FLEET ENERGY ASSESSMENT

PREPARED FOR

CITY OF WEST KELOWNA

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PREPARED BY

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v1.4

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GLOSSARY KEY TERMS AND ACRONYMS

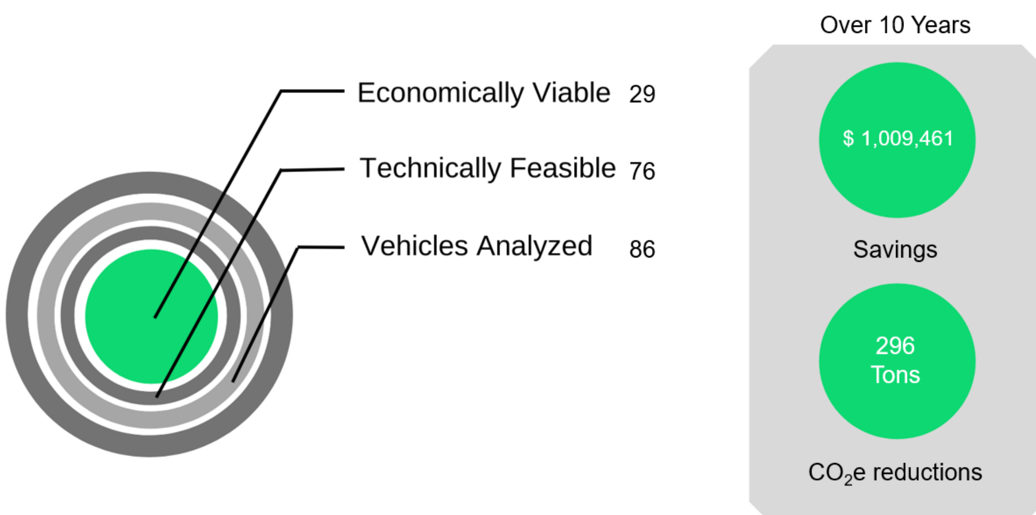
A / AMP	Amperes/ Amps
CEC	Canadian Electrical Code
BEV	Battery Electric Vehicle
D	Diesel Vehicle
EV	Electric Vehicle
EVEMS	Electric Vehicle Energy Management System
EVSE	Electric Vehicle Supply Equipment
HDV	Heavy-duty vehicle, Class 7-8.
ICE	Internal Combustion Engine
SUV	Sport utility vehicle
KW	Kilowatt - Unit of electrical power (1kW = 1000W)
KWH	Kilowatt-hour – Unit of energy or electrical consumption
LDV	Light-duty vehicles, Class 1 though 2H, i.e., F-150.
LOAD SHARING	Multiple EVSE share a single circuit.
LOAD MANAGEMENT	Autonomous disconnection of circuits
M&HD	Medium and Heavy-duty Vehicles, Class 2G through 8
PHEV	Plug-in Hybrid Electric Vehicle
TCO	Total Cost of Ownership
T CO2E	Metric Tonne of Carbon Dioxide Equivalate
V	Voltage
VKT	Vehicle Kilometers Traveled
WHITE FLEET	Service and administrative vehicles
X	Gasoline Vehicle
ZEV	Zero-Emissions Vehicle

1 EXECUTIVE SUMMARY

The City of West Kelowna is committed to reducing its greenhouse gas (GHG) emissions and has commissioned ChargeFWD to conduct a fleet and facility assessment for transitioning the municipal fleet to zero-emission vehicles (ZEVs) over the next decade. Fleets across British Columbia are making progress in electrification and setting ambitious targets for GHG emission reductions.

29 vehicles should be replaced with ZEV upon vehicle replacement.

Figure 1 - Overview of fleet assessment scope and results



The case for City of West Kelowna to begin the transition to zero emission vehicles (ZEV) is favorable over the timeline extending through 2034. This is primarily for three reasons.

First, the duty cycles required by the 29 vehicles align well with available electric vehicle technology, making it technically feasible to replace over half of the vehicles with ZEVs.

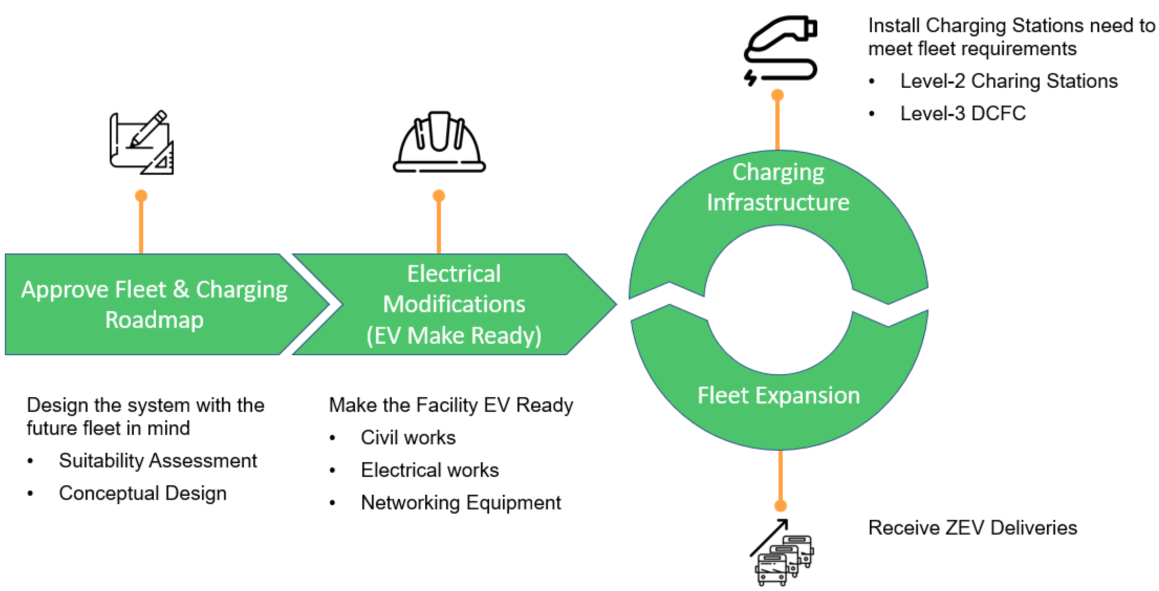
Second, transitioning a portion of the fleet to electric vehicles provides significant opportunities for cost savings.

And third, the City of West Kelowna has sufficient electrical capacity on its existing sites to support the required charging infrastructure without major electrical modifications, such as a service upgrade.

The next steps for the City of West Kelowna involve adjusting capital and operation budgets to align with the vehicle replacement roadmap and charging infrastructure installations proposed in this report. The first priority is to make the site EV Ready by completing all necessary electrical and network modifications to support the future EV fleet charging.

Transitioning the fleet to zero emission vehicles starts with a plan.

Figure 2 - Flow chart for fleet ZEV transitioning process



The **EV Ready** process, also known as "EV make ready", involves completing all required electrical and networking modifications upstream of the charging stations in one comprehensive project. This approach reduces the total cost in the long run, as major and disruptive works, such as electrical service upgrades and trenching in parking areas, are completed in a single project rather than multiple incremental projects each time a new EV is added to the fleet.

Once the site is EV Ready, the **installation and commissioning of charging stations** can be carried out as EV charging needs grow. Once a charging station is commissioned operational costs for maintenance and subscription fees will begin.

2 INTRODUCTION

This fleet and facility assessment focuses on evaluating the electrification potential of City of West Kelowna fleet vehicles and determining the necessary charging infrastructure to support the transition to zero-emission vehicles (ZEVs). The assessment encompasses a detailed examination of 86 vehicles comprising the fleet (refer to Appendix B: Vehicle Replacement Roadmap).

The current fleet relies on traditional internal combustion engine vehicles, resulting in undesirable greenhouse gas emissions. In 2023, the fleet is estimated to emit approximately 416 tonnes of CO2e. This assessment aims to model the operational, financial, environmental, and energy impacts associated with replacing the fleet with ZEVs. Furthermore, it seeks to determine the required charging infrastructure to facilitate this transition.

Our approach is to model four scenarios.

- Scenario 1: Baseline or business as usual - This scenario models a like-for-like replacement of each vehicle.
- Scenario 2: Prioritize emission reductions - Vehicles are replaced with ZEVs, regardless of cost, at the end of their lifespan.
- Scenario 3: Minimize total cost of ownership - Vehicle replacements are strictly based on the business case, emphasizing cost-effectiveness.
- Scenario 4: Roadmap FWD - Our recommended approach blends the priorities of scenarios 2 and 3.

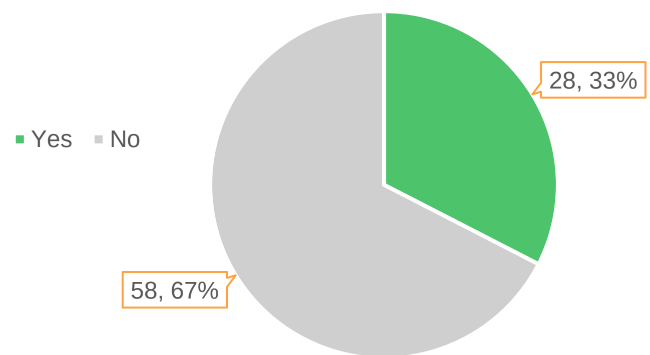
Through this report, we will provide guidance on the timing and selection of vehicles for replacement, as well as the required charging infrastructure to support the integration of ZEVs into the fleet. Moreover, we will assess whether the existing depots possess adequate electrical capacity to accommodate the charging infrastructure. Lastly, a cost estimate will be provided to execute the necessary scope of work for installing the charging infrastructure and facilitating the transition to a ZEV fleet.

We are confident that the outcomes of this assessment will inform and guide City of West Kelowna in its efforts to embrace sustainable transportation practices and reduce its environmental impact.

3 KEY FINDINGS

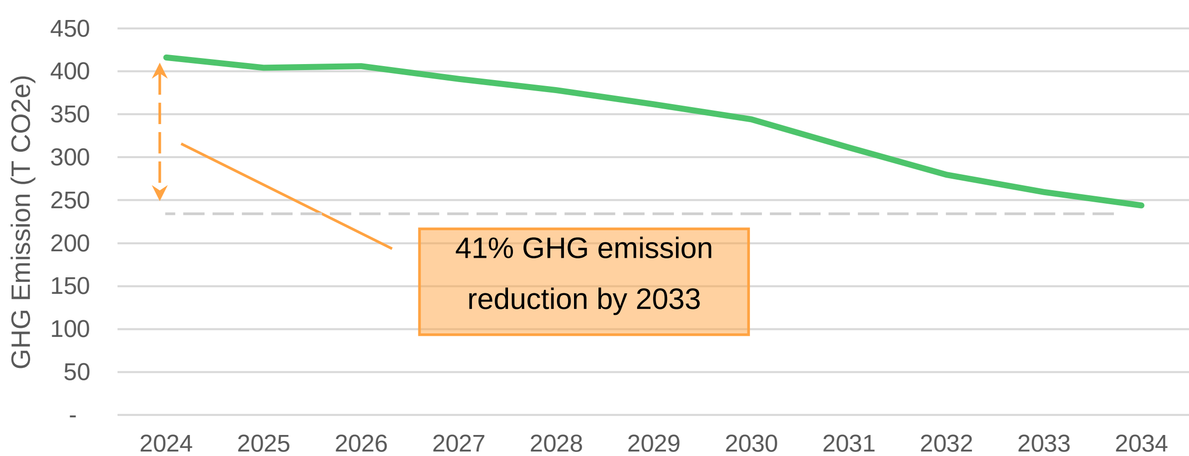
Of the municipal fleet, one-third is suitable for replacement with Zero Emission Vehicles (ZEVs), as the remaining 58 vehicles lack technical feasibility or economic viability with current market-available ZEV technology.

Figure 3 - Proportion of fleet vehicles with suitable ZEV replacement option, count, percentage of fleet



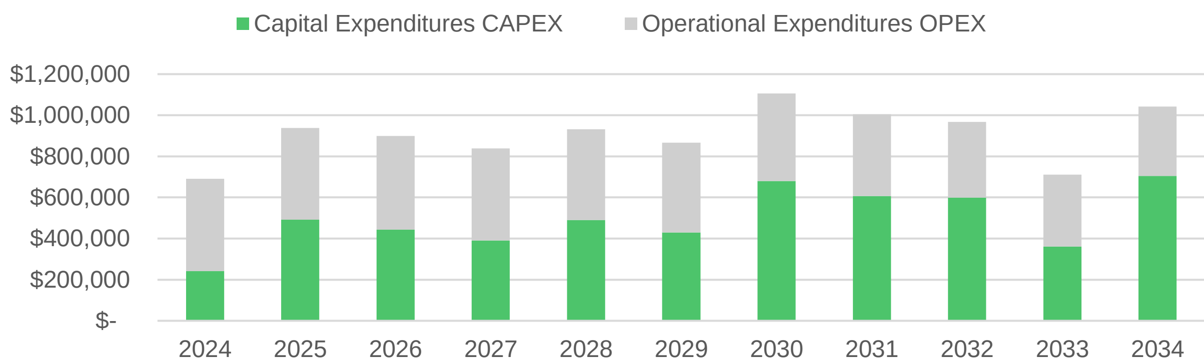
By 2034 GHG emissions from the fleet could drop by 41%

Figure 4 - Forecasted annual GHG emissions (T CO2e) over 10-year period under ***scenario 4*** *which is the recommended Roadmap FWD*



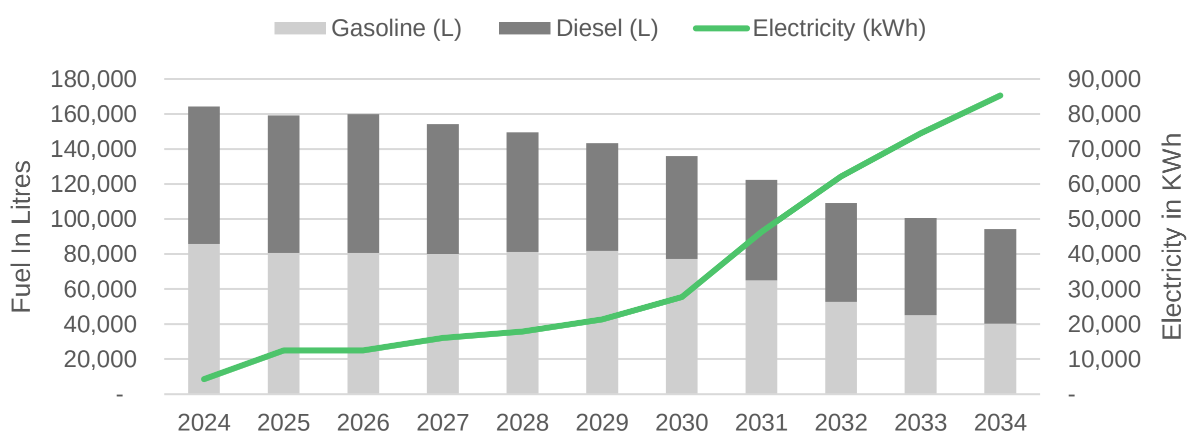
The capital expenditures in EV assets will result in sustainable operational cost savings.

Figure 5 - Fleet expenditures grouped by CapEx & OpEx over 10-year period under ***scenario 4*** Roadmap FWD



As much as 85 MWh of annual load growth is forecasted for ZEV charging.

Figure 6 - Fuel and Electricity consumption for fleet over 10-year period under ***scenario 4*** *Roadmap FWD*



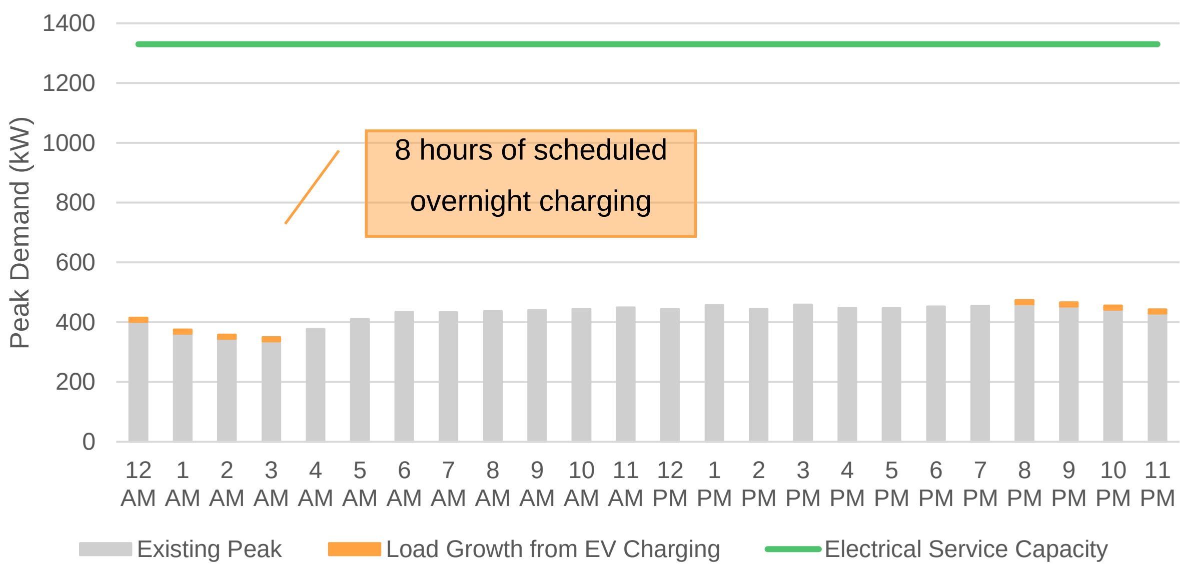
The existing electrical services on site have sufficient capacity for charging.

Table 1 - Load Calculation results for Boucherie 2760 Cameron

DISTRIBUTION	LOADING
EXISTING SERVICE SIZE* (DERATED 80%)	1330 kW
EXISTING PEAK DEMAND	461 kW
SPARE CAPACITY PRIOR TO EVSE LOAD	870 kW
PROPOSED NEW EVSE LOAD	70 kW
SPARE CAPACITY AFTER EVSE INSTALLATION	800 kW

Overnight charging minizines the requirement for high power charging

Figure 7 - Weekday peak demand profile for fleet charging under scenario 4 Roadmap FWD at Boucherie 2760 Cameron



4 FLEET ASSESSMENT RESULTS

The fleet assessment results provide actionable insights and a comprehensive roadmap for the systematic replacement of existing vehicles with zero-emission vehicles (ZEVs). The vehicle replacement roadmap, detailed in (Appendix B: Vehicle Replacement Roadmap), outlines a clear timeline for procurement, promoting a smooth transition to a greener fleet. By following this roadmap, City of West Kelowna can maximize environmental and financial benefits, while minimizing operational disruption. This strategic approach considers vehicle availability, infrastructure readiness, and operational requirements, enabling the timely adoption of ZEVs aligned with your sustainability goals.

4.1 ASSESSMENT OF VEHICLE SUITABILITY

Based on the data collected and the analysis performed, we have developed a vehicle suitability matrix that provides an overview of each vehicle in the fleet and its suitability for replacement with an electric equivalent.

ZEVs are not suitable for all vehicle replacements due to technical and economic factors.

Table 2 - Fleet ZEV replacement suitability matrix

	VEHICLE TYPE	POWER REQUIREMENT (KW)	SUITABILITY RANKING
1.	Fleet: Small to medium vehicles	3.3	High
2.	Fleet: Large vans / pickups	6.6	Moderate
3.	Fleet: Trucks	6.6-16.2	Low
4.	Employee	1.5	High
5.	Public Parking	3.3	High

Incorporating these results into the vehicle replacement roadmap, we will now proceed with prioritizing the replacement of high suitability vehicles, while keeping future advancements in electric vehicle technology in mind for low suitability vehicles.

4.2 PHASED VEHICLE REPLACEMENT

The vehicle replacement roadmap outlines the replacement of 29 vehicles over 10 years from 2024 to 2034, categorized by drivetrain type, vehicle type and replacement year. The phased vehicle replacement is based on the vehicle replacement policy outlined in section 6.2.1 Vehicle Replacement Policy.

This phased replacement plan enables a gradual integration of ZEVs into the fleet, minimizing disruptions and allowing for efficient fleet management. The timeline aligns with anticipated advancements in electric vehicle technology and charging infrastructure.

Scenario 4 is our recommended roadmap FWD for vehicle replacements and EV charging infrastructure.

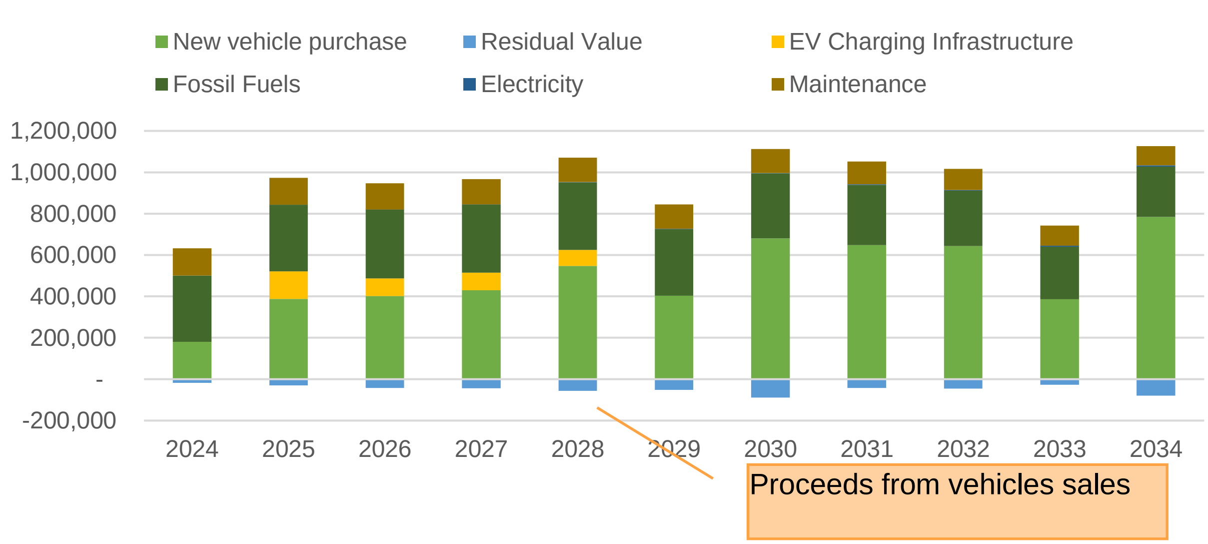
Table 3 - Summary table of financial and environmental results for each scenario

	Scenario 1 *Baseline / Like for Like Replacement*	Scenario 2 Prioritize GHG Emission Reductions	Scenario 3 Minimize Total Cost of Ownership	Scenario 4 Roadmap FWD
10-year Total Cost of Ownership ($)	$8,957,815	$10,683,469	$9,439,562	$9,967,276
Cumulative GHG Emissions (T CO_2e)	4,092	3,652	3,901	3,796

By following the plan, the City of West Kelowna will experience reduced emissions, improved operational efficiency, and long-term cost savings.

Capital investments in new vehicles and EV charging will lead to operational cost saving long term.

Figure 8 - Categorized fleet expenditures over 10-year period under scenario 4 roadmap FWD



5 FACILITY ASSESSMENT RESULTS

The facility assessment results offer insights and a path forward for implementing the necessary infrastructure to support the transition to zero-emission vehicles (ZEVs). By referring to the detailed findings in Appendix C: Conceptual Design Drawings, City of West Kelowna can gain a comprehensive understanding of the infrastructure enhancements needed to accommodate the ZEV fleet.

5.1 GAP ANALYSIS

Currently City of West Kelowna has existing EV charging infrastructure at Rosewood Water treatment plant. Plans for EV charging is included in the development of the new City Hall and Operation Centre. We have determined that the fleet could require as much as **85 MWh of electricity annually** to support ZEV operations in 2034. To deliver this energy to the fleet we have determined that a total of 33 level-2 charging stations will be sufficient to support the needs if the electric fleet in 2034.

Charging Infrastructure costs after rebates and before taxes

Table 4 - Key figures for charging infrastructure required to support the roadmap FWD.

Location	Number for Charging Ports	Qty. Stations x Breaker Size x Station to Breaker Ratio	EV Ready Cost Estimate	Charging Infrastructure Cost Estimate	CleanBC Rebate Estimate
Boucherie	7	3 x 60A 3:1 4 x 60A 1:1	$ 94,660	$ 39,310	$ 65,000
City Hall	12	4 x 60A 2:1	$ 48,355	$ 36,718	$ 70,000
Operations Centre	9	9 x 60A 1:1	$ 57,299	$ 30,093	$ 65,000
Water Treatment Plants	1	1 x 40A 1:1	$ 10,535	$ 5,636	$ 9,900
RCMP & Museum	3	2 x 60A 2:1 1 x 40A 1:1	$ 49,825	$ 11,596	$ 35,000
Firehouse	1	1 x 40A 1:1	N/A	$ 5,306	$ 5,000

Due to available existing unused circuit

A level-2 charging station on a dedicated 60-amp 208-volt circuit will provide 11.5kW of power. This is the equivalent of ~75km of range for one hour of charging. When the same station is on a shared branch circuit with a 3:1 breaker to charge ratio, the minimum power is 3.8kW, which is the equivalent of ~25km of range added per hour of charging.

5.2 CAPITAL COSTS BOUCHERIE: 2760 CAMERON RD

The scope of works includes the supply, install and commissioning of seven networked level-2 charging stations.

5.2.1 CONCEPTUAL DESIGN OF EV FLEET READY (BOUCHERIE)

The EV Ready phase of the project involves completing the following actions:

- Installation of dedicated EV charging switchgear and transformer.
- Coring out of the electrical room to the exterior of the building.
- Trenching and cabling from electrical room to parking areas.
- Installation of five 60a / 208v circuits.
- Installation of seven energized terminal outlets in stalls.
- Installation of charging station pedestal pads.
- Installation of bollards and/ or mechanical protection for charging stations.
- Installation of an outdoor networking kit and connection to existing router.

ChargeFWD recommends making the site EV Ready. This phase includes bringing power to the parking area by energizing seven outlets fed by 60-amp 208-volt 3-share or dedicated circuits and bring internet access to each EV charging parking stall.

5.2.2 CONCEPTUAL DESIGN OF CHARGING INFRASTRUCTURE (BOUCHERIE)

Once the maintenance yard is made EV Ready, ChargeFWD recommends installing and commissioning seven level-2 charging stations. The following actions will be taken for this installation:

- Installation of seven 48-amp level-2 charging stations.
- Installation of pedestals for level-2 charging stations.
- Installation of bollards and/ or mechanical protection for charging stations.

- Energizing and commissioning charging stations.

5.3 CAPITAL COSTS CITY HALL: 3731 OLD OKANAGAN HWY

The scope of works includes the supply, install, and commissioning of twelve networked level-2 charging stations. The stations will be in the rear staff parking lot.

5.3.1 CONCEPTUAL DESIGN OF EV FLEET READY (CITY HALL)

The EV Ready phase of the project involves completing the following actions:

- Installation of dedicated EV charging electrical distribution.
- Trenching and cabling from the electrical room to parking areas.
- Installation of four 60A / 208V branch circuits.
- Installation of twelve energized terminal outlets in stalls.
- Connection of a 2:1 breaker to station ratio for each branch circuit.
- Installation of charging station pedestal pads.
- Installation of bollards and/or mechanical protection for charging stations.
- Installation of an outdoor networking kit and connection to the existing router.

ChargeFWD recommends making the site EV Ready by providing power to the parking area with twelve outlets powered by 60-amp 208-volt branch circuits, using a 2:1 breaker to station ratio for optimal distribution and efficiency.

5.3.2 CONCEPTUAL DESIGN OF CHARGING INFRASTRUCTURE (CITY HALL)

Once the site is EV Ready, ChargeFWD recommends installing and commissioning twelve level-2 charging stations. The following actions will be taken for this installation:

- Installation of twelve 48-amp level-2 charging stations.
- Installation of pedestals for level-2 charging stations.
- Installation of bollards and/or mechanical protection for charging stations.
- Energizing and commissioning charging stations.

The infrastructure will be set up to accommodate twelve level-2 charging stations on four 60A branch circuits, utilizing a 2:1 breaker to station ratio to efficiently manage the power distribution while ensuring the successful operation of the charging stations.

5.4 CAPITAL COSTS OPERATIONS CENTRE: 2515 BARTLEY COURT

The scope of works includes the supply, install, and commissioning of nine networked level-2 charging stations.

5.4.1 CONCEPTUAL DESIGN OF EV FLEET READY (OPERATIONS CENTRE)

The EV Ready phase of the project involves completing the following actions:

- Installation of dedicated EV charging switchgear and transformer.
- Trenching and cabling from the electrical room to parking areas.
- Installation of nine dedicated 60A / 208V circuits.
- Installation of nine energized terminal outlets in stalls.
- Installation of charging station pedestal pads.
- Installation of bollards and/or mechanical protection for charging stations.
- Installation of an outdoor networking kit and connection to the existing router.

ChargeFWD recommends making the Operation Centre EV Ready by providing power to the parking area with nine dedicated 60-amp 208-volt circuits, each circuit dedicated to a single charging station for optimal performance and efficiency.

5.4.2 CONCEPTUAL DESIGN OF CHARGING INFRASTRUCTURE (OPERATIONS CENTRE)

Once the site is EV Ready, ChargeFWD recommends installing and commissioning nine level-2 charging stations. The following actions will be taken for this installation:

- Installation of nine 48-amp level-2 charging stations.
- Installation of pedestals for level-2 charging stations.
- Installation of bollards and/or mechanical protection for charging stations.

- Energizing and commissioning charging stations.

The infrastructure will be set up to accommodate nine level-2 charging stations, each connected to its dedicated 60A circuit. This dedicated setup ensures efficient power delivery and reliable operation of the charging stations at the Operation Centre.

5.5 CAPITAL COSTS POWERS CREEK TREATMENT PLANT, RCMP & MUSEUM, AND FIRE HOUSE 30

The scope of work includes the supply, install, and commissioning of one networked level-2 charging station at the Powers Creek Treatment Plant, two stations at the RCMP, and one station at each the Museum and Fire House 30.

5.6 OPERATIONAL COSTS

Operational Costs for charging Infrastructure include:

- Subscription Fees for the charging station management System: $210/ annually per port
- Payment Processing Fees: 4% of all payments processed.
- Utility Charges: Such as energy and demand charges
- Charging Station Maintenance: Our recommendation is the have a spare station on site to replace any malfunctioning or broken hardware.

5.6.1 ENERGY BILL IMPACTS

EVs drive up kWh usage in line with distance traveled. Overnight charging mitigates or eradicates demand charges, ensuring cost-efficient energy use despite increased consumption. For more information on this topic please refer to Utility Energy and Demand Charges

5.7 EVSE HARDWARE & SOFTWARE SPECIFICATION

For level-2 charging station hardware we have specified the 48-amp level-2 charging station from **Philhong** as our recommendation for EVSE. These charging stations are ISO 15118 ready which when pared with a capable vehicle will enable plug and charge features.

The charging station management system provider we have specified is SWTCH. Refer to Charging Station Management Systems for more information on this topic. *Refer to Appendix D: Specification Documents for spec sheets.*

6 BACKGROUND AND ANALYSIS

In our assessment, we analyzed operational, financial, energy, and environmental impacts of transitioning the municipal fleet to zero-emission vehicles (ZEVs). This included evaluating ZEV performance, upfront and lifecycle costs, energy consumption, and charging infrastructure requirements. Our analysis also highlighted environmental benefits, like reduced emissions and improved air quality.

6.1 OPERATIONAL IMPACTS

We reviewed the current fleet make-up and duty cycle to assess the suitability of transitioning to zero-emission vehicles (ZEVs). This involved analyzing the charging schedule and determining the charging needs based on the fleet's usage patterns. We also considered the existing vehicle replacement policy to align the adoption of ZEVs with the City of West Kelowna long-term goals. By examining these factors, we gained insights into the operational implications of introducing ZEVs and ensured a seamless integration of electric vehicles into the fleet.

6.1.1 CURRENT FLEET MAKE-UP AND DUTY CYCLE

Duty cycle plays a major factor in the conversion to electric fleets. A duty cycle is the route a vehicle operates on a regular basis. The below duty cycle analysis determines the suitability of ZEV replacements. The three key indicators that determine whether a duty cycle is suitable for electrification is the *average* and *maximum daily Vehicle Kilometers Traveled (VKT)* and the overnight *dwell time* at the depot. The daily average and maximum VKT must fall within the range constraint of the ZEV replacement. The overnight dwell time determines the power rate requirement for any supporting charging infrastructure.

Vehicle VKT is high, which helps the business case for electric vehicles.

Table 5 - Summary of fleet duty cycle grouped by body class.

Body Class	Count	Ave. daily VKT	Ave. Max daily VKT
Pickup	43	49	150
Sedan	2	28	170
SUV	14	37	135
Minivan	2	36	155
Van	3	35	105
Chassis Cab	13	47	140
Truck	9	45	175

Each vehicle's duty cycle is unique but for the purposes of this report they have been grouped by body class and their data has been averaged. From the data provided by the City of West Kelowna a fleet list was summarised and estimated average duty cycle calculations performed. To complete the analysis additional data sources such as NRCan's fuel consumption data[1] and Atlas Policy's DRVE tool[2] was utilized as a foundation for our results.

6.1.2 CHARGING REQUIREMENTS

Below is an example of a charge requirement review of one of the organizations fleet vehicles. With a charging dwell time of 8 hours, we ensured that the vehicles had sufficient time to replenish their energy reserves. By comparing the daily energy consumption with the available charging time, we can determine the necessary charging capacity for the fleet. Knowing the fleet charging capacity allows us to understand what an optimized charging infrastructure looks like for City of West Kelowna.

[1] Fuel consumption ratings, May 2021
https://open.canada.ca/data/en/dataset/98f1a129-f628-4ce4-b24d-6f16bf24dd64

[2] Dashboard for Rapid Vehicle Electrification (DRVE), May 2021
https://www.atlasevhub.com/materials/drve/

Charging requirements need to be calculated based on the duty cycle and vehicle range.

Table 6 - Example of data used to calculation charging requirements.

Current Vehicle 29719 FAC GMC Savana	
Est. Average Daily VKT	43 km
Est. Maximum Daily VKT	113 km
Est. Overnight Dwell Time	8 hrs
Replacement Vehicle Ford E-Transit	
Consumption	35 kWh / 100 km
Range	203 km

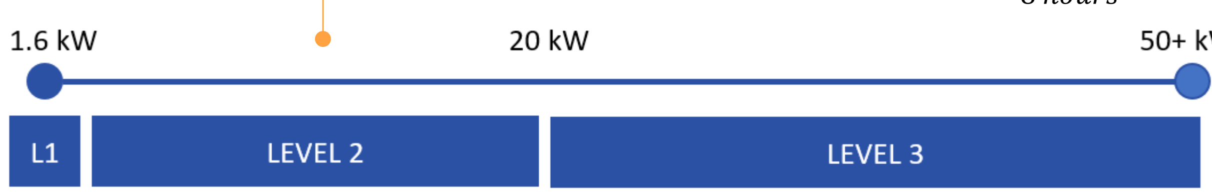
power requirement for charging infrastructure can be calculated using these figures.

Overnight level-2 charging is the most cost-effective option for fleet charging.

Figure 9 - Example of charging requirement calculation

$$\text{Power requirement for charging infrastructure} = \frac{\text{Max. Daily VKT} \times \text{Consumption}}{\textit{Dwell Time}}$$

$$4.9\ \text{kW} = \frac{113\ \text{km} \times 35\ \text{kWh}/100\ \text{km}}{8\ \textit{hours}}$$



From these calculations we can see that the duty cycle of unit 29719 can be performed by a E-Transit BEV and that the minimum required charging infrastructure to support this vehicle would be a level-2 charging station.

6.2 FINANCIAL IMPACTS

6.2.1 VEHICLE REPLACEMENT POLICY

The City of West Kelowna's emission reduction policy has set the following targets for the fleet in 2025 and 2030.

- 10% of light duty vehicles are to be ZEV by 2025
- 30% of light duty vehicles are to be ZEV by 2030

The City of West Kelowna municipal fleet will adhere to a vehicle replacement policy with a target replacement cycle of 12 years or 160,000 km depending on the result of a vehicle condition report. Medium and heavy-duty vehicles are due for replacement after 8,000 hrs.

During the replacement process, we will conduct a Total Cost of Ownership (TCO) analysis for both suitable Zero-Emission Vehicles (ZEVs) and Internal Combustion Engine (ICE) vehicle options.

If a suitable ZEV is available on the market, we will compare its TCO with that of the corresponding ICE vehicle. If the TCO of the ZEV is lower, it will be selected as the preferred replacement option due to its cost-effectiveness and environmental benefits.

In cases where the TCO of the ICE vehicle is lower, we will perform a comprehensive cost-benefit analysis. This analysis will evaluate the marginal cost difference between the two options and the potential emissions reductions. By quantifying the emissions reductions in terms of a monetary value, we will determine the cost per tonne of carbon dioxide equivalent (CO2e) emissions reduced.

This vehicle replacement policy ensures that the City of West Kelowna makes informed decisions based on the TCO analysis, considering both the financial aspects and the environmental impact of the fleet. It aims to prioritize the adoption of ZEVs when they present favorable cost advantages while allowing for flexibility in exploring emission reduction opportunities beyond the vehicle replacement itself.

6.2.2 TOTAL COST OF OWNERSHIP CALCULATIONS

The TCO (Total Cost of Ownership) analysis is a crucial step in determining the most cost-effective vehicle replacement option. Our process involves setting a target date for each vehicle replacement within the fleet. Subsequently, we leverage our comprehensive database of suitable makes and models to identify potential replacement vehicles.

This database contains extensive information on various factors that contribute to the overall TCO. It includes data on maintenance costs, fuel or energy efficiency, insurance costs, manufacturer's suggested retail price (MSRP), and operational requirements such as range, towing capacity, or seating capacity. Additionally, we consider the residual value of the existing vehicle, factoring in the potential proceeds from selling it upon replacement.

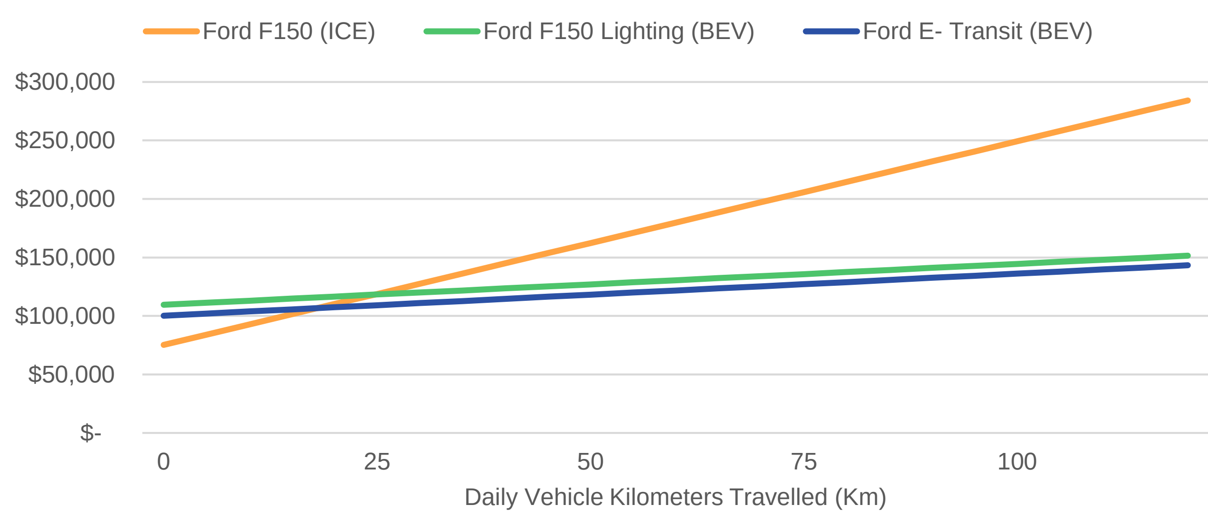
To perform the TCO analysis, we begin by extracting the historical vehicle kilometers traveled data for the existing vehicle. We then calculate the TCO for both an ICE and a ZEV replacement, whenever feasible. This involves assessing the estimated costs associated with each vehicle option over its projected lifespan, including fuel or energy expenses, maintenance and repair costs, insurance premiums, and depreciation.

By comparing the TCO of the ICE and ZEV replacements, we can determine which option offers a more cost-effective solution for the City of West Kelowna. Factors such as fuel or energy savings, potential maintenance cost reductions, and any available government incentives or rebates for ZEVs are carefully considered in the analysis.

TCO insight: ZEV enthusiasts often emphasize the lower total cost of ownership of electric vehicles, arguing that the reduced operational costs compensate for the higher initial purchase price. However, our analysis has revealed that this is not consistently applicable to most organization fleets, as their total vehicle kilometers traveled often fall below the threshold required to justify the higher purchase price of a ZEV solely based on fuel savings. For electric vehicles to be economically viable, they need to be utilized extensively. The optimal scenario for ZEV adoption is a duty cycle ranging from 60km to 200km of daily vehicle kilometers traveled. Within this range, the savings generated by reduced fuel and maintenance costs outweigh the higher initial purchase price of ZEVs, making the purchase economically advantageous. It's important to note that ZEVs currently available on the market can technically achieve a daily range of 200km. As the price parity between ICE and ZEVs is attained, the lower limit of the 60km to 200km range will decrease to zero km. When there is no cost difference between the purchase price of an ICE vehicle and a ZEV, the ZEV naturally becomes the most cost-competitive option.

Daily vehicle mileage is the key metric when the business case for ZEV.

Figure 10 - Total Cost of Owner (TCO) example, over 12-year vehicle lifecycle



The TCO analysis provides a comprehensive view of the financial implications of each vehicle replacement option, allowing the City of West Kelowna to make informed decisions based on long-term cost considerations. It enables us to assess not only the immediate purchase and operational costs but also the potential savings and benefits over the vehicle's lifespan, ultimately supporting the transition to a more cost-effective and sustainable fleet.

6.3 ENERGY & ENVIROMENTAL IMPACTS

Building upon the fuel and energy consumption predictions derived from the TCO analysis, we proceed to model the total energy consumption of the fleet. This analysis not only helps us estimate the energy requirements for operating the fleet but also serves as a foundation for forecasting emissions. In line with the BC Methodological Guidance for Quantifying GHG Emissions, we consider emissions factors specific to different vehicle types and their respective energy sources. By combining the modeled energy consumption with the appropriate emissions factors, we can accurately estimate the greenhouse gas (GHG) emissions associated with the fleet's operations. This analysis provides valuable insights into the energy impacts of the fleet and allows us to identify potential areas for emissions reduction and optimization strategies.

7 CONCLUSION

In conclusion, our fleet and facility assessment has provided insights into the potential transition of the City of West Kelowna municipal fleet to zero-emission vehicles (ZEVs). Through our analysis, we have explored four scenarios and their respective impacts on the total cost of ownership (TCO) and cumulative greenhouse gas (GHG) emissions over a 10-year period from 2024-34.

Roadmap FWD offers the most cost-effective environmental solution.

Table 7 - Summary of four Scenario's

Scenario	Description	Financial (10-year CAPEX, OPEX)	Environmental (CO_2e Reductions)	Reduction in Fuel Consumption (10-year Litres)
1	Like for Like	$8,957,815	No Reduction	No Reduction
2	Prioritize GHG Emission Reductions	$10,683,469	11%	205,840
3	Minimize Total Cost of Ownership	$9,439,562	5%	84,374
4	Roadmap FWD	$9,967,276	7%	144,397

Based on these findings, it is evident that transitioning the fleet to zero-emission vehicles presents an opportunity to reduce greenhouse gas emissions and align with the City of West Kelowna environmental goals. Additionally, careful consideration of the TCO and GHG emissions in the selection and replacement of vehicles is vital for achieving a sustainable and cost-effective fleet.

Ultimately, the City of West Kelowna can make an informed decision based on its priorities and objectives, taking into account the financial implications, environmental impact, and long-term sustainability. The insights provided by this assessment will serve as a valuable foundation for the City of West Kelowna to embark on a successful transition towards a cleaner and more efficient fleet of vehicles.

7.1 NEXT STEPS

1. Approval of Vehicle Replacement Roadmap: Present the findings and recommendations of this assessment to the relevant stakeholders for review and approval. The vehicle replacement roadmap, which outlines the timeline and prioritization of vehicle replacements, should be carefully evaluated and endorsed to initiate the transition process.
2. Budget Allocation: With the approved roadmap, it is important to align the capital and operational budgets with the proposed vehicle replacements and charging infrastructure installations. Adequate funding should be allocated to cover the costs associated with the procurement of new vehicles, charging station installations, electrical upgrades, and ongoing maintenance.
3. EV Fleet Ready Infrastructure Upgrade: Initiate the EV fleet ready infrastructure upgrade project. Engage qualified contractors or electricians to perform the necessary electrical modifications and ensure compliance with local regulations and safety standards. This comprehensive upgrade will prepare the facilities for the future EV fleet and streamline the installation of charging stations.
4. Vehicle Replacement and Charging Station Installation: Once the EV fleet ready infrastructure is in place, proceed with placing orders for the recommended vehicle replacements. Collaborate with reputable suppliers or dealerships to ensure timely delivery of the selected ZEVs. Concurrently, coordinate the installation and commissioning of charging stations at the strategically identified locations within the facilities.

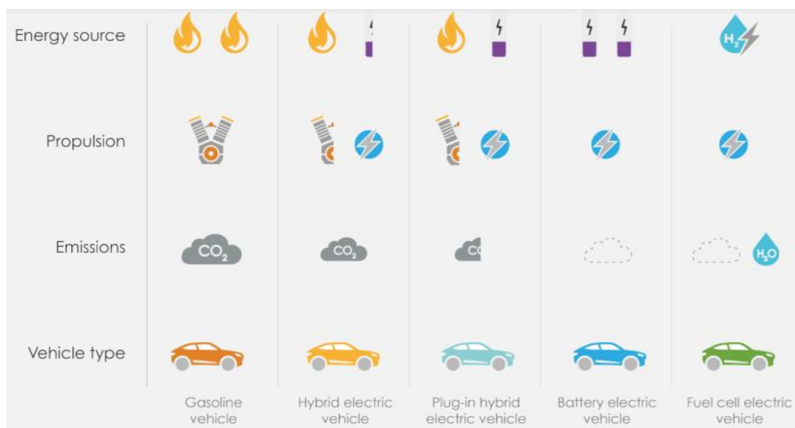
By following these next steps, the City of West Kelowna can effectively progress towards its goal of adopting zero-emission vehicles. The careful planning and execution of the required charging infrastructure, along with the approval of the vehicle replacement roadmap and budget allocation, will set the stage for a successful and sustainable transition.

APPENDIX A: FUNDAMENTALS

ELECTRIC VEHICLE BASICS

An electric vehicle (EV) is any vehicle with an electric drivetrain. The electric drivetrain is what differentiates an electric vehicle from a conventional fossil- fueled vehicle where the drivetrain is mechanical. What is interesting to note is that the first cars were electric way back at the end of the 19th and early 20th century. An intense competition then began between the two types of vehicles. Fossil- fueled cars became the clear winner over electric cars. As a result, the internal combustion engine car has dominated the market since then. However, decades of research and development into batteries, motors and power electronics technologies have helped bring electric vehicles back toward the forefront. We now have affordable EVs; the one you see in the picture here has a 380-KM range and can be charged in less than an hour. 5 million electric cars are already on the roads globally as of 2020 and this number is expected to dramatically rise in the future.

The table below shows the overview of all types of vehicles we see on roads. In the case of internal combustion engine (ICE) vehicles, they are solely powered by an internal combustion engine and have the most emissions. Hybrid Electric Vehicles (HEV) and Plug-In Hybrid Electric Vehicles (PHEV) are powered by both an internal combustion engine and an electric motor that uses energy stored in a battery. The battery is charged by the internal combustion engine in both cases. For a PHEV, the vehicle can be plugged into an electric power source to charge the battery. Battery Electric Vehicles (BEV) use no fossil fuel and have zero tail- pipe emissions. Like a PHEV, the EV batteries are charged by plugging the vehicle into an electric power source. Finally, a Full Cell Electric Vehicle (FCEV) uses fuel cells powered by hydrogen and a battery to power the vehicle using an electric drivetrain.



REGULAR MAINTENANCE	COMBUSTION ENGINE	ELECTRIC VEHICLE
Oil Change	Every 12,000 to 16,000 km	Not required
Tires	Rotate every 8,000 to 12,000 km: Wheel alignment annually	Rotate, align, and change at same intervals or follow manufacture recommendations
Brakes	Inspect every six months; Service every 30,000 to 80,000 km	Inspect annually; service intervals vary but are generally half as frequent as combustion engines.
Brake Fluid	Every two to three years	Every two to three years
Engine Air Filter	Every two years	Not required
Cabin Air Filter	Annually	Every two years
Coolant	Check twice annually; change every 50,000 km	Not required
Transmission Fluid	Top up or replace every 100,000 to 160,000 km	Not required
Spark Plugs	Change every 130,000 to 160,000 km	Not required
Timing Belt	Change every 100,000 km when equipped	Not required

ELECTRIC VEHICLE CHARGING

An electric vehicle (EV) is any vehicle with an electric drivetrain. The electric drivetrain is what differentiates an electric vehicle from a conventional fossil- fueled vehicle where the drivetrain is mechanical. Electric vehicles may be either fully electric, referred to as battery electric vehicles (BEVs); or a combination of electric and gasoline powered, identified as plug-in hybrid electric vehicles (PHEVs). Both require recharging of the battery via electric vehicle charging equipment.

Electric vehicle charging equipment, referred to as electric vehicle supply equipment (EVSE), is classified in the following major categories:

Description of EV Charging levels

Level	Description
1	15 or 20A, 120V 1φ power outlet
2	40A-100A, 208V 1φ or 240V 1φ EVSE
3	30A or higher, 480V 3φ EVSE.

Fast, reliable, and safe charging options are required for electric vehicles. Not too long ago there were limited scenarios for electric vehicles to achieve all three of these requirements. Many car owners and fleet managers would not consider electric vehicles as a viable option unless there were safe, reliable charging facilities in predictable ranges and locations. In contrast, investors of charging infrastructure typically expect quick and regular income after EV infrastructure installations. Today the gap between the availability of safe and reliable EV chargers and users is lessening. It could be noted that this trend mirrors the roll out of fossil fueled vehicles and gas stations from around a century ago.

Level-2 offers the best value for money.

Power output and price range of charging stations

Level-1	Level-2	Low Power DCFC	DCFC	High Power DCFC
Note: you'll need your own cable to plug in to the wall for Level 1	J1772 connector	SAE Combo (CCS) CHAdeMO Tesla	SAE Combo (CCS) CHAdeMO Tesla	SAE Combo (CCS) CHAdeMO Tesla
1.4kW	1.4-19.2kW	20-35kW	50-100kW	100kW+
$300 - $2K	$3K-$12K	$30K	$90K	$100K+

Level-1: charging (8 km/hr) utilizes a regular 15A or 20A power outlet. While level 1-may be adequate for some vehicles, or some days of driving, it is insufficient for those times when greater distances are traveled, and greater amounts of electricity are necessary.

Level-2: charging (25 km/hr) stations are essentially power delivery devices, like a switch, with electronics for communications with the vehicle to manage the charging process. For level-2 charging the actual "charger" is onboard the vehicle and includes a rectifier to supply direct current (DC) to the battery. This is different to DCFC, which incorporate a rectifier that bypasses the onboard charger. For this reason, the charging power received from a level-2 charger is limited by the onboard charger of the vehicle, which ranges from 3.3kW to 19.2kW, depending on vehicle make. Most level-2 chargers are designed to operate on a dedicated circuit, without interruption from adjacent chargers.

Level 3 (DCFC): charging (>100km/hr) is typically not financially viable in most business applications due to its high costs. Level-3 charging is referred to as Direct Current Fast Charging (DCFC). Level-3 charging is now available as standard for most BEVs in North America, with the connector known as a SAE Combo (CCS1). The CHAdeMO connector is an alternative DCFC charging standard which was mostly used by Japanese auto makers. Tesla vehicles can also use an adapter to make use of the CHAdeMO or CCS1 connector.

With regards to level-3 DC fast charging the SAE Combo (CCS1) connector has become the standard in North America.

However, most Tesla drivers opt to use Tesla's supercharger network which makes use of Tesla's proprietary connector. Level-3 (DCFC) chargers are typically provided as a part of extensive highway networks for long distance travel. The major DCFC networks in B.C. include Tesla, Electrify Canada, Petro-Canada, Canadian Tire, and BC Hydro. Motivation for the installations can predominantly be attributed to greenhouse gas (GHG) emissions reduction and operational requirements, i.e., financial return was not the motivating factor.

The coming decade will see the most change the fleet management sector has seen in a century. Electrification, automation, and connected/ shared mobility are three innovations that are on track to disrupt the current way transportation and logistics services are performed. While it is impossible to predict the future, it is best practice to forecast where the industry is going, to be as prepared as possible.

Going forward, fleet managers will have to work much closer with energy and facility managers to successfully deploy EV charging infrastructure.

The traditional goal of an energy manger is to conserve energy. For fleet electrification projects to be successful, energy managers will have to prioritize low carbon fuels and energy sources.

The facility managers role regarding fleet electrification will be to supply, install, own, and maintain charging equipment. Fleet managers need to provide clear guidance to these departments on best practices, their requirements, and expectations.

The role of a fleet manager will undergo change as well. Fewer scheduled and unscheduled vehicle repairs are to be expected with ZEV fleets, however, more time managing charging is expected. Forecasting range requirements of the next days operation will be vital to ensuring all vehicle are able to perform their duty cycles.

Although rolling out ZEV infrastructure is a large capital expense; savings can be achieved when installing ZEV infrastructure by effective planning and limiting rework. Financial support is currently available to fleet operators in the form of rebates for electrical modifications and charging infrastructure. Most fleet facilities can support some adoption of ZEVs without major retrofits. However, high levels of ZEV adoption often require major electrical modifications or energy management systems.

There are three best practices to keep charging infrastructure and electricity demand costs to a minimum:

1. "Make Ready" the facility with roughed in electrical modifications with enough capacity for the future fleet and install the charging stations modularly as and when are required.
2. Charge the vehicles as slow as possible during off peak hours.
3. If space allows place charging stations so that multiple stalls can be serviced from the same station.

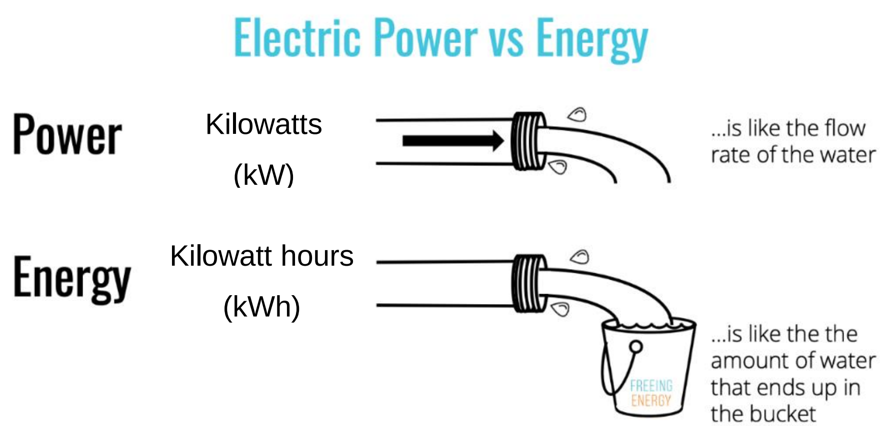
Before fully understanding the costs, fleet managers and EV drivers might initially seek the fastest charging available (i.e., level-3 aka DCFC), as this is comparable with the experience of fueling an ICE vehicle. After analyzing the vehicles energy requirement, charging window and cost of infrastructure, fleet managers most often conclude that networked level-2 charging stations provide the best balance of convenience and value for money. Networked charging stations provide the ability to set permissions (who is allowed to charge) and can help to monitor and optimize electrical usage, i.e., energy consumption can be programmed to occur during off-peak hours.

Level-2 charging stations fall into three categories, non-networked, closed network, and open network.

1. **Non-networked** stations as the name suggests have no smart features as they are not connected to a charging station management platform. Non-networked stations are often lower cost than networked station but lack the features that connectivity can provide.
2. **Closed network** charging stations are networked charging stations where the hardware is designed to operate only on the manufacturers network. The manufactures would design the hardware (the charging station) and the software (the charging station management system) in house. This can lead to stranded assets if the manufacturer either goes out of business or chooses not to continue to support the station.
3. **Open network** is the use of the Open Charge Point protocol (OCPP). For open networked charging stations there are various reputable hardware vendors to choose from such as ABB, Delta, Lite-on, Siemens and Enel X. For the software there is a limited but growing number of providers. In Canada SWTCH and ChargeLab are two established charging station management platforms.

UTILITY ENERGY AND DEMAND CHARGES

To understand electrical utility bills, it is important to understand the difference between power and energy.



For more information on BC Hydro rate tariffs please view this document.

Demand charges are a component of electric utility bills that can significantly impact the overall cost of electricity for commercial and industrial customers, including those served by BC Hydro. Understanding demand charges is crucial for effective management of electric vehicle (EV) charging infrastructure and optimizing cost savings.

Demand charges are based on the highest level of electricity usage, known as peak demand, during a specific time interval (typically measured kilowatts). BC Hydro determines this interval based on their specific rate structure.

During each billing period, BC Hydro assesses both energy consumption (measured in kilowatt-hours) and peak demand. While energy consumption reflects the total amount of electricity used over a period, peak demand reflects the maximum amount of electricity drawn from the grid at any given time. Demand charges are calculated based on the highest peak demand recorded during a billing period.

For EV charging infrastructure, demand charges can have a significant impact on electricity costs, especially if there are instances of high simultaneous charging activities, leading to spikes in demand. It is important to manage and control the charging load to avoid unnecessary peaks in demand and mitigate potential cost implications.

Here are some strategies to minimize demand charges:

Load Management: Implement load management techniques to distribute and optimize the charging load across multiple charging stations. This helps to flatten the demand profile and reduce peak demand levels.

Smart Charging: Utilize smart charging technologies and software that can dynamically adjust the charging rates or schedules based on grid conditions, demand response signals, or time-of-use pricing. This allows for efficient utilization of available power capacity and reduces the likelihood of exceeding peak demand thresholds.

Time-of-Use Charging: Consider implementing time-of-use charging, where EV charging rates vary based on the time of day. By encouraging charging during off-peak hours when electricity demand is lower, demand charges can be minimized.

Battery Energy Storage: Incorporate battery energy storage systems into the EV charging infrastructure. These systems can store electricity during periods of low demand and release it during peak demand, effectively reducing the grid's load and mitigating demand charges.

By implementing these strategies, BC Hydro customers can optimize their EV charging infrastructure to manage demand and mitigate potential increases in demand charges.

CHARGING STATION MANAGEMENT SYSTEMS

Charging Station Management Systems (CSMS) are essential tools for effectively managing and optimizing networked charging infrastructure. These systems provide a centralized platform to monitor, control, and maintain charging stations, enabling efficient operation, and enhancing the user experience. CSMS offer several key features that contribute to the successful management of charging stations.

Load Sharing: One of the primary challenges in managing charging stations is balancing the available power capacity to ensure efficient and reliable charging for all users. CSMS addresses this challenge by offering load sharing capabilities. Load sharing enables the distribution of available power capacity among multiple charging stations or charging points within a station. This feature ensures that power is allocated intelligently, avoiding overloads and optimizing the utilization of available resources. Load sharing helps prevent instances of charging station downtime or reduced charging speeds due to excessive power demand, ultimately enhancing the charging experience for EV users.

Billing and Monitoring: CSMS streamlines the billing process for EV charging services. It provides comprehensive monitoring of charging sessions, recording important data such as energy consumption, charging duration, and transaction details. With this information, CSMS enables accurate and transparent billing for EV users, service providers, and facility owners. CSMS can integrate with various billing systems, allowing for flexible pricing models, such as flat rates, time-based rates, or demand-based rates. Additionally, CSMS provides real-time monitoring and reporting functionalities, offering insights into charging station utilization, energy consumption patterns, and revenue generation. This data-driven approach facilitates effective decision-making, service optimization, and financial management for charging infrastructure operators.

Access Control: Access control is a critical feature offered by CSMS to ensure secure and controlled access to charging stations. CSMS enables the implementation of user authentication mechanisms, such as RFID cards, mobile apps, or PIN codes, to verify the identity of EV users and grant them access to the charging infrastructure. This feature helps prevent unauthorized usage and ensures that charging stations are exclusively available to authorized users, such as employees, residents, or specific membership holders. Access control functionalities can also include reservation systems, enabling users to schedule charging sessions in advance, ensuring availability and convenience.

ENERGY AND LOAD MANAGEMENT

Load management systems represent a compromise between electrical infrastructure costs (e.g., wire and pipe) and charging performance.

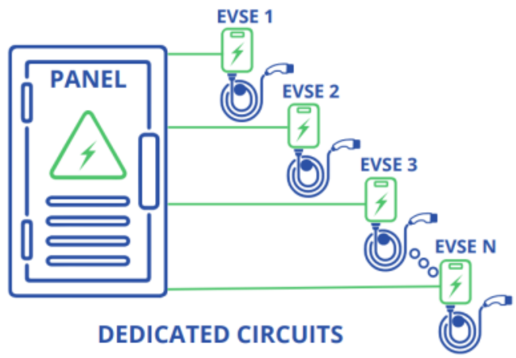


Figure 3: EVSE on dedicated service

Advantages include:

- Reduced electrical infrastructure costs.
- Greater utilization of electrical infrastructure.
- Reduced electrical demand and associated utility demand charges (where applicable).
- Integral power and energy metering.
- Improved monitoring features and network capabilities.
- Greater service support.

Disadvantages include:

- Reduced charging performance.
- Requirement to standardize on EVSE make.
- Reduced options of available EVSE.
- Increased EVSE cost and monthly fees.

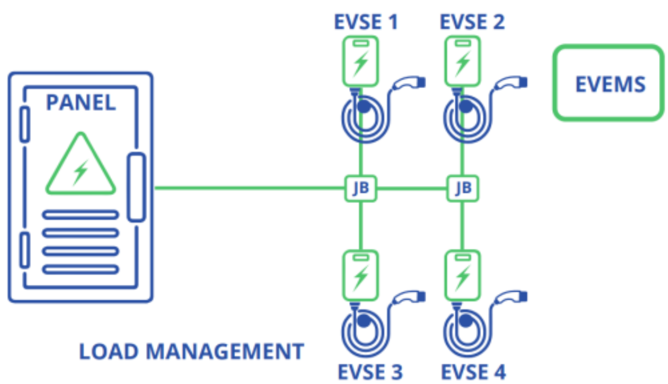


Figure 4: EVSE on shared branch

An additional level of load management includes monitoring of the main electrical service. When it comes to networked charging stations, both hardware device manufacturer and backend networking software suppliers should be evaluated. Networked level-2 charging stations can be categorized into two groups: proprietary and non- proprietary hardware. The most common non-proprietary EVSEs operate under the Open Charge Point Protocol (OCPP). Some of the most installed networked charging makes / models include the FLO CoRe+, ChargePoint CT4000, ENEL-X Juicebox and Lite-On Platinum. In terms of proprietary networks FLO and ChargePoint hold the most market share. For non- proprietary networks there are many more options, however, Swtch and Chargelab are the most popular in Canada.

SERVICE MONITORING

Service monitoring, for the purpose of this report, is metering off the main electrical board of a building to instantaneously determine available spare capacity, and dynamically control charging accordingly. Such systems are particularly valuable where existing spare electrical capacity is extremely limited. Systems capable of service monitoring typically incorporate load management at the panel and circuit levels (circuit sharing).

The systems maximize power available for charging, as they are not restricted by the peak demand of the building. For new buildings this allows reduction of transformer sizes, and for existing buildings this means ability to accommodate charging that may not otherwise be possible without replacement of the utility service, high voltage transformer (where one exists), and main electrical board.

Additional equipment over and above a typical load management system is minor and includes sensors (current transformers) installed on the main electrical board and connection to the management system. The major addition is in the software controls of the system to be able to utilize the data from the metering and apportion charging power accordingly.

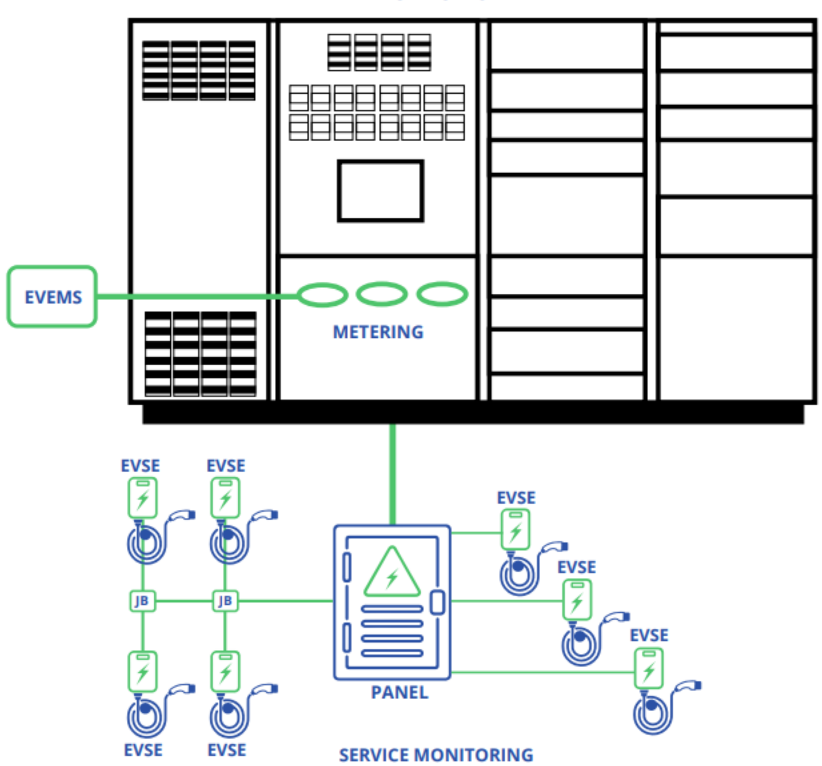
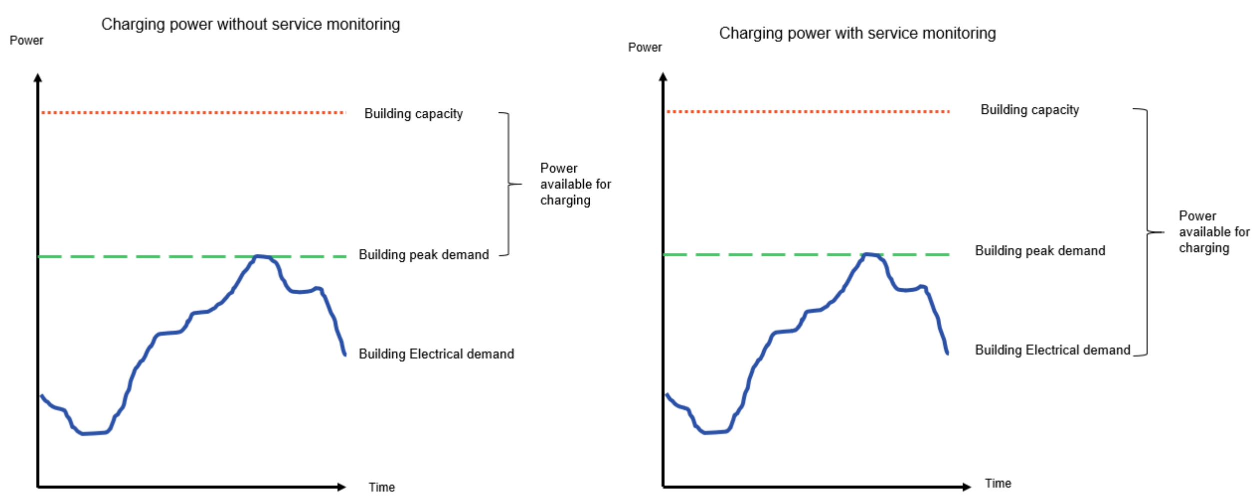


Figure 5: EVSE with service monitoring

Most existing buildings are not capable of accommodating EV charging with dedicated circuit solutions. Conversely, many existing buildings are capable of accommodating EV charging, provided load management solutions are deployed. Service monitoring systems are particularly valuable where spare electrical capacity is extremely limited, and unable to accommodate the required number of parking stalls, even with implementation of load managed solutions.

All configurations other than service monitoring systems are restricted to operate between peak demand and building capacity. While service monitoring systems are commercially available with solution providers such as Variablegrid and Unico Power, the technology is in relative infancy. The advantages of service monitoring systems are the ability to maximize utilization of spare capacity of building electrical systems and minimize peak demand. The disadvantages are reliability and durability risks and/or increased costs.

(left) Charging power without service monitoring vs (right) Charging power with service monitoring.



ASSUMPTIONS AND INPUTS

EMISSION FACTORS

Methodological Equation:

$$Annual\ GHG\ Emissions = Emission\ Factor \times Annual\ Consumption$$

Emission Factor per L of Fuel or kWh of electricity:

	kg_CO2e/L	kg_CO2e/kWh

Gasoline (E5)	2.379	
Diesel (B4)	2.65	
BC Hydro		0.01067

REBATE PROGRAMS

VEHICLES INCENTIVE PROGRAMS

Incentives for Zero-Emission Vehicles (iZEV) Program

Specialty Use Vehicle Incentive

CleanBC Go Electric Passenger Vehicle Rebate Program

CHARGING INFRASTRUCTURE REBATE PROGRAMS

The rebates available in BC for EV Charging installation and upgradation work is Go Electric Fleets Program funded by Provincial government (CleanBC) with additional funds from the NRCAN ZEVIP program.

GO ELECTRIC FLEETS PROGRAM

1) **Financial Support for Electrical Modification and/or electrical service upgrade.**
   If electrical modification and/or electrical service upgrades are needed to support fleet electrification, the costs associated with such projects can be a barrier to ZEV adoption. To support the facilities of an organization to be ZEV fleet ready, the Go Electric Fleets Program provides financial support for the electrical work needed to provide enough energy to support a ZEV fleet. *This Program component will reimburse the costs of electrical work/service upgrades or modifications at the rate of 33% of total costs to a maximum rebate of $20,000.* Organizations can have separate applications for different sites but can only receive rebates for a maximum of four sites.
   Eligible costs include:
   - Engineering design services.
   - New panels and breakers.
   - New transformer.

- Wiring and conduit additions
- Upgrades to utility service.

2) Charging Infrastructure Rebate

Access to charging infrastructure will be necessary for any fleets choosing to adopt electric vehicles (EVs) such as battery-electric or plug-in hybrid electric vehicles. However, the costs associated with EV charging equipment can be a barrier to adoption. To help Organizations address this barrier, the Go Electric Fleets Program provides financial assistance to customers to design, procure and install charging infrastructure, to be used by the fleet.

i) Level-2 Charging

This Program component will reimburse purchase and installation costs of eligible, new, Level 2 charging equipment at the rate of 75% of total costs, up to a maximum of $5,000 per station (for a limited time, starting May 18, 2022; otherwise 50% up to a maximum of $2,000). Rebates will be capped at $50,000 per applicant.

ii) Level-3 (DCFC)

Applicants are offered two tiers of rebates for DCFC stations, installed for use by fleet vehicles, as detailed in the table below.

DCFC rebate levels

Charger Output	Maximum Rebate Amount	Maximum Rebate Amount for Indigenous Communities and Businesses
DCFC: 20kW to 49kW	50% of project costs up to $20,000	75% of costs up to a maximum of $35,000
DCFC: 50kW or higher	50% of project costs up to $50,000	75% of costs up to a maximum of $75,000

Eligible costs include:

- Purchase of the charging station.
- Labour and construction costs for the installation of the charging station, and associated conduit by a licensed electrical contractor.

- Electrical and other related permits.
- Parking and electrical design to accommodate the charging stations.

CLEANBC GO ELECTRIC REBATES FOR HOMES & WORKPLACES

Funded by the Government of B.C.'s Ministry of Energy, Mines and Low Carbon Innovation, and with financial support from the Government of Canada, BC Hydro administers the CleanBC Go Electric (EV) charger rebate program. The program provides rebates for the purchase and installation of electric vehicle (EV) chargers and infrastructure to get homes and workplaces across B.C. ready for EVs. Workplaces can get a rebate of up to *$5,000 per charger (limited-time increase, regularly $2,000) to purchase and install eligible level-2 networked EV chargers for employee use, to a maximum of *$25,000 (limited-time increase, regularly $14,000). To be eligible, pre-approval from BC Hydro is required prior to purchasing and/or installing chargers.

Eligible workplace applicant organizations can have separate applications for different locations, up to a maximum of four.

BC Hydro Workplace Charging

****** Rebates are subject to change and availability at the time of project kick off ******

OTHER PROGRAMS

Zero Emission Vehicle Infrastructure Program

ICE Chargeup

EV Ready Fleet Plan

APPENDIX B: VEHICLE REPLACEMENT ROADMAP

Summary of the recommended roadmap for vehicle replacements under scenario 4.

CURRENT YEAR/MAKE/MODEL	ASSET ID	REPLACEMENT YEAR	RECOMMENDED REPLACEMENT	EXAMPLE	DEPOT	ELECTRIFICATION COST / SAVING	TOTAL COST OF OWNERSHIP	CHARGING REQUIREMENT
2006 GMC Full Size Truck	29144 REC GMC Yukon	2024	Pickup (ICE)	FORD F150 Hybrid	Boucherie: 2760 Cameron Rd	FORD F150	63,806	-
2009 Ford Ranger	29303 Bylaw FORD Ranger	2024	Pickup (BEV)	FORD F-150 LIGHTNING	City Hall: 3731 Old Okanagan Hwy	FORD F-150 LIGHTNING	95,372	-
2012 Ford F-550	29906 Parks FORD F550	2024	Chassis Cab (ICE)	FORD F450	Operations Centre: 2515 Bartley Court	FORD F450	204,289	-
2011 GMC Savana	29719 FAC GMC Savana	2025	Van (BEV)	FORD E-TRANSIT	Boucherie: 2760 Cameron Rd	FORD E-TRANSIT	61,716	4.9
2011 Ford E150	29717 FAC FORD Econo	2025	Van (BEV)	FORD E-TRANSIT	Boucherie: 2760 Cameron Rd	FORD E-TRANSIT	60,123	4.3
2011 Ford Escape	29305 Bylaw FORD Escape	2025	Small SUV (BEV)	HYUNDAI IONIQ 5	City Hall: 3731 Old Okanagan Hwy	HYUNDAI IONIQ 5	52,330	3.6
2011 Ford Escape	29407 Eng. FORD Escape	2025	Small SUV (BEV)	HYUNDAI IONIQ 5	City Hall: 3731 Old Okanagan Hwy	HYUNDAI IONIQ 5	45,443	1.9
2012 Chevrolet Sonic	29332 City Hall CHEVROLET Sonic	2025	Sedan (BEV)	KIA NIRO EV	City Hall: 3731 Old Okanagan Hwy	KIA NIRO EV	39,823	1.9
2010 Ford Ranger	29406 Eng. FORD Ranger	2025	Light Pickup (ICE)	FORD RANGER	City Hall: 3731 Old Okanagan Hwy	FORD RANGER	43,350	-
2011 Ford F-150	29408 Parks FORD F150	2025	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	67,074	-
2012 Ford F-150	29704 Parks FORD F150	2025	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	65,318	-
2009 Sterling Ram Cab Chassis	29405 OP STERLING Utility	2026	Chassis Cab (ICE)	FORD F450	Operations Centre: 2515 Bartley Court	FORD F450	177,824	-
2011 Freightliner M2 106 Medium Duty	29410 Parks FREIGHTLINER M2 106	2026	Truck (ICE)	FREIGHTLINER M2 112	Operations Centre: 2515 Bartley Court	FREIGHTLINER M2 112 Plus	189,765	-

CURRENT YEAR/MAKE/MODEL	ASSET ID	REPLACEMENT YEAR	RECOMMENDED REPLACEMENT	EXAMPLE	DEPOT	ELECTRIFICATION COST / SAVING	TOTAL COST OF OWNERSHIP	CHARGING REQUIREMENT
2011 Ford F-350	29409 UTL FORD F350	2026	HD Pickup (ICE)	FORD F250	Operations Centre: 2515 Bartley Court	FORD F250	74,480	-
2011 GMC Sierra	29411 Roads GMC Sierra	2026	HD Pickup (ICE)	FORD F250	Operations Centre: 2515 Bartley Court	FORD F250	64,906	-
2014 Ford F-150	29727 Parks FORD F150	2026	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	70,077	-
2015 Chevrolet Silverado	29733 FAC CHEVROLET Silverado	2027	Pickup (ICE)	FORD F150 Hybrid	Boucherie: 2760 Cameron Rd	FORD F150	65,702	-
2013 Ford Escape	29726 Eng. FORD Escape	2027	Small SUV (BEV)	HYUNDAI IONIQ 5	City Hall: 3731 Old Okanagan Hwy	HYUNDAI IONIQ 5	49,095	2.0
2015 Nissan Rogue	29729 BLDG NISSAN Rogue	2027	Small SUV (BEV)	HYUNDAI IONIQ 5	City Hall: 3731 Old Okanagan Hwy	HYUNDAI IONIQ 5	51,131	2.8
2012 Dodge Ram 5500	29718 UTL DODGE 5500	2027	Chassis Cab (ICE)	FORD F450	Operations Centre: 2515 Bartley Court	FORD F450	124,263	-
2013 Ford F-550	29910 Parks FORD F550	2027	Chassis Cab (ICE)	FORD F450	Operations Centre: 2515 Bartley Court	FORD F450	187,773	-
2013 Ford F-350	29725 UTL FORD F350	2027	HD Pickup (ICE)	FORD F250	Operations Centre: 2515 Bartley Court	FORD F250	100,157	-
2013 Ford F-150	29724 Roads FORD F150	2027	Pickup (ICE)	FORD F150	Operations Centre: 2515 Bartley Court	FORD F150	68,835	-
2013 Freightliner M2 106 Medium Duty	29907 Roads ELGIN Sweeper	2028	Truck (ICE)	FREIGHTLINER M2 112	Operations Centre: 2515 Bartley Court	FREIGHTLINER M2 112 Plus	199,602	-
2016 Ford F-550	29730 Roads FORD F550	2028	Chassis Cab (ICE)	FORD F450	Operations Centre: 2515 Bartley Court	FORD F450	131,706	-
2016 Ford F-350	29734 OP FORD F350	2028	Chassis Cab (ICE)	FORD F450	Operations Centre: 2515 Bartley Court	FORD F450	105,733	-
2016 Ford F-550	29608 Parks FORD F550	2028	Chassis Cab (ICE)	FORD F450	Operations Centre: 2515 Bartley Court	FORD F450	137,927	-

CURRENT YEAR/MAKE/MODEL	ASSET ID	REPLACEMENT YEAR	RECOMMENDED REPLACEMENT	EXAMPLE	DEPOT	ELECTRIFICATION COST / SAVING	TOTAL COST OF OWNERSHIP	CHARGING REQUIREMENT
2016 Dodge Grand Caravan	30020 RCMP DODGE Caravan	2028	Minivan (PHEV)	CHRYSLER PACIFICA	RCMP & Museum: 2390 Dobbin Rd	CHRYSLER PACIFICA HYBRID	68,648	-
2016 Ford F-350	29720 WTP FORD F350	2028	HD Pickup (ICE)	FORD F250	Water Treatment Plants: 3184 Shelter Dr, 1550 Rosewood	FORD F250	123,076	-
2019 Ford Transit	29758 FAC FORD Cargo Van	2029	HD Van (BEV)	FORD E-TRANSIT	Boucherie: 2760 Cameron Rd	FORD E-TRANSIT	59,341	4.6
2017 Nissan Sentra	29735 BLDG NISSAN Sentra	2029	Sedan (BEV)	KIA NIRO EV	City Hall: 3731 Old Okanagan Hwy	KIA NIRO EV	45,342	7.0
2014 Volvo VHD	29793 UTL VOLVO Water Truck	2029	Truck (ICE)	FREIGHTLINER M2 112	Operations Centre: 2515 Bartley Court	FREIGHTLINER M2 112 Plus	194,376	-
2017 Chevrolet Silverado	29601 Parks CHEVROLET Silverado	2029	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	67,586	-
2017 Ford F-150	29736 UTL FORD F150	2029	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	94,287	-
2017 Ford F-350	29738 UTL FORD F350	2029	HD Pickup (ICE)	FORD F250	Operations Centre: 2515 Bartley Court	FORD F250	178,191	-
2018 Hyundai Tucson	29307 Bylaw HYUNDAI Tuscon	2030	Small SUV (BEV)	HYUNDAI IONIQ 5	City Hall: 3731 Old Okanagan Hwy	HYUNDAI IONIQ 5	59,075	4.4
2018 Nissan Rogue	29320 IS NISSAN Rogue	2030	Small SUV (BEV)	HYUNDAI IONIQ 5	City Hall: 3731 Old Okanagan Hwy	HYUNDAI IONIQ 5	44,598	1.4
2019 Kia Sportage	29742 BLDG KIA Sportage	2030	Small SUV (BEV)	HYUNDAI IONIQ 5	City Hall: 3731 Old Okanagan Hwy	HYUNDAI IONIQ 5	49,733	2.3
2019 Kia Sportage	29744 Eng. KIA Sportage	2030	Small SUV (BEV)	HYUNDAI IONIQ 5	City Hall: 3731 Old Okanagan Hwy	HYUNDAI IONIQ 5	43,542	1.2
2018 Hyundai Tucson	29335 HS HYUNDAI Tuscon	2030	Small SUV (ICE)	TOYOTA RAV 4	City Hall: 3731 Old Okanagan Hwy	TOYOTA RAV 4	36,897	-
2015 Kenworth T880	29728 UTL KENWORTH T880 Dump	2030	Truck (ICE)	FREIGHTLINER M2 112	Operations Centre: 2515 Bartley Court	FREIGHTLINER M2 112 Plus	210,169	-

CURRENT YEAR/MAKE/MODEL	ASSET ID	REPLACEMENT YEAR	RECOMMENDED REPLACEMENT	EXAMPLE	DEPOT	EXAMPLE	TOTAL COST OF OWNERSHIP	CHARGING REQUIREMENT
2016 Freightliner M2 106 Medium Duty	29732 Parks FREIGHTLINER Dump Truck	2030	Truck (ICE)	FREIGHTLINER M2 112	Operations Centre: 2515 Bartley Court	FREIGHTLINER M2 112 Plus	198,111	-
2018 GMC Sierra	29715 UTL GMC Sierra	2030	HD Pickup (ICE)	FORD F250	Operations Centre: 2515 Bartley Court	FORD F250	143,950	-
2018 GMC Sierra	29605 Parks GMC Sierra	2030	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	73,060	-
2010 Dodge Grand Caravan	30000 RCMP DODGE Caravan	2030	Pickup (ICE)	FORD F150 Hybrid	RCMP & Museum: 2390 Dobbin Rd	FORD F150	58,724	-
2019 Kia Sportage	29740 Bylaw KIA Sportage	2031	Small SUV (BEV)	HYUNDAI IONIQ 5	City Hall: 3731 Old Okanagan Hwy	HYUNDAI IONIQ 5	55,115	4.8
2019 Ford F-150	29752 UTL FORD F150	2031	Pickup (BEV)	F-150 LIGHTNING	Operations Centre: 2515 Bartley Court	FORD F-150 LIGHTNING	121,550	7.2
2019 Ford F-150	29746 UTL FORD F150	2031	Pickup (BEV)	F-150 LIGHTNING	Operations Centre: 2515 Bartley Court	FORD F-150 LIGHTNING	121,576	5.1
2019 Ford F-550	29756 Roads FORD F550	2031	Chassis Cab (ICE)	FORD F450	Operations Centre: 2515 Bartley Court	FORD F450	144,531	-
2019 Ford F-250	29754 UTL FORD F250	2031	HD Pickup (ICE)	FORD F250	Operations Centre: 2515 Bartley Court	FORD F250	74,999	-
2019 Ford F-150	29750 UTL FORD F150	2031	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	85,319	-
2019 GMC Terrain	30010 RCMP GMC Terrain	2031	Small SUV (BEV)	HYUNDAI IONIQ 5	RCMP & Museum: 2390 Dobbin Rd	HYUNDAI IONIQ 5	44,426	2.8
2019 Ford F-150	29748 WTP FORD F150	2031	Pickup (BEV)	F-150 LIGHTNING	Water Treatment Plants: 3184 Shelter Dr, 1550 Rosewood	FORD F-150 LIGHTNING	128,780	14.3
2020 Ford F-250	29774 Roads FORD F250	2032	Pickup (BEV)	F-150 LIGHTNING	Operations Centre: 2515 Bartley Court	FORD F-150 LIGHTNING	124,929	6.1
2020 Chevrolet Silverado	29776 UTL CHEVROLET Silverado	2032	Pickup (BEV)	F-150 LIGHTNING	Operations Centre: 2515 Bartley Court	FORD F-150 LIGHTNING	124,143	7.3

CURRENT YEAR/MAKE/MODEL	ASSET ID	REPLACEMENT YEAR	RECOMMENDED REPLACEMENT	EXAMPLE	DEPOT	EXAMPLE	TOTAL COST OF OWNERSHIP	CHARGING REQUIREMENT
2020 Ford F-150	29772 UTL FORD F150	2032	Pickup (BEV)	F-150 LIGHTNING	Operations Centre: 2515 Bartley Court	FORD F-150 LIGHTNING	124,304	6.9
2020 Ford F-450	29762 Parks FORD F450	2032	Chassis Cab (ICE)	FORD F450	Operations Centre: 2515 Bartley Court	FORD F450	169,179	-
2020 Ford F-450	29764 Parks FORD F450	2032	Chassis Cab (ICE)	FORD F450	Operations Centre: 2515 Bartley Court	FORD F450	143,288	-
2020 Chevrolet Silverado	29766 Parks CHEVROLET Silverado	2032	Pickup (ICE)	FORD F150	Operations Centre: 2515 Bartley Court	FORD F150	69,700	-
2020 Chevrolet Silverado	29768 Parks CHEVROLET Silverado	2032	Pickup (ICE)	FORD F150	Operations Centre: 2515 Bartley Court	FORD F150	75,392	-
2021 Ford F-150	29788 UTL FORD F150	2033	Pickup (BEV)	F-150 LIGHTNING	Operations Centre: 2515 Bartley Court	FORD F-150 LIGHTNING	127,952	7.2
2021 Ford F-150	29790 UTL FORD F150	2033	Pickup (BEV)	FORD F-150 LIGHTNING	Operations Centre: 2515 Bartley Court	FORD F-150 LIGHTNING	126,777	10.1
2021 Ford F-550	29770 Parks FORD F550	2033	Chassis Cab (ICE)	FORD F450	Operations Centre: 2515 Bartley Court	FORD F450	154,526	-
2021 Ford F-350	29786 Roads FORD F350	2033	HD Pickup (ICE)	FORD F250	Operations Centre: 2515 Bartley Court	FORD F250	116,547	-
2022 Ford Escape	29792 Eng. FORD Escape	2034	Small SUV (BEV)	HYUNDAI IONIQ 5	City Hall: 3731 Old Okanagan Hwy	HYUNDAI IONIQ 5	46,736	2.7
2022 Ford F-150	L29796 WTP FORD F150	2034	Pickup (BEV)	FORD F-150 LIGHTNING	Operations Centre: 2515 Bartley Court	FORD F-150 LIGHTNING	123,351	5.7
2022 Ford F-150	L29796 WTP FORD F150	2034	Pickup (BEV)	FORD F-150 LIGHTNING	Operations Centre: 2515 Bartley Court	FORD F-150 LIGHTNING	123,351	5.7
2022 Freightliner 108 SD	29784 Roads FREIGHTLINER Dump Truck	2034	Truck (ICE)	FREIGHTLINER M2 112 Plus	Operations Centre: 2515 Bartley Court	FREIGHTLINER M2 112 Plus	281,015	-
2022 Ford F-550	29778 UTL Cube Truck	2034	Chassis Cab (ICE)	FORD F450	Operations Centre: 2515 Bartley Court	FORD F450	107,487	-

CURRENT YEAR/MAKE/MODEL	ASSET ID	REPLACEMENT YEAR	RECOMMENDED REPLACEMENT	EXAMPLE	DEPOT	EXAMPLE	TOTAL COST OF OWNERSHIP	CHARGING REQUIREMENT
2022 Ford F-550	29778 UTL Cube Truck	2034	Chassis Cab (ICE)	FORD F450	Operations Centre: 2515 Bartley Court	FORD F450	107,487	-
2022 Ford F-150	L29797 WTP FORD F150	2034	Pickup (ICE)	FORD F150	Operations Centre: 2515 Bartley Court	FORD F150	94,833	-
2022 Ford F-350	29794 Parks FORD F350	2034	HD Pickup (ICE)	FORD F250	Operations Centre: 2515 Bartley Court	FORD F250	94,474	-
2022 Ford F-350	29794 Parks FORD F350	2034	HD Pickup (ICE)	FORD F250	Operations Centre: 2515 Bartley Court	FORD F250	94,474	-
2020 Freightliner 114 SD	29760 Roads FREIGHTLINER Vac Truck	2035	Truck (ICE)	FREIGHTLINER M2 112 Plus	Operations Centre: 2515 Bartley Court	FREIGHTLINER M2 112 Plus	231,748	-
2023 Freightliner M2 106 Medium Duty	29795 Roads Freightliner Dump Truck	2035	Truck (ICE)	FREIGHTLINER M2 112 Plus	Operations Centre: 2515 Bartley Court	FREIGHTLINER M2 112 Plus	191,270	-
2023 Freightliner M2 106 Medium Duty	29795 Roads Freightliner Dump Truck	2035	Truck (ICE)	FREIGHTLINER M2 112 Plus	Operations Centre: 2515 Bartley Court	FREIGHTLINER M2 112 Plus	191,270	-
2023 Ford F-150	29801 Roads FORD F150 Hybrid	2035	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	85,989	-
2023 Ford F-150	29799 Roads FORD F150	2035	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	83,565	-
2023 Ford F-150	29798 UTL FORD F150	2035	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	95,649	-
2023 Ford F-150	29802 WTP FORD F150 Hybrid	2035	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	85,989	-
2023 Ford F-150	29801 Roads FORD F150 Hybrid	2035	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	85,989	-
2023 Ford F-150	29799 Roads FORD F150	2035	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	83,565	-
2023 Ford F-150	29798 UTL FORD F150	2035	Pickup (ICE)	FORD F150 Hybrid	Operations Centre: 2515 Bartley Court	FORD F150	95,649	-

CURRENT YEAR/MAKE/MODEL	ASSET ID	REPLACEMENT YEAR	RECOMMENDED REPLACEMENT	EXAMPLE	DEPOT	TOTAL COST OF OWNERSHIP	CHARGING REQUIREMENT
2023 Ford F-150	29802 WTP FORD F150 Hybrid	2035	Pickup (ICE)	FORD F150	Operations Centre: 2515 Bartley Court	85,989	-
2023 Mitsubishi Outlander PHEV	29800 WTP MITSUBISHI Outlander	2035	SUV (BEV)	FORD MUSTANG MACH-E	Water Treatment Plants: 3184 Shelter Dr, 1550 Rosewood	65,461	5.2
2023 Mitsubishi Outlander PHEV	29800 WTP MITSUBISHI Outlander	2035	SUV (BEV)	FORD MUSTANG MACH-E	Water Treatment Plants: 3184 Shelter Dr, 1550 Rosewood	65,461	5.2

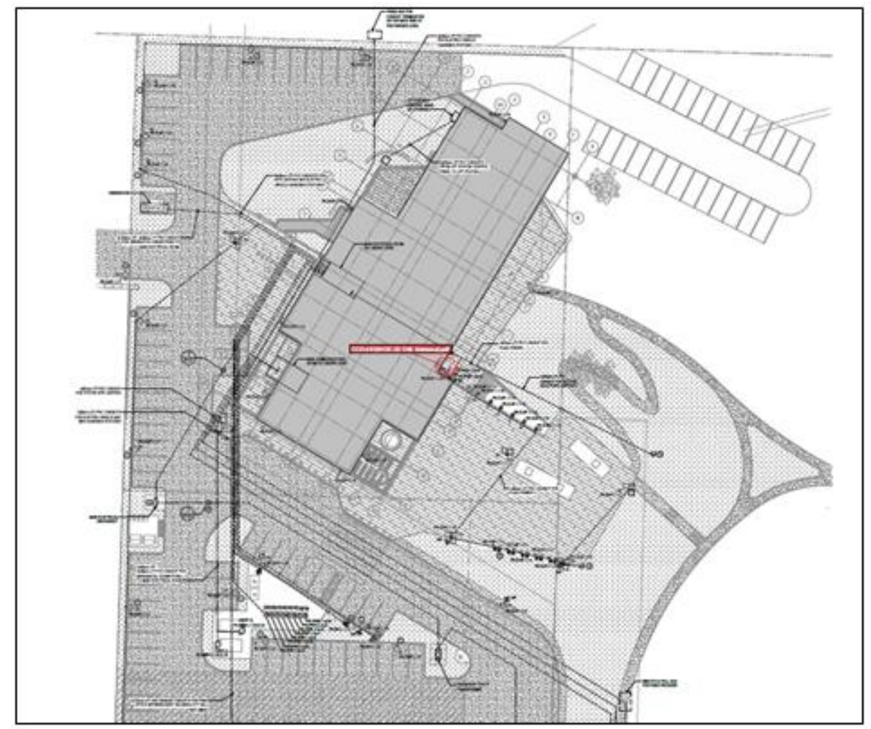
APPENDIX C: CONCEPTUAL DESIGN DRAWINGS

These conceptual designs show the suggested placement of EV charging infrastructure.

CITY HALL EV CHARGING

DRAWING LIST	
E0	COVER
E1	EVSE LAYOUT
E2	SINGLE LINE DIAGRAM

SYMBOL LEDGEND	
	WALL MOUNTED L2 EVSE
	DUAL WALL MOUNTED L2 EVSE
	PEDESTAL MOUNTED L2 EVSE
	DUAL PEDESTAL MOUNTED L2 EVSE
	DCFC
	CABLES AND CONDUITS
	PANELBOARD
	TRANSFORMER
	ROUTER
	WIRELESS ACCESS POINT



CLIENT: City of West Kelowna

PREPARED BY: ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

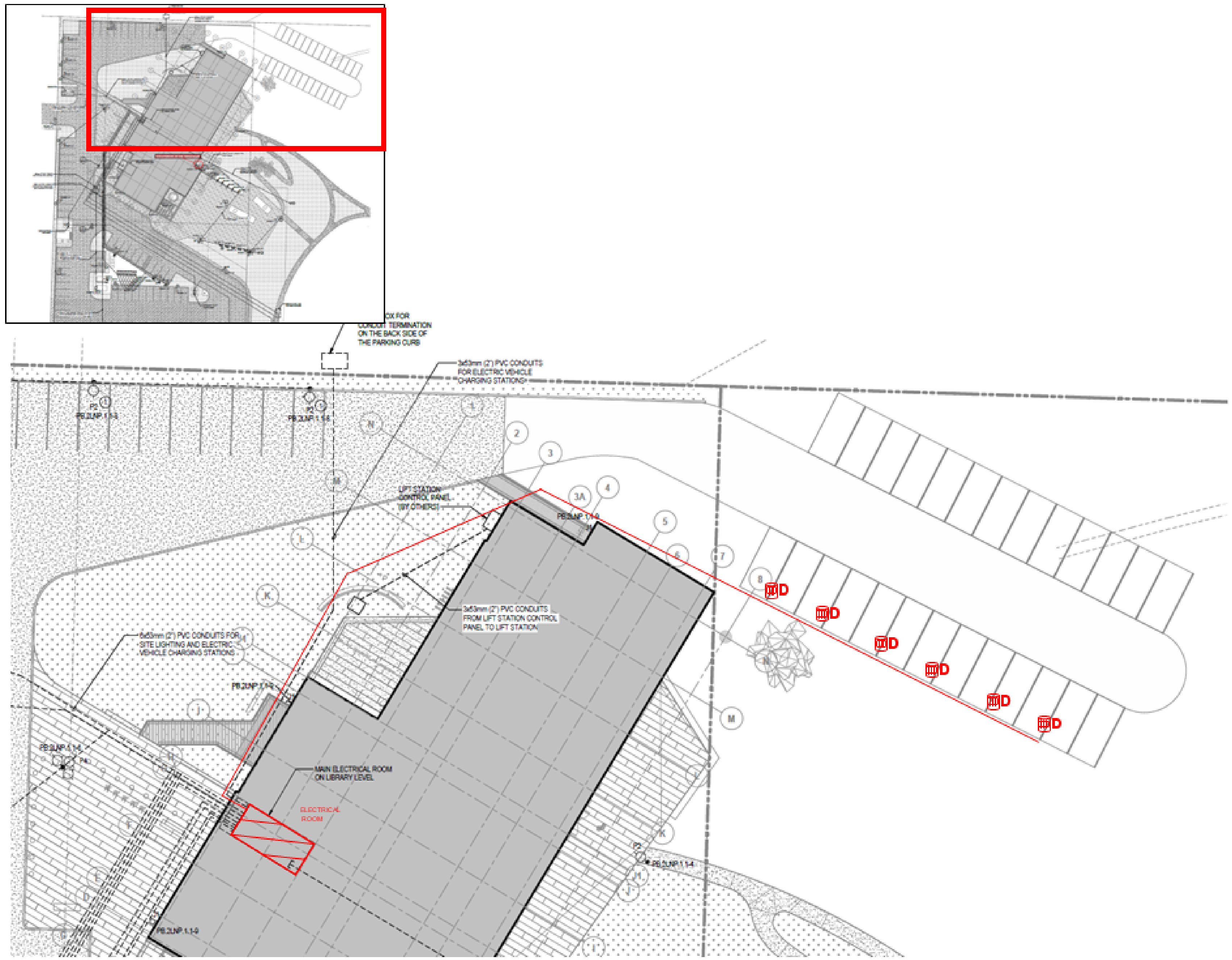
PROJECT NAME:
CITY HALL EV CHARGING

PROJECT ADDRESS:
3731 OLD OKANAGAN HWY,
WEST KELOWNA,
BC V4T 1K7

DRAWING TITLE:
COVER

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0210

DRAWING NUMBER:
E0



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CLIENT:

City of West Kelowna

PREPARED BY:

ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:

CITY HALL EV CHARGING

PROJECT ADDRESS:

3731 OLD OKANAGAN HWY, WEST KELOWNA, BC V4T 1K7

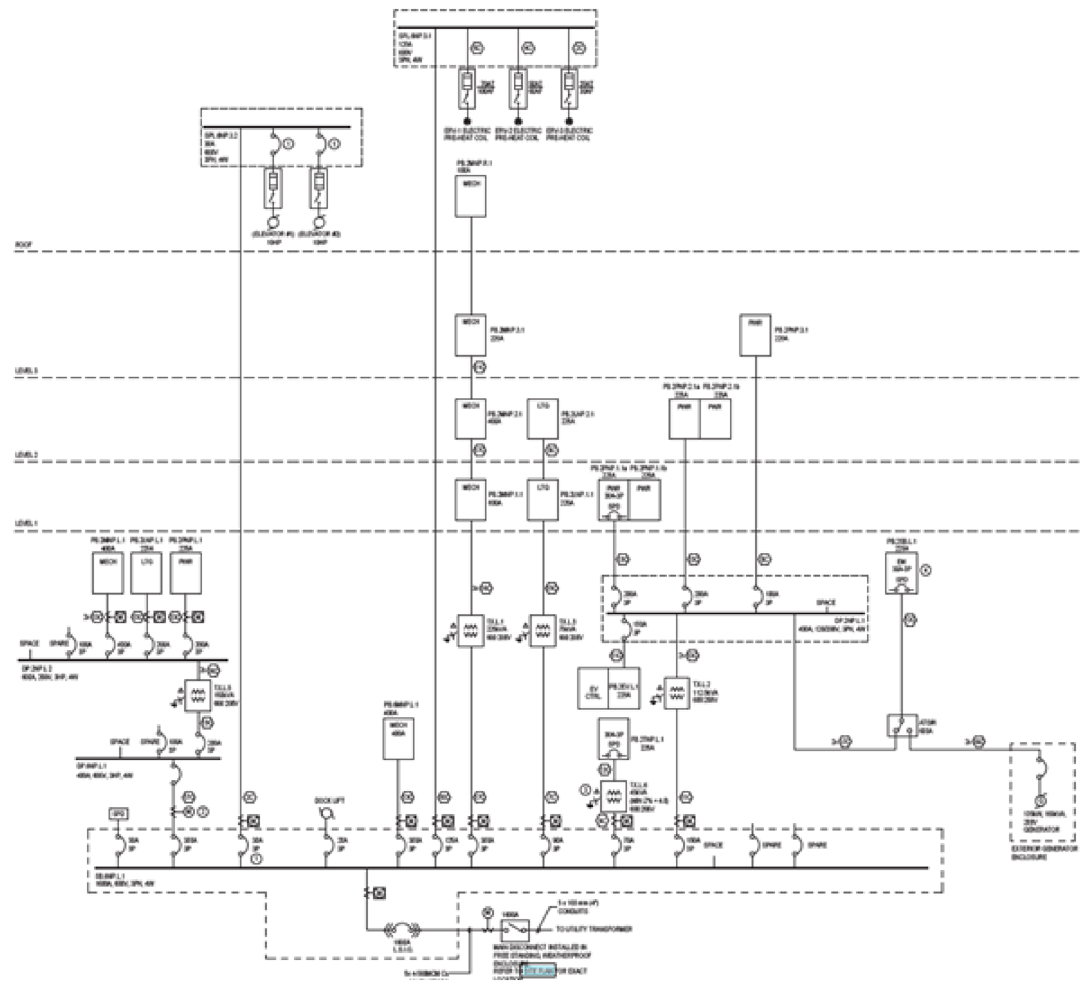
DRAWING TITLE:

EVSE LAYOUT

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0310

DRAWING NUMBER:

E1



CLIENT:

CITY OF WEST KELOWNA

PREPARED BY:

ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:

CITY HALL EV CHARGING

PROJECT ADDRESS:

3731 OLD OKANAGAN HWY, WEST KELOWNA, BC V4T 1K7

DRAWING TITLE:

SINGLE LINE DIAGRAM

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0310

DRAWING NUMBER:

E2

BOUCHERIE FACILITIES EV CHARGING

DRAWING LIST	
E0	COVER
E1	EVSE LAYOUT
E2	NETWORKING LAYOUT
E3	LOAD CALCULATION
E4	PHOTOS

SYMBOL LEDGEND	
	WALL MOUNTED L2 EVSE
D	DUAL WALL MOUNTED L2 EVSE
	PEDESTAL MOUNTED L2 EVSE
D	DUAL PEDESTAL MOUNTED L2 EVSE
	DCFC
	CABLES AND CONDUITS
	PANELBOARD
	TRANSFORMER
	ROUTER
	WIRELESS ACCESS POINT

CLIENT:

CITY OF WEST KELOWNA

PREPARED BY:

ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:

BOUCHERIE FACILITIES EV CHARGING

PROJECT ADDRESS:

2760 CAMERON RD
WEST KELOWNA,
BC V1Z 2T6

DRAWING TITLE:

COVER

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0210

DRAWING NUMBER:

E0

Contractor must check and verify all dimensions and conditions on site and report any discrepancies to designer and/or engineer prior to proceeding with work.

DO NOT SCALE DRAWINGS

N

CLIENT:

CITY OF WEST KELOWNA

PREPARED BY:

ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:

BOUCHERIE FACILITIES EV CHARGING

PROJECT ADDRESS:

2760 CAMERON RD
WEST KELOWNA,
BC V1Z 2T6

DRAWING TITLE:

EVSE LAYOUT

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0210

DRAWING NUMBER:

E1

Contractor must check and verify all dimensions and conditions on site and report any discrepancies to designer and/or engineer prior to proceeding with work.

DO NOT SCALE DRAWINGS

N

CLIENT:

CITY OF WEST KELOWNA

PREPARED BY:

ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:

BOUCHERIE FACILITIES EV CHARGING

PROJECT ADDRESS:

2760 CAMERON RD
WEST KELOWNA,
BC V1Z 2T6

DRAWING TITLE:

NETWORKING LAYOUT

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0310

DRAWING NUMBER:

E2

Spare Capacity on Electrical Service (kW)	
Existing Spare (Before any charging stations are installed)	870
After EV charging Loads are added	800

Service Capacity (KVA)	De-rated Capacity (kW)	Historic Peak Load (kW)
1663	1330	461

DISTRIBUTION	LOADING
EXISTING SERVICE SIZE* (DERATED 80%)	1330 kW
EXISTING PEAK DEMAND	461 kW
SPARE CAPACITY PRIOR TO EVSE LOAD	870 kW
PROPOSED NEW EVSE LOAD	70 kW
SPARE CAPACITY AFTER EVSE INSTALLATION	800 kW

Load Calculation Assumptions for Service

Meter Number	
Account Number	
Single (1) or 3 Phase (√3)	1.7321
Amps	1,600
Voltage	600
Power Factor	100%
W to kW conversion	1000
12 month Historic Peak Load (kW)	461
NEW Level-2 Loads	70
NEW Level-3 Loads	-
NEW Loads Total	70

Contractor must check and verify all dimensions and conditions on site and report any discrepancies to designer and/or engineer prior to proceeding with work.

DO NOT SCALE DRAWINGS

CLIENT: City of West Kelowna

PREPARED BY: ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:
BOUCHERIE FACILITIES EV CHARGING

PROJECT ADDRESS:
2760 CAMERON RD
WEST KELOWNA,
BC V1Z 2T6

DRAWING TITLE:
LOAD CALCUATION

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0310

DRAWING NUMBER:
E3

(1/E4) PHOTO 1 – PAD MOUNTED TRANSFROMER
NTS

(2/E4) PHOTO 2 – MAIN SWITCHBOARD
NTS

(3/E4) PHOTO 3 – VEHICLE PARKING AREA
NTS

(4/E4) PHOTO 4 – VEHICLE PARKING AREA
NTS

CLIENT: City of West Kelowna

PREPARED BY: ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:
BOUCHERIE FACILITIES EV CHARGING

PROJECT ADDRESS:
2760 CAMERON RD
WEST KELOWNA,
BC V1Z 2T6

DRAWING TITLE:
PHOTOS

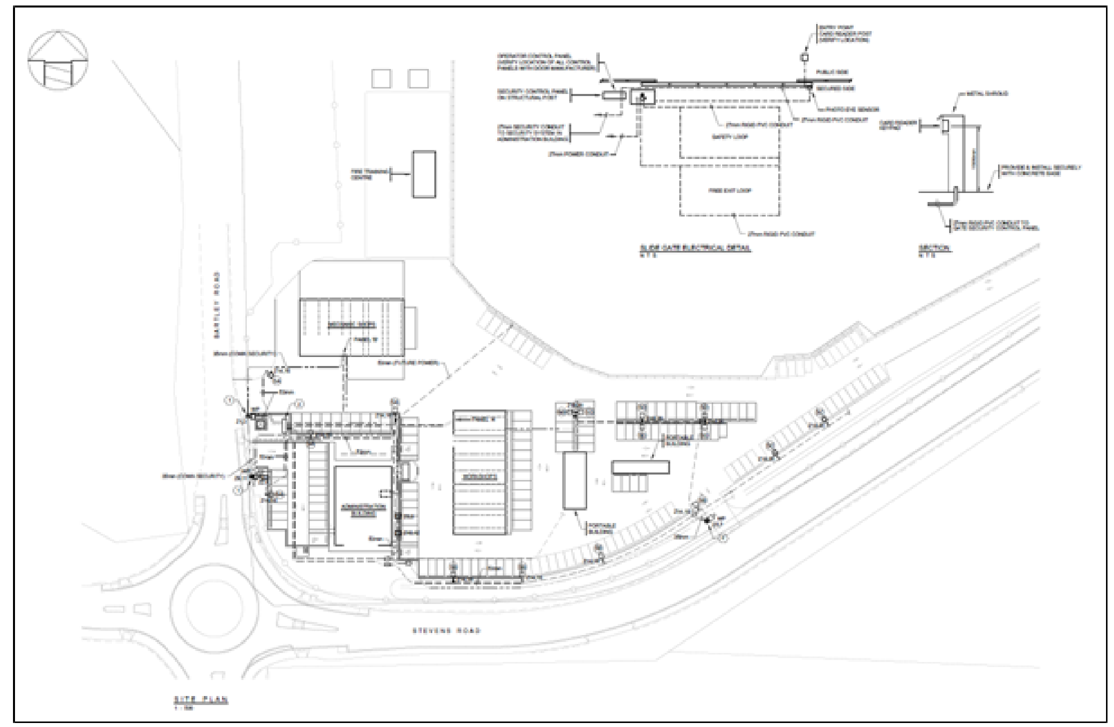
DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0210

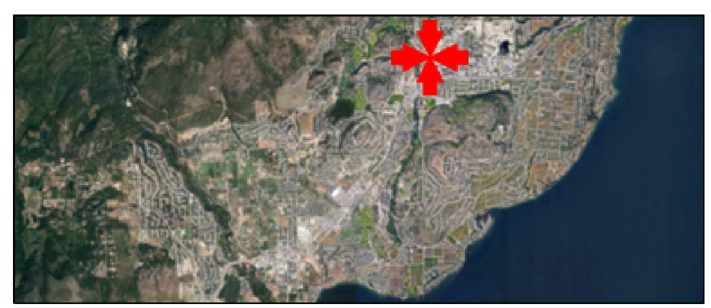
DRAWING NUMBER:
E4

OPERATIONS CENTRE EV CHARGING

DRAWING LIST	
E0	COVER
E1	EVSE LAYOUT
E2	SINGLE LINE DIAGRAM AND PANEL Z

SYMBOL LEDGEND	
	WALL MOUNTED L2 EVSE
	DUAL WALL MOUNTED L2 EVSE
	PEDESTAL MOUNTED L2 EVSE
	DUAL PEDESTAL MOUNTED L2 EVSE
	DCFC
	CABLES AND CONDUITS
	PANELBOARD
	TRANSFORMER
	ROUTER
	WIRELESS ACCESS POINT





CLIENT:

CITY OF WEST KELOWNA

PREPARED BY:

ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:

OPERATIONS CENTRE EV CHARGING

PROJECT ADDRESS:

2515 BARTLEY RD
WEST KELOWNA,
BC V1Z 2M7

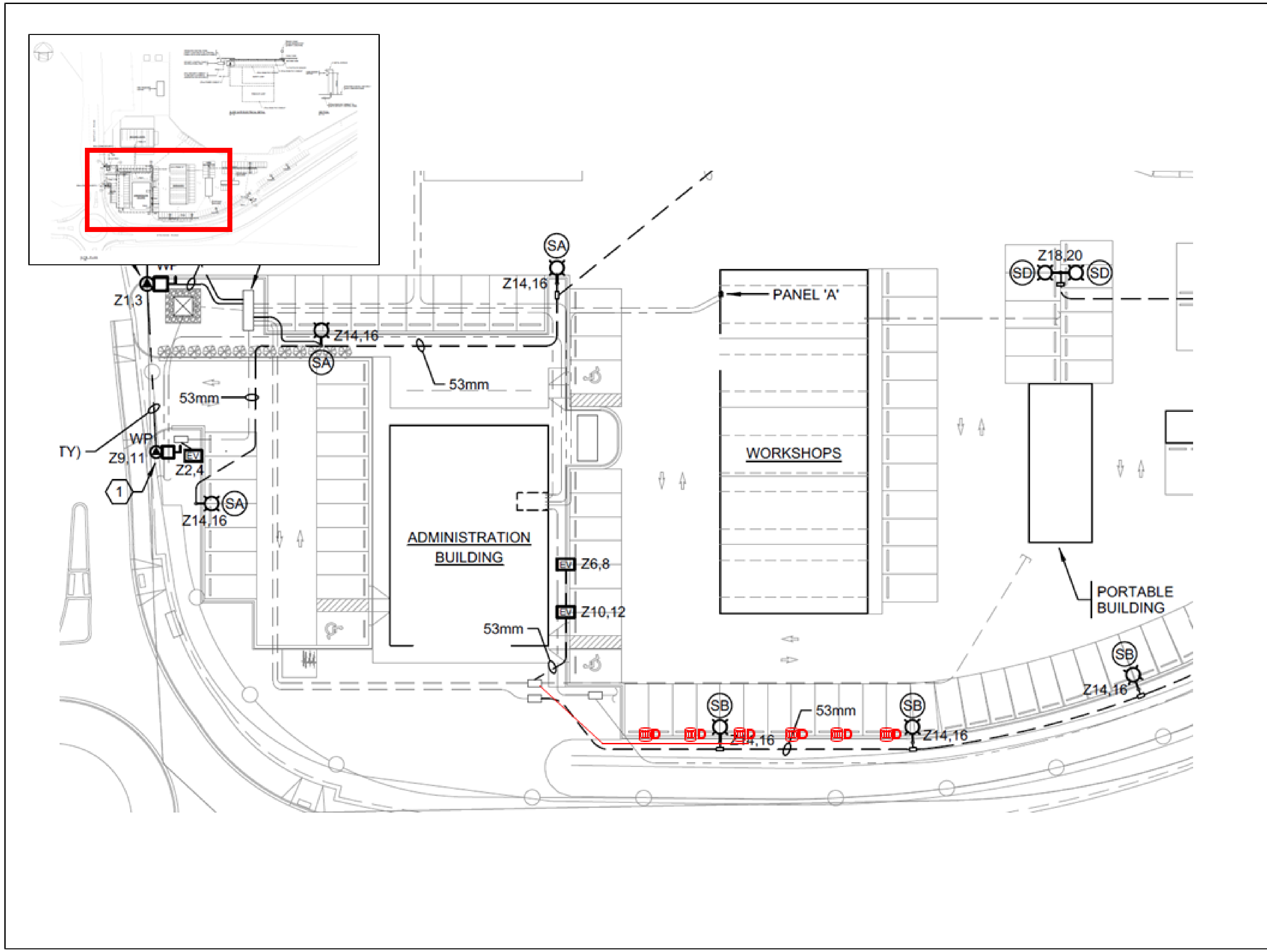
DRAWING TITLE:

COVER

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0310

DRAWING NUMBER:

E0



Contractor must check and verify all dimensions and conditions on site and report any discrepancies to designer and/or engineer prior to proceeding with work

DO NOT SCALE DRAWINGS

N

CLIENT:

City of West Kelowna

PREPARED BY:

ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:

OPERATIONS CENTRE EV CHARGING

PROJECT ADDRESS:

2515 BARTLEY RD
WEST KELOWNA,
BC V1Z 2M7

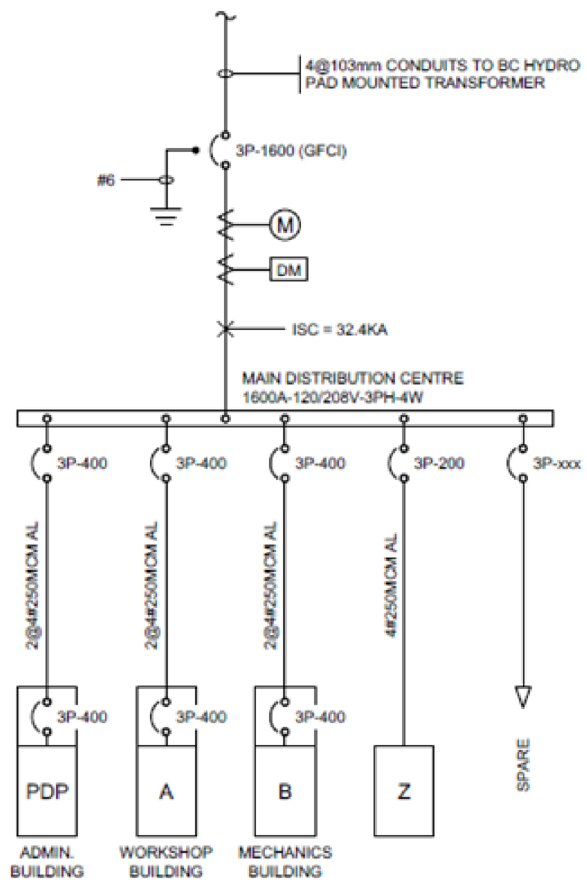
DRAWING TITLE:

EVSE LAYOUT

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0210

DRAWING NUMBER:

E1



SINGLE LINE DIAGRAM

N T S

225A-120/208V-3PH-4W

PANEL 'Z'

LOAD	TRIP AMP	BR. NO.	BUS A B C	BR. NO.	TRIP AMP	LOAD
WEST ENTRANCE GATE	2P	1		2	2P	EV CHARGER
	20	3		4	40	
SOUTH ENTRANCE GATE	2P	5		6	2P	EV CHARGER
	20	7		8	40	
SOUTHWEST ENTRANCE GATE	2P	9		10	2P	EV CHARGER
	20	11		12	40	
		13		14	2P	AREA LIGHTING
		15		16	20	
		17		18	2P	AREA LIGHTING
		19		20	20	
		21		22	15	LIGHTING CONTROL
		23		24		
		25		26		
		27		28		
		29		30		
		31		32		
		33		34		
		35		36		
		37		38		
		39		40		
		41		42		

Contractor must check and verify all dimensions and conditions on site and report any discrepancies to designer and/or engineer prior to proceeding with work

DO NOT SCALE DRAWINGS

CLIENT: CITY OF WEST KELOWNA

PREPARED BY: ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:

OPERATIONS CENTRE EV CHARGING

PROJECT ADDRESS:

2515 BARTLEY RD
WEST KELOWNA,
BC V1Z 2M7

DRAWING TITLE:

SINGLE LINE DIAGRAM AND PANEL Z

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0310

DRAWING NUMBER:

E2

RCMP & MUSEUM FACILITIES EV CHARGING

DRAWING LIST	
E0	COVER
E1	EVSE LAYOUT
E2	LOAD CALCULATION
E3	PHOTOS

SYMBOL LEDGEND	
	WALL MOUNTED L2 EVSE
D	DUAL WALL MOUNTED L2 EVSE
	PEDESTAL MOUNTED L2 EVSE
D	DUAL PEDESTAL MOUNTED L2 EVSE
	DCFC
	CABLES AND CONDUITS
	PANELBOARD
	TRANSFORMER
	ROUTER
	WIRELESS ACCESS POINT

CLIENT: City of West Kelowna

PREPARED BY: ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:
RCMP & MUSEUM FACILITIES EV CHARGING

PROJECT ADDRESS:
2390 DOBBIN RD, WEST KELOWNA, BC V4T 2H9

DRAWING TITLE:
COVER

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0210

DRAWING NUMBER:
E0

EXISTING PANEL HAS A SPARE 30A CIRCUIT TERMINATING IN JUNCTION BOX IN EXTERIOR OF THE BUILDING NEAR PARKING AREA

Contractor must check and verify all dimensions and conditions on site and report any discrepancies to designer and/or engineer prior to proceeding with work.

DO NOT SCALE DRAWINGS

N

CLIENT: City of West Kelowna

PREPARED BY: ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:
RCMP & MUSEUM FACILITIES EV CHARGING

PROJECT ADDRESS:
2390 DOBBIN RD, WEST KELOWNA, BC V4T 2H9

DRAWING TITLE:
EVSE LAYOUT

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0210

DRAWING NUMBER:
E1

MUSEUM 2375 PAMELA RD, WEST KELOWNA

	Spare Capacity on Electrical Service (kW)
Existing Spare (Before any charging stations are installed)	38
After EV charging Loads are added	30

Service Capacity (KVA)	De-rated Capacity (kW)	Historic Peak Load (kW)
96	77	39

DISTRIBUTION	LOADING
EXISTING SERVICE SIZE* (DERATED 80%)	77 kW
EXISTING PEAK DEMAND	39 kW
SPARE CAPACITY PRIOR TO EVSE LOAD	38 kW
PROPOSED NEW EVSE LOAD	8 kW
SPARE CAPACITY AFTER EVSE INSTALLATION	30 kW

RCMP 2390 DOBBIN RD, WEST KELOWNA,

	Spare Capacity on Electrical Service (kW)
Existing Spare (Before any charging stations are installed)	271
After EV charging Loads are added	261

Service Capacity (KVA)	De-rated Capacity (kW)	Historic Peak Load (kW)
416	333	62

DISTRIBUTION	LOADING
EXISTING SERVICE SIZE* (DERATED 80%)	333 kW
EXISTING PEAK DEMAND	62 kW
SPARE CAPACITY PRIOR TO EVSE LOAD	271 kW
PROPOSED NEW EVSE LOAD	10 kW
SPARE CAPACITY AFTER EVSE INSTALLATION	261 kW

CLIENT: City of West Kelowna

PREPARED BY: ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:
RCMP & MUSEUM FACILITIES EV CHARGING

PROJECT ADDRESS:
2390 DOBBIN RD, WEST KELOWNA, BC V4T 2H9

DRAWING TITLE:
LOAD CALCUATION

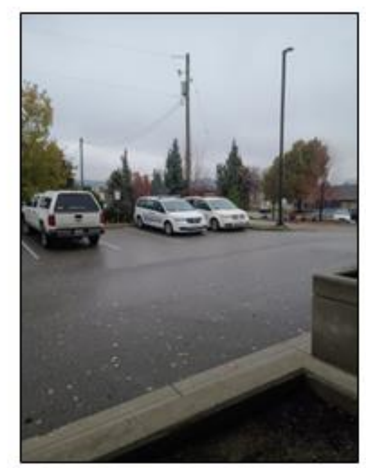
DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0310

DRAWING NUMBER:
E2

1
E3
PHOTO 1 –PARKING AREA (MUSEUM)
NTS

2
E3
PHOTO 2 – ENERGIZED OUTLET (MUSEUM)
NTS

3
E3
PHOTO 3 – BUILDING LAYOUT (RCMP)
NTS



4
E3
PHOTO 4 – VEHICLE PARKING AREA (RCMP)
NTS

Contractor must check and verify all dimensions and conditions on site and report any discrepancies to designer and/or engineer prior to proceeding with work.

DO NOT SCALE DRAWINGS

CLIENT:

CITY OF WEST KELOWNA

PREPARED BY:

ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:

RCMP & MUSEUM FACILITIES EV CHARGING

PROJECT ADDRESS:

2390 DOBBIN RD, WEST KELOWNA, BC V4T 2H9

DRAWING TITLE:

PHOTOS

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0210

DRAWING NUMBER:

E3

WATER TREATMENT PLANTS EV CHARGING

DRAWING LIST	
E0	COVER
E1	EVSE LAYOUT
E2	NETWORKING LAYOUT
E3	LOAD CALCULATION
E4	PHOTOS

SYMBOL LEDGEND	
	WALL MOUNTED L2 EVSE
	DUAL WALL MOUNTED L2 EVSE
	PEDESTAL MOUNTED L2 EVSE
	DUAL PEDESTAL MOUNTED L2 EVSE
	DCFC
	CABLES AND CONDUITS
	PANELBOARD
	TRANSFORMER
	ROUTER
	WIRELESS ACCESS POINT

CLIENT:

PREPARED BY:

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:

WATER TREATMENT PLANTS EV CHARGING

PROJECT ADDRESS:

2760 CAMERON RD
WEST KELOWNA,
BC V1Z 2T6

DRAWING TITLE:

COVER

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0210

DRAWING NUMBER:

E0

1
E1

POWERS CREEK TREATMENT PLANT SHETLER DR

NTS

N

CLIENT:

CITY OF WEST KELOWNA

PREPARED BY:

ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:

WATER TREATMENT PLANTS EV CHARGING

PROJECT ADDRESS:

3184 SHETLER DR,
WEST KELOWNA,
BC V4T 1M4

DRAWING TITLE:

EVSE LAYOUT

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0210

DRAWING NUMBER:

E1

1
E2
POWERS CREEK TREATMENT PLANT SHETLER DR
NTS

N

CLIENT:

PREPARED BY:

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:
WATER TREATMENT PLANTS EV CHARGING

PROJECT ADDRESS:
3184 SHETLER DR,
WEST KELOWNA,
BC V4T 1M4

DRAWING TITLE:
NETWORKING LAYOUT

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0210

DRAWING NUMBER:
E2

	Spare Capacity on Electrical Service (kW)
Existing Spare (Before any charging stations are installed)	394
After EV charging Loads are added	384

Service Capacity (KVA)	De-rated Capacity (kW)	Historic Peak Load (kW)
576	461	67

DISTRIBUTION	LOADING
EXISTING SERVICE SIZE* (DERATED 80%)	461 kW
EXISTING PEAK DEMAND	67 kW
SPARE CAPACITY PRIOR TO EVSE LOAD	394 kW
PROPOSED NEW EVSE LOAD	10 kW
SPARE CAPACITY AFTER EVSE INSTALLATION	384 kW

Load Calculation Assumptions for Service

Single (1) or 3 Phase (√3)	1.7321
Amps	1,600
Voltage	208
Power Factor	100%
W to kW conversion	1000
12 month Historic Peak Load (kW)	67
NEW Level-2 Loads	10
NEW Level-3 Loads	-
NEW Loads Total	10

1
E3
POWERS CREEK TREATMENT PLANT SHETLER DR
NTS

CLIENT:
CITY OF WEST KELOWNA

PREPARED BY:
ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:
WATER TREATMENT PLANTS EV CHARGING

PROJECT ADDRESS:
3184 SHETLER DR, WEST KELOWNA, BC V4T 1M4

DRAWING TITLE:
LOAD CALCUATION

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0310

DRAWING NUMBER:
E3

1 / E4 PHOTO 1 – MAIN ELECTRICAL ROOM
NTS

2 / E4 PHOTO 2 – SUB PANEL
NTS

3 / E4 PHOTO 1 – 30 KVA TRANSFROMER
NTS

4 / E4 PHOTO 2 – PARKING AREA
NTS

CLIENT: City of West Kelowna

PREPARED BY: ChargeFWD

REV	DESCRIPTION	DATE
1	ISSUED FOR REPORT	NOV 10, 2023

PROJECT NAME:
WATER TREATMENT PLANTS EV CHARGING

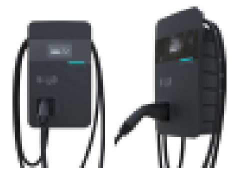
PROJECT ADDRESS:
3184 SHETLER DR, WEST KELOWNA, BC V4T 1M4

DRAWING TITLE:
PHOTOS

DATE:	NOVEMBER 10, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0210

DRAWING NUMBER:
E4

APPENDIX D: SPECIFICATION DOCUMENTS

Model Name		AX48 Series
Safety		UL/cULus (North America)
Picture		
Power Specification		
AC Input	Input Rating	Single-Phase: 200~240Vac
	AC Input Connection	L1/L2/GND or L/N/PE
	Input Current	48A
	Frequency	50Hz/60Hz
AC Output	Output Current	48A
	Output Power	11.5kW (240Vac*48A)
User Interface & Control		
Display		LED Pilot Lamp (standard), 5-inch LCD (Optional)
User Authentication		RFID (ISO/IEC 14443A/B, ISO/IEC 15693, FeliCa™, MIFARE), ISO 15118
Meter		Meter IC (1% Accuracy)
Communication		
External		LAN+WiFi (Standard) or LAN+4G+WiFi (Optional)
Internal		OCPP 1.6 JSON (Upgradeable to 2.0) EEBUS (Support in 2022)
Environmental		
Operating Temperature		-30°C ~ +50°C (-22°F ~ +122°F) Standard
Humidity		< 85% (RH) @50°C (+122°F)
Altitude		≤ 2000m (6562ft)
Enclosure Protection (IK/IP Level)		NEMA TYPE 4
Cooling Method		Natural Cooling
Mechanical		
Dimension(WxDxH)		295mm x 158mm x 505mm (11.61in x 6.22in x 19.88in)
Weight		<7kg (15.43lbs) with Socket; <10kg (22lbs) With Cable
Cable Length		5m (16.4ft) 7.5m (24.6ft) with Optional Cable Management
Protection		
RCD/CCID		CCID 20
Input Side		UVP, OVP, Surge Protection, Ground Fault
Output Side		OCP, Control Pilot Fault, Residual Current Protection
Protocol		OTP, Relay Welding Detection, CCID Self-Test, MCU Function Fault Detection
Regulation		
Certification		UL2594, UL2231-1/-2, CTEP, EnergyStar™
Wireless Certification		FCC/IC
Charging Interface		SAEJ1772 Type 1 Plug