CITY OF NANAIMO
THE HARBOUR CITY

DARKHORSE
ANALYTICS

Nanaimo Fire Rescue: Operations Division

2022 MASTER PLAN

March 2022

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Introduction & Background

Background

Nanaimo Fire Rescue (NFR) engaged Darkhorse Analytics to conduct a comprehensive review of the delivery of fire protection, rescue, and emergency medical services to the community. This report serves as the Nanaimo Fire Rescue Operations Division Master Plan. It provides a review of NFR's current deployment and response effectiveness; future service demand projections, and strategies for service delivery to meet the needs of the community well into the future.

Report Organization

Community Profile
Values at risk, Demographics, Incidents

Fire Service Overview
Finance, Staffing, Services, Training

Industry Standards & Best Practices
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Current State Response Diagnostics
Deployment, Incident Trends, Interval Analysis, First Due Analysis, Effective Response Force

Future Demand Modeling
Community Forecast, Incident Demand Forecast, Scenario's for Intervention

Needs, Themes and Recommendations
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Goals of the report

1. The report provides information about how fire services are provided and how the agency currently operates. The information is presented in accordance with the current industry and provincial standards.
2. This report cites findings and makes recommendations, as appropriate, related to each finding. Findings and recommendations throughout this report are sequentially numbered. A complete list of these findings and recommendations is provided in Part 3.

3. The result is a master plan built on a solid technical foundation upon which to understand the advantages and disadvantages of the choices facing the departments leadership regarding the best way to provide fire services and, more specifically, at what level of desired outcome and expense.

Limitations of the report

1. Each community, through the public policy process, is expected to understand the local fire and non-fire risks and its ability to pay, and then choose its level of fire services. While this report and technical explanations provide a framework for a discussion of how to best enhance response effectiveness in Nanaimo, neither this report nor the Darkhorse team can make the final decisions, nor can they cost out every possible alternative in detail. Once final strategic choices receive policy approval, City and Fire District staff can conduct any final costing and fiscal analyses as typically completed in their normal operating and capital budget preparation cycle.
2. The focus of this Master Plan: Operations Division is an effective response system. This report does not address the pre-incident strategies and tactics to reduce risks in the community. While assessing community risk is a key part of the report, and recognizing that fire prevention and education activities have a positive effect on community risk,

Project Approach

The Darkhorse approach to this Master Plan assessment involved:

- Interviewing City stakeholders to better understand the environment, costs, service levels, history of service level decisions and current deployment methodologies.
- Gathering and reviewing three years of computer-aided dispatch (CAD) and record management system (RMS) data., historical reports, and available risk data, provided by the City
- Utilizing Darkhorse Wrangler to clean and vet CAD and RMS data.
- Developing a community risk assessment based on the CFAI methodology.
- Utilizing analytic tools to review and explore historical incidents and response data.
- Identifying and evaluating future population and development growth.
- Utilizing Darkhorse Deployment to model expected response performance, travel times, and incident volumes.
- Identifying and evaluating potential alternative service delivery models.
- Recommending appropriate response performance goals.

Executive Summary

Darkhorse Analytics was engaged by Nanaimo Fire Rescue (NFR) to conduct a comprehensive review of the delivery of fire protection, rescue, and emergency medical services to the community. This report serves as the culmination of that evaluation and provides a review of each component of NFR as well as details future service demand projections and strategies for service delivery to meet the needs of the community well into the future.

The report begins with an overview and description of the community and the service delivery infrastructure currently utilized by NFR, as well as a summary of management components, finance, policies, and organizational structure. It follows with a detailed analysis of current response times and how they relate to benchmarks.

NFR conducted a Hazard, Risk, and Vulnerability Assessment in 2014. Although many of the hazards remain the same, the growth in the city necessitates an updated community risk assessment. Response performance and effectiveness have degraded over time and there are growing issues around wildland interface and HAZMAT exposure. We recommend that NFR conduct a Community Risk Assessment based on a standard methodology such as CPSE's SOC/CRA or FEMA's THIRA model. This should be tightly integrated with the City's risk and emergency management efforts.

When looking at structure fires in Nanaimo – even assuming a low-risk response – NFR will struggle to field an Effective Response Force in a timely manner without additional resources. Currently, the service aims to respond to structure fires with an effective force of 16 firefighters if available. Although this is possible when all staff are available, 25% of the time, simultaneous calls occur. Furthermore, it is difficult to find sufficient off duty staff to backfill the service during incidents.

Given the growth and nature of structures within Nanaimo, we recommend aligning with the NFPA low hazard target of 17 firefighters with a plan to eventually meet the medium hazard target of 28FF. This Master Plan details a series of changes that will result in the largest possible improvements for the lowest possible cost.

Unit availability is the major issue hindering NFR response performance. To address this, we recommend that NFR staff the two existing rescue units in stations 1 and 2 in the near term. This will deal with the depth of coverage needed in the downtown core and bring the service more in line with its peers. It will improve First Due performance by around 1% and boost low-hazard ERF by over 25% (from 9% to 35%).

Distance issues are the second main issue facing Nanaimo. We recommend the addition of a staffed fifth station to improve both First Due and ERF performance. The optimal location of a new station is along the main transportation corridor midway between stations 1 and 2 (near the intersection of Townsite Rd and Boundary Cr). This will improve First Due performance by around 2.5% and ERF performance by another 13%.

Next, we recommend that NFR add another crew to Station 1. This will improve the ERF performance by another 12.5%, bringing it up to a level where more than half of structure fires can be reached with a low-hazard 17FF contingent. It also sets the stage for NFR to begin effectively dealing with medium hazard incidents that occur in multi-family dwellings and require a much larger response.

Effectively, these three changes allow NFR to address structure fires in the busiest region of the City in a timely manner while also providing some coverage during simultaneous events. Note, unlike most of its peer communities, Nanaimo is impossible to support with mutual aid in a timely manner.

The training centre at its current location is a huge value for the service. It allows on-shift training and contributes to the high standards achieved by NFR. There are some concerns about the smoke generated in live-fire exercises. We recommend that NFR make every effort to allay these concerns short of moving the Centre. This may include alerting people when exercises are planned, adjusting the schedule based on wind direction, or moving entirely to smokeless options such as natural gas.

VIERA is a valuable asset of the department. It contributes to the high level of training and reputation of the service. It also provides a much-needed injection of funding. We believe that continued growth is both possible and desirable, but that the current management structure is straining both VIERA and the department. We recommend that NFR look at options to add dedicated resources and adjust the management structure to facilitate this opportunity.

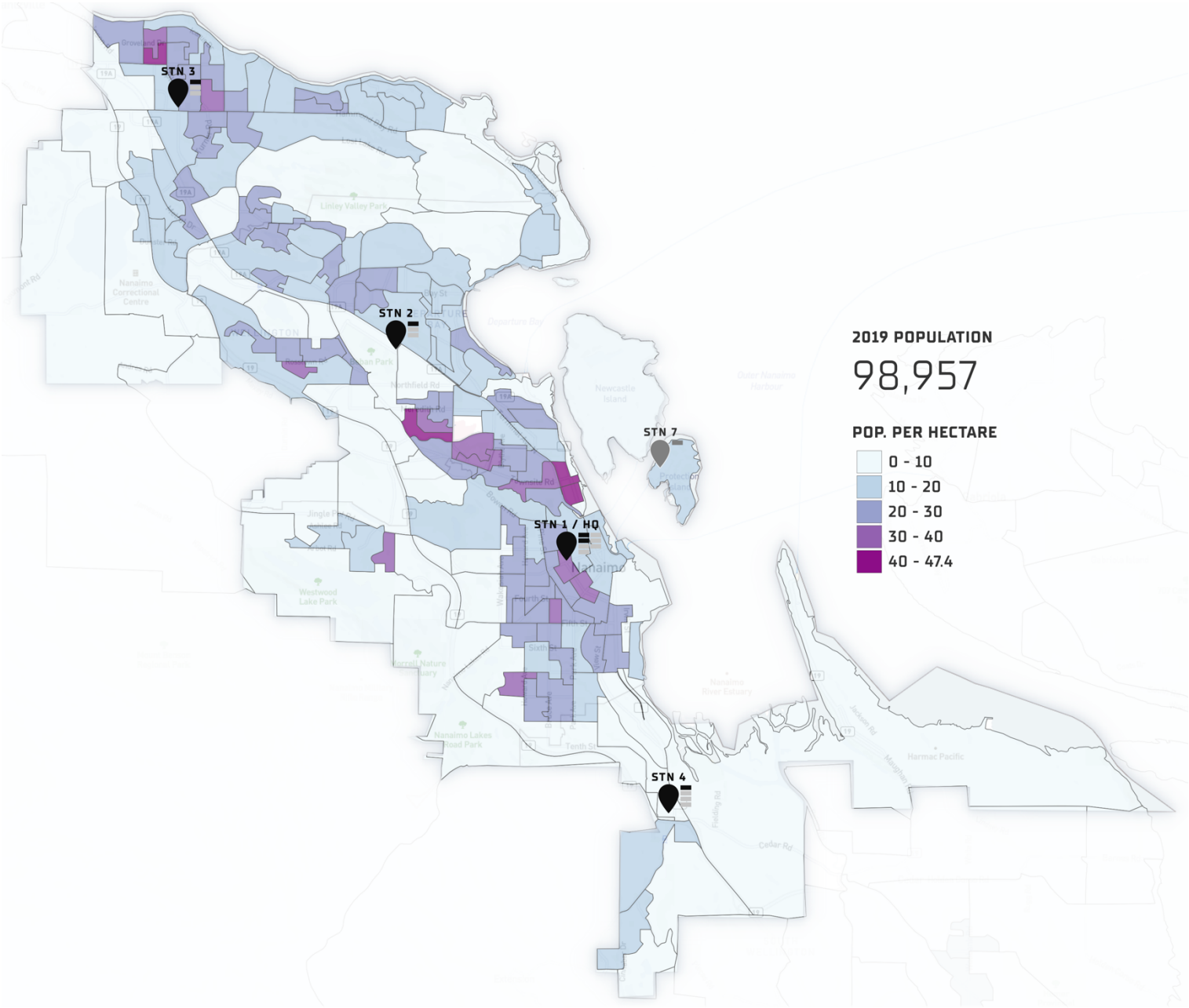
Protection Island faces a diminishing Paid-on-call workforce and a challenge in finding suitable recruits to restock the dwindling pool of volunteers. Although the Island generates fewer than one call per week, new training requirements are onerous on the existing staff. We recommend that NFR consider a phased transition to career firefighters stationed in Nanaimo proper but bolstered with enhanced prevention and mitigation on the Island. Access will also need to be addressed whether through a dedicated boat or other options.


CITY OF NANAIMO
THE HARBOUR CITY

Community Profile

Overview

Nanaimo is a city spanning 90.76 km^2 on the east coast of Vancouver Island in British Columbia, Canada. As referenced in the latest community report; "The economic hub of Central and North Vancouver Island, Nanaimo boasts a vibrant business community and exceptional quality of life."



In February 2021, according to the City of Nanaimo's best estimates, population surpassed 100,000. Incorporated in 1874, and traditionally an economy based around coal mining and forestry, the current economic drivers are technology, provincial government, and tourism.

City Governance

An elected Council composed of a mayor and eight councillors governs the City of Nanaimo. Councillors are elected for four-year terms and each member of Council represents the City at large. Members of the current City Council were elected on October 20, 2018. The Community Charter gives Council the authority to set budgets, levy taxes and establish policies to guide the growth, development, and operation of the City for the benefit and protection of its residents.

Finances

Municipal annual budgets consist of an operating and capital budget. The operating budget plans for the day-to-day costs of providing services to residents and businesses. The capital budget plans for the purchase of municipal assets and infrastructure, such as roads and water lines. Through the budgeting process, municipal administration identifies the source of funding to cover these costs. These funding sources include property taxes, service fees, government grants, financial reserves, or borrowing.

Nanaimo's operating budget in 2019 was $145m, with roughly 12.9% going to the Nanaimo Fire Rescue (including Emergency Management and 911). In 2021, the NFR budget increases slightly to 13.8%.

Strategic Objectives [2019 – 2022]

Nanaimo's 2019 – 2022 strategic plan outlines the vision for Nanaimo:

To be a community that is livable, environmentally sustainable, and full of opportunity for all generations and walks of life.

Four strategic themes were identified and highlighted by Nanaimo City Council as key areas of focus for the duration of their term in office.

- Environmental Responsibility
- Livability
- Economic Health
- Governance Excellence

Values at Risk

Nanaimo Fire & Rescue serves to protect the people, infrastructure, and environment of Nanaimo. The following sections provide an overview of these values.

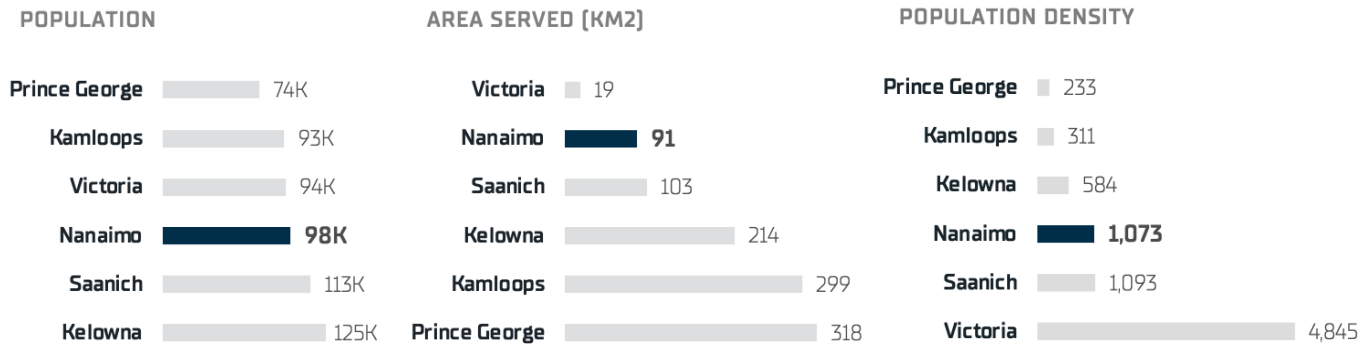
Demographics

The City estimates the 2019 of Nanaimo at 98,957, with an average growth rate of 1.9% per year over the last 10 years. (The 2021 Canada Census reports 99,863 residents in Nanaimo)

2019	Population (estimated)	98,957
2019	Business Licences	6,233
2019	Businesses with Employees	3,977
2019	Service Sector – % of total employment	87%
2019	Goods Sector – % of total employment	13%
2019	Unemployment rate	4.6%
2019	Median household income	$69,492
2019	Per Capita income	$37,509
2019	Education - % with Bachelor level or higher	23.3%

source

Compared to a cohort of similar services, Nanaimo is the third most densely populated city behind Saanich and Victoria. Nanaimo is a community that is mostly urban, while some others have a larger rural component as well.



Just like the rest of BC, Nanaimo is facing broader population-based trends such as an aging population and the impact of the opioid crisis. These trends will impact NFR with an increase in medical emergencies, rising cases in fires due to negligence, and a continued requirement to serve a more vulnerable population.

Land Use and Occupancy Type

In Nanaimo, there are 40,885 private dwellings, 39,165 which are occupied by usual residents (95.8% occupancy rate). The median value of these dwellings is $359,760, which is higher than the national median at $341,556.

2019	Dwellings by Structure – Single Family	25,567
2019	Dwellings by Structure – Multi-family	14,288
2019	Value of Building Permits	$445.3m
2019	Housing Starts	1,259

source

The City had ~30 major project (>$2 million) building permits issued in 2018 and 2019. Many of these are multi-family and multi-story buildings.

Notable higher risk facilities and areas:

- Recycling facility (225 Eaton Street)
- Imperial Oil Terminal (2000 Zorkin Rd)
- Industrial buildings (Pine St., Selby St., and Old Victoria Rd)
- Railway yard (7 Port Drive)
- Wastewater treatment (4600 Hammond Bay)
- Nanaimo Regional General Hospital (1952 Bay Street
- Vancouver Island University (900 Fifth Street),
- Duke Point Industrial area
- Superior Propane (2585 McCullough Road)

In addition to these, Nanaimo boasts several marinas, high-rises, and industrial facilities and is surrounded by wildland interface areas

Transportation Network

Nanaimo is a transportation gateway and a central destination for Vancouver Island. The city is served by two airports: Nanaimo Airport (YCD) and Nanaimo Harbour Water Airport. Nanaimo also has three BC Ferry terminals located at Departure Bay, Duke Point, and downtown. Highways 1, 19 and 19A traverse the city.

The Duke Point Expansion Project will greatly enhance the areas trade capabilities. The increase in construction, buildings, and people will increase the areas risk and likelihood of emergency incidents.

Environment

Nanaimo is a coastal area with no major elevation changes, though the terrain is rolling which contributes to vehicle response time.. It features a significant amount of greenspace and parks, such as the Linley Valley Cottle Lake Park and the Morell Nature Sanctuary

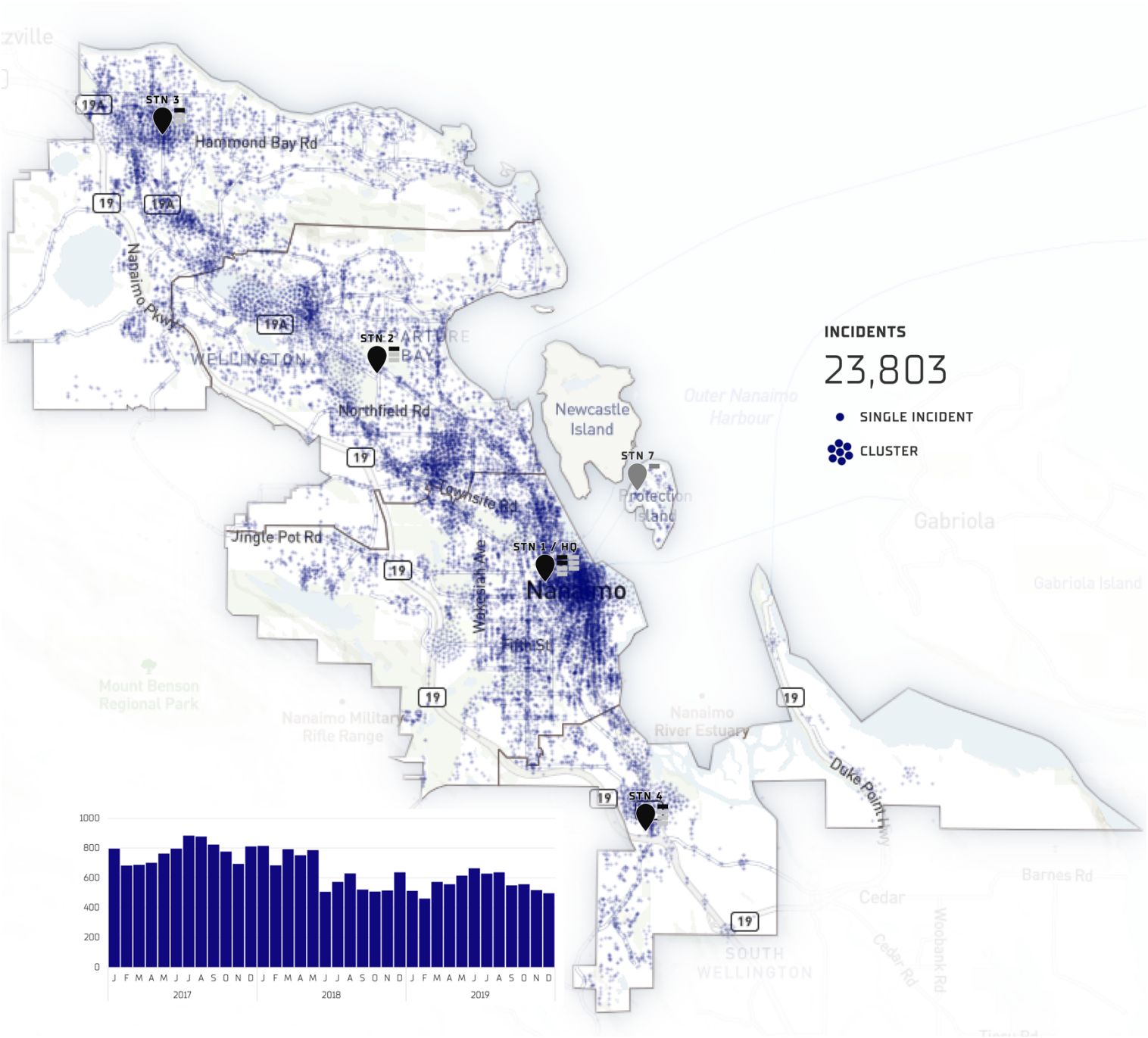
A unique part of the city is located on a small island separated by water from Nanaimo proper. The community of Protection Island is located 1.5 km north-east of downtown Nanaimo. It houses approximately 350 full time residents, and there are no paved roads on the island.

The 2016 Community Wildfire Protection Plan (B.A. Blackwell) states that "the city is not under great threat from continuous crown fire behavior but is at risk of surface fires." However, there is concern (from stakeholder engagement interviews) of the increasing fire load in surrounding wildland areas.

Emergency Incidents

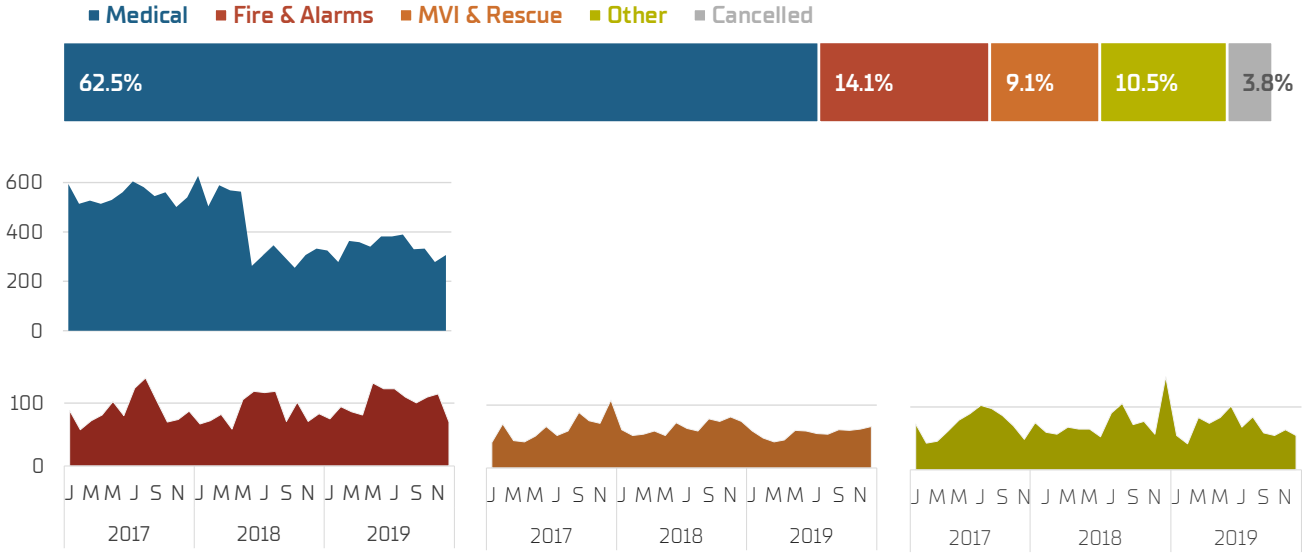
Emergency incidents are the most prolific indicators of risk in the community. Incident density typically follows population density. The city has a high density of incidents in the population-dense urban centre, and an increased density around the transportation corridor. Long term care facilities are also drivers of incident demand.

2017 TO 2019 INCIDENTS



Emergency Incident mix

INCIDENT CATEGORIES, BY MONTH



Medical First Response (MFR) Incidents

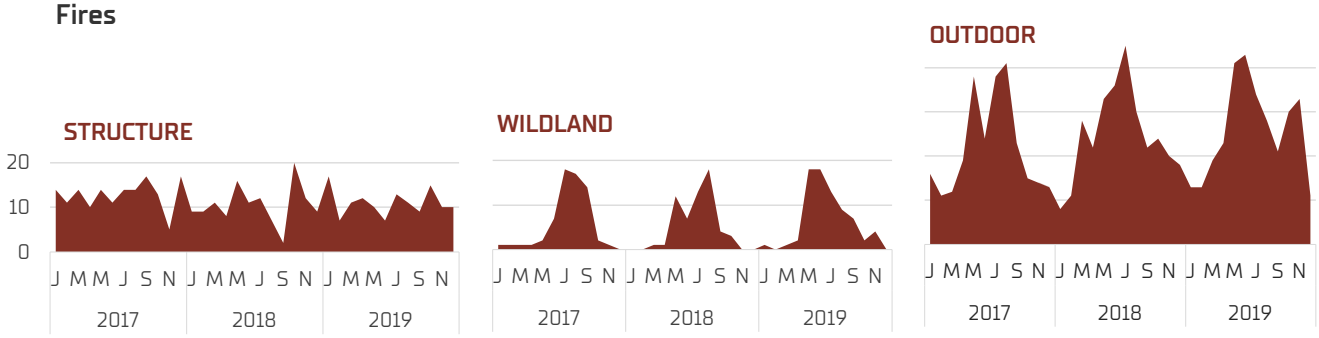
Most incidents are MFR in nature, accounting for 62.5% of incidents. This represents a typical incident mix for urban career fire services across Canada.

In June 2018, BCEHS revised their response policy. The effects of this change resulted in BC fire services responding to less low acuity calls in their communities. For NFR, the policy change resulted in an average of 234 fewer medical calls per month, affecting mainly B and C priority incidents.

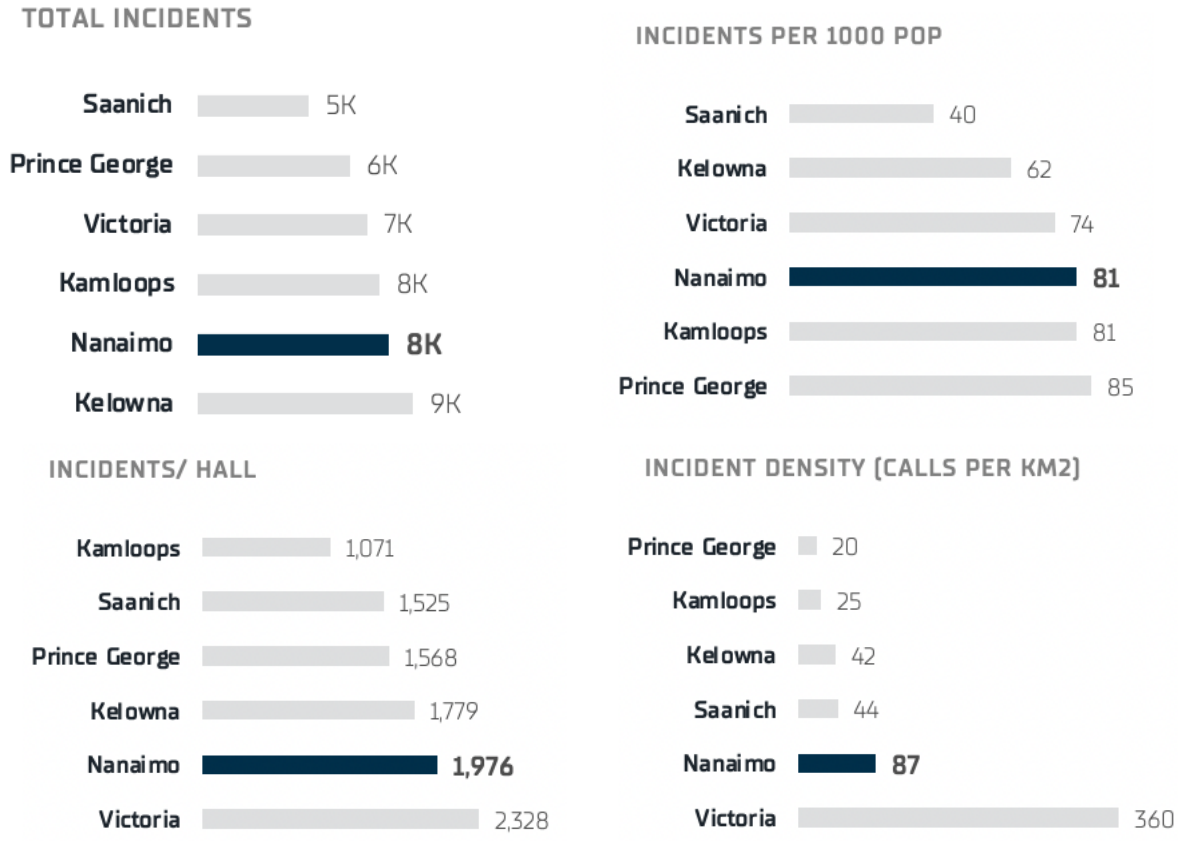
AVERAGE INCIDENTS/MONTH – PRE & POST BCEHS POLICY CHANGES

BCEHS has alerted NFR (and all affected BC fire services) that the 2020 change in dispatch policy due to Covid19 has been reversed and as of June 2021, call volumes will increase and renormalize. It is still unclear if changes made in 2018 will also renormalize, thereby causing an even greater increase in call volumes. A significant increase is already visible in NFR reporting data, though it is not clear if the call volumes will return to the pre-2018 levels, increase beyond them, or land somewhere between. NFR will need to watch the data closely as the policy changes stabilize and make adjustments to resource plans accordingly.

Fires

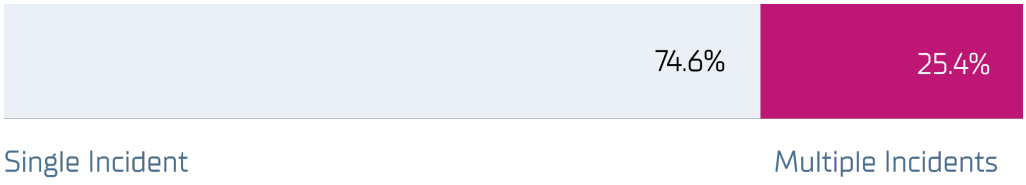


Peer Comparisons

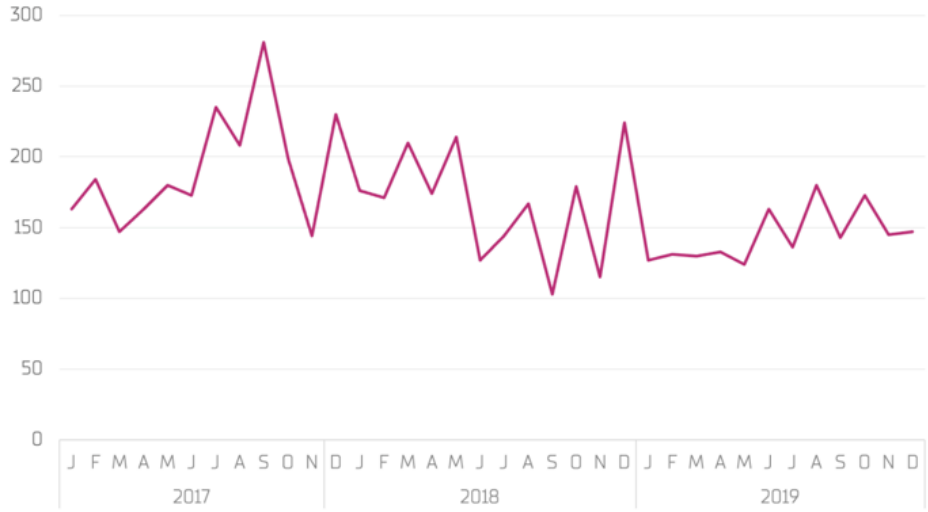


Concurrent Incidents

When an incident occurs, 25% of the time there is at least one other incident in progress.



CONCURRENT INCIDENTS, BY MONTH



Findings

1. The process of assessing community risk has become fundamental to the planning and delivery of fire & EMS services. We note that NFR currently does not have a recent and detailed community risk assessment. While this report makes an initial attempt at assigning risk, it is not an in-depth Community Risk Assessment. We recommend that Nanaimo undergo a detailed Community Risk Assessment based on CPSE Standards of Cover guidelines to better understand the hazards, threats, and vulnerabilities in the area and what level of service is required to appropriately mitigate.
2. We also note that at the end of this study, BCEHS confirmed that COVID-related dispatch policies would change and thus significantly increase MFR response requirements. There are additional dispatch changes which were being piloted by BCEHS since 2018. If these revert to the historical pattern, we expect to see an even greater increase in MFR incidents. We recommend that NFR continu to collaborate with the health partners at BCEHS to ensure there is alignment and clarity in expectations.

Fire Service Overview

Nanaimo Fire Rescue (NFR) has authority and operates through **Bylaw 2011 NO. 7108** to provide all hazard response to the City of Nanaimo, including emergency response to fires, medical call, rescue incidents, and natural disasters. NRF also provides specialized services such as hazardous materials and technical rescue response.

NFR has 106 FTEs[1] consisting of IAFF, CUPE and Management members. Currently, five stations are located throughout the city, staffed by a composite staffing model; four stations (1-4) are operated 24/7 by 85 career firefighters, and Station 7, located on Protection Island, is served by 8 Paid-on Call firefighters.

Community risk reduction is achieved through prevention programs, public education, training, and effective response. Fire prevention and education consists of four career members who manage the permit, fire code, investigations, and education activities. These services provide for the preservation of life, property, and the environment, which contributes to the well-being of the community.

NFR additionally runs the Vancouver Island Emergency Response Academy, which provides accredited training service in fire and emergency response to other municipal Fire and Emergency services organizations across BC and Canada.

[1] Note, as of January, 2022, NFR has 102 FTEs

Key Services

Prevention

Fire prevention officers are an integral part of the business license, building development, and the planning review and approval process. They carry out several duties, including:

- Reviewing proposed commercial building plans.
- Approving fire safety plans and pre-plans for commercial and public occupancies.
- Reviewing and approving new developments and new business occupancies.
- Inspecting the 3,145 commercial and public buildings for re code
- Maintaining compliance as required by the Fire Services Act
- Designing and delivering public education to the community including the smoke alarm campaign.
- Ensuring fire code compliance and enforcement.
- Enforcing fire bylaws.
- Conducting fire investigations.

Fire Administration

- Recruiting new personnel
- Finance and budgeting
- Purchasing and asset management
- Managing Human Resources
- Supporting Labour Relations
- Maintaining facilities
- Managing and administering VIERA
- Strategic planning

Operations

Fire fighters carry out the main business of NFR. Duties include:

- Responding to emergency and non-emergency incidents.
- Training fire personnel for proficiencies to meet standards and certifications in 8 disciplines.
- Installing smoke alarms.
- Training the public in bystander cardiopulmonary resuscitation (CPR).
- Conducting community outreach and station tours.
- Conducting fire and life safety inspections

They also aim to meet turnout benchmarks:

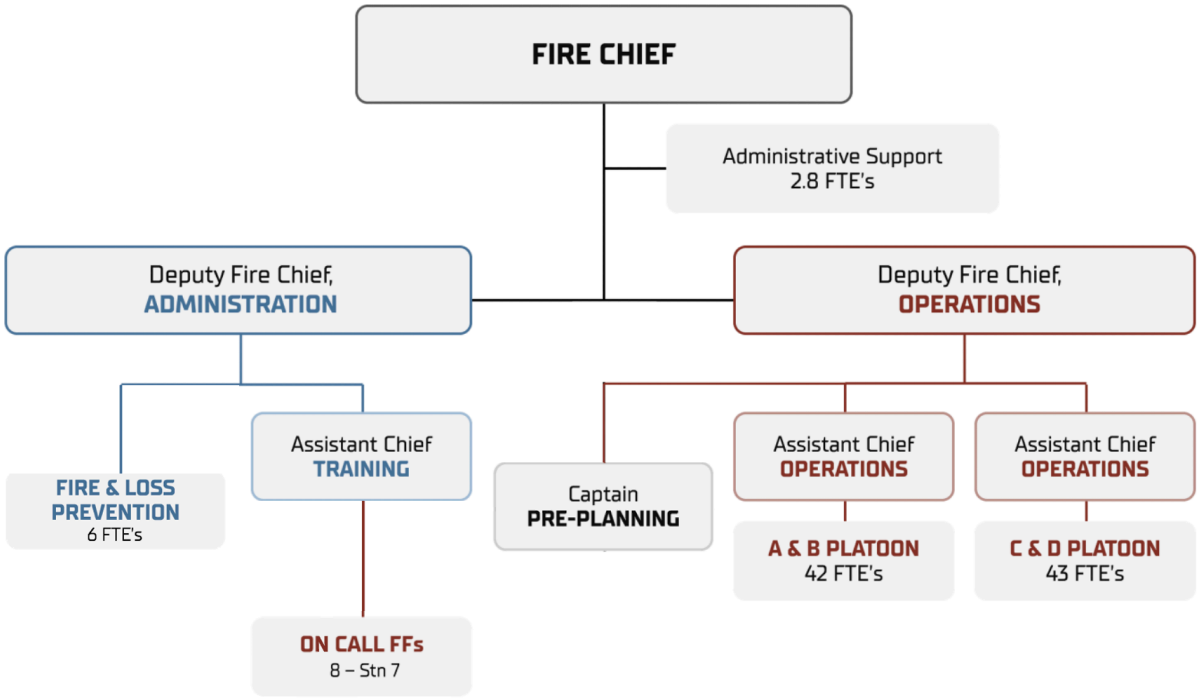
- Non-medical incidents: 1m20s, 90% of the time
- Medical incidents: 1m00s, 90% of the time

Surrey Fire Regional Dispatch is responsible for all emergency dispatch and will provide enhanced reporting and analytics as part of their service offering.

Staffing Model

Organization Hierarchy (2019)

The organization is centered around a fire chief with two deputy fire chiefs, one in administration and one in operations.

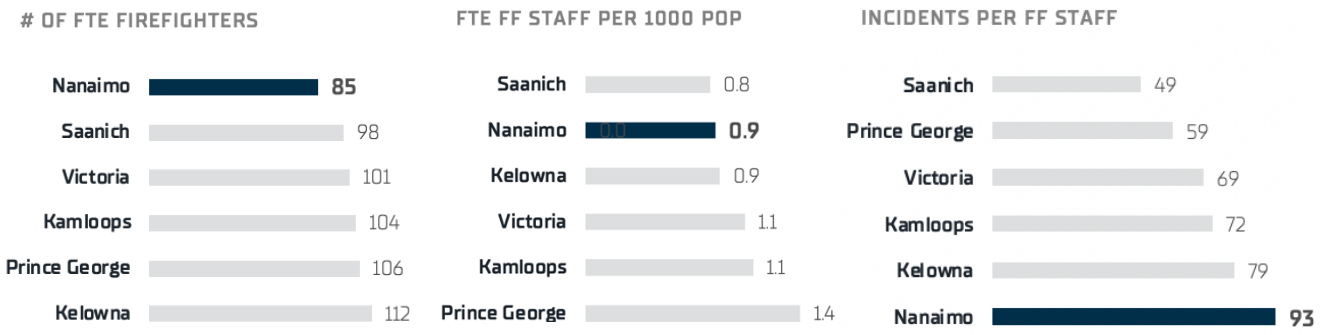


Minimum (FTE) Staffing by Station

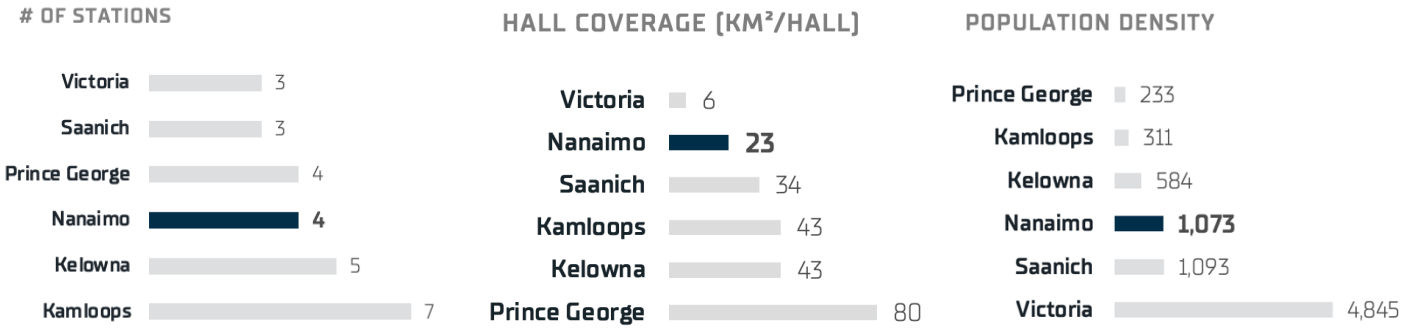
Station	Min. Staff/shift
Station 1	4
Station 2	4
Station 3	4
Station 4	4

Frontline staff comparisons

Currently, Nanaimo boasts 85 full-time suppression staff. Compared to the cohort group, NFR has the lowest number of full-time firefighters, and the second lowest ratio of firefighters per 1,000 population behind Saanich and the second highest incidents per staff behind Kelowna. Compared to its peer group, Nanaimo appears under-resourced. As we will show in the Standard of Cover analysis, resource intensity (depth of coverage) is currently under pressure and will be more so as the community grows.



Stations & Apparatus



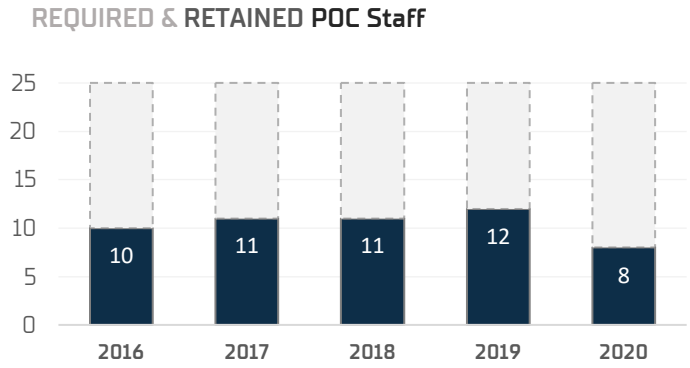
NFR fire hall coverage is at the lower end of the cohort, which is typical of a denser population. Given the shape of the community, travel time is a primary factor in effective

response. Only a small portion of the city has the double or triple coverage necessary to quickly mobilize for a structure fire.

Protection Island – Zone 7

Zone seven is a unique area of the Nanaimo fire department. It consists of a paid on-call fire station serving Protection Island. There were 118 incidents on the island in the time between January 2017 and December 2019, which works out to slightly less than one incident per week. The majority of these were medical calls.

While close to the downtown core in absolute distance, due to the water barrier the residents of Protection Island should expect a service level that is in essence equivalent to rural and remote areas. This area is currently staffed by a small contingent of 8 Paid-on-Call firefighters. This number has been declining and is not sufficient to ensure availability in an incident. This understaffed state has been in place for at least five years and is compounded by recruitment challenges in the area and increasing training standards.



Recruitment of new POC staff requires a committed effort in all rural areas but poses a particular challenge in the small community of Protection Island. The 8 staff already effectively represent 2% of the total population of 335 full time residents. As a retirement community with an aging population, eligible candidates will be hard to find.

Furthermore, increasing training requirements demand more time from the POC staff, which could pressure retention and willingness for POC. Currently, a new firefighter is required to complete 957 hours of initial training and a new officer is required to complete 1215 hours.

Training

Training is one of the cornerstones of an effective fire service. It is important to invest in and track training hours, and to maintain an accurate set of training requirements for various positions.

Training Standards

NFPA publishes more than 300 consensus codes and standards intended to minimize the possibility and effects of fire and other risks. NFPA codes and standards, administered by more than 250 Technical Committees comprising approximately 8,000 volunteers, are adopted, and used throughout the world.

NFR observes a number of these standards as training standards for staff qualification. The NFPA 1001 Standard for Fire Fighter Professional Qualifications is a requirement upon hire.

Type	Details
NFPA 1001: Standard for Fire Fighter Professional Qualifications (Accredited)	• Requirement of hiring
EMA First Responder Certification and License	• Trained in-house by FR Instructors
NFPA 1002: Standard for Fire Apparatus Driver/Operator Professional Qualifications (Not Accredited)	• Trained in-house by EVOD Instructors • Chapter 4 and 5 of 1002 for all members
NFPA 1006: Standard for Fire Apparatus Driver/Operator Professional Qualifications (Not Accredited)	• Trained in-house by Tech Rescue Instructors • Chapter 5 of 1006 (2013) for all members • Chapter 6 and 7 of 1006 for (2013) for Tech Rescue Team Members only
NFPA 1041: Standard for Fire and Emergency Services Instructor Professional Qualifications (Accredited)	• Chapter 4 of 1041 for all members before they enter the acting officer pool
NFPA 1021: Standard for Fire Officer Professional Qualifications (Accredited)	• Chapter 4 of 1021 for all members before they enter the acting officer pool and before they become a confirmed lieutenant • Chapter 5 of 1021 for all members before they become a confirmed captain
NFPA 1521: Standard for Fire Department Safety Officer Professional Qualifications (Accredited)	• Chapter 4 of 1021 for all members before they enter the acting officer pool and before they become a confirmed lieutenant
NFPA 1031: Standard for Professional Qualifications for Fire Inspector and Plan Examiner	• Chapter 4 for Fire Loss Prevention at year 1 • Chapter 5 for Fire Loss Prevention at year 3
NFPA 1033: Standard for Professional Qualifications for Fire Investigator	• Chapter 4 for Fire Loss Prevention at year 2
NFPA 1072: Standard for Hazardous Materials/Weapons of Mass Destruction Emergency Response Personnel Professional Qualifications	• NFPA 1072 chapter 4 and 5 are required for 1001

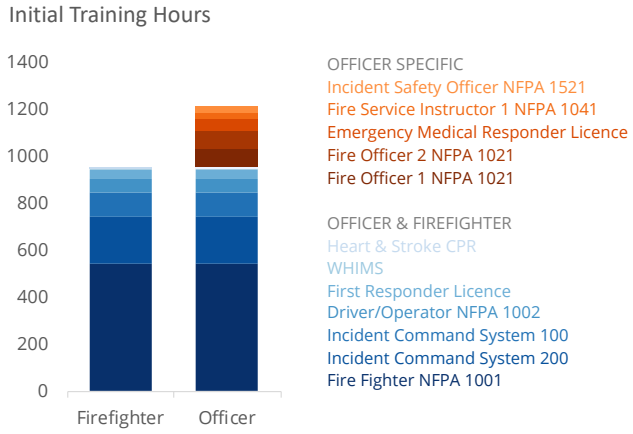
Training Records

NFR brings an impressive training record, with over 66,000 training hours combined over the last 3 years. The ability to conduct on-shift training due to the location of the Training Centre (at Station 2) is a huge advantage for the service.

2017	14,929
2018	17,178
2019	34,597
Grand Total	**66,704**

Types of training range from advanced certification and technical training to fitness, safety, company operations, and more recently, Covid-19 protocols. Below is an overview of the most common types and the total training time conducted over the last 3 years.

Type	Total Hours (2017 – 2019)
Safety	12,492.6
Emergency Vehicles Operations / Driving 1002	11,832.3
Technical Rescue	9,654.6
Company Operations	9,374.7
First Responder	8,651.8
Hazardous Materials 1072	8,250.3
Fire Ground Survival	5,407.1
Firefighter 1001	3,025.3
Career Recruit	2,461.0
Auto Extrication	2,262.8
Fitness	2,213.5
Fire Officer	1,993.8
Fire Operations	1,908.7
Equipment	1,376.9



Training Centre

NFR has a Training Centre at Station 2 which allows for on-shift training. This eliminates the requirement for staff to come in during off-days and is an extremely effective way to keep staff trained while also ensure there is adequate coverage. This ability has probably contributed to the impressive training record, with over 66,000 training hours combined over the last 3 years.

However, recently concerns have been brought up of wind blowing smoke to a nearby public works area, causing burden to this redevelopment. Conducting training elsewhere would alleviate this nuisance but would greatly reduce the cost effectiveness that the

current location brings. A shift to natural gas to perform live fire exercises may alleviate the issue while still maintaining the central location.

Vancouver Island Emergency Response Academy (VIERA)

VIERA is a service provided by NFR to other municipal Fire and Emergency services organizations across BC and Canada. The service is one of only 70 worldwide accredited by PRO Board to provide accredited certification in a multitude of fire and emergency related training courses, such as Live Fire training, Hazmat Operations, or Technical Rescue.

The VIERA is currently a profit center and an additional source of revenue for NFR. It also establishes NFR as a leader in standards and certification and demonstrates the culture of continuous improvement throughout the broader emergency management community.

Our stakeholder engagement suggested that despite the value this area brings, it is understaffed and under-resourced. There is an opportunity to ensure the focus on this asset remains strong and that VIERA receives the funding and resources to sustain it, as this department suggests a strong opportunity for NFR.

Findings

1. Front line staffing when compared to the cohort is low, and when coupled with a depth of coverage analysis, strongly suggests that NFR is understaffed. This theme was also acknowledged throughout the stakeholder engagement phase. The high density of Nanaimo is a contributing factor to the low firefighter to incident ratio, but there are issues around simultaneous calls which could change significantly due to expected changes in BCEHS[2] policy.
2. Protection Island is currently understaffed, with significant recruitment and training challenges. We recommend that NFR consider phasing out the POC program on protection island and serve the neighborhood from the Nanaimo proper with career staff. Any solution would need to consider equipment, enhanced prevention, and mitigation, as well as a way to efficiently mobilize in the unlikely event of a major incident.
3. Notifying community partners of scheduled live fire drills and switching to smokeless alternative fuel sources in the training location would reduce nuisance and inconvenience while maintaining current cost-effective training opportunities.
4. VIERA represents an opportunity to increase revenue and NFR's role as a leader in the Emergency Management community. Continued focus, investment, and appropriate staffing is recommended, with considerations to manage VIERA as its own operational unit.

[2] As of January 2022, BCEHS has not provided guidance as to the status of the pilot program they implemented which reduced NFR calls by ~25%. If the pilot is discontinued, we expect a significant increase in NFR incidents.

Best Practices

Emergency incidents include situations with the most severe time constraints. An effective response system is one that can consistently mitigate emergencies in an appropriate time for the risks involved, thereby increasing the likelihood of a positive outcome for the communities' values at risk.

Speed & Weight

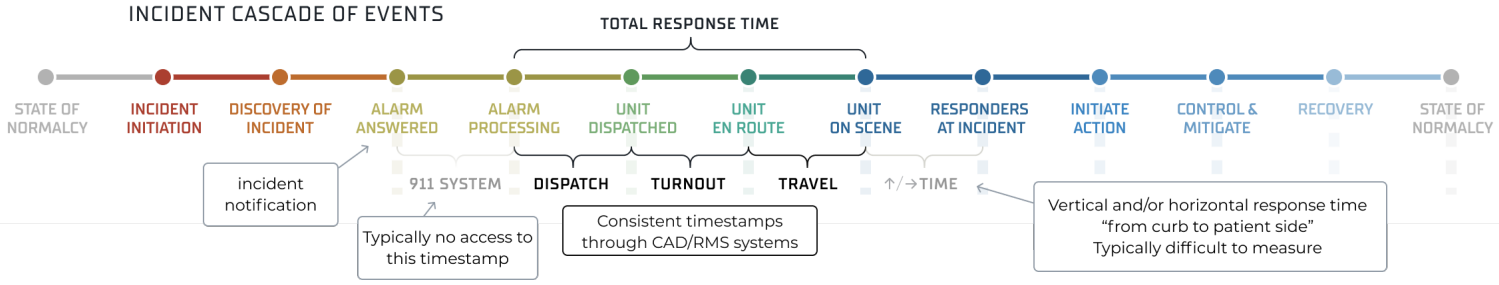
Effective fire service deployment is about the speed and weight of the response.

Speed refers to the initial response (first-due), the first unit or crew to arrive on scene. When an emergency incident occurs, all-risk intervention resources need to respond within an appropriate time to control routine to moderate emergencies without the incident escalating to greater size or severity.

Weight refers to multiple-unit responses for more serious emergencies, such as building fires, multiple-patient medical emergencies, or technical rescue incidents. In these situations, an adequate number of firefighters - an effective response force (ERF) - must be assembled within a reasonable time to safely control the emergency and prevent it from escalating into a more serious event.

What can we measure?

Every incident has a cascade of events, starting from incident initiation and completing once the emergency is resolved, and the location has returned to its normal state. Different intervals can be measured to determine performance from the various subfunctions of an emergency management system.



With the available data, we can measure three intervals that make up total response time: Dispatch, Turnout, and Travel.

Industry Standards

The National Fire Protection Association (NFPA) is the industry standard for response benchmarks. It has three primary response standards, NFPA 1221 for alarm handling, NFPA 1720 for volunteer/POC, rural and suburban services, and NFPA 1710 for career, urban services.

NFPA 1710

First Response (speed)	Effective Response Force (weight)
URBAN 6m20s, 90% of the time • Dispatch - 1m00s, 90% of the time • Turnout - 1m20s, 90% of the time • Travel - 4m00s, 90% of the time	**URBAN – LOW HAZARD** 17FF in 10m20s, 90% of the time **URBAN – MODERATE HAZARD** 28FF in 10m20s, 90% of the time **URBAN – HIGH HAZARD** 43FF in 12m34s, 90% of the time

NFR Standards

NFR's first response standard aligns to the industry standard NFPA 1710. However,

First Response (speed)	Effective Response Force (weight)
URBAN 6m20s, 90% of the time • Dispatch - 1m00s, 90% of the time • Turnout - 1m20s, 90% of the time • Travel - 4m00s, 90% of the time	**URBAN** 16FF in 10m20s, 90% of the time

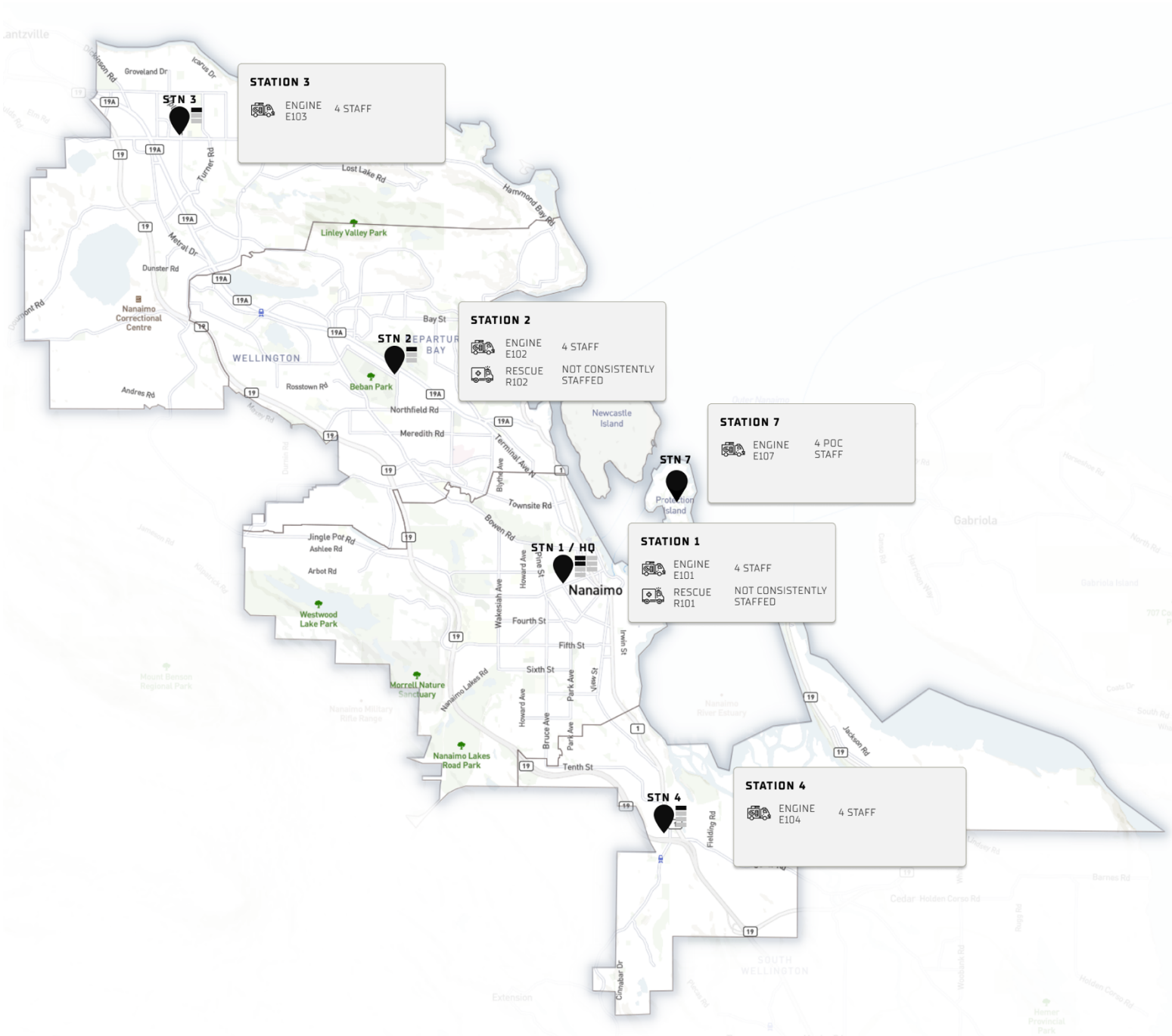
CFAI/CPSE recommends a service develops response standards for each risk reduction category (eg: medical first response, fire, rescue, HAZMAT, etc). The current Effective Response Force that NFR adheres to uses the same time and fractile response target of the NFPA 1710 (10m20s, 90% of the time), but has a lower number of firefighters (16 as opposed to 17). We note that this is a common situation with many growing communities of Nanaimo's size. At around 100,000 population, a community typically begins to have dozens if not hundreds of multi-family dwellings and often a number of highrise buildings.

Whereas a 16 firefighter model was sufficient to do the critical staffing of a single family dwelling (supported by call backs, mutual aid, and volunteers), this becomes untenable as the community grows. The risk of concurrent events or multi-family dwelling events rises to the point where 16 firefighters is inadequate for the level of risk. In Nanaimo, the situation is exacerbated by the fact that timely mutual aid is virtually impossible. There are no communities sufficiently close to provide timely support.

A major component of this plan is to develop a roadmap where NFR can adequately address the growing risk facing the community. Having 17 firefighters typically available is integral to that goal. The scenario section of this report details the recommended approach which both addresses risk while recognizing fiscal reality.

Current State Analysis

Resource Deployment



Response Data

The dataset used spanned three years from January 2017 to December 2019. NFR incident levels and mix are typical of a growing urban environment. Workload (responses) is driven by medical incidents, peaking in the summer months after which declining to relatively stable levels. June 2018 saw a 24% decrease in responses after a BCEHS policy change mandating fire services no longer be notified to respond to some lower acuity incidents. It is not clear if or when this policy (and corresponding decrease in calls) will be reversed.

2017 TO 2019 RESPONSE DATA

Apparatus Records	Unique Incidents	Missing response data	Invalid locations	Timestamp Issues
29,263	23,791	453 (1.9%)	1,095 (3.7%)	2,013 (6.9%)

The analysis was based on 29,263 apparatus records representing 23,791 unique incidents. Data quality was high, with only 453 (1.9%) incidents removed from the analysis due to missing response data. There were 1,095 (3.7%) incidents with invalid locations, and 2,013 (6.9%) responses with timestamp issues, missing either in service and in quarters timestamps, or arrival timestamps.

Station Zone overview

Zone	Incidents	Responses	3yr Trend	Response Mix
1	9,739	11,974		
2	6,355	7,835		
3	4,962	5,962		
4	1,477	1,763		
7	118	308		

(All data from 2017-2019)

Medical Fire & Alarms MVI & Rescue Other Cancelled

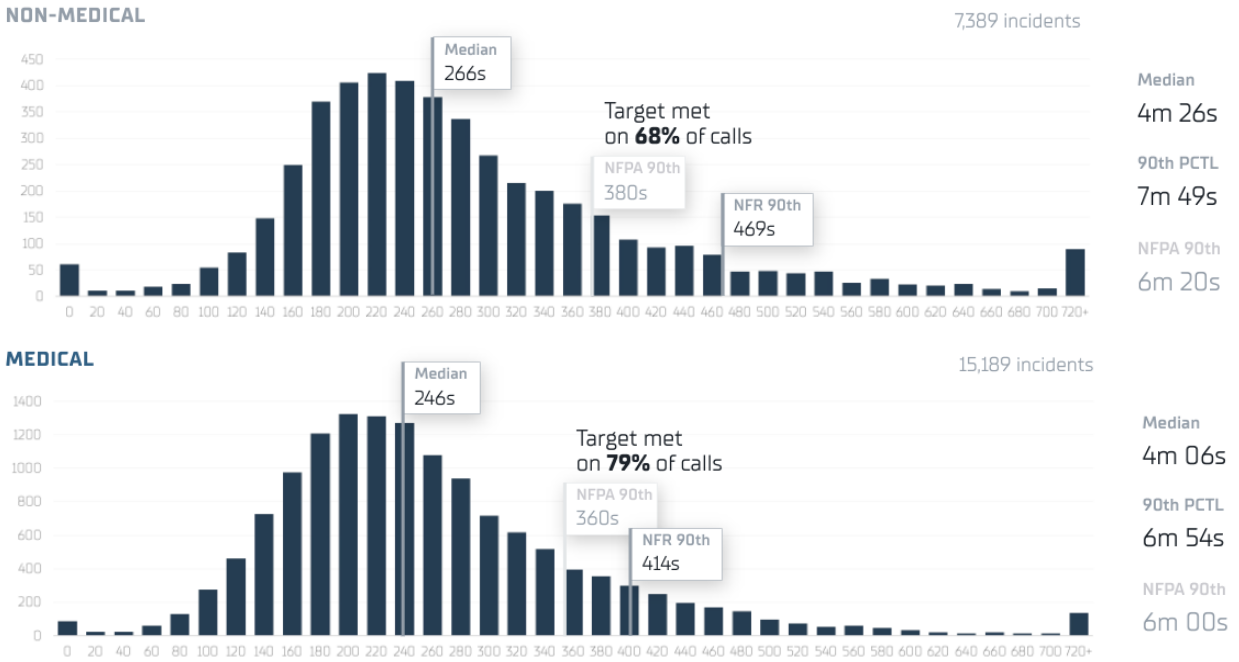
The Station 1 catchment – including City – has the highest call volume, with over 40% of total incidents. In addition to the City Centre, there are two high demand areas comprising the Harewood area. The Station 2 catchment accounts for the second highest incident volume at just under 27%. Calls in this area are driven by retirement communities and the Nanaimo General Hospital. The Station 3 catchment has one of the lower incident counts, but it has one of the highest single call volume locations. The Nanaimo Seniors Village accounts for 7% of all calls in this zone. The Station 4 zone accounts for the lowest proportion of incidents at 6% of the total. Calls in this zone are driven by Maki Road.

Station Responses, (in zone, coloured, out of zone, grey)

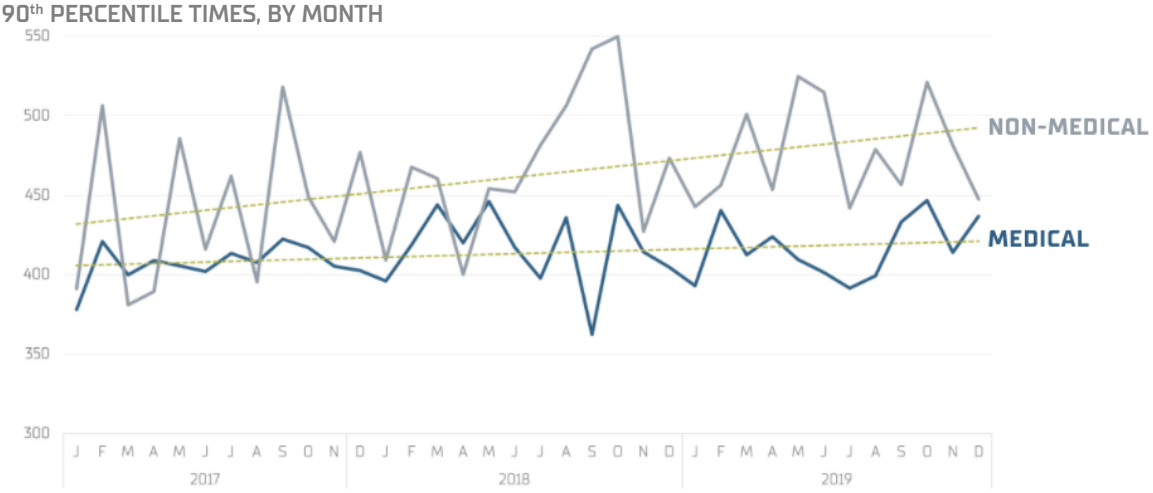
First Due Response Analysis

First Due refers the first unit or crew to arrive on scene. These units are tasked with arriving on scene as quickly as possible for controlling the emergency and preventing the incident from escalating to a second alarm or greater size, which can unnecessarily deplete departmental resources. Units must be strategically distributed across the community to meet speed goals, an effective first due total response time. The NFPA 1710 first due 90th percentile response targets are 6:20 minutes for non-medical calls and 6:00 minutes for medical.

RESPONSE TIME DISTRIBUTIONS

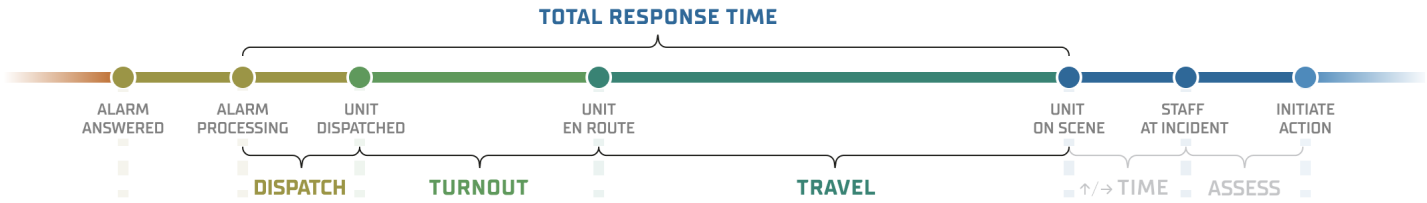


90th PERCENTILE TIMES, BY MONTH



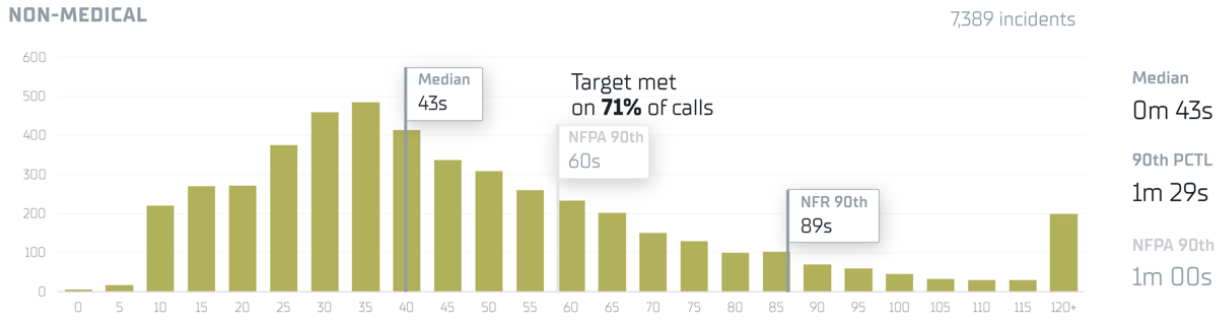
Response Time Intervals

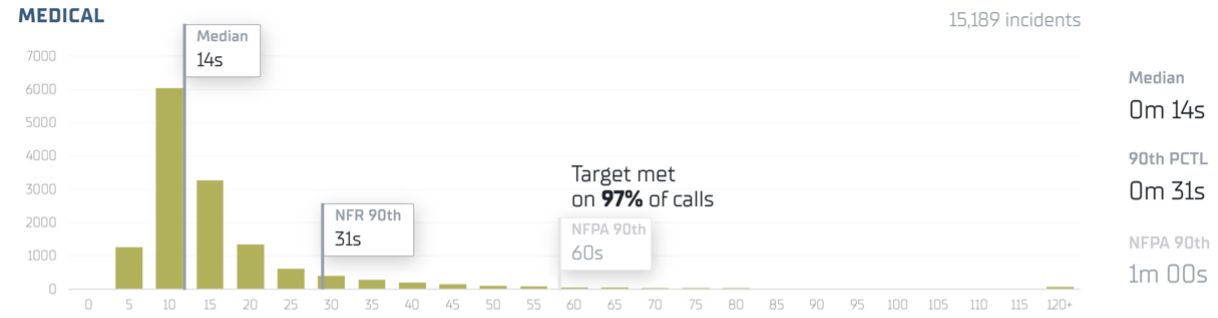
A typical response is divided into several intervals, including the alarm handling time which is comprised of call processing and dispatch; the turnout time, which represents the time from unit dispatch to enroute; and the travel time, which is the time it takes a unit to reach the scene once it is enroute. Each of these intervals have their own specified NFPA targets



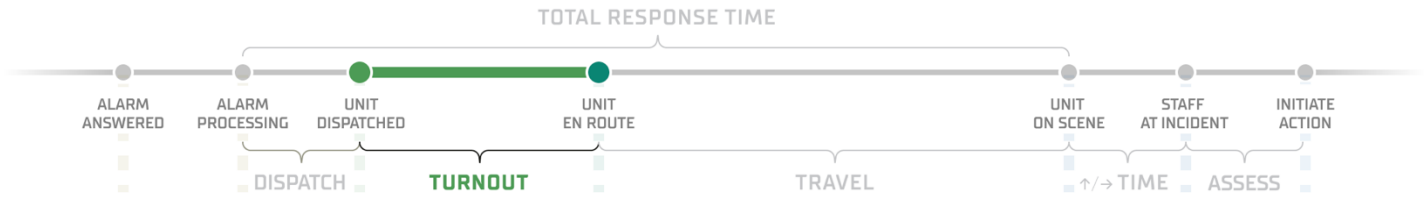
Interval Analysis

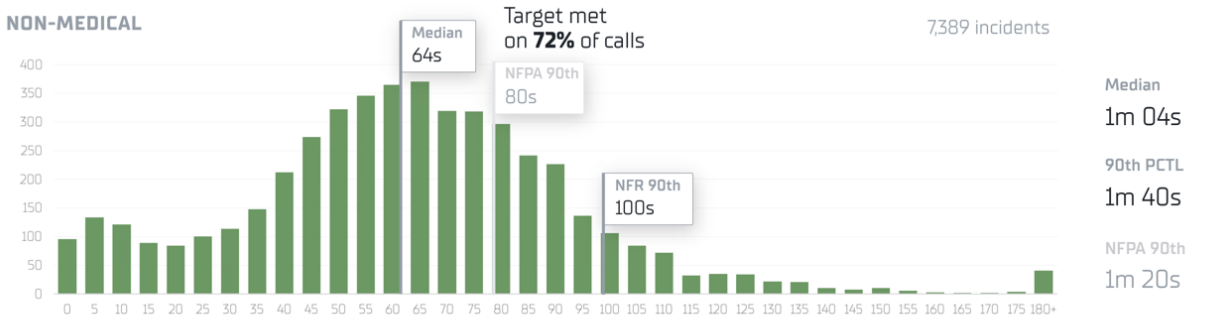
DISPATCH

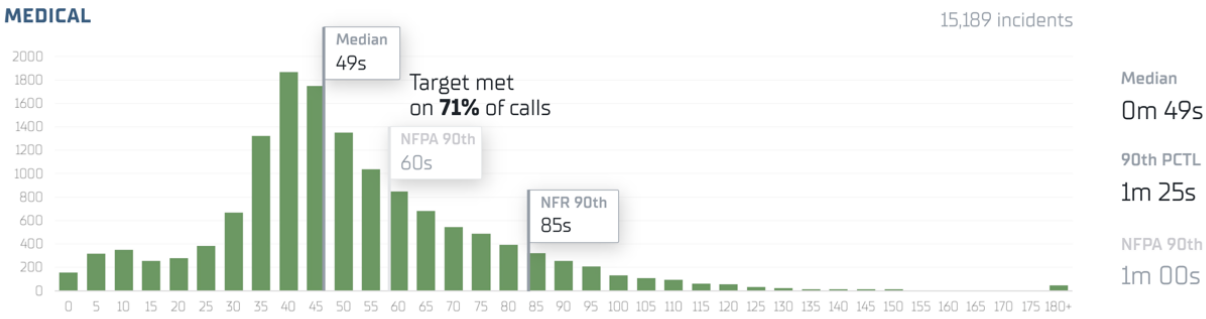




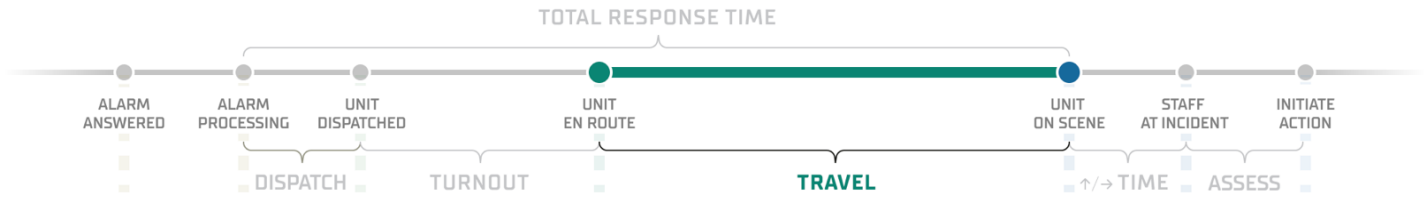
TURNOUT

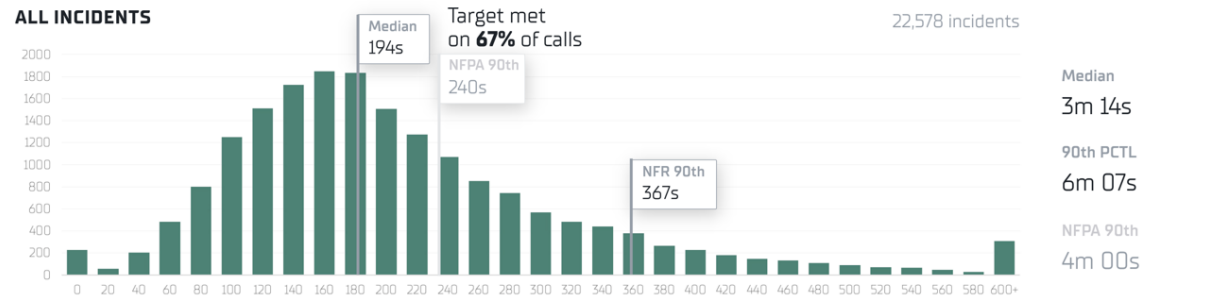




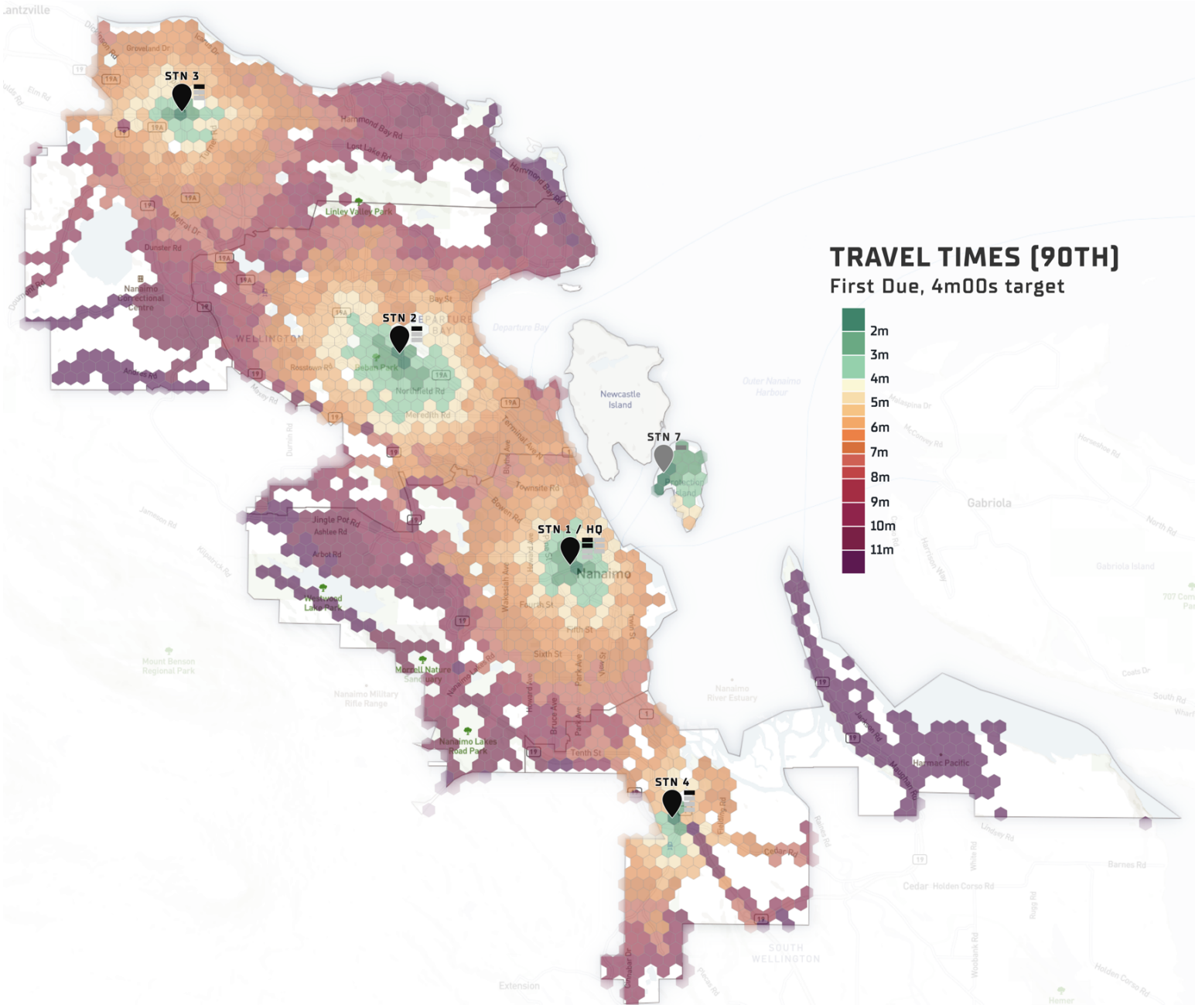


TRAVEL



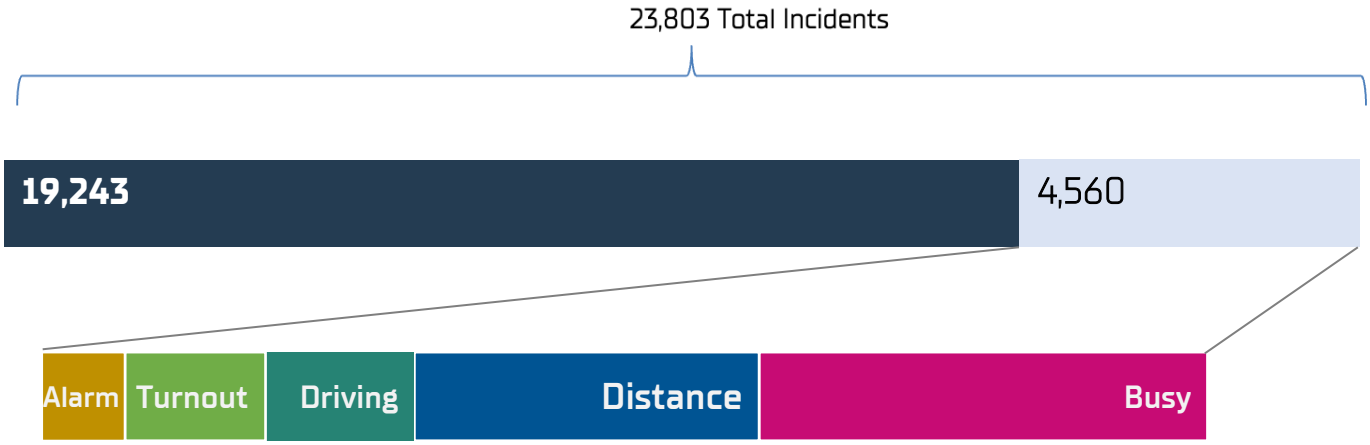


First Due Travel time modelling map



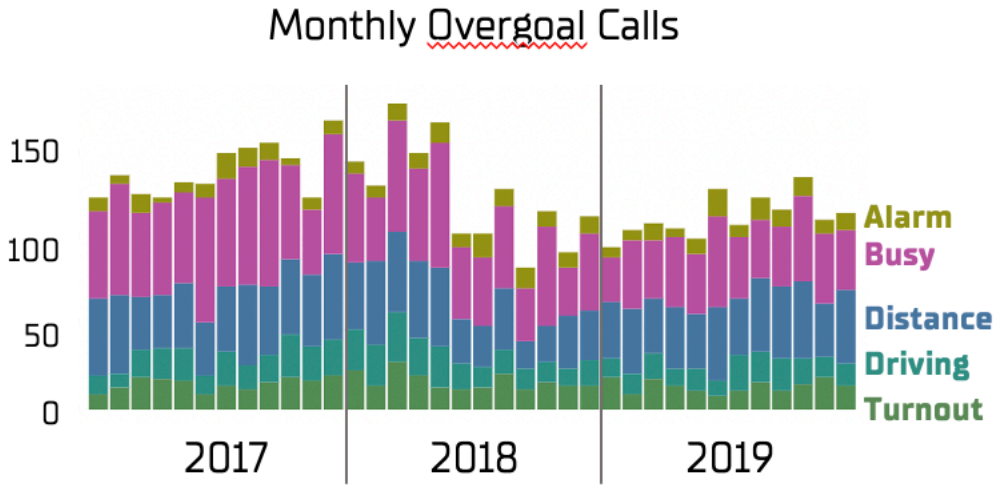
First Due Overgoal Analysis

Examining the root cause for calls exceeding their target can provide insight into opportunities for improvement. Responses were defined as overgoal if they were over the targeted 90th percentile time. From 2017 to 2019, **4,560** (approximately 20%) of NFR's responses were overgoal.



The results of the overgoal analysis shows that 38% of responses that did not meet their 90th percentile target time were due to the busy-ness of the system. The responging unit was from another station zone because the unit in the closest station was already on another call.

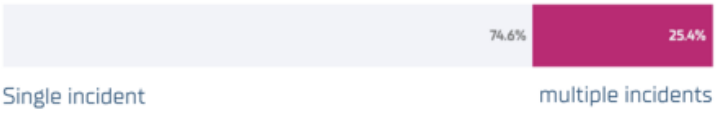
The second and third most frequent for a response being overgoal was distance (30%) and driving (13%). In both cases, the closest station was either two far away to get there on average, or too far away to get there if there was any additional delay from traffic or weather.



Examining the overgoal causes over time shows a an improvement that coincides with the BCEHS policy change of June 2018 – particularly the busy issues. We expect these to revert to higher levels in the event that BCEHS ends the pilot.

Busy issues are primarily addressed by adding new vehicles and crews to the system. This aligns with our objective of improving ERF response in the City. Reducing distance issues is accomplished by either moving our adding stations to the system. Driving problems are similar to distance issues. In some cases they can be resolved by better traffic pre-emtption, but in many cases, these are calls on the edge of a stations reach and are only met by having more or better-located stations.

Concurrent incidents – effects of busyness



Within NFR, roughly one quarter of calls occur when the system is already responding to another call. Given the growth in the City and the potential changes in BCEHS policy, this number will increase in the future and put the City at greater risk.

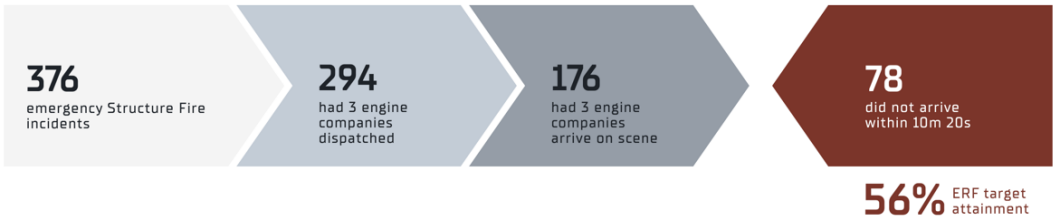
Findings

1. Busy problems account for the highest proportion of overgoal call issues at 38%. The system is struggling to respond to the high call levels and this will only degrade as the City grows
2. Distance and Driving Problems are the next largest contributors to response performance issues at 30% and 13% respectively. This is primarily due to the nature of the call patterns in Nanaimo: high volumes spread along a single corridor. It is the areas between the stations and along the corridor that contribute the most (as opposed to outlying areas in the periphery of the City).

Effective Response Force (ERF) Analysis

The effective response force analysis (ERF) examines the ability of the force to assemble enough firefighters and units for serious emergencies, such as structure fires, multiple patient incidents, vehicle accidents with extrication requirements, or technical rescue incidents. The 90th percentile response targets according to the NFPA 1710 ERF are 10:20 minutes for low and medium hazard emergencies, and 10:30 minutes for high hazard. The NFR response target is three units in 10:20 minutes for all hazard levels.

Within the current dataset, there were 376 emergency structure fire incidents, where 294 had three engine companies dispatched, and 176 had three engine companies arrive on scene. Of those, 78 did not arrive within 10:20 minutes, resulting in an ERF target attainment of 56%.



The sample size of this data is relatively small, and thus drawing conclusions based on this data should be done carefully. Only certain areas may have seen incidents in the observed time period. By using predictive modeling, we can show the expected performance and the probability of attaining the ERF target for each area.

ERF Modelling

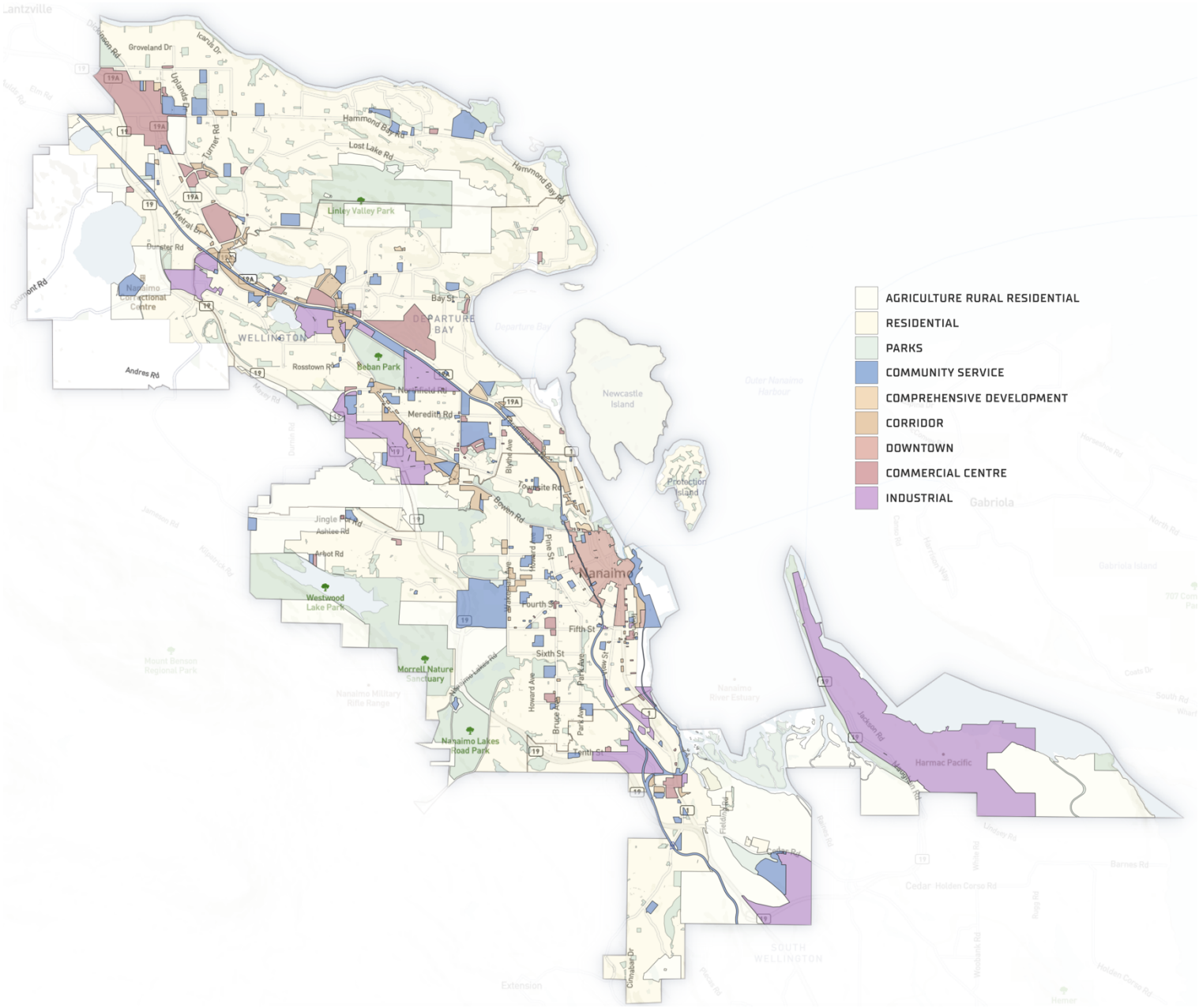
A detailed Community Risk Assessment (CRA) provides a comprehensive accounting of risks and hazards in the community. As no such CRA is in place, land use zones can be used as a rough estimate for community risk.

For this modeling, NFR assigned a high, moderate, or low risk level to each land use zone. Examples of high-risk zones are Urban Hospital Centers, High Density Residential, and Industrial zones. Moderate risk would include zones such as City Commercial Centre or Three and Four Unit Residential. Examples of low-risk zones include Single Dwelling Residential or Island Residential. A full list of land use areas and their accompanying risk level is presented in the Appendix.

A spatial analysis of the NFR's ability to meet 90th percentile targets for each of the risk zones was performed (detailed methodology can be found in the appendix). This method is an approximation, and we recommend NFR conduct a full community Risk Assessment based on CPSE accredited standards to complement this analysis.

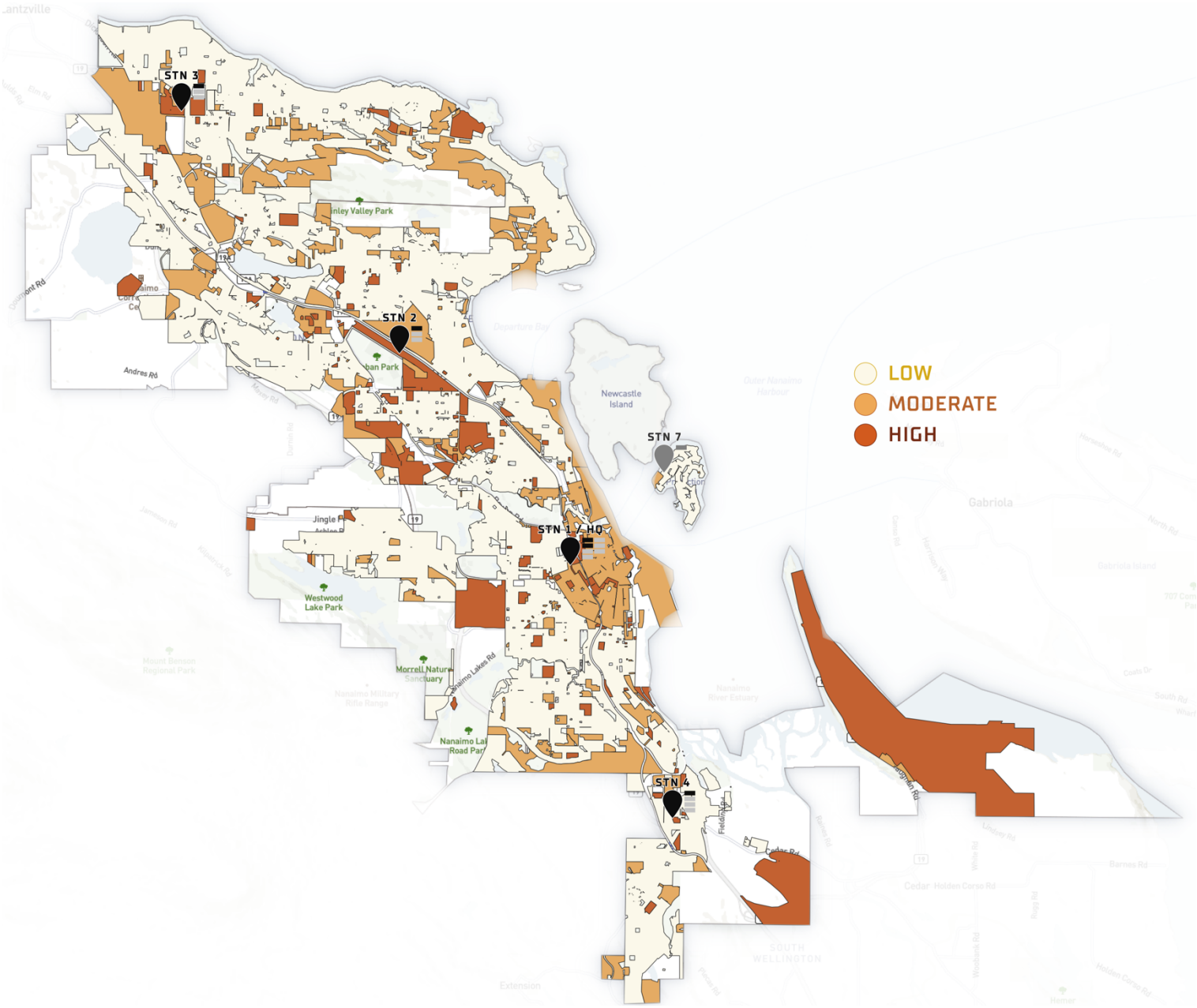
Land Use Zones

Nanaimo is a city with a densely populated urban center, surrounded by areas of agricultural, rural, residential, industrial, and parks and recreation, with a high traffic density corridor.



Risk levels by area, using Land Use Zones as a proxy

This map utilizes the land use zones in the previous map to display splay suggested areas of risk based on land zones. A full overview of risk assigned to each land use zones can be found in the appendix.

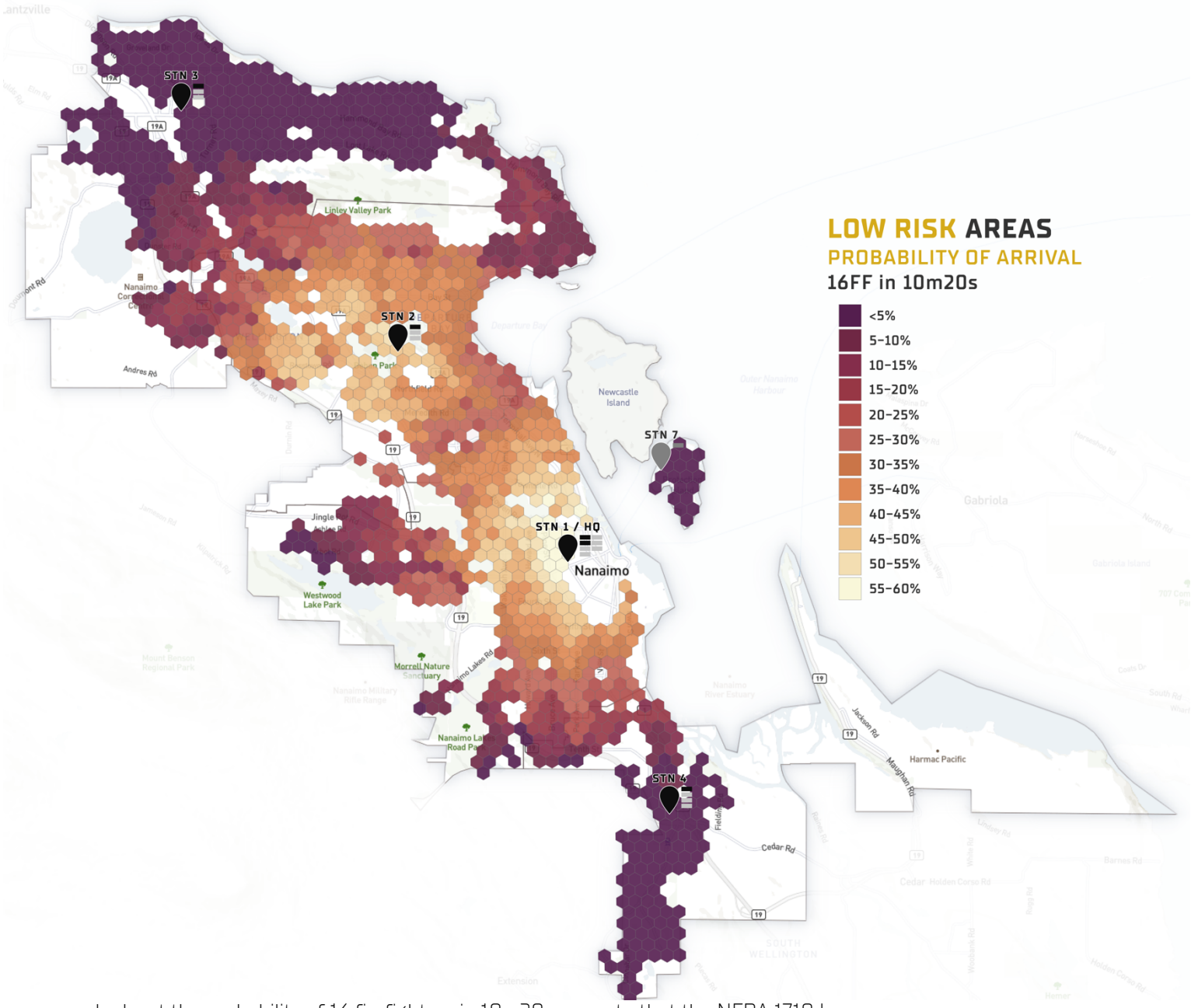


The next three pages visualize the probability to assemble a 16FF effective response force in 10m20s to high, moderate, and low risk areas. We note that with the current minimum staffing, 16FF is all that can be sent to a major fire and if sent, leave the City completely

exposed to a second event. Furthermore, given the geography of Nanaimo, they will not arrive within the target time.

Low Risk – ERF Probability of Arrival

The low-risk zones are relatively large, and vast majority of them fall below a 60% chance of attaining the target of all units arriving within 10:20 minutes. The peripheries of the city have no chance of meeting the target due within the targeted time. While this analysis

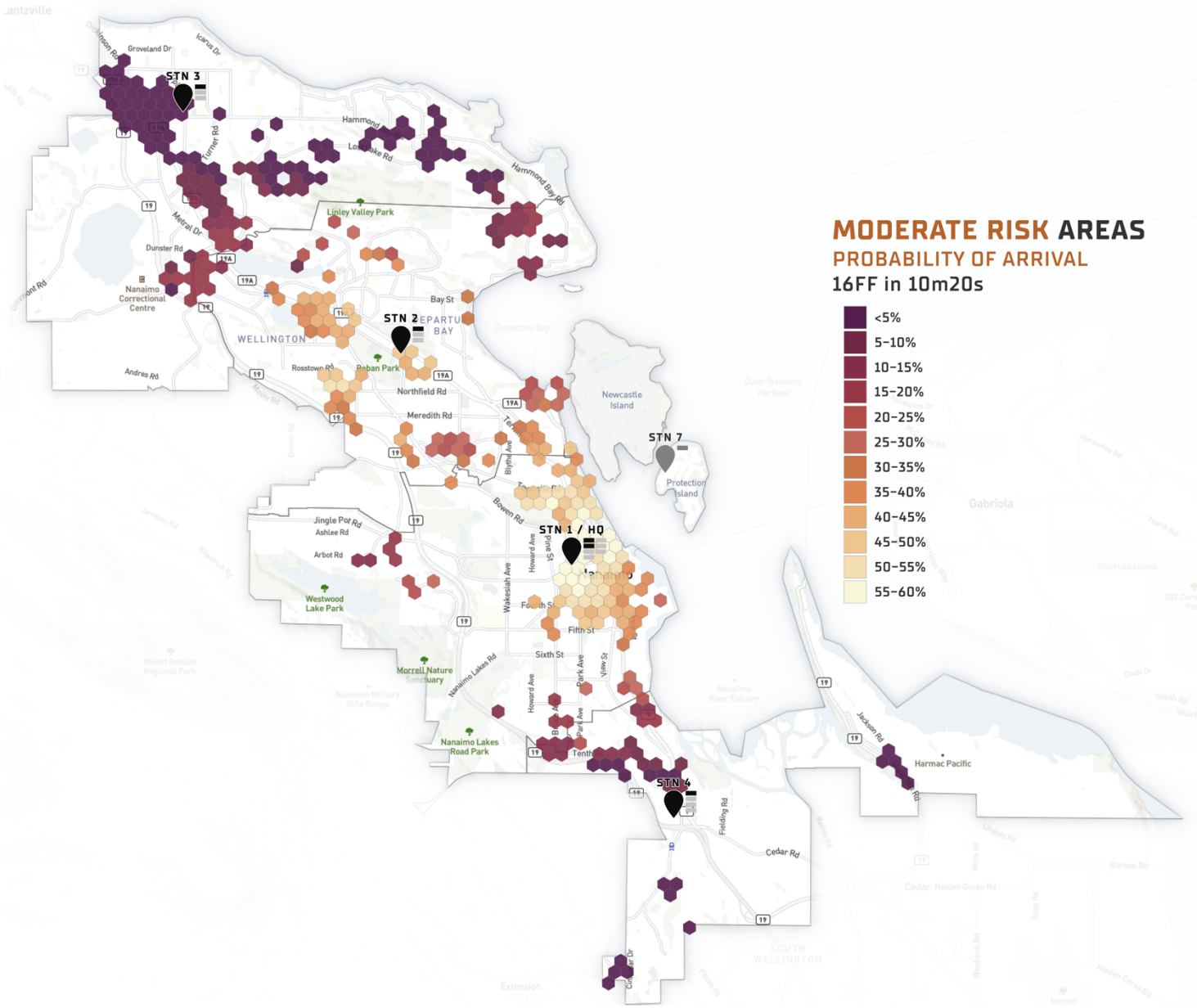


looks at the probability of 16 firefighters in 10m20s, we note that the NFPA 1710 Low Hazard Standard is 17FF in 10m20s.

Moderate Risk – ERF Probability of Arrival

The moderate risk zones show a similar performance with only those immediately surrounding stations 1 and 2 reaching a 60% probability of 16 firefighters in 10:20 minutes. Most moderate risk areas will fall within this probability, however, the area surrounding stations three and four have virtually no chance of meeting this target. This is again because units from all stations must arrive to the incident within the target time. Stations 3 and 4 are simply too far for all units to achieve this goal.

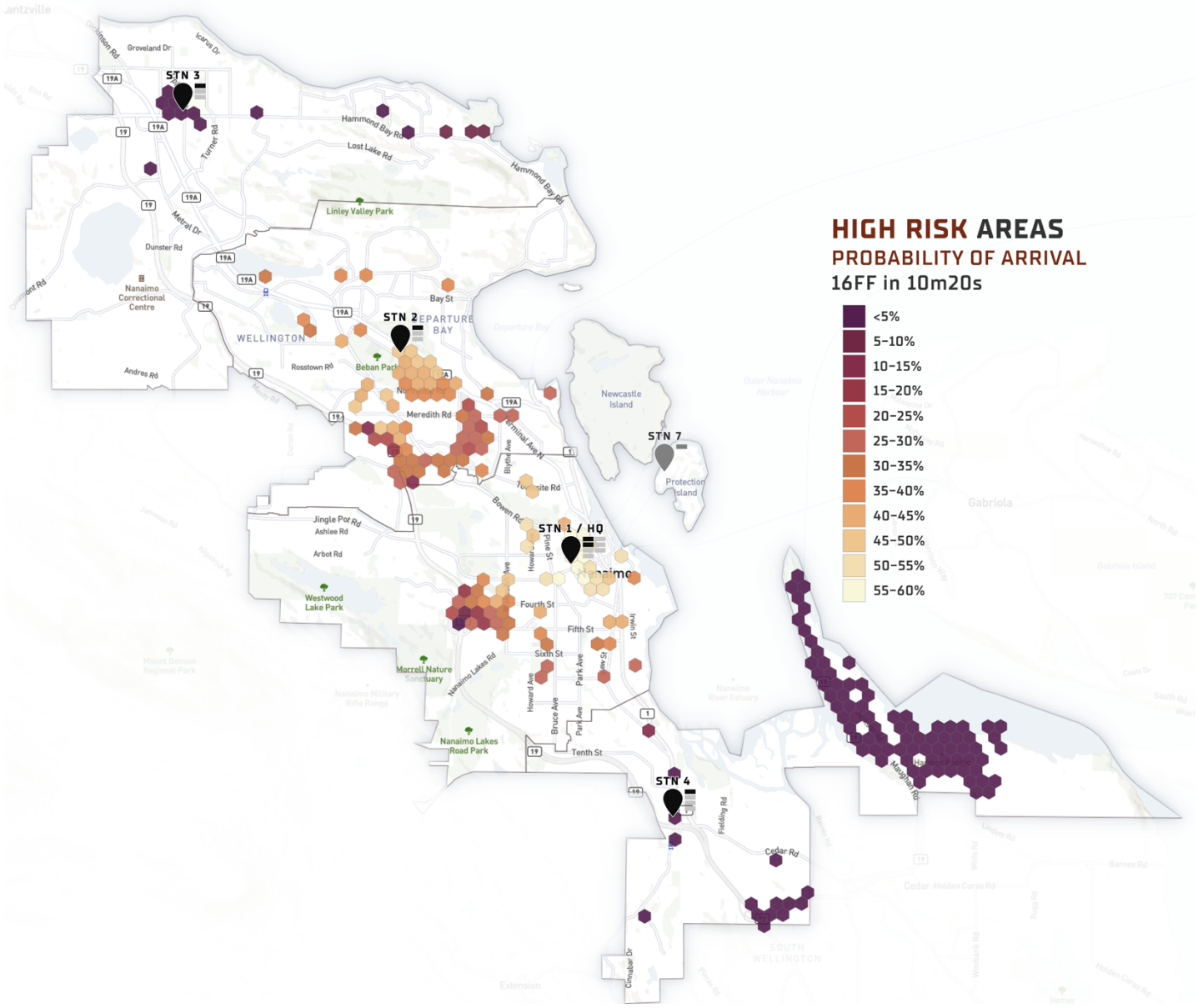
While this analysis looks at the probability of 16 firefighters in 10m20s, we note that NFPA 1710 Moderate Hazard Standard is 28FF in 10m20s.



High Risk – ERF Probability of Arrival

Once again, only the areas around the central two stations can approach 60% of target performance, while the high hazard zones around station 3 and 4 are not covered with an effective response force.

While this analysis looks at the probability of 16 firefighters in 10m20s, we note that the NFPA 1710 High Hazard Standard is 43FF in 12m30s.



Future Demand Modelling

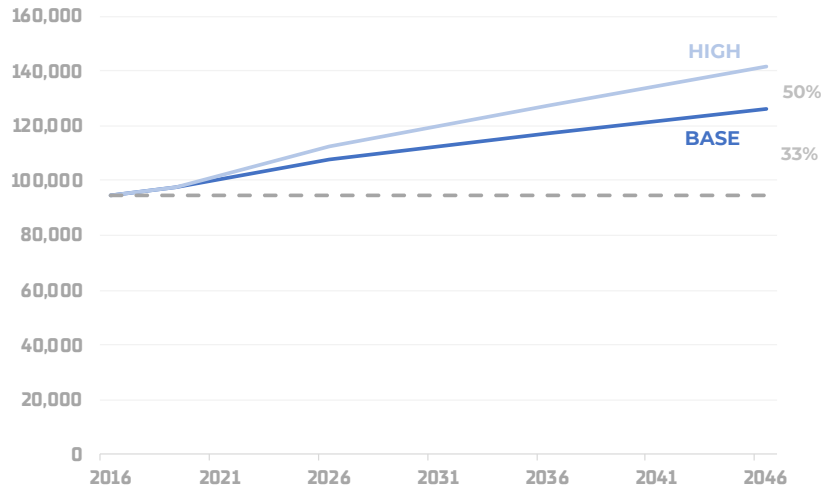
Appropriate demand forecasting is key to ensure response effectiveness viability over the long term. Incident demand follows fluctuations in population. Simply put, where there are people, there will be incidents requiring emergency services.

Nanaimo's incident volumes and locations are predicted to increase in accordance with the current demand locations and population (and employment) growth forecast.

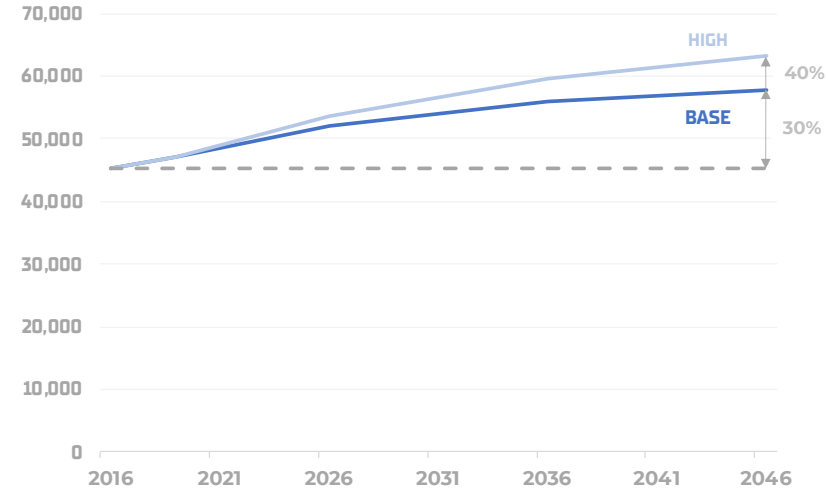
Community Growth

As the City grows and develops, there will be an increased demand for fire services. The total population has already surpassed 100,000 (as of 2021) and is estimated to grow by 1% yearly between 2016 and 2046, with the largest growth rate seen in the 85+ age group.

Population Growth Forecast



Employment Growth Forecast



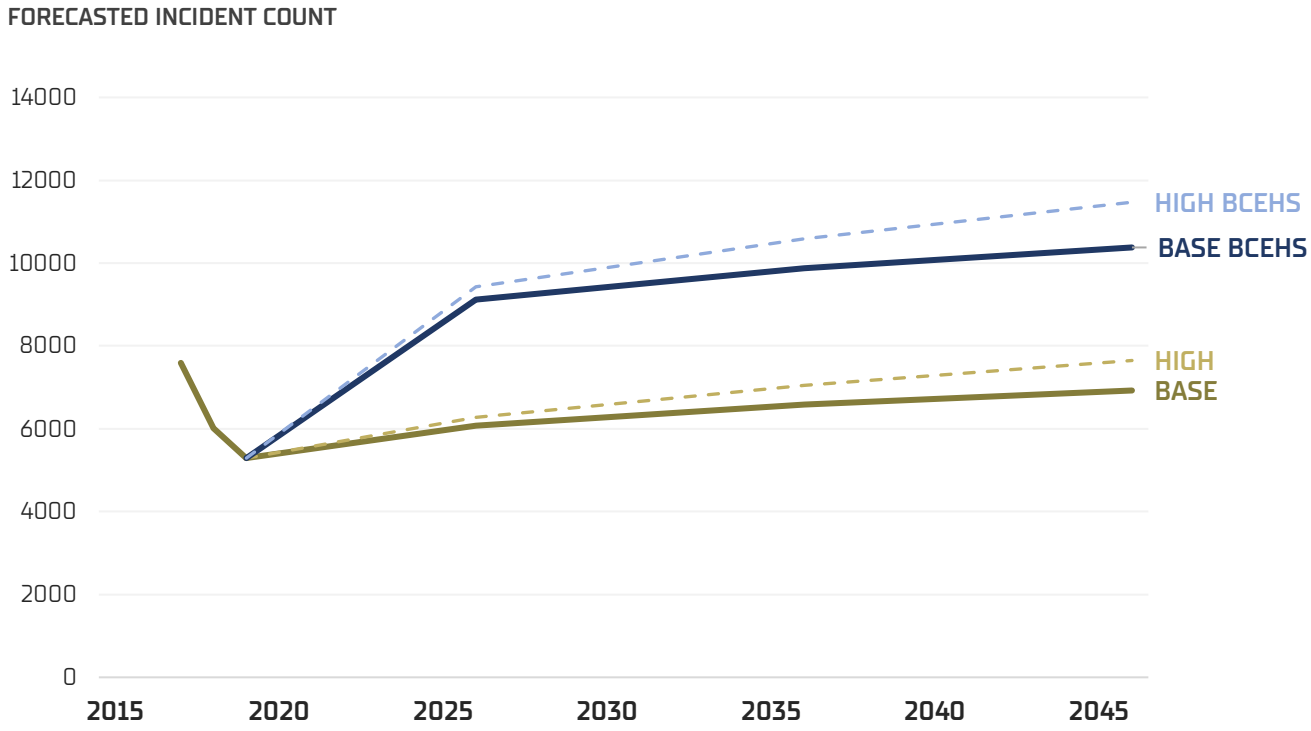
Incident Demand Forecasting

Future incident demand was predicted based on a model built from historical data. Given the changes by BCEHS in June 2018, forecasts were built using 2017 data as the basis for the prediction, as well as 2019 data. Both base and high case forecasts were built using population and employment data provided by the City. The forecast was primarily driven by the Official Community Plan (Jan 2019) and the the Nanaimo Population, Housing & Employment Projections developed by VannStruth Consulting in June, 2020. These forecasts align with the Reimagine Nanaimo City Plan.

Given the uncertainty around BCEHS policy and its impact, we have created a second forecast that begins from a higher starting point (the blue line). Given the communications from BCEHS and the corresponding increase in call volume, we believe that the true incident count will more closely match the blue line.

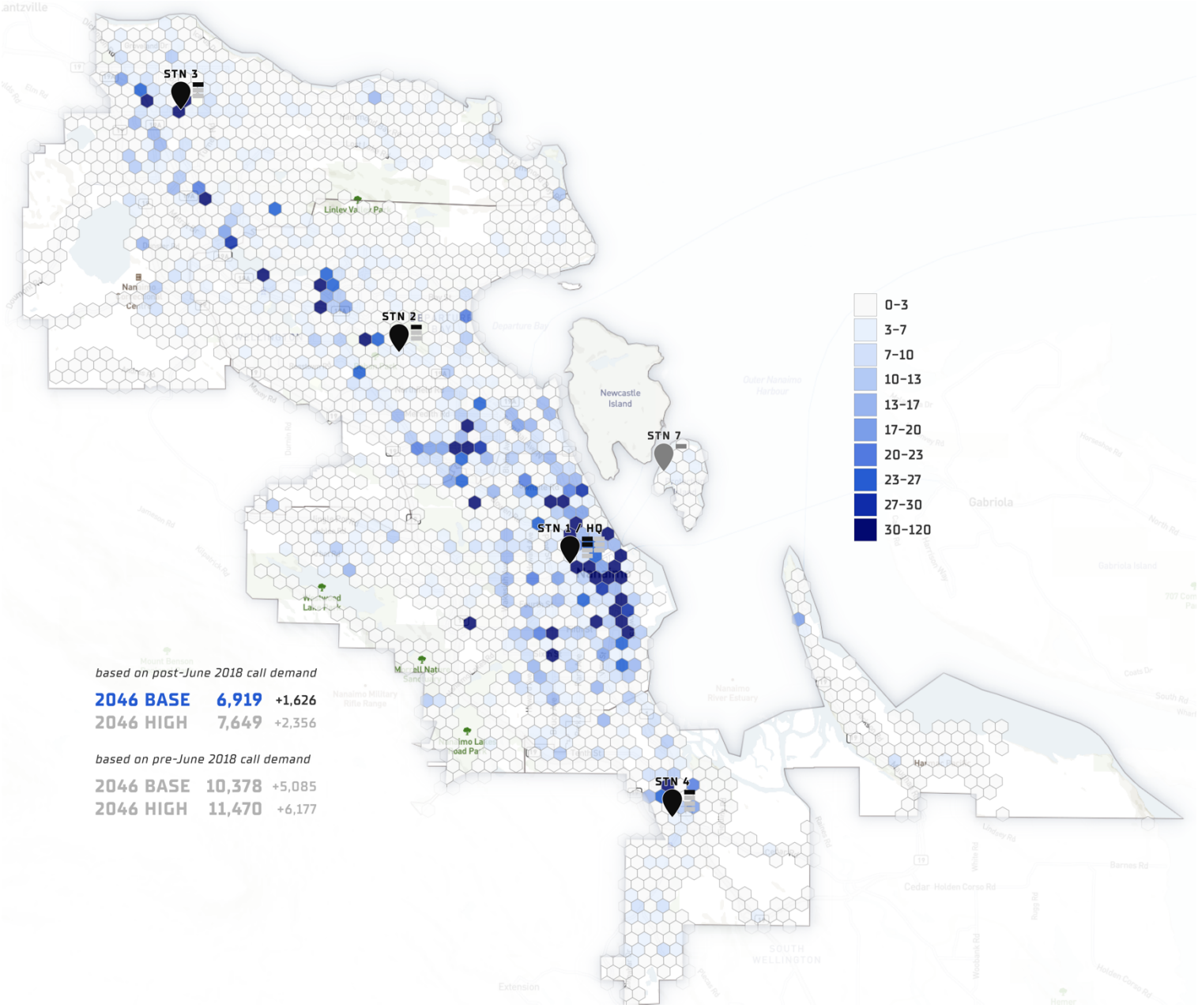
The population is forecasted to grow by 33% from 2016 to 2046 in the base case, and 50% in the high case. Employment is expected to grow by similar amounts of 30% in the base and 40% in the high case.

The forecast shows an increase in incidents of approximately 1,625 in the base case and 2,350 in the high case by 2046. If we assume the higher starting point from BCEHS, then NFR can expect in excess of 10,000 calls/yr by 2045 and potentially as high as 11.500.



A unique call rate was calculated for each planning zone based on the population and employment forecasts and the current incident density. Using this information future response effectiveness can be estimated.

FORECASTED 2046 (BASE) EMERGENT INCIDENT DEMAND – SPATIAL



The map above represents the spatial pattern of incident demand that we expect over the next 25 years. Although are some changes, the general pattern of a "corridor of incidents" will continue.. The city core and transportation corridor will experience Ithe majority of the growth and continue to drive demand. The demand around the Hammond Bay, Westwood, and Wellington areas are expected to remain relatively constant.

Future Demand Scenario Modelling

Scenario modelling is used to investigate possible strategies to increase performance over time. The Darkhorse method is a probabilistic approach of determining response drive times and performance both now (what happens if we close 1 station?) and in the future (what will our response performance be in 10-years?)

We determine the most likely route travelled for all emergency responses in the dataset using standard routing methods

- Determine most likely route travelled for all emergency responses in the dataset using standard routing methods.
- Model average travel time as a function of distance using historical actuals in each zone.
- Model variability as a function of average travel time in each zone.

For the scenarios, we focused the incident demand derived from the 2046 high population forecast and for context included the current demand and 2046 high estimate (included the potential increase on medical first responses). Impacts on speed (first due) and weight (17 firefighter ERF) are noted for each scenario provided.

Scenario Exploration

The overarching goal was to explore resource options to increase response performance for both First Due and the 17FF ERF, towards attaining the targeted time 90% of the time. As part of this endeavor, we tested several interventions to see which changes to station configuration, deployment, or staffing would have the greatest positive impact.

The series of interventions represents our recommended scenario for the 10-year lifetime of this master plan. It provides the best combination of performance improvement and risk reduction while accounting for the fiscal realities facing the City:

Intervention	Description	Objective
A	Staff Rescues at Stn1 and Stn2 (4FF)	Reduce busy problems; improve ERF
B	Add Stn5 (Townsite Rd & Boundary Cr.)	Reduce distance, driving, and busy problems; Improve ERF
C	Add second engine crew at Stn1 (4FF)	Improve ERF; Reduce busy problems

Given the gap in current performance, interventions A and B should be committed to early in the life of the master plan.

We looked at three additional long-term options to keep pace with the City's growth. We do not see these as recommendations, but as directional considerations that should be reviewed over time.

- Add Station 6 (19A and Mostar Rd)
- Move Station 2 (Departure Bay and Norwell)
- Add a crew to Station 2.

A. Increase staffing in Stations 1 and 2

Staffing the two rescue units in stations 1 and 2 brings a significant improvement in both First Due and ERF performance. It also brings NFR closer to parity with its peers like Kamloops or Saanich. Finally, it reduces risk exposure. Unlike the peers evaluated in this report, Nanaimo does not have the luxury of robust and timely mutual aid. NFR is substantially on its own in the critical early part of a major incident. Staffing the two rescues reduces this exposure.

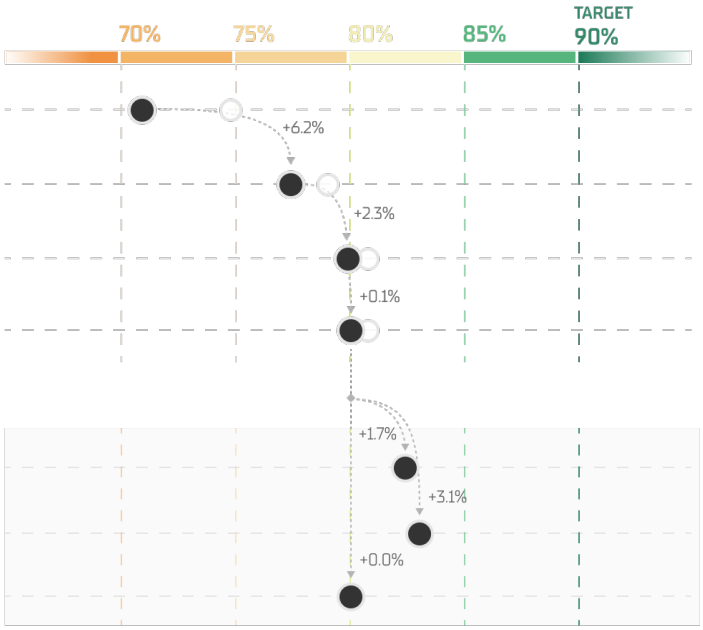
B. Add Station 5 near Townsite Rd & Boundary Cr.

The optimal next location for a fire hall is at approximately Townsite Rd and Boundary Cr. This location provides excellent first response in an already incident dense and growing area, additional support to zone 1, and an enhanced ability to assemble a larger force in an appropriate amount of time.

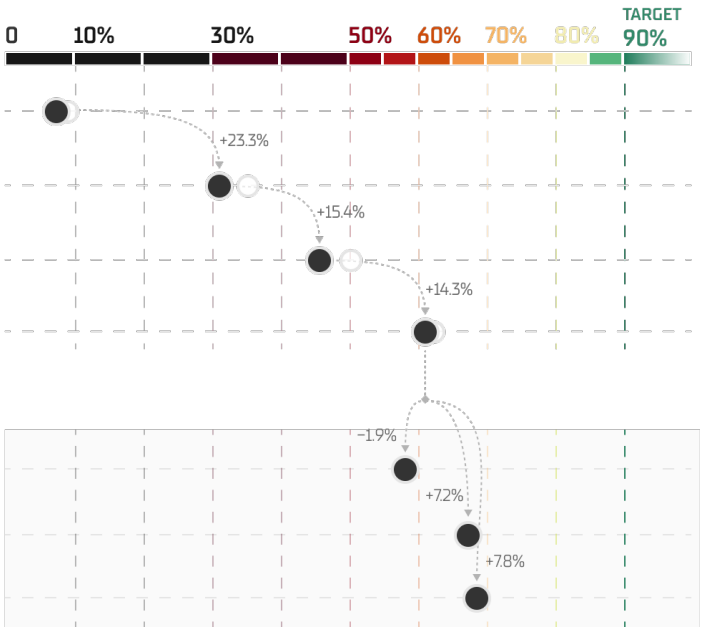
C. Add a Second Crew at Station 1

Placing an additional crew into Station 1 is the last step in building a more resilient service to serve the Nanaimo of the future. Adding this crew takes the total FF FTE to 28 and paves the way for NFR to begin meeting medium hazard structure fires with an effective response force in a timely manner. It provides excellent coverage in the downtown core and brings ERF performance up to 60% City-wide.

First Due

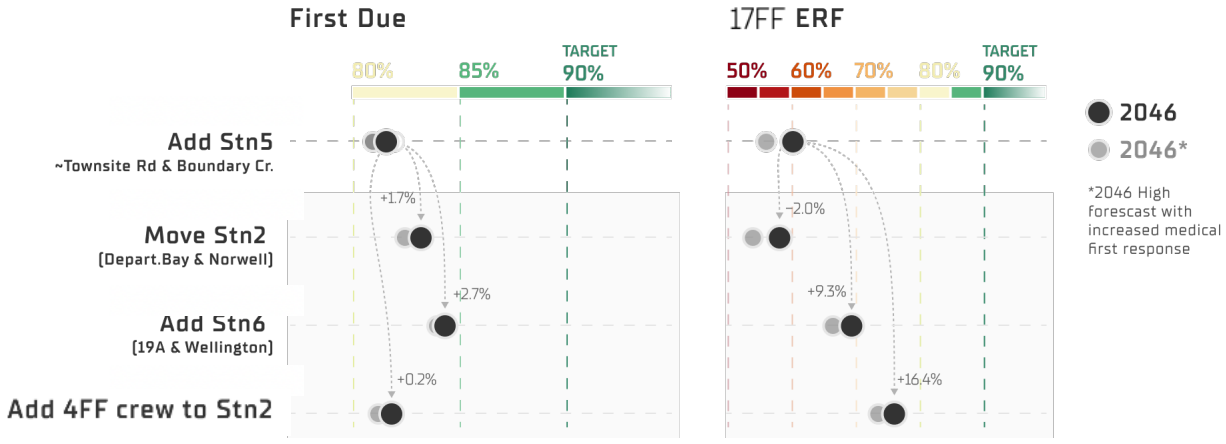


17FF ERF



Longer Term Considerations

Given the current forecast, there are number of scenarios that could improve the speed and weight of response. These interventions are medium- to long-term and should be revisited as the growth picture becomes clearer.



Other Findings

Previous Plan (2005) Recommendations

The 2005 Standards of Cover suggested new Station locations at Hammond Bay and Westwood.

- The Westwood location is still reasonable, however the recommended location around Townsite Rd & Boundary Cr. has a far more impact.
- The incident demand in Hammond Bay is low and looks to remain so for the future. A new station here would not be busy enough to support a crew.

Training Centre Location

- The ability to provide on-shift training is essential to NFR's operational success while being fiscally responsible. The current location is optimal for the foreseeable future.

Duke Point

- Incident demand here is very low, but consequence is high if there is an incident. We recommend focused mitigation efforts be used to reduce the risk.

Appendix

Stakeholder Engagement

Community Profile

Jurisdictional Scan and Benchmarking Study

Industry Standards and Best Practice

Response Diagnostics

Deployment Modelling

Methodology

Stakeholder Engagement

Themes

Themes	Review from Interviews

Communication & Collaboration with City	• Fire Chief sits on management committee
	• Massive improvement from historical communication and relationships
	
	Relationship with FD
	• Shows up and is professional
	• Chief's team is excellent
	• Work a little with staff on planning
	• Running EOC exercises (desktop)
	  ○ Team is on top of everything
	  ○ Very accommodating
	• Tight control on budget
	A+

Training	• Should the Training Centre move? What would be the impacts?
Management	• Understaffed
Community Partner Relationships	• Primarily healthy, open communication • Concerns with BCEHS

Risks & Challenges	Biggest risk - managing approx. 500 hectares of natural wildland
	  ○ Westwood area
	  ○ Protection Island
	  ○ New Castle Island
	• Would be nice to have a more systemic approach to wildland interface risk
	• High fuel load
	  ○ fuel reduction strategies?
	  ○ Matter of time?
	
	HAZMAT training
	• Gas, Chlorine, Ammonia
	  ○ Know the systems better
	• Operating Guidelines
	  ○ can they enter certain public facilities (HAZMAT)?
	  ○ Access and understanding to all utility buildngs
	  ○ Venues, owned by city but run by a third party (Eg: curling club HAZMAT)
	  ○ Integrating training approach
	
	Vulnerable population
	• Homelessness – encampment issues
	  ○ Arson
	  ○ Cooking fires
	• Opioids
	
	Climate change adaptation
	
	Duke point
	• changes coming - the main shipping terminal is moving to Duke Point
	  ○ Higher traffic expected

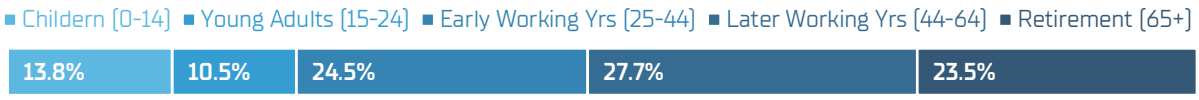
	○ Big expansion
Deployment	• BC building code - spatial separation when drive times are over 10min ○ Bunch of work done ○ Karen brought in a group, but in house analysis ○ Defendable map of where the 10min response area • Response availability ○ Training response - FF can train on there on, and are available ○ Scheduled training - notifies dispatch - put into "training" - started 3mo (May 14) ○ Response matrix - OC ○ All training on shift • Decision to move NExtGen911 to another provider was an excellent choice
Public Perceptions	
Health & Wellness	
VIERA	• Administrative staffing concerns ○ Who should run it? ○ It is a viable business unit, but will require focused effort to maintain and improve • Main goal is to bring in revenue to offset budget • Bonus – subsidized training for NFR staff
Community Growth	• Sandstone development • Duke Point expansion • New street standard – narrower streets, less storefront access • Nanaimo does have a sprinkler bylaw - above and beyond want BC requires ○ 4 units and up (lowers risk) • Aggressive growth last few years ○ Last 20yrs - only single fam ○ Now 50/50 mid-rise buildings ○ Now - purpose build rentals ○ Long time trying to get growth around urban centres and malls • Now becoming one of their biggest assets

Community Profile

Land Use Zones and Risk

Category	Zone Name	Abbreviation	Risk
Residential	Single Dwelling Residential	R1 / R1a / R1b	Low
Residential	Single Dwelling Residential - Small Lot	R2	Low
Residential	Island Residential	R3	Low
Residential	Duplex Residential	R4	Low
Residential	Three and Four Unit Residential	R5	Moderate
Residential	Low Density Residential	R6	Low
Residential	Row House Residential	R7	Low
Residential	Medium Density Residential	R8	Moderate
Residential	High Density (High Rise) Residential	R9	High
Residential	Steep Slope Residential	R10	Moderate
Residential	Recreational Vehicle Park	R11	Low
Residential	Mobile Home Park Residential	R12	Low
Residential	Old City Duplex Residential	R13	Moderate
Residential	Old City Low Density (Fourplex) Residential	R14	Moderate
Residential	Old City Medium Density Residential	R15	Moderate
Agricultural Rural Residential	Rural Resource	AR1	n/a
Agricultural Rural Residential	Urban Reserve	AR2	n/a
Corridor	Residential Corridor	COR1	Low
Corridor	Mixed Use Corridor	COR2	n/a
Corridor	Community Corridor	COR3	n/a
Commercial Centre	Local Service Centre	CC1	Moderate
Commercial Centre	Neighbourhood Centre	CC2	Moderate
Commercial Centre	City Commercial Centre	CC3	Moderate
Commercial Centre	Woodgrove Urban Centre	CC4	Moderate
Commercial Centre	Hospital Urban Centre	CC5	High
Commercial Centre	Commercial Recreation Centre	CC6	Moderate
Downtown	Core	DT1	Moderate
Downtown	Fitzwilliam	DT2	Moderate
Downtown	Wallace	DT3	Moderate
Downtown	Terminal Avenue	DT4	Moderate
Downtown	Chapel	DT5	Moderate
Downtown	Port Place	DT6	Moderate
Downtown	Quennell Square	DT7	Moderate
Downtown	Old City Mixed Use	DT8	High

Downtown	Old City Central	DT9	High
Downtown	Old City Infill Business Commercial	DT10	Moderate
Downtown	Old City Infill Service Commercial	DT11	Moderate
Downtown	Gateway	DT12	Moderate
Parks, Rec, and Culture	Parks, Recreation and Culture One	PRC1	n/a
Parks, Rec, and Culture	Parks, Recreation and Culture Two	PRC2	n/a
Parks, Rec, and Culture	Parks, Recreation and Culture Three	PRC3	n/a
Industrial	Highway Industrial	I1	High
Industrial	Light Industrial	I2	Moderate
Industrial	High Tech Industrial	I3	High
Industrial	Industrial	I4	High
Community Service	Community Service One	CS1	High
Community Service	Community Service Two	CS2	High
Community Service	Community Service Three	CS3	n/a
Waterfront	Waterfront	W1	n/a
Waterfront	Harbour Waterfront	W2	Moderate
Waterfront	Newcastle Waterfront	W3	Moderate
Waterfront	Industrial Waterfront	W4	High



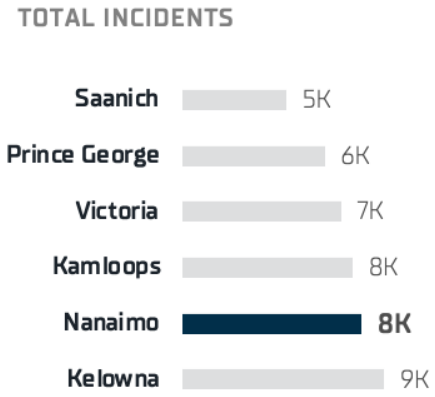
Percent of population by age

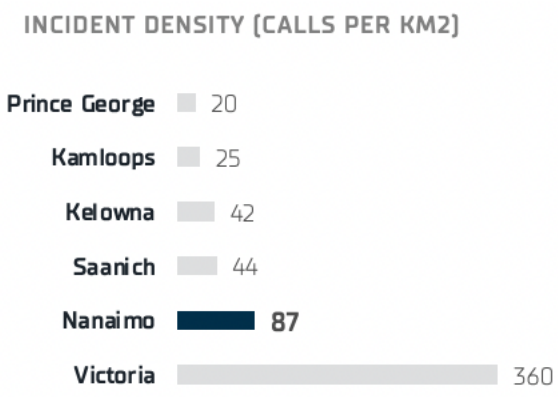
Jurisdictional Scan and Benchmarking Study

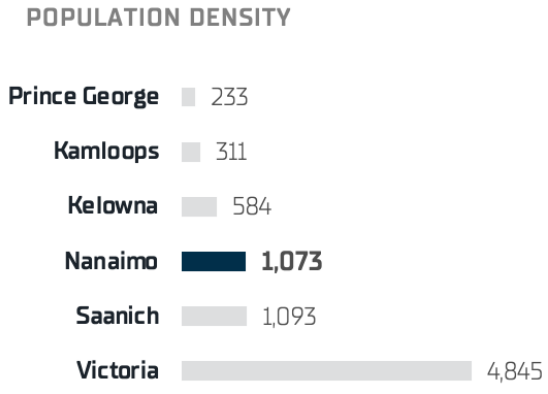
As part of the review, NFR was compared with 5 urban, career departments chosen for a broad range of factors. Information from each service was requested and gathered, and the results tabulated to understand how NFR and Nanaimo compared against a cohort of similar services.

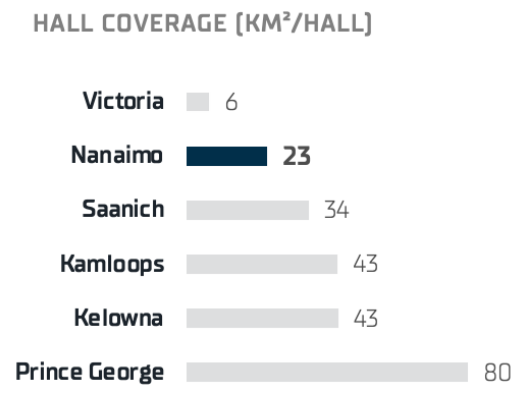
Service Area Profile

SERVICE	POPULATION	AREA (km2)	STATIONS	FTE STAFF	TYPE OF SERVICE
Nanaimo	99.9k	91.3	4	105	Career/POC
Saanich	123.2k	103.4	3	140	Career/POC
Kelowna	143.0k	214	5	140	Career/POC
Kamloops	100.0k	299	7	130	Career/POC
Prince George	81.23k	318	4	148	Career
Victoria	94k	19.4	3	123	Career





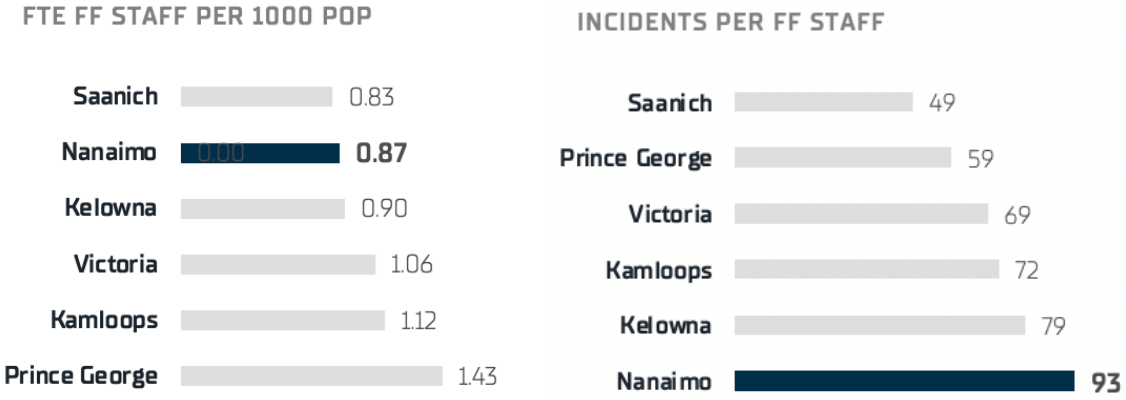




Incident & response comparisons

Nanaimo has a high population density and a high density of incidents (second only to Victoria) compared to other regions, and thus and thus a higher density of halls in order to respond to the underlying demand..

Staffing comparisons



Relative to other departments, only Saanich has a lower number of firefighters per population unit while only Kelowna has a higher incidents per FF staff.

Benchmarking Study Summary

Throughout the comparison, we see that Nanaimo Fire & Rescue consistently do more with less. Relative to the population and the incident numbers, there are a low number of total firefighters.

It is also noteworthy that Nanaimo shows a very high incident density, higher than would be expected for the population density. This could be due to risk factors and may suggest that further focus on prevention and education which should work to decrease total incidents.

Industry Standards and Best Practices

Emergency incidents include situations with the most severe time constraints. An effective response system is one that can consistently mitigate emergencies in an appropriate time for the risks involved, thereby increasing the likelihood of a positive outcome for the communities' values at risk

Time is the critical factor for people and property in an emergent incident.

Incident Lifecyle

Every incident has a cascade of events, starting from incident initiation and completing once the emergency is resolved, and the location has returned to its normal state.

INCIDENT CASCADE OF EVENTS

The response system is not activated until there is a notification of the incident. From the time of 9-1-1 receiving the call, an ideal effective deployment system is beginning to manage the problem within 7:00 to 8:00 minutes. This is right at the point where an incident can escalate, such as brain death becoming irreversible, or a fire has grown to the point of leaving the room of origin and becoming very serious.

Once on scene, the situation is assessed, and mitigation action commences. Effectiveness on scene is determined by training, critical tasking and pre-plans, appropriate equipment, and number of staff.

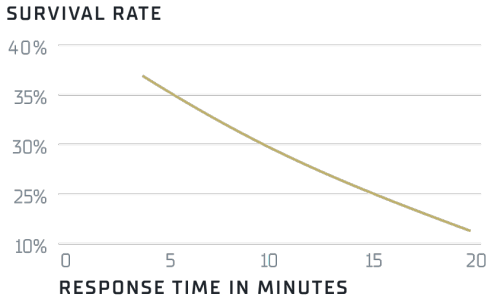
Protect the Community

The values at risk in any community are the people, buildings, and critical infrastructure. Should an incident occur, time becomes the critical factor in mitigating the situation.

Cardiac Arrest

For example, the brain can only survive 5:00–6:00 minutes without oxygen. Cardiac arrest and other events can cause oxygen deprivation to the brain. Numerous studies have shown that without CPR/defibrillation, survival rates drop around two percent for every additional minute of response.

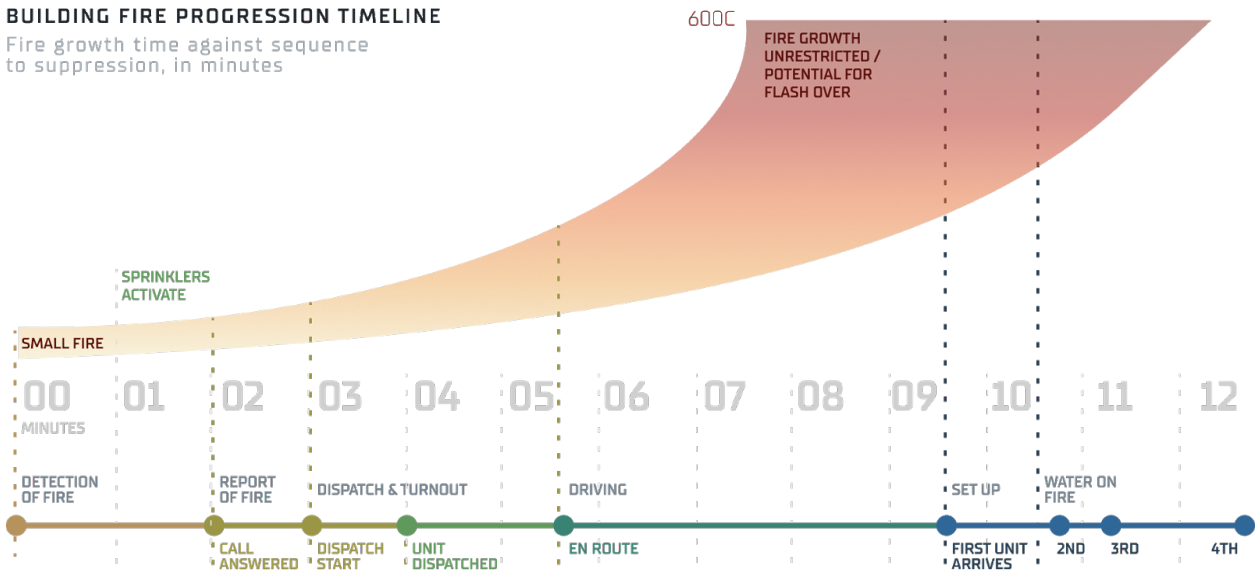
Survival rate drops ~2% for every additional minute of response time.



"Response times and outcomes for cardiac arrests in Las Vegas casinos" by Karch et al, 2010

Structure Fires

Today, fires reach hotter temperatures more quickly due to building geometrics, larger homes, increased fuel loads, and changing construction materials. In a building fire, a small incipient fire can grow to involve the entire room in a 6:00 to 8:00 minute time frame.



As well, studies have shown that property damage increases by ~3% for each additional minute of response.

If the response system is to achieve positive outcomes in severe fire and emergency situations requiring an ERF, all responding crews must arrive, assess the situation, and deploy effective measures before the situation escalates.

Protect the Responders

Due to the nature of the work, there is a consistent risk to responders due to the uncertainty when arriving at any incident, responders cannot safely operate without the right number of personnel. The department develops critical tasks for each incident type and pre-plans for typical and higher risk incidents (eg: structure fires) with detailed critical tasks required to control the incident as quickly as possible. The fewer the number of responders on scene - for first response, second response, and full alarm response - the longer the critical tasks take, thereby increasing risk to all values involved. Appropriate staffing becomes a health and wellness concern for employees as much as improving the effectiveness of the response system.

For services with full-time crews, NFPA 1710 recommends that each company be staffed with four firefighters, including an officer, and that the company officer must operate as a part of the company to supervise and oversee safety. For POC crews (Protection Island), mitigation efforts shouldn't begin until at least four firefighters, including an officer, arrive on scene.

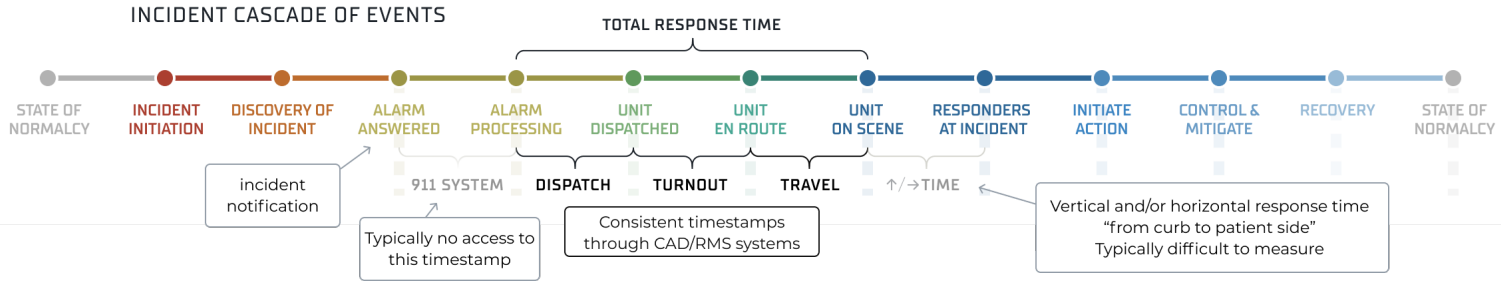
In 2010, the National Institute of Standards and Technology (NIST) released a study on the effectiveness of two to five-person crews. The results indicated that the four-person crew is more effective than smaller crews.

Response Standards

The purpose of response standards A municipality should have response targets that are within a range to give an emergency situation hope for a positive outcome.

Response intervals are time increments in the cascade of events that the system is able to measure consistently. A Communications Center's Computer Aided Dispatch (CAD) system typically collects timestamps for dispatch, turnout, and travel times.

Response Intervals



In most fire services, it is difficult (and often not possible) to receive timestamps from the initial receipt of the 911 call (Alarm Answered), thus the industry-standard total response time measurement starts at the time the call is transferred to the department's dispatch service.

The dispatcher identifies the issue and dispatches the appropriate resources. Once dispatched, the crew assembles and drives to the incident location.

Upon scene arrival, the crew must approach the patient or emergency, assess the situation, and appropriately deploy its skills and tools. Even in easy-to-access situations, this scene set up can take 2:00 minutes or more. This time frame may be increased considerably due to long driveways, apartment buildings with limited access, multi-story apartments or office complexes, or shopping center buildings.

Unfortunately, there are times when the emergency has become too severe for the responding crew to reverse. However, when an appropriate response time policy is combined with a well-designed deployment system, only anomalies like bad weather, poor traffic conditions, or multiple emergencies slow down the response system. Consequently, a properly designed system will give citizens the hope of a positive outcome for their tax dollar expenditure.

For this report, total response time is the sum of the agency's fire dispatch center's dispatch time, crew turnout, and road travel time. This is consistent with best practice recommendations.

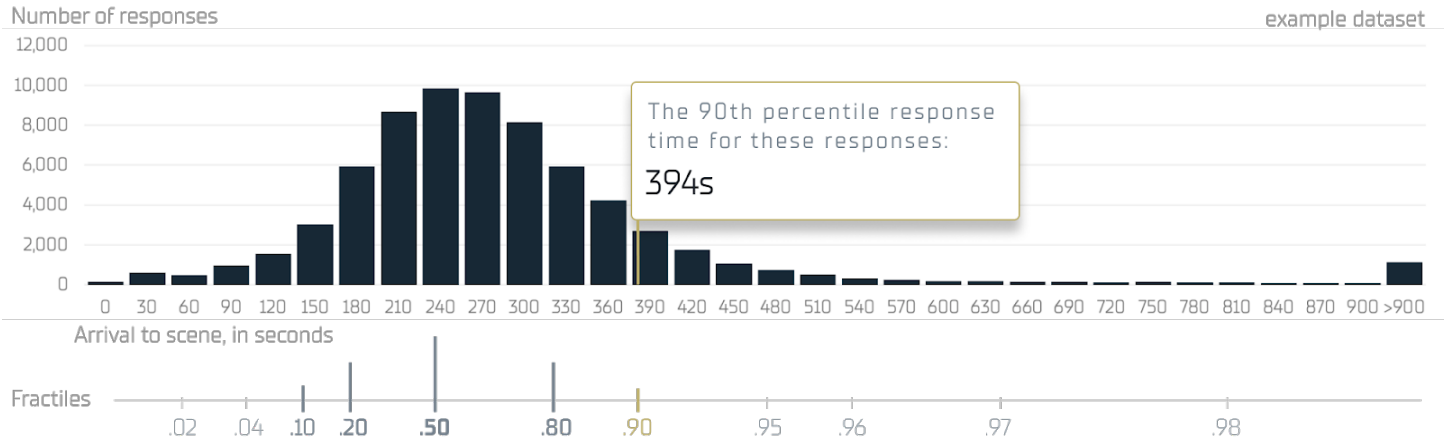
Measuring Response Times

Time is the critical factor in mitigating emergencies.

Industry best practice is to use percentiles (typically the 90th for urban and 80th percentile for rural) when measuring response times as opposed to the average response time. Using an average makes it impossible to know how many incidents had response times that were far above the average or just above. By using a distribution of response times for all responses, the percentile (or fractile) time can be more easily understood. This is an accurate method to examine the service delivery of a department.

One way to view using the 90th percentile target time, is to say that nine out of ten responses will arrive in this amount of time or less.

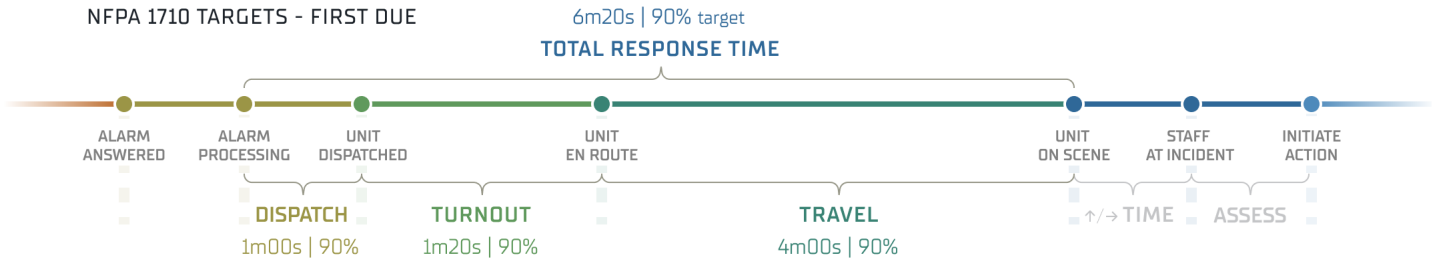
Example of a response time distribution, with 90th percentile time

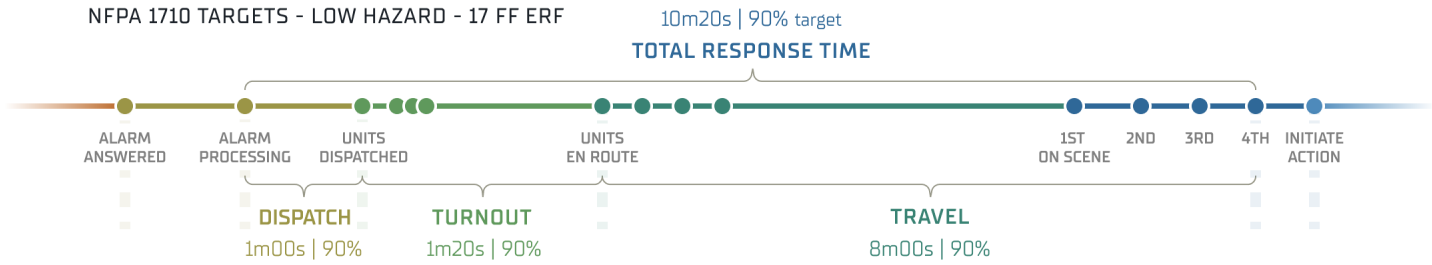


Once a time benchmark or target is set, the service can then measure its response performance, with the goal of continuous improvement toward positive outcomes.

NFPA Standards

The National Fire Protection Association (NFPA) is the industry standard for response benchmarks. It has three primary response standards, NFPA 1221 for alarm handling, NFPA 1720 for volunteer/POC, rural and suburban services, and NFPA 1720 for career, urban services.





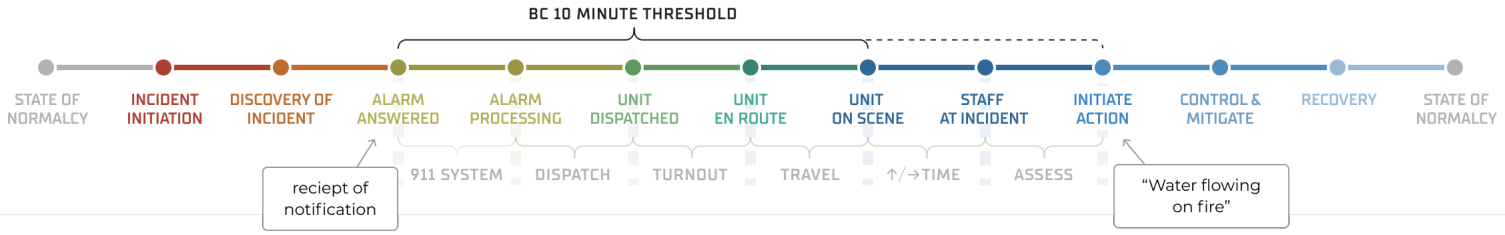
British Columbia Building Code Response Time Threshold

The BC Building Code recognizes a 10-minute (90th percentile) response time target defined in the BC Building Code 2018

As noted, Office of Housing and Construction Standards information bulletin:

The BC Building Code uses different criteria to establish spatial separation requirements for un-sprinklered buildings, depending on the response time of a fire department. Where the response time, measured according to the parameters in the BC Building Code, exceeds 10 minutes in 10% or more of the calls to the building, requirements related to limiting distance may be affected.

Its primary purpose is to inform safer building and community standards. However, this threshold has and is being used in municipalities across the province, however, it does not



fully address the challenges and opportunities to maintain and improve an effective response system.

MEDICAL

03 Medical
- Ambulance O.S
  - Services Required
  - Not required
- Good Intent
- Industrial Accident
- Medical Assist (lift,etc.)
- Medical Response
  - Priorities A, B, C, D, E
- Multiple Casualty Incident
- Patient refused service
- Stood down by BCAS

FIRE & ALARMS

01 Structure

02 Outdoor

02 Wildland
- Brush/Landscape Fire
- Brush/Wildland Fire

02 Vehicle
- Car Fire with Exposures
- Car/Vehicle Fire

05 Alarm
- Activated
  - CO Detector
  - Smoke /Heat Detector
- Alarm Pulled
- Automatic Fire Alarm
- Caller Hang-up
- Fire Alarm/system trouble
- Fire Drill not reported to F.D.
- Good Intent
- Prank Call
- Reset Prior to Arrival
- Smoke Alarm
- Sprinkler System

RESCUE & MVI

06 Rescue
- Collapsed Building
- Confined Space
- Elevator
- High Angle/Embankment Resuce
- Locked in/out
- Water Rescue - Harbour
- Water Rescue - Lakes
- Water Rescue - River/Creek

08 MVI
- MVI - Medical
- MVI - Services not required
- MVI - Extrication
- MVI - False alarm - Code incident
- MVI - Fire
- MVI - Fuel Release
- MVI - Incident Stabilization
- MVI - Minor

OTHER

04 Public Service
- Activated Medical Alarm
- Assist Police
- Illegal Burning - complaint
- Legal burning - complaint
- CO Detector
- Electrical Malfunction
- Hydro wires down
- Investigation mechanical malfunciton
- Investigation - odor/smoke
- Unclassified

07 HAZMAT
- Car/Vehicle leaking fuel
- Hazmat Spill/Leak
- Natural gas leaks and odor
- Spill/Leak Non-Hazmat

10 Other
- Extension
- No Response

CANCELLED

Cancelled

Data issues

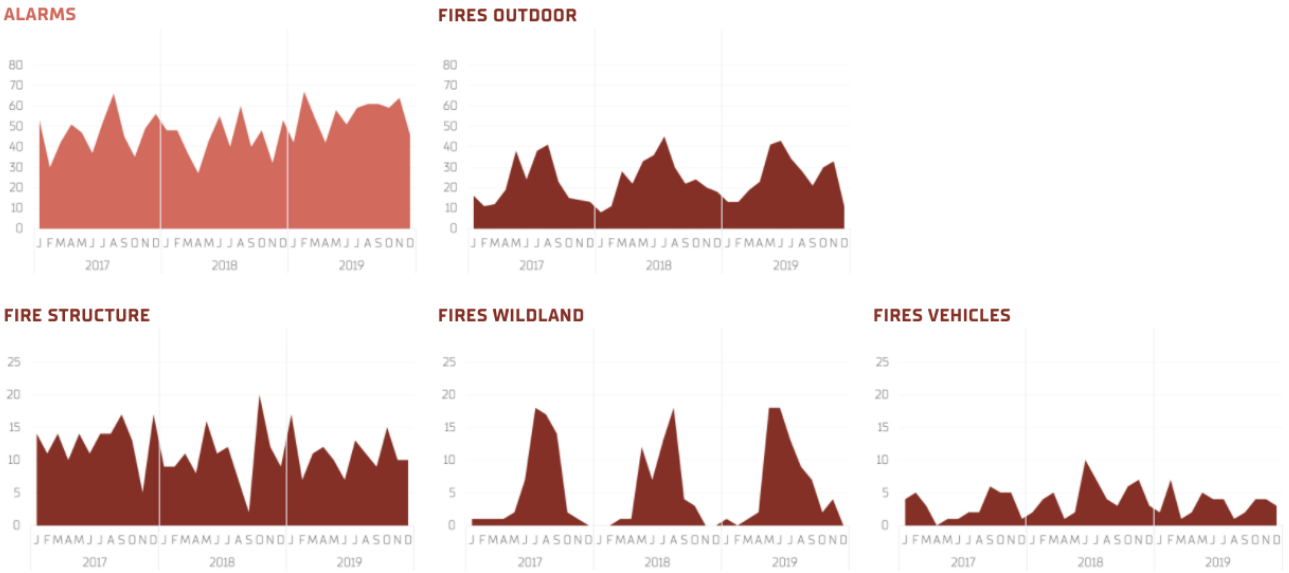
Response Diagnostics

Fire & Alarm Incidents

Alarm responses have increased in the last half of 2019. Alarm reports are an indication of fire risk in the community and require an effective response force to be assembled.

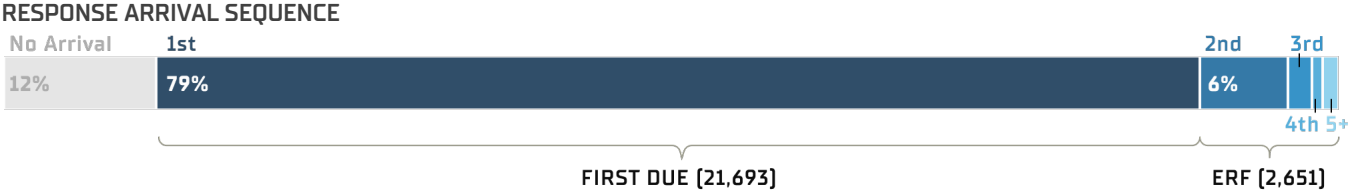
Outdoor fires peak in the spring and summer and have shown consistent patterns over time. Fire structures appear to have decreased in 2018 and 2019 from 2017 levels. Woodland fires peak in the summer months and show roughly similar patterns with perhaps a longer season into the fall in 2019. Vehicle fires are relatively low and show consistent patterns.

Fire categories, by month



Responses

NFR typically only sends one crew/apparatus to an incident. This is efficient and due to limited resources.

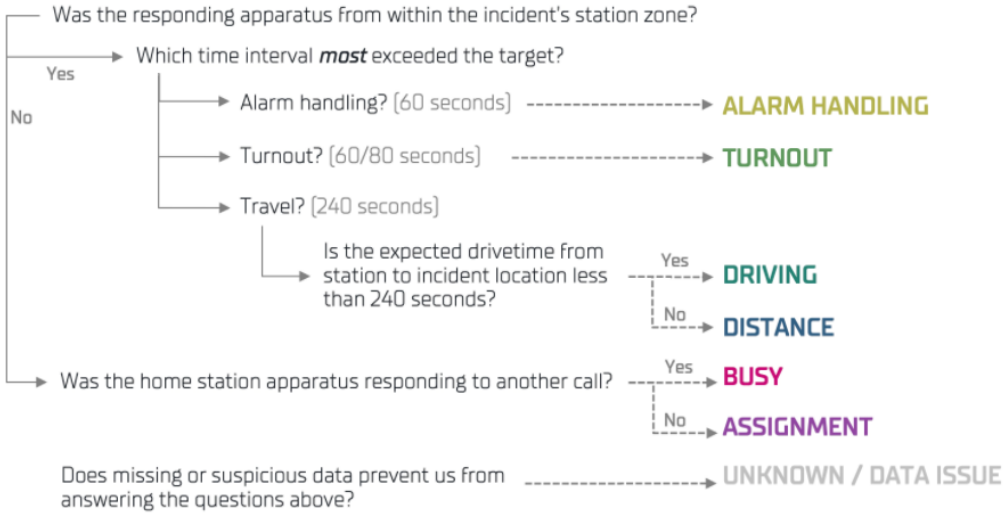


There are four primary incident risk categories that NFR typically responds to. They are medical, fire and alarms, rescue and MVI, and all Other. Cancelled calls shown in grey.

When an incident is dispatched, 25.4% of the time there is at least one other incident occurring. This trend saw a marked decrease after the BCEHS policy change in June 2018, although there does appear to be a slight increasing trend starting mid 2019.

Overgoal Analysis

The overgoal analysis examined the reasons for calls exceeding their target. This can provide insight into opportunities for improvement. Responses were defined as overgoal if they were over the targeted 90th percentile time. Approximately 4,813 (25%) of NFRs responses were overgoal. A root cause that is primarily responsible for the response being over target is assigned according to the following flowchart:


Was the responding apparatus from within the incident's station zone?
Yes
Which time interval most exceeded the target?
Alarm handling? (60 seconds)
ALARM HANDLING
Turnout? (60/80 seconds)
TURNOUT
Travel? (240 seconds)
Is the expected drivetime from station to incident location less than 240 seconds?
Yes
DRIVING
No
DISTANCE
No
Was the home station apparatus responding to another call?
Yes
BUSY
No
ASSIGNMENT
Does missing or suspicious data prevent us from answering the questions above?
UNKNOWN / DATA ISSUE

Forecast

BASELINE SCENARIO						HIGHER-GROWTH SCENARIO				
	2016	2026	2036	2046	Average Growth	2016	2026	2036	2046	Average Growth
Population	**94,525**	**107,779**	**117,374**	**125,970**	**1.0%**	**94,525**	**112,272**	**127,612**	**141,339**	**1.4%**
Age 0 to 14	13,351	15,284	15,463	16,289	0.7%	13,351	16,092	17,088	18,578	1.1%
Age 15 to 24	10,834	10,991	12,487	12,882	0.6%	10,834	11,570	13,781	14,678	1.0%
Age 25 to 34	12,372	12,055	12,099	13,785	0.4%	12,372	12,634	13,397	15,712	0.8%
Age 35 to 44	10,811	14,464	14,031	14,243	0.9%	10,811	15,042	15,328	16,185	1.4%
Age 45 to 54	12,228	12,636	16,105	15,831	0.9%	12,228	13,214	17,394	17,765	1.3%
Age 55 to 64	14,279	13,695	13,990	17,485	0.7%	14,279	14,269	15,265	19,380	1.0%
Age 65 to 74	11,457	15,140	14,510	14,993	0.9%	11,457	15,704	15,737	16,809	1.3%
Age 75 to 84	6,102	10,045	12,891	12,565	2.4%	6,102	10,279	13,688	13,881	2.8%
Age 85+	3,092	3,469	5,799	7,898	3.2%	3,092	3,469	5,935	8,352	3.4%

Modelling Methodology

Predictive modelling consists of creating a mathematical approximation of the real system that can be used to test "what-if?" scenarios and predict future outcomes. These models can be used to identify gaps and test different scenarios to support decision making and investment. For example, if a new fire station is to be built, what is the optimal placement? The model allows several different locations to be tested before any money is invested.

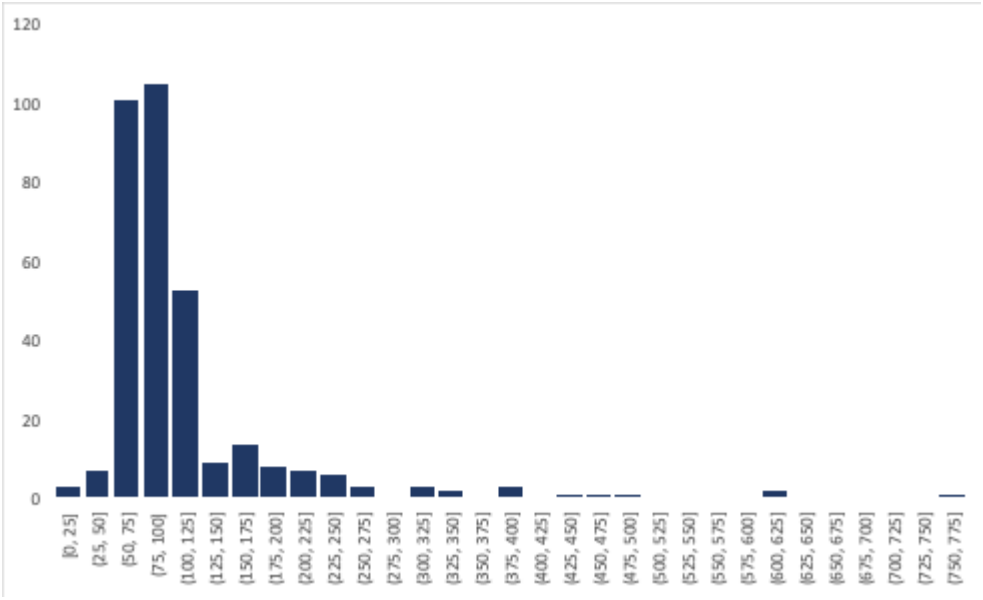
Drive time modelling can also be used in a spatial analysis to determine coverage performance. Since there is no actual drive time data from every station to every point on a map, a model has to be built to approximate the drive to all areas. This is done by fitting a mathematical equation to the real data.

Expected drive times derived from the model are used along a road network to determine the coverage given a travel target. Traditionally, results are binary, either the travel target was met or it wasn't at each distance in the road network. For example, if the travel target is 240 seconds, the figure below shows distances below 3000 meter are met within the target, but those over 3000 meters are not.

This approach, however, can lead to suboptimal results because in reality the cutoff between making a target or not is not binary. A certain number of responses will arrive 4000m away within the target time. Perhaps road conditions were perfect, or traffic was light. On the other hand, some responses will not meet the target even for close locations. In the above example, target attainment would be 50%.

To get a more accurate understanding of performance, it is preferable to use the probability of arriving at a location rather than a hard yes or no. Taking the same example as above, using probability of arriving within the target time yields a target attainment of 65%.

Looking at an example from Nanaimo, the figure below shows the drive times for 330 incidents from station 3 to the seniors village at 6081 Uplands Drive.



It can be seen that the travel time for the majority of responses is between 50 and 100 seconds. However, there are three responses under 25 seconds and six over 425 seconds. The modelled drive times are shown with the solid gold line.

Predictive Modelling Methodology

Darkhorse response modelling is a probabilistic approach of determining response drive times and performance both now (what happens if we close 1 station?) and in the future (what will our response performance be in 10-years?)

We determine the most likely route travelled for all emergency responses in the dataset using standard routing methods

- Determine most likely route travelled for all emergency responses in the dataset using standard routing methods.
- Model average travel time as a function of distance using historical actuals in each zone.
- Model variability as a function of average travel time in each zone.

TRADITIONAL METHOD

Expected drivetime is estimated along a road network, and results in a binary "coverage". This can lead to suboptimal decisions. Times modelled in seconds(s).

Distance	1000m	2000m	3000m	4000m
Average drivetime	99s	171s	243s	314s
Covered in 240s?	Yes	Yes	No	No

THE DARKHORSE METHOD

We model the probability of arriving within the target time. Times modelled in seconds (s).

Distance	1000m	2000m	3000m	4000m
Average drivetime	99s	171s	243s	314s
Probability of arriving in 240s	95%	83%	56%	24%

Modelling Outputs

First Due Response Performance

Using high estimate of demand and assuming reversion to pre-2018 BCEHS protocols.

		Performance (%)			
	Interventions	Current	2026	2036	2046
	Current	74.7	72.6	71.9	71.3
A	Staff Rescues at Stn1 and Stn2 (4FF)	78.4	77.8	77.7	77.5
B	Add Stn5 (Townsite Rd & Boundary Cr.)	80.8	80.2	80.0	79.8
C	Add second engine crew at Stn1 (4FF)	80.8	80.2	80.1	79.9
	From option C				
D	Add Station 6 (19A and Mostar Rd)			82.9	82.7
E	Move Station 2 (Departure Bay and Norwell)			82.5	82.3
F	Add a crew to Stn2			80.1	79.9

17FF ERF Expected Response Performance

		Performance (%)			
	Interventions	Current	2026	2036	2046
	Current	9.4	8.3	8.0	7.7
A	Staff Rescues at Stn1 and Stn2 (4FF)	35.6	32.5	31.5	31.0
B	Add Stn5 (Townsite Rd & Boundary Cr.)	48.5	47.4	47.0	46.4
C	Add second engine crew at Stn1 (4FF)	61.0	62.0	60.8	60.7
	From option C				
-	Add Station 6 (19A and Mostar Rd)			67.8	67.5
-	Move Station 2 (Departure Bay and Norwell)			59.0	58.8
-	Add a crew to Stn2			68.8	68.5