



CITY OF YELLOWKNIFE

Firehall Building Study

FINAL Report



July 22, 2020

City of Yellowknife
P.O. Box 580
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Yellowknife, NT
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Attention: Clem Hand, Manager Corporate Services & Risk Management

Firehall Building Study

Dear Mr. Hand,

Dillon Consulting Limited (Dillon) is pleased to provide you with the attached Firehall Building Study which addresses the spatial and functional requirements of the existing firehall while also considering the City of Yellowknife's future capital infrastructure needs.

We would be pleased to discuss any aspect of this Study and look forward to continuing to work together.

Sincerely,

DILLON CONSULTING LIMITED

A handwritten signature in blue ink that reads "J Pape".

Janny Pape
Project Manager, Associate

JP:knp

Our file: 20-2132

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Introduction

Dillon Consulting (Dillon) was retained by the City of Yellowknife (City) and the Yellowknife Fire Division (Y.K.F.D. or Division) to develop this Firehall Building Study (Y.F.B.S. or Study). This Study is intended to provide a comprehensive assessment of the City's existing firehall including; building condition, functionality and location to support the emergency response needs of a growing community.

The Y.K.F.D. operates as a fully integrated Fire/EMS model that provides both emergency fire and medical services. In 2019, the Division responded to approximately 4,500 calls for service including both emergency and non-emergent medical transports to and from the Yellowknife Airport. The Y.K.F.D. has recently transitioned from a staffing model that included the use of both paid on call and full-time time staff to the current operating model that utilizes solely full-time staff.

The Y.K.F.D. operates from a single firehall, located at 100 Taylor Road, originally constructed in 1989, with an addition being completed in 2010 to address the growing needs of the Division. In 2014 the City's Public Safety Communications Centre (P.S.C.C.) was also relocated from Public Works to this location. This Study will consider the current condition of the building including its amenities to support both the current and future administrative and functional needs of the Y.K.F.D. and its location to sustain effective and efficient emergency response services over the 20 year community planning horizon.

To further assist the City's decision making process, this Study includes options for Council's consideration in supporting the current and future facility needs of the Y.K.F.D. These options have been informed by a review of applicable legislation and standards, in addition to a number of previous related reports and studies completed by the City. The analysis within this Study was also informed by consultation with City and Y.K.F.D. staff. In response to the COVID-19 pandemic all consultation was done virtually, including a comprehensive firehall tour facilitated by Deputy Fire Chief MacLean.

The options presented within this Study include:

- A. Sustaining the existing location and completing renovations to the existing building;
- B. Sustaining the existing location, demolishing the existing building and constructing a new building;
- C. Completing A or B and considering a second satellite firehall; and
- D. Completing A or B and considering a second satellite firehall and a future third firehall.

The information presented within this Study also includes estimated financial impacts and order of magnitude costs for each of the options presented to further inform the decision making process and next steps within the overall firehall planning process within the City of Yellowknife.

2.0

Applicable Legislation, Standards and Occupational Health and Safety Regulations

2.1

Territorial Legislation and Regulations

This Study was prepared in consideration of the relevant territorial legislation and related regulations, including the Safety Acts of the Northwest Territories and Nunavut which govern the Occupational Health and Safety Regulations. This Study includes references to these governing documents as well as several codes including the Workers' Safety and Compensation Commission - Northwest Territories & Nunavut Firefighter Code of Practice and the National Building Code of Canada (2015).

2.1.1

Safety Acts of the Northwest Territories and Nunavut and the Occupational Health and Safety Regulations

This Firehall Building Study considers the requirements of the Occupational Health and Safety Regulations made under the Safety Acts of the Northwest Territories and in Nunavut.

The Occupational Health and Safety Regulation requires an employer to:

- (a) "Provide and maintain systems of work and working environments that ensure, as far as is reasonably possible, the health and safety of workers;
- (b) Arrange for the use, handling, storage and transport of articles and substances in a manner that protects the health and safety of workers;
- (c) Provide information, instruction, training and supervision that is necessary to protect the health and safety of workers; and
- (d) Provide and maintain a safe means of entrance and exit from the work site".

The Firefighter Code of Practice has been developed by the Workers' Safety and Compensation Commission (W.S.C.C.) in accordance with subsections 18(3) and 178(4) of the Northwest Territories and Nunavut Safety Act provides practical guidance to both the employer and worker that ensures procedures are in place to safeguard the health and safety of firefighters and the public.

Firefighter safety must be a high priority considering the activities and services to be provided by a fire department. This must include the provision of department policies and procedures, or Operating Guidelines (O.G.) or alternatively Operating Procedures (O.P.) that are consistent with the direction of the Safety Acts, the Occupational Health and Safety Regulations and the Northwest Territories and Nunavut Codes of Practice for Firefighters.

2.2 Industry Standards and Best Practices

The following section presents an overview of current industry standards representing current best practices within the fire service in North America.

2.2.1 National Fire Protection Association Standards

The National Fire Protection Association (N.F.P.A.) is an international non-profit organization that was established in 1896. The organization's mission is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating consensus, codes and standards, research, training, and education. With a membership that includes more than 70,000 individuals from nearly 100 nations, N.F.P.A. is recognized as one of the world's leading advocates of fire prevention and an authoritative source on public fire safety.

The use of N.F.P.A. fire suppression standards are not a legislated requirement for the delivery of fire suppression services within the N.W.T., however, these standards provide a recognized industry best practice that is supported by industry leading research and broad stakeholder input into their development. Within this Firehall Building Study the N.F.P.A. 1710 Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2020 Edition) has been utilized to inform the fire suppression service level analysis.

The standards that were reviewed and considered as part of the facility condition and functional needs assessment component of this Firehall Building Study are included in Table 1 below.

Table 1: N.F.P.A. Standards Overview

Standard	Description
N.F.P.A. 1500: Standard on Fire Department Occupational Safety, Health, and Wellness Program (2018 Edition)	This standard specifies the minimum requirements for an occupational safety, health and wellness program for a fire department. This includes specifications for training, fire apparatus and equipment safety, protective clothing and equipment, safety during emergency operations and traffic incident management, facility safety, medical and physical requirements for firefighter personnel as well as the requirements for a behavioural health and wellness program.
N.F.P.A. 1581: Standard on Fire Department Infection Control Program (2015 Edition)	This standard provides the minimum criteria for infection control within a firehall facility, fire apparatus, on the scene of an incident and/or any other area where members of the fire department are involved in emergency or routine operations.

Standard	Description
N.F.P.A. 1851: Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting (2020 Edition)	This standard establishes a program for the maintenance, decontamination and repair of structural and proximity firefighting protective ensembles and ensemble to reduce safety risks and potential health risks.
N.F.P.A. 1710: Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2020 Edition)	This standard specifies the minimum criteria addressing the effectiveness and efficiency of the career public fire suppression operations, emergency medical service and special operations delivery in protecting citizens of the jurisdiction and the occupational safety and health of the fire department employees.
N.F.P.A. 1221: Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems (2019 Edition)	This standard specifies the minimum requirements for the installation, performance, operation, and maintenance of public emergency services communications systems and facilities.

2.3

N.F.P.A. 1710 Standard (2020 Edition)

Based on our research and through discussions with the City, the N.F.P.A. 1710 Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by a Career Fire Department (2020) was deemed most applicable to the Yellowknife Fire Division.

The N.F.P.A. 1710 Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments (2020 Edition) provides fire suppression staffing performance benchmarks for municipalities that utilize only career (full-time) firefighters. This standard identifies minimum firefighter deployment benchmarks based on the fire risks present within a range of building occupancy types and fire related risks. The N.F.P.A. 1710 Standard includes the following fire suppression deployment models based on the type of building occupancy and potential fire risks present:

- Initial Arriving Company (Pumper);
- Second Arriving Company (Pumper);
- Single-Family Dwelling Initial Full Alarm Assignment;
- Open-Air Strip Shopping Center Initial Full Alarm Assignment;
- Apartment Initial Full Alarm Assignment; and
- High-Rise Full Alarm Assignment.

For the purposes of this Study, the evaluation includes consideration of the Initial Arriving Company, Second Arriving Company, and Single-Family Dwelling Initial Full Alarm Assignment performance benchmarks. These benchmarks are the most relevant for the purpose of assessing firehall location.

2.3.1 Initial Arriving Company

The Initial Arriving Company is commonly referenced within the fire service as the initial responding apparatus deployed to respond to an emergency incident. Fire service leaders and professional regulating bodies have agreed that until a sufficient number of firefighters are initially assembled on-scene, initiating tactics such as entry into the building to conduct search and rescue, or initiating interior fire suppression operations are not safe practices. If fewer than four firefighters arrive on scene, they must wait until a second apparatus, or additional firefighters arrive on scene to have sufficient staff to commence these initial activities.

Within the N.F.P.A. 1710 Standard an 'Initial Arriving Company' is referenced as an 'Engine Company' with a minimum staffing of four firefighters whose primary functions are to pump and deliver water and perform basic firefighting at fires, including search and rescue.

The City's current fire suppression deployment model ensures the response of an "Initial Arriving Company" with a minimum staffing of four firefighters as referenced in the N.F.P.A. 1710 Standard by staffing the first-due apparatus (i.e. pumper) with a minimum of four firefighters at all times.

The N.F.P.A. 1710 fire suppression deployment model for the initial arriving company requires a minimum of four firefighters arriving on scene with an 'Engine Company' within a four minute (240 seconds) travel time to 90% of the fire suppression incidents.

2.3.2 Second Arriving Company

The N.F.P.A. 1710 Standard (2020 Edition) includes a new performance benchmark for the deployment and arrival of the second responding apparatus. The standard does not reference a specific type of apparatus for the second arriving company but does require that it be staffed with a minimum of four firefighters. The term 'company' in this standard can be defined as "being usually organized and identified as engine companies, ladder companies, rescue companies, squad companies or multi-functional companies".

The N.F.P.A. 1710 fire suppression deployment model for the second arriving company requires a minimum of four firefighters arriving on scene with a 'Second Company' within a six minute (360 seconds) travel time to 90% of the fire suppression incidents.

2.3.3 Single-Family Dwelling - Initial Full Alarm Assignment

In comparison to the deployment of an 'Initial Arriving Company' the term 'Initial Full Alarm Assignment' refers to "those personnel, equipment, and resources ordinarily dispatched upon notification of a structure fire." An initial full alarm assignment represents the 'total' number of firefighters initially deployed to a structure fire.

In this deployment standard, a single-family dwelling is defined as "a typical 2,000 ft² (186 m²) two-storey single-family dwelling without basement and with no exposures". This definition is a further example of the broad definitions utilized by the N.F.P.A. that in this instance may not necessarily represent the definition of a typical single-family dwelling in the Northwest Territories.

The N.F.P.A. 1710 fire suppression deployment model for an initial full alarm assignment to a single-family dwelling includes a minimum deployment of 16 firefighters (17 if an aerial device is used) described as the 'total effective response force' arriving on scene within an eight minute (480 second) travel time to 90% of the fire suppression incidents in this occupancy type. This Study considers the N.F.P.A. 1710 fire suppression deployment model for initial full alarm assignment to a single-family dwelling only.

2.3.4 Emergency Medical Services

In consultation with senior management of the Y.K.F.D. it was agreed that the 4, 6 and 8 minute travel time performance benchmarks contained in the 2020 Edition of the N.F.P.A. 1710 Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments and presented within this Study accurately represent the emergency response performance benchmarks the Division endeavours to deliver for both fire suppression and emergency medical services.

Therefore, the proposed 4, 6 and 8 minute travel time emergency response performance benchmarks have been used to inform the firehall location and spatial analysis presented within this Study. The scope of work to complete this Study does not consider the deployment requirements for staffing as presented within the N.F.P.A. 1710 standard.

2.4 Related Plans, Reports and Studies

2.4.1 2010 Inspection and Report - Structure All Consulting Engineers Ltd.

In 2010, Structure All Consulting Engineers Limited was retained by the City of Yellowknife to inspect and report on the condition of the existing firehall facility. The report contains information regarding the original construction of the building, previous reconstruction, observed cracking and other deficiencies that were observed at that time. The report provided the City with a range of recommendations for completing repairs, reconstruction and concluded that a "Do Nothing" approach would allow for the continued deterioration of the building's wall system leading to increased moisture infiltration. For the

purposes of this Study, the 2010 Inspection and Report was used to enhance our team's understanding of the building's design, construction and structural elements.

2.4.2 2016 Firehall Structural Assessment – Associated Engineering (B.C.) Ltd.

Associated Engineering (B.C.) Limited was retained in 2016 to conduct a structural assessment of the City of Yellowknife's Firehall. The assessment includes recommendations on repairs and preventative maintenance requirements based on visual, non-intrusive evaluation of the Firehall, including the apparatus bays, operations area and hose tower. Through consultation with Deputy Fire Chief MacLean, we learned that all but one of the recommendations within 2016 Firehall Structural Assessment have been completed, which also addresses the concerns noted in the 2010 Inspection and Report prepared by Structure All Consulting Engineers Ltd. . The outstanding recommendation related to cleaning and resealing cracks in the main floor of the apparatus bays and external apron slab providing vehicle access to the apparatus bay has not yet been addressed.

2.4.3 2016 Yellowknife Fire Division Master Plan

The 2016 Yellowknife Fire Division Master Plan was prepared by Behr Energy Services Ltd. The Master Plan includes 30 recommendations that are intended to assist the City of Yellowknife in developing long-term strategies for emergency services. Where applicable, the recommendations of the 2016 Master Plan have been considered in developing the options presented within this Study for Council's consideration.

2.4.4 2018 Accessibility Audit

In 2018, The City of Yellowknife retained the services of S.P.H. Planning and Consulting to conduct an Accessibility Audit (Audit) on City-owned facilities, including the Y.K.F.D. firehall. The Audit involved a field investigation and review of City infrastructure which assessed the overall structural design of the facilities as well as their functional accessibility for individuals with mobility, visual, hearing, cognitive and sensory disability challenges. Dillon Consulting Limited was contracted to finalize the project which resulted in a report that identified any accessibility issues present at the facilities along with recommendations for structural renovations or replacements and their associated budgetary considerations.

Where applicable, the findings and recommendations made within the Audit pertaining to the Y.K.F.D. firehall are included for reference in Section 6.0 – Facility Review and Assessment of this Study. The recommendations included in the 2018 Accessibility Audit specific to the firehall have an estimated cost of \$362,250. The cost summary from the Audit is as follows:

- Short term (0-2 year timeframe) \$46,750;
- Medium term (3-6 year timeframe) \$75,500;
- Long term (7-10 year timeframe) \$240,000.

Through consultation with senior Division staff we were informed that the City is awaiting the findings of this Study to inform the next steps with regards to responding to the recommendations of the 2018 Accessibility Audit.

3.0

Existing Firehall Operations

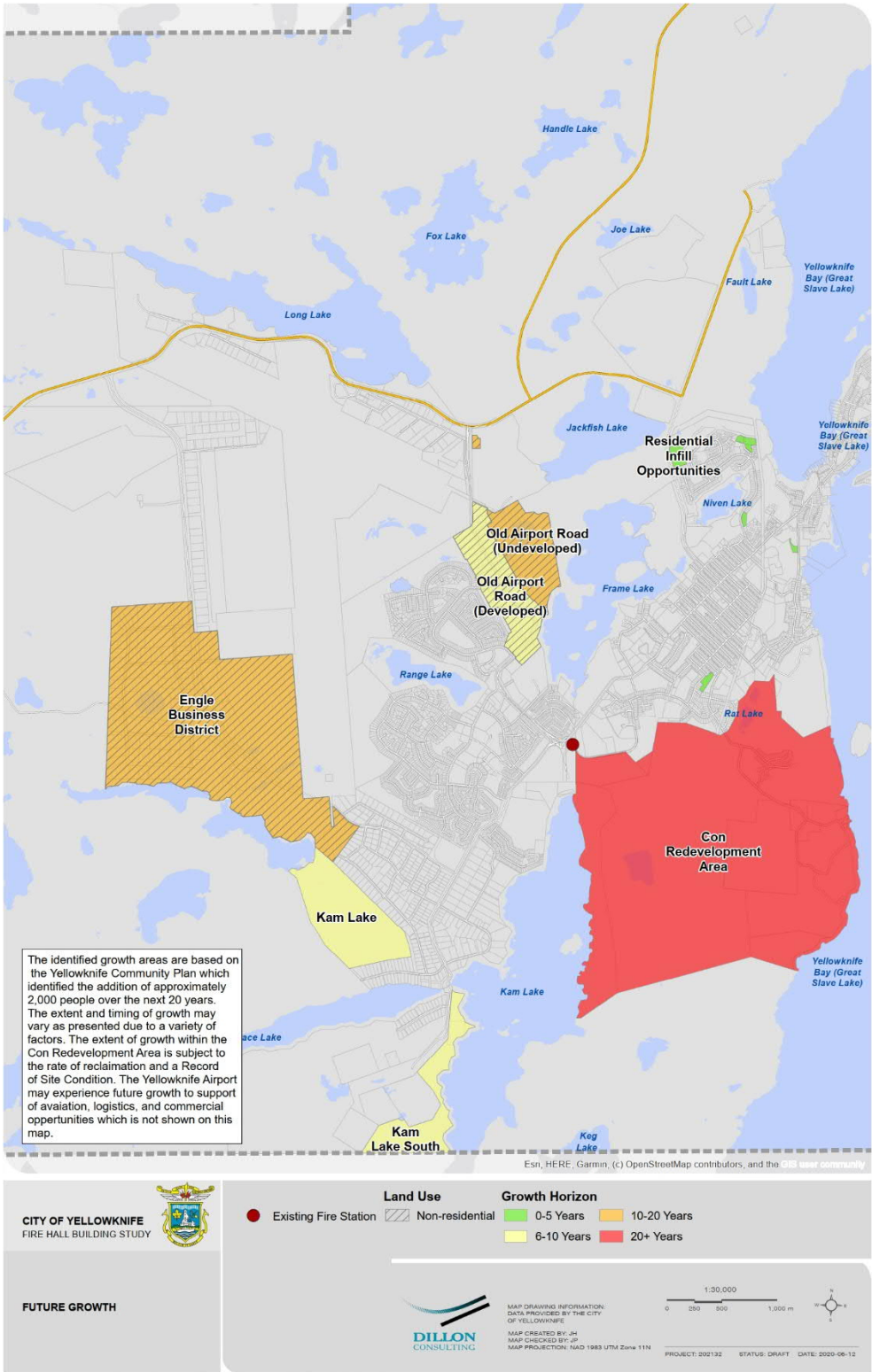
3.1

City of Yellowknife

The City's 2019 Community Plan Update provides the following description: "Established as the capital of the Northwest Territories in 1967, Yellowknife has grown from a small collection of tents and wooden shacks, to a diverse and metropolitan city on the shore of Great Slave Lake. From its humble beginnings, Yellowknife has become an important cultural landmark in the territory and is a gateway city to the rest of Canada's North."

A 20 year community planning horizon within the City is displayed in Figure 1 and discussed in Section 4.0 Firehall Location Assessment and Spatial Analysis of this Study.

Figure 1: Future Growth Areas



3.2 Yellowknife Fire Division

The City of Yellowknife's Fire Division (Y.K.F.D.) established by By-law No. 4502 - Emergency Response and Fire Protection Services By-law provides fire and emergency medical response services to approximately 18,800 residents¹ of the City of Yellowknife as well as to surrounding areas. The Y.K.F.D. reports approximately 4,500 calls for assistance each year, with 87% of the calls being medically related².

The Fire Chief and three Deputy Fire Chiefs oversee a complement of 32 full-time members, who are cross-trained in fire, rescue and emergency medical services. The team operates out of one centrally located firehall at 100 Taylor Road which houses the division's fleet of three ambulances, two quintuple combination pumpers, one pumper, two tankers, one heavy rescue, one side by side Utility Terrain (U.T.V.), two pick-up trucks and one electric sedan.

Over the years, the Y.K.F.D. has evolved dramatically to address the City's growth and associated increased service demands. Since the firehall was built in 1989, the Y.K.F.D. has transitioned from a composite department to career fully integrated fire and emergency medical service. Although an addition and renovations were completed in 2010, crews have gradually increased from two to today's minimum staffing of six. The City's emergency dispatch services relocated from the Yellowknife Public works to the Y.K.F.D. firehall in 2015, however the Public Safety Communications Centre was not designed in keeping with industry standards at the time. Collectively, these space and functionality factors have begun to pose challenges for the day to day operations of the Y.K.F.D. with amenities reaching capacity or in need of upgrades to address accessibility requirements.

As an integrated Fire/Emergency Medical Services provider, the Y.K.F.D. is staffed by a combination of firefighters and medical responders. Although their roles and responsibilities for providing emergency response services may differ their utilization of the firehall as a base of operations is quite similar. The functionality principles presented within this section of the report highlight firefighters, however in our view, these principles are also applicable to all first responders.

3.3 Historic Emergency Response Performance

The Y.K.F.D. has adopted the Yellowknife Fire Division Blue Policy - Emergency Mandates and Public Services. The policy, dated July 2019 entitled Minimum Staffing, establishes minimum staffing of six members of the Y.K.F.D.

The policy references the Y.K.F.D.'s intent to deliver fire suppression and emergency medical services in accordance with the professional standards developed by the National Fire Protection Association

¹ Statistics Canada, 2016 Census

² City of Yellowknife, 2019 Terms of Reference

standards and the Canadian Medical Association standards (for emergency medical services provided). The policy acknowledges Council's role in determining the level of service for fire protection service provision within the community taking into account levels of response may vary within the City depending on a multitude of factors (e.g. available water supply, accessibility challenges, etc.).

3.4 Facility Review and Assessment



The facility review and assessment portion of this Firehall Building Study focuses on the existing infrastructure, amenities and functional needs within the firehall to accommodate the day to day operations of the Y.K.F.D.

This section assesses whether the existing firehall facility can accommodate the needs of a modern career fire and emergency medical service. It will consider the existing facility conditions and potential for options to renovate or expand the facility in order to accommodate the operation needs of the Fire

Division. The project will ultimately summarize, within the Study report, what the ideal and appropriate facility needs are and how best to accommodate them within the firehall options explored in Section 4.0 Firehall Location Assessment/Spatial Analysis of this Study.

The facility condition and functional needs assessment includes consideration of applicable legislation and current industry standards and best practices (discussed in greater detail in Section 2.0 - Applicable Legislation, Standards and Occupational Health and Safety Regulations), current and future staffing and functional needs (including staff training, administration and communications workspace, accommodations, amenities, storage, technology, etc.), building systems and accessibility requirements.

Where applicable, this Firehall Building Study has also taken into account the recommendations for staffing, resources and workspace needs contained within the 2016 Yellowknife Fire Division Master Plan.

3.4.1 Functionality Principles

It is well understood that firefighting poses many health and safety hazards to the firefighters themselves as they are exposed to contaminants such as chemical substances, biological pathogens or other hazardous materials on the fireground and other incidents they respond to. These contaminants can be found on personnel protective equipment (P.P.E.), apparatus, hoses, and equipment and can cross-contaminate anything they come into contact with.

Studies have concluded firefighters face a nine percent increase in cancer diagnoses, and a 14 percent increase in cancer-related deaths, compared to the general population in the U.S.³ In Canada, the link between cancer and exposure to contaminants as a result of firefighting activities is widely accepted, so much so that cancer is presumed to be an occupational disease of the firefighter occupation by workplace compensation boards across Canada.⁴ It is the responsibility of the fire department to provide standard operating procedures as well as training related to the decontamination of firefighters exposed to fireground toxic contaminants as well as to provide facilities or means for decontamination. Firefighters returning from fire scenes or other incidents can bring carcinogens and toxins from the incidents into the firehall, contaminating apparatus bays as well as living areas if proper measures are not in place.

With the right design, it is possible for contaminants to be restricted within the firehall to certain zones using “Hot Zone Design”.⁵ This concept is based on the idea that all spaces which have the potential to be exposed to contaminants (such as carcinogens) are concentrated into one area of the firehall, allowing for separation between areas of contamination and areas for living and work space to prevent the occurrence of cross contamination.

These areas have been referred to as “hot zones” and “cold zones”. More specifically, hot zones include spaces that house and store apparatus, tools, hoses, equipment or P.P.E. such as the apparatus bays, mechanical rooms, S.C.B.A. rooms, decontamination room and laundry extractor, dry racks, etc. By contrast, cold zones contain all areas intended for firefighter occupancy and use by fire department personnel (such as administrative staff). These areas often support community needs including public education events or outreach programs taking place in the firehall itself. Cold zone specific areas can include offices, dormitories, the kitchen and dining area, personal lockers, exercise and training rooms as well as regular laundry areas. Lastly, the area where the hot and cold zones interface, is referred to as the “transition zone”, which ideally limits the movement of personnel between the two zones, thus limiting the circulation of contaminants. The transition zone involves corridors providing direct and unobstructed access to and from the apparatus bay area so as not to impede turn out times.

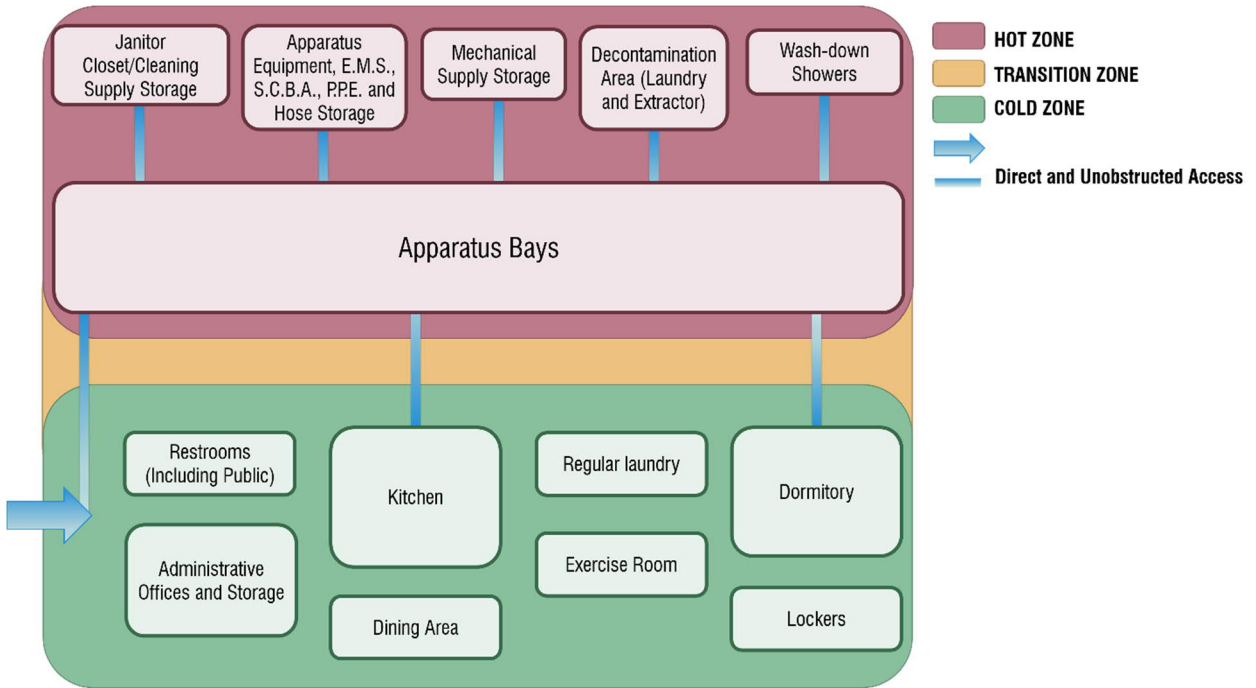
Where applicable, this Firehall Building Study has also taken into account hot zone design and assesses how the Y.K.F.D. firehall’s current configuration adheres to these functionality principles for cross-contamination prevention between the contaminated area and living and work areas. The storage of medical supplies has been considered due to Y.K.F.D.’s integration of fire and emergency medical services. Figure 2 illustrates the concept of hot zone design further and displays the spatial relationship between the various function of the ideal firehall.

³ Firefighters and Cancer, National Fire Protection Association, (n.d.), <https://www.nfpa.org/News-and-Research/Resources/Emergency-Responders/Health-and-Wellness/Firefighters-and-cancer>

⁴ Firefighters’ Presumption Regulations R-039-2010 Amended By R-099-2015, Workers’ Compensation Act.

⁵ Paul Erickson, Hot Zone Design: Contain the Contaminants, Firehouse, Aug 1st, 2014, <https://www.firehouse.com/firehalls/building-components/article/11588372/firehall-design-supplement>

Figure 2: Hot Zone Design



3.5 Division Firehall – General Description

The Yellowknife Fire Division operates from a two-storey firehall located at 100 Taylor Road. The firehall is approximately 12,509 ft² in size and has a building footprint of approximately 29,060 ft² and is supported on piles socketed to bedrock. A two-storey addition was added to the operations area in 2011 to accommodate the growth of the Y.K.F.D. complement, as well as increased call volume associated with the City’s growth.

3.5.1 Building Systems

3.5.1.1 Heating, Ventilation and Air Conditioning Systems

The building’s original central heating, ventilation and air conditioning (H.V.A.C.) system serves the firehall, and supplementary systems throughout the building have been added to support renovations and additional operations. For example, there is an air conditioning unit and air exchange which exhausts through a firewall to the apparatus bay to control the heat from the electrical infrastructure. The fitness room and dormitory, which were added as part of the renovations completed in 2010, are serviced by a separate air conditioning and air exchange system from the central H.V.A.C. system. This is consistent with

N.F.P.A. standards for fire department facilities which require that ventilation, heating and cooling shall be provided in all sleeping areas. However, as referenced in RFP #19-059, the firehall’s current H.V.A.C. systems are not effective and do not serve the entire facility. The existing building system controls cannot be significantly modified to accommodate future expansion in the fire hall.

Another consideration for the enhancement of H.V.A.C. systems is the facility’s ability to provide sufficient heating to areas that store and ventilate firefighting turn out gear. Efficient heating systems are essential to air drying turn out gear as drying time is dependent on the ambient conditions. Improper storage of turn out gear can lead to health and safety issues for firefighters.



3.5.1.2 Fire Protection and Security Systems

During the course of the virtual tour of the firehall, it was noted that the building is not equipped with a fire alarm, sprinkler system or security system. A personal identification card and/or personal identification code is required to access rooms within the facility.

3.5.1.3 Backup Heating and Power Supply

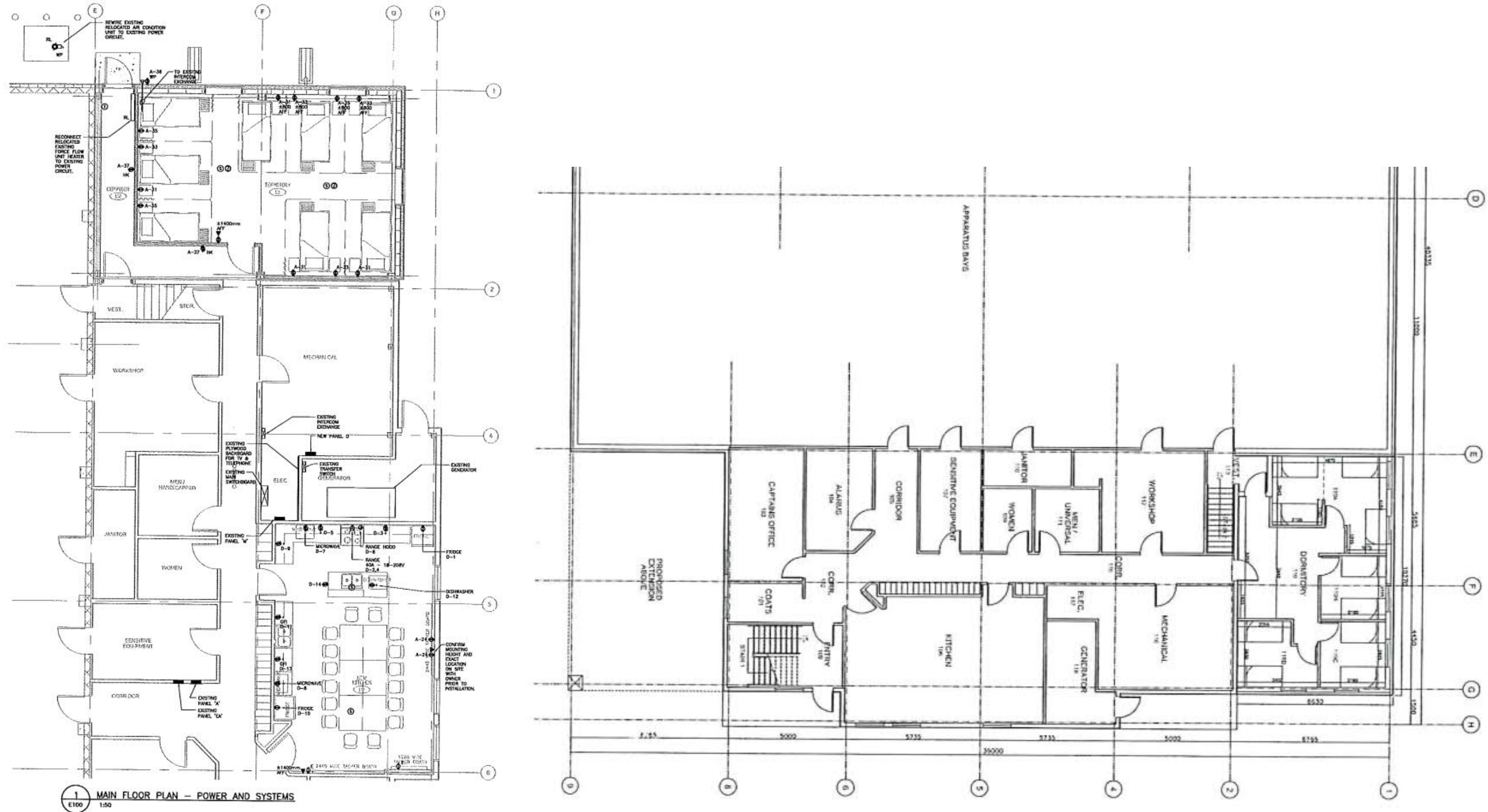
In the event of a power outage, the firehall is equipped with backup heating and power generators which will continue to provide heat and power to essential services for the fire hall. Emergency backup heating and power is generated by two fuel-fired boilers and a gen-set, respectively that are fueled by an approximately 1000 gallon above ground tank located in the exterior compound. There is a backup tank and emergency transfer switch next to the boilers with the fuel capacity for approximately 24 hours. The Y.K.F.D. plans to connect to the City facilities hub, which provides emergency power to the public works building and the multiplex sports arena across the street from the firehall. Heating for the hub is generated from a biomass system fueled by wood pellets.

3.5.2 Ground Floor

The ground floor consists of a main hallway, dormitory, mechanical room, and decontamination room which leads through to the apparatus bays.

Figure 3 illustrates the general layout of the ground floor of the Y.K.F.D. firehall. This schematic design of the firehall ground floor was created by Stantec Consulting Ltd. in 2011 and is the most recent schematic available.

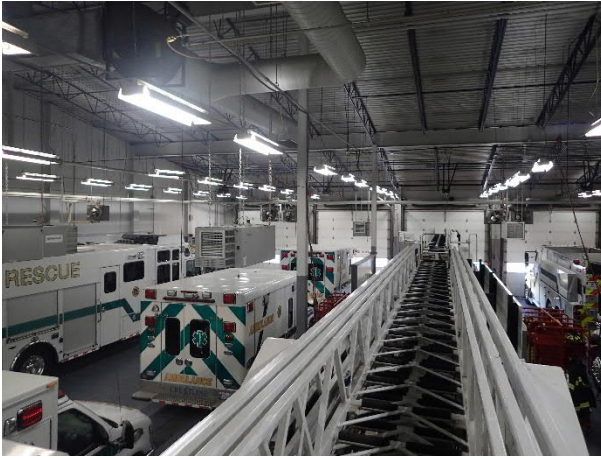
Figure 3: Ground Floor Layout and Design



Source: Yellowknife Firehall Expansions & Renovations, Stantec Consulting Ltd., 2011

3.5.2.1

Apparatus Bays



The firehall has four apparatus bays, accounting for 8,612ft² of the facility, none of which have drive-through capability. The four apparatus bays house apparatus, ancillary vehicles, bunker gear and training props, as well as provide space for apparatus and equipment maintenance. The bay floors are in good condition with no structural defects or unevenness. The 2016 Firehall Structural Assessment noted visible cracks in the apparatus bays however these cracks were not considered to be significant structural concern at the time of the Assessment.

Although drive-through apparatus bays require a larger site size, inclusion of drive through capability in a firehall design include the following advantages: minimized risk of accidents and damage associated with back up fire apparatus; secondary apparatus and vehicles can respond from the rear exit if parked behind a front line apparatus; and a secondary means of exist for front line apparatus in the event the primary door is obstructed for whatever reason.

The Y.K.F.D.'s fleet of three ambulances, two quintuple combination pumpers, a pumper, two tankers, a heavy rescue unit, a side by side Utility Terrain Vehicle (U.T.V.), two pick-up trucks and a fire prevention sedan park in the apparatus bay. The bays are outfitted with fans and a three-stage AirMation air scrubber to control diesel exhaust emitted from the apparatus. Turnout gear is stored on ready racks between the apparatus, along the walls adjacent to the apparatus, and at the back of the bays. Extra turnout gear is also stored on open racks at the back of the apparatus bays.

It is widely understood that prolonged exposure to diesel exhaust has been linked to an increased risk of cardiovascular and cardiopulmonary disease as well as respiratory disease and lung cancer. Although the firehall's current layout provides a separation between residential and mechanical areas of the firehall to reduce the likelihood of contaminants from entering the living quarters, the existing firehall is not equipped with air locks or air curtains. The firehall does not have a diesel emissions control system that directly connects to the apparatus, and turnout gear is stored on the apparatus floor, rather than in a separate, ventilated room. Although the AirMation air scrubber is an effective air cleaning solution, it does not prevent the turnout gear from being exposed to exhaust emissions

Maintenance for all vehicles is conducted at the front of Bay 1, which is equipped with a workbench. Training props are stored at the rear of the apparatus bays. The firehall does not currently have a dedicated wash bay. A dedicated wash/decontamination bay is becoming a common feature in modern

firehalls. Consideration may be warranted to improving the floor drain system to minimize the environmental impact from frequent apparatus washing.

There are two supply rooms to support apparatus bay operations, a janitorial closet, and an air supply room. The janitorial closet is equipped with a washer and dryer, and shelves for the storage of supplies.

The air supply room is a small room with a standalone air conditioning unit. There is a cascade system with four supply tanks, an air compressor, and self-contained breathing apparatus (S.C.B.A.) fill station. The S.C.B.A. fill system is at the end of its life, and is budgeted to be replaced in the 2021 capital replacement plan. The noise generated by the S.C.B.A. fill station and its compressor can be a disturbing for those working inside the Public Safety Communications Centre (P.S.C.C.) as the air supply room is located directly across the hall from it. The air supply system also fills tanks for medical oxygen, which are then stored on the exterior of the building, outside the hose tower.

Medical supplies are stored in a cabinet on the apparatus bay floor, and overflow medical hardware and supplies are stored in the janitorial closet. The janitorial closet also contains a washer and dryer for regular laundry separate from bunker gear contamination.

3.5.2.2 Parking and Main Entrance

There are three administration and visitor parking spaces, a parking lot, and an overflow parking area. Y.K.F.D. has indicated that staff parking and yard space is limited. A training hydrant is located in the parking area.

The 2018 Accessibility Audit found that there were no accessible parking spaces provided at the firehall and recommended that one be provided. The report also found that the approach to the main entrance of the building as well as the concrete walkways were not designed to be accessible and an upgrade to the concrete surfaces was recommended along with the provision of an accessible route to and from the main entrance to the accessible parking space. Outdoor seating and main entrance signage were found to be inaccessible as well.

3.5.2.3 Hose Tower

The three-storey hose tower is roughly 384ft² in size and is used to wash and hang hose to dry. Its entrance is located off Bay 4 and provides access to the roof of the firehall and the exterior. The hose tower has been observed to be in good condition, with no sign of strain or structural defects. Hose and foam concentrate are stored in the hose tower, leaving insufficient space for storing washing, testing and maintaining hose. The ventilation system in the hose tower currently operates for 30 minute intervals, which does not allow adequate time for the hose to dry. Adjustments to the existing system may be sufficient to mitigate this issue.

3.5.2.4

Operations Areas – Mechanical Room and Decontamination RoomMechanical Room

The mechanical room houses the original pneumatic system which was previously converted to electric, and can be monitored on an online dashboard via Johnson Controls. The pneumatic system has a primary vertical air compressor, and a backup compressor that are connected to the bay floor to refill air brakes in apparatus. There is an air handling unit with a condensing coil for air conditioning, two boilers, and a biomass heat transfer pump. There is also a hot water tank, and infrastructure for electrical, phone, and Information Technology infrastructure. Internet is provided at the firehall via fibre optic connection, which is then distributed to other City buildings by microwave link. Infrastructure has been added over time and the space of the mechanical room is no longer adequate. Some cracks have been observed in the drywall finishes of the ceiling and walls, but they are not believed to be of structural significance in the 2016 Structural Assessment.

Decontamination Room

Turn out gear is currently decontaminated within the firehall in a decontamination room separated from other fire division activities. The Y.K.F.D.'s decontamination room provides for the decontamination of turn out gear with two vertical extractors and a closet.

3.5.2.5

Living Quarters – Restrooms, Dormitory and KitchenRestrooms

The firehall currently has two gender neutral washrooms, each fitted with a sink, a toilet, and a shower. One of these washrooms is wheelchair accessible, with more space and grab bars. Although the existing washroom facilities meet occupational health and safety regulations, they will be insufficient to accommodate any increase in fire division personnel as demands for service increase in the future. Through consultation with the Y.K.F.D. issues with accessing sufficient hot water for showers as the water supply is shared with the apparatus bays. With only two showers, it is challenging for personnel to fully decontaminate in keeping with N.P.F.A. 1500 requirements.

Dormitory

The dormitory is 507 ft² in size. The main hallway on the first floor is lined with lockers for personnel to keep personal belongings. Four overflow lockers for personnel are currently located in the dormitory. Personal storage space is limited.

The dormitory is located on the main floor of the firehall and includes a total of nine beds, which are separated by hanging curtains on tracks for privacy. The florescent lighting has been replaced with L.E.D. bulbs. Y.K.F.D. staff have noted the need for improved ventilation and more space in the dormitory. There is a lack of storage space for bedding. It is becoming more common for firehalls to be designed with day and night lighting as well as upgrades to dispatching call out systems intended to improve quality

of life for firefighters. These upgrades allow for less abrupt wake ups by crews responding to emergencies during nighttime hours. Y.K.F.D. have identified the need for different tones for fire, E.M.S. and medivac calls.

Kitchen

The kitchen was extended in the 2010 renovation, however with the relocation of the P.S.C.C. staff to the firehall in 2015, the number of staff using the facility amenities increased. The kitchen is now 486 ft² in size. The kitchen space also acts as common area for staff, however this space is limited. The kitchen is equipped with two fridges, sinks, and microwaves, a stove top, wall oven, and dishwasher, however lacks food storage space. There is a common dining area which is also used for informal meetings and training. There are two emergency shutoffs for the kitchen located in the firehall, enabling crews to shut down cooking appliances quickly in the event they are called away to respond to an emergency.

During the virtual tour, it was observed that the kitchen lacks commercial cooking equipment, which may be more suitable amenities to accommodate Y.K.F.D. personnel.

3.5.2.6 Office Space

There is an office designated for the Duty Officer located on the main floor of the building. It is equipped with a main desk for the officer and two additional works stations. These work stations can be used for online training and personal use. The current office space is limited.

3.5.2.7 Public Safety Communications Centre (P.S.C.C.)

The P.S.C.C. was located in the public works building before a renovation in 2015. Prior to the renovation in 2015, this room was used as a fire prevention office, and a staffing lounge. The P.S.C.C. is 240 ft² in size. There are two full dispatch centre desks, and a supervisor desk. The room is serviced by the overall HVAC system, and can get very warm due to the number of people and electronics. The communication centre staff are currently sharing the washroom facilities with other fire division staff on the ground floor of the firehall, this is discussed further in Table 2.

Due to the expansion of capacity and increase in the number of calls for service, the existing P.S.C.C. no longer comfortably accommodates the staff required to handle expanding demands for service. The 2016 Fire Master Plan indicates that although the existing P.S.C.C. contains the necessary equipment and technology to meet current demands, there are a number of areas that needed upgrading to meet industry requirements. Some areas listed as needing improvement include:

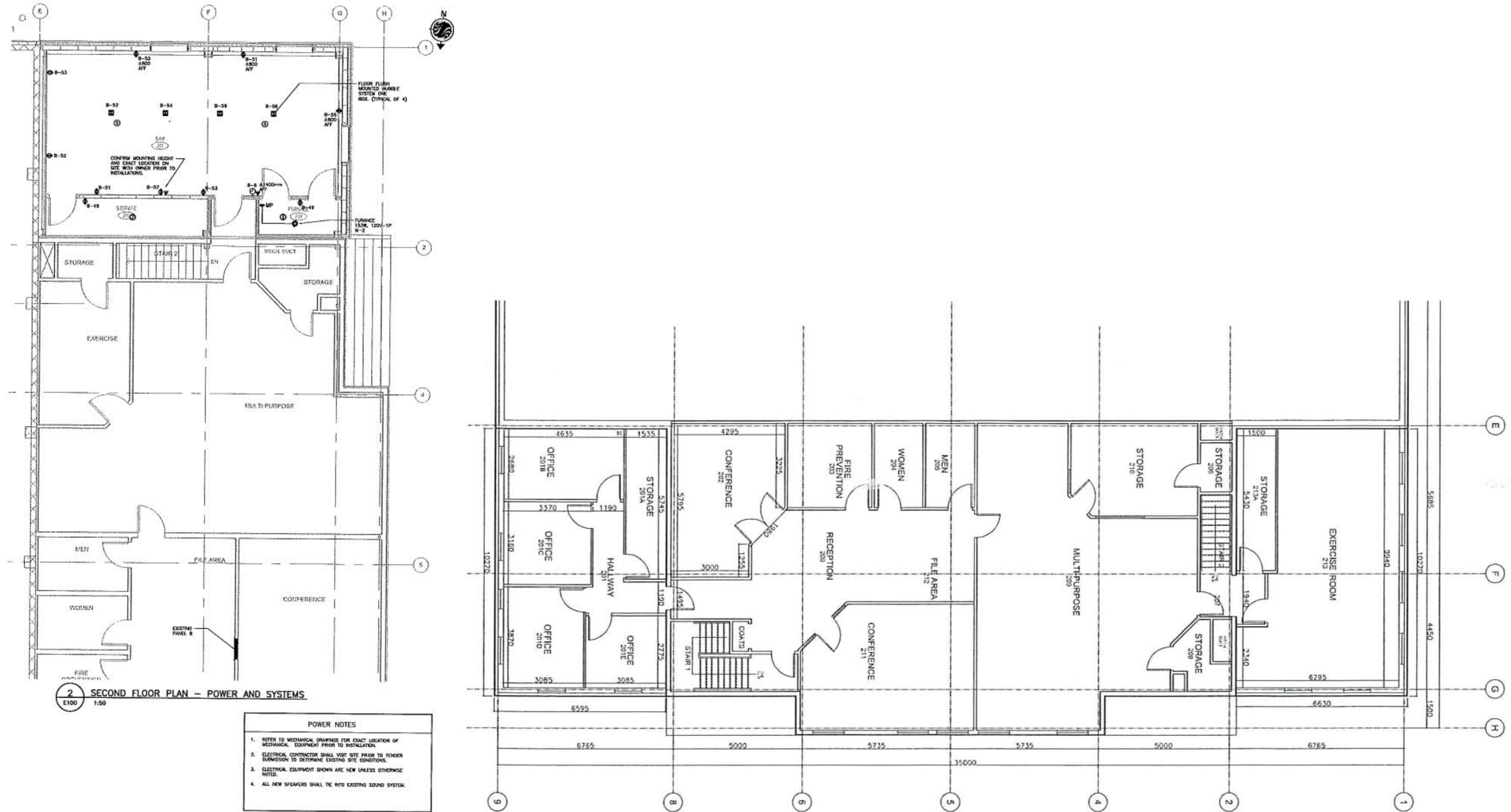
- Available floor space;
- Security;
- Proximity of supplemental equipment to dispatch consoles;
- Quiet room for dispatchers on break;

- Proximity of washrooms and other necessary amenities to the secured dispatch area; and
- Private office areas for supervisors.

3.5.3 Second Floor

There are two staircases leading to the second floor, however as noted in the 2018 Accessibility Audit, there is currently no elevator access provided between the first and second floors of the firehall. Figure 4 provides the most recent schematic design of the firehall second floor layout.

Figure 4: Second floor Layout and Design



Source: Yellowknife Firehall Expansions and Renovations, Stantec Consulting Ltd., 2011

3.5.3.1 Administration Area

The main entrance to the firehall leads into a stairwell to which administration is located on the second floor. The administration area has a waiting room and reception area, and four offices including an office for the Fire Chief, and three offices for the Deputy Fire Chiefs. There are two unisex washrooms in the administrative area, each equipped with a toilet and sink. Administrative supplies are stored in a print room / storage room adjacent to the administration area.

3.5.3.2 Multipurpose Area

The boardroom has a kitchenette and large table, and seating area. This area functions as a meeting space, and a training space for larger groups. All main lights installed in the vaulted ceiling were previously converted to L.E.D.

The firehall does not have adequate space for training or senior management meetings, as usage of this boardroom space is in high demand during the day to day operation of the Y.K.F.D. It also serves as the alternate Emergency Operations Centre during emergency events. Any increase in staffing would compound these pressures further.

The original exercise room was split into two separate rooms which are now used for the storage of fire prevention / public education materials, and for gear and general storage. Beyond the fire prevention / public education storage room is a sub storage room with the I.T. and radio communications infrastructure. There is an air conditioning unit and air exchange unit which exhausts through a firewall to the apparatus bay to control the heat from the electrical infrastructure. On the far side of the boardroom is the fitness room and stairwell to the main floor.

3.5.3.1 Fitness Room

With cardiac events and work related cancers being the leading cause of firefighter deaths, N.F.P.A. 1500 Standard on Fire Department Occupational Safety, Health, and Wellness Program (2018 Edition) recommends fire departments provide space for physical fitness.

The Y.K.F.D. added a fitness room as part of the addition to the firehall in 2010. This area is climate controlled with a separate air conditioning and air exchange system. The fitness room has sufficient equipment to maintain good physical health. All uniform supplies are kept in the storage room within the fitness room. The stairwell outside the fitness room leads to the apparatus bays, interior hallway, and exit on the main floor.

3.5.3.2 Available Training Space

As mentioned throughout this section, classroom and online training takes place in various areas of the firehall, including the duty officer's office, which is equipped with additional work desks, the main

boardroom, when it is available, and at times the common dining area, creating challenges in addressing the training needs of the Division.

In addition to classroom training, the Y.K.F.D. operates and maintains a training facility located on the Yellowknife Airport property which includes a live fire training component enabling fire division personnel to meet the job performance requirements, however the existing firehall does not have a designated on-site training facility that allows for all season usage.

3.6 Firehall Condition & Functional Needs Summary

Table 2 summarizes the findings of the Facility Condition/Functional Needs Assessment of the existing Y.K.F.D. firehall, identifying whether individual components of the facility are compliant with applicable legislation, requirements, standards and best practices for firehalls, workplace safety and/or accessibility. It also reviews the functionality principles discussed in Section 3.5 and whether the current firehall provides sufficient separation between potentially contaminated areas and areas designated for living and working.

Table 2: Functional Needs Summary

Facility Component	Functionality Principles	Existing Conditions	Compliant/Not Compliant/Acceptable/Not Acceptable*	Component Costs (Class D OPC)**
Building Systems				
H.V.A.C. (entire building)		<ul style="list-style-type: none"> Current H.V.A.C. systems are not effective and do not serve the entire facility. Unable to be significantly modified to accommodate future expansion 	Not Acceptable	\$562,500.00
H.V.A.C. (sleeping areas)	N.F.P.A. 1581, 5.3.2 requires that ventilation, heating and cooling shall be provided in all sleeping areas.	<ul style="list-style-type: none"> Fitness room and dormitory serviced by a separate air conditioning and air exchange system from the central H.V.A.C system. 	Compliant	N/A
Emergency Power Supply (entire building)		<ul style="list-style-type: none"> Firehall is equipped with backup power generators which will continue to provide power to essential services for the fire hall. 	Acceptable	N/A
Emergency Power Supply (Communications Centre)	N.F.P.A. 1221, 4.7.1.2 requires that communication centres be provided with critical operations power systems and have a reliable emergency power source.	<ul style="list-style-type: none"> The Y.K.F.D. is currently meeting this requirement as the firehall is equipped with backup power generators. 	Compliant	N/A
Ground Floor				
Apparatus Bays (Diesel Exhaust System)	N.P.F.A. 1500, 10.1.5 recommends ensuring the prevention of firefighters from exposure to exhaust emissions as well as the contamination of their living and sleeping areas from these emissions.	<ul style="list-style-type: none"> Bays are outfitted with fans and a three-stage AirMation air scrubber to control diesel exhaust. 	Acceptable	N/A

Facility Component	Functionality Principles	Existing Conditions	Compliant/Not Compliant/Acceptable/Not Acceptable*	Component Costs (Class D OPC)**
Apparatus Bays (Diesel Exhaust System)	According to the “hot zone design” or functionality principles discussed in Section 4.1 of this Study, potential areas of contamination or “hot zone” areas should be separated from any living and working spaces.	<ul style="list-style-type: none"> • Diesel emissions control system does not directly connect to the apparatus, and turnout gear is placed on the apparatus floor and on open racks • Although the AirMation air scrubber is an effective air cleaning solution, it does not prevent the turnout gear from being exposed to exhaust emissions. • The fire division has indicated that all access doors from operations bay to living quarters equipped with door seals that prevent the egress of air through the door seams into the living quarters (hot to cold transition). 	Not Acceptable	\$50,600.00 (structure) \$30,000.00 (separate ventilation system)
Apparatus Bays (Turnout Gear)	N.F.P.A. 1851, 9.1.1 recommends turnout gear not be exposed to sources of lighting that emit ultraviolet (U.V.) rays, including, but not limited to, fluorescent lighting, direct sunlight, and indirect sunlight. Storage of turnout gear in both direct and indirect ultraviolet (U.V.) light can cause degradation to the fibers of the garments, resulting in accelerated aging of turn out gear.	<ul style="list-style-type: none"> • Turnout gear stored on ready racks between the apparatus, along the walls adjacent to the apparatus, and at the back of the bays exposed to indirect sources of lighting. 	Not Compliant	\$15,000.00

Facility Component	Functionality Principles	Existing Conditions	Compliant/Not Compliant/Acceptable/Not Acceptable*	Component Costs (Class D OPC)**
Apparatus Bay Area (janitorial closet)	N.F.P.A. 1581, 5.7.4.2 requires that non-contaminated clothing and laundry not be washed in the machine(s) used for cleaning protective ensembles and contaminated firehall/work uniforms or contaminated clothing.	<ul style="list-style-type: none"> Y.K.F.D. currently provides a washer and dryer for non-contaminated clothing in the janitorial closet located in the apparatus bay area. 	Compliant	N/A
Parking and Main Entrance Areas	2018 Accessibility Audit found that parking, outdoor seating, entrance signage and main entrance of the building did not meet accessibility requirements.	<ul style="list-style-type: none"> No accessible parking spaces; Approach to the main entrance of the building and concrete walkways were not designed to be accessible; Outdoor seating and main entrance signage not accessible; Parking is limited at the existing location. 	Not Compliant	\$65,750.00***
Hose Tower	The 2016 Fire Hall Structural Assessment references areas showing signs of water ponding in close proximity to the new addition and around the hose tower.	<ul style="list-style-type: none"> Hose tower in good condition and have no sign of strain or structural defects; Asphalt adjacent to the hose tower has been previously reported to need replacement to prevent water from ponding against or close to the building. 	Acceptable	N/A

Facility Component	Functionality Principles	Existing Conditions	Compliant/Not Compliant/Acceptable/Not Acceptable*	Component Costs (Class D OPC)**
Mechanical Room	According to the “hot zone design” or functionality principles discussed in Section 4.1 of this Study, potential areas of contamination or “hot zone” areas should be separated from any living and working spaces.	<ul style="list-style-type: none"> Houses the original pneumatic system which was previously converted to electric; Space is limited. 	Acceptable	N/A
Decontamination Room (presence)	N.F.P.A. 1851 requires organizations to provide a means for cleaning ensemble elements. Contaminated turnout gear should be stored separately from these areas and ensembles and their elements that are not action ready are to be stored in clean, dry and well ventilated areas (N.F.P.A. 1851, 9.1.10)	<ul style="list-style-type: none"> Turn out gear is currently decontaminated within the firehall in a decontamination room separated from other fire division activities. 	Compliant	N/A
Decontamination Room (air locks)	According to the “hot zone design” or functionality principles discussed in Section 4.1 of this Study, the decontamination room should be restricted to “hot zone” areas and separated from any living and working spaces.	<ul style="list-style-type: none"> The fire division has indicated that all access doors from the operations area to the living quarters are equipped with door seals that prevent vapour or carcinogens from the contaminated clothing from migrate into the “cold zone” area of the ground floor. 	Acceptable	N/A

Facility Component	Functionality Principles	Existing Conditions	Compliant/Not Compliant/Acceptable/Not Acceptable*	Component Costs (Class D OPC)**
Restrooms	<p>Worker's Safety and Compensation Commission's Occupational Health and Safety Regulations state that an employer is required to provide a certain number of toilets that is proportionate to the number of workers employed. The regulation specifies that two toilets are to be available in workplaces with 11 to 25 workers. Where there are more than ten workers and both male and female persons are employed at any time, the employer shall provide separate toilet facilities for workers of each sex.</p> <p>2018 Accessibility Audit recommends changes to the washroom's paper dispenser, seat cover and soap dispenser.</p>	<ul style="list-style-type: none"> • Two unisex washrooms, each fitted with a sink, a toilet, and a shower; • One of these washrooms was built to be handicap accessible; • Currently meeting regulations, but not able to support increase in fire division personnel 	Not Acceptable	\$15,000.00***
Restrooms (showers)	<p>N.F.P.A. 1500 4.5.3.1 indicates that following exposure to toxic contaminants, personal hygiene procedures include taking a soap and water shower within an hour of an incident.</p> <p>The Northwest Territories and Nunavut Firefighter Code of Practice requires decontamination facilities be provided or arranged based on potential exposures that firefighters might encounter based on a department's state level of service.</p>	<ul style="list-style-type: none"> • There are two gender neutral washrooms located on the ground floor with one shower stall in each; • Although fire division personnel are provided with showers, in order to decontaminate in a timely fashion, more showers are required; • Based on the functionality principles discussed in Section 4.1 of this Study, decontamination 	Not compliant	\$20,700.00

Facility Component	Functionality Principles	Existing Conditions	Compliant/Not Compliant/Acceptable/Not Acceptable*	Component Costs (Class D OPC)**
		showers should be restricted to the “hot zone area” and separated from areas of living and working. Currently, there are no direct connections between the washrooms and the apparatus bay area and firefighters need to walk through the main corridor to access the showers.		
Dormitory (Spacing)	N.F.P.A. 1581, 5.3.1 requires that a minimum of 5.6 metres squared (60 ft ²) of floor space per bed shall be provided in sleeping areas.	<ul style="list-style-type: none"> • Contains four overflow lockers; • Total of nine beds, which are separated by hanging curtains; • Current dormitory spacing is inadequate for the number of bed (540ft² required under standard, 507ft² existing space). 	Non-compliant	\$5,500.00
Dormitory (Smoke Alarms and Sprinklers)	N.F.P.A. 1500, 10.1.3.1 requires smoke detectors to be installed outside every sleeping area in the immediate vicinity of the bedrooms and on all levels of the firehall and N.F.P.A. 1500 10.1.3.4 requires existing and new fire department facilities to have carbon monoxide detectors installed in locations in sleeping and living areas.	<ul style="list-style-type: none"> • Smoke alarms in place; • Carbon monoxide detection in place. 	Compliant	N/A

Facility Component	Functionality Principles	Existing Conditions	Compliant/Not Compliant/Acceptable/Not Acceptable*	Component Costs (Class D OPC)**
Kitchen Area (Amenities)	Kitchen amenities at the Y.K.F.D. fire hall are consistent with industry standards which require fire department facility kitchens to include specified appliances (N.F.P.A. 1581, 5.2.4).	<ul style="list-style-type: none"> Two fridges, sinks, and microwaves, a stove top, wall oven, and dishwasher; Common dining area; Two emergency shutoffs for the kitchen located in the firehall. 	Compliant	N/A
Kitchen Area (Commercial Cooking)	N.F.P.A. 96 includes requirements to reduce the potential fire hazard of commercial cooking operations. All cooking equipment used in processes producing smoke or grease-laden vapors shall be equipped with an exhaust system that complies with all the equipment and performance requirements of this standard (4.1.1). This includes the use of commercial range hoods (Chapter 5).	<ul style="list-style-type: none"> It was observed that the kitchen area stove does not have a commercial range hood; Commercial appliances may be more suitable to accommodate the needs of the Y.K.F.D. 	Acceptable	N/A
Duty Officer Office	None	<ul style="list-style-type: none"> A main desk for the officer and two additional work stations. 	Acceptable	N/A
Communications Centre (H.V.A.C.)	N.F.P.A. 1221, 4.4.1.2 requires that H.V.A.C. systems should be independent systems that serve only the communication centre.	<ul style="list-style-type: none"> Communication Centre shares H.V.A.C. system with the entire building. 	Not Compliant	\$25,000.00
Communications Centre (Construction)	N.F.P.A. 1221, 4.3.3 requires that communication centres be separated from other portions of the building occupied for purposes other than emergency communications by fire barriers having a fire resistance rating of 2 hours.	<ul style="list-style-type: none"> Confirmed through conversation with Y.K.F.D. that there is a 45 minute fire resistance rating between the P.S.C.C. and other portions of the building 	Not Compliant	\$42,200.00

Facility Component	Functionality Principles	Existing Conditions	Compliant/Not Compliant/Acceptable/Not Acceptable*	Component Costs (Class D OPC)**
Communications Centre (Washrooms)	N.F.P.A. 1221, 4.3.8 requires that the operations room to be equipped with a toilet facility and a lunch area that are directly accessible to the tele-communicators within the secured area.	<ul style="list-style-type: none"> P.S.C.C. staff use the Y.K.F.D. amenities. The P.S.C.C. is not equipped with separate facilities. 	Not compliant	\$34,950.00
Communications Centre (Water)	N.F.P.A. 1221, 4.3.8 requires that communications centres be provided with backup facilities for sanitation and drinking water to provide for the health and safety of employees during extended periods of failure of public water or sewer systems.	<ul style="list-style-type: none"> P.S.C.C. staff use the Y.K.F.D. amenities. The P.S.C.C. is not equipped with separate facilities. 	Not compliant	\$20,000.00
Communications Centre (Fire protection)	N.F.P.A. 1221, 4.5.2 requires that the communication centre and spaces adjoining the communications centre shall be provided with an automatic fire detection, alarm, and notification system.	<ul style="list-style-type: none"> The firehall is not equipped with a fire alarm. 	Not compliant	\$10,000.00
Communications Centre (Fire protection)	N.F.P.A. 1221, 4.5.3 requires that the building that houses the communication centre be protected throughout by an approved, supervised automatic sprinkler system.	<ul style="list-style-type: none"> The firehall is not equipped with an automatic sprinkler system. 	Not Compliant	\$15,000.00
Communications Centre (Security)	N.F.P.A. 1221, 4.6.2 and 4.6.2.1 requires that entry to the communications centre be restricted to authorized persons only and that potential points for unauthorized entry be protected by an electronic intrusion detection system.	<ul style="list-style-type: none"> Confirmed through consultation with Y.K.F.D. that the P.S.C.C. does have controlled access. 	Compliant	N/A

Facility Component	Functionality Principles	Existing Conditions	Compliant/Not Compliant/Acceptable/Not Acceptable*	Component Costs (Class D OPC)**
Second Floor				
Second Floor (Access)	2018 Accessibility Audit found that the second floor of the building is not accessible.	<ul style="list-style-type: none"> • Two staircases; • No elevators present. 	Not Compliant	\$210,000.00***
Administration Area	None	<ul style="list-style-type: none"> • Waiting room and reception area, and four offices; • Two unisex washrooms; • Print room / storage room. 	Acceptable	N/A
Multipurpose Area	None	<ul style="list-style-type: none"> • Boardroom with a kitchenette and large table, and seating area; • Shared space for training as well as administrative meetings, cannot accommodate increase in staffing. 	Not Acceptable	\$23,525.00 (addition of separate conference room)
Multipurpose Area (as the alternate Emergency Operations Centre)	None	<ul style="list-style-type: none"> • Building generator makes this a convenient site for an alternate E.O.C., however there is insufficient space to accommodate both day to day operations and an E.O.C. in the boardroom. • Space is already strained as it is used for training and administrative meetings and there would be lack of adequate washroom facilities to accommodate emergency management personnel. 	Not Acceptable	See Multipurpose Area above

Facility Component	Functionality Principles	Existing Conditions	Compliant/Not Compliant/Acceptable/Not Acceptable*	Component Costs (Class D OPC)**
Storage areas (Two in multi-purpose area)	None	<ul style="list-style-type: none"> Storage room for fire prevention / public education materials; Sub-storage room with the I.T. and radio communications infrastructure. 	Acceptable	N/A
Fitness Room	N.F.P.A. 1583, 4.4.2 requires the fire department to provide the opportunity and the means for regular exercise training.	<ul style="list-style-type: none"> Fitness room has sufficient equipment to maintain good physical health; Uniform supplies are kept in the storage room within the fitness room 	Compliant	N/A
Training Space	None	<ul style="list-style-type: none"> Training takes place in the boardroom shared with administrative staff and in the common dining room and office workspaces when needed and where available; Training areas are currently not meeting the needs of the fire division. 	Not Acceptable	The addition of a conference room as referenced in the Multipurpose Area notes, will allow for the training space to be dedicated to training.

*These terms denote the following:

Compliant – denotes that current conditions are compliant with applicable functionality principles.

Not Compliant – denotes that current conditions are not compliant with applicable functionality principles.

Acceptable – denotes that current conditions are meeting the needs of the fire division.

Not Acceptable – denotes that current conditions are not meeting the needs of the fire division, yet are compliant with applicable functionality principles.

** Component costs do not include general conditions, contingency or engineering fees.

*** Costing from the City's 2018 Accessibility Audit

4.0

Firehall Location Assessment/Spatial Analysis

4.1

Methodology

The firehall location analysis presented within this Study considers the ability of the existing location to support the delivery of effective emergency response services including both fire suppression and medical response services. In order to assess the existing Y.K.F.D. emergency response coverage, a Geographical Information System (G.I.S.) model was developed utilizing the ESRI's Network Analyst tool. The G.I.S. model was informed by the emergency response calls including both fire suppression and medical related calls for the period from January 1st, 2015 to December 31st 2019.

Two options were explored utilizing the ESRI Network Analyst tool to develop a G.I.S. model that accurately reflected the Y.K.F.D.'s existing emergency response travel time capabilities. These options included calibration of the G.I.S. model based on a sample of the historical fire suppression emergency response locations, and secondly utilization of the City's posted road speed limits. Utilizing the relevant road based information, such as road length provided by the City it was determined through consultation with senior Y.K.F.D staff that the City's posted speed limit G.I.S. model most accurately represented the Division's existing emergency response travel time coverage capability.

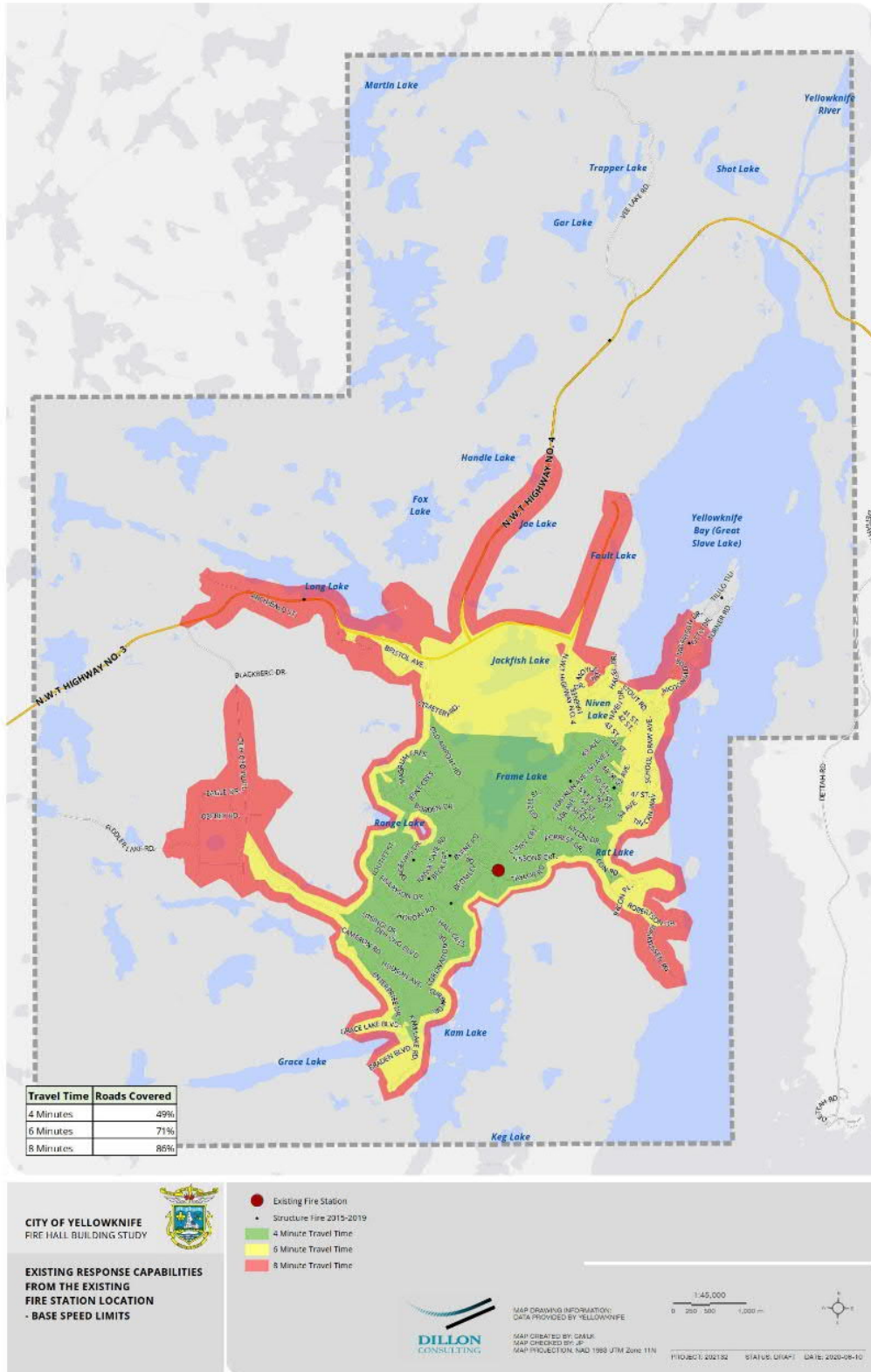
Utilizing the ESRI Network Analyst Tool and applying the City's posted road speed limits three optional G.I.S. models were developed to assess the alternatives for firehall locations within the City of Yellowknife. These G.I.S. models included; the existing firehall location; the Yellowknife Airport and a location in the Niven Lake area. The G.I.S. models presented within this Study indicate the predicted 4, 6 and 8 minute travel time capabilities of the Y.K.F.D. from the three proposed optional firehall locations.

4.1

Option 1 – Existing Firehall Location

Option 1 illustrates the existing 4, 6 and 8 minute emergency response travel time coverage capabilities of the Y.K.F.D. from the existing fire hall location. Figure 5 illustrates that an apparatus deployed from this location can provide coverage to 49.0% of the City's existing road network within a four minute travel time. Within a six minute travel time an apparatus can provide coverage to 71% of the City's existing road network and within an eight minute travel time can cover 86% of the City's existing road network.

Figure 5: Option 1 - Existing Firehall Location



4.2

Option 2 - Addition of Satellite Firehall

Option 2 illustrates the potential benefits to considering the use of the existing firehall located at the Yellowknife Airport as a satellite firehall to further enhance the emergency response capabilities of the Y.K.F.D. being provided from the existing firehall location. This option would result in the City operating two firehalls and the need to also consider enhancing the existing staffing model. Figure 6 illustrates the improved travel time coverage of this proposed two firehall model that would result in 61% of the roads being covered within a four minute travel time by the initial apparatus being deployed from these firehalls. Similar improvements would be achieved for the 6 minute travel time coverage of 83%, and 90% for 8 minute travel time coverage of the City's existing road network.



Figure 6 illustrates that the addition of a satellite firehall at the Yellowknife Airport would result in improved emergency response coverage to areas including N.W.T. Highway No. 3, Deh Cho Boulevard, Osprey Road and the Engle Business District. As much of this area is not equipped with hydrants, there is even greater benefit to improving emergency response times in this part of the City.

Between the years 2014 and 2019, the Y.K.F.D. performed 8,715 non-emergency ground transports, accounting for roughly half of the Division's annual call volume. These non-emergency calls involve transporting medically evacuated patients from Northern communities from the Yellowknife Airport to the Stanton Territorial Hospital or transporting patients from the Hospital to the airport to travel to another health care facility outside of the Northwest Territories. Staffing a crew at a satellite firehall with close proximity to the airport may also reduce the amount of time crews are engaged in non-emergent transports.

As part of this Study, we reviewed an agreement between the City and the Government of the Northwest Territories whereby the Y.K.F.D. responds to incidents on Highway No. 3 outside of the City. Under this agreement, the City receives up to \$37,000 annually to provide ground ambulance and highway rescue services. The addition of a satellite firehall at the airport would significantly improve Y.K.F.D. response times to these incidents due to the facility's proximity to the N.W.T. Highway No. 3.

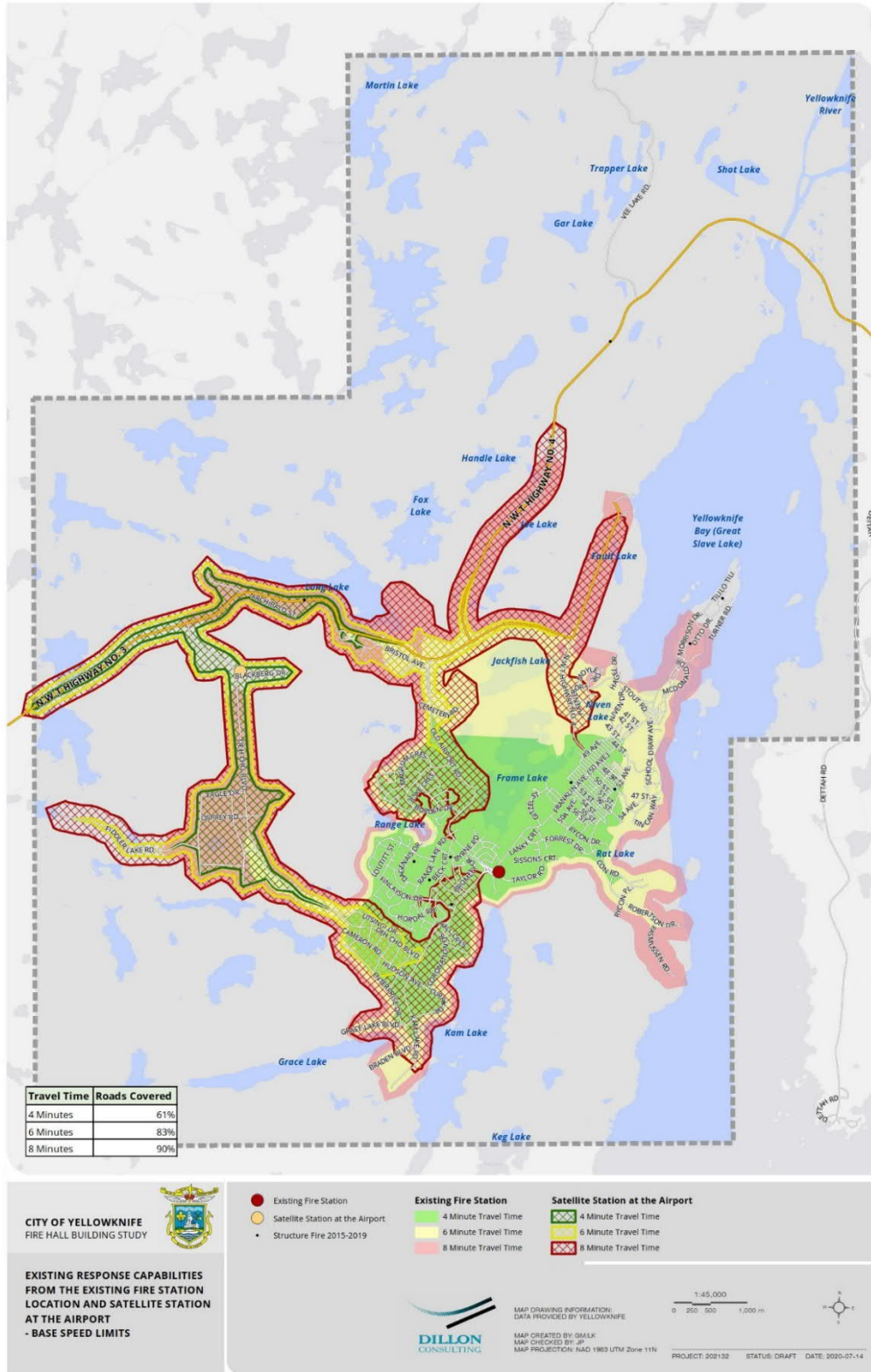
For the purposes of this Study, we considered the potential opportunity for the Y.K.F.D. to share space with an existing Combined Services Building located at the Yellowknife Airport. The facility is currently utilized by airport emergency services and maintenance personnel. The building has two drive through apparatus bays, fitness room, shop area, locker room, lunch room, two offices and storage area for equipment. Through consultation with the Y.K.F.D. we understand that in addition to the airport's two crash rescue units and command vehicle, there is ample room to house an additional fire apparatus and

ambulance. The costing information for this option is for a 350-400 ft² addition to the existing Combined Services Building to accommodate the amenities required for a crew to staff the satellite firehall. More details relating to the costing for this option are found in Section 5.0 Cost Estimating for Firehall Options.

In addition to improved coverage, decreased time spent on non-emergency ground transports and potentially reduced response times to calls on Highway No. 3, the Yellowknife Fire Division has access to a training facility at the airport site. The facility is shared with the airport's Crash Team, R.C.M.P. and emergency services teams from two local diamond mines. The designated training area is equipped with a fixed three storey prefab shipping container, vehicle extrication area, confined space props and an airplane fuselage. The training area offers both live Class A fire and Class B props.

In our view, the benefits of exploring a potential collocation arrangement warrant discussion between the parties.

Figure 6: Addition of Satellite Firehall

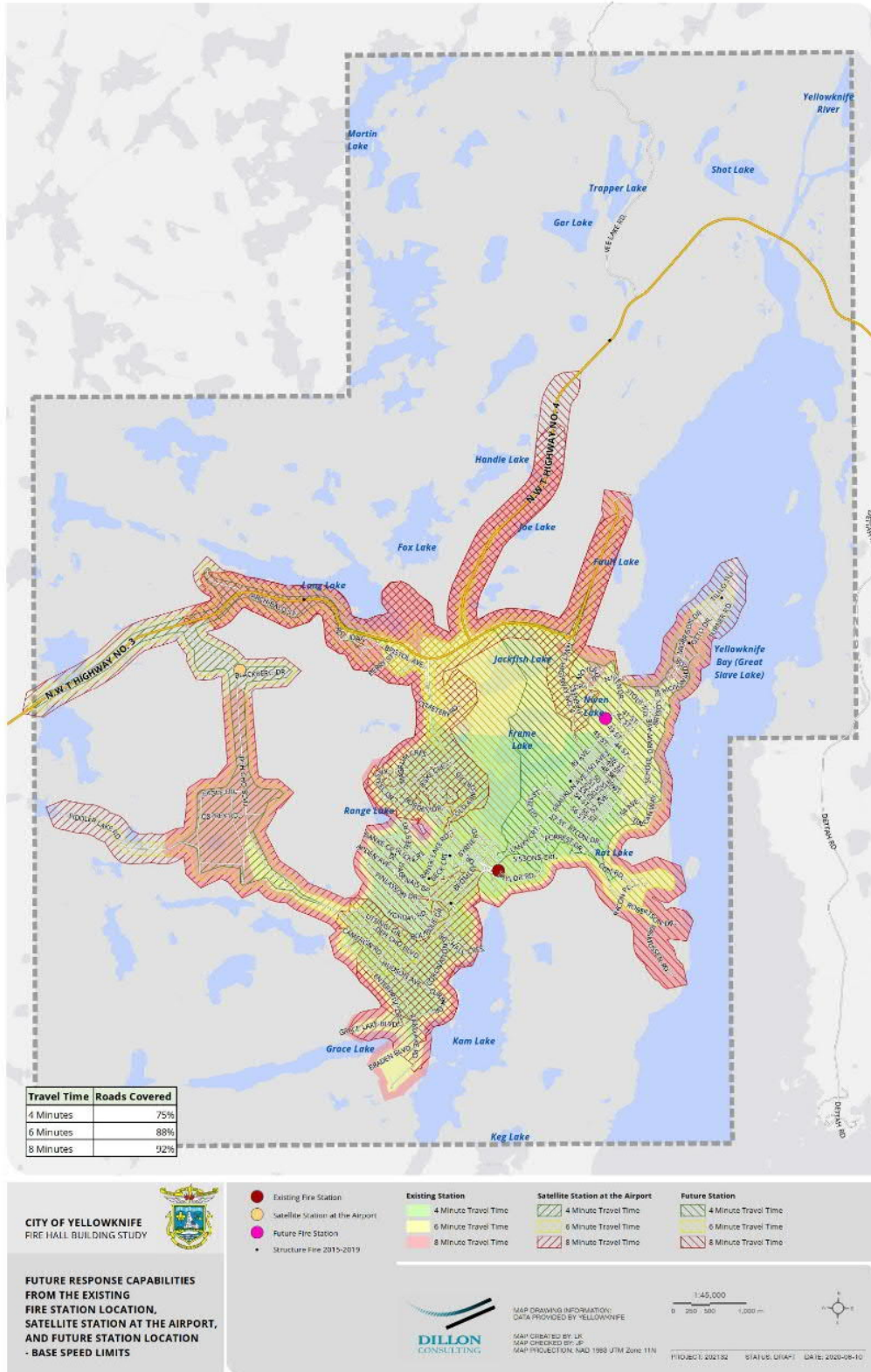


Option 3 - Addition of Third Firehall

Option 3 illustrates the further benefits that the City could achieve if it was to consider a three firehall model in the future. The implementation of this option would include sustaining the existing firehall location, developing a satellite firehall at the Yellowknife Airport and constructing a new, second satellite firehall in the Niven Lake area.

Figure 7 illustrates the improved travel time coverage of this proposed three firehall model that would result in 75% of the roads being covered within a four minute travel time by the initial apparatus being deployed from these firehalls. Similar improvements would be achieved for the 6 minute travel time coverage of 88%, and 92% for 8 minute travel time coverage of the City's existing road network. This option results in improved emergency response coverage in the downtown City core, downtown residential, Niven residential, and in the Old Town residential areas.

Figure 7: Addition of Third Firehall



Firehall Location Summary

In summary, the analysis presented within the previous sections indicates that if the City makes the decision to sustain the use of a one firehall model then the Taylor Road location should be sustained given the balance between its effective emergency response coverage capabilities, and its proximity to the City's infrastructure hub. By adding a firehall at the Yellowknife Airport, response coverage will improve in the areas including N.W.T. Highway No. 3, Deh Cho Boulevard, Osprey Road and the Engle Business District. Response coverage in the Niven Lake area could be achieved if the City opts to construct third firehall in the future to address residential growth.

5.0

Cost Estimating for Firehall Options

This section outlines the Class D (+/- 40%) opinion of probable construction costs based on the level of detail developed in this report. These costs are based on best available information to date and contain contingencies and estimation allowances, to allow for details yet to be designed and uncertainty in equipment and material pricing.

The costs presented in this report are based on the following square footages for each option provided:

- 3,127 ft² (existing station renovation/addition);
- 18,500 ft² (existing station rebuild);
- 400 ft² (satellite station addition);
- 7,000 ft² (future third station).

Conceptual designs for the proposed options above were not provided. There are unknown details as well as design decisions that will be made during detailed design, which will impact the opinion of probable cost.

The opinion of probable cost reflects our best judgment at this stage of the project. Dillon has no control of future construction market conditions, which could significantly impact construction costs. The following notes also apply to the basis of costing:

- the OPCC includes a contingency allowance of twenty percent (20%). This is included to account for changes resulting from unforeseen conditions during construction and affecting construction cost;
- no taxes are included;
- no bonding or insurance costs are included;
- no allowance for accommodations is included;
- no moving, administration and financing costs are included.

R.S. Means Facilities Maintenance/ Repair Cost data is the most widely known and respected publication in cost estimating, and was used to determine new construction and replacement costs. R.S. Means provides cost estimate data for new construction projects, adjusted for local conditions in the vicinity of the City of Yellowknife. R.S. Means and Dillon's estimates assume the following:

- External contractors will perform the construction work.
- External contractors are governed by unionized labour laws.
- Overtime costs were not considered;
- Working days were assumed to be eight hours, in daylight, under moderate temperatures.

All of the costs were estimated to fall within a standard competitive bid range for general contractors. Local conditions (such as availability of labour, materials, construction schedule, and market conditions at the time of construction) may cause the actual cost of the work to be outside of the industry norms.

5.1 Renovation/Addition Existing Firehall

Table 3: Cost Estimates for the Renovation/Addition to Existing Firehall

Component	Component Costs
Demolition	\$ 120,300.00
Substructure	\$ 76,200.00
Building Envelope	\$ 236,400.00
Interiors	\$ 92,700.00
Fixed Furnishings	\$ 3,800.00
Heating Systems	\$ 281,300.00
Cooling Systems	\$ 140,600.00
Air Handling Systems	\$ 140,600.00
Plumbing	\$ 125,000.00
Main Electrical Service and Distribution	\$ 390,600.00
Security/Access Systems	\$ 234,400.00
Fire Suppression Systems	\$ 62,500.00
Accessibility and Other Issues	\$ 314,600.00
General Conditions (O&P)	\$ 380,900.00
Contingency	\$ 260,000.00
Engineering Fees (Design and CA)	\$ 318,000.00
Total Component Cost	\$ 3,177,900.00

5.2

Rebuild Of Existing Firehall

Due to the size of the site of the existing firehall and the footprint of the current facility, a rebuild will necessitate a phased approach. This approach will allow for the continuity of operations of the Yellowknife Fire Division during the course of construction.

Table 4: Cost Estimates for the Rebuild of Existing Firehall

Component	Component Costs
Demolition	\$ 218,000.00
Substructure	\$ 228,00.00
Building Envelope	\$ 1,224,000.00
Interiors	\$ 654,000.00
Fixed Furnishings	\$ 22,500
Heating Systems	\$ 468,800.00
Cooling Systems	\$ 234,400.00
Air Handling Systems	\$ 234,400.00
Plumbing	\$ 312,500.00
Main Electrical Service and Distribution	\$ 703,000.00
Security/Access Systems	\$ 234,400.00
Fire Suppression Systems	\$ 312,500.00
Accessibility	\$ 157,500.00
General Conditions (O&P)	\$ 1,000,700.00
Contingency	
Engineering Fees (Design and CA)	\$ 667,100.00
Total Component Cost	\$ 6,671,400.00

5.3

Addition to Satellite Firehall

The cost estimates outlined in Table 5 include a 350-400 ft² addition to satellite station accommodate the amenities of a fire/medic crew (i.e. washroom and shower facilities, lunchroom/dayroom/kitchen).

Table 5: Cost Estimates for the Addition to Satellite Firehall

Component	Component Costs
Demolition	\$ 26,400.00
Substructure	\$ 10,800.00
Building Envelope	\$ 33,600.00
Interiors	\$ 13,200.00
Fixed Furnishings	\$ 3,000.00
Heating Systems	\$ 14,000.00

Component	Component Costs
Cooling Systems	\$ 6,000.00
Air Handling Systems	\$ 6,000.00
Plumbing	\$ 8,000.00
Main Electrical Service and Distribution	\$ 18,000.00
Security/Access Systems	\$ 6,000.00
Fire Suppression Systems	\$ 8,000.00
Accessibility	\$ -
General Conditions (O&P)	\$ 30,600.00
Contingency	\$ 18,400.00
Engineering Fees (Design and CA)	\$ 22,400.00
Total Component Cost	\$ 224,400.00

5.4 Future Third Firehall

Table 6: Cost Estimates for a Future Third Firehall

Component	Component Costs
Demolition	\$ -
Substructure	\$ 170,700.00
Building Envelope	\$ 530,000.00
Interiors	\$ 207,500.00
Fixed Furnishings	\$ 8,500.00
Heating Systems	\$ 245,000.00
Cooling Systems	\$ 105,000.00
Air Handling Systems	\$ 105,000.00
Plumbing	\$ 140,000.00
Main Electrical Service and Distribution	\$ 315,000.00
Security/Access Systems	\$ 105,000.00
Fire Suppression Systems	\$ 140,000.00
Accessibility	\$ -
General Conditions (O&P)	\$ 414,200.00
Contingency	
Engineering Fees (Design and CA)	\$ 276,100.00
Total Component Cost	\$ 2,762,000.00

5.5 Firehall Design and Location Considerations

Our research indicates that there is an evolving trend within the fire service towards the importance of understanding the programming needs of a fire firehall as a core element in the fire firehall design phase.

The primary objective of fire firehall design remains as creating a functional and effective emergency response. However, there has been more recognition within the industry that design features such as the travel distances within the fire firehall for firefighters to efficiently gain access to fire suppression apparatus has a direct impact on the functional efficiency (e.g. turnout time) that should be considered as an element of the fire firehall programming process prior to the design phase.

In 2016 Dillon partnered with Johnson Davidson Architecture & Planning (JDa) to prepare a fire firehall renewal strategy for the City of Vancouver, which shared similar objectives to the subject I.R.S. Prior to initiating the project in Vancouver the City had retained JDa to develop a Typical Firehall Programming Report (T.F.P.R)¹². Through consultation with members of the Vancouver Fire & Rescue Services the T.F.P.R. resulted in a clear understanding of the site requirements, such as parking for both staff and the public, security and safety needs, street access and traffic control requirements. Input was also received into the internal firehall programming needs, such as the types and number of rooms, including training/community room, workshop, decontamination washroom, kitchen, captain's office, gear storage, and dormitories. Collectively this information formed the foundation for developing standards for functionality and firehall design.

Our research identified a similar project was completed for the City of Seattle, Washington. The City of Seattle Firehall Program Manual states its primary objective as being "A primary objective of this manual is to streamline Seattle's fire firehall design process. By documenting specific program criteria and standardizing certain design features, Seattle's fire firehalls will gain operational consistency and efficiency".

In our view, these documents represent examples of leading industry practices in identifying the programming needs of a firehall as a core element of the overall design process. The importance of this research relates to the following programming and design objectives that should be considered for standardization within all future fire firehall renewal (existing firehalls) and new firehall construction:

- Firehall programming and design should prioritize functional efficiency both internally (travel time to apparatus) and externally (access to street network);
- Firehall design should consider use of standardized materials and finishes that support minimizing maintenance requirements and longevity of life cycle replacement needs;
- Firehall programming and design should prioritize a safe working and living environment and recognize potential hazards such as blood and air borne pathogens, and recognized industry mitigation practices such as those identified within the Occupational Health and Safety Regulations and the Firefighter Code of Practice;
- Exterior firehall design should recognize the City's history and neighbourhood design and wherever possible and accommodate all apparatus currently utilized by the Y.K.F.D., and future apparatus and crews that may be required as a result of community growth.

Within the fire service industry there is a wealth of articles, research and reports informing fire firehall design. Firehouse Magazine one of the well-known industry publications authored a collection of information related to Firehall Design¹⁴ that provides some valuable information related to specific elements of the fire firehall design process including apparatus bay sizes, multi-storey designs, cost and security.

5.5.1 Apparatus Bays

Our research indicates that fire services have historically designed and constructed firehalls with a focus on their current, and projected functional needs over a ten-year planning horizon. As a result, decisions with respect to the required number of apparatus bays, their size and function have in many instances been focused on short-term functional needs rather than assessing this core element as part of the life cycle planning of a major capital investment such as a new fire firehall with a life expectancy of 40 years.

5.5.2 Firehall Colocation

Our research indicates that there is an evolving trend within the fire service towards evaluating the potential benefits of colocation when considering the future infrastructure needs of a community. Within the fire service the term colocation has traditionally included the location of two or more emergency services such as a firehall and ambulance facility or police station. There are many examples of where colocation has even expanded to include other public buildings such as a library or community centre. In our view, and as previously discussed in Section 6.0 Firehall Location Assessment/Spatial Analysis there are a number of advantages to collocating a satellite firehall at the existing facility at the Yellowknife Airport.

More recently the concept of colocation within the fire service has expanded even further. Factors such as the decreasing availability of land that support the department's emergency response time requirements, the availability of infrastructure funding, and the evolution of public community planning policies support the need to consider colocation as of the department's asset management process.

In 2015 the Montgomery County Maryland Planning Department published a Colocation White Paper¹⁵ that identifies a range of factors that support colocation as an option, these include:

- A lack (and high cost) of undeveloped land;
- Aged and obsolete facilities;
- Demographic changes impacting service needs;
- Added amenities / reduction in duplication of services;
- Desire to enhance user one-stop access / community identity;
- Capital and operational cost savings;
- Experience with mixed-use and higher density development;
- Smart growth initiatives;
- Inclusionary demographic and economic profiles;

- Environmental objectives;
- Advancing principles of long-term asset management and reuse; and Institutional (agency) interest, knowledge and experience.

Comparative Analysis of Options

Table 7 presents a comparative analysis of the options described in **4.0 Firehall Location Assessment/Spatial Analysis**. Option 1 provides both the renovation and addition of the existing firehall well as a rebuild of the facility. Both the renovation/addition and rebuild options, the facility's size has been increased by 25% to accommodate both the current and future functional needs of the Y.K.F.D.

Table 7: Comparison of Options

Firehall Location Option	Response Time	Road Coverage	Historic Structure Fire Call Coverage	Cost	Other considerations
Option 1 Existing Conditions	4 Minutes	49.25%	64.71%	Renovation/ addition \$3,177,900.00	<ul style="list-style-type: none"> - Preferred site for single station model; - City owned property - Serviced site; - Existing infrastructure hub;
	6 Minutes	71.13%	64.71%		
	8 Minutes	86.27%	88.24%	Rebuild \$6,671,400.00	
Option 2 Addition of a Satellite Firehall	4 Minutes	61.48%	76.47%	\$224,400.00	<ul style="list-style-type: none"> - Serviced site; - Minimal cost for increased response coverage; - Improved coverage in industrial development areas and Hwy. No 3; - Improved response coverage in a non-hydranted area of the City; - Close proximity to Yellowknife Airport to accommodate non-emergent medical transports; - Existing training facility;
	6 Minutes	82.87%	76.47%		
	8 Minutes	90.16%	88.24%		
Option 3 Addition of a Third Firehall	4 Minutes	75.31%	88.24%	\$2,762,000.00	<ul style="list-style-type: none"> - Site, servicing, and equipment costs; - Operating and staffing cost associated with increased staffing levels; - Improved response coverage in the Niven Lake area to address future residential growth;
	6 Minutes	88.43%	94.12%		
	8 Minutes	91.85%	94.12%		

Conclusions

The analysis within this study confirms that the existing firehall location provides an effective base for providing emergency response services utilizing a one firehall model. However, the existing firehall has reached its expected life expectancy and is need of either extensive renewal including additional square footage to accommodate the existing and future operational needs of the Y.K.F.D., or demolition of the existing building and construction of a new larger building that would meet the long-term needs of the Y.K.F.D. The analysis also confirms that there is an opportunity for the City to explore expanding the existing Combined Services Building at the Yellowknife Airport and utilizing this building as a second 'satellite' firehall to further enhance the existing emergency response capabilities of the Y.K.F.D. as well as their provision of non-emergent medical transfers. Staffing a 'satellite' firehall at the airport would further enhance the delivery of emergency response fire suppression services to the Engle Business District and the N.W.T. Highway 3 corridor.

This study also identifies the potential benefits of a second 'satellite', or third firehall in the Niven Lake area. This option is presented to provide Council with further insight into how the existing emergency response services could be further enhanced in planning for future community growth in the northwest area of the City.