment/Response*			
10	Detail Design (100% Design)	11/5/24	7/3/25[1]	8
11	*Inclusive of 1-month Comment/Response*			
12	**Contracting Phase**			
13	Advertise Construction	7/25/25	10/30/25	4
14	*In lieu of DBB, then concurrent with design*			
15	Award Construction Contract	11/4/25	12/30/25[2]	2
16	*In lieu of DBB, then concurrent with design*			
17	**Construction Management Phase**			
18	Construction with NTP	12/24/25	12/31/27	24
19	Substantial Completion	8/16/27	8/16/27	N/A
20	Commissioning and Certification	8/17/27	2/15/28	6
21	**Administrative Closure Phase**			
22	Closeout Activities	1/3/28	6/30/28	6



*[0] **Table (schedule) in the PDR** is based on a traditional Design-Bid-Build Contract Delivery Method.*
[1] In an alternative contract delivery method, the Detail Design Phase is concurrent with Advertising, Bid and Award e.g. w/PDB/CMGC but requires the overall 22 months for design w/Builder.
[2] Construction End Date will include continuation of design period to this end date.

Table of Critical Discussions

No.	KEY ISSUE & KEY DECISIONS	Agree	No	TBD (Date)
1.	**Power Resiliency**: provide in the 2028 Facility Upgrade			
2.	**200 kW Power Blocks & 1:2 Charging Ratio**: Design Approach			
3.	**9.86 MW Service Request**: concurrence to submit			
4.	**Diesel Fueling Station**: maintain this critical function?			
5.	**Bus Wash**: Recommendation to replace w/new (not in PDR)			
6.	**Bus Maintenance Lift Bay**: Provide at expense of BEB bus(es)			

Thank you!

Attachment 4

Zero-Emission Bus Rollout Plan

Prepared for:

CALIFORNIA AIR RESOURCES BOARD

Prepared By:

wsp

SFMTA

Rollout Plan Revision History			
Revision Number	**Editor**	**Date**	**Notes**
0	Bhavin Khatri	5/14/21	Final release
1	Ivan Magana	07/06/22	Edits to Fleet Procurement schedule and Facilities schedule

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Acronyms & Abbreviations

BEB	Battery Electric Bus
CalEPA	California Environmental Protection Agency
CARB	California Air Resources Board
CEQA	California Environmental Quality Act
CNG	Compressed Natural Gas
DAC	Disadvantaged Community
DHEB	Diesel-Hybrid Electric Bus
FCEB	Fuel Cell Electric Bus
ICEB	Internal Combustion Engine Bus
ICT	Innovative Clean Transit
kW(h)	Kilowatt (hour)
MME	Muni Metro East
O&M	Operations & Maintenance
OCS	Overhead Catenary System
PG&E	Pacific Gas & Electric
RNG	Renewable Natural Gas
SMR	Steam-Methane Reform
SFPUC	San Francisco Public Utilities Commission
SFMTA	San Francisco Municipal Transportation Agency
FTA	Federal Transit Administration
WDT	Wholesale Distribution Tariff
ZE	Zero-Emission
ZEB	Zero-Emission Bus
ZETB	Zero-Emission Trolley Bus

1 Rollout Plan Summary

Agency Background	
Transit Agency's Name	San Francisco Municipal Transportation Agency
Mailing Address	1 S. Van Ness Avenue San Francisco, CA 94105
Transit Agency's Air District	Bay Area Air Quality Management District
Transit Agency's Air Basin	San Francisco
Total number of Buses in Annual Maximum Service	680[1]
Urbanized Area	San Francisco - Oakland
Population of Urbanized Area	3,557,982[2]
Contact information of general manager, chief operating officer, or equivalent	Jeffrey Tumlin Director of Transportation 415.646.2522 mailto:XXXXX@sfmta.comjeffrey.tumlin@sfmta.com
Rollout Plan Content	
Is your transit agency part of a Joint Group[3]	No
Is your transit agency submitting a separate Rollout Plan specific to your agency, or will one Rollout Plan be submitted for all participating members of the Joint Group?	N/A
Please provide a complete list of the transit agencies that are members of the Joint Group (optional)	N/A
Contact information of general manager, chief operating officer, or equivalent staff member for each participating transit agency member	N/A
Does Rollout Plan have a goal of full transition to ZE technology by 2040 that avoids early retirement of conventional transit buses?	Yes
Rollout Plan Development and Approval	
Rollout Plan's approval date	03-16-21
Resolution No.	210316-038
Is copy of Board-approved resolution attached to the Rollout Plan?	Yes (Appendix A)
Contact for Rollout Plan follow-up questions	Bhavin Khatri, PE, PMP Zero Emission Program Manager 415.646.2586 bhavin.khatri@sfmta.com
Who created the Rollout Plan?	Consultant
Consultant	WSP

[1] This is based on January 2020 (pre-COVID) service.
[2] ACS 2019 (https://censusreporter.org/profiles/40000US78904-san-francisco-oakland-ca-urbanized-area/)
[3] The ICT regulation defines a Joint ZEB Group or Joint Group (13 CCR § 2023.2) as two or more transit agencies that choose to form a group to comply collectively with the ZEB requirements of section 2023.1 of the ICT regulation.

2 Introduction

In accordance with the California Air Resource Board's (CARB) Innovative Clean Transit regulation (ICT regulation), the following report serves as the San Francisco Municipal Transportation Agency's (SFMTA) Rollout Plan to transition its bus fleet to 100% zero-emission (ZE) by 2040.

2.1 Background

2.1.1 California Air Resource Board's Innovative Clean Transit Regulation

Effective October 1, 2019, the ICT regulation requires all public transit agencies in the state to transition from internal combustion engine buses (ICEBs) to zero-emission buses (ZEBs), such as battery-electric (BEB) or fuel cell electric (FCEB), by 2040. The regulation requires a progressive increase of an agency's new bus purchases to be ZEBs based on its fleet size.

ICT regulation does not apply to overhead catenary trolley buses (ZETB), but they are a part of zero-emission vehicles.

To ensure that each agency has a strategy to comply with the 2040 requirement, the ICT regulation requires each agency, or a coalition of agencies, to submit a ZEB Rollout Plan before purchase requirements take effect. The Rollout Plan is considered a living document and is meant to guide the implementation of ZEB fleets and help transit agencies work through many of the potential challenges and explore solutions. Each Rollout Plan must include several required components and must be approved by the transit agency's governing body through the adoption of a resolution, prior to submission to CARB.

According to the ICT regulation, each agency's requirements are based on its classification as either a "Large" or "Small" transit agency. The ICT defines a Large Transit Agency as an agency that operates in the South Coast or the San Joaquin Valley Air Basin and operates more than 65 buses in annual maximum service or it operates outside of these regions, but in an urbanized area with a population of at least 200,000 and has at least 100 buses in annual maximum service. A Small Transit Agency is an agency that doesn't meet the above criteria.

The SFMTA, as a Large Transit Agency must comply with the following requirements:

July 1, 2020 – Board of Directors (Board) approved Rollout Plan must be submitted to CARB

January 1, 2023 – 25% of all new bus purchases must be ZE

January 1, 2026 – 50% of all new bus purchases must be ZE

January 1, 2029 – 100% of all new bus purchases must be ZE

January 1, 2040 – 100% of fleet must be ZE

March 2021 – **March 2050** – Annual compliance report due to CARB

Due to the impacts of COVID-19, the SFMTA requested and was granted an extension for the submission of the Rollout Plan to March 31, 2021. The purpose of this request was to ensure that critical items such as the SFMTA's direction and decisions on trolley buses, yard rebuilds, stakeholder engagement, and future funding were included in the analysis to define the framework of its ZEB transition more accurately.

2.1.2 Zero-Emission Bus Technologies

According to the ICT regulation, a ZEB is a bus with zero tailpipe emissions and is either a BEB or a FCEB. The following subsections provide a brief overview of each technology and how they compare to ICEBs. While both BEB and FCEB technologies provide ZE benefits, the feasibility and viability of their application is largely based on an agency's service and operational parameters. The following provides a brief overview of BEB and FCEB technologies.

Battery-Electric Buses (BEBs)

BEBs use onboard batteries to store and distribute energy to power an electric motor and other onboard systems. Similar to many other battery-powered products, BEBs must be charged for a period of time to be operational.

BEB charging technology exists to charge vehicles at the yard (overnight or midday) or on-route (typically during layovers). A yard charging strategy typically consists of buses with high-capacity (kilowatt-hour or kWh) battery packs that are charged for four to eight hours with "slow" chargers - usually less than 100 kilowatts (kW) – while being stored overnight. An on-route charging strategy typically consists of buses with low-capacity battery packs that are charged with "fast" chargers – usually in excess of 100 kW – during bus layovers (typically 5-20 minutes). BEBs are charged via several dispenser types (conductive and inductive) and orientations (overhead or ground-mounted). The most common dispensers in the U.S. market are plug-in and pantographs, as presented in Figure 2-1.

Figure 2-1. Plug-In and Pantograph Charging

Sources: YorkMix (Left) and ABB (formerly ASEA Brown Boveri) (Right)

Under existing conditions, BEBs cannot meet the ranges that ICEBs can. BEBs typically have a range of 125-150 miles, which is highly dependent on a myriad of factors, including climate, driving behavior, and topography. For this reason, if an agency's service blocks cannot be completed with BEBs, other capital-intensive strategies may be needed to meet range requirements, including, but not limited to additional BEBs, on-route charging infrastructure, service changes, and/or a mixed-fleet strategy with the incorporation of FCEBs.

Fuel Cell Electric Buses (FCEBs)

FCEBs can typically replace ICEBs at a 1:1 replacement ratio without significant changes to operations and service. A FCEB uses hydrogen and oxygen to produce electricity through an electrochemical reaction to power the propulsion system and auxiliary equipment. This ZE process has only water vapor as a byproduct. The fuel cell is generally used in conjunction with a battery, which supplements the fuel cell's power during peak loads and stores electricity that is recaptured through regenerative braking, allowing for better fuel economy.

The process, operations, and equipment used to refuel hydrogen buses is similar to "lighter-than-air" fuels such as compressed natural gas (CNG). Typically, hydrogen is produced via steam-methane reform (SMR) or electrolysis. SMR, the most common method of producing hydrogen, uses high-pressure steam to produce hydrogen from a methane source, such as natural gas. Electrolysis, on the other hand, uses an electric current to decompose water into hydrogen and oxygen. After the hydrogen is produced, it can be delivered to the site via pipeline or delivered by a truck (as either a gas or liquid). Hydrogen is then stored, compressed, and dispensed to the buses on-site. Depending on space availability and resources, some agencies can produce hydrogen on-site.

Some of the most pressing challenges for FCEB operations is the limited supply network and the amount of energy, space, and high capital costs required to isolate, compress, and store hydrogen. Also, if renewable natural gas (RNG) - such as methane capture from organic matter – is not used as an alternative to natural gas via SMR operations, there are some concerns that FCEBs may not be the most sustainable vehicle to achieve GHG targets.

2.1.3 ZEB Suitability for the SFMTA's Service and Operations

The choice between adopting BEBs or FCEBs is contingent on the unique needs and conditions of an agency. Several variables need to be factored into this decision, including costs associated with bus acquisitions and associated infrastructure, spatial requirements, energy/fuel costs, and community acceptance. Based on existing conditions and the stated variables, BEBs appear to be the most suitable technology for the SFMTA to meet the requirements of the ICT regulation. The following provides a brief summary of the main findings of this analysis:

BEBs are more affordable than FCEBs at this time. There are barriers to entry for both BEBs and FCEBs, with both technologies exceeding the cost ICEBs. However, BEBs have achieved better economies of scale and are currently significantly less expensive than FCEBs.

The SFMTA's bus facilities are too space-constrained to accommodate FCEB-supporting infrastructure. Infrastructure to support BEBs (charging cabinets, dispensers, and associated utility equipment) can all be contained within the SFMTA's yard (either elevated or ground-mounted). In contrast, the infrastructure required for FCEBs (storage tanks, dispensers, etc.) requires a large footprint due to sizing and the National Fire Protection Association's (NFPA) required buffers. For example, a 15,000-gallon vertical hydrogen storage tank has a footprint of approximately 40 by 50 feet (not including the fueling island). This same tank would need to be located at least 75 feet from all air intakes, 50 feet from liquid or gas lines, and at least 25 feet from public ways, railroads, and property lines due to NFPA requirements. With the SFMTA's yards already being space-constrained in an urban environment, the SFMTA would risk losing a lot of potential bus parking – assuming that the infrastructure complies with NFPA requirements.

The SFMTA's existing rates for electricity are very competitive. With exceptionally low energy costs, powering BEBs is expected to be significantly less expensive than supplying hydrogen via liquid delivery. Hydrogen costs currently average around $8/kg and can have wide variability depending on local production supply and distance from the chosen supplier.

Hydrogen operations in the SF's dense neighborhoods may be a barrier to public acceptance. BEBs are widely accepted by communities and supported in terms of sustainability initiatives by both cities and transit agencies alike. This is in large part due to near or zero local emissions and quiet operations. Communities are generally more cautious with the installation of hydrogen storage near their community due to the risk of hydrogen seepage and combustion. When located near urban or residential areas, significant stakeholder outreach is often required to garner support for on-site hydrogen storage. With the majority of the SFMTA's yards located in urban regions, adoption of hydrogen may result in community pushback and potential delays in rollout.

2.1.4 San Francisco Municipal Transportation Agency

The SFMTA is a department of the City and County of San Francisco. The SFMTA plans and operates bus, rail, historic streetcar, cable car, and paratransit transit service within the City and County of San Francisco. In addition, the SFMTA also manages parking, traffic, bicycling, walking, and taxis in the city. Prior to the COVID-19 pandemic, the SFMTA provided approximately 726,000 weekday and 220 million annual passenger boardings.[4] 71% of these boardings — 520,000 per weekday and over 156 million annually — occurred on 76 weekday bus routes. Ridership from 654,300 weekday boardings in FY06 to 726,100 in FY16.[5]

Service Area

The SFMTA serves approximately 49 square miles within the City and County of San Francisco (Figure 2-2). San Francisco has added over 78,000 residents and over 175,000 jobs since 2009, and now has a population of 883,000 and 720,000 total jobs.[6]

Utility Provider

The San Francisco Public Utilities Commission (SFPUC) provides electrical service for the SFMTA service area by way of Pacific Gas & Electric (PG&E) electrical infrastructure. The SFPUC operates Hetch Hetchy Power, a Publicly Owned Utility. Although the SFPUC has served all municipal agencies within the City and County of San Francisco for many decades, it relies upon PG&E's transmission and distribution grid to serve its customers, for which PG&E receives a fee.

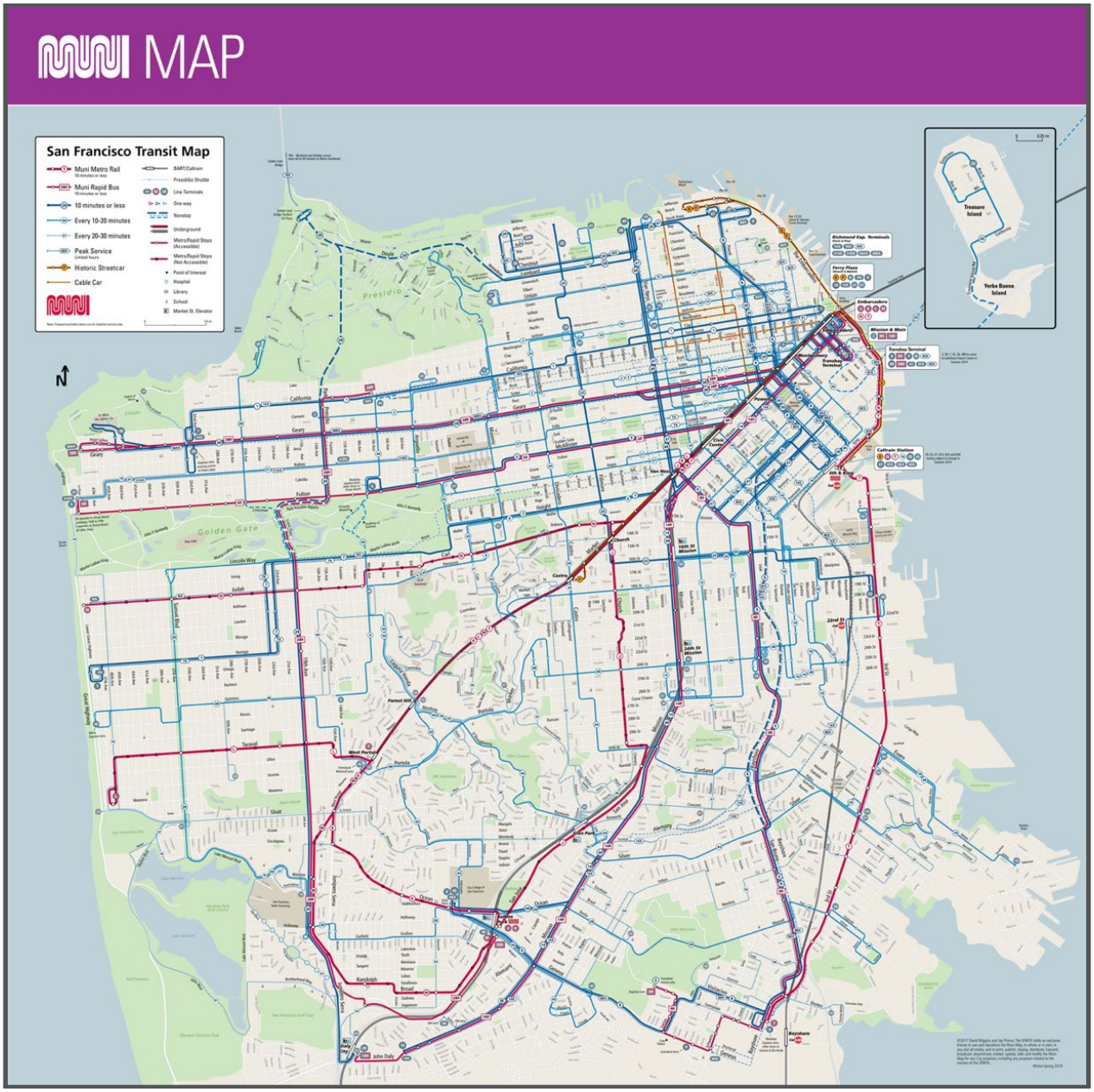
This situation, with the lack of designated service territory boundaries between the two utilities, is unlike any other in the country, and greatly limits the SFPUC's visibility into the detailed grid infrastructure and capacities. Despite multiple requests to gather details, PG&E will not provide information on feeder capacities unless the SFPUC submits an application for service through the Wholesale Distribution Tariff (WDT), a process that may require upwards of $150,000 and two years+ per service location to perform a System Impact Study to determine the capacity available for new loads.

Under the WDT, each SFPUC customer inter-tie point is viewed by PG&E as a utility-to-utility connection. As such, PG&E applies the rules of the WDT to each SFPUC customer connection. This is significant to the SFMTA in several ways, but particularly in terms of project timelines and budget. Each service upgrade that utilizes the PG&E grid must go through PG&E's review process. The SFPUC therefore has no control over processing delays or resource constraints. Upon completion of the review, any grid or infrastructure upgrades required by PG&E are born solely by the SFPUC customer. Being an SFPUC customer, the SFMTA would not be eligible for any betterment cost sharing, like PG&E retail customers

[4] SFMTA Short-Range Transit Plan Fiscal Year 2019 – Fiscal Year 2030, p. 9.
[5] SFMTA Bus Fleet Management Plan 2017-2030, p. 25.
[6] SFMTA San Francisco Mobility Trends Report 2018, Jan 28, 2019, p2.

would, regardless of the quantity of PG&E customers that would benefit from the investment. Similarly, the SFMTA is ineligible for PG&E's EV Fleet programs, which provide funding for grid infrastructure builds and upgrades that support EV charging.

Figure 2-2. SFMTA System Map



Source: SFMTA, Winter/Spring 2019, prior to COVID- 19 induced service suspension

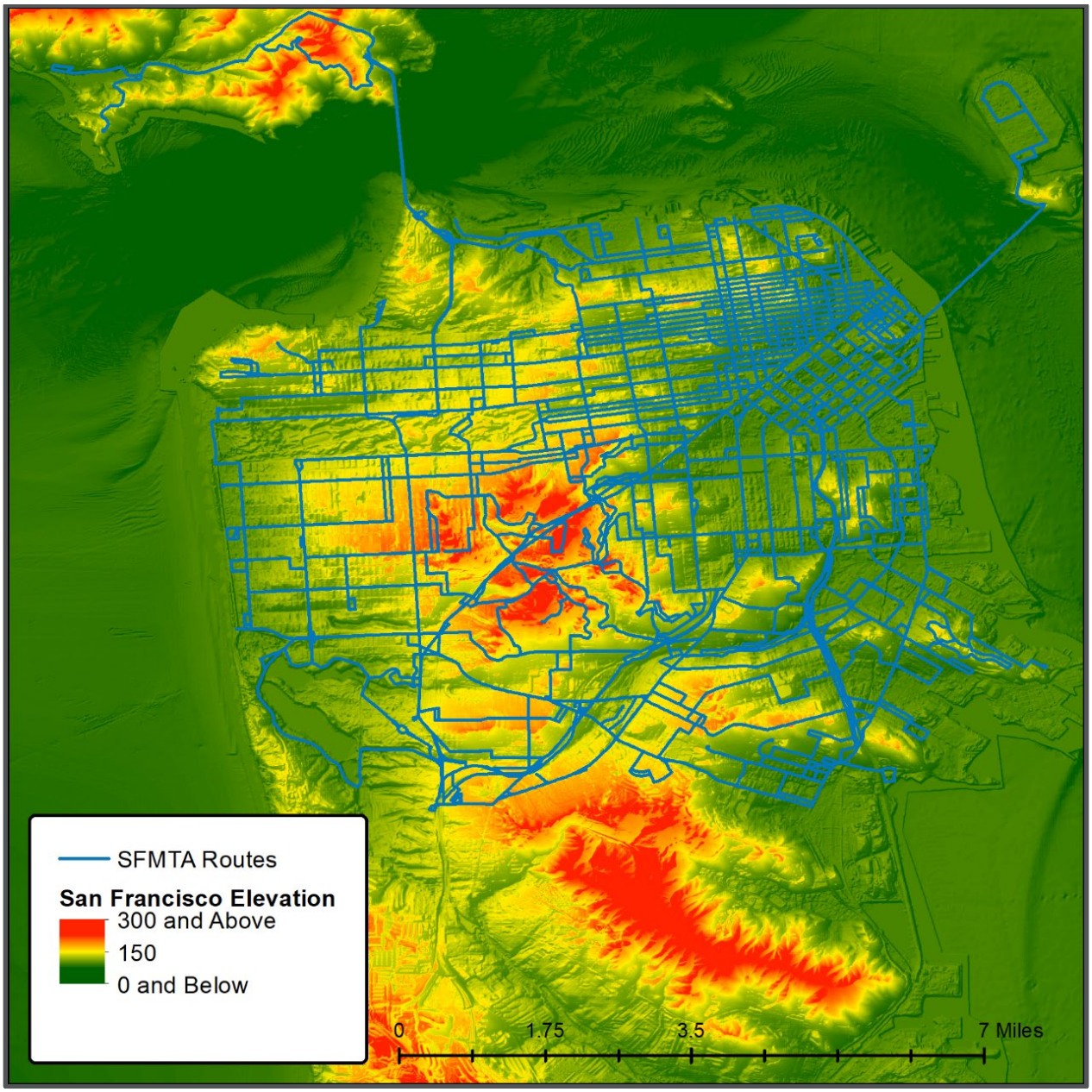
Environmental Factors

San Francisco's Mediterranean climate is characterized by dry summers and wet winters with relatively mild temperatures. Temperature does not vary much throughout the year, with average high temperatures of approximately 70°F during the summer, and average low temperatures of 45°F during the coldest winter days.

Topography is varied, with scores of hills ranging from seal level to over 900 feet in elevation. This varied topography, combined with the effects of cold ocean currents, gives rise to microclimates.

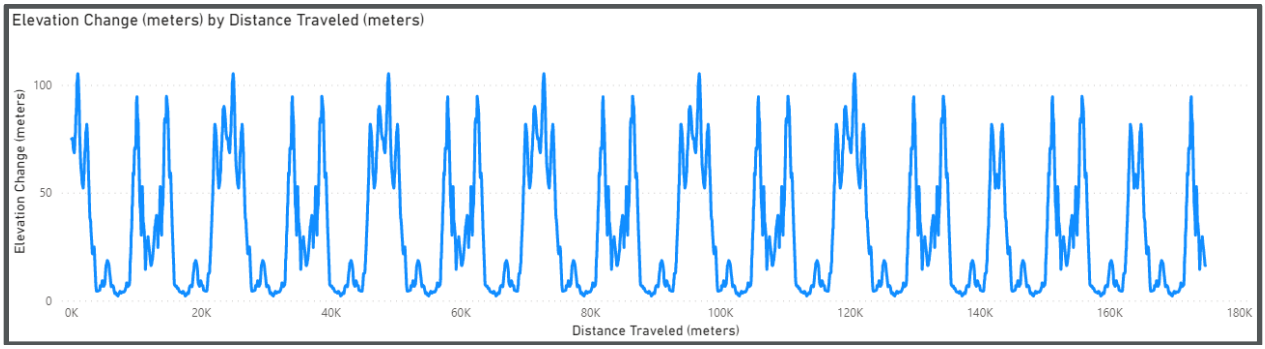
The SFMTA's buses must travel over multiple hills in a day – the steepest grade is 23%. Figure 2-3 shows San Francisco's service and the elevation profile, with much of the service feeding into downtown (which is near sea-level) over numerous hills. An example of the elevation change a transit vehicle may do while in-service is shown in Figure 2-4 with weekday vehicle block 1005 continuously traveling up and down hills for the entirety of its service. The block gains a total of 3,542 meters or 2.2 miles in a day (the equivalent of over 38 football fields or 11.6 times the height of San Francisco's tallest building, the Salesforce Tower, at 1,070 feet).

Figure 2-3. San Francisco Service and Elevation Profile



Source: WSP, USGS DEM

Figure 2-4. Vehicle Block 1005 Elevation Change



Source: WSP, USGS DEM

Schedule and Operations

As of January 2020, the SFMTA directly operates 844 diesel-hybrid and trolley buses on 76 regular weekday routes, which include supplemental Muni Metro Rail Owl service and routes with Rapid and Express service (e.g. Route 14, Route 14R, and Route 14X are three different routes) but excludes weekend-only route 76X and intermittent service to the Chase Center (78X and 79X).[7] These buses are served by six maintenance and storage yards: Flynn, Islais Creek, Kirkland, Potrero, Presidio, and Woods. Bus support functions also occur at 1399 Marin, and the SFMTA is planning bus storage improvements on 4 undeveloped acres east of the Muni Metro East light rail division. The SFMTA's trolley buses operate exclusively out of Potrero and Presidio yards, both of which are over 100 years old.

The SFMTA's fixed-route bus service is organized into six categories or types of service:

1. **Rapid Bus:** Routes that operate every 10 minutes, or more frequently, all day on weekdays and are the focus of transit-priority measures.
2. **Frequent:** Routes that also operate every 10 minutes, or more frequently, all day on weekdays in major corridors, but make more frequent stops than Rapid Bus routes.
3. **Grid:** Routes that form the framework of "trunk" routes across the city (along with Rapid and Frequent bus routes, and Muni SFMTA), with 12-30 minute headways all day on weekdays.
4. **Connector:** Shorter routes that provide coverage (including neighborhood "circulator" service to hillside neighborhoods) that generally operate every 30 minutes all day on weekdays.
5. **Specialized:** Routes with a focused purpose, including: express routes (primarily peak period-only services for commuters); supplemental service (to middle and high schools); and special event service (i.e., sporting events, concerts, etc.). Frequencies on these routes vary.
6. **Owl:** Some routes operate 24 hours a day, while other overnight routes (operating between 1 and 5 a.m.) are comprised of segments of multiple routes.

COVID-19-Related Impacts

As a response to the economic and health impacts of COVID-19, the SFMTA has made major interim service changes, including the closure of Muni Metro and prioritization of core bus routes (per the Muni Core Service Plan).

[7] This is based on January 2020 (pre-COVID) service.

The Muni Core Service Plan (April 2020) prioritizes the most-used routes to provide access to San Francisco's medical facilities while also increasing the volume of buses (to promote social distancing) for riders that are most reliant on transit. As of September 2020, the COVID-19 situation has resulted in a 71% reduction in bus boardings and a 95% reduction in transit revenue compared to the same time in 2019.

The federal government, through the CARES Act, provided some relief to the SFMTA to address the funding shortfall. However, long-term service levels will be contingent on revenues, ridership, and finding creative solutions to deliver that service efficiently and effectively.

COVID-19 directly impacts the SFMTA's transition to a zero-emission fleet due to increased uncertainty of various important factors: future ridership, changes and adaptations to service planning, continued emergency declarations and operations, general economic health or recession, and capital funding.

2.1.5 The SFMTA's Existing ZEB Efforts

The SFMTA is a national leader in confronting climate change and embracing the prospects of a ZE future. The SFMTA has taken multiple steps to not only meet the requirements of CARB's ICT regulation, but also its own ambitious ZE goals, as detailed below.

— The SFMTA currently operates the largest fleet of ZE trolley buses in North America. Trolley buses run on 100% greenhouse gas-free hydropower via an overhead catenary system (OCS). The SFMTA also operates over 600 diesel-hybrid vehicles that run on batteries and renewable diesel.

— In April 2018, in celebration of Earth Day, the then current mayor, Mark Farrell, committed the City of San Francisco to net-zero greenhouse gas emissions by 2050, which would eliminate the city's carbon footprint. The SFMTA is already doing its part and accounts for less than 2% of citywide transportation emissions (45%).

— In partnership with the San Francisco Department of the Environment, the SFPUC, and other city agencies and stakeholders, the SFMTA supported the development of the Electric Mobility Roadmap that lays out a vision for reducing public health and environmental impacts of private transportation. The Roadmap also identifies strategies to help realize an emission-free transportation sector.

— In May 2018, the Board adopted its Zero-Emission Vehicle Policy resolution (ZEV Policy). Under the ZEV Policy, demonstrating the SFMTA's commitment to achieving a 100% zero-emission fleet by 2035.[8]

— In November 2019, the SFMTA procured nine 40-foot BEBs (three each from New Flyer, Proterra, and BYD). These buses will be piloted in regular revenue service to analyze performance and to assist in developing a long-term charging strategy (expected delivery in early 2021).[9] This pilot program includes an electrical and facility upgrade at Woods Yard to accommodate BEB charging equipment and infrastructure.

— In 2018, as part of its Green Zone program, the SFMTA replaced 68 buses with diesel-hybrid buses outfitted with higher capacity batteries and a GPS-enabled switch, which automatically switches the bus to EV mode as it enters geo-fenced areas (Green Zones) throughout the city. In Green Zones,

[8] Due to the impacts of COVID-19 (reduction in ridership, funding, etc.), the SFMTA is revisiting this policy to align it with the ICT regulation (2040).
[9] Nine buses are currently procured with an additional three in negotiations.

the vehicles operate entirely on battery power, reducing and eliminating SFMTA-generated emissions in some of the city's most environmentally burdened communities.

— In February 2020, the SFMTA awarded a contract to WSP to provide a roadmap for the SFMTA's transition to BEB facilities and transit fleet vehicles. This partnership will produce several deliverables that will guide the SFMTA to meet their electrification goals, including a BEB Facility Implementation Master Plan (Master Plan).

— In 2021, the SFMTA procured three 40-foot BEBs from Nova. These buses will be piloted in regular revenue service along with the existing BEBs to analyze performance and to assist in developing a long-term charging strategy (expected delivery in late 2022).

2.2 Rollout Plan Approach

In accordance with the Rollout Plan Guidance, this document provides an overview of several key components to the SFMTA's ZEB transition, including fleet acquisitions, schedule, training, and funding considerations.

Due to the rapidly evolving nature of ZEB technologies, it is likely that the recommended approaches in this Rollout Plan will be adjusted and changed over time. For that reason, the SFMTA will continue to evaluate technologies and strategies throughout the transition process. Areas that are currently under study will be indicated, where applicable. The service-related information in this Rollout Plan is based on January 2020 service (pre-COVID) and the fleet numbers are based on September 2020.

It should also be noted that COVID-19 has caused unprecedented losses in the SFMTA's revenue through the loss of ridership (fares) and the reduction in sales tax revenue. For these reasons, the SFMTA has reduced service and operations and continues to adapt in the near term and forecast the long-term implications on the system and the agency's capital projects and goals. While the impact of COVID-19 on the SFMTA's electrification pursuant to the ICT regulation is still unclear, the SFMTA will continue planning and adjust as needed once COVID-19 is stabilized and trends are more predictable.

2.3 Rollout Plan Structure

In accordance with CARB's Rollout Plan Guidance, the SFMTA's Rollout Plan includes all required elements. The required elements and corresponding sections are detailed below:

— Transit Agency Information (Section 1: Rollout Plan Summary)

— Rollout Plan General Information (Section 1: Rollout Plan Summary)

— Technology Portfolio (Section 2.1.3: ZEB Suitability for the SFMTA's Service and Operations)

— Current Bus Fleet Composition and Future Bus Purchases (Section 3: Fleet and Acquisitions)

— Facilities and Infrastructure Modifications (Section 4: Facilities and Infrastructure Modifications)

— Providing Service in Disadvantaged Communities (Section 5: Equity Considerations)

— Workforce Training (Section 6: Workforce Training)

— Potential Funding Sources (Section 7: Costs and Funding Opportunities)

— Start-up and Scale-up Challenges (Section 8: Start-up and Scale-up Challenges)

3 Fleet and Acquisitions

The following section provides an overview of the SFMTA's existing fleet, planned ZEB technology, and proposed procurement schedule.

3.1 Existing Bus Fleet

The SFMTA bus fleet includes diesel-hybrid (DHEB) and electric trolley buses ranging from 30- to 60-feet. As of September 2020, the SFMTA operates a fleet of 844 buses.

The fleet is served by six bus maintenance and storage yards, two for trolley buses, two for 60-foot buses, and two for standard (30- and 40-foot) buses. Table 3-1 provides a detailed overview of the SFMTA's existing bus fleet.

Table 3-1. Summary of the SFMTA's Existing Bus Fleet

Manufacturer	Series	Fuel Type	Length	In Service Year	Bus Type	Quantity
New Flyer	8601-8662; 8701-8710; 8713-8750	DHEB	40'	2013	Standard	111
	8711			2014		1
	8800-8859; 8861; 8864-8866; 8869; 8871			2016		66
	8751-8780; 8860; 8862-8863; 8867-8868; 8870; 8872-8901			2017		66
	8902-8955			2018		54
	8956-8969			2019		14
	6500-6544; 6546-6553; 6700		60'	2015	Articulated	54
	6545; 6554; 6560-6605l; 6701-6730			2016		78
	6606-6644; 6646-6647; 6649-6650; 6653			2017		44
	6645; 6648; 6651-6652; 6654-6697			2018		48
	5701-5798	Trolley Bus	40'	2018	Standard	98
	5799-5885			2019		87
	7201-7225		60'	2015	Articulated	24
	7224; 7226-7260			2016		36
	7261-7280			2017		20
	7281-7293			2018		13
Orion	8501-8530	DHEB	30'	2007	Standard	30
					Total Buses	**844**

Source: SFMTA, September 2020

3.1.1 Battery-Electric Bus Technologies

The SFMTA intends to transition its DHEBs to BEBs. The SFMTA's future BEBs are expected to be compatible with the Society of Automotive Engineers' (SAE) J1772 (plug-in) and SAE J3105 (pantograph) charging standards. By supporting both standards, the SFMTA's buses will have the flexibility of charging in multiple layouts and orientations. The plug-in standard will allow buses to charge while being serviced, and the pantograph standard will allow buses to charge at the base and at potential on-route charging locations. The roof-mounted charging rails that are associated with the pantograph standard will allow the SFMTA's BEBs to access "fast" high-power charging (in excess of 150 kW) for a limited duration.

Based on the SFMTA's existing service needs and yard configurations, it is recommended that an inverted pantograph-charging strategy be implemented to support BEBs at all six yards. The pantographs will be supported by an overhead frame that covers the surface of the bus parking tracks. The overhead strategy was deemed to be the most suitable due to space constraints at the SFMTA's yards. The overhead frame will also be able to support photovoltaic panels (where applicable) and electrical equipment and components (conduit, etc.). Exceptions to the overhead frame solution could potentially occur in multi-level facilities as they are rebuilt, such as Potrero and Presidio Yards. Future design of those facilities would likely either include an overhead frame or an equipment mezzanine, but the SFMTA will leave those decisions to the facility design teams.

The proposed facility layouts for each yard are based on utilizing a 150-kW DC charging cabinet in a 1:2 charging orientation (one DC charging cabinet energizes two separate dispensers/buses). This charger-to-dispenser ratio maximizes space utility, reduces capital costs, and meets the requirements to charge the fleet during servicing and dwell time on the site while minimizing the peak electrical demand. That said, the SFMTA continues to monitor technological advancements and may explore other strategies that are advantageous to the SFMTA.

Figure 3-1 shows an example of a pantograph and charge rails.

Figure 3-1. Inverted Pantograph and Charge Rails

Source: WSP

3.2 Procurement Schedule

In accordance with the ICT regulation, the SFMTA will prioritize ZEB purchases and progressively increase the percentage of ZEB purchases over time. As planned, starting in 2027, all the SFMTA's new bus purchases will be zero-emission vehicles (BEB and Trolleys) - two years before the ICT regulation requires.

Early retirement should not be an issue pursuant to the ICT regulation (2040) based on the SFMTA's future purchases. However, if early retirement becomes a risk, one potential strategy is to place newly acquired buses on the SFMTA's longest (distance) service blocks. This will ensure that buses meet the Federal Transit Administration's (FTA) 500,000-mile minimal useful life requirement sooner. Prior to implementing such a measure, the SFMTA will conduct an equity analysis to ensure that service distribution and vehicle choice is equitable across neighborhoods and districts.

Table 3-2 summarizes the SFMTA's anticipated procurements through 2040 and Figure 3-2 presents the percentage of the fleet that are powered by zero-emission technologies or fossil fuels through the same timeframe. Table 3-3 summarizes the SFMTA's planned fleet totals through 2040. These are built on the assumption that BEBs and associated battery capacities will be available to meet the SFMTA's service block ranges so that a 1:1 replacement ratio with DHEBs is achievable. It should be noted that this is

contingent on the availability of funding, whether battery technology can meet the SFMTA's range requirements, and whether facilities and utility enhancements are completed. The COVID-19 pandemic has caused uncertainty in the long-term impacts to the SFMTA's funding and service. Staff is actively analyzing these changes and will update the schedule accordingly.

In 2023/4, the SFMTA plans to apply at least 20 "Bonus Credits" and up to 12 BEBs early purchases (SFMTA would have 12 BEBs operating in revenue service during this time) to their procurement to satisfy the 25% ZEB purchase requirement. In the year 2027 and beyond, all new bus purchases will be 100% zero-emission vehicles – two years prior to the ICT regulation's requirements.

Table 3-2. Summary of the SFMTA's Future Bus Deliveries (Through 2040)*

Existing Fleet	32ft MC		40ft MC			40ft TB		60ft MC		60ft TB	Total Procured
Procurement Type	Hybrid Rep.	BEB Rep.	Hybrid Rep.	BEB Rep.	BEB Exp.	Trolley Rep.	BEB Rep.	BEB Rep.	BEB Exp.	Trolley Rep.	
2021					3						3
2022	30				9						39
2023											0
2024				12							12
2025			69						6		75
2026			31								31
2027								48			48
2028				11				79	4		94
2029				45	34			5	26		110
2030				48				42	20		110
2031				28				50		12	90
2032				40					2	48	90
2033				31		21			5	33	90
2034					20	80			10		110
2035		9			20	81					110
2036		21		21	5	3					50
2037				69							69
2038				31				6			37
2039								48			48
2040				11				79			90
Notes	"MC": Motor Coach (Hybrid or Battery Electric Bus), "TB": Trolley Bus, "Exp.": Expansion, "Rep.": Replacement, "BEB": Battery Electric Bus										

Note: The SFMTA's existing DHEBs are expected to be replaced with BEBs 12 years after their in-service date. This procurement schedule assumes a 1:1 replacement ratio with BEBs being replaced every 12 years (mirroring 12-year warranties) and does not incorporate fleet growth projections/additions as these are still currently under study.

*SFMTA expects that the NTP for the buses delivered in the table above would be issued at least 12-18 months in advance.

Figure 3-2. Percentage of Zero-Emission and Fossil Fuel Fleet (2021-2040)

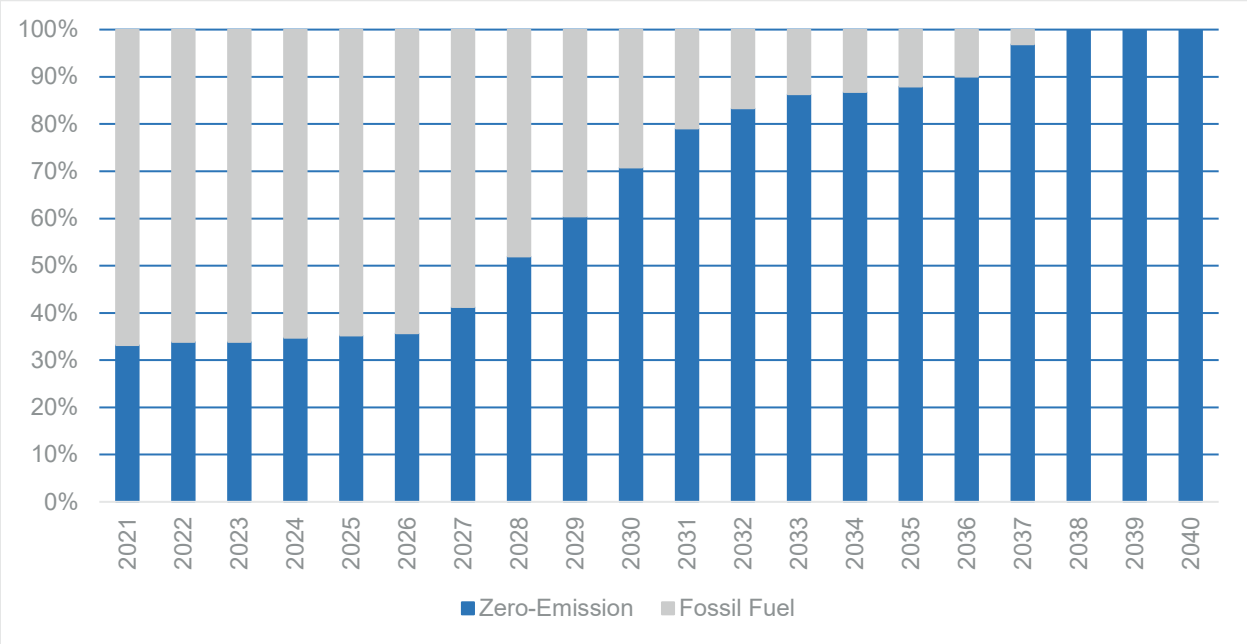


Table 3-3. Total Fleet Size Each Year

	32 DHEB	32 BEB	40 DHEB	40 BEB	40 TB	60 DHEB	60 TB	60 BEB	Total
2021	30	0	312	3	185	224	93	0	847
2022	30	0	312	12	185	224	93	0	856
2023	30	0	312	12	185	224	93	0	856
2024	30	0	312	24	185	224	93	0	868
2025	30	0	312	24	185	224	93	6	874
2026	30	0	300	24	185	224	93	6	862
2027	30	0	300	24	185	176	93	54	862
2028	30	0	289	35	185	97	93	137	866
2029	30	0	244	114	185	92	93	168	926
2030	30	0	196	162	185	50	93	230	946
2031	30	0	168	190	185	0	93	280	946
2032	30	0	128	230	185	0	93	282	948
2033	30	0	100	258	185	0	93	287	953
2034	30	0	100	278	185	0	93	297	983
2035	21	9	100	298	185	0	93	297	1003
2036	0	30	100	303	185	0	93	297	1008
2037	0	30	31	372	185	0	93	297	1008
2038	0	30	0	403	185	0	93	297	1008
2039	0	30	0	403	185	0	93	297	1008
2040	0	30	0	403	185	0	93	297	1008
Notes	"DHEB": Diesel Hyrbid Electric Buses, "BEB": Battery Electric Bus, "TB": Trolley Bus,								

Source: WSP

3.2.1 ZEB Bonus Credits

Based on the ICT regulation, the SFMTA is entitled to 18 bonus credits for their existing trolley buses[10] and will have 12 early purchases available for their planned BEB pilot buses[11], resulting in 30 available credits for the SFMTA. As indicated above, the SFMTA plans to exercise these credits in the 2023/4 procurement. In lieu of the 25% ICT ZEB purchase requirement, the SFMTA will use 28 of their credits (25% of 112 buses).

3.2.2 ZEB Range Requirements and Costs

Approximately 9% of the SFMTA's existing bus blocks travel farther than 150 miles per weekday – a range that exceeds current batteries' capabilities.[12] To reduce impacts to service, there are several strategies that the SFMTA can consider to meet service (range) requirements, including midday charging, battery/charging management systems, on-route chargers, additional bus purchases, and solar and battery storage. In addition, with battery technology rapidly evolving, future battery capacities and efficiencies may be sufficient to serve all blocks..

3.2.3 ZEB Conversions

Conventional bus conversions to ZEB technologies are not currently being considered. However, the SFMTA will remain open to conversions if they are deemed financially feasible and align with ZEB adoption goals.

[10] Per the ICT regulation: "Each electric trolley bus placed in service between January 1, 2018, and December 31, 2019, receives one-tenth of a Bonus Credit that will expire by December 31, 2024."
[11] Nine buses are currently procured with an additional three in negotiations.
[12] This is based on January 2020 (pre-COVID) service.

4 Facilities and Infrastructure Modifications

The following sections provide an overview of the existing fleet (by yard), proposed charging strategies, infrastructure, yard improvements, and program schedule.

4.1 Overview of Existing Facilities

The SFMTA has six yards, all of which will require significant capital improvements to accommodate a 100% zero-emission fleet. Table 4-1 summarizes the number and type of buses that are currently stored at each facility and Figure 4-1 presents the locations of each yard.

Table 4-1. Summary of Existing Yards and Fleets

Yard	Address	Total	Diesel-Hybrid Buses			Trolley Buses	
			30’	40’	60’	40’	60’
Flynn	1940 Harrison St.	119	-	-	119	-	-
Islais Creek	1301 Cesar Chavez St.	115	10	-	105	-	-
Kirkland	2301 Stockton St. and 151 Beach St.	91	-	91	-	-	-
Potrero	2500 Mariposa St.	146	-	-	-	53	93
Presidio	949 Presidio Ave.	132	-	-	-	132	-
Woods	1095 Indiana St.	241	20*	221	-	-	-
	Total	844	30	312	224	185	93

Source: SFMTA Master Fleet Assign Ratio, September 2020

Figure 4-1. The SFMTA's Bus Yards

Source: WSP

4.2 ZEB Facility and Infrastructure Strategy

Since ZEB technology continues to evolve, it is difficult to commit to a costly strategy that may quickly become outdated or obsolete. However, it is also important to ensure that strategies are future-ready. For this reason, the recommended facility and infrastructure modifications are based on what each yard is planned to accommodate in 2040 per the *2017 SFMTA Facilities Framework* report and resulting *Building Progress* capital program. Since service changes and bus movements may occur multiple times a year, by establishing a full-build scenario, the SFMTA can optimize and tailor strategies based on existing (or anticipated) service.

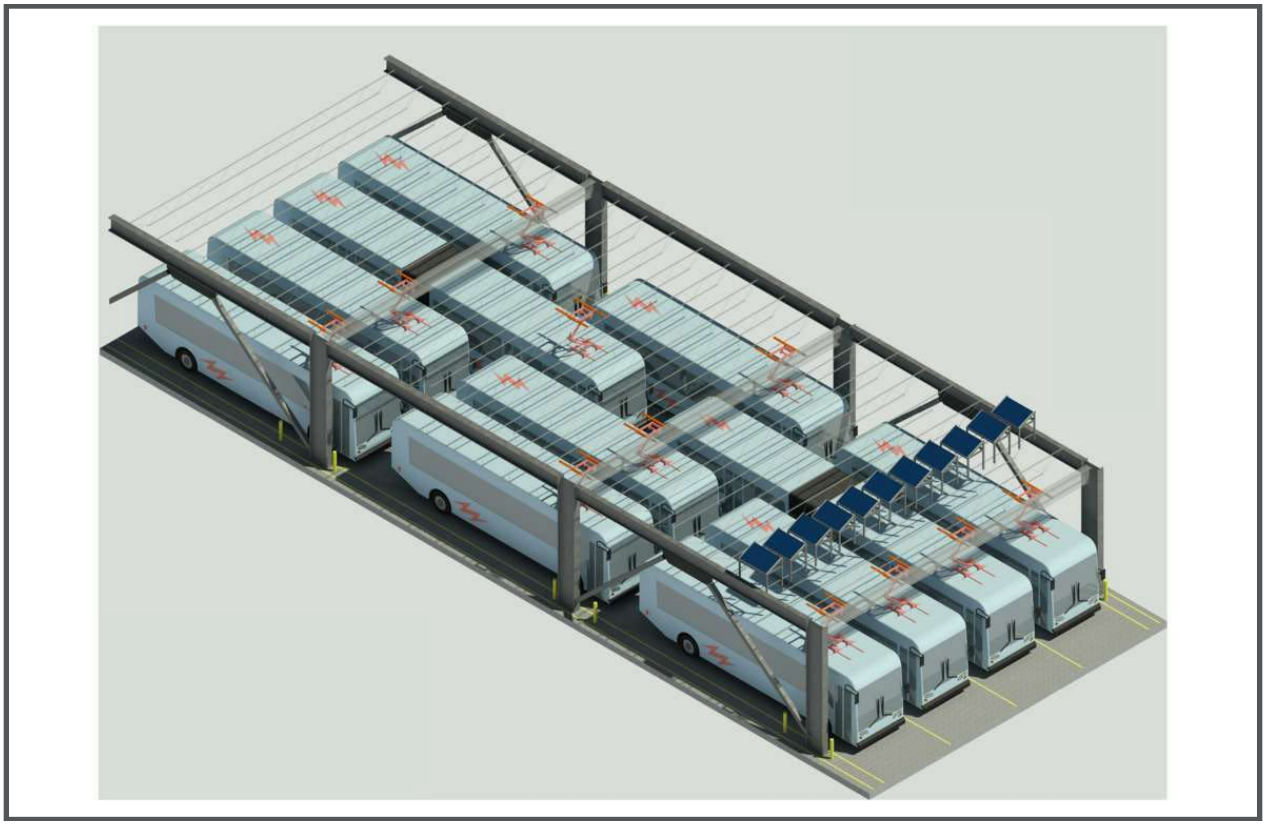
The SFMTA's transition to a zero-emissionfleet will require an increase in the electrical supply to the site, enhancements and expansions of electrical equipment, and the installation of gantries, chargers, dispensers, and other components. These modifications must occur at all six yards. While the SFMTA is not currently actively seeking on-route charging locations, we remain open to the concept, particularly if it is required to meet the service plan.

During preliminary concept discussions, both conductive and inductive charging solutions were considered and analyzed by the SFMTA and the design team. Based on several factors, including the space constraints at each yard and the desire for uniform infrastructure for ongoing maintenance efficiency, the SFMTA committed to an inverted pantograph strategy for all yards. However, where applicable, such as in maintenance areas, plug-in dispensers may be utilized.

To support the inverted pantographs, a scalable and modular overhead support structure is proposed in open bus yards to retain maximum bus parking capacity while implementing BEB charging. This type of overhead structure can be rapidly modified to meet changes in the SFMTA's fleet mix. The system consists of an overhead structure spanning up to four tracks of bus parking with pantographs mounted at various five-foot intervals as required by the assigned bus fleet. Charger cabinets, switchboards, transformers, and all electrical distribution will be kept above the bus parking area, where possible, to avoid costly trenching and reduce service interruptions during the transition.

Figure 4-2 illustrates inverted pantographs mounted to the modular overhead support structure.

Figure 4-2. Inverted Pantographs and Modular Support Structure



Source: WSP
Note: The frame can also support plug-in dispensers.

The proposed layouts are based on utilizing a 150-kW DC charging cabinet in a 1:2 or 1:3 charging orientation (one DC charging cabinet energizes two separate dispensers/buses). This charger-to-dispenser ratio would meet the requirements to charge the SFMTA's fleet overnight and minimize peak electrical demand.

4.3 ZEB Transition

The process of integrating BEBs into the SFMTA's fleet is very complex. Each yard will need to have sufficient power (utility enhancements) and charging infrastructure in place before buses are delivered. While the utility enhancements can generally be done without impacting normal operations, the installation of the support structure and charging equipment (chargers, switchgear, transformer, etc.) could negatively impact operations. For that reason, the planning of distinct on-site construction stages and program-level phasing is essential.

Staging

To avoid service disruptions and operational impacts, the SFMTA's yards will undergo BEB upgrades in several on-site stages. These "stages" are segments of the yard that will be temporarily shut down to install the necessary BEB-supporting infrastructure. The buses that would normally occupy the staging space will be temporarily relocated on-site (if space allows) or to a neighboring yard or facility. This approach will ensure that construction and normal operations can proceed concurrently. This construction method avoids the complete shutdown of the yard undergoing improvements, which reduces the risks of service impacts.

The number of stages and number of buses that need to be temporarily relocated during each stage vary based on a yard's layout, existing fleet, and additional capacity.

Phasing

In order to electrify the fleet by 2040, it will be necessary to have multiple yards undergoing construction, concurrently. "Phases" are essentially classifications of when and how these yards are grouped. Typically, the phase in which a yard is transitioned is based on agency's priorities or technical feasibility. The SFMTA is also concurrently implementing a facility capital rebuild program. When conceived in 2017, the *Building Progress Program* proposed rebuilds of the SFMTA's three oldest and most obsolete facilities: Potrero Yard, Presidio Yard, and Kirkland Yard. The *Building Progress Program* must be adapted to accommodate zero-emission vehicle infrastructure projects.

The number of phases, stages, and details on bus relocations are currently being analyzed and will be finalized in the SFMTA's ongoing Feasibility and Fleet Transition Plan Study.

Figure 4-3 presents a concept of Islais Creek Yard and how its construction can be staged.

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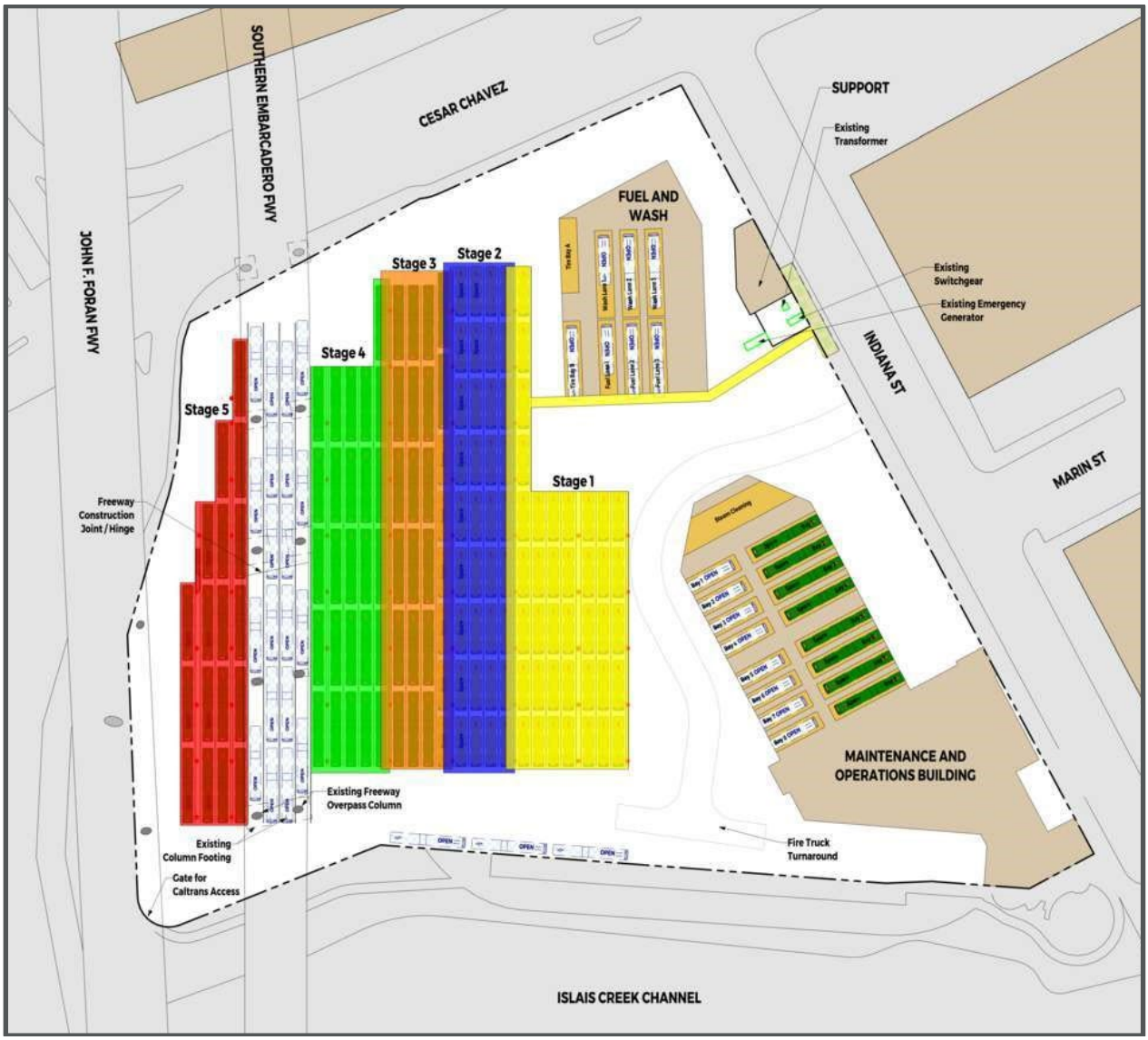
Figure 4-3. SFMTA Staging Example



Source: WSP

4.4 Transition Considerations

There are multiple factors and timetables that must be considered to meet the SFMTA's zero-emission fleet goals in accordance with the ICT regulation. Since BEBs are not operational unless the facilities are in place to energize them, it is essential to meet deadlines because it can impact both service and ICT regulation compliance.

The following provides a brief overview of the various processes and timetable assumptions for each, Figure 4-4 presents the proposed schedule for the SFMTA's zero-emission fleet conversion.

Bid Documents

The electrification process will require multiple subject matter experts, planners, designers, architects, engineers, OEMs, and contractors. For this reason, multiple requests for proposals (RFPs) will need to be developed and put out for bid for various phases of the project. For example, there may need to be an

RFP for a firm to take the project from 30% design to 100% design. There may also be a separate RFP for the construction component. This assumes a typical design-bid-build concept. For more complex rebuild projects, like Potrero and Presidio Yards, the projects will be delivered in a joint development progressive design-build or design-build model. The SFMTA will continue to evaluate the best strategy to meet goals. If a design-bid-build strategy were to be implemented, it is assumed that each stage of bidding would take six months.

BEB-Supporting Enhancements

With the amount of time it will take to construct the pantograph-supporting structures and other BEB enhancements, it is assumed that each "stage" of construction at a yard will take approximately six months to be completed. For example, a yard with three distinct stages would take approximately 18 months to be BEB-ready.

Utility Infrastructure Enhancements

Even with BEBs and BEB-supporting equipment in place, the fleet can only operate if the electrical utility and supporting circuits can meet the energy and power demands of the BEBs. In the SFMTA's case, power is provided by PG&E by way of SFPUC. The SFMTA must undergo a lengthy and uncertain process to request and receive additional power. This process includes an application, a study, permitting, planning and design, and construction (on behalf of SFPUC). This process could take as long as five years. The utility enhancements dictate when a yard is deemed fully operational for BEBs.

BEB Bus Procurements

It is assumed that buses can be procured 18 months before the conclusion of the BEB-supporting enhancements. Typically, ordering buses is not an arduous endeavor. However, the procurements will have to be aligned with the construction of charging equipment at the yard and utility enhancements.

Environmental Clearance

Yards that are scheduled to be demolished and rebuilt, such as Potrero and Presidio, are considered "projects" under the California Environmental Quality Act (CEQA) and an environmental impact report (EIR) will need to be prepared. The process of developing and certifying an EIR can take 2-3 years, pre-construction. The other four divisions may be exempt from developing an EIR pursuant to California's Senate Bill 288, if all requirements, including workforce and labor provisions, of the exemption can be met. The exemption, in part, grants extensions to "transit agency projects to construct or maintain infrastructure to charge or refuel zero-emission transit buses," However, the specific details and guidelines for the exemptions will be further evaluated in subsequent stages of planning.

Temporary Relocations

The SFMTA's 1399 Marin and Muni Metro East (MME) facilities have been identified as sites that can temporarily store and dispatch buses during construction at other sites. For instance, when Potrero and Presidio are being reconstructed, the SFMTA is planning to temporarily relocate their trolley bus fleets there. Procurement tables and construction schedules will have to be in alignment with the timing of these temporarily relocations to avoid scheduling delays or impacts to operations or service.

Yard Management and Operations

The layout and operations of the yard will be vastly different during and after construction. Currently, there are no range issues with the SFMTA's buses and the time it takes to fuel buses is negligible. However, with the transition from DHEBs to BEBs, more considerations to how buses are parked, operated, and

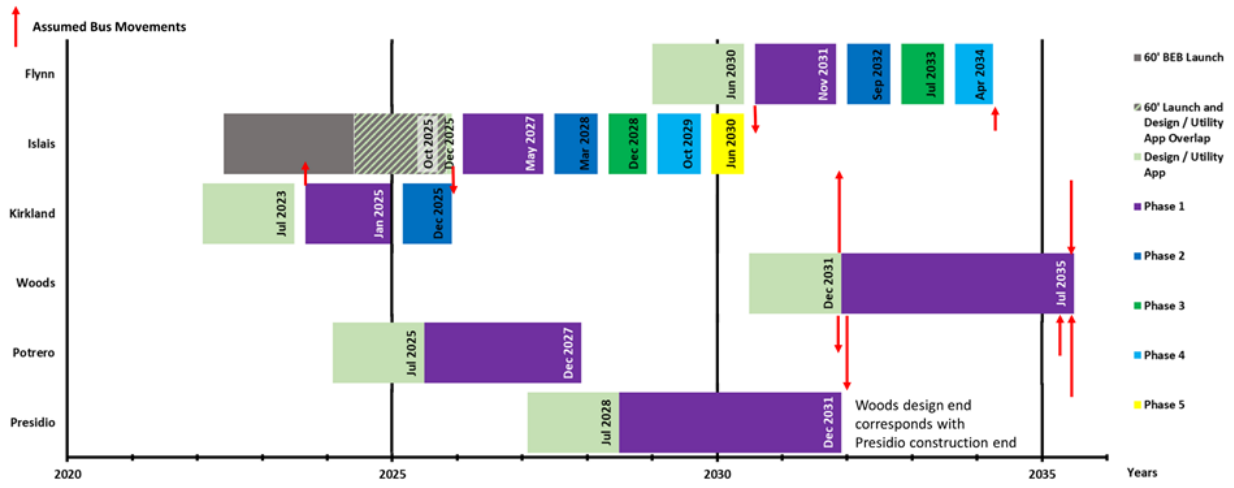
dispatched will be required due to the reduction in range and relatively long charge times. These issues will be even more important during the time(s) that yards are operating mixed fleets (BEB, TB, and DHEB). To mitigate any negative impacts to operations, significant planning and updates to standard operating procedures will be needed to achieve a successful transition.

Schedule

As indicated above, there are multiple prevailing factors that will dictate the SFMTA's transition schedule. Figure 4-4 illustrates a conceptual schedule that can meet ICT regulation goals. This schedule largely follows the priorities of the *2017 Facilities Framework* report and uses the utility provider's conservative five-year estimate as the span of time it will take to enhance all facilities. This schedule does not consider the specifics of bus procurement quantities, service planning, or phasing and is highly contingent on the SFMTA's funding and PG&E and SFPUC's ability to meet construction deadlines.

It should also be noted that the SFMTA is currently evaluating the cost effectiveness of implementing the BEB transition at two facilities that are generally in poor condition (Kirkland and Woods). The capital investment of BEB conversion is significant, and the SFMTA is committed to fiscally responsible capital projects that meet the larger needs of the SFMTA's service and workforce. All of these factors will have impacts to the conceptual schedule.

Figure 4-4. Conceptual Schedule



Source: WSP

4.5 Summary of Yard Enhancements

By 2040, all of the SFMTA's yards will be capable of operating a 100% zero-emission fleet. Table 4-2 summarizes the modifications and schedule of each yard, and the following sections detail the process of each yard's transition from existing conditions to zero-emission vehicle-readiness. The facility narrative is listed in alphabetical order.

Table 4-2. SFMTA ZEB Yard Summary

Yard	Address	Main Functions	Planned Infrastructure	Existing Capacity (2020)	Designated Charging Positions (2035)	Upgrades Req'd?	Timeline
Flynn	1940 Harrison St.	Storage/ O&M	Inverted Pantograph	119	107	Yes	2029-2034
Islais Creek	1301 Cesar Chavez St.	Storage/ O&M	Inverted Pantograph	132	117	Yes	2024-2030
Kirkland	2301 Stockton St. and 151 Beach St.	Storage/ O&M	Inverted Pantograph	95 (Day) 116 (Night)	91	Yes	2022-2025
Potrero	2500 Mariposa St.	Storage/ O&M	Inverted Pantograph	146	216	Yes	2024-2027
Presidio	949 Presidio Ave.	Storage/ O&M	Inverted Pantograph	132	227	Yes	2027-2031
Woods	1095 Indiana St.	Storage/ O&M	Inverted Pantograph	209	250	Yes	2030-2035

Source: WSP
Note: Potrero and Presidio will be fully rebuilt; the scope of the projects includes more than BEB enhancements. Woods will likely also be fully rebuilt.

4.5.1 Flynn Yard

Existing Conditions

Flynn Yard is located at 1940 Harrison Street in the City of San Francisco.

Currently, 119 60-foot diesel-hybrid buses are stored, maintained, fueled, and serviced at Flynn Yard. The yard includes a maintenance area with drive-through bays, transportation area, stand-alone wash canopy, and a stand-alone fuel canopy. All of these facilities are integrated into the lone, single-story building on the site. A tire shop is located separately from the main facility in a building across Harrison Street. The southeast corner of the main Flynn Yard has a cutout that houses separate businesses not related to or owned by the SFMTA. Electrical utility service is provided by the SFPUC.

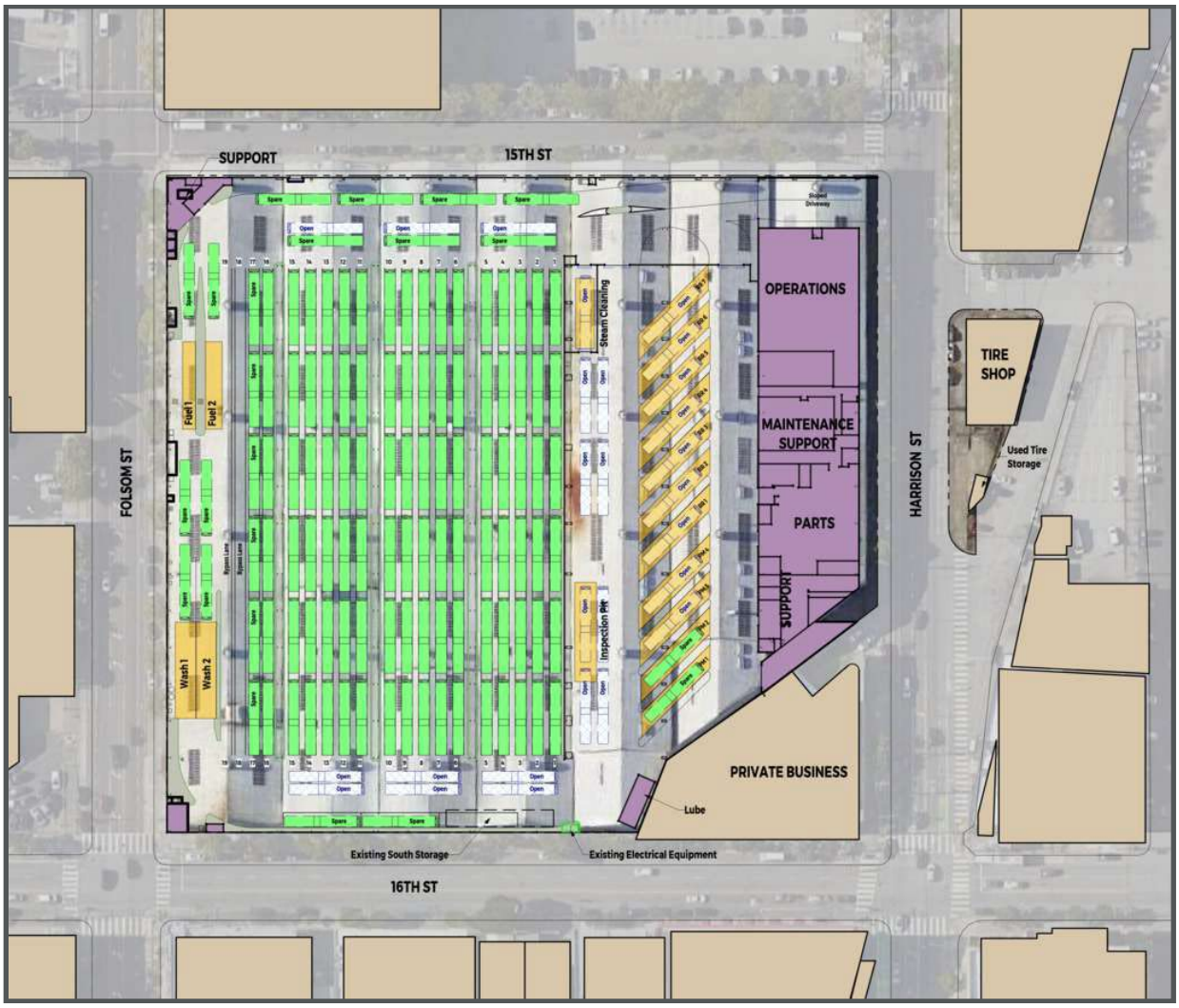
After revenue service, buses enter the yard from Harrison Street and are parked in unassigned, stacked (nose-to-tail) storage tracks in the northern circulation area. Individual buses are then pulled from the storage tracks and taken by nightly service staff to the fuel lanes for fare retrieval, interior cleaning, and fueling before pulling forward to the bus wash lanes. After fuel and wash, buses are re-parked in the storage tracks. Buses remain parked until morning pull out unless a maintenance issue has been identified. Non-revenue vehicles (NRVs) are parked in a row of spaces near the transportation area adjacent to the bus circulation's northernmost lane.

An aerial and site plan of Flynn Yard are presented in Figure 4-5 and Figure 4-6, respectively.

Figure 4-5. Flynn Yard - Existing Conditions (Aerial)

Source: Google Earth

Figure 4-6. Flynn Yard - Existing Conditions (Site Plan)



Source: WSP

Planned ZEB Modifications

The Flynn Yard will be capable of storing and charging 109 total BEBs. 107 buses can be charged with pantographs via an overhead supporting structure that spans the area of the existing parking tracks. An additional two buses can be charged in the maintenance bays via plug-in dispensers.

Table 4-3 summarizes the ZEB infrastructure planned at Flynn Yard.

Table 4-3. Flynn Yard ZEB Infrastructure Summary

Primary Charging Strategy	Overhead Inverted Pantograph
No. of Existing Buses (September 2020)	119
No. of BEBs Supported (2040)	109
No. of Charging Cabinets	56
No. of Dispensers/Charging Positions	109

Source: WSP
Note: It is assumed that one charger will provide power for two charging positions/buses/dispensers (1:2 ratio)

The following BEB equipment and locations are proposed:

— 56 DC charging cabinets located on a platform attached to the overhead support structure. 55 of these charging cabinets will distribute to 107 pantograph-charging positions over the existing storage tracks and satellite spaces. An additional charging cabinet will power two dispensers installed in the maintenance bays.

— The support structure columns are to be placed every two to three tracks. These columns will also provide the support for the overhead mounted pantographs.

The charging cabinets will be served by the following electrical infrastructure:

— Two interrupter switches and a meter to be installed on the southern exterior of the building along 16th Street. The first interrupter will be owned and operated by PG&E, and the second interrupter and meter will be owned by SFPUC. Power will be distributed from the meter up along and through the building exterior to the medium-voltage switchgear.

— One medium-voltage switchgear and three medium- to low-voltage transformers with corresponding low-voltage switchgear will be installed on the proposed platforms.

Figure 4-7 illustrates the Flynn Yard at full build-out.

Figure 4-7. Flynn Yard - Full ZEB Build-Out

Source: WSP

Phasing and Construction Strategy

As discussed, the specific phasing for each yard is still being analyzed. However, this section provides details on the proposed improvements in Phase 1 and work to be completed in subsequent phases.

Phase 1

The recommended first phase for the Flynn Yard would include the installation of two new interrupter switches on the exterior of the facility along 16th Street, routing the utility-provided power into the facility to the site's new transformers. Conduit and routing from the utility should be sized to serve the yard's full fleet. Phase 1 will also include the construction of the overhead support structure with distribution conduit, transformers and switchgears, pantographs, and charging cabinets to serve the easternmost four tracks of bus parking.

Future Phases

Each subsequent phase of deployment will be accomplished by adding a similar modular overhead support structure and the required charging infrastructure to support the number of buses to be charged in the phase. The breakdown of this phasing will follow the SFMTA's growth plans and prioritization schedule.

4.5.2 Islais Creek Yard

Existing Conditions

Islais Creek Yard is located at 1301 Cesar Chavez Street in the City of San Francisco.

Currently, 115 diesel-hybrid buses (10 30-foot and 105 60-foot) are stored, maintained, fueled, and serviced at Islais Creek Yard. The yard includes the following separate structures and major site areas: a two-story maintenance building, two-story transportation building, and a combined fuel, wash, and tire repair building. Electrical utility service is provided by the SFPUC.

After revenue service, buses enter the yard from Indiana Street and are parked in numbered, stacked (nose-to-tail) storage tracks. Individual buses are then pulled from the storage tracks and taken by nightly service staff to the fuel lanes for fare retrieval, interior cleaning, and fueling before pulling forward to the bus wash lanes. After fuel and wash, buses are re-parked in the storage tracks. Buses remain parked until morning pull out unless a maintenance issue has been identified. NRVs are parked throughout the site on facility exteriors and the yard perimeter.

Interstate 280 (I-280) traverses over the western side of the site with support columns located in the bus parking yard. Caltrans owns the property under I-280, which the SFMTA leases for bus parking. Due to Caltrans' I-280 maintenance requirements of the support columns and freeway, the SFMTA's ability to construct in this area of the yard may be significantly restricted. Any proposed BEB or other construction under I-280 need to be reviewed and approved by Caltrans.

An aerial and site plan of Islais Creek Yard are presented in Figure 4-8 and Figure 4-9, respectively.

Figure 4-8. Islais Creek Yard - Existing Conditions (Aerial)

Source: Google Earth

Figure 4-9. Islais Creek Yard - Existing Conditions (Site Plan)

Source: WSP

Planned ZEB Modifications

The Islais Creek Yard will be capable of storing 153 total BEBs, of which, 149 can be charged (simultaneously). 145 buses can be charged with pantographs via an overhead supporting structure that spans the area of the existing parking tracks. An additional four buses can be charged in the maintenance bays via plug-in dispensers. As previously mentioned, Caltrans has an existing easement that may preclude or limit BEB infrastructure. The final determination of what can be built within this easement will be evaluated in future analyses.

Table 4-4 summarizes the ZEB infrastructure planned at Islais Creek Yard.

Table 4-4. Islais Creek Yard ZEB Infrastructure Summary

Primary Charging Strategy	Overhead Inverted Pantograph
No. of Existing Buses (September 2020)	115
No. of BEBs Supported (2040)	153
No. of Charging Cabinets	75
No. of Dispensers/Charging Positions	149

Source : WSP
Notes: It is assumed that one charger will provide power for two charging positions/buses/dispensers (1:2 ratio).
Any proposed BEB or other construction under I-280 needs to be reviewed and approved by Caltrans.

The following BEB equipment and locations are proposed:

- 73 DC charging cabinets located on a platform attached to the overhead support structure spanning a portion of the bus storage tracks and terminating at the edge of the overhead I-280 offset limits.[13] These charging cabinets will distribute to 145 pantograph-charging positions over the existing main storage tracks with a gap in charging positions under I-280 for storing spare buses. The charging positions begin again in the parking area west of I-280's offset limits.

- The overhead support structure columns are to be placed every three to four tracks. These columns will also provide the support for the overhead mounted pantographs.

- Two charging cabinets and four dispensers located in the maintenance building (with four dispensers) will charge the eight remaining spare buses that cannot be charged in the main parking area.

The pantographs and charging cabinets will be served by the following electrical infrastructure:

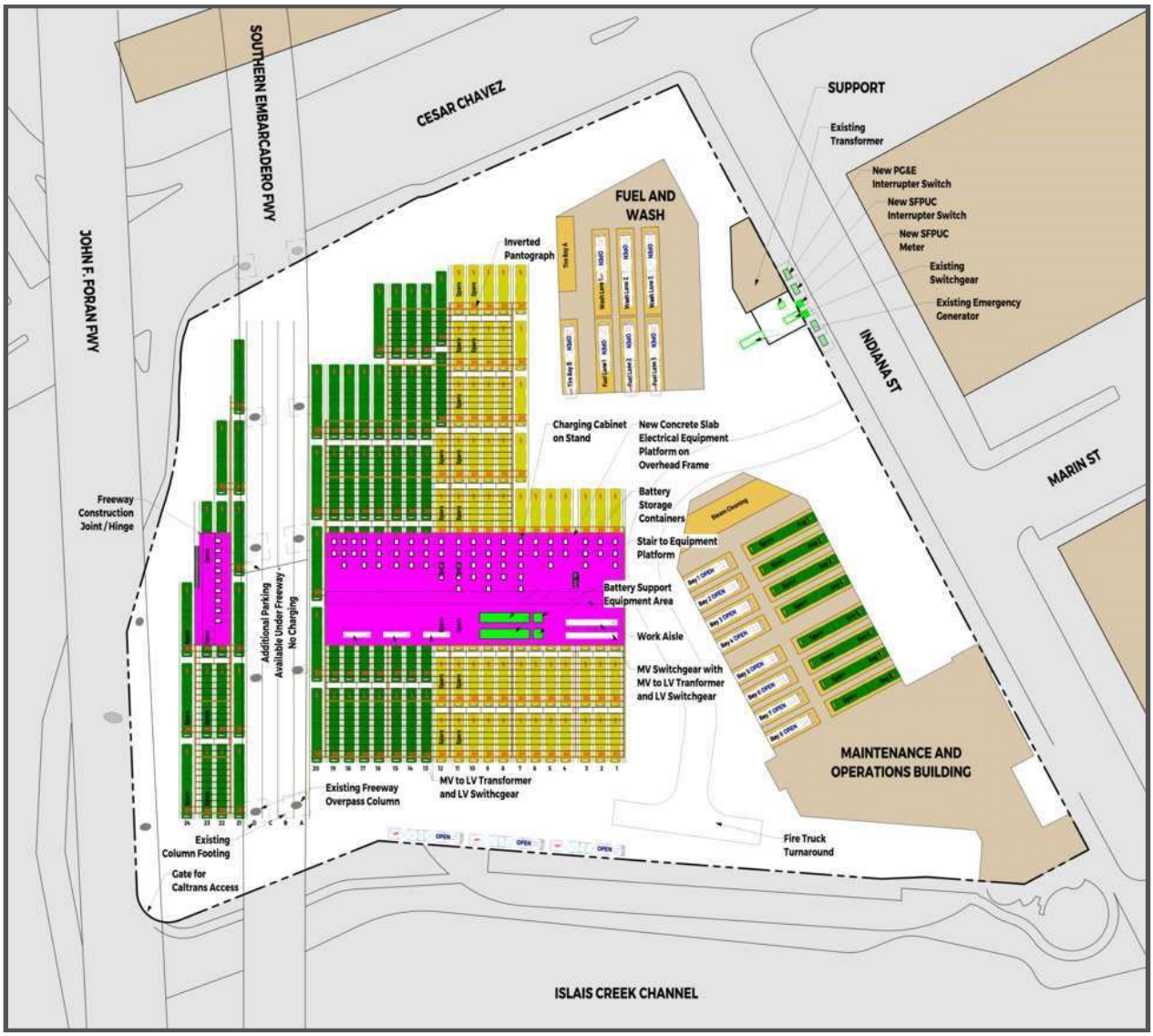
- Two interrupter switch pairs and two meters will be installed in the existing electrical yard. The first interrupter in each pair will be owned and operated by PG&E, and the second interrupter in each pair and both meters will be owned by SFPUC. Power will be distributed from the meter up along the fuel and wash building before crossing to the platform to the medium-voltage switchgear.

- Two medium-voltage switchgears and five medium- to low-voltage transformers with corresponding low-voltage switchgear will be installed on the platform, above the bus parking area. The switchgear and transformers will be rated for exterior use.

Figure 4-10 illustrates the Islais Creek Yard at full build-out.

[13] Any proposed BEB or other construction under I-280 needs to be reviewed and approved by Caltrans.

Figure 4-10. Islais Creek Yard - Full ZEB Build-Out



Source: WSP

Phasing and Construction Strategy

As discussed, the specific phasing for each yard is still being analyzed. However, this section provides details on the proposed improvements in Phase 1 and work to be completed in subsequent phases.

Phase 1

The recommended first phase for the Islais Creek Yard involves the installation of the four interrupter switches and two meters in the existing electrical yard and the routing of utility-provided power into the facility to the site's new transformers. Conduit and routing from the utility should be sized to serve the yard's full fleet. Phase 1 will also include the construction of the overhead support structure with distribution conduit, transformers and switchgears, pantographs, and charging cabinets to serve the easternmost seven tracks of bus parking.

Future Phases

Each subsequent phase of deployment will be accomplished by adding a similar modular overhead support structure and the required charging infrastructure to support the number of buses to be charged in the phase. The breakdown of this phasing will follow the SFMTA's growth plans and prioritization schedule

4.5.3 Kirkland Yard

Existing Conditions

Kirkland Yard is located at 2301 Stockton Street and 151 Beach Street in the City of San Francisco.

Currently, 91 standard diesel-hybrid buses are stored, maintained, fueled, and serviced at Kirkland Yard. The yard includes the following separate structures and major site areas: a maintenance canopy, one-story maintenance support building, one-story transportation building, wash lane (centered in the yard), stand-alone fuel building, and fuel storage yard with support equipment. Electrical utility service is provided by the SFPUC.

After revenue service, buses enter the yard from Stockton Street and are parked in unassigned, stacked (nose-to-tail) storage tracks. Individual buses are then pulled from the storage tracks and taken by nightly service staff to the fuel lanes for fare retrieval, interior cleaning, and fueling before pulling forward to the bus wash lane, Track 9, if being washed (not all buses are washed due to site restrictions). After fuel and wash, buses are re-parked in the storage tracks. Buses remain parked until morning pull out unless a maintenance issue has been identified. NRVs are parked in a row of spaces along the northern site perimeter, where possible.

The *Building Progress Program* envisions a full rebuild of Kirkland Yard following completion of Presidio Yard (estimated 2029-2030). However, due to the operational necessity of Woods Yard and the high capital cost of converting to BEB at Woods, the SFMTA is now prioritizing the rebuild of Woods Yard in advance of Kirkland Yard. This means that Kirkland would be upgraded to BEB in its existing configuration as an interim improvement before a full buildout of the site closer to 2040.

An aerial and site plan of Kirkland Yard are presented in Figure 4-11 and Figure 4-12, respectively.

Figure 4-11. Kirkland Yard - Existing Conditions (Aerial)

Source: Google Earth

Figure 4-12. Kirkland Yard - Existing Conditions (Site Plan)

Source: WSP

Planned ZEB Modifications

The Kirkland Yard will be capable of storing 81 total BEBs, of which, 77 can be charged (simultaneously). 72 can be charged with pantographs via an overhead supporting structure that spans the area of the existing parking tracks. An additional five buses can be charged in the maintenance bays via plug-in dispensers. To meet the 2040 conversion timelines, this would be an interim improvement for approximately 10-15 years. Then, the Kirkland Yard would need to be fully rebuilt around 2040.

Table 4-5 summarizes the ZEB infrastructure planned at Kirkland Yard.

Table 4-5. Kirkland Yard ZEB Infrastructure Summary

Primary Charging Strategy	Overhead Inverted Pantograph
No. of Existing Buses (September 2020)	91
No. of BEBs Supported (2040)	81
No. of Charging Cabinets	39
No. of Dispensers/Charging Positions	77

Source : WSP
Note: It is assumed that one charger will provide power for two charging positions/buses/dispensers (1:2 ratio).

The following BEB equipment and locations are proposed:

— 36 DC charging cabinets located on a platform attached to the overhead support structure spanning the northwest quadrant of the parking area. These charging cabinets will distribute to 72 pantograph-charging positions mounted from overhead support structures over the bus parking tracks.

— The overhead support structure columns are to be placed every three to four tracks. These columns will also provide the support for the overhead mounted pantographs.

— Three charging cabinets installed on a mezzanine located inside the new maintenance building adjacent to or near the electrical room. These charging cabinets will be connected to five dispensers installed between every two bays. This will provide charging for the nine buses that cannot be charged in the main parking area.

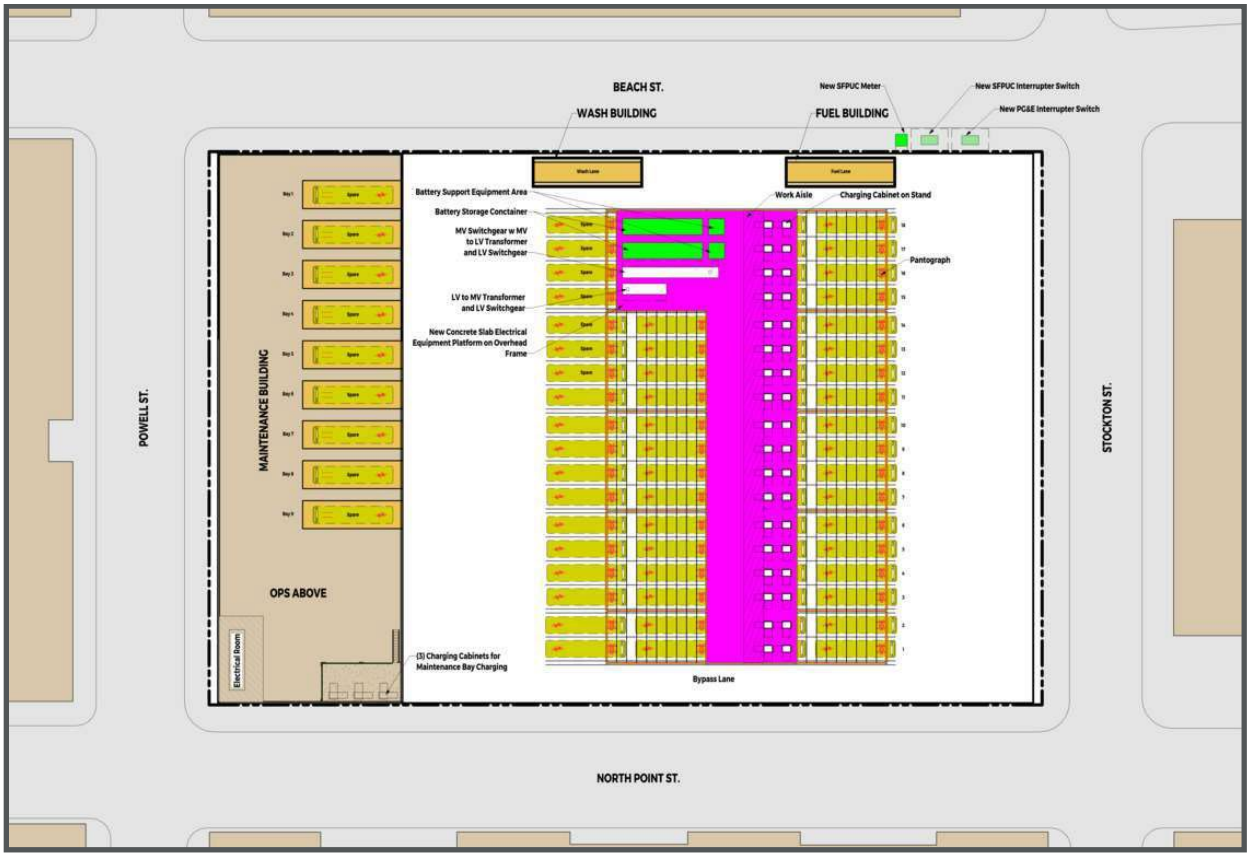
The pantographs and charging cabinets will be served by the following electrical infrastructure:

— One pair of interrupter switches and a meter will be installed on the northeast side of the site along Beach Street. The first interrupter will be owned and operated by PG&E, and the second interrupter and meter will be owned by SFPUC. Power will be routed up along the new fuel lane and across to the platform to feed the new medium-voltage switchgear.

— One medium-voltage switchgear and two medium- to low-voltage transformers with corresponding low-voltage switchgear will be installed on the platform, above the bus parking area. The switchgear and transformers will be rated for exterior use.

Figure 4-13 illustrates a conceptual rebuild of Kirkland Yard with associated ZEB improvements.

Figure 4-13. Kirkland Yard - Full ZEB Build-Out



Source: WSP

Phasing and Construction Strategy

Kirkland Yard was expected to be fully demolished and redeveloped prior to implementing BEBs on the site. However, due to financial and schedule issues, the SFMTA is developing an interim improvement at Kirkland that may include BEB infrastructure and several smaller facility improvement projects.

4.5.4 Potrero Yard

Existing Conditions

Potrero Yard is located at 2500 Mariposa Street in the City of San Francisco.

Currently, 146 trolley buses (53 40-foot and 93 60-foot) are stored, maintained, fueled, and serviced at Potrero Yard. The yard includes the following separate structures and major site areas: a two-story combined maintenance and transportation building, separate tire shop and body building, wash area, carbon-check area, and two separate bus parking yards. The upper yard and body/tire building are located on the deck above the maintenance building which is accessible from the north via 17th Street. Electrical utility service is provided by the SFPUC.

After revenue service, buses enter the yard from Mariposa Street and are parked in unassigned, stacked (nose-to-tail) storage tracks in front of the carbon check area. Individual buses are then pulled from the storage tracks and taken by nightly service staff to have their carbon checked, fare retrieved, interior cleaned, and fueled before pulling forward to the bus wash area. After fuel and wash, buses are re-parked in the storage tracks. Buses remain parked until morning pull out unless a maintenance issue has been identified. NRVs are parked along the western site perimeter.

Potrero Yard is over 100 years old and anticipated to be demolished and rebuilt with modern bus facilities and potential residential element per the Potrero Yard Modernization Project. The expected in-service date for the new building is end of 2026.

Figure 4-14 presents Potrero Yard under existing conditions.

Figure 4-14. Potrero Yard - Existing Conditions (Aerial)

Source: Google Earth

Planned ZEB Modifications

As previously mentioned, the Potrero Yard Modernization Project aims to rebuild and expand the 4.4-acre site. The goal of the project is to replace the obsolete two-story maintenance building and bus yard with a modern, three-story, efficient bus maintenance and storage garage, equipped to serve the SFMTA's grown fleet as it transitions to zero-emission fleet.

As of February 2021, the Project is about to enter the Request for Proposals phase, during which zero-emission vehicle modifications will be defined. As the future yard will to be multi-level, the Potrero Yard design guidelines include an overhead structure-mounted inverted pantograph-charging solution. Depending on the design choices made by the future Potrero Yard design team, the required electrical infrastructure could be installed in multiple configurations to suit the final design of the facility. Table 4-6 summarizes the zero-emission vehicle infrastructure proposed at Potrero Yard.

Table 4-6. Potrero Yard Zero-Emission Vehicle Infrastructure Summary

Primary Charging Strategy	Overhead Inverted Pantograph
No. of Existing Buses (September 2020)	146
No. of BEBs Supported (2027)	85

Source: WSP
Note: It is assumed that one charger will provide power for two charging positions/buses/dispensers (1:2 ratio)

Phasing and Construction Strategy

Since Potrero Yard will be fully redeveloped prior to implementing BEBs on the site, it is recommended that the entire infrastructure and charging position deployment be included in the redevelopment project. This will allow the BEBs transition to occur concurrently to the planned redevelopment construction process and avoid any further operational interruptions.

4.5.5 Presidio Yard

Existing Conditions

Presidio Yard is located at 949 Presidio Avenue in the City of San Francisco.

Currently, 132 40-foot trolley buses are stored, maintained, fueled, and serviced at Presidio Yard. The yard includes the following separate structures and major site areas: a two-story combined maintenance and transportation building, wash area, carbon check area, and bus parking yard. Electrical utility service is provided by the SFPUC.

After revenue service, buses enter the yard from Presidio Avenue and are parked in unassigned, stacked (nose-to-tail) storage tracks in front of the carbon check area. Individual buses are then pulled from the storage tracks and taken by nightly service staff to have their carbon checked, fare retrieved, interior cleaned, and fueled before pulling forward to the bus wash area. After fuel and wash, buses are re-parked in the storage tracks. Buses remain parked until morning pull out unless a maintenance issue has been identified. NRVs are parked along the northern site perimeter.

Presidio Yard is over 100 years old and anticipated to be demolished and rebuilt with modern bus facilities. The Presidio Yard Modernization Project began pre-development and planning in early 2020. The expected in-service date for the new building is end of 2029.

Figure 4-15 presents Presidio Yard under existing conditions.

Figure 4-15. Presidio Yard - Existing Conditions (Aerial)

Source: Google Earth

Planned Zero-Emission Vehicle Modifications

Similar to Potrero Yard, Presidio Yard is planned to be fully redeveloped.

Although the design for the redevelopment project and specific zero-emission vehicle modifications are still being evaluated, it is recommended that the Presidio Yard adopt an overhead structure-mounted inverted pantograph-charging solution. Depending on the design choices and criteria developed by the SFMTA and the future Presidio Yard design team, the required electrical infrastructure could be installed in multiple configurations to suit the final design of the facility.

Table 4-7 summarizes the zero-emission vehicle infrastructure planned at Presidio Yard.

Table 4-7. Presidio Yard ZEB Infrastructure Summary

Primary Charging Strategy	Overhead Inverted Pantograph
No. of Existing Buses (September 2020)	132
No. of BEBs Supported (2031)	85

Source : WSP
Note : It is assumed that one charger will provide power for two charging positions/buses/dispensers (1:2 ratio).

Phasing and Construction Strategy

Since Presidio Yard is expected to be redeveloped prior to implementing BEBs on the site, it is recommended that the entire infrastructure and charging position deployment be included in the redevelopment project. This will allow the BEB transition to occur concurrently to the planned redevelopment construction process and avoid any further operational interruptions.

4.5.6 Woods Yard

Existing Conditions

Woods Yard is located at 1095 Indiana Street in the City of San Francisco.

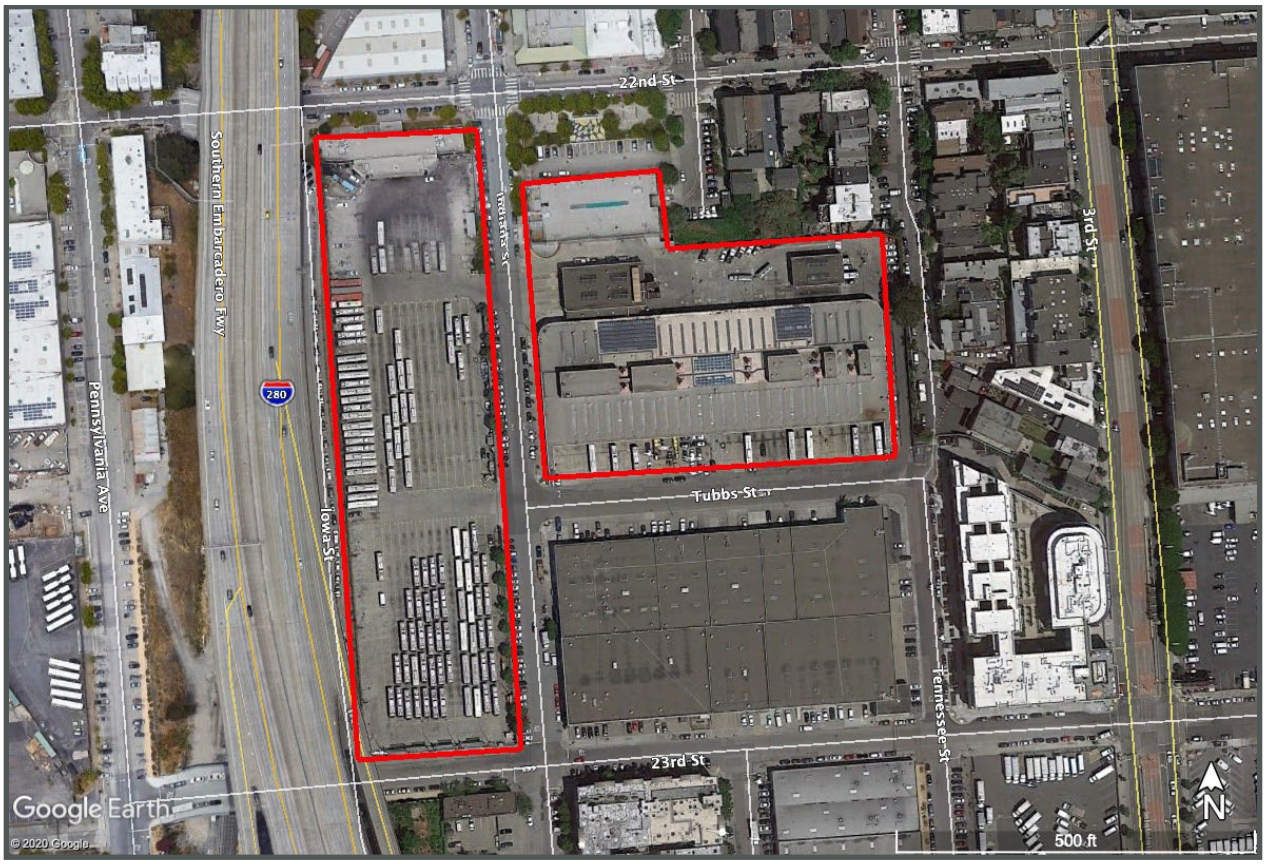
Currently, 221 (221 40-foot and 20 30-foot) diesel-hybrid buses are stored, maintained, fueled, and serviced at Kirkland Yard. The 20 30-foot buses are exclusively used for training purposes. Woods has the largest bus capacity in Muni's system and is of strategic importance in the overall Muni service plan. The yard includes the following separate structures and major site areas: a two-story maintenance building, two-story tire shop, stand-alone fuel building, and stand-alone wash building. The site is bisected from north to south by Indiana Street. Electrical utility service is provided by the SFPUC.

After revenue service, buses enter the yard from Indiana Street and are parked in unassigned, stacked (nose-to-tail) storage tracks. Individual buses are then pulled from the storage tracks and taken by nightly service staff to the fuel lanes for fare retrieval, interior cleaning, and fueling before pulling forward to the bus wash lane. After fuel and wash, buses are re-parked in the storage tracks. Buses remain parked until morning pull out unless a maintenance issue has been identified. NRVs are parked in a row of spaces along the northern site perimeter, between the fuel and wash areas.

As a result of BEB facility conversion scope and high cost of improvements and electrical upgrade, the SFMTA is analyzing a potential full rebuild and expansion of the Woods Yard following completion of Presidio Yard. Woods Yard is inefficient in its site design and the maintenance function limits it to only 40-foot buses, which constrains the SFMTA's overall maintenance flexibility. If a rebuild scenario moves forward for Woods Yard, the anticipated in-service date range would be between 2032-2035.

An aerial and site plan of Woods Yard are presented in Figure 4-16 and Figure 4-17, respectively.

Figure 4-16. Woods Yard - Existing Conditions (Aerial)



Source: Google Earth

Figure 4-17. Woods Yard - Existing Conditions (Site Plan)

Source: WSP

Planned ZEB Modifications

If BEB infrastructure is integrated into the Woods Yard's existing layout, it will be capable of storing 233 total BEBs, of which, 177 can be charged (simultaneously). 158 can be charged with pantographs via an overhead supporting structure that spans the area of the existing parking tracks. An additional 19 buses can be charged in the maintenance bays via plug-in dispensers. It is assumed that not all assigned buses will be able to be charged concurrently. As buses finish charging, they should be moved to non-charging positions to allow the next bus to begin charging.

Woods Yard is also candidate for a full rebuild – an option that is still under study. It is assumed that if it is rebuilt, the proposed layout will be designed to charge the entire fleet, simultaneously.

Table 4-8 summarizes the ZEB infrastructure planned at Woods Yard.

Table 4-8. Woods Yard ZEB Infrastructure Summary

Primary Charging Strategy	Overhead Inverted Pantograph
No. of Existing Buses (September 2020)	241
No. of BEBs Supported (2040)	233
No. of Charging Cabinets	90
No. of Dispensers/Charging Positions	177

Source : WSP
Note: It is assumed that one charger will provide power for two charging positions/buses/dispensers (1:2 ratio).

The following BEB equipment and locations are proposed:

— 44 DC charging cabinets located primarily on a platform attached to the overhead support structure spanning the southern block of bus parking. These charging cabinets will distribute to 87 pantograph-charging positions mounted from overhead support structures over the existing main bus parking tracks and satellite spaces.

— 36 DC charging cabinets located primarily on a platform attached to the overhead support structure spanning the northern block of bus parking. These charging cabinets will distribute to 71 pantograph-charging positions mounted from overhead support structures over the existing main bus parking tracks and satellite spaces.

— The overhead support structure columns are to be placed every three to four tracks. These columns will also provide the support for the overhead mounted pantographs.

— In the maintenance building, 10 charging cabinets will be installed and connect to 19 dispensers. The dispensers will be mounted between every two bays. This will provide charging to 37 buses that cannot be charged in the main parking area.

The pantographs and charging cabinets will be served by the following electrical infrastructure:

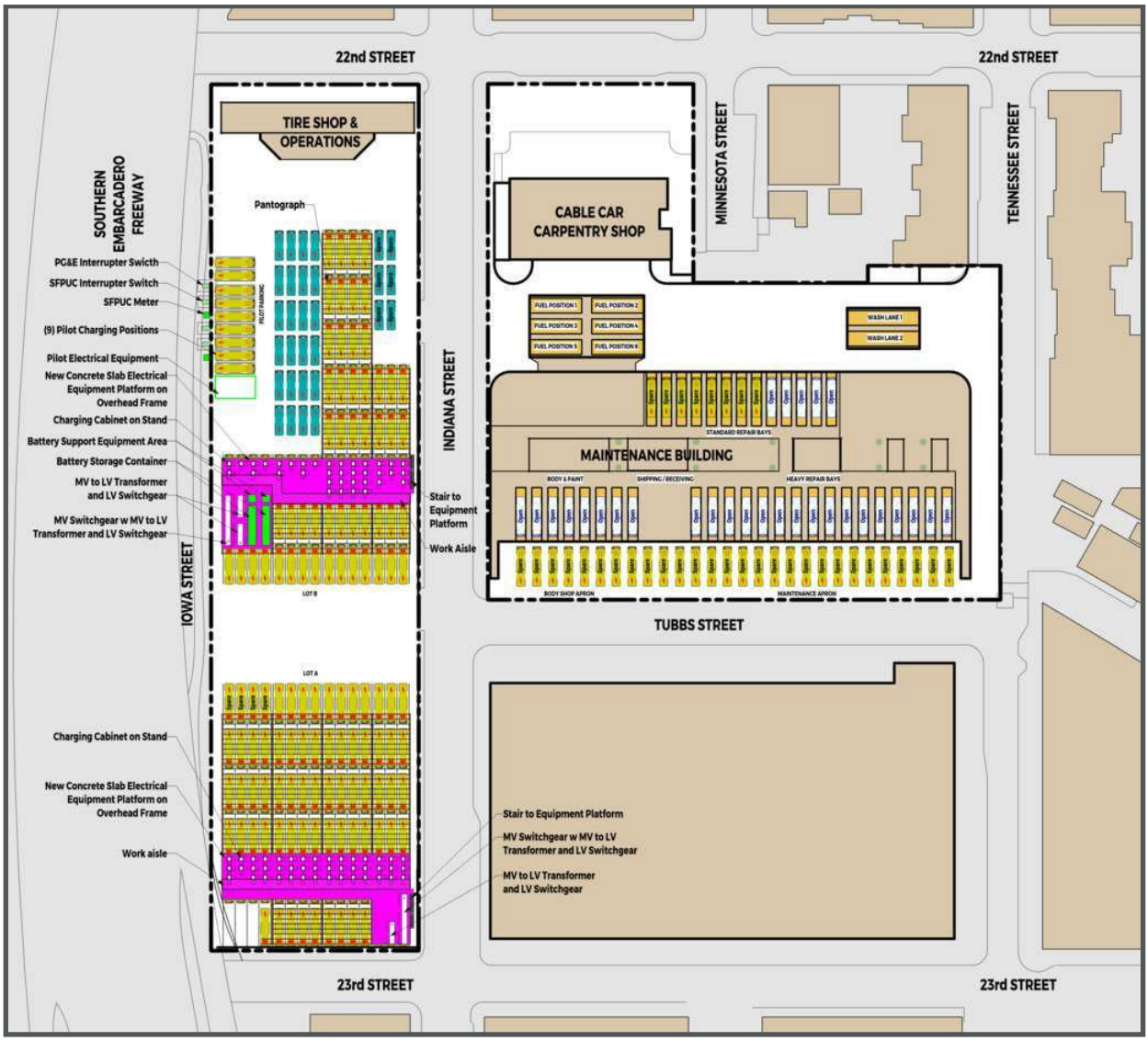
— Two interrupter switch pairs and two meters will be installed on the west side of the site along Iowa Street. The first interrupter in each pair will be owned and operated by PG&E, and the second interrupter in each pair as well as both meters will be owned and operated by SFPUC. Power will transition from the meters to the medium-voltage switchgear located on the two platforms located at the north end of the site and the south end of the site, above the bus parking.

— On the northern platform, one medium-voltage switchgear and three medium- to low-voltage transformers with corresponding low-voltage switchgear will be installed. The switchgear and transformers will be exterior rated.

— On the southern platform, one medium-voltage switchgear and two medium- to low-voltage transformers with corresponding low-voltage switchgear will be installed. The switchgear and transformers will be exterior rated.

Figure 4-18 illustrates the Woods Yard at full build-out.

Figure 4-18. Woods Yard - Full ZEB Build-Out



Source: WSP

Phasing and Construction Strategy

As discussed, the specific phasing for each yard is still being analyzed. However, this section provides details on the proposed improvements in Phase 1 and work to be completed in subsequent phases.

Phase 1

The recommended first phase for the Woods Yard includes the installation of four new interrupter switches and two meters on the exterior of the facility along Iowa Street, routing the utility-provided power into the site along the eastern wall to the site's new transformers. Conduit and routing from the utility should be sized to serve the yard's full fleet. Phase 1 will also include the construction of the overhead support structure with distribution conduit, transformers and switchgears, pantographs, and charging cabinets to serve the northern block of bus parking.

Future Phases

Each subsequent phase of deployment will be accomplished by adding a similar modular overhead support structure and the required charging infrastructure to support the number of buses to be charged in the phase. The breakdown of this phasing will follow the SFMTA's growth plans and prioritization schedule.

5 Equity Considerations

The following section provides an overview of disadvantaged communities within the SFMTA's service area and information on how the SFMTA plans to ensure that zero-emission vehicles are prioritized in these communities.

5.1 Disadvantaged Communities

Disadvantaged communities (DACs) refer to areas that suffer the most from a combination of economic, health, and environmental burdens. The California Environmental Protection Agency (CalEPA) and California's Senate Bill 535, define a "disadvantaged" community as a community (census tract) that is located in the top 25th percentile of U.S. Census tracts identified by the results of the California Communities Environmental Health Screening Tool (CalEnviroScreen). CalEnviroScreen uses environmental, health, and socioeconomic data to measure each census tract (community) in California. Each tract is assigned a score to gauge a community's pollution burden and socioeconomic vulnerability. A higher score indicates a more disadvantaged community, whereas a lower score indicates fewer disadvantages.

The replacement of DHEBs with BEBs will yield many benefits in the communities they serve, including a reduction of noise and harmful pollutants. Given that DACs are disproportionately exposed to these externalities, they should be considered and prioritized during initial deployments of BEBs. The SFMTA will ensure that equity and DACs are prioritized as yards are equipped with charging infrastructure and as buses are deployed on the yard's BEB-compatible blocks.

In addition to upcoming BEB deployments, the SFMTA specifically addresses equity through two focused initiatives: The Muni Service Equity Policy and the Green Zone project.

The SFMTA Service Equity Policy is a process to identify and correct transit performance disparities. The SFMTA has prepared three equity strategy reports since the policy was adopted in 2014. The 2016 Equity Strategy identified seven neighborhoods: Bayview, Chinatown, Excelsior/Outer Mission, Inner Mission, Tenderloin, Visitacion Valley, and Western Addition. The Oceanview/Ingleside neighborhood was added in the 2018 Equity Strategy, and Treasure Island was added in the 2020 Equity Strategy. The intent is that these neighborhoods see improvement equal to or better than the overall system.

The "Green Zone" project, initiated in 2019, utilizes existing technology that permits diesel-hybrid vehicles to run on full electric battery power in select neighborhoods with poor air quality. 68 of these vehicles have larger batteries and a GPS-enabled switch, which will cause the bus to automatically switch to EV mode as it enters geo-fenced areas (Green Zones) throughout the city. The geo-fenced zones were chosen to focus primarily on Muni Equity Strategy neighborhoods, those with high percentages of low-income households and people of color, and where respiratory illnesses occur at a disproportionate rate.

5.2 Summary of The SFMTA's DACs

To understand the potential benefits that ZEBs will provide to DACs in the SFMTA's service area, it is necessary to establish if (1) a yard is in a DAC, and (2) if its routes travel within or alongside a DAC boundary.

As shown in Table 5-1 and Figure 5-1, none of the SFMTA's bus yards are located within a DAC. However, routes that are served from each yard *do* serve DACs – Woods Yard serves the most DACs (12), which account for approximately 6% of all of its communities served. As noted above, several routes

are operated with buses from more than one garage, so a single route in a DAC could be served by multiple yards.

Table 5-1. The SFMTA's Disadvantaged Communities - Yard Summary

Yard	In DAC?	NOx Exempt Area?	Communities Served	DACs Served	Pct. Of DACs Served
Flynn	No	No	102	2	2%
Islais Creek	No	No	112	4	4%
Kirkland	No	No	120	5	4%
Potrero	No	No	74	2	3%
Presidio	No	No	92	4	6%
Woods	No	No	192	12	6%

Source: CalEnviroScreen 3.0

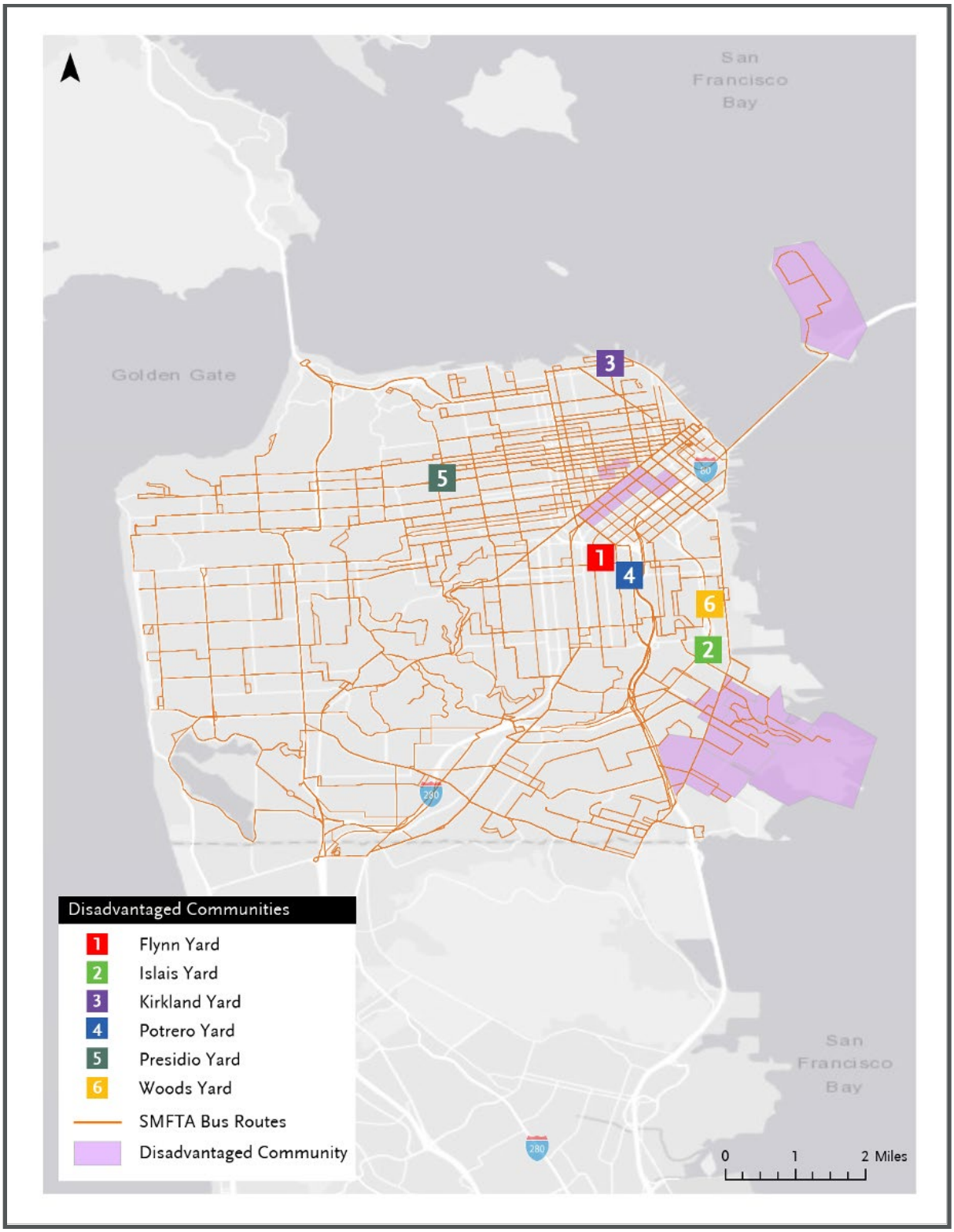
Table 5-2 details the number of DAC-serving routes by yard.

Table 5-2. The SFMTA's Disadvantaged Communities - Route Summary

Yard	No. of DAC-Serving Routes	DAC-Serving Routes
Flynn	5	9R, 14R, 14X, 38R, 714
Islais Creek	7	7, 7X, 8, 8AX, 8BX, 38, 714
Kirkland	6	12, 19, 30, 47, 81X, 83X
Potrero	5	5, 5R, 6, 14, 30,
Presidio	4	21, 24, 31, 45
Woods	22	5, 7, 7X, 9, 23, 25, 27, 29, 38, 44, 54, 81X, 83X, 91, K-OWL, L-OWL, N-OWL, JBUS, KTBUS, LBUS, MBUS, NBUS

Source: CalEnviroScreen 3.0

Figure 5-1. The SFMTA's Disadvantaged Communities and Bus Yards



Source: CalEnviroScreen 3.0

6 Workforce Training

The following section provides an overview of the SFMTA's plan to train personnel on the impending transition.

6.1 Training Requirements

The transition to an allzero-emissionfleet will significantly alter SFMTA's service and operations. Converting to BEBs from their existing DHEBs is logistically complicated and will impact all ranks of the organization.

Training for the operation, maintenance, and handling of BEBs will be conducted after bus procurement and in advance of delivery. Training conditions and schedules will be included in procurement documents, as they are with all existing procurements. For example, SFMTA has already procured nine buses for their pilot project (expected delivery in 2021).[14] Table 6-1 provides an example of training modules that are included with one of their procurements.

It is expected that all relevant personnel will be sufficiently trained before buses arrive. If other OEM-provided buses are procured in the future and/or if new components, software, or protocols are implemented, it is expected that SFMTA's staff will be trained well in advance of the commissioning of these additions.

Table 6-1. Zero-Emission Bus Training Modules (Sample)

Module	Hours
General Vehicle Orientation	8
Multiplex System	32
Entrance and Exit Doors	8
Wheelchair Ramp	4
Brake Systems and Axles	16 (8 per axle)
Air System and ABS	8
Front and Rear Suspension, Steering, and Kneeling	8
Body and structure	4
Propulsion & ESS Fam/HV Safety	24
Charging Equipment	4
Electric HVAC, AC Maintenance (Vendor Specific)	24
Propulsion & ESS Troubleshooting	16
Operator Orientation	8
Towing and Recovery	4

Source: SFMTA, 2019

The following provides a list of personnel and positions that will need to be retrained upon adoption of BEBs (this list is not exhaustive):

[14] Nine buses are currently procured with an additional three in negotiations.

- **Bus Operators and Supervisors**
  Bus operators and field supervision will need to be familiarized with the buses, safety, bus operations, and pantograph operations.

- **Facilities Maintenance Staff**
  Maintenance staff will need to be familiarized with scheduled and unscheduled repairs, high-voltage systems, and the specific maintenance and repair of equipment.

- **First Responders**
  Local fire station staff will need to be familiarized with the new buses and supporting facilities.

- **Tow Truck Service Providers**
  Tow truck providers will need to be familiarized with the new buses and proper procedures for towing ZEBs.

- **Mechanics**
  Mechanics will need to be familiarized with the safety-related features and other components of ZEBs.

- **Instructors**
  Maintenance and bus operator instructors will need to understand all aspects of the transition of ZEBs to train others.

- **Utility Service Workers**
  Staff will become familiarized with proper charging protocol and procedures that are ZEB-specific.

- **Management Staff**
  Maintenance and Operations managerial staff will be familiarized with ZEB operations and safety procedures.

7 Costs and Funding Opportunities

The following section identifies preliminary capital costs and potential funding sources that the SFMTA may pursue in its adoption of ZEBs.

7.1 Preliminary Capital Expenditure Costs

While costs for a full fleet transition are still being analyzed, it is estimated that the costs of chargers, pantographs, buses, and on-site construction, alone, will be in excess of $1.8B (2020 dollars). This estimate is based on a 1:1 bus replacement ratio. The following costs are excluded from the estimate:

- purchase of additional buses (due to range limitations)
- on-site battery storage or photovoltaics
- charge management software
- on-route charging infrastructure
- costs associated with the transition (i.e., temporary relocating and rerouting of service)

The estimate is only based on infrastructure *within* the SFMTA's property lines – it does not consider utility infrastructure enhancements that are required to energize the fleet (design, permitting, and construction of substations, circuits, etc.). The SFMTA has been advised by the SFPUC that it is most likely that PG&E will pass along the cost of any downstream improvements to the SFMTA, at a likely cost of several million dollars per site. Costs are variable and the SFPUC could not provide a per cost mile estimate due to site-specific factors such as age of existing infrastructure, location of existing electrical improvements, density of equipment within the utility vault, etc.

Furthermore, Potrero and Presidio yards (and likely Woods) are planned to be fully rebuilt. An August 2020 cost estimate for the Potrero Yard Modernization Project (bus facility component only) exceeds $406M, not including BEB supporting infrastructure. Prior to the ICT regulation, the current state of the facility has caused the SFMTA to reconsider the priority to rebuild Woods in advance of Kirkland. The SFMTA is still analyzing the facility sequencing and scope of work, with the cost of BEB improvements as a major factor in decision making. The costs associated with the demolition, staging, and construction at these existing sites is also not included with the capital cost estimate.

The cost for BEB improvements at each yard ranges from a low estimate of $130M (Kirkland) to a high of $406M (Potrero). The average capital cost per yard is approximately $303M.

The associated costs of a full fleet transition for each yard is provided in Table 7-1.

Table 7-1. Preliminary Bus and Charger Infrastructure (Only) Expenditure Estimates by Yard

Yard	Buses	Charging Infrastructure (Only)	Total
Flynn	$174.4M	$65.5M	$239.9M
Islais Creek	$236.8M	$83.0M	$319.8M
Kirkland	$101.3M	$28.7M	$130.0M
Potrero	$303.4M	$102.6M	$406.0M
Presidio	$272.3M	$81.8M	$353.1M
Woods	$286.4M	$86.4M	$372.8M
Total	$1.4B	$448M	$1.8B

Source: WSP
Notes: These estimates do not reflect the full facility upgrades required which are highly variable based on state of repair, location, etc. Pending further analysis, there will likely be additional capital improvements and costs to ensure a successful zero-emission vehicle operation, including battery storage, photovoltaics, additional vehicles, contingency components, utility enhancements, etc.
-Rounded to the nearest tenth.

7.2 Potential Funding Sources

There are a number of potential federal, state, local, and project-specific funding and financing sources that may be available to the SFMTA. The SFMTA will monitor funding cycles and pursue opportunities that yield the most benefits for the agency pursuant to the ICT regulation. Table 7-2 identifies the many funding opportunities that the SFMTA may take advantage of in the next 20 years.

Table 7-2. ZEB Funding Opportunities

Type	Agency	Funding Mechanism
Federal	United States Department of Transportation (USDOT)	Better Utilizing Investments to Leverage Development (BUILD) Grants
	FTA	Capital Investment Grants – New Starts
		Capital Investment Grants – Small Starts
		Bus and Bus Facilities Discretionary Grant
		Low- or No-Emission Vehicle Grant
		Metropolitan & Statewide Planning and Non-Metropolitan Transportation Planning
		Urbanized Area Formula Grants
		State of Good Repair Grants
		Flexible Funding Program – Surface Transportation Block Grant Program
	Federal Highway Administration (FHWA)	Congestion Mitigation and Air Quality Improvement Program

Type	Agency	Funding Mechanism
	Environmental Protection Agency (EPA)	Environmental Justice Collaborative Program-Solving Cooperative Agreement Program
	Department of Energy (DOE)	Design Intelligence Fostering Formidable Energy Reduction and Enabling Novel Totally Impactful Advanced Technology Enhancements
State	CARB	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)
		State Volkswagen Settlement Mitigation
		Carl Moyer Memorial Air Quality Standards Attainment Program
		Cap-and-Trade Funding
	California Transportation Commission (CTC)	Solution for Congested Corridor Programs (SCCP)
	Caltrans	Low Carbon Transit Operations Program (LCTOP)
		Transportation Development Act
		Transit and Intercity Rail Capital Program
		Transportation Development Credits
		New Employment Credit
Local and Project-Specific		Joint Development
		Parking Fees
		Tax Rebates and Reimbursements
		Enhanced Infrastructure Financing Districts
		Opportunity Zones

Source: WSP

8 Start-Up and Scale-Up Challenges

The SFMTA is an industry leader in implementing clean fleets and we share the California Air Resource Board's (CARB) vision to mitigate the impacts of climate change. The transportation sector is San Francisco's largest contributor to the city's overall carbon footprint. As the biggest source of greenhouse gas emissions, it makes up nearly half of all citywide emissions. The pollutants from cars, trucks and other private vehicles account for more than 70% of transportation emissions, while public transportation accounts for only 5% of transportation emissions. SFMTA's transit fleet accounts for less than 2% of public transportation emissions (which is less than .01% of the city's overall greenhouse gas emissions). Our initial analysis identifies significant challenges to further reducing our 2% share of emissions via a full ZE transition by 2040. These include time constraints, unpredictable advancements in ZE technology that could risk transit performance and service reliability, and significant capital, operational, and ongoing maintenance costs while our budget remains impacted by the COVID-19 pandemic. The following list of challenges is not exhaustive, and the SFMTA would like to explore with CARB the additional risks and complications to the ICT regulation.

- **Uncertainty of COVID-19.** COVID-19 has impacted all facets of our global economy, and transit is not an exclusion. During the pandemic, the SFMTA's ridership has plummeted and caused major shortfalls in revenue, resulting in impacts to both capital programs and operations. In addition, a global economic recession that came about with almost no warning is worsening as the COVID-19 crisis persists. At this time, it is unclear what the long-term impacts will be on service. There is a possibility that service ridership levels may not return to previous levels, resulting in changes to procurement and funding. As we look towards our recovery, we believe our limited resources are best used in retaining and growing our ridership. By prioritizing our commitment to providing reliable, high-frequency buses, we will improve environmental conditions at a lower cost than total fleet conversion While current CARB fleet conversion goals will help us further reduce, we believe high quality service is the key to even greater emissions reductions. The SFMTA will continue to analyze trends to determine service changes and plans.

- **Rapid Technological Advancement.** The SFMTA is currently planning for a transition based on the fleet as of September 2020 (with January 2020 service, pre-COVID). The SFMTA will soon need to make decisions on fleet requirements and it is difficult to anticipate future technological changes, such as improved batteries and chargers. The SFMTA (and the market) will have to make decisions to purchase fleets based on what is known at the time of the contract. This exposes the SFMTA to a risk of missing out on improvements that come soon after contract execution, rendering purchased technologies outdated on arrival.

- **Insufficient BEB Performance and Range.** The BEB industry is constantly innovating and developing vehicles with longer ranges and more efficient batteries. However, the SFMTA's analysis currently shows some service blocks that cannot be completed under existing technologies, particularly the hilliest routes. Unless battery technologies evolve, the SFMTA will have to spend additional monies to meet range requirements due to OEM's inability to develop better performing batteries.

- **Resiliency and Emergency Response.** The SFMTA is also seeking solutions to address resiliency and emergency response within the context of a zero-emission fleet. Service that is dependent on electricity is vulnerable during outages and emergencies. In addition, the SFMTA provides regional emergency responses and high-capacity evacuation for wildfires, which would be challenging to do with reduced bus ranges, such as zero-emission vehicles. Thus, the SFMTA is considering retaining

a DHEB sub fleet for these rare occasions, although we acknowledge this fleet would not be CARB-compliant.

- **High Capital and O&M Costs.** To maintain pre-COVID-19 service with BEBs (with existing technologies), the SFMTA would need more vehicles (more than a 1:1 replacement ratio). The SFMTA's facilities are at crush capacity and cannot accommodate even 10% more vehicles. Therefore, to convert with current technologies, the SFMTA would have to acquire additional real estate and build new facilities, which is a daunting and extremely expensive endeavor. Additionally, the SFMTA's buses operate on some of the steepest grades in the US. The gradeability will require the SFMTA to purchase extended warranties (likely 12-year) which increases the purchase price of each bus, and it can also lead to more expensive midlife overhaul costs – further ballooning the lifecycle costs of the transition.

- **Uncertain Capital Funding Streams in a Major Economic Recession.** Adoption of BEBs has many benefits, including potential lifecycle cost savings. However, the investment required for capital and change management is significant. In an increasingly constrained funding environment, and with little to no operating reserves due to the recession induced by COVID-19, the SFMTA does not have funds for these capital projects if specific funding streams are not identified through other resources. The conversion of the SFMTA's bus facilities to accommodate BEBs is especially complex, particularly given the 2040 time horizon. Like much of United States' public infrastructure, the SFMTA is faced with aged, obsolete facilities and significant deferred maintenance due to decades without flexible facility funding. The SFMTA's Building Progress Program, a facility capital renewal program, aims to strategically address this state of disrepair by rebuilding the SFMTA's oldest and most obsolete facilities. This ambitious and billion-dollar program includes BEB adaptability of two yards but leaves four with no funding framework for the significant modifications that BEB requires.

  To electrify the full fleet by 2040, SFMTA would need to have multiple yards undergoing construction concurrently. In addition, the high cost of the improvement requires a cost-benefit analysis of making BEB improvements without addressing existing condition of the facilities. For at least two facilities (Kirkland and Woods), BEB conversion without complete rebuild of the sites is not fiscally responsible. This clearly adds additional budget, schedule, and risk complexity to the BEB conversion decision matrix.

- **Strains on Market Supply.** The ICT regulation will put a lot of pressure on OEMs to produce ZEBs at unprecedented rates. However, it is not only California that is interested in converting to ZEBs. These monumental policy changes make it challenging to meet ZEB goals for agencies if the supply of buses cannot meet demand. This may cause strains on supply, resulting in risk to meeting purchase requirement deadlines. If the supply industry cannot keep up and we end up with a less reliable vehicle, this could suppress transit use and not meet program goals. We cannot go electric if vehicles are not reliable.

- **Transition Complexity**. Maintaining service and adhering to ICT regulation purchase requirements, all while managing on-site construction, facility rebuilds, temporary bus relocations, bus procurements, and utility enhancements introduces a lot of risk to the SFMTA's program. If one element of this transition doesn't go as planned, there will be implications for other components of the program.

- **Dependence on SFPUC and PG&E Enhancements**. All of the SFMTA's yards will require additional electrical service and infrastructure. Installation of the support structure and charging equipment (chargers, switchgear, transformer, etc.) will impact transit operations. To date, PG&E has not

provided a path for the SFMTA to collaborate on planning for electrical service enhancement at the SFMTA bus yards, despite the San Francisco Public Utilities Commission's (SFPUC) persistence. Additionally, it is anticipated that utility infrastructure enhancements will also need to occur outside of the SFMTA's property lines, which may require for upstream improvements to the power grid. Current cost estimates do not consider these improvements, and the SFMTA has been advised by the SFPUC that PG&E will most likely pass these costs to the SFMTA at the likely cost of several million dollars per site.

- **Additional Strain on PG&E Resources.** Further complicating the SFMTA's dependency on PG&E coordination is the State's competing policies, programs, and regulation of other electric fleets, including commercial fleets and private vehicles. As State transportation electrification efforts take hold, PG&E will be incentivized to address the needs of rate-paying customers first. The SFMTA anticipates that commercial rate-paying customers will be prioritized over the SFMTA (as a wholesale customer).

- **The Results of the SFPUC Power Rate Study.** The SFPUC is currently undertaking an analysis of their rate structure. The SFMTA currently pays a wholesale distribution rate and receives power to its traction power system and facilities at very favorable rates. The outcome of this study and any resulting rate change impacts the SFMTA's cost to convert from DHEB to BEB.

- **Managing Power Demand**. The transition to BEBs will require strategies to ensure that the SFMTA can utilize power in the most efficient way. The SFMTA is coordinating with utility providers to determine methods to reduce peak demands. However, managing demand may also come at a hefty capital cost, something that staff is currently analyzing.