City of Richmond

Report to Committee

To:	Public Works and Transportation Committee	**Date:**	October 22, 2016
From:	Tom Stewart, AScT. Director, Public Works Operations	**File:**	02-0780-01/2016-Vol 01
Re:	**Electric Vehicle Fleet and Charging Station Infrastructure**		

Staff Recommendation

1. That the tiered approach and key considerations for acquiring electric vehicles within the City's vehicle fleet, as outlined in the staff report titled "Electric Vehicle Fleet and Charging Station Infrastructure", dated October 22, 2016 from the Director, Public Works Operations, be endorsed; and

2. That staff report back regarding the potential installation of community Level 3 charge stations, including an energy cost recovery approach, as part of advancing greenhouse gas emissions under the City's Community Energy and Emissions Plan.

Tom Stewart, AScT.
Director, Public Works Operations
(604-233-3301)

Att. 1

REPORT CONCURRENCE		
ROUTED TO:	**CONCURRENCE**	**CONCURRENCE OF GENERAL MANAGER**
Sustainability	☑	
REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE	**INITIALS:** CJ	**APPROVED BY CAO** for

Staff Report

Origin

At the regular Council meeting held on April 25, 2016, Council endorsed the Green Fleet Action Plan – 2015 Progress Report. This report highlighted numerous actions being undertaken to reduce vehicle emissions, highlighting 7% reduction since 2011. This is slightly below desired trending (should be at minimum 8%) to meet 20% reduction by 2020.

This report focuses on the electric vehicle component of the City's Green Fleet Action Plan and explores potential expansion of electric vehicles as part of accelerating targeted emissions reduction. In addition, City and community electric vehicle charging infrastructure is discussed.

This report supports Council's 2014-2018 Term Goal #4 Leadership in Sustainability:

> *Continue advancement of the City's sustainability framework and initiatives to improve the short and long term livability of our City, and that maintain Richmond's position as a leader in sustainable programs, practices and innovations.*
>
> *4.1. Continued implementation of the sustainability framework.*

This report supports Council's 2014-2018 Term Goal #6 Quality Infrastructure Networks:

> *Continue diligence towards the development of infrastructure networks that are safe, sustainable, and address the challenges associated with aging systems, population growth, and environmental impact.*
>
> *6.2. Infrastructure is reflective of and keeping pace with community need.*

Analysis

Background

Corporately, the City has adopted the Green Fleet Action Plan, which establishes a target to reduce greenhouse gas (GHG) emissions by 20% by 2020 (using 2011 as the baseline year). Ensuring fuel-efficient vehicles are a component of the City's fleet is one of many strategies outlined in the Green Fleet Action Plan that will be necessary to meet this target.

At the community level, the City's Official Community Plan includes targets to reduce community GHG emissions 33% below 2007 levels by 2020 and 80% below 2007 levels by 2050. The City's Community Energy and Emissions Plan (CEEP) outlines strategies and actions to reduce community energy use and GHG emissions. The CEEP states that zero carbon transportation systems (including plug-in electrics) will be needed at the community level to meet these targets.

Electric vehicles are near-zero GHG on the British Columbia grid due to the method in which electric power is produced, therefore, are a necessary option to consider moving forward in reducing corporate and community emissions.

City's Electric Vehicle Fleet

The City's electric vehicle fleet is currently composed of nine electric vehicles, including one Nissan Leaf, three Chevrolet Volts, and five Olympia Ice Bears (ice resurfacers). There are an additional 44 hybrid or high fuel-efficiency units.

Electric vehicles offer considerable environmental benefits in relation to reducing fuel emissions. As highlighted in the Green Fleet Action Plan – 2015 Progress Report, annual emissions savings for electric or hybrid units versus a conventional gasoline vehicles are considerable:

- Gasoline vehicle: 4.83 tonnes CO_{2e}
- Hybrid vehicle: 2.64 tonnes CO_{2e}
- Full electric vehicle: 0.0225 tonnes CO_{2e}

While electric vehicles and hybrids have higher capital costs, the total cost of ownership is comparable when fuel is taken into consideration, as outlined below. Note this does not factor in maintenance costs. Typically, electric vehicles have lower maintenance costs than their gasoline counterparts, however, electric vehicle battery life is approximately 10 years, after which battery capacity is diminished (to approximately 60%-70%). Gasoline vehicles could have longer life spans than electric vehicles, depending on use.

Table 1: Total Cost Ownership Comparison – Gasoline, Hybrid and Full Electric Vehicles

	2011 Chevrolet Cruze Unit 1450	2016 Ford Fusion Hybrid Unit 1775	2012 Nissan LEAF Electric Unit 1621
City of Richmond Purchase Price (not including tax)	$17,945	$27,191	$35,720
Actual Fuel economy L/100KM	10.6 L/100 KM	5.8 L/100 KM	2.1 Le/100 KM
Fuel/Energy Used Per Year Based on 15,000 KM Driven	1,590 Litres	870 Litres	2,343 kWh
GHG Emissions/Year	4.83 tonnes CO_{2e}	2.64 tonnes CO_{2e}	0.0225 tonnes CO_{2e}
GHG Emissions For 10 Years	48.3 tonnes CO_{2e}	26.4 tonnes CO_{2e}	0.225 tonnes CO_{2e}
Cost of Fuel/Electricity for 10 Years Based on $1.08/L for Gasoline	$17,172	$9,396	$2,343
Total Cost of Ownership Excluding Maintenance for 10 Years	$35,117	$36,587	$38,063

One of the challenges with incorporating electric vehicles into the City's fleet is its dynamic nature. There are a wide variety of functions City vehicles must perform that require power or range requirements beyond the current capability of the electric vehicle market. For example, service vehicles, crane trucks, dump trucks, backhoes and related equipment require traditional fuel sources to generate the power needed to support vehicle operation as well as ancillary equipment. Other units may need to travel or operate beyond the range capability of current electric vehicles.

A recommended approach, and one which is designed to support leadership in creating demand in the electric vehicle market, would be to apply the following approach to vehicle replacements within the City's passenger vehicle fleet (not including minivans, trucks, etc.):

1. *Apply a Tiered Approach to Vehicle Replacements:*

    a. Full electric vehicle – as a first/priority consideration
    b. Electric vehicle with gasoline back up – as a second priority consideration
    c. Hybrid vehicle – as a third priority consideration
    d. Most fuel-efficient gasoline vehicle – where an electric or hybrid unit is not feasible

2. *Key Considerations in Evaluating Replacements:*

    a. Operational considerations need to remain the key driver in determining the suitability of various fuel-efficient vehicles. These include:
        i. Distance travel requirements versus vehicle range available
        ii. Travel distances in relation to environmental benefits (i.e. is there a sufficient amount of driving required to achieve the emissions savings versus the vehicle replacement cost)
    b. Availability of existing electric vehicle charging infrastructure and/or the cost of installation
    c. Availability of suitable vehicles in the marketplace
    d. Life-cycle costing and available capital budget allocations for vehicle replacements
    e. Other considerations such as carpool limitations and range anxiety (fear of running out of battery power which leads to hesitation purchasing full electric vehicles in case sufficient access to charging infrastructure is unavailable)

    Currently, approximately 50% of the City's passenger vehicle fleet is electric vehicle or hybrid (32 out of 67 units). If the remaining gasoline fueled units were converted (as a minimum to hybrid technology), the estimated annual emissions savings would be approximately 35 tonnes or 1% toward our 20% reduction target by 2020.

    It is important to note that within the present marketplace, many passenger cars are available as hybrids or full electric. The robustness of the electric vehicle/hybrid marketplace is primarily limited to the passenger car category. Industry is, however, starting to ramp up plans to produce a greater selection of vehicles with larger passenger vehicles in mind, i.e. minivans. As the marketplace expands to these styles of units, broader adoption of electric vehicles into the City's fleet can be pursued.

In summary, and as part of the Green Fleet Action Plan, staff suggest applying the tiered approach and key considerations listed above as passenger cars become eligible for replacement. As the marketplace for additional units expands, electric vehicles for these vehicle replacements will also be considered under the tiered approach outlined above. The additional capital cost associated with electric vehicle/hybrid replacements will be reflected in the annual capital budget

submission for City fleet vehicle replacements. Similarly, anticipated fuel savings will be reflected in annual operating budgets.

Electric Vehicle Charging Infrastructure

There are two categories of electric vehicle charging infrastructure discussed in this report: 1) City Vehicle Fleet Charging Stations, and 2) Community Electric Vehicle Charging Stations.

1. *City Vehicle Fleet Charging Stations:*

   The City has installed infrastructure to ensure charging capacity is available for electric vehicles in the City's fleet at the Works Yard and City Hall facilities:

   a. Works Yard – Level 2 charging infrastructure for charging City fleet vehicles includes one unit with two charge points within the Works Yard operations site, and one unit with two charge points in the Works Yard general parking lot (this can be used for City electric vehicles or staff's personal vehicles)
   b. City Hall – Level 2 charging infrastructure is located in the underground parkade and includes two charge points for electric vehicles stationed at this location
   c. City Hall Annex – Level 2 charging infrastructure includes one unit with two charge points for electric vehicles stationed at this location

2. *Community Electric Vehicle Charging Stations:*

   In March, 2013, as part of a funding opportunity through the Provincial Government, the City also installed four public Level 2 charge stations (total of eight charging ports) at the following locations:

   a. Steveston Community Centre
   b. Thompson Community Centre
   c. Cambie Community Centre
   d. City Hall

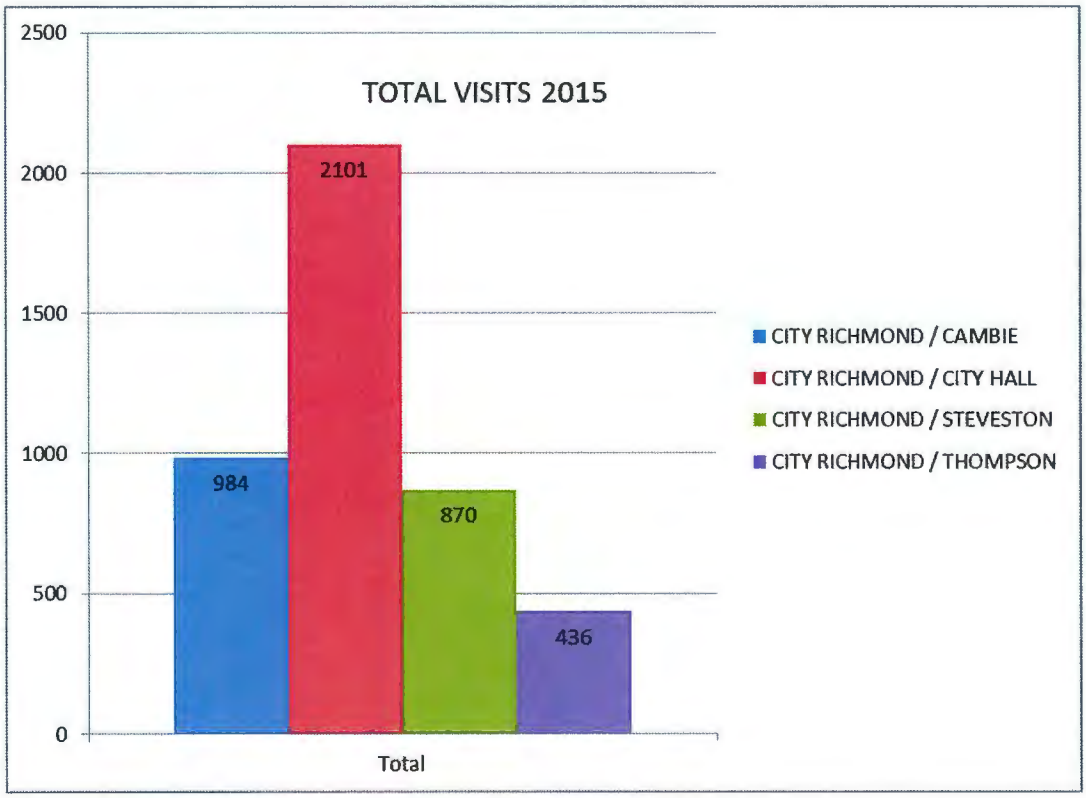
   As noted in the Green Fleet Action Plan Update report, usage of these stations has tripled year over year from 2013 – 2015. The following table outlines the increased usage. In 2016 alone, until September 30, these stations have helped reduce community emissions by 16.3 tonnes.

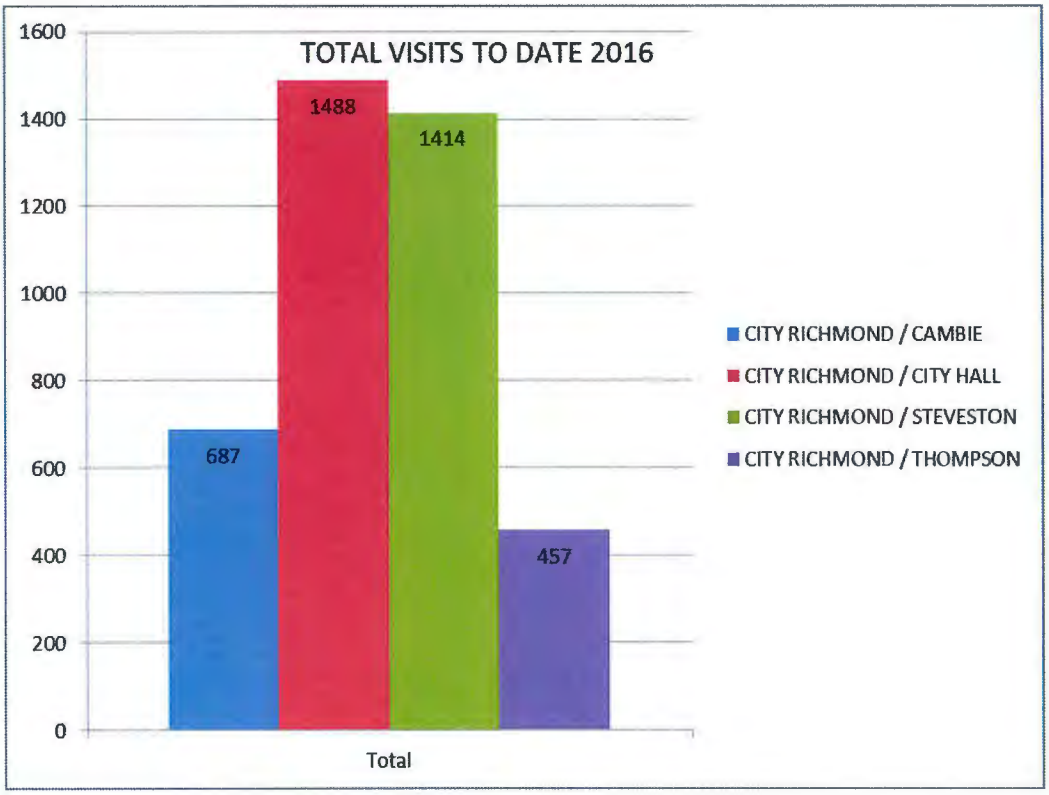
Table 2: Charging Stations March, 2013 – September 30, 2016

	2013 Mar-Dec	2014	2015	2016 Jan-Sept
Times Used (all stations)	776	1,974	4,597	5,326
Charging Time (all stations)	975.3 hours	2,609.4 hours	8,376.9 hours	8,861.0 hours
Energy Used (all stations)	4,345.05 kWh	11,809.75 kWh	35,904.32 kWh	38,806.75 kWh
Energy Cost	At $0.10 Per kWh energy cost	At $0.10 Per kWh energy cost	At $0.10 Per kWh energy cost was	At $0.10 Per kWh energy cost was

	2013 Mar-Dec	2014	2015	2016 Jan-Sept
	was $434.50	was $1,180.97	$3,590.43	$3,880.66
GHG Savings (all stations)	1.8 tonnes CO_2e	5.0 tonnes CO_2e	15.1 tonnes CO_2e	16.3 tonnes CO_2e
Gasoline Savings (all stations)	545.3 U.S. gallons	1,482.1 U.S. gallons	4,506.0 U.S. gallons	4,506.0 U.S. gallons
	2,064.0 L	5,609.8 L	17,055.2 L	18,344.9 L
Fuel Cost Savings	At $1.30 per L, fuel cost savings was $2,661.97	At $1.25 per L, fuel cost savings was $7,180.54	At $1.08 per L, fuel cost savings was $18,419.61	At $1.03 per L, fuel cost savings was $18,895.25

In 2016, the station with the highest number of visits is City Hall, followed by Steveston Community Centre, Cambie Community Centre, and Thompson Community Centre, as shown in the following graphs.





It is interesting to note that users of these stations charge mostly during weekdays – 71% in comparison to 29% on weekends. A graph depicting usage during the average weekday and weekends by station and overall is shown below:

Table 3: Number of Visits from January to September 2016

	Monday – Friday Visits		Weekend Visits	
City Hall	1488	37.45%	190	1.98%
Cambie Community Centre	687	17.30%	640	40.35%
Steveston Community Centre	884	22.25%	530	33.42%
Thompson Community Centre	914	23%	226	14.25%
Total	3973	71%	1586	29%

On average, vehicles plugged in at these locations are actively charging 75% of the total time parked. This is a good indicator that visitors are not abusing the parking privilege these stations provide for electric vehicles given the high percentage of time they are actively charging.

The continued and increasing usage of these stations is a strong indication that community adoption of electric vehicles is trending up. In addition, there has also been an increase in the number of charging stations available for public use provided by others within the private sector. According to information from Plug-In BC's website, there are 16 other private sector locations in Richmond (including the Richmond Olympic Oval) where electric vehicle adopters can charge their vehicles. The locations are listed below. A map showing all public charging stations in Richmond is included as Attachment 1.

Table 4: Locations of Private Charging Stations

Station Name	Address	Level 2 Stations	Level 3 Stations
1. Richmond Olympic Oval	6111 River Road, Richmond, BC, V7C 0A2	2	
2. YVR	3211 Grant McConcachie Way, Richmond, BC, V7B	2	
3. Park n' Fly	6380 Miller Road, Richmond, BC	1	
4. Pacific Gateway Hotel	3500 Cessna Drive, Richmond, BC, V7B 1C7	2	
5. Nature's Path	9100 Van Horne Way, Richmond, BC, V6X 1W3	1	
6. Best Western Abercorn Inn	9260 Bridgeport Road, Richmond, BC, V6X 1S1	2	
7. Auto West BMW	10780 Cambie Road, Richmond, BC, V6X 3K9	1	1
8. IKEA	3320 Jacombs Road, Richmond, BC, V6V 1Z6	2	
9. NEDCO	4455 No. 6 Road, Richmond, BC, V6V 1P6	4	
10. Mercedes Benz Richmond	5691 Parkwood Way, Richmond, BC	1	
11. Pan Pacific Nissan	31220 Smallwood Place, Richmond, BC	1	
12. ADESA	16179 Blundell Road, Richmond, BC, V6W 0A3	1	
13. Ironwood Plaza East	11662 Steveson Highway, Richmond, BC, V7A	2	
14. Ironwood Plaza West	11320 Steveston Highway, Richmond, BC, V7A	2	
15. River Green	5271 Brighouse Way, Richmond, BC, V7C 4V4	1	
16. Aberdeen Centre	4151 Hazelbridge Way, Richmond, BC, V6X 0A4	2	
Total		27	1

Even with increasing amounts of available charging capacity in Richmond, it would be prudent for the City to consider expanding and advancing available electric vehicle infrastructure in keeping with CEEP strategies and actions. The following section explores options for added charging capacity.

Proposed Approach to Expanding Community Electric Vehicle Infrastructure

Options for expanding electric vehicle infrastructure include adding Level 2 charge stations and/or the introduction of Level 3 charge stations. The difference relates to charge time required to reach a full charge, i.e. a Level 3 charge can take 15-30 minutes versus a Level 2 charge which takes 4-6 hours. Level 3 charging addresses range anxiety – concern over running out of battery power – which leads to hesitation purchasing full electric vehicles if sufficient access to charging infrastructure is not available. Level 3 stations provide a quick charge for riders who are travelling longer distances and/or require a fast charge as part of carrying out daily routines.

In order to foster continued growth in community electric vehicles, the addition of Level 2 infrastructure and the introduction of Level 3 infrastructure could be considered as follows:

a. Level 2 charging infrastructure could be included as part of new or major facility and/or park upgrades and be made available for public use

b. Level 3 charging infrastructure could be installed at strategic locations, particularly those that align with high-use transportation corridors (i.e. Highway 91, Highway 99, Knight Street)

Overarching principals such as cost considerations, proximity to other charging infrastructure, and operational feasibility will need to be evaluated on a project-specific basis as part of this approach.

In relation to Level 3 charge stations, there may be sponsorship opportunities available to support installation. For example, staff were approached by BMW/Auto West Group in August, 2016 with a proposal to provide a number of Level 3 charge units at no cost, where the City installs, provides and maintains the infrastructure. BMW proposes to include company advertising on the Level 3 charge units. This would need to be reviewed in greater detail in relation to the hardware offered by BMW as compared with emerging plug-in standards as well as the value offered in relation to the City's costs for providing the infrastructure. There may also be other industry sponsors who would be interested in similar opportunities.

Staff recommend reviewing the installation of Level 3 charge stations in further detail, and reporting back to Council. Conceptually, four locations could be considered to introduce Level 3 charging infrastructure. Upon Council endorsement, staff will include a capital submission for consideration as part of the 2017 budget process. As part of this, staff will also be able to review funding and sponsorship opportunities and include this information in a subsequent report.

Review of Limitations/Energy Cost Recovery

The City's Level 2 community charging infrastructure is provided at no cost to users. There are no time limits on the duration electric vehicles can be parked in designated electric vehicle stalls. The only existing limitation is that use of these stalls is limited to electric vehicles only. While consideration could be given to implementing parking restrictions and/or charging a fee for parking/charging, this is not recommended at this time for the following reasons:

a. the accumulated cost of the electricity use to the City is approximately $9,100

b. other public charging infrastructure (provided by the private sector) remains free

c. it is important to encourage broader adoption of electric vehicle technology by continuing to provide free and convenient access

d. existing users of City-provided electric vehicle charge stations are charging 75% of the time they are actively parked and plugged into the station, meaning they are not overextending or taking unfair advantage of the parking opportunity electric vehicle stalls provide

e. there have been minimal complaints regarding use of the electric vehicle parking stalls, therefore corrective action is not required at this time

Staff will continue, however, to review potential introduction of a fee for Level 2 charging as industry trends develop and the electric vehicle market matures.

In relation to Level 3 charge stations, these are projected to be more costly to install and present a considerable convenience for electric vehicle owners due to shorter charge times. For these reasons, staff would expect to recommend a fee be charged for access to Level 3 charging. This

consideration and projected revenue will be included and discussed in a subsequent report on Level 3 charge stations.

Financial Impact

Added capital costs associated with the purchase of electric vehicles as a component of the City's fleet are included in annual capital submissions for fleet vehicle replacements.

Conclusion

The expansion of electric vehicles and/or other fuel-efficient vehicles into the City's fleet will be a necessary aspect of the City's replacement program in order to reduce emissions 20% by 2020. Electric or hybrid vehicles should be given priority consideration for passenger cars as existing vehicles are due for replacement. A tiered approach, with guideline considerations, is recommended.

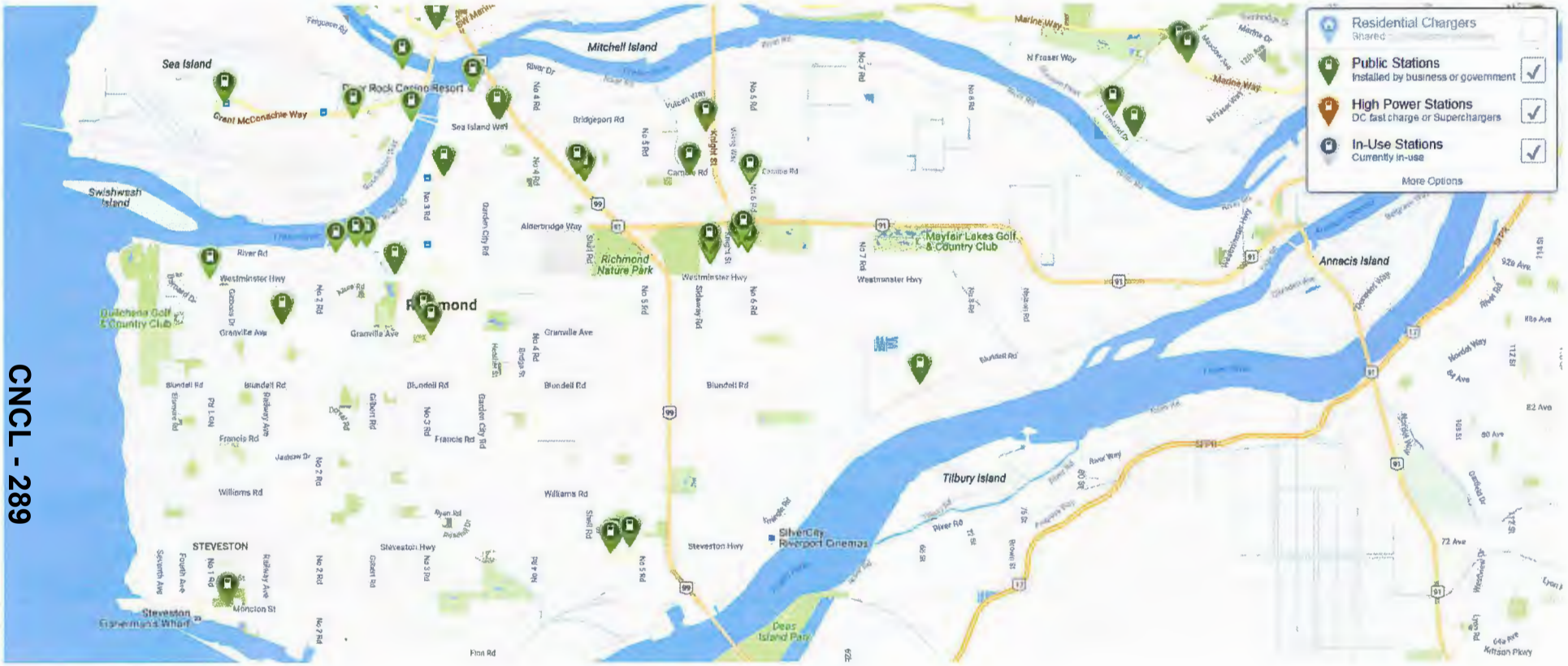
Use of City-provided community electric vehicle charging infrastructure has tripled year over year for the last 3 years and as of September 2016 has exceeded total 2015 usage. There have been a number of private sector public charging stations added in Richmond as well. These are indications that uptake in electric vehicle ownership is increasing. It is recommended the City take additional actions to further promote community electric vehicles as part of the actions outlined in the City's CEEP strategy. This report suggests expanding Level 2 charging infrastructure in association with new construction or major upgrades of City facilities and parks. In addition, staff recommend reporting back on consideration to introduce City-provided Level 3 charging infrastructure at strategic locations that align with high-use transportation corridors.

Suzanne Bycraft
Manager, Fleet and Environmental Programs
(604-233-3338)

SJB:

Att. 1: Publicly Available Electric Vehicle Charging Locations in Richmond

Attachment 1 – Publicly Available Electric Vehicle Charging Locations in Richmond



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