Government of Prince Edward Island

# Prince Edward Island Cell Gap Analysis

## Final Report

# Contents

# 1. Executive Summary

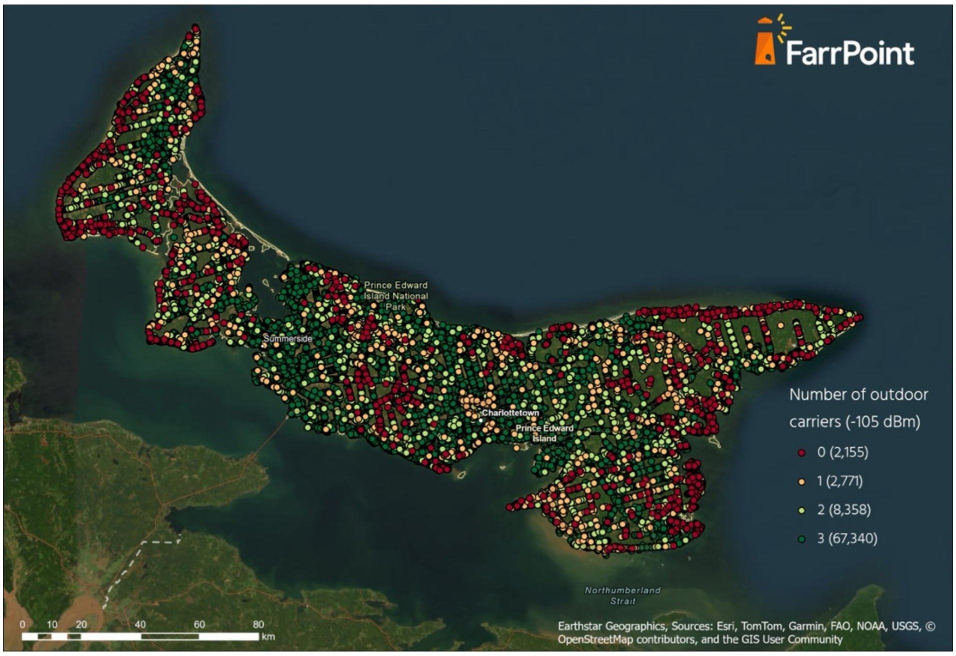
**The Government of Prince Edward Island (GPEI) appointed connectivity consultancy firm FarrPoint to undertake a study to evaluate cellular coverage performance across the province.**

The results from this study provide GPEI with knowledge of the existing cellular performance, the areas of poor coverage, and the scale of capital cost required to improve services through new tower provision.

**The results from the study, which used a mix of desktop and drive surveys, include:**

- Areas of partial and total not-spots (areas with no cell coverage) are spread widely across the province
- The study identified 23 potential new cell tower sites that would give the best coverage of unserved addresses and road networks.
- Capital costs for developing these 23 towers have been estimated at between $14.2m and $21.7m.
- With the 23 new sites, a total of 1,612 of the 2,458 uncovered civic addresses at outdoor levels, and 4,536 out of the 6,974 addresses at indoor level could be covered. In addition, 317km of the 2,210km uncovered roads at in-vehicle levels are covered and 585km at outdoor levels are covered.

The figure below highlights areas with no coverage from any cellular operators in red, one operator - in yellow, and 2 or 3 operators - in green.




*PEI Address Coverage (Outdoor) Map by Number of Cellular Operators*

The study also provides five recommendations for next-step actions, which are detailed in the Conclusions section.

# 2. Introduction

This report presents the results of the Cell Gap Analysis study completed by FarrPoint for the Government of Prince Edward Island (GPEI).

## 2.1 Background

The importance of excellent cell coverage is well understood across the marketplace as being a key enabler for business and social activities, whether that be on the move, at home or in the workplace. Cellular usage is predominantly based on LTE (4G) technology as the current widely available standard. This provides good, responsive speeds which are adequate for the vast majority of use cases and with multiple handsets and packages available to allow widespread adoption.

Coverage is provided across Prince Edward Island (PEI) by the commercial cellular operators Bell, Rogers, and Eastlink through a network of cell towers and roaming agreements. The coverage from these towers depends on technical parameters, including frequency, antenna height and power which can vary by tower location and operator. The performance to the end user is also reliant on the data throughput from these towers, and that again depends on the technical parameters of frequency channel and onward connectivity from the towers into the operators' networks.

Cell towers come in different sizes to serve different environments. The largest and most common are macro sites, which are used by operators to serve larger geographic areas. These are sometimes complemented by micro-cells (or small cells), which are smaller, lower-powered units designed to provide more localised coverage and increase capacity in more densely populated areas.

Tower locations are designed on a cost/benefit basis to provide the maximum return for the operators in terms of subscriber take-up and retention. The effect of this is that in rural areas where subscriber numbers are low, or in hard to serve areas where the cost to provide is high, coverage will be less.

GPEI appointed FarrPoint to undertake a study to map out and measure the cellular connectivity capabilities across the province and identify where improvements could be made.

## 2.2 Approach

The study is based on a combination of desktop analysis, complemented by on the ground measurements and analysis. This is shown in Figure 1.

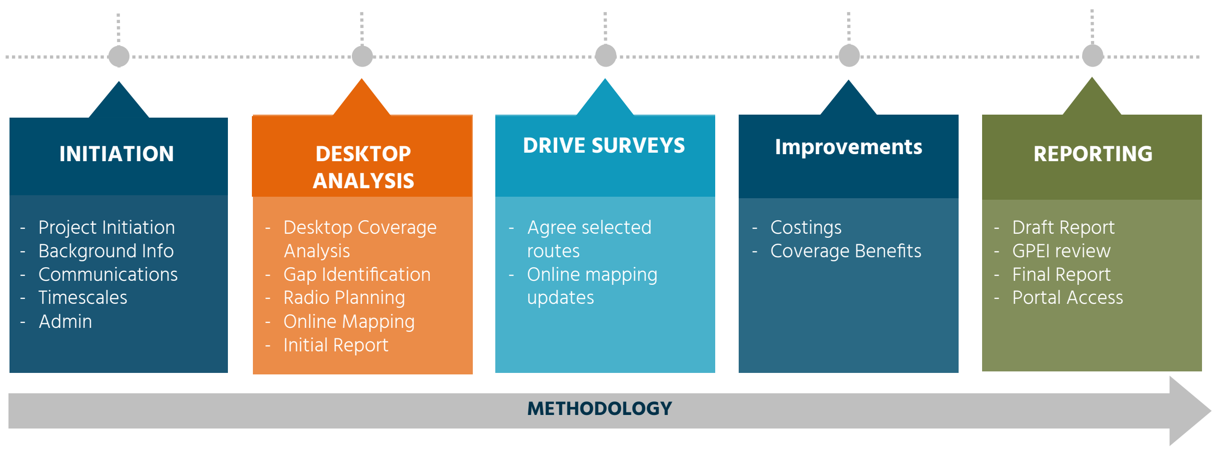



*Figure 1: Project Approach*

## 2.3 Report Structure

Following this introductory section, the remainder of the report is set out as follows:

- Section 2 presents the initial desktop analysis of coverage;
- Section 3 describes the drive surveys undertaken and their input to the analysis;
- Section 4 presents details of the coverage infill solutions and costs;
- Section 5 provides conclusions;
- Appendix A provides a link to the initial Desktop Analysis.

# 3. Initial Results & Analysis

## 3.1 Approach

Desktop analysis was conducted of coverage using available data on tower locations, heights, frequency, channel bandwidth, and power. This detail was sourced from the Government of Canada Spectrum Management System Data and was input into FarrPoint's ATDI HTZ Communications radio planning software to assess potential coverage from each tower.

The results were then input to FarrPoint's online GIS (Geographic Information System) and online mapping portal, together with an overlay of the following data sets:

- Mast/Sector locations (from CRTC);
- Civic Address Data (from GPEI);
- Government Buildings (Geocoded from GPEI data);
- National Road Network (from GPEI);
- Civic Address points (Feb 2022), NBD Pseudo-household points (Feb 2022) and Roads (Feb 2022).

This allowed for the calculation of the number of locations without coverage, the % geographic coverage and % road coverage across the province. The roads are broken down into trunk, collector and local roads[1].

The predicted LTE (4G) coverage from the three operators was overlaid to identify the number of operators present in each location. This was performed at two coverage levels:

- Outdoor Coverage: areas with an RSRP[2] of ⩾ -105dBm;
- Indoor Coverage: areas with an RSRP of ⩾-95dBm.

These thresholds are the minimum levels required to complete a short voice call or to achieve a data download speed of at least 2Mbps.

Note that the outdoor signal thresholds are lower than indoors as signal levels need to be higher within buildings to compensate for attenuation from walls, etc.

Any references to "Coverage" or "No Coverage" in this document refer to these thresholds.

## 3.2 Initial Results

The results are broken down into:

- overall geographic coverage;
- address coverage;
- primary road coverage.

[1] Trunk roads or arterial roads are major intercity routes (Routes 1,2,3,4,142); Collector highways are paved connecting communities; local are paved and unpaved smaller routes around communities

[2] RSRP = Reference Signal Received Power, signal power received at each location

Appendix A provides further examples of the outputs from the desktop analysis report which produce the summary results presented in this section. This summary provides a more accessible and clearer presentation of the findings.

## Geographic Coverage

Figure 2 presents the indoor and outdoor area coverage of the whole province for each operator.

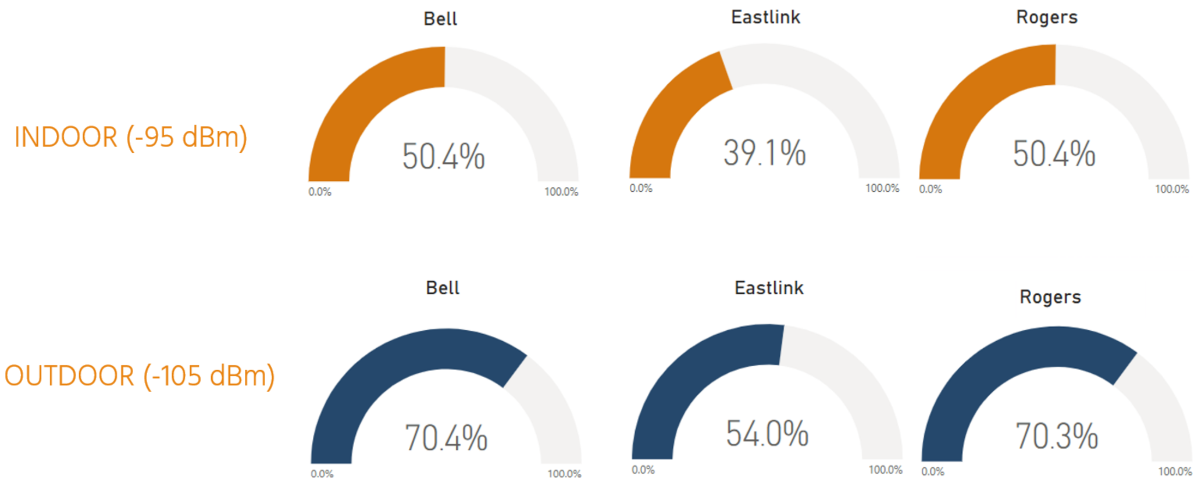



*Figure 2: Geographic Coverage by Operator*

Geographic coverage will include areas with no population and with no road network and so areas of no coverage would be expected. The metrics of address coverage and road coverage are of more interest to support economic and social activity.

## Address Coverage

Figure 3 presents the indoor and outdoor coverage of the total number of civic addresses in the province for each operator. This shows, for example, that Bell covers 78.3% of addresses with indoor coverage compared to Eastlink who cover 67.7%.

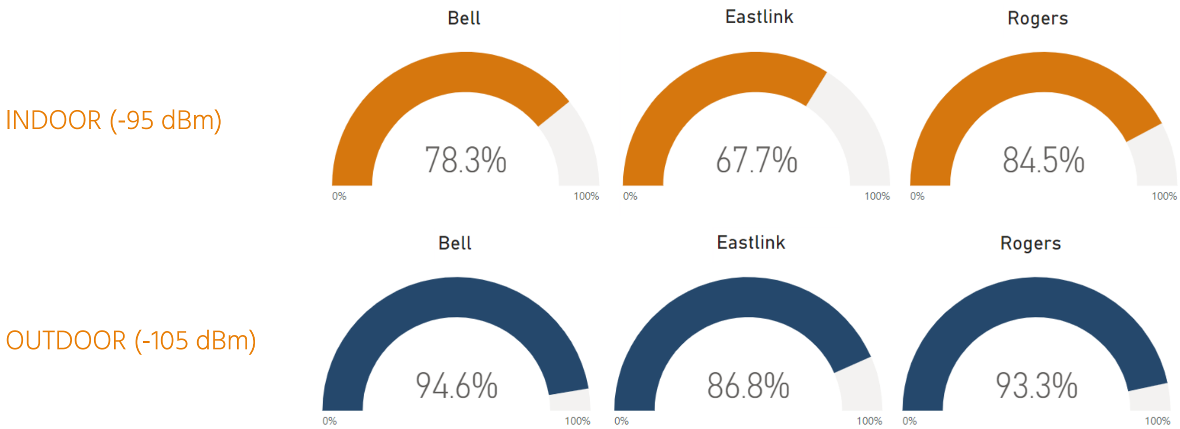



*Figure 3: Address Coverage by Operator*

This is also represented in the mapping portal by the number of civic addresses that can receive service from at least one operator, as shown in Figure 4 for outdoor operations.

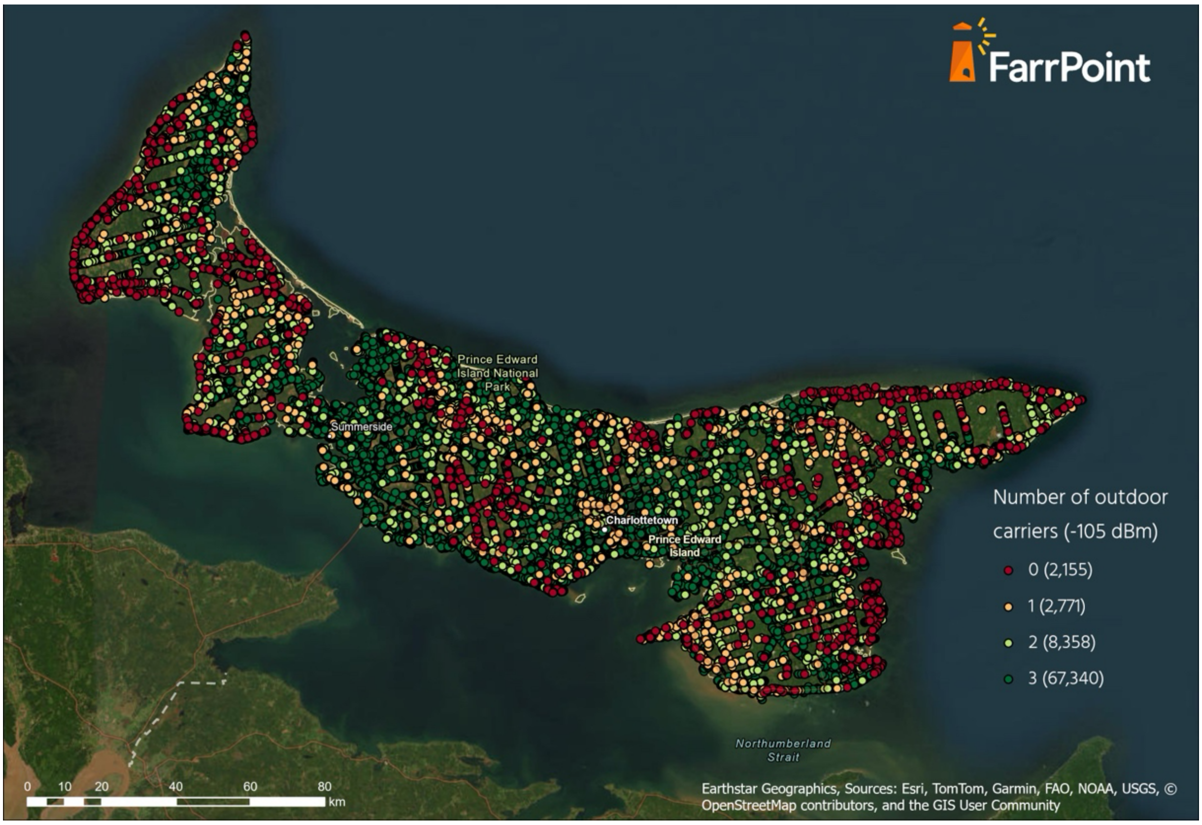



*Figure 4: Address Coverage (Outdoor) Map by Number of Operators*

This shows that properties on the shoreline to the north and east are likely to have no coverage from any operator.

Figure 5 presents the predicted indoor and outdoor coverage by the number of operators, with the no coverage results also broken down by county.

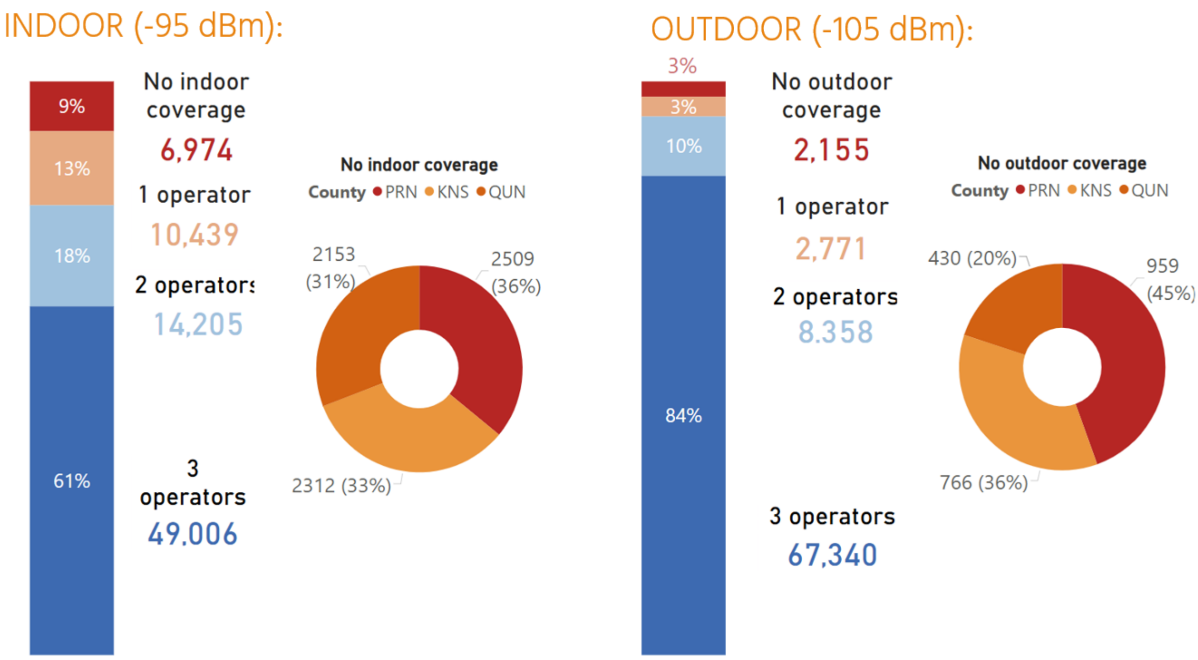



*Figure 5: Address Coverage by Number of Operators*

For example, this shows that there are 6,974 premises with no indoor coverage from any operator, and this is relatively evenly split across the three counties. For outdoor coverage, there are 2,155 premises with no coverage, with nearly half of these in Prince County.

## Road Coverage

Figure 6 presents the indoor and outdoor coverage along the roads of the province for each operator and broken down by road type. This shows, for example, that Bell covers 84.1% of trunk roads for in-vehicle (equivalent to indoor) coverage compared to 67.6% of local roads for the same measure.

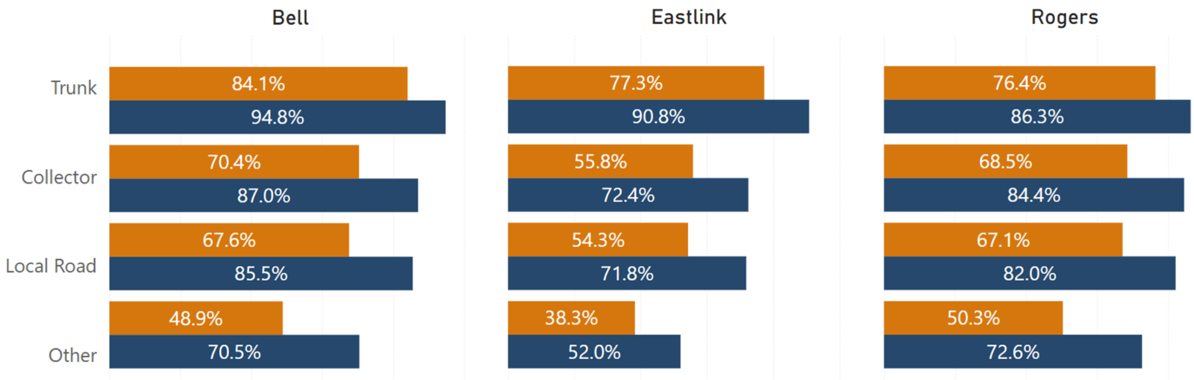



*Figure 6: Road Coverage by Number of Operators and Road Type*

Figure 7 presents the indoor (in-vehicle) and outdoor road coverage by the number of operators, with the no coverage results also broken down by road type.

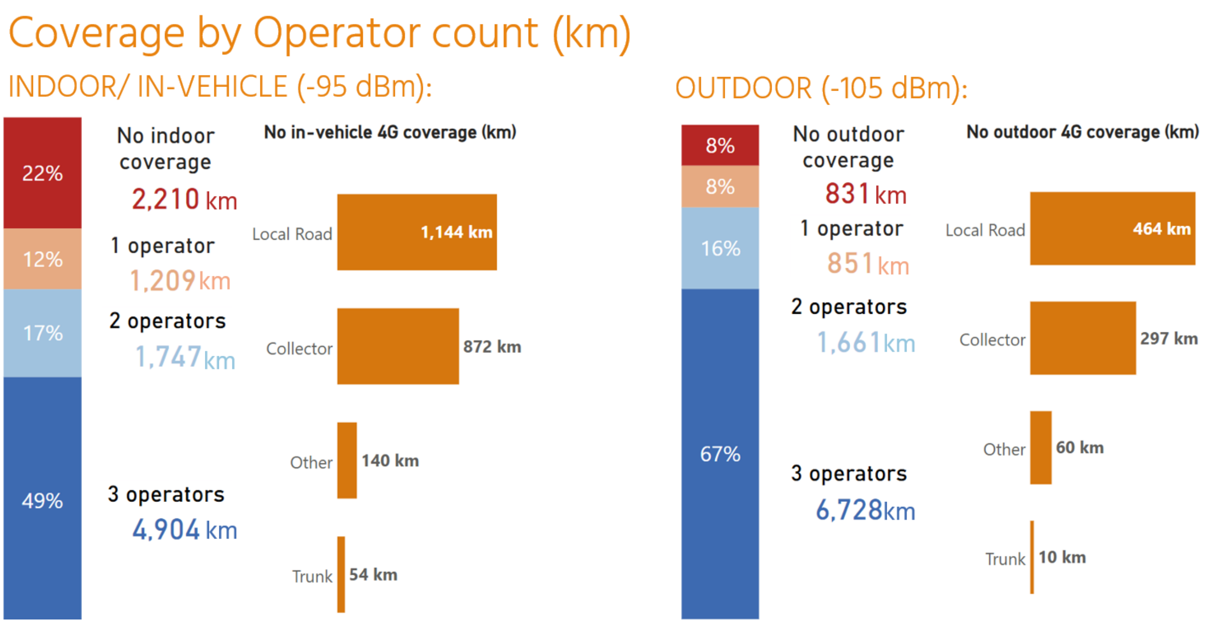



*Figure 7: Road Coverage by Number of Operators*

This shows, for example, that there are 2,210km of roads with no in-vehicle coverage, and 54km of this is on trunk roads.

Figure 8 shows the map of the number of operators for in-vehicle road coverage.

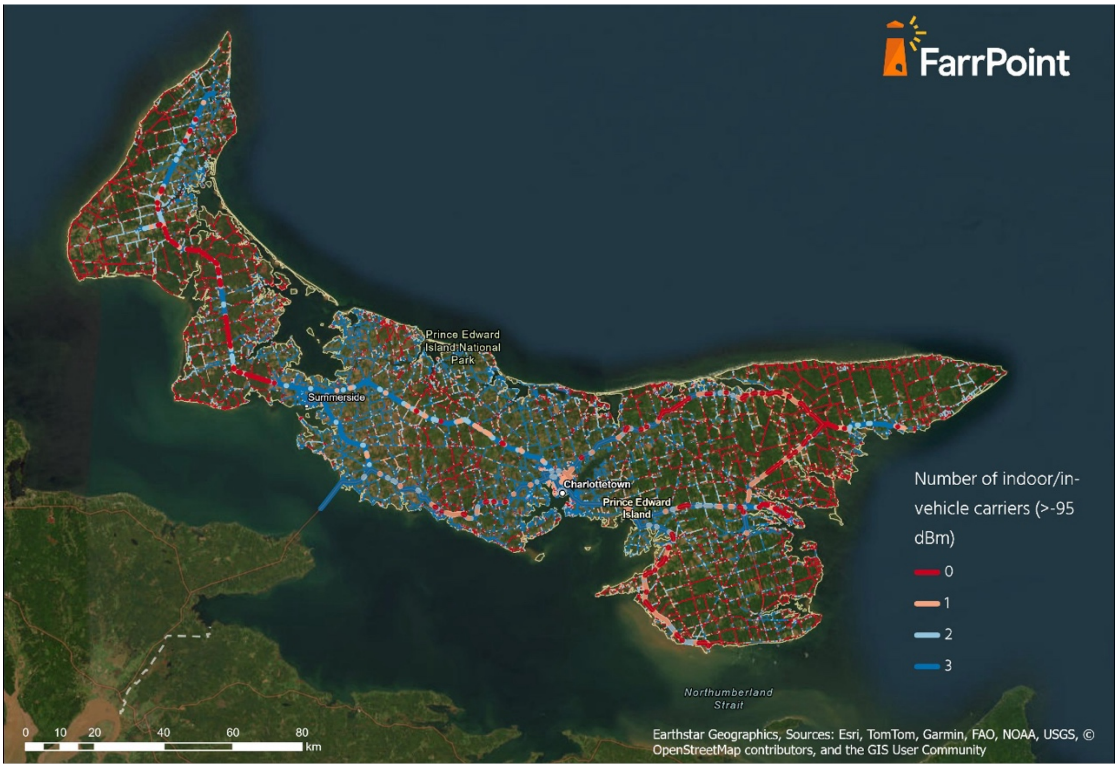



*Figure 8: Road Coverage Map by Number of Operators*

This shows that roads in Prince and Kings counties are more likely to have segments of no in-vehicle coverage.

## 3.3 Government Buildings

GPEI provided FarrPoint with a list of government buildings across the province. This was analysed for coverage from the existing cell operators using the coverage predictions described in this section.

Figure 9 shows the number of operators providing a minimum indoor coverage level of -95dBm to each of the buildings.

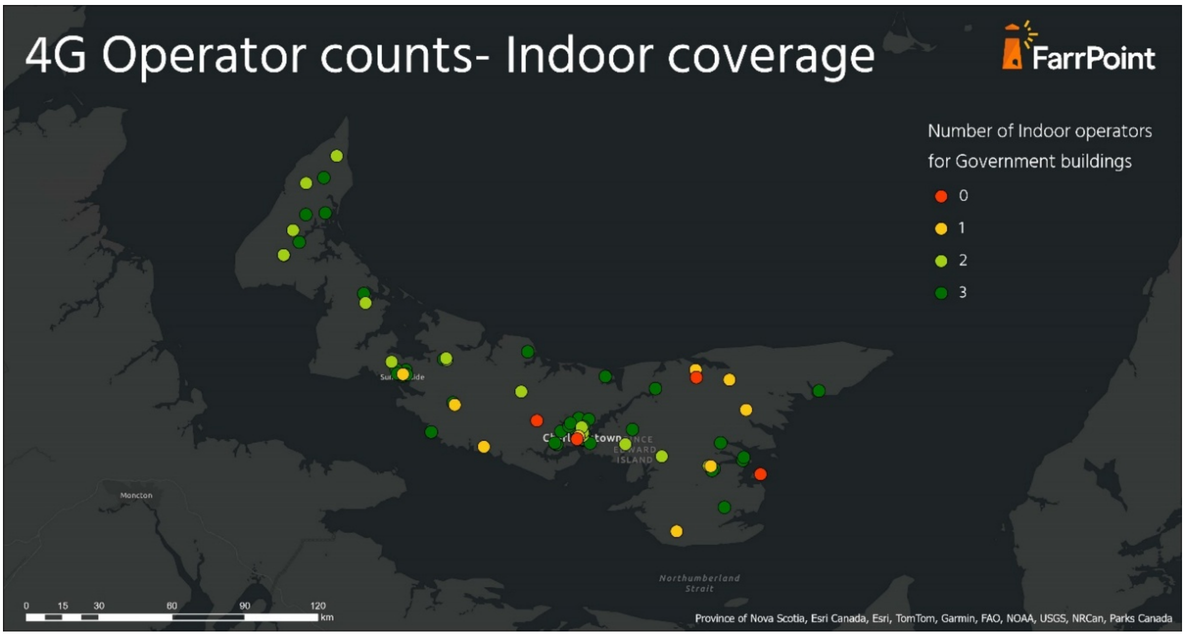



*Figure 9: Predicted Indoor Coverage of Government Buildings*

Figure 10 shows the coverage levels from each operator across the government buildings estate. The graphs also show the coverage levels at the outdoor (-105dBm) level.

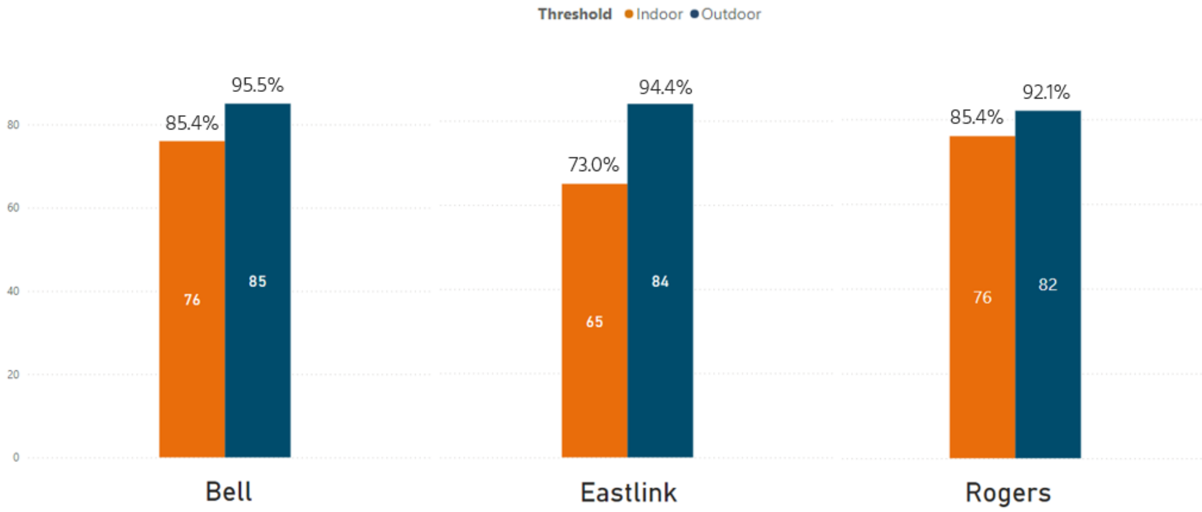



*Figure 10: Predicted Operator Coverage of Government Buildings*

These results show:

- There are **four** government buildings (of 89) with no indoor coverage and **one** with no outdoor coverage;
- **Bell** has the best outdoor coverage of government buildings;
- **Bell and Rogers** have the best indoor coverage of government buildings.

## 3.4 Conclusions

The desktop coverage analysis, based on the existing tower sites across the province, shows a range of civic addresses and road routes with no predicted coverage from any operator. These are predominantly along the coast of Prince County and Kings County, with some additional areas in the centre of Queens County.

The total number of civic addresses with no indoor predicted coverage amounts to 6,974 out of a total 80,624 addresses in the province (8.6%). This drops to 2,155 for outdoor coverage (2.7%). These addresses are dispersed across the province.

It was noted that although Bell has many more cells in the province than Rogers ( ~2800 vs ~830, respectively), Rogers has a generally greater signal penetration in housing areas, as evidenced in Figure 3. It is likely this is in part due to the greater average antenna height deployed by Rogers compared with Bell. Bell has deployed a significant number of cells with low heights of up to 15 metres within close proximity of each other. These microcell sites will greatly improve capacity in dense urban areas. Rogers has deployed a greater number of macro sites on tall structures compared with Bell, and this may contribute to improved in-building penetration, though capacity may be at a premium by comparison with Bell.

For roads, there are 831km of roads which are not served with outdoor coverage by any operator.

# 4. Drive Surveys

## 4.1 Approach

To complement the desktop prediction analysis, drive surveys were carried out by GPEI staff using FarrPoint's cellular coverage equipment installed on vehicles driven on chosen routes. This equipment automatically measures the strength of all cellular operators as the vehicle is driven and transfers the data to the FarrPoint mapping portal. The routes driven total approximately 3,300km and are shown in Figure 11.


*Figure 11: Drive Survey Routes*

# 4.3 Drive Results

## Coverage

The drive survey results were uploaded to the online portal. This is shown in Figure 12 in terms of the number of operators offering 4G indoors/in-vehicle at each measuring point.

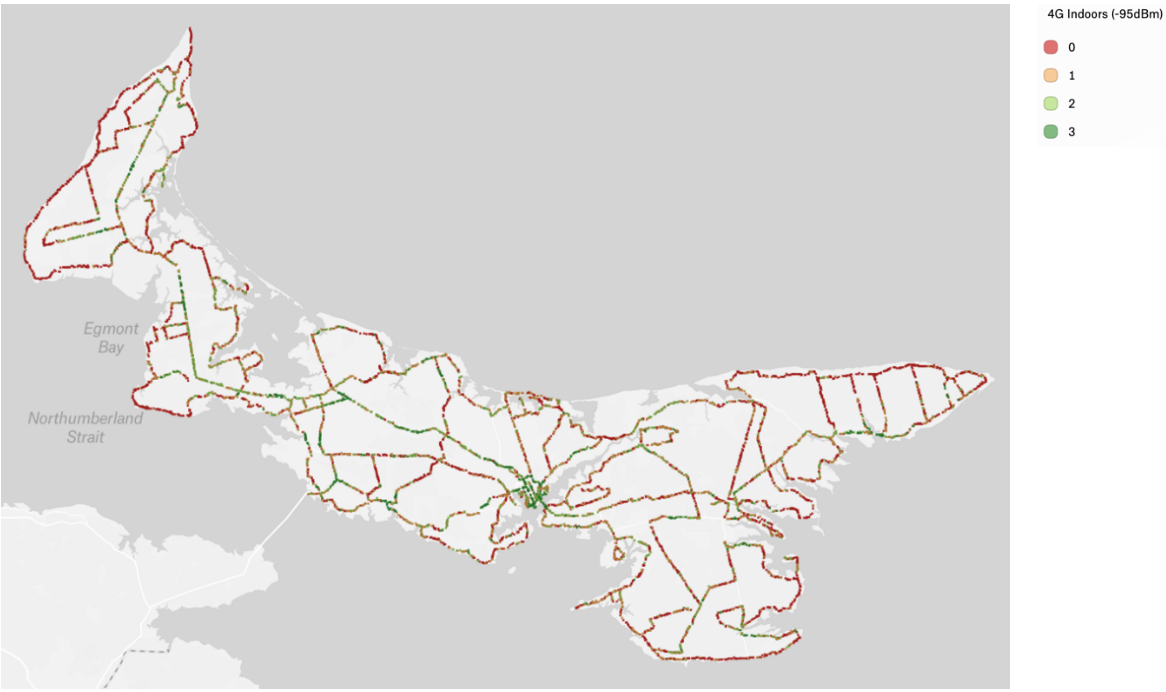



*Figure 12: Drive Survey Results – Operator Count (Indoor / In-Vehicle Coverage)*

## Speed Tests

The survey units perform tests on each cell site as the routes are driven, with the results provided as a layer on the online portal to which the GPEI team has access. The results for each operator are shown below:

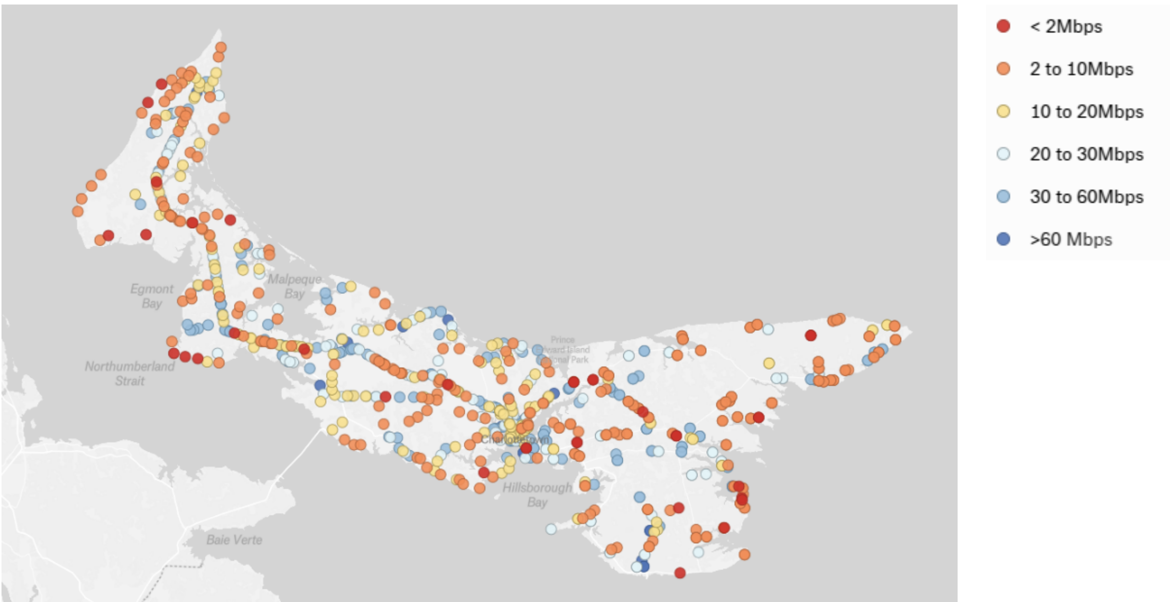



*Figure 13: Download Speed Test Results - Bell*

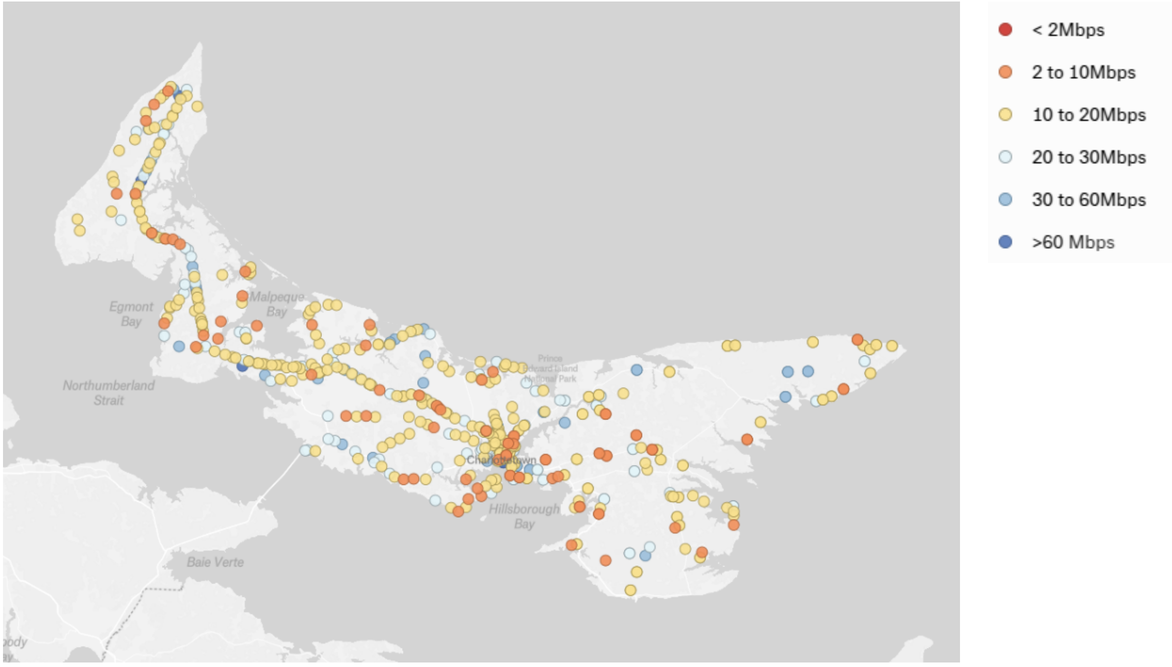



*Figure 14: Download Speed Test Results - Rogers*

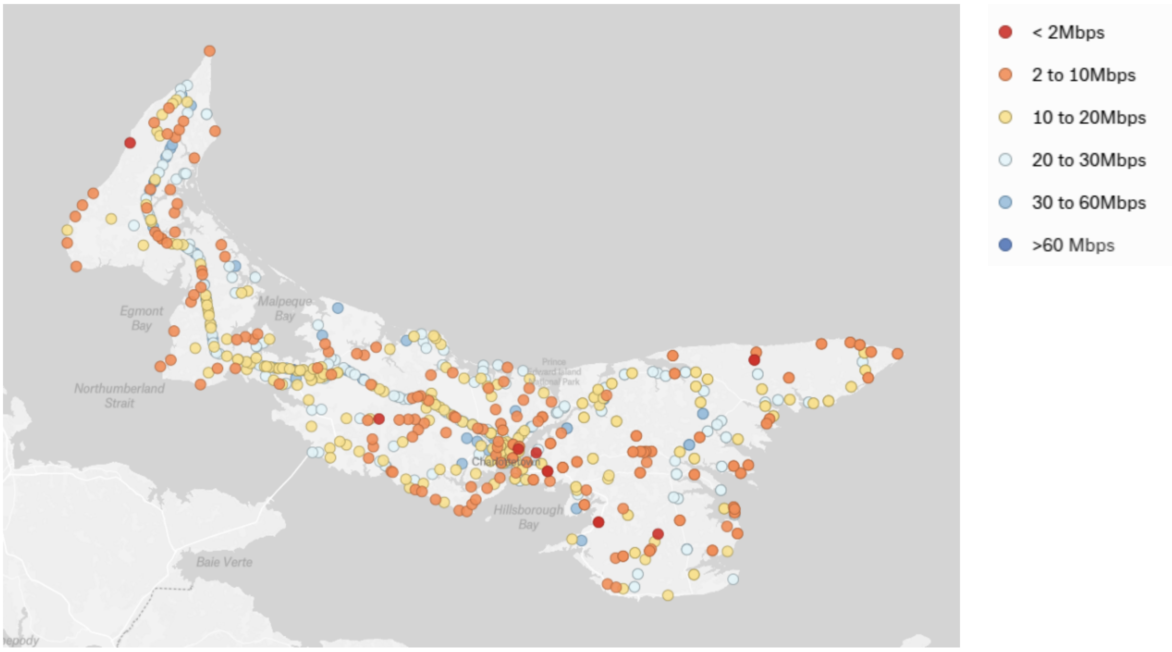



*Figure 15: Download Speed Test Results - Eastlink*

A comparison of the maximum and average upload and download speeds across the three operators is shown below:

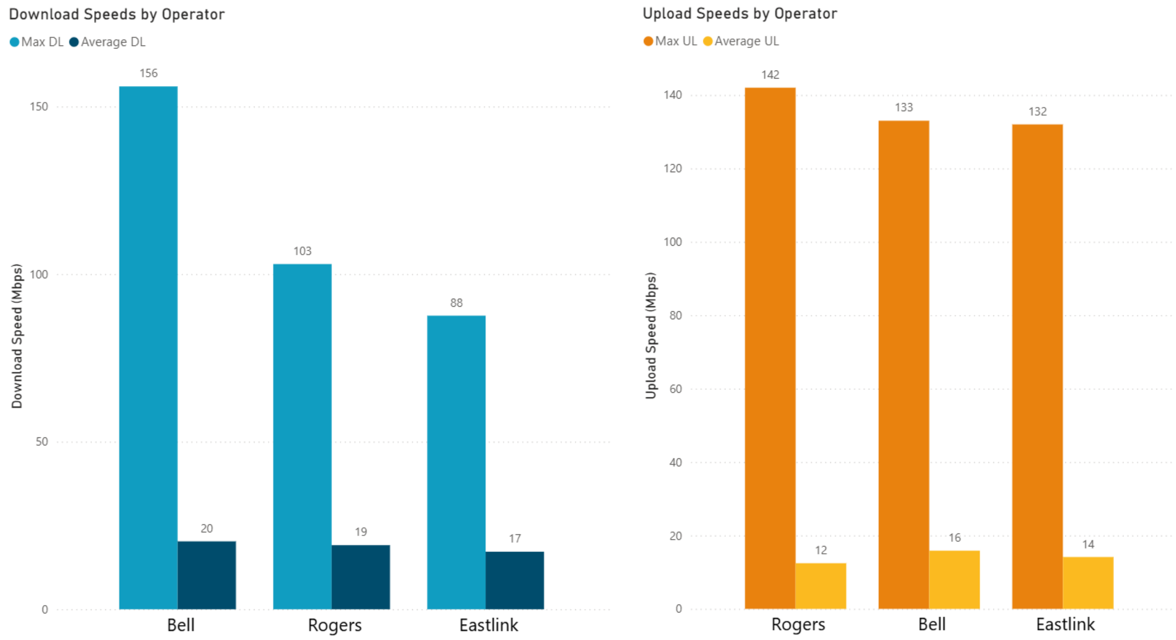



*Figure 16: Comparison of Speed Test Results by Operator (DL = Download, UL = Upload)*

In more detail, the spread of results for each operator is shown below:

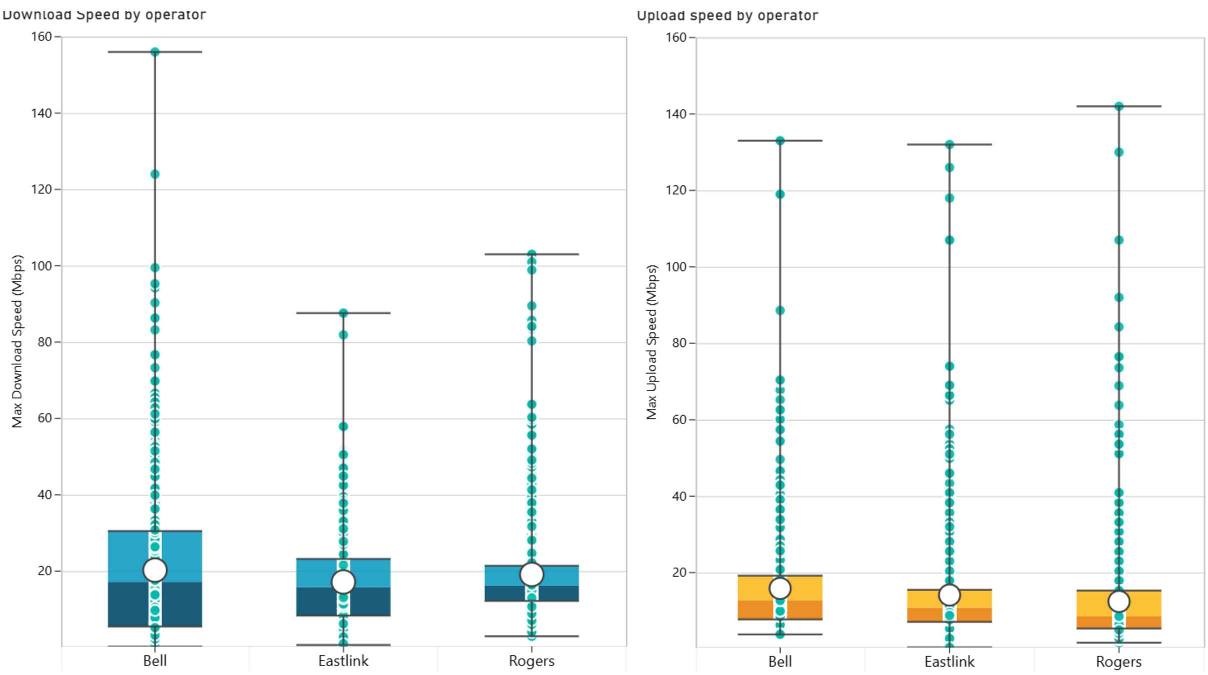



*Figure 17: Spread of Speed Test Results by Operator*

These performance tests were completed at different times and in different locations and so represent a snapshot of the potential user experiences for each operator. Within Charlottetown, for example, download speeds for Bell are generally higher than for Rogers or Eastlink due to the greater number of infill microcells that Bell deploy.

Across the results, there is generally decent performance, with some examples of low download speeds, potentially due to congestion at the time of the test. The results show that no network has any serious and consistent issues with download speeds.

## 4.4 Conclusions

A combination of the drive survey results and the predicted coverage data were used to identify road sections with no coverage. If the predicted data showed coverage and the drive survey didn't back that up, the area was included in the target for coverage improvements. If the predicted coverage showed no coverage and the drive survey showed it was covered, that section was removed from the target for improvements. This resulted in the addresses with no outdoor coverage rising from 2,155 to 2,458.

**It should be noted that coverage to individual properties and road segments may also vary depending on vegetation, obstruction by buildings, weather conditions, the device used, and other factors.**

The combined results of the drive surveys and desktop modelling show the following indoor/in-vehicle coverage.

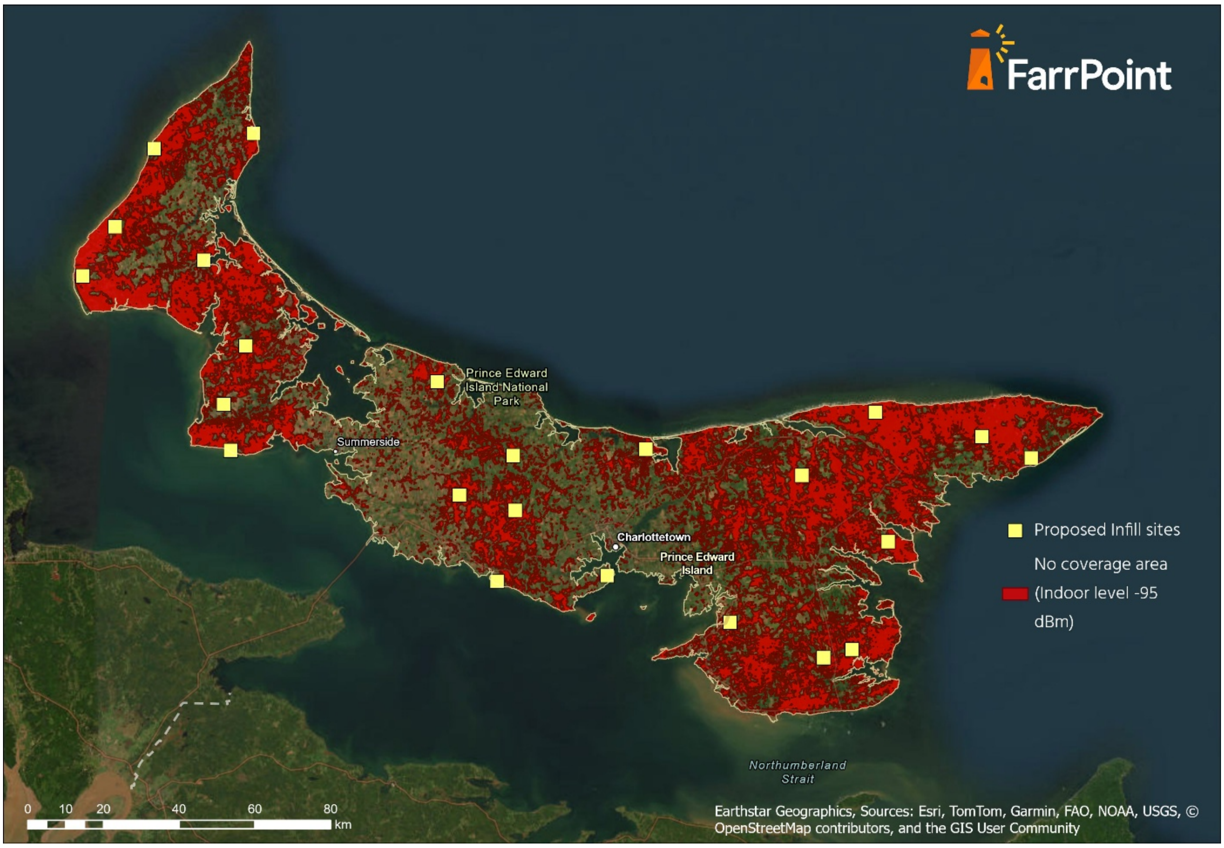



*Figure 18: Combined Drive Survey and Desktop Modelling Results. Areas of No Coverage*

# 5. Improvement Options

## 5.1 Introduction

The analysis has shown a number of areas of poor coverage across the province. This can take the form of 'total not-spots' where there is no coverage from any operator or 'partial not-spots' where there is coverage from at least one operator but not all three. To a customer of one of these absent operators, this location would also be seen as a total not-spot.

To address these poor coverage areas, and specifically the total not-spots, potential new infill sites were investigated to determine which locations will provide the most improvement in terms of increased coverage.

## 5.2 User Performance

User performance is affected by a number of parameters. Firstly, the user must have coverage of a cell signal for the cell phone to register with the network and be capable of sending and receiving information. Cell coverage is provided from the network of cell towers, with the strength of the signal reducing with distance from the cell tower. At the very edge of the cell, coverage becomes marginal, so there can be instances where the user may notice intermittent coverage. In general, however, cell coverage is present to different strengths (coverage bars on the phone) or not available, i.e. a no-spot.

Coverage from towers is provisioned through directional sectors with antennas pointing to where coverage is needed. Often, this is provided using three 120° directional antennas giving a circle of coverage emanating from the tower. However, towers may have different arrangements depending on their location and may be more directional if, for example, coverage is required to the front of the tower but not the back.

With coverage in place, the cell tower must have sufficient capacity to handle the users connected to each individual sector, and then back through the connection from the tower to the operator's network. Depending on the number of users connected at a specific location, a user may see full coverage on their phone but be unable to make a connection as there is no capacity available at that time. This capacity fluctuates depending on the number of users in the area, but the coverage does not. As a result, performance tests to measure download speeds, for example, are snapshots in time and do not guarantee the same results will be obtained on a later test.

## 5.3 Coverage & Capacity

There are a number of options which could be implemented to improve user performance. We split these into coverage and capacity.

### Coverage

Coverage improvements can be made through the provision of new cell towers or in some cases through technical adjustments to existing sites. These changes may be around alterations to antenna positioning, power levels or frequency use. This is in the domain of the cell operators who can review these parameters if there is particular demand for coverage in an area, but improvements are often marginal.

New cell towers require significant investment and take time to deliver. These are split into macro sites, which are larger towers serving a wider geography, and small cells, which can be rooftop mounted or located on street furniture to provide more localised coverage, normally in an urban environment.

New tower locations were determined using FarrPoint's HTZ Communications radio planning software, which was programmed to determine the best location of towers to cover the most unserved addresses. Radio propagation models were developed to then provide coverage predictions from these new locations. The tower parameters used were similar to neighbouring towers in terms of frequency and channel bandwidth, with height and power being optimised for each location.

The planning software will continue to identify new tower sites until all unserved addresses are connected, even if that means the last few towers only have one or two subscribers, which is clearly uneconomic. A threshold is needed, and in this case, 20 connected subscribers were used as the point at which the software will stop identifying further new tower sites.

Figure 19 shows the results of this infill analysis and the predicted coverage from the 23 new tower locations.

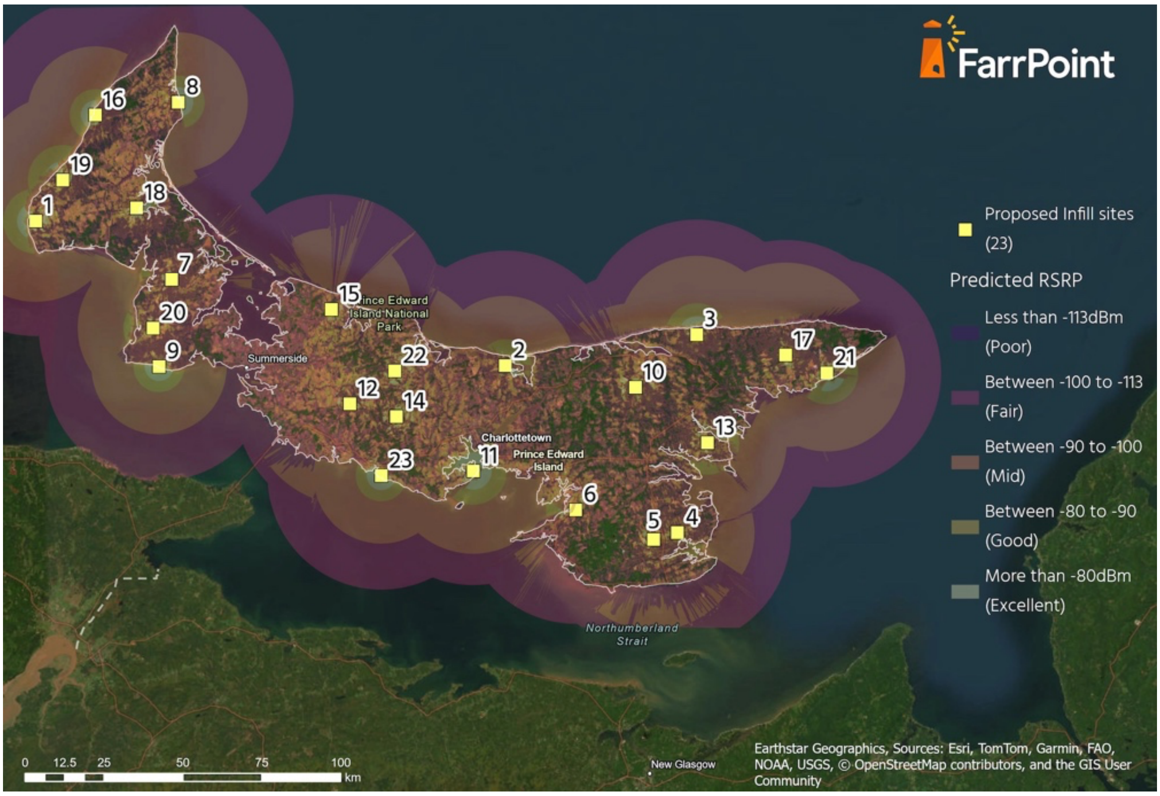



*Figure 19: Infill Analysis Results – New Tower Locations and Predicted Coverage*

## Capacity

Responsibility for capacity improvements rests with the cell operators as capacity is determined by the design and dimensioning of their cell network. User experience reporting can demonstrate to operators that their service is not meeting customer needs.

Where there are identified areas of regular capacity constraint, such as urban centres for example, public bodies such as the GPEI can support improvements by working with operators to help them deploy additional infill cell sites. These 'small cells' can be located in more locations than the larger 'macro towers', for example roof tops and street furniture, increasing capacity in very local areas.

### Approach

Options to improve coverage are through the deployment of new macro towers to serve the coverage gaps identified in the desktop modelling and the drive surveys. Macro towers are the most appropriate option outside of urban centres as they provide large areas of coverage.

## 5.4 Unit Costs

Budgetary capital costs for new tower locations have been developed based on the following cost elements:

- Tower structure;
- Land cost;
- Tower build;
- Planning and Project Management;
- Access cost and power provision;
- Backhaul provision;
- LTE equipment.

The capital costs provide an indication of the scale of investment required at each new tower location. The allocation of costs between government subsidy and commercial operator is not made and would be subject to the design of any intervention that may be planned.

This gives a budgetary cost of $617,500 - $945,000 per tower, varying with the exact nature of each site location and requirement.

Note that these costs are for macro sites, which are the most appropriate for more rural locations outside inner urban areas. For comparison, the capital costs for small cell solutions will be budgetary ~$100k-$150k.

## 5.5 Impact

The potential new tower locations are shown below, ordered by the number of unserved addresses that they cover, as follows:

| Ref | Site ID | Location | Connected Addresses |
|---|---|---|---|
| 1 | 1 | West Cape | 204 |
| 2 | 16 | Miminegash | 199 |
| 3 | 19 | Glengary | 180 |
| 4 | 13 | St. Georges | 164 |
| 5 | 4 | Peter's Road | 159 |
| 6 | 5 | Alliston | 137 |
| 7 | 3 | Goose River | 125 |
| 8 | 9 | Mt. Carmel | 115 |
| 9 | 8 | Kildare Capes | 104 |
| 10 | 14 | North Wiltshire | 96 |
| 11 | 20 | Urbainville | 85 |
| 12 | 17 | New Harmony | 84 |
| 13 | 21 | Munn's Road | 66 |
| 14 | 18 | Roxbury | 64 |
| 15 | 15 | Long River | 59 |
| 16 | 12 | Rose Valley | 55 |
| 17 | 7 | Port Hill Station | 49 |
| 18 | 11 | Rocky Point | 49 |
| 19 | 2 | Grand Tracadie | 46 |
| 20 | 10 | Bangor | 31 |
| 21 | 22 | Saint Patricks | 28 |
| 22 | 6 | Lower Newtown | 22 |
| 23 | 23 | DeSable | 14 |

*Table 1: Impact of Potential New Sites – Number of Unserved Addresses Covered*

Some of these sites also cover lengths of roads. To evaluate the combined impact of a site on both addresses and road coverage, an overall impact score is calculated using the following weightings:

- Trunk road coverage = 4 x additional Km of coverage offered;
- Collector road = 3 x additional Km of coverage offered;
- Address = 2 x additional addresses covered;
- Local Road = 1 x additional Km of coverage offered.

This gives the following ranking of sites in terms of the combined benefits across addresses and road networks in the province.

| Ref | Site Id | Location | Total score | Addresses | Trunk Roads (km) | Collector Roads (km) | Local Roads (km) |
|---|---|---|---|---|---|---|---|
| 1 | 16 | Miminegash | 499.4 | 199 | 0 | 30.4 | 10.2 |
| 2 | 1 | West Cape | 437.6 | 204 | 0 | 0 | 29.6 |
| 3 | 13 | St. Georges | 423.5 | 164 | 0.4 | 16.9 | 43.2 |
| 4 | 4 | Peter's Road | 403.6 | 159 | 0.1 | 20.8 | 22.8 |
| 5 | 19 | Glengary | 386.6 | 180 | 0 | 0 | 26.6 |
| 6 | 5 | Alliston | 356.6 | 137 | 0.2 | 20.8 | 19.4 |
| 7 | 3 | Goose River | 344.8 | 125 | 1.1 | 15.2 | 44.8 |
| 8 | 17 | New Harmony | 265.6 | 84 | 0 | 20.4 | 36.4 |
| 9 | 9 | Mt. Carmel | 245.8 | 115 | 0 | 0 | 15.8 |
| 10 | 8 | Kildare Capes | 243.5 | 104 | 0.2 | 6.7 | 14.6 |
| 11 | 14 | North Wiltshire | 203.9 | 96 | 0 | 0 | 11.9 |
| 12 | 20 | Urbainville | 196.3 | 85 | 0 | 0 | 26.3 |
| 13 | 18 | Roxbury | 184.6 | 64 | 0 | 9 | 29.6 |
| 14 | 21 | Munn's Road | 146.9 | 66 | 0 | 0 | 14.9 |
| 15 | 7 | Port Hill Station | 135.2 | 49 | 0 | 0 | 37.2 |
| 16 | 15 | Long River | 124.5 | 59 | 0 | 0 | 6.5 |
| 17 | 10 | Bangor | 113.6 | 31 | 0.2 | 9 | 23.8 |
| 18 | 12 | Rose Valley | 113.4 | 55 | 0 | 0 | 3.4 |
| 19 | 11 | Rocky Point | 111.6 | 49 | 0 | 2.4 | 6.4 |
| 20 | 2 | Grand Tracadie | 105.5 | 46 | 0.2 | 1.2 | 9.1 |
| 21 | 6 | Lower Newtown | 62 | 22 | 1.4 | 3 | 3.4 |
| 22 | 22 | Saint Patricks | 58.8 | 28 | 0 | 0 | 2.8 |
| 23 | 23 | DeSable | 30.3 | 14 | 0 | 0 | 2.3 |
| | | | **Totals** | **2135** | **3.8** | **155.8** | **441** |

*Table 2: Impact of Potential New Sites – Combined Impact Based on Addresses and Roads Covered*

This table shows the effect of each individual site. As some sites overlap each other in terms of coverage, when this duplication is removed, the total improvement from all 23 sites is coverage to 1,612 of the 2,458 addresses with no outdoor coverage and 317km of the 2,210km of roads. Note that for outdoor road coverage, these 23 sites give a combined coverage of 585km of coverage.

## 5.6 Total Costs

The capital costs for these 23 sites are estimated at between **$14.2m and $21.7m**. This reduces to between **$12.4m - $19m** for the top 20 sites.

## 5.7 Improvements Results

### Address Coverage

Figure 20 shows the predicted address coverage from the existing cell towers. Figure 21 shows the improved coverage with the inclusion of the 23 new sites.

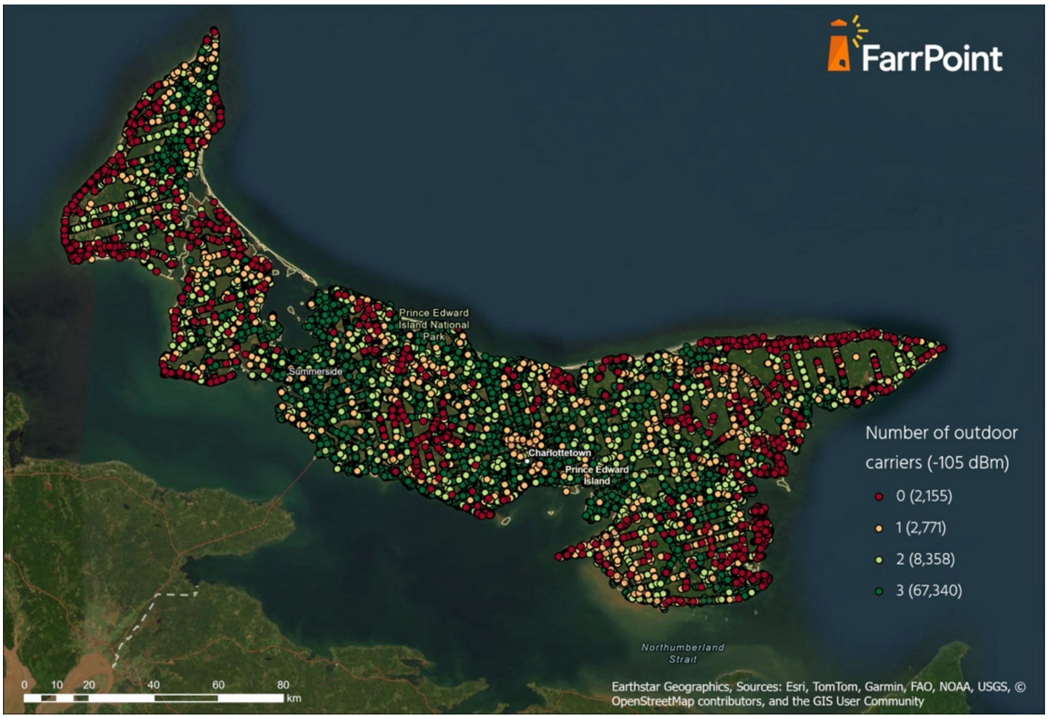



*Figure 20: Address Coverage From Existing Cell Sites*

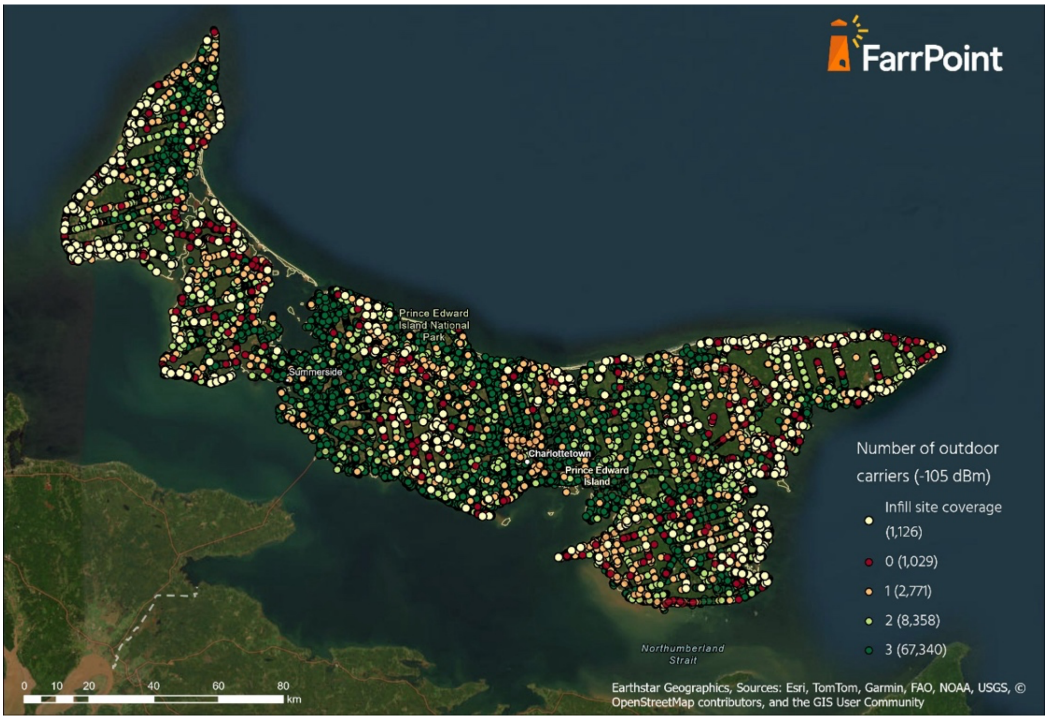



*Figure 21: Improved Address Coverage - 23 Additional Cell Sites*

## Road Coverage

Figure 22 shows the initial predicted road coverage.  Figure 23 shows the additional coverage with the inclusion of the 23 new sites.

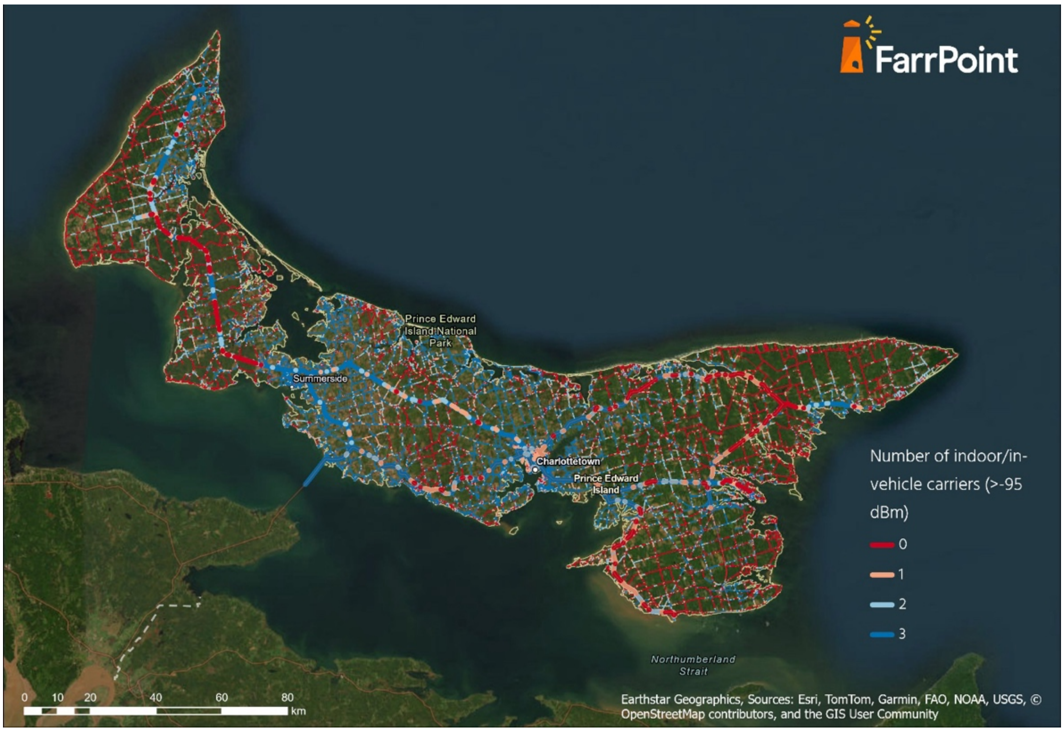



*Figure 22: Road Coverage from Existing Cell Sites*

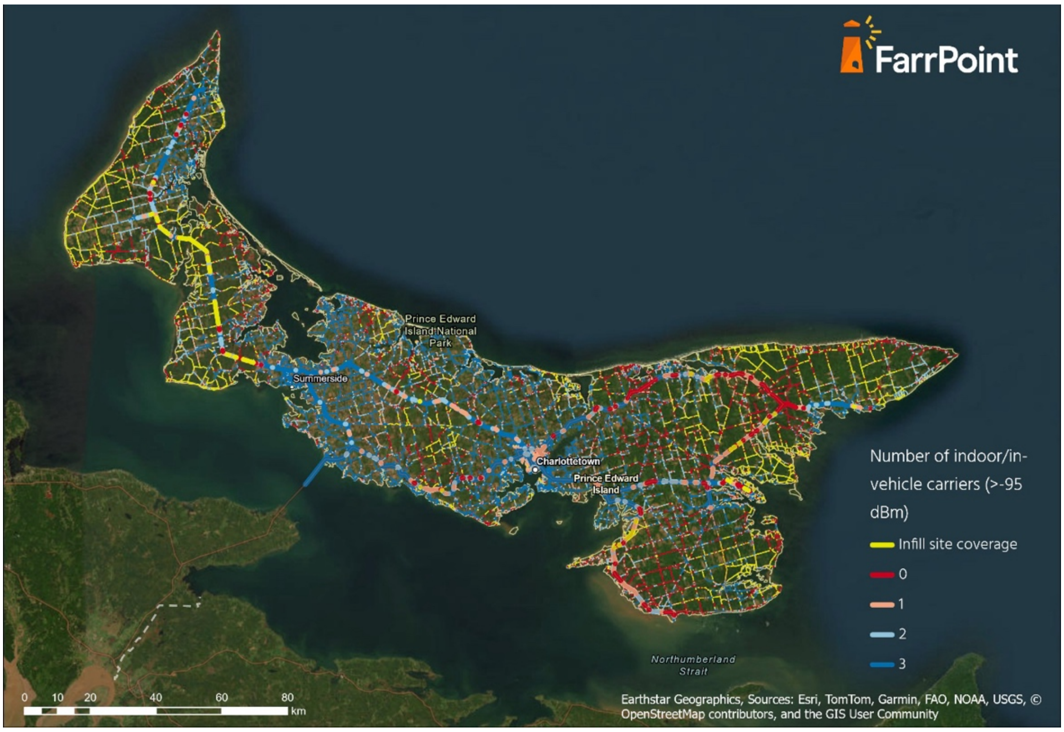



*Figure 23: Improved Road Coverage  - 23 Additional Cell Sites*

## 5.8 Future Considerations

The solution to improving service is limited to what the operators will provide through their public networks. Private networks, for example, are not considered potential solutions as they are more suited to industrial sites with specific use cases and closed user groups.

Small cells complement macro tower installations and can be deployed at lower cost, but their use will depend on operator support and their integration into the operator network.

Public assets, such as the Government buildings identified in Section 3.3, could be offered to operators as potential locations for towers, either macro or small cells, as part of an intervention project.

A small cell installation on such a building could provide better coverage to the building and also extend coverage to the nearby area. Further analysis would be required to determine the suitability of the sites in terms of potential coverage, power availability, access conditions etc. If an intervention project is initiated, we suggest GPEI conduct a suitability assessment of the sites and those that pass are offered as potential sites for operators to consider.

It should be noted that 100% geographic coverage, road coverage, or address coverage is not a realistic target for operators through terrestrial infrastructure. There will always be areas where investment is not justified. The case can be improved with an intervention by lowering barriers through, e.g., capital funding, provision of sites, power, land, etc., but there will still be pockets of no coverage remaining.

It is important to consider the economic and social impact of these remaining areas to determine if more needs to be done. In some cases, no coverage may be acceptable.

Where coverage is needed and justified, and terrestrial infrastructure cannot be provided through all the means described above, developments in Direct-to-Device (D2D) technology could provide a level of service sufficient for some use cases. This is a complementary technology using Low Earth Orbit (LEO) satellites to connect directly to the handset without the need for traditional macro or small sites. It is not a replacement, however, as capacity, performance, and end-user cost are less favourable. It also requires a modern smartphone and will offer text and voice communication as a premium service to those users who wish to subscribe.

Early-stage D2D satellite constellations are currently being launched, and the industry is in the early days of building the scale needed to provide continuous service. Likely timelines before this technology is generally available to consumers are 2027 onwards.

# 6. Conclusions

This study used a mix of desktop analysis and drive surveys to determine the existing cellular coverage across the province. The results show areas of partial and total not-spots, which are spread across the province as measured by address coverage and road coverage.

23 potential new tower sites have been determined that give the best coverage of unserved addresses and road networks.

Costs for the development of these towers have been estimated using industry-standard unit costs. Applying these to the 23 sites gives an estimated capital cost of between $14.2m and $21.7m.

With the 23 new sites, a total of 1,612 of the 2,458 uncovered civic addresses could be covered at outdoor level (846 remaining), as well as 317km of the 2,210km unserved roads for in-vehicle coverage (1,893km remaining), and 585km of the 2,210km at outdoor levels (1,625km remaining).

These results provide GPEI with an understanding of the existing cellular coverage across the province, the areas of poor coverage, and the scale of capital cost required to provide additional coverage.

The recommended next steps are set out below and are centred around market engagement leading up to a potential intervention project.

The business case for delivering new towers, if there are low subscriber numbers, will be hard to justify for the operators. Engagement by GPEI will help confirm this and to what extent the operators will support an intervention. For those locations which cannot be served by new traditional macro towers or reengineering of existing towers and which the province deems important to cover, other solutions will need to be considered. This could include fully funding towers (capex and opex) and direct-to-cell in some cases.

## 6.1 Recommendations

The recommended next steps are:

Recommendation 1: Further analysis should be carried out using local knowledge to determine if the benefit from these tower locations is justified. For example, a tower location may have been identified in this study which local knowledge highlights only provides coverage to vacation homes or very minor roads which may not be a priority for the GPEI. This exercise will provide a final list of potential new tower sites.

Recommendation 2: Site visits should be conducted at each of the final list of potential tower locations. The site visits should determine the site details, potential tower locations, access availability etc. This will provide additional information for future site development considerations.

Recommendation 3: The GPEI should engage with cellular operators to determine the potential for investment to improve coverage. This process could be completed using a Request for Information (RFI) and should highlight the results of this study and the site visits as potential locations for towers. The RFI should request information on operators' current improvement plans, and where gaps remain in investment, the commercial models of interest, budgetary costs and potential timescales if an intervention model was launched.

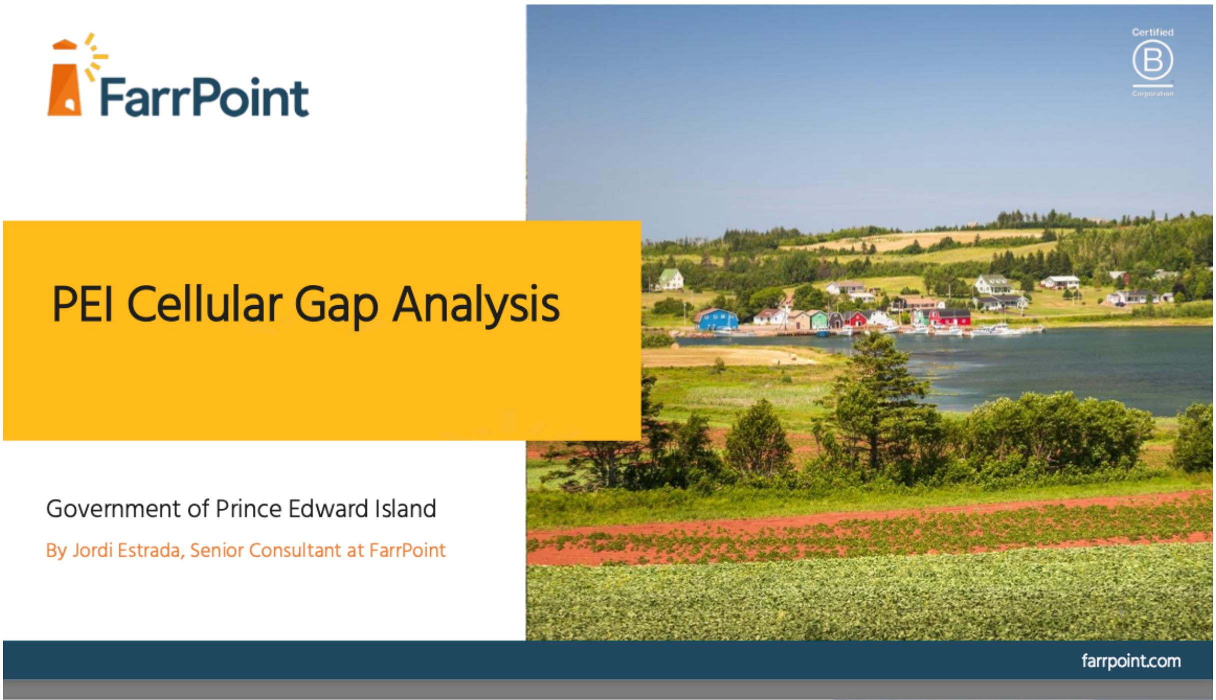
Recommendation 4: Following a review of RFI responses, the GPEI should consider a suitable intervention model which uses the minimum public expenditure to obtain maximum cellular performance benefit. This could take a number of forms, potentially including site acquisition and ownership, tower build and ownership, active equipment provision and ownership and ongoing operation and maintenance. A business case should be developed for funding, and if successful, a cell coverage intervention should commence.

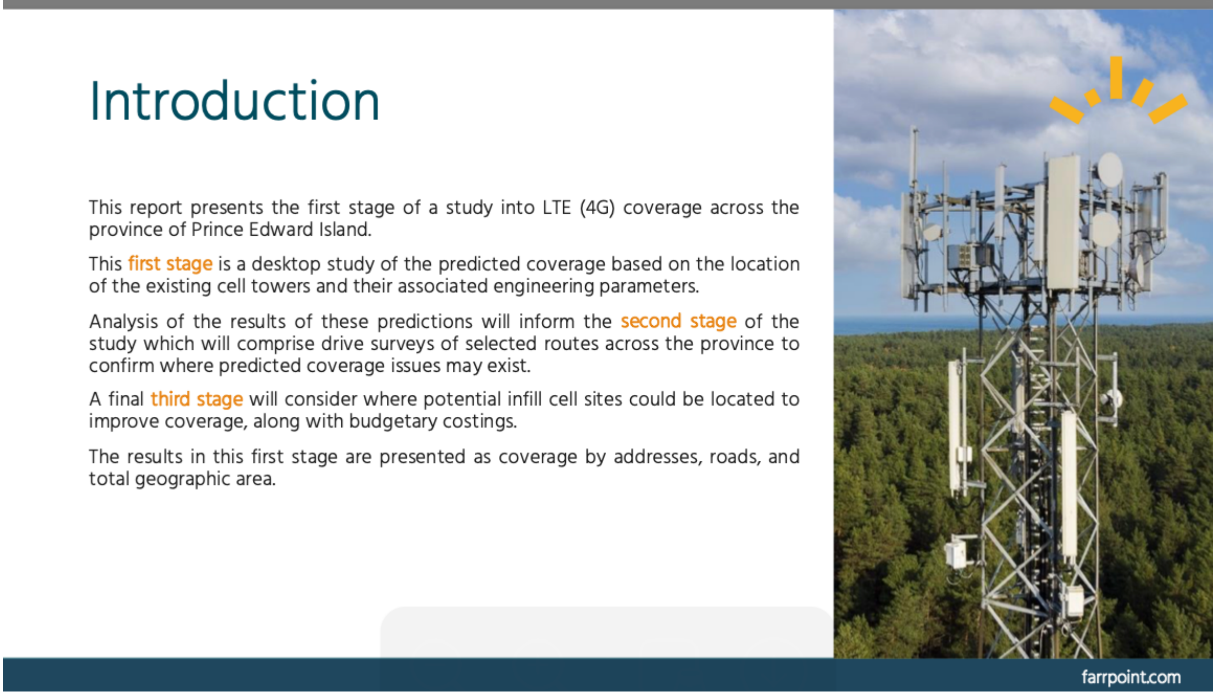
Recommendation 5: To address any areas that require a service post any agreed intervention, GPEI should consider alternative options to serve those addresses or road sections. This is likely to require a number of different solutions on a case-case basis and may include fully funding towers (capex and opex), small cell solutions, Wi-Fi calling if fixed broadband is available, and direct-cell for example. The strategy for these remaining areas can only be determined post-operator engagement.

# Appendix A – Predicted Coverage Modelling

## Predicted Coverage Modelling Report

The FarrPoint-produced report of PEI Cellular Gap Analysis, as referenced in Section 3.2, can be viewed by visiting the link below: https://www.farrpoint.com/uploads/store/mediaupload/1769/file/PEI1D1V1.0-Mobile-Coverage-Analysis.pdf



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