1.3 STUDY APPROACH

The primary data collection tool used in determining the economic impact of business operating at the airport was an online survey/questionnaire which was sent to all tenants and organizations based at YLW.[3] The list of the 46 organizations that participated in the survey is shown in Appendix A. A response rate of 93% was achieved for the survey, although some responses were incomplete. Responses could not be obtained from three companies, including one charter helicopter company and two scheduled airlines both with limited service at YLW. The economic impact of these companies was estimated based on the number of aircraft based at YLW for the charter helicopter company and number of movements at YLW for the scheduled carriers and the impacts and aircraft/movements of similar companies at YLW for which responses were obtained. The estimated FTE employees of these three companies represent only 1.4% of total FTE jobs and errors in these estimates of even 50% would represent only 0.7% of the total employment impact.

An online survey was used as the primary data collection tool to determine the economic impact of businesses operating at the airport.

To protect the confidentiality of the respondents, all data outputs were aggregated into categories of activity taking place at the airport (see Table 1).

Table 1. Activity Categories

ACTIVITY CATEGORY	EXAMPLES
Airport Operations	Airport operator and sub-contracted firms, air traffic control, security firms, other government departments / agencies operating at airport
Scheduled Carrier	Air carriers operating scheduled passenger services
Charter Operator	Air carriers operating charter and medevac services
Aircraft/Aviation Services	FBO and fuelling, maintenance and repair, aircraft modification, aircraft cleaners, aircraft sales / leasing, aircraft parts, ground-handling
Airport Commercial Services	Retail concessions, F&B operations, car rentals
General Aviation	Private, Corporate, Flight training
Ground Transportation	Taxi, limo, bus, other public transportation, vehicle parking
Other	Hotel, Tourism promotion and other organizations

To calculate the direct impacts of organizations providing only partial responses, the values were estimated using other data provided, data from other similar organizations, or values from the B.C. Input-Output Model, as appropriate.

Indirect and induced impacts are almost impossible to determine by examination of the individual businesses affected by airport activity. Instead, economic impact studies, including the last study for YLW, use economic multipliers for estimating the indirect and induced impacts. Similarly, multipliers

[3] A covering and link to an online survey questionnaire was distributed via email. Follow ups were completed with non-respondents via email and telephone.

from the B.C. Input-Output Model were used in this study. The total impacts, which include the direct, indirect and induced impacts, are those for the province of B.C., not just the Kelowna or the Central Okanagan. Care was taken to use the multipliers appropriate for the various industry groups operating at the airport. These impacts are less precise than the direct impacts and greater importance should therefore be given to the direct impacts when assessing the overall impact.

Ongoing, long-term impacts were based on the current economic impacts applied to forecasts of passenger and aircraft traffic. Temporary impacts associated with capital improvements were also calculated based on the construction value estimates provided by the Airport.

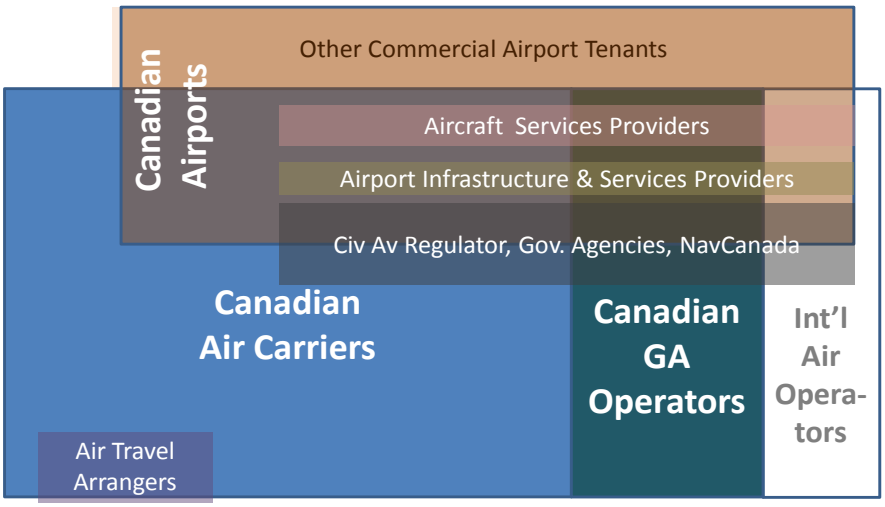
The catalytic impacts of air travel using YLW are more difficult to estimate and, except for tourism, only qualitative measures of these impacts could be determined. Information for determining the catalytic benefits was collected through a second survey of other businesses operating in the region to collect information on the importance of YLW to their business. Also, other key stakeholders not based at the airport, such as the City of Kelowna Economic Development, Okanagan Economic Development Commission and Kelowna Tourism were contacted to get their views on the importance of the airport to the regional economy. The economic impacts of tourism associated with air travel to YLW were estimated using information from Kelowna Tourism, past studies of economic impact of tourism in Kelowna area, and from the passenger market study for YLW.

2 AIRPORTS AND THEIR IMPACT ON THE ECONOMY

Airports are a critical component of the Canada's air transportation industry, providing the land-based infrastructure from which aircraft operate. Figure 1 presents a summary of Canada's air transportation industry and how airports fit in. Air operators, including both air carrier and General Aviation (GA), are the largest portion of the industry, but much of their economic impact does not overlap with airports. Thus, while airports generate significant economic impact to the region they serve, they enable the aviation industry to function which produces a much larger economic impact throughout Canada.

Figure 1. Canada's Air Transportation Industry and How Airports Fit In

(Source: SLI Airports+Aviation Group)



2.1 AIRPORTS AS ECONOMIC GENERATORS

Commercial airports provide essential, if not indispensable public services. YLW, as with most commercial airports, has tenants engaged in a wide array of aeronautical and general business enterprises located on, and generating revenue for, the airport. YLW's annual operating budget runs into the millions of dollars, with capital projects accounting for millions more. The Air Terminal Building complex, general aviation facilities, airport support facilities such as maintenance buildings and equipment, and aircraft operating areas such as runways, taxiways and aprons easily value in the hundreds of millions of dollars. YLW, as with all large commercial airports, is "big business", and impacts the social, economic and political life of the Central Okanagan region.

Airports provide significant economic and transportation benefits, and have become an integral part of their local, regional and national economies. They are a key catalyst for economic growth through employment and the utilization of goods and services and provision of vital links to the rest of Canada and internationally. YLW, as with most airports, has a profound influence on the quality of life and ability of businesses to attract skilled workers.

Airports are key catalysts for economic growth through employment and the utilization of goods and services, and provision of vital links to the rest of Canada and internationally.

Airports integrate world markets and promote the international

exchange of people, products, investment and ideas. They also provide a variety of other public benefits such as time and cost savings associated with air transportation. Many businesses operating in the region are heavily dependent on air transportation and the availability of efficient and affordable air services at YLW have allowed the tourism and other businesses to expand which has driven economic development both in the region and Canada as a whole.

Airports provide communities with a focal point, and with essential infrastructure to:

- attract new investment and skilled personnel;
- retain and expand existing companies;
- have businesses relocate to the area;
- promote success; and
- enhance competitiveness.

There are some distinct advantages for communities or regions that are within the reach of efficient air transportation. By facilitating the activity of industrial and service sectors – connecting them to global economic activity – airports play a key role in a community's ability to attract and retain businesses.

Economic development agencies interviewed indicated that YLW has provided all these dynamics and that these have acted as strong regional drivers and been a fundamental catalyst of business growth.

Clearly, air transportation has facilitated business' ability to move its products around the world. It has, however, played a far more important role in bringing business managers together, enabling them to build the links, communications and personal relationships necessary to achieve such a level of international business activity. This has been critical in the development of the Information Technology (IT) industry in Kelowna. Despite continuous advances in telecommunications technologies, the growth in global business over the last 50 years could not have been achieved without the personal contact established by the world's civil aviation system[4].

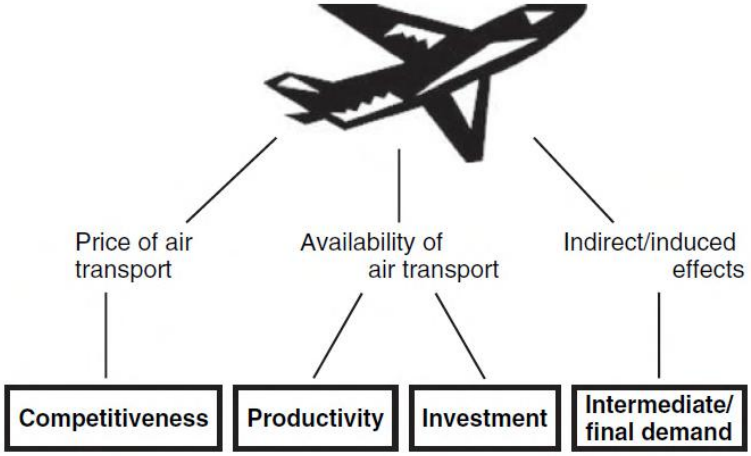
Figure 2, originally described in a report by Oxford Economics Limited[5] depicts how air transportation can affect the economy in a broader way than traditionally measured by input-output models. For example, if prices of aviation services increase, this could lead to higher fares or longer transport times, which could reduce competitiveness among firms that make heavy use of air transportation. There is also a long-run impact of aviation on productivity growth in other sectors of the economy; as well as an impact of changes in productivity growth on investment and the amount of capital equipment available for production in other sectors of the economy.

Somewhat separate, but of significant importance, is the fact that airports attract inbound tourism with the consequent development of the tourism industry generating growth, income and employment.

[4] "The National Economic Impact of Civil Aviation, July 2002", DRI-WEFA, Inc. in collaboration with the Campbell-Hill Aviation Group, Inc.

[5] Exhibit sourced from ACRP Synthesis 7 "Airport Economic Impact Methods and Models – A Synthesis of Airport Practice", ISBN 978-0-309-09801-1, 2008. Original

Figure 2. Direct, Catalytic and Indirect/Induced Impacts



3 KELOWNA INTERNATIONAL AIRPORT

3.1 AIRPORT OVERVIEW

The Kelowna International Airport (YLW) is located 6 miles northwest of the City of Kelowna, the largest city in B.C. outside the B.C. Lower Mainland, with a population of 130,000[6]. The primary catchment area is the Central Okanagan, which has a population of 190,000.

Kelowna International Airport is the second most important airport in the province based on passenger traffic.

YLW is the second busiest airport in British Columbia and is served by 9 airlines providing domestic, transborder and international service.

In March 2015, YLW was served by nine airlines providing scheduled or major charter service as shown in Table 2. These carriers link Kelowna to eleven destinations year-round (ten domestic, one U.S) and five seasonal destinations, including two in the U.S. and four in Mexico. A number of charter carriers also provide domestic passenger service from the Air Terminal Building (ATB) in 2014/2015, including Air North, Flair Airlines and Canadian North, and the private operator, Suncor. United Airlines and Northwestern Air also recently served YLW, but their services were suspended in early 2015.

Table 2. Scheduled Air Carriers Operating at YLW in January 2014 and Destinations

AIRLINE	DESTINATION(S)
Air Canada / Air Canada Regional	Vancouver, Calgary, Toronto
WestJet / Encore	Vancouver, Calgary, Toronto, Edmonton, Victoria, Saskatoon, Fort McMurray, Cancun, Los Vegas, Phoenix, Puerto Vallarta, San Jose Cabo
Canadian North Airlines	Vancouver, Whitehorse
Central Mountain Air	Kamloops, Prince George
Pacific Coastal Airlines	Cranbrook, Trail
Alaska Airlines / Horizon	Seattle
Ait Transat	Cancun, Puerto Vallarta
Sunwing	Ixtapa-Zihuatanejo

KF Aviation (previously Kelowna Flightcraft) is YLW's largest tenant and has its base at YLW providing both aircraft maintenances and freighter services from the airport. KF Aviation provided freighter services throughout Canada on behalf of Purolator until March 15th 2015 when their contract expired. They currently operate once weekly scheduled courier flight from YLW and also provide on demand

[6] 2015 BC Stats

charter air cargo service. Carson Air operates daily courier services out of YLW on behalf of FedEx. Some cargo at YLW is also carried in the belly of passenger aircraft on scheduled passenger service.

YLW had 101 aircraft based at the airport in March 2015. Two-thirds of the based aircraft were owned by commercial operators and included 17 narrow-body jets, 4 wide-body jets, 30 turboprops and 9 helicopters. All 33 privately owned aircraft were piston.

At the start of 2015, there were 46 organizations operating at the airport – see Table 3 and Figure 3. Air carriers (scheduled and charter) is the largest aviation sector at the airport.

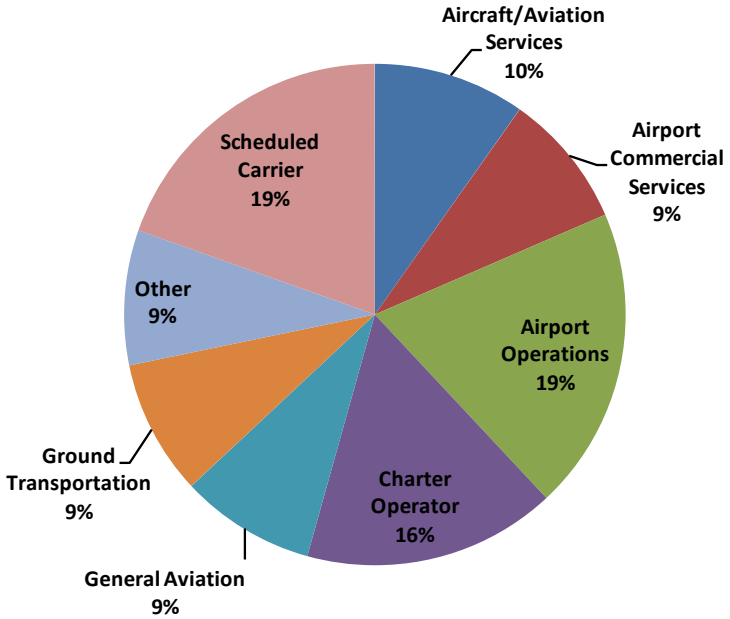
Table 3. Distribution of Organizations Operating at the Kelowna International Airport by Primary Category of Operation – 2014

AVIATION SECTOR	NO. OF ORGANIZATIONS	% OF TOTAL
Airport Operations	9	20%
Scheduled Carrier^	9	20%
Charter Operator	8*	16%
Aircraft/Aviation Services	5*	10%
Airport Commercial Services	4	23%
General Aviation	4	9%
Ground Transportation	4	5%
Other	4	9%
TOTAL	**46**	**100%**

Notes: * One large company, KF Aviation, operates both charter and Aircraft/Aviation services and has been included in both categories (once in the total)
^ Air carriers operating scheduled charter services (Canjet and Air Transat) are included as Scheduled air carriers

Figure 3. Distribution of Organizations Operating at the Kelowna International Airport 2014

(Measured by number of organizations in each primary category of operation)



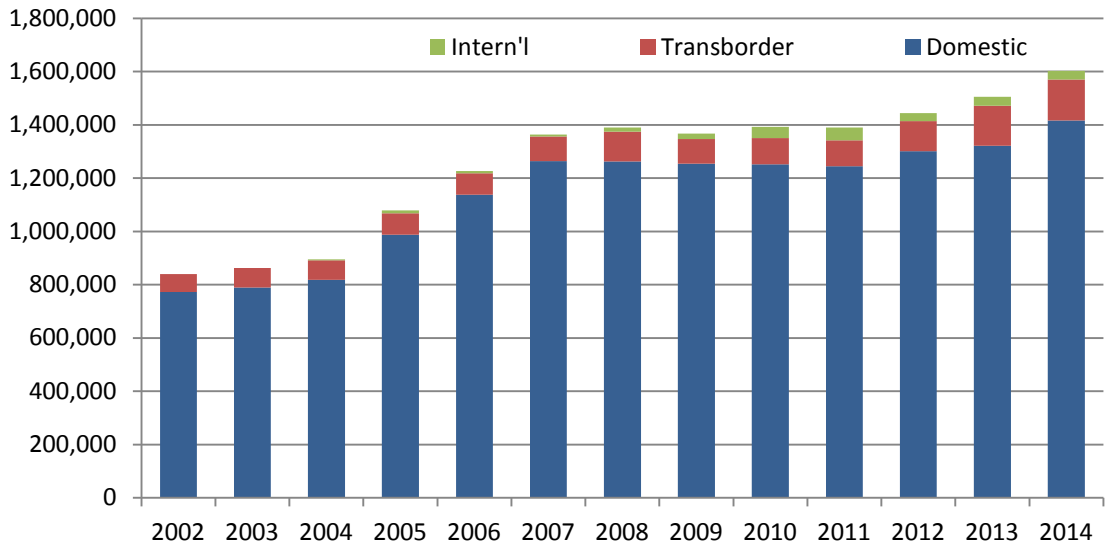
3.2 TRAFFIC AT THE AIRPORT

Passenger Traffic

YLW handled 1.6 million Enplaned/Deplaned (E/D) passengers in 2014, an increase of 7.1% over 2013. Domestic passengers totaled 1.4 million, 88.3% of the total. As shown in Figure 4, passenger traffic at YLW increased slowly in the late 1990 and early 2000s; but grew strongly during the four-year period of strong economic growth from 2005 to 2008. Traffic declined in 2009 with the global financial crisis and recession, then recovered slowly in 2010 and 2011, before growing strongly again in 2012 to 2014. YLW first received transborder service in 2004. Since then, transborder passengers have accounted for 6.5% to 10% of total traffic, the high being reached in 2013. Other international traffic has fluctuated between 0.3% and 3.5% of total traffic, the high being recorded in 2011.

YLW handled 1.6 million passengers in 2014, an increase of 7.1% over 2013.

Figure 4. Total Passengers at YLW by Year (2002 – 2014)

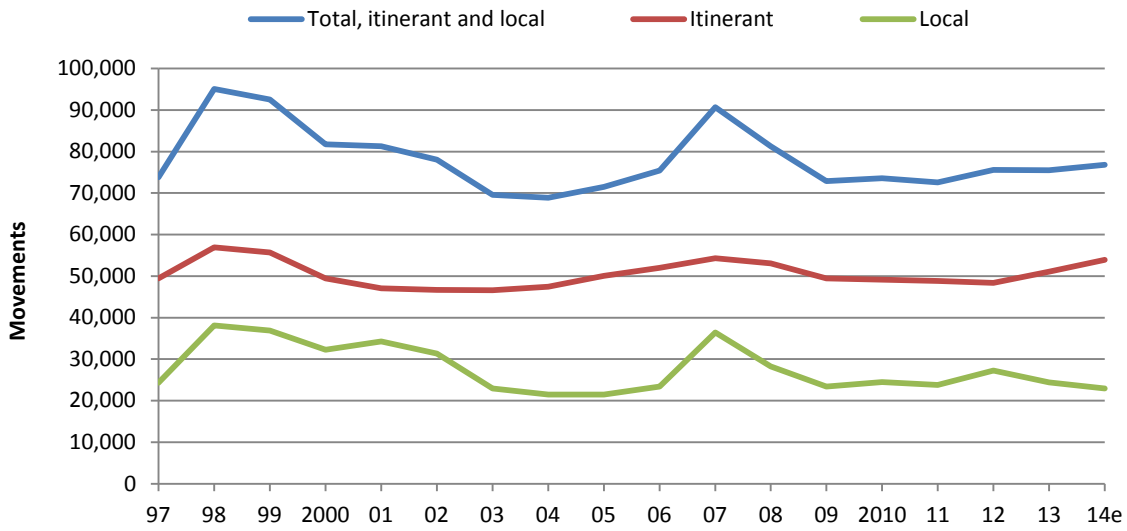


Air Traffic Movements

The number of annual aircraft movements at YLW has fluctuated over the past 18 years, as shown in Figure 5[7], but has not changed significantly. The variation generally follows periods of economic growth in the region. The variation in total movements is largely due to changes in local movements (essentially recreation and flight training aircraft movements) which account for 30-40% of all movements. Over most of the 18-year period, annual itinerant movements showed a similar trend as local movements, but with less variation. However, since 2012, itinerant movements have increased strongly (5.6%/yr) while local movements have declined significantly (-8.3%/yr).

The number of total annual aircraft movements has not changed significantly in the past 18 years.

Figure 5
Annual Itinerant and Local Aircraft Movements, 1997 to 2014

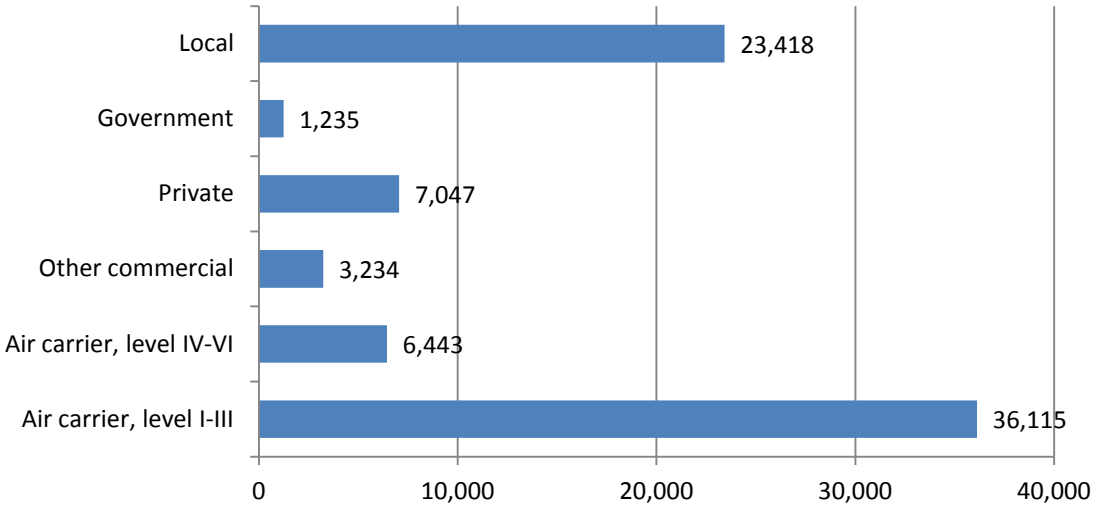


Source: Statistics Canada

Most aircraft movements are by air carriers with the larger Level I-II carriers accounting for 67% of itinerant movements and the other smaller air carriers accounting for another 12% (see Figure 6). Local movements account for 30% of total movements.

[7] 2014 values estimated based on values for January to October for that year

Figure 6. Local and Itinerant Movements by Operator Segment in 2014



Source: Statistics Canada

Air Cargo

Statistics Canada data indicates total annual cargo handled at YLW peaked in 2012 at 2,971 tonnes, but declined by 22% in 2013 to 2,327. Approximately 60% of the cargo is inbound, and unloaded at YLW. Tonnages available from a carrier accounting for a third of the total tonnages indicated their cargo handled increased by 1% in 2014.

Five air carriers based at YLW reported carrying air cargo in 2014. The most common types of cargo included:

- Wine;
- Fruit;
- Personal effects;
- Company material (COMAT) / aircraft parts;
- Kenneled animals; and
- General cargo which includes unpacked and packed goods, for example in cartons, crates, bags or bales, often palletized.

3.3 E/D Passenger Traffic Forecast

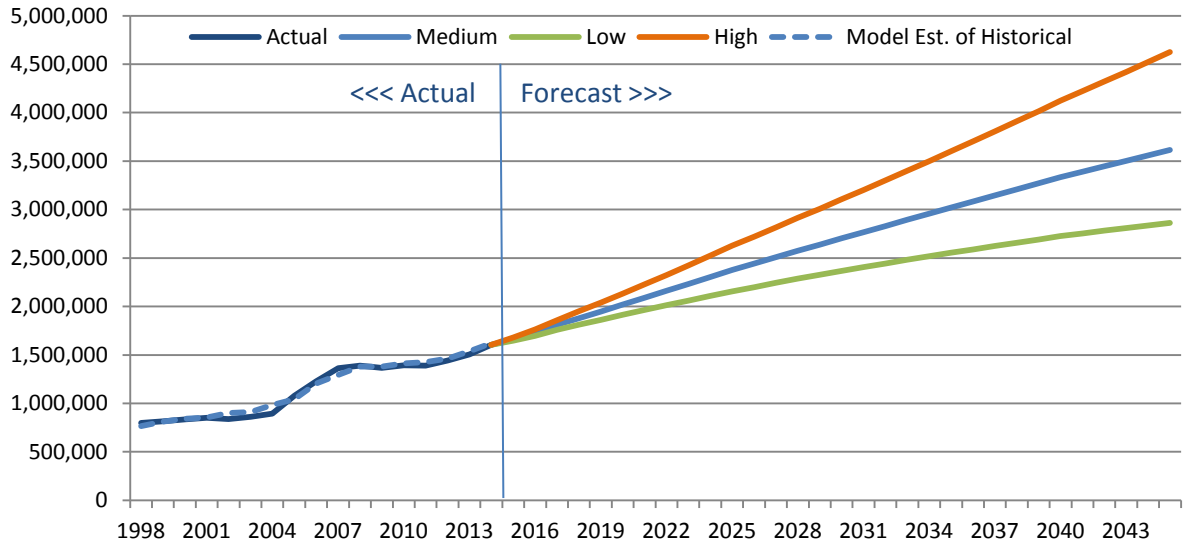
Passenger traffic forecasts show continued strong growth (medium case scenario).

The forecast E/D passengers through to 2045 are given in Table 4 by sector, with average annual growth rates, and are shown graphically in Figure 7 for the Medium, Low and High Case scenarios. The forecasts show that traffic will continue to grow at a fairly strong rate of 3.9% in 2015, down from 6.5% in 2014 under the Medium Case Scenario. Stronger growth of 4.1%, 4.4%, and 3.8% is forecast for 2016, 2017 and 2018, with growth slowing to 3.7% in 2019. Growth slows gradually after that to 3.2% in 2025.

Table 4. Forecast E/D Passengers and Average Annual Growth Rates by Sector under the Medium Case Scenarios, 2014 to 2045

Year	E/D Passengers			
	Domestic	Transborder	Intern'l	Total
2014	1,416,512	153,342	33,045	1,602,899
2015	1,497,572	132,104	35,324	1,665,000
2016	1,538,377	157,794	37,829	1,734,000
2017	1,603,250	167,155	40,595	1,811,000
2018	1,661,570	174,183	43,247	1,879,000
2019	1,721,521	181,452	46,027	1,949,000
2020	1,781,332	188,777	48,892	2,019,000
2025	2,084,427	226,908	64,665	2,376,000
2030	2,359,136	263,543	80,322	2,703,000
2035	2,622,218	300,490	97,292	3,020,000
2040	2,880,720	338,503	115,777	3,335,000
2045	3,107,172	374,256	134,572	3,616,000
Average Annual Growth Rates				
2004-2014	5.6%	7.5%	27.9%	6.0%
2009-2014	2.5%	10.6%	10.0%	3.2%
2014-2019	4.0%	3.4%	6.9%	4.0%
2019-2025	3.2%	3.8%	5.8%	3.4%
2025-2030	2.5%	3.0%	4.4%	2.6%
2030-2040	2.0%	2.5%	3.7%	2.1%

Figure 7. Actual and Forecast E/D Passengers under the Medium, Low and High Case Scenarios



4 ECONOMIC IMPACT ASSOCIATED WITH ACTIVITY AT AIRPORT

To protect the confidentiality of information provided by private operators, their information has been aggregated into categories of activity. All impacts quoted, unless otherwise noted, include those from respondent organizations and inferred impacts from respondent organizations providing only partial responses.

4.1 EMPLOYMENT

Direct

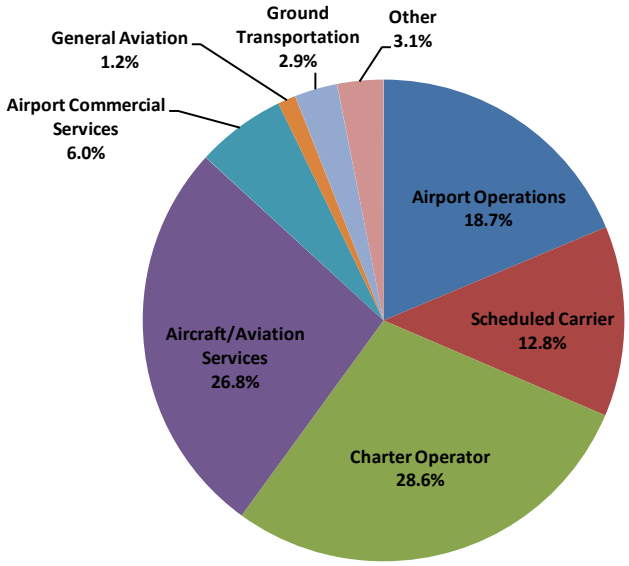
Direct employment at the airport was calculated in terms of full-time equivalents (FTEs). The conversion from jobs to FTE, where necessary, was based on an available 2080 working hours per year (40 hours a week, 52 weeks per year).

Tenants, concessionaires, service providers and organizations based at the airport were asked to report employment directly related to activities at the airport. 2014 employment figures were provided for 44 of the 46 current organizations. Values for the other two businesses were estimated based on information provided by the airport. The latter accounted for only 1.4% of total full time equivalent (FTE) jobs at the airport.

There are 46 companies operating at YLW. These companies generated 1,411 FTE direct jobs in 2014 – an increase of 9%, or 121 new direct jobs

There were 46 organizations operating at YLW in 2014 with 1,411 FTE direct jobs. Of these, 1,306 FTE jobs were located at the airport and another 105 FTE jobs were attributable directly to operations at the airport. The 105 jobs represents the portion of the time those employees spend either at the airport or providing services to users of the airport (e.g., flight crew not based at YLW, but operating flights to/from YLW). There were another 10 FTE voluntary workers at the airport (excluded from the 1,411 total FTE jobs given above). The 1,411 FTE jobs represent an increase of 9% from the 1,290 direct jobs at the airport in 2010. Figure 8 show the distribution of direct employment at YLW in 2014. Charter Operators is the largest activity category as measured by direct employment, followed closely by Aircraft/aviation Services, then by Airport Operations.

Figure 8. Distribution of Direct Employment at YLW (2014)



Indirect

Indirect employment was calculated by using a multiplier applied to the direct effects in an open model, less the direct effects. Different multipliers were used for different activity categories.[8] **Indirect employment at YLW in 2014 is estimated at 735 FTE jobs.**

Induced

Induced employment was calculated by using a 'total' multiplier applied to the direct effects less the direct and indirect effects. Different multipliers were used for different activity categories. **Induced employment at YLW in 2014 is estimated at 516 FTE jobs.**

Summary

Table 5 summaries the 2014 employment impacts at YLW.

Operations at YLW directly employ over 1,400 people on a full-time equivalent basis. In addition, when accounting for indirect and induced effects, over **2,660** people are employed because of activities on airport property which represents an increase of 6% from 2010.

For every 1,000 enplaning passengers, there are 1.8 direct full time jobs (FTE).

For every 1,000 passengers, there are 1.8 direct full time jobs created.

[8] Multipliers from the Statistics Canada for B.C. were used for the following activity categories: Air Transportation Industry, Airport Commercial Services, Other federal government services (except defence) for Airport Operations, Aircraft/Aviation Services, Traveller accommodation, Urban transit systems for Ground Transportation, and Transportation Engineering Construction.

Table 5. 2014 Employment Impacts at YLW

	Direct	Indirect	Induced	Total
Airport Operations	263	100	114	477
Scheduled Carrier	180	150	83	413
Charter Operator	403	334	185	922
Aircraft/Aviation Services	378	98	98	575
Airport Commercial Services	85	20	14	119
General Aviation	17	14	8	39
Ground Transportation	40	9	4	54
Other	44	9	9	61
Grand Total	**1,411**	**735**	**516**	**2,661**

4.2 LABOUR INCOME

Direct

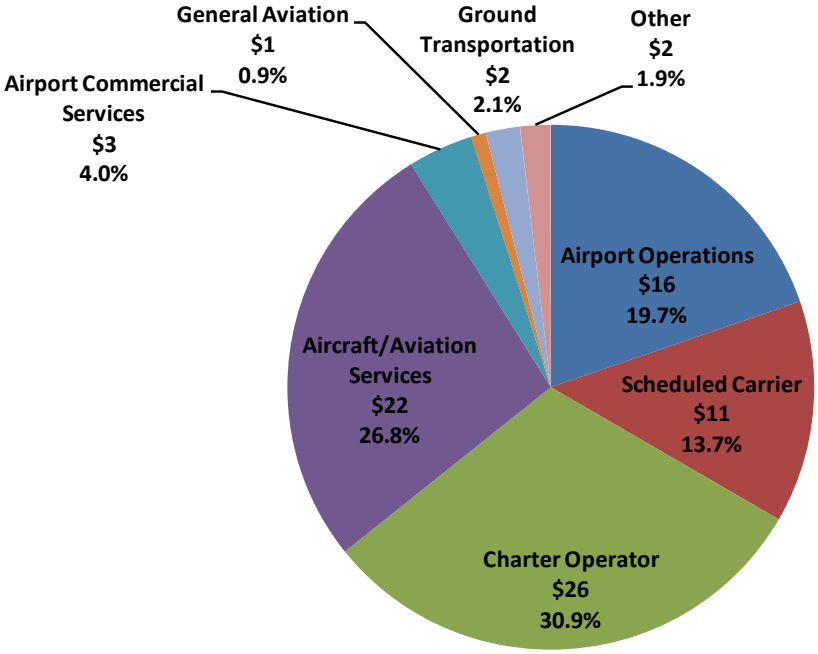
Tenants, concessionaires, service providers and organizations based at the airport were asked to report employment earning and wages for their employees directly involved in activities at the airport. Twenty-two organizations reported average labour income figures. For other organizations, average labour incomes were determined based on other similar organizations or average values for those types of businesses in the B.C. input-output tables with adjustments for inflation and average wage rates it Kelowna relative to the provincial average.

The average FTE salary at YLW is $58,610. YLW contributes $83 million in labour income to the economy.

It is estimated that activity at **YLW directly contributes $83 million in labour income**, an increase of 18% over 2010. This equates on average to $58,610 per FTE. Figure 9 shows the distribution of direct labour income at YLW in 2014.

Charter Carrier is the largest activity category as measured by direct labour income, followed by Aircraft/ Aviation Services.

Figure 9. Distribution of Direct Labour Income at YLW (2014, millions)



Indirect

Indirect labour income was calculated by using the appropriate economic multiplier, as discussed in Section 1.3, applied to the direct effects given above. Different multipliers were used for different activity categories. **Indirect labour income at YLW in 2014 is estimated at $37 million.**

Induced

Induced labour income was calculated by using a 'total' multiplier applied to the direct effects less the direct and indirect effects. Different multipliers were used for different activity categories. **Induced labour income at YLW in 2014 is estimated at $22 million.**

Summary

Table 6 summaries the 2014 labour income impacts at YLW.

Persons employed at YLW **directly earn almost $83 million** which combined with indirect and induced effects mean that close to **$142 million** is earned because of activities on airport property.

Table 6. 2014 Labour Income Impacts at YLW (millions)

ACTIVITY CATEGORY	DIRECT	INDIRECT	INDUCED	TOTAL
Airport Operations	$16.3	$3.3	$3.5	$23.0
Scheduled Carrier	$11.3	$7.6	$3.5	$22.4
Charter Operator	$25.5	$17.1	$7.9	$50.6
Aircraft/Aviation Services	$22.2	$6.4	$5.3	$33.9
Airport Commercial Services	$3.3	$1.3	$0.9	$5.5
General Aviation	$0.8	$0.5	$0.2	$1.5
Ground Transportation	$1.7	$0.6	$0.2	$2.6
Other	$1.6	$0.4	$0.4	$2.3
TOTAL	**$83**	**$37**	**$22**	**$142**

4.3 ECONOMIC OUTPUT

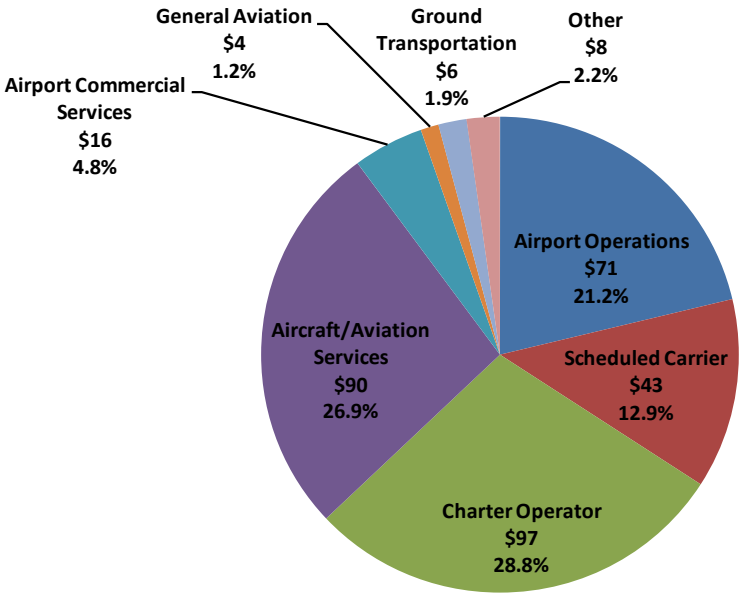
Direct

Tenants, concessionaires, service providers and organizations based at the airport were asked to report direct output (components of sales of goods and services, including that of the Airport Authority) directly related to activities at the airport. Only ten organizations reported direct output figures and for the others direct output was inferred based on the type of service provided, other information collected (e.g., concession revenue collected by airport), output rates per FTE employee for similar tenants, and/or ratios of direct output to employment income from the B.C. input-out-put model.

It is estimated that activity at YLW **directly contributes over $336 million in direct output**.

Figure 10 shows the distribution of direct output at YLW in 2014. Charter Operators and Aircraft/Aviation Services are the largest aviation sectors as measured by direct gross output, followed by Airport Operations. Specifically there is approximately almost $420 in direct gross output generated on a per enplaned passenger basis.

Figure 10. Distribution of Direct Output at YLW (2014, millions)



Every time a passenger boards an airplane at YLW, $420 of direct gross output is generated. This translates to a total of $336 million in direct output or $600 million when indirect and induced effects are considered.

Indirect

Indirect output was calculated by using the appropriate economic multiplier applied to the direct effects given above. Different multipliers were used for different activity categories. **Indirect output at YLW in 2014 is estimated at $169 million.**

Induced

Induced output was calculated by using a 'total' multiplier applied to the direct effects less the direct and indirect effects. Different multipliers were used for different activity categories. **Induced output at YLW in 2014 is estimated at $94 million.**[9]

Summary

Table 7 summarizes the 2014 gross output impacts at YLW.

Organizations based at YLW **directly produce over $336 million** in gross output which combined with indirect and induced effects mean that close to **$600 million** is produced because of activities on airport property.

[9] Induced impacts of employment, wages and output are significantly lower than those estimated in the previous study for 2010. Discussions with Statistics Canada have confirmed the multiplier and applicable methodology that is used in this report. While direct and indirect impacts have demonstrated growth over 2010, the sizeable methodological difference in the calculation of the induced impact compared to that assumed to be used in the previous study results in a negative variation from 2010 on the calculation of total output.

Table 7. 2014 Gross Output Impacts at YLW (millions)

ACTIVITY CATEGORY	DIRECT	INDIRECT	INDUCED	TOTAL
Airport Operations	$71	$41	$21	$133
Scheduled Carrier	$43	$25	$9	$77
Charter Operator	$97	$55	$20	$172
Aircraft/Aviation Services	$90	$34	$34	$159
Airport Commercial Services	$16	$6	$5	$28
General Aviation	$4	$2	$1	$7
Ground Transportation	$6	$3	$2	$11
Other	$8	$3	$2	$13
TOTAL	**$336**	**$169**	**$94**	**$599**

4.4 GDP

Direct

Gross Domestic Product (GDP) is calculated using Statistics Canada economic multipliers for B.C. applied to direct output previously estimated. Different multipliers were used for different activity categories. $336 million in direct output is estimated to produce **$152 million in direct GDP.**

Indirect GDP

Indirect GDP was calculated using Statistics Canada economic multipliers for B.C. applied to direct GDP and results in an estimate of **$75 million in indirect GDP.**

Induced GDP

Induced GDP was calculated using Statistics Canada economic multipliers for B.C. applied to direct GDP and results in an estimate of **$79 million in induced GDP.**

Summary

Table 8 summarizes the 2014 GDP impacts at YLW.

Organizations based at YLW **directly produce over $152 million** in GDP. Combined with indirect and induced effects, it means that over **$306 million** GDP is produced because of activities on airport property.

Table 8. 2014 GDP Impacts at YLW (millions)

ACTIVITY CATEGORY	DIRECT	INDIRECT	INDUCED	TOTAL
Airport Operations	$49	$12	$21	$82
Scheduled Carrier	$16	$12	$8	$36
Charter Operator	$36	$27	$19	$81
Aircraft/Aviation Services	$35	$17	$23	$75
Airport Commercial Services	$7	$4	$4	$15
General Aviation	$2	$1	$1	$3
Ground Transportation	$3	$1.5	$1	$5

Other		$5	$1	$2	$8
	TOTAL	$152	$75	$79	$306

4.5 TAXES

There are many taxes associated with activities at the airport. Some are paid by passengers, some are paid by companies operating at the airport and by their employees, and other taxes are paid by the Airport Authority itself in its procurement processes. These are summarized below:

In 2014, the City of Kelowna received $1.4 million in taxes (or in lieu of taxes) from the airport and its tenants.

- Statistics Canada provides Average Expenditure Statistics for households in each province[10]. In B.C., the average household spends 14.2% of their income on personal income taxes. By applying this percentage to the $82.7 million in earnings directly associated with activity at the airport activity, approximately **$11.7 million in direct personal income taxes** was remitted to the provincial and federal governments in 2014, with $8.3 million going to the Federal Government and $3.5 million going to the B.C. Government.
- Statistics Canada also reports that the average British Columbian household spends 32% of their income on retail goods and services. By applying 5% GST to the amount spent on retail goods and services, (32% x $82.7 million in earnings x 5% GST) we estimate that **$1.3 million in direct GST** was paid to the federal government by persons employed by organizations at the airport.
- The Provincial Sales Tax is charged at a rate of 7% on retail sales. Using the Statistics Canada data for B.C. it is estimated that 17% of income is spend on retail goods which would result in a total of **$845,000** to the provincial government by persons employed on airport property.
- The GST is paid by passengers on airfares. One-way fares from YLW average approximately $300[11] (including AIF, ATSC, NavCanada, and optional airline fees) resulting **in GST payments of** $25.5 million. Splitting this between the origin and destination airports of each passenger, this represents GST payments attributable to YLW of **$12.5 million.**
- Passengers and employees pay GST on their food and beverage concession purchases and car rentals at the airport; this is estimated at **$800,000**.
- The GST is also applicable on expenditures on vehicle parking and ground transportation (primarily taxi fares) to/from the airport and is estimated to result in **$450,000** to the federal government.
- In 2014, the Airport remitted $338,000 in lieu of property taxes to the City of Kelowna. Tenants at the airport also paid property taxes of $1.10 million in 2014 resulting in a total of **$1.4 million in taxes to the City.**

[10] Statistics Canada – 2013 Average household expenditures, by province and territory

[11] Value of $295 given in Air Service Update by InterVistas, Jan 23, 2014, for top 10 markets in 2013. Assumed average fare in 2014 over all domestic and transborder markets was 2% higher at $300.

- The combined federal / provincial corporate tax rate is approximately 17% for B.C. Using gross output of $288 million[12], and net income estimates of 10% of gross output, we estimate that the organizations based at YLW pay approximately **$4.9 million in corporate tax** of which almost approximately 74% goes to the Federal Government.
- All employers at the airport are required to pay payroll taxes including Canada Pension Plan (CPP), employment insurance (EI), and worker's compensation. These are estimated at **$6.4 million.**
- Air passengers are also levied, through the Air Travellers Security Charge (ATSC) which is applied to the price of their airline ticket, to cover the cost of security screening services. Currently the ATSC is set at $7.48 for a domestic round-trip, $12.71 for a transborder departure and $25.91 for an international departure. Assuming half of the domestic round-trip charge is attributable to YLW (i.e., $3.74) and using the distribution of passenger traffic at YLW, it is estimated that in 2014, passengers paid approximately **$6.7 million in ATSC** for departures from YLW.
- The Province of British Columbia levies an aviation fuel tax of 2 cents per litre of aviation fuel sold and a carbon tax of 7.38 c/L. It is estimated that the province collected approximately **$28,000 in aviation fuel taxes** in 2014 from fuel sales at YLW, but collected a total of $5.7 million due to fuel used on flight operations to/from YLW. In addition, the Federal government levies a $0.04 c/L excise tax on aviation jet fuel sold for domestic flights and collected an estimated **$12,000 on fuel** sold at YLW, but collected $2.42 million due to fuel used for flights to/from YLW. Less than 1% of the fuel used on flights to/from YLW is purchased at YLW.
- Residents of B.C. must pay **Medical Service Plan (MSP)** premiums to the provincial government. The rates vary by net income and family size and in 2014 are estimated to average $67 for singles, and $128 for families per month. Assuming that all single direct employees and half the direct employees with family pay, the total annual MSP premiums paid by workers at YLW will be approximately **$934,000 to the provincial government.**
- Workers Compensation Board (WCB) contributions of approximately $550,000 to the provincial government in 2014.

The estimates of the taxes paid broken down by type and level of government are summarized in Table 9. Activity at YLW resulted in $45.6 million in taxes being paid in 2014.

Table 9. Taxes Paid by Type and Level of Government in 2014

FEDERAL	(million)
Income tax*	$8.3
Corporate tax*	$3.6
GST - Air tickets (YLW share)	$11.2
- Concession & car rentals	$0.8
- Vehicle parking & ground transport	$0.5
- Expenditures of direct income	$1.3
Fuel Sales tax on fuel sold at YLW**	$0.01

[12] Excludes output of Airport, Nav Canada and government departments & agencies (TC, CATSA, CBSA) as they do not pay corporate taxes.

Payroll taxes	$6.4
ATSC	$4.1
Total Federal Taxes	**$36.2**
Provincial	
Income tax*	$3.5
Corporate tax*	$1.3
PST - Retail concessions & car rentals	$0.9
- Expenditures of direct income	$0.8
Fuel Sales tax & Carbon Tax on fuel sold at YLW**	$0.03
Health Insurance Plan premiums	$0.9
Workers Compensation Board contributions	$0.5
Total Provincial Taxes	**$8.0**
MUNICIPAL	
Municipal taxes	$1.4
Total Federal, Provincial & Municipal	**$45.6**

Notes:

* Income tax assumed to be split 70% Federal & 30% Provincial, and Corporate tax assumed to be split 74% Federal & 26% Provincial.

** Tax on fuel sales much higher if all fuel on flights to/from YLW is considered.

The total value of taxes paid of $45.6 million is significantly higher than the value of $31 million given in the previous study for 2010, primarily due to:

- Higher GST revenue on air tickets – previous study appears to have underestimated the GST revenue[13]
- GST and PST collected from expenditures of employees due to direct employment at the airport which were excluded from the previous study
- ATSC revenue which was excluded from the previous study
- Higher GST and PST revenues collected on car rentals (current analysis included the full GST & PST on all rentals from the airport)
- Higher corporate taxes collected – difference due to the way in which taxable income was estimated.

Activity at YLW resulted in $45.6 million in taxes paid to all levels of government in 2014

[13] GST revenue was estimated at $4 million attributable to YLW (1/2 of total for round-trips). GST revenues of $400,000 on the Airport Improvement Fees and $350,000 on the ATSC were estimated separately giving a total of $4.75 million collected on airfares in 2010. At the GST rate of 5% this implies total cost of airfares of $95 million for departures from YLW. In 2010 there were 1,350,441 E/D passengers, or 675,221 departing passengers. This implies an average one-way airfare of only $142. However, in their Air Service Update of Jan 23, 2014, InterVistas gives a chart showing the average base fare for the top 10 markets as being $265 in 2010 and $295 in 2013.

4.6 IMPACT OF AN ADDITIONAL DAILY B737 FLIGHT

Each additional flight at YLW will require additional employee time for a range of personnel from flight crew, air traffic controllers, baggage handlers, airline check-in and departure lounge staff, aircraft cleaners and maintenance providers, security screeners, and airport operations, ground transportation and airport concessions staff. Many employees are employed full-time and are not working at full capacity all the time and, depending on the time of day of the additional flight, may be able to provide services for these flights without requiring additional employment. In other situations additional staff may need to be employed.

The 2010 Economic Impact Study included an analysis of the microeconomic impact of additional WestJet short and long haul daily B737-700 services to Calgary and Toronto, respectively. It was determined through this micro analysis that the additional jobs created from the addition of these new direct services would generate 16 new jobs (FTE) for the Calgary daily service and 21 new jobs (FTE) for the longer haul Toronto daily service. Although this more in–depth analysis is not part of the scope of the current study undertaking, a high-level desktop calculation, as outlined below, using more general and broad employment benchmarks reveals a range of 16 - 38 new jobs would be generated from the addition of a single daily B737 flight. This would appear to support the findings of the previous report. The analysis finds that 16 FTE jobs directly relate to air carrier and supporting services; while the higher range of 38 FTE jobs support all passenger-related activities at the airport, excluding aircraft maintenance, charter and GA activities.

The impact of a single additional daily B737-700 flight at typical load factors was examined in two ways:

- Determine impact considering the time spent by the various airline and contracted employees servicing the flight. The incremental airline related jobs per year at YLW was estimated to be 16 FTE jobs at YLW[14] and this represents the minimum additional jobs.

16-38 new jobs are generated from the addition of a single daily B737 flight.

- Determine impact considering the total impact of scheduled service flights[15] at YLW and assume the proportion of these impacts related to a single daily B737 flight represents the impact of that flight. Excluding jobs related to aircraft maintenance, charter and GA operations, and a small proportion of airport operations staff (5% assumed), there are approximately 700 FTE jobs at YLW serving scheduled operations. A single daily B737-700 flight would carry approximately 75,000 annual E/D passengers, or 5.4% of the total passengers at YLW in 2014. The portion of total jobs at YLW associated with a single B737-700 flight is therefore approximately 38. As there is usually some slack in the system with all employees not operating at full capacity, an additional flight will likely not result in the full 38 jobs that its passenger share would suggest and 38 FTE jobs therefore represents the maximum additional jobs.

[14] Value presented in Section 7.2 of 2010 Kelowna International Airport Economic Impact Study by InterVistas, Feb. 2011. Labour elements included in this value are described in Section 7.1.
[15] Includes Sunwing and Air Transat flights

4.7 ONE-TIME IMPACTS OF AIRPORT EXPANSION PROJECTS

In addition to the employment and other economic impacts of on-going operations at YLW, there are also economic impacts associated with capital construction programs at the airport. In 2014, the Airport undertook $8.122 million of capital improvements to airport facilities and tenants spent another $120,000, bringing the total spent on capital improvements to $8,239 million.

The economic impacts of the YLW's capital expenditures were estimated using the cost of the capital projects and Statistics Canada economic multipliers for B.C. of direct employment generated by each dollar of capital spending and corresponding wages, GDP and economic output. The capital expenditure in 2014 is estimated to have created:

- 42 FTE annual direct jobs;
- $2.67 million direct labour income; and
- $3.45 million direct GDP.

4.8 SUMMARY

A summary of outputs can be found in Table 10.

- There are 46 organizations operating at YLW in 2014 with 1,411 full time equivalent (FTE) direct jobs. This is an increase of 9% from 2010. Total employment including indirect and induced employment increased 6% from 2010 to 2,660 FTEs.
- It is estimated that activity at YLW directly contributes $83 million in labour income. This is an increase of 18% since 2010. Total labour income including indirect and induced effects is over $142 million. On average labour income is $58,610 per direct FTE at YLW.
- It is estimated that activity at YLW contributes $336 million in direct output. Total output including indirect and induced effects is almost $600 million.
- $336 million in direct output is estimated to produce $152 million in direct GDP. Total GDP including indirect and induced effects is over $300 million.

Table 10. Summary of Economic Impacts at YLW – 2014

ACTIVITY CATEGORY	DIRECT	INDIRECT	INDUCED	TOTAL
Employment (Person/yrs)	1,411	735	516	2,661
Wages (million)	$83	$37	$22	$142
Output (million)	$336	$169	$94	$599
GDP (million)	$152	$75	$79	$306

Direct economic impacts are 9% higher for jobs than found in the previous Economic Impact study, and between 12% and 26% higher for wages, output and GDP. Larger increases in the dollar values are partly due to inflation over the five years which has increased the price of goods by 6% between 2010 and 2014. The indirect impacts are generally consistent with the previous study allowing for changes in multiplier values provided by Statistics Canada, increasing by 6% to 25%.

Induced impacts of employment, wages and output are significantly lower than those estimated in the previous study for 2010. The previous study had the induced benefits being higher than, or close to, the indirect benefits. This is atypical in most circumstances and therefore may have been overestimated. Discussions with Statistics Canada have confirmed the multiplier and applicable methodology that is used in this report. Therefore, while direct and indirect impacts have demonstrated growth over 2010, the sizeable methodological difference in the calculation of the induced impact results in a negative variation from 2010 on the calculation of total output ($600M vs. $610M).

5 CATALYTIC AND SOCIO-ECONOMIC CONTRIBUTION

5.1 IMPACT OF TOURISM ENABLED BY THE AIRPORT

Air transportation is a critical enabler of the tourism industry bringing people from distant places to the region. In 2011, 1.5 million tourists visited the Kelowna area, up 27% from the number in 2006 (6% per year). In 2014, the number of tourists was expected to reach 1.7 million[16]. Leisure accounts for almost half of the booking of overnight accommodation in Kelowna. Air travel is particularly important for meetings/conferences, events, and golf and ski vacations, while summer vacation travellers tends to predominantly access the area by road.

Most tourists come from Canada, the large majority of these from B.C. (60%) or Alberta (23%). Approximately 17% come from more distant provinces where all would likely fly, with Ontario being the largest of these accounting for 7% of domestic tourists. International tourists account for about 10% of tourists, the majority of these from the U.S. (mostly Washington State), with 1-2% of the total coming from Europe, and a similar number from other international regions.

Based on the origin of tourists and information from the Passenger Market Study for YLW in 2010, it is estimated that 55% of passengers at YLW are visitors to the region. In 2014, this equates to 440,000 visitors.

Provincial and regional tourism data do not provide separate estimates of the spending by tourist in the Okanagan who travel by air to region. An Economic Impact Study conducted in 2011 for Kelowna Tourism provides estimates of the total impact of tourism to the City of Kelowna and the Central Okanagan (plus the Big White ski resort). The impacts of tourists arriving by air in 2014 were estimated from these finding as follows:

- To determine the spending of tourists coming by air, it was necessary to assume that spending patterns, excluding car rental, are similar, on average, between those arriving by air and those accessing the area by other modes. While spending by tourists arriving by air is likely higher, no good data is available on which to estimate the difference. Impacts for air mode tourists are therefore likely conservative.
- The tourism impacts given in the 2011 study include the economic impact on the airport of the passengers arriving by air (i.e., the airfares and associated impacts at the airport). Since these impacts are already included in the Airport economic impacts, they were subtracted to avoid double counting.
- The economic impact due to the car rental services at the airport was assumed to be all attributable to visiting passengers.
- Average wages, and output and value added per passenger, were assumed to have increased at the rate of inflation in B.C. between 2010 and 2014.

[16] Economic Impact Study of Tourism in Kelowna prepared for Kelowna Tourism by InterVistas Consulting, Dec. 2011; and interview with Kelowna Tourism

The estimated tourism economic impact of visitors travelling by air in 2014, excluding airport component, are presented in Table 11 (categories used in the table are those used in the 2011 study). These tourism impacts are very significant equalling approximately 71% of FTE employment, a third of the wages and gross output, and a quarter of GDP impacts of YLW. As mentioned earlier, this is likely a conservative estimate. The direct output equates to an average of $366 per visitor. This compares with average spending by tourists in Canada of $265 for domestic, $510 for US, and $1,390 for other international visitors in 2011[17]. Note that tourists include groups such as those visiting friends and relatives who would typically have much lower expenditures than those on a vacation or on business.

The economic impact of visitors travelling by air in 2014 is $190 million (gross output).

Table 11. Tourism Economic Impact of Visitors Travelling by Air, Excluding Airport Component, in 2014

Impact Component	Employment		Wages	GDP	Gross output
	Jobs	Person-yrs	($ Million)	($ Million)	($ Million)
Direct Impacts					
Accommodation	528	372	$13	$22	$37
Net Other Tourism Industries*	671	387	$15	$36	$77
Visitor Spending**	711	555	$16	$25	$47
Total Direct Excl. Airport Component	**1,910**	**1,314**	**$44**	**$83**	**$161**
Net Indirect	493	247	$3	$2	$11
Net Induced***	586	311	$4	$4	$17
Total Impact	**2,990**	**1,872**	**$51**	**$90**	**$190**

Notes:

* "Other Tourism Industries" impact reflects employment in attractions and other supporting businesses and organizations of the tourism sector in the region, but excludes air transportation.

** "Visitor Spending" impact is based on the 2011 Visitor Survey Spending Profile conducted by Kettle Valley Research in July and August 2011, and includes expenditure on retail, food & beverage and local transportation within the greater Kelowna area.

*** Does not include indirect and induced impacts for visitor spending (value is only for Accommodations and Other Tourism Industries) in order to avoid double-counting of impacts.

Source: Economic Impact Study conducted in 2011 for Kelowna Tourism, interview with Kelowna Tourism, and SLI analysis

5.2 IMPACTS ON BUSINESSES IN THE REGION

Other than tourism, the economic impacts of the availability of convenient local air service on businesses in the region are difficult to quantify. Instead, a qualitative analysis of the importance of the airport to businesses and organizations in the Central Okanagan region was undertaken. In addition, the good examples of industry segments that have benefited are given.

[17] The Canadian Tourism Industry – A Special Report by the Tourism Industry Association of Canada, Fall 2012

A survey of businesses and organizations in the Central Okanagan was conducted to obtain feedback on the importance of YLW to their business/organization. The overall response rate to the survey was low, as is typical for these types of surveys; but many groups for which YLW is important responded and provided some useful insights to the importance of the airport. The 32 respondents covered a wide range of types of businesses and organizations as is shown in Table 12. The respondents had a total of 1,720 employees in the region, the most being in the transportation services, accommodation and food services, and finance and insurance industries. Most of those responding (80%) indicated that the airport was *very important* to their business/organization, and another 17% indicated it was *somewhat important*. It should be noted, however, that businesses that do not rely on the airport are more likely not to respond as they would see little value in spending time to respond.

Table 12. Summary of Responses to the Economic Influence Survey of Businesses and Organizations in the Central Okanagan

Business/Organization Group	No. Responses	Local Employees	Overall Importance of YLW*
Accommodation and Food Services	4	414	4.0
Arts, Culture, Entertainment	1	21	3.0
Business Organization	3	13	3.7
Finance and Insurance	3	275	3.3
Manufacturing	1	40	3.0
Professional Services	5	163	4.0
Real Estate	2	13	4.0
Transportation Services	4	720	4.0
Travel/Tourism Agent/Promotion	5	55	4.0
Other**	4	6	3.3
Total	**32**	**1,720**	**3.8**

* Average rating, rating varied from 1 – No Importance, to 4 – Very Important

** Includes respondents from Community Association, Construction, Recreation and Retail Trade groups

Businesses that operate only within the Okanagan placed less importance on the airport, but business with national and international operations, almost all (90%), indicated the airport is *very important* to their business.

The airport impacts businesses and organizations in different ways. Figure 11 shows the average importance rating of various different impacts for business and organizations responding to the survey. Not unexpectedly, bringing customers from outside the region was given as the most important. Second, however, was the importance of the airport in their investment decisions in locating or expanding in the Okanagan region. This is often an overlooked, or underappreciated, benefit of the airport and is critical to the economic development of the region. The importance of the airport in attracting skilled employees to their business in the Central Okanagan also ranked as one of the more importance impacts of the airport.

Figure 11. Average Importance Rating of Various Ways Airport Impacts Businesses and Organizations in the Central Okanagan

Note: Based on responses to the economic influence survey of businesses and organization;
Rating varied from 1 – No Importance, to 4 – Very Important

YLW benefits different industries in different ways, as is outlined below.

- Bringing customers from outside the region – this was rated by respondents as *very important* for the travel, manufacturing, real estate and transportation services industries, and to a lesser extent the food and accommodation services.
- Connecting staff with other offices of business/ organization – this was rated by respondents *somewhat important* to the finance and insurance, transportation, and arts, culture & entertainment industries.
- Connecting staff with clients/customers – this was rated by respondents as *very or somewhat important* the food and accommodation, professional services, travel and transportation services industries.
- Connecting staff with suppliers – this was rated by respondents as *somewhat important* to the food and accommodation and travel industries.
- Connecting staff with other businesses and organizations suppliers – this was rated by respondents as *very important* for the food and accommodation industry and, *somewhat important* to the transportation services, professional services, and arts, culture and entertainment industry.

- Moving items quickly to/from other regions – this was rated by respondents as *somewhat important* for the real estate, transportation services, and arts, culture an entertainment industries.
- Attracting skilled employees to the respondents' business in the Central Okanagan – this was rated by respondents as *very important* for the real estate industry and, *somewhat important* to the transportation services, finance and insurance, accommodation & food services, and arts, culture & entertainment industries.
- Respondents' decision to locate their business in the Okanagan – this was rated by respondents as *very important* for the real estate, accommodation & food services, and transportation services industries.
- Investment decisions in locating or expanding business or organization in the Okanagan region – this was rated by respondents as *very important* for the transportation services, real estate, and arts, culture & entertainment industries, and *somewhat important* to the accommodation & food services, finance & insurance, manufacturing, and travel industries.

Some comments from businesses in the region include:

"Having availability of flights is key to this very important region."

"It Influences our business a great deal."

"The more direct flights between Kelowna and other major cities opens the opportunity for further Tourism development and expansion. If there is the demand of guests then there's more opportunity to develop more attractions and activities for the traveler while visiting the city."

"YLW and its continued expansion and ability to attract more airlines and more direct flights to sun and Europe and Asia destinations is very, very important to us."

"People mobility within organization of greatest importance."

A good example of an industry where good local air service is critical is the technology industry. The direct and indirect impact of the Okanagan technology sector in 2013 was estimated to be $1.02 billion. This includes direct impacts of 6,500 employees and $797 million in revenues generated by tech companies as well as an indirect impact of $223 million created by businesses that supply inputs to the technology sector. The two most predominant sectors are technology software and services, and new media and Internet technology. Overall, in the high tech sector revenues increased by 3.5% to $23.2 billion and the GDP had 3.4% growth, which is double the overall provincial GDP growth.[18] One prominent business, Disney Canada, has over 300 employees in Kelowna and relies on air service for employees to meet with other staff, primarily in Los Angeles, and attend meetings and conferences. Another prominent company in the sector is Bardel Entertainment which employed 650 artists and professionals in B.C., including over 50 in Kelowna in 2013, and is projecting to grow to over 100 employees in 2016. Again, air service is important for collaborating with staff in their Vancouver office and meeting clients such as DreamWorks, Nickelodeon, Disney, Warner Bros. and Cartoon Network-Adult Swim, many of which are in the U.S. According to the Kelowna City Chamber of Commerce, Kelowna is quickly becoming a high-tech hub in animation, video game development, aerospace

[18] Study on Technology Sector in the Okanagan by Accellerate Okanagan, Jan. 2015

development and Information Technology services. Accelerate Communications Group Inc., which promotes the technology sector in the Okanagan, indicates that the airport is very important for connecting businesses in the region with other offices, clients, suppliers and other businesses in the sector. YLW is very important to the growth of this sector.

5.3 Enables Commuter Workers to Other Areas

The airport allows people to live in the region and air commute to work outside the region, particularly to large oil and gas development projects in Alberta and B.C, typically on a 10-day on, 10-day off work schedule. These workers and their families live in the Okanagan region and most of their disposable income is spent in the region and stimulates the local economy.

The number of commuter workers working on resource development projects and their incomes are difficult to determine, but some data is available which indicates the magnitude of the economic impact to the Okanagan region. In 2014, there were 851 movements at YLW of medium or regional jets or medium or large turboprop aircraft to airports serving resource projects at Fort Mackay/Albian, Conklin, Christina Lake, Fort St. John, Terrace and Dawson Creek. Assuming typical seat capacity and load factors on these flights, it is estimated they carried 10,800 workers from the Kelowna area to these work sites, noting that these workers make multiple trips over the year. In addition, WestJet commenced daily scheduled service using 78-seat Q400 aircraft to Fort McMurray in May 2014. This service will carry approximately 34,000 E/D passengers annually, or 17,000 enplaned passengers. Surveys taken at Fort McMurray Airport indicate that 40% of passengers are commuting to/from work on oil sands projects, although the proportion will likely be less on Westjet flights to Kelowna. Assuming 25%, this would imply another 4,200 worker commuting trips from YLW for a total of 15,000 commuter work trips annually. Assuming a typical work schedule and hourly rate, it is estimated that these workers generated approximately $75 million in income in the year May 2014 to April 2015, much of which will be spent in the Central Okanagan[19].

5.4 Value of Air Transport Beyond What Users Pay for Air Services

Air transportation has value beyond just the cumulative amount of output produced by the industry and the associated indirect and induced outputs. The amount people pay for air travel drives the output produced by the aviation industry. However, people, whether travelling for business, work, personal reasons or leisure, value their air trips at least as much as the airfare they pay, otherwise they would not travel. For many air trips they value the trip at much more than the price paid, particularly business/work trips. The amount they value their trips above what they pay is very difficult to determine, particularly at an airport level. However, an analysis of the consumer surplus generated by air travel provides a method of estimating, at least approximately, the total benefit to air travellers. A study of the consumer surplus that Canadians derived from air travel indicated that the **total value that consumers place on the industry is roughly double the cumulative of GDP produced by the industry.**

[19] Assuming 10 day work shift associated with each commuter work trip, average 10 hour shift and wage of $50 per hour.

5.5 SOCIO ECONOMIC IMPORTANCE OF AIRPORT

The Kelowna International Airport provides key socio-economic contributions to residents, businesses and visitors.

The airport provides critical support for the public sector in the regional essential for the communities they service. The public services include:

- **Health care** – Emergency or high-risk transfers (critical care) are always made by air; patients often travel by air for specialist treatment not available in the region, and doctors and other medical staff use YLW to visit the regional hospital and to attend conferences and other meetings.
- **Education** – University and college students often use air transport at the start and end of each term to access the university/college campus, both those from the region travelling out-of-town and visiting students attending university/college in the Okanagan. Air transportation is important to staff to attend conferences and other meetings.
- **Policing / Law Enforcement / Courts** – RCMP officers and judges often need to travel for meetings, witnesses and prisoners may you air transport depending on the location of the trial.

In addition, the airport improves the quality of life of residents of the region by allowing them to travel to more distant locations to see family and friends, attend to personal matters (such as funerals, health issues, etc.), attend social, cultural and sporting events, and go on vacation.

6 KELOWNA INTERNATIONAL AIRPORT'S FUTURE ECONOMIC IMPACT

The future economic impact is generated by both recurrent (ongoing) airport operations as well as by temporary activities related to construction and development at the airport.

6.1 RECURRENT AIRPORT OPERATIONS

Even without airport development, the airport would continue to generate recurrent impacts based on ongoing operations. In Section 2.4 it was forecast that in year 2020, a total of 2.019 million passengers will travel through the airport, an increase of 26%; and 2.38 million in 2025 (48% increase).

Over the past 5 years, direct employment has grown at 65% of the rate of growth of passenger traffic, while growth rates on average for direct wages, output and GDP have been roughly equal to the growth in passenger traffic. However, adjusting for inflation, the rate of growth for direct wages, output and GDP has followed the same trend as that of direct jobs. Future recurrent direct economic impacts of airport operations were estimated assuming the same trend continues and are summarized in Table 13. By the year 2020 operations at YLW can be expected to generate approximately $393 million (2014$) in direct output. This in turn equates to approximately 1,649 FTE workers being directly employed at the airport and $97 million (2014$) in direct wages.

Table 13. Future Impacts Due to Recurrent Airport Operations at YLW

ACTIVITY CATEGORY	2015	2017	2020	2025
Employment	1,446	1,530	1,649	1,853
Wages (million, 2014$)	$84.8	$89.7	$96.6	$108.6
Output (million, 2014$)	$344.6	$364.5	$392.9	$441.5
GDP (million, 2014$)	$155.5	$164.5	$177.3	$199.2

6.2 PROPOSED CAPITAL EXPENDITURES

The Airport is in the process of expanding the air terminal building and further expansion may be necessary over the next 10 years. The capital investment associated with the expansion of the terminal will involve expenditure on construction, equipment, and raw and finished materials, all of which support employment, GDP, economic output and taxes receipts. The economic impacts of the YLW's terminal expansion were estimated using the cost of the capital projects and Statistics Canada economic multipliers of direct employment generated by each dollar of capital spending and corresponding wages, GDP and economic output for B.C.

In addition to the terminal building, tenants at YLW are planning to spend another $xx million on capital improvements over the next three years.

Using the Provincial Input-Output model for the construction industry, we can esimate that should the Airport and tenants complete the full devleopment program as outlined in their capital plans, the following non-recurring eocnomic impacts will occur.

TO BE COMPLETED WHEN PROPOSED CAPITAL EXPENDITURES ARE FINALIZED

Table 14. Future Temporary Impacts Due to Planned Development at YLW

MEASURE	2015	2016	2017	2018	2019	2020 – 2025	CUMULATIVE TOTAL
Direct Gross Output							
Direct GDP							
Direct Employment							
Direct Labour Income							

As shown above, proposed devleopment at the airport will directly create xx additional FTE of employment during this period, an average of xx per year.

7 CONCLUSIONS

TO BE FINALIZED WHEN PROPOSED CAPITAL EXPENDITURES ARE FINALIZED

The previous economic impact study conducted for the Kelowna International Airport (YLW) was completed in 2011 using data from calendar year 2010. Since that time, the Kelowna International Airport traffic has increased by 15% over the five years.

YLW provides significant economic and transportation benefits and is an integral part of the local and regional economy. Table 15 summarizes the economic benefits of YLW as measured in 2014. Indirect and induced impacts were determined using Statistics Canada economic multipliers for B.C.

Table 15. Summary of Economic Impacts at YLW – 2014

ACTIVITY CATEGORY	ASSOCIATED WITH AIRPORT ACTIVITY				CATALYTIC
	DIRECT	INDIRECT	INDUCED	TOTAL	TOURISM
Employment (Person/yrs)	1,411	737	525	2,673	1,872
Wages (million)	$83	$37	$22	$142	$51
Output (million)	$336	$169	$94	$599	$190
GDP (million)	$152	$75	$79	$306	$90

Tourism is one of the major catalytic impacts associated with the airport. As shown in the above table, the total impacts of visitors to the region travelling by air are significant with 1,872 FTEs, $51 million in wages, $190 million in output and $90 million in GDP. This equates to roughly 70% of the total employment impact of the airport and between 26% and 36% of the total income, output and GDP impacts of the airport. Businesses and organizations in the region indicated that the airport is very important in bringing customers to the region. The second most important impact of YLW was on investment decisions to expand in the region, followed by connecting staff with other businesses/organizations, clients, and other offices of their business/organization. The airport is also important in attracting skilled workers to the region. YLW is therefore very important to economic growth in the Okanagan region.

An additional single daily B737-700 flight at YLW is estimated to result in between 16 and 38 FTE jobs at YLW. Other measures of economic impact relative to traffic and employment numbers are provided in Table 16.

Table 16. Additional Economic Impact Measures (2014)

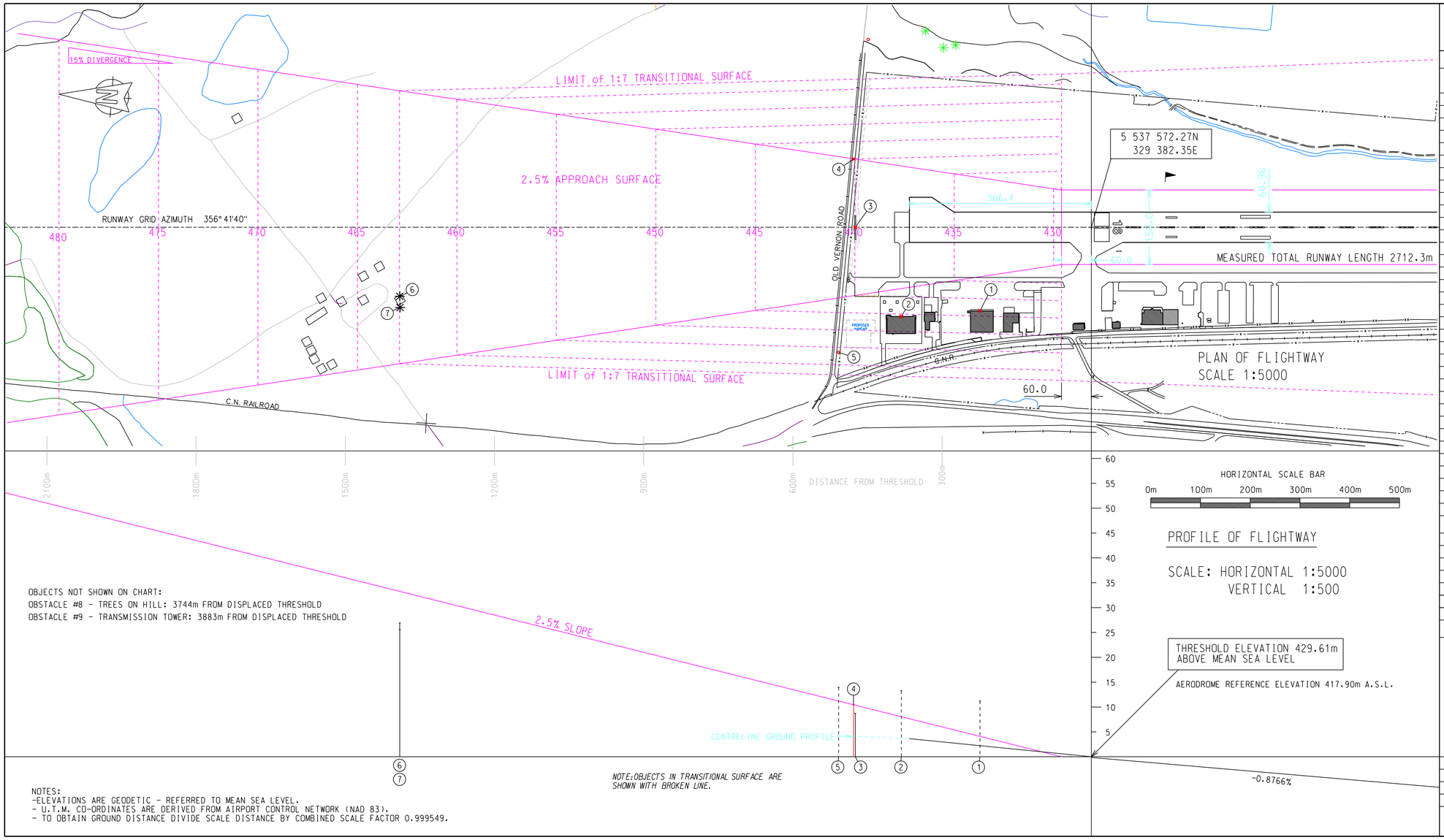
MEASURE	2014
Passengers (E/D)	1,602,899
Direct Output per E/D Passenger	$210
Direct Output per Landing (All Movements)	$7,087
Direct Output per Direct FTE	$238,258
Direct Wages per Direct FTE	$58,608
Increase in total FTE for every 1,000 increase in E/D passengers	1.8
Number of Landings per direct FTE	34

In conclusion, with 1,411 FTEs and $336 million in direct output, YLW is a powerful economic generator for the Kelowna area. In addition, capital expenditures at the airport increase direct employment and direct output by another 42 FTEs in 2014 (3% of total). The value of transportation services beyond what travellers pay for their air tickets cannot be determined, but consumer surplus economic theory indicates that inclusion of this benefit to air travellers would roughly double the economic impacts presented above.

APPENDIX A – LIST OF AIRPORT TENANTS / CONCESSIONNAIRES

CURRENT YLW TENANT / BASED ORGANIZATION
Kelowna int'l Airport Authority
Okanagan Aero Engine (1999) Ltd.
Strategic Aviation Services LTD
Ironman Holdings LTD
ARINC
Devon Transport Ltd. (Budget)
Skyway (Tims, White Spot, Duty Free, etc)
Enterprise Rent-A-Car Canada Company
Avis Rent A Car
G4S Secure Solutions, Aviation
BC Corps of Commissionaires
Transport Canada
RCMP
Nav Canada
CBSA
CATSA
Ambassadors
North Cariboo Air
NT Air
Enerjet
Flair Airlines Ltd
Carson Air ltd.
Canjet
Royal Star Enterprises Inc.
Western Bus Lines
All Rush Express
Kelowna Cabs
Big White Central Reservations
Tourism Kelowna
Coast Capri Hotel
Suncor Energy
Kelowna T Hangars
Kelowna and District Flying Club
Air North
WestJet
Pacific Coastal Airlines
Alaska - Horizon Air
Central Mountain Air
Air Canada / Express-Jaz
Bouygues Energies & Services
KF Aerospace (prev. Kelowna Flightcraft) - Air Carrier
Great Slave Helicopters
Skyline Helicopters Ltd.
Air Transat
Canadian North
Southern Interior Flight School

Appendix F : Kelowna International Airport Master Plan 2045 Economic Impact Study Update



OBJECTS NOT SHOWN ON CHART:
OBSTACLE #8 - TREES ON HILL: 3744m FROM DISPLACED THRESHOLD
OBSTACLE #9 - TRANSMISSION TOWER: 3883m FROM DISPLACED THRESHOLD

NOTES:
-ELEVATIONS ARE GEODETIC - REFERRED TO MEAN SEA LEVEL.
- U.T.M. CO-ORDINATES ARE DERIVED FROM AIRPORT CONTROL NETWORK (NAD 83).
- TO OBTAIN GROUND DISTANCE DIVIDE SCALE DISTANCE BY COMBINED SCALE FACTOR 0.999549.

NOTE:OBJECTS IN TRANSITIONAL SURFACE ARE SHOWN WITH BROKEN LINE.

City of Kelowna

OBSTACLES

NO.	DESCRIPTION	ELEVATIONS TOP	ALLOW	GROUND	CO-ORDINATES NORTH	EAST
1	BUILDING PEAK	440.90	443.50		5537786	329202
2	BUILDING PEAK	442.94	445.69		5537943	329181
3	BLAST FENCE	438.34	439.98		5538046	329355
4	MOBILE OBSTRUCTION	440.17	440.06	435.87	5538057	329492
5	UTILITY POLE	443.58	456.45		5538065	329102
6	FIR TREE	456.75	462.79		5538952	329164
7	POPLAR GROUP	454.58	462.77		5538950	329141
8	TREES ON HILL	529.77	521.71		5541322	329400
9	TRANSMISSION TOWER	541.62	525.18		5541465	329475

NO.	SURVEYED BY	CALC. BY	CHECKED BY	DRAWN BY	DATE
2	SNC LAVALIN	J.H.		J.H.	MAR.2013
1	SNC LAVALIN	J.H.		J.H.	DEC.2010

REVISION

KELOWNA AIRPORT, B.C.

FLIGHTWAY OBSTRUCTION CHART

RUNWAY 16 APPROACH AT 2.5% SLOPE

drawn by: J. HAY
field by: J. HAY (JULY 95)
checked by:
date: JAN. 1996

SNC·LAVALIN
AIRPORT GROUP - VANCOUVER B.C.

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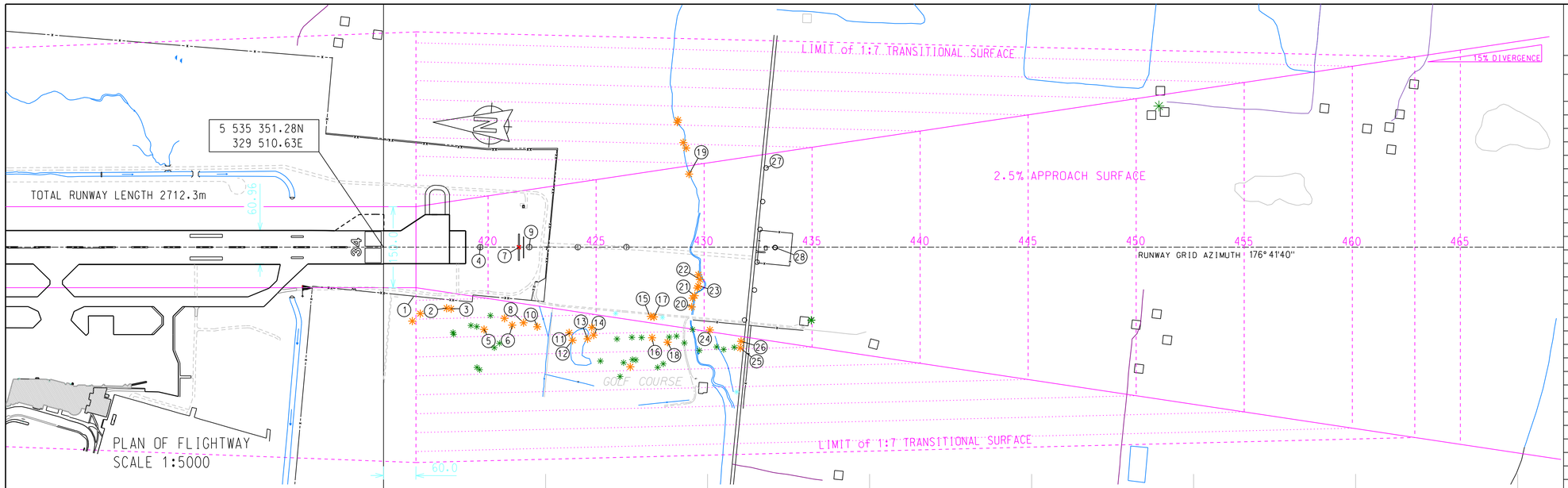


PLAN OF FLIGHTWAY
SCALE 1:5000

HORIZONTAL SCALE BAR

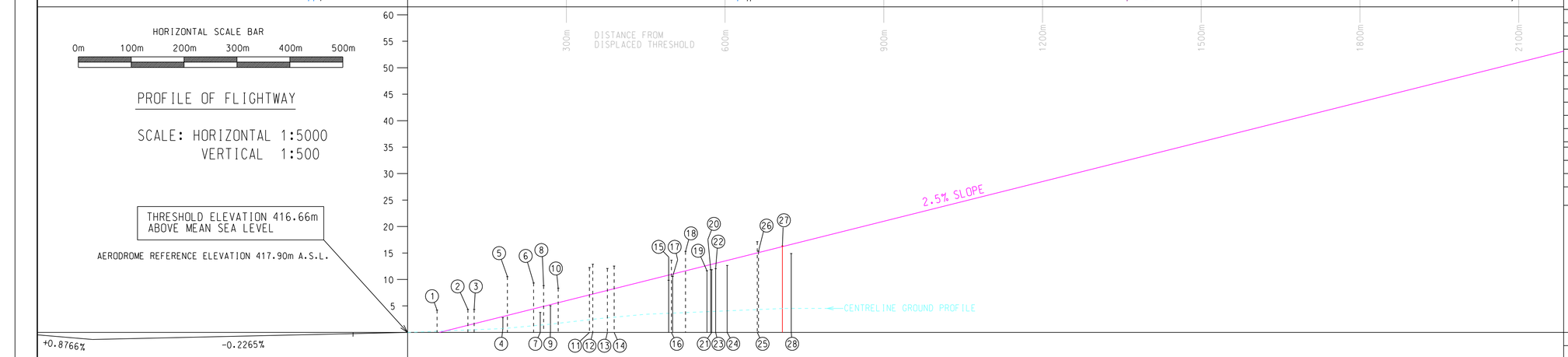
0m 100m 200m 300m 400m 500m

PROFILE OF FLIGHTWAY

SCALE: HORIZONTAL 1:5000
VERTICAL 1:500

THRESHOLD ELEVATION 416.66m
ABOVE MEAN SEA LEVEL

AERODROME REFERENCE ELEVATION 417.90m A.S.L.



NOTE:OBJECTS IN TRANSITIONAL SURFACE ARE SHOWN WITH BROKEN LINE.

NOTES:
- ELEVATIONS ARE GEODETIC - REFERRED TO MEAN SEA LEVEL.
- U.T.M. CO-ORDINATES ARE DERIVED FROM AIRPORT CONTROL NETWORK (NAD 83).
- TO OBTAIN GROUND DISTANCE DIVIDE SCALE DISTANCE BY COMBINED SCALE FACTOR 0.999549.

City of Kelowna

OBSTACLES

NO.	DESCRIPTION	ELEVATIONS TOP	ALLOW	GROUND	CO-ORDINATES NORTH	EAST
1	SCRUB BUSH	420.87	419.06		5535290	329422
2	FIR TREE	421.00	422.11		5535228	329405
3	FIR TREE 512	421.00	422.17		5535220	329404
4	ODAL #1	419.46	419.64	418.1	5535172	329521
5	WILLOW TREE 043	427.20	428.22		5535157	329369
6	WILLOW TREE 439	426.00	427.45		5535105	329379
7	BLAST FENCE	420.45	421.43		5535101	329525
8	WILLOW TREE 041	425.50	427.15	415.4	5535086	329382
9	ODAL #2	421.70	421.91	418.2	5534082	329526
10	WILLOW TREE 040	425.00	427.83	415.2	5535058	329380
11	WILLOW TREE 447	428.90	429.90	415.5	5534998	329371
12	WILLOW TREE F68	429.53	430.72		5534992	329359
13	POPLAR TREE 351	428.77	431.32	414.8	5534965	329363
14	DECIDUOUS TREES	429.20	430.28	415.6	5534952	329371
15	FIR TREE F49	426.50	427.50		5534851	329411
16	DECIDUOUS TREE F50	430.30	431.01		5534844	329375
17	FIR TREE 093	427.24	427.69		5534844	329410
18	DECIDUOUS TREE F47	431.95	432.25		5534817	329369
19	POPLAR TREE	428.30	429.30		5534794	329678
20	DECIDUOUS TREES F29	428.50	429.48		5534773	329434
21	DECIDUOUS TREES F28	428.50	429.53		5534772	329455
22	DECIDUOUS TREES F26	428.70	429.80		5534763	329485
23	DECIDUOUS TREES F27	428.70	429.72		5534766	329473
24	FIR TREE F36	429.30	430.26		5534739	329392
25	FIR TREE F34	433.80	434.79		5534681	329362
26	FIR TREE F32	432.00	433.04		5534679	329374
27	UTILITY POLE	432.90	432.89		5534653	329698
28	NDB ANTENNA	431.71	433.29	421.2	5534627	329552

NO.	SURVEYED BY	CALC. BY	CHECKED BY	DRAWN BY	DATE
2	SNC LAVALIN	J.H.		J.H.	FEB.2013
1	SNC LAVALIN	J.H.		J.H.	OCT.2011

REVISION

KELOWNA AIRPORT, B.C.

FLIGHTWAY OBSTRUCTION CHART

RUNWAY 34 APPROACH AT 2.5% SLOPE

drawn by: J. HAY
field by: J. HAY (JULY 95)
checked by:
date: JAN. 96

SNC·LAVALIN
AIRPORT GROUP - VANCOUVER B.C.

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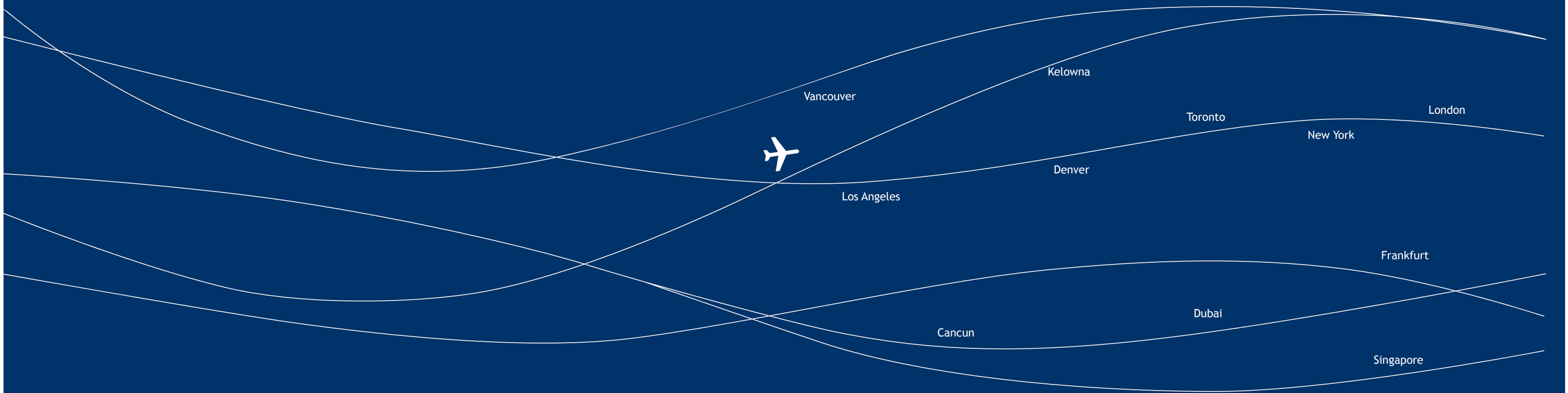
Appendix G : Air Terminal Building Expansion Schematic Design

Kelowna International Airport

Air Terminal Building Expansion
Schematic Design Report

November 2010

YLW
Kelowna International Airport



Report prepared by:

DIALOG

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Your Link to the World

1.0 INTRODUCTION

The Schematic Design Report for the Kelowna International Airport Air Terminal Building Expansion Project represents the completion of the initial phase of design. It is the bridge between the Master-plan and the Design Development stages and provides the Kelowna International Airport with the information to build a greater understanding of the relationship of the programme elements, building systems, organization within and relationship to the apron and airfield design, initial architectural design and preliminary cost estimates for the scope proposed.

The scope of this document includes concept design information on all major building systems inclusive of architectural, structural, mechanical, electrical, civil, baggage, building code and sustainability considerations. The information included herein was authored by the larger consultant team as follows:

Programme Manager	|	Leigh Fischer
Airfield Masterplanning	|	Leigh Fischer
Retail	|	Leigh Fischer
Architecture	|	Dialog
Structural Engineering	|	Dialog
Mechanical Engineering	|	Dialog
Electrical Engineering	|	Dialog
Sustainability Consulting	|	Dialog
Terminal Planning	|	Suehiro Architecture
Signage and Wayfinding	|	Entro
Cost Estimating	|	Hanscomb Ltd.

All work was developed in coordination with the Kelowna International Airport Authority, various internal stakeholders, agencies, airlines as well as the Airport Advisory Committee and the Accessibility Advisory Committee.

Schematic Design terminal expansions to meet passenger demand projected for the year 2025. To facilitate and calibrate this work, a Functional Programme Analysis was prepared that reviewed existing facilities against the growth projections and determined the required space needs using IATA LOS C standards. Further, a review of the existing mechanical and electrical systems was completed and an audit report completed for the sequential updating of these systems in conjunction with a defined phased programme of works. A sustainability study prepared several options for an integrated systems approach to meet CO2 reductions targets set by the City of Kelowna. Finally, the schematic design was divided into five phases of work, the first four of which are intended to be delivered by 2016 in concert with demand requirements and within defined financial constraints. The building design is to facilitate the defined aircraft parking layout prepared by Leigh Fischer.

2.0 DESIGN PARAMETERS

2.1 Airport Master Plan Forecast

The Kelowna International Airport Master Plan 2025, February 2007 records the enplaned and deplaned million annual passenger (MAP) for 2009 and forecasts the same for 2015 and 2025 as follows:

Passenger Forecast

2009 1.367 MAP (actual)
2015 1.630 MAP
2025 2.400 MAP

This data forms the basis for all programming and functional requirements for the air terminal building expansion project.

2.2 Functional Programme Analysis

Prior to the design process, the "Design Phase Air Terminal Facilities Programme Analysis*" was developed. Its' purpose was to establish a functional programme for the air terminal building expansion. It used an analysis of existing and future needs and was based on the Master Plan annual passenger growth projections to determine estimated passenger planning activity levels for the peak month, design day, design hour and surges within the design hour using IATA calibrations. Its' findings and requirements were prepared with guidance from the YLW airport authority and the airport development manager.

Further, the analysis used an assessment of aviation demand based on extraction of passenger activity from existing peak month, design day airline flight schedules that identify design hour and peak 20 minute data. A projected flight schedule was developed to generate passenger activity for 2015 and 2025 planning horizons.

Design hour passenger activity was further segregated into three travel sectors for analysis and was recorded as follows:

DEPARTURES PEAK HOUR PASSENGERS BY SECTOR		
2015	Domestic Departures	285 Passengers
2015	International Departures	110 Passengers
2015	Transborder Departures	115 Passengers
2025	Domestic Departures	345 Passengers
2025	International Departures	235 Passengers
2025	Transborder Departures	190 Passengers

ARRIVALS PEAK HOUR PASSENGERS BY SECTOR		
2015	Domestic Arrivals	340 Passengers
2015	International/Transborder Arrivals	325 Passengers
2025	Domestic Arrivals	450 Passengers
2025	International/Transborder Arrivals	405 Passengers

The full Design Phase Air Terminal Facilities Programme Analysis can be found in the Kelowna ATB Development Concept Design, May 31, 2010. Submitted by Jacobs Engineering

Using the data a detailed analysis was prepared to determine the Functional Programme areas required to service the passenger flows. The following is a summary of the programme areas:

FUNCTIONAL PROGRAMME FOR 2025 DEMAND	
AREA	***SM***
Check-in Counters	140
Check-in Queuing	321
Outbounding Bag & Offices	1338
Airline Offices	436
Check-in Circulation	117
Public Area	786
Public Area not in program	
Security Station - Queue	117
Security Station - Stations	660
Security Station - Offices	120
CBSA PIL	334
CBSA Secondary	765
International Device & Claim Zone	786
International Claim Hall	601
International Meeter Hall	640
Domestic Device & Claim Zone	871
Baggage Service Office	55
Domestic Meeter Hall	477
Holdroom D+I+TB	905
Holdroom TB only	457
Podium & Gate Control	440
Concessions Food	1056
Concessions Retail	528
Concessions Support	238
Admin/Operational Spaces	1690
Building Systems	2029

- *It should be noted that the services of an Air Terminal Retail Consultant were provided after the development of the Functional Programme. The Retail Programme requirements and variances from the above are described later in this document.*

2.3 Level of Service

Levels of Service designations describe the comfort and quality of the passenger experience. Levels of service define the maximum waiting times within process areas, and the design standards for amount of area allotted per passenger within each service area. The industry standard measure of level of service (as defined by IATA) is LOS C. The Schematic Design of the Kelowna International Airport is based upon achieving a LOS C for all passenger areas within the terminal.

2.4 Area Reconciliation

The design team used the functional programme to develop a concept plan*. The concept plan was reviewed and accepted by the Kelowna International Airport Authority, and forms the basis of the Schematic Design.

**Refer to the Kelowna ATB Development - Concept Design, May 31, 2010*

3.0 SITE MASTER PLAN CONSIDERATIONS

3.1 Site Constraints

The existing air terminal has significant site constraints on all sides.

To the west, the existing groundside roadway, parking areas and site topography present different challenges to the expansion plans. It was a requirement of the project that the existing groundside roadway, access from the western parking lot and pedestrian crossings were to remain. An approximate 3 meter grade difference exists from the south end of the rotunda to the south parking lot. Re-grading of the curbside is not desirable.

To the east, aircraft parking and airfield operations and obstacle limitation surfaces define expansion capabilities. The Jacobs “May 27, 2010 Aircraft Parking Layout, Kelowna International Airport” appended to this report describes the parameters in detail.

The greatest expansion capacity for the terminal building is to the south. This will require the replacement of the parking lot immediately to the south of the existing terminal. Grading from east to west must be studied as there is a considerable slope down from the airfield to the curbside.

To the north, expansion will be defined by planned future Gate 0 operations and current access to the fire hall.

3.2 Future Parkade

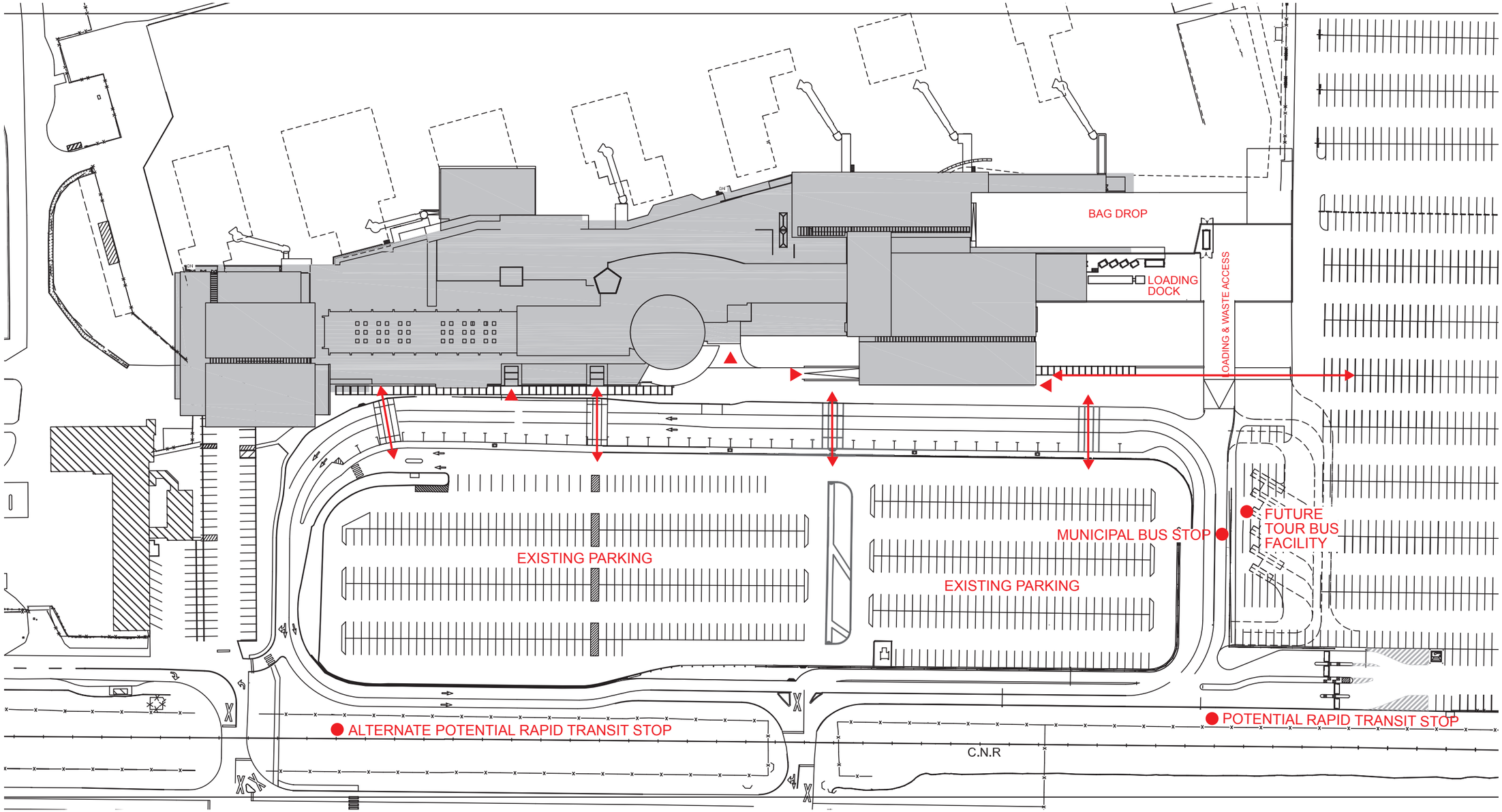
There are long term plans for a parkade to be built on the site of the west parking lot. At this time, there are no specific design plans that indicate pedestrian or vehicle access locations.

3.3 Pedestrian Crossings at Curbside

The four existing pedestrian crossings at the curbside roadway are located to connect directly with the existing entry points to the terminal. This condition will continue as is for the two northerly crossings.

The new Domestic Arrivals facility will provide two entry points. The south entry point will give direct access south to the south parking lot as well as functioning for curbside drop off and pick ups. As the grade is 3 meters lower than the floor elevation of the Domestic Meeter Greeter facility, two escalators, a stair and an elevator are provided just inside of the entry point. As it is anticipated that the majority of passengers using this entry point will be moving between the terminal and the south parking lot, no pedestrian crossing is provided to the west parking lot across the curbside roadway.

The north entry point to the Domestic Arrivals facility is accessed by a 5% grade up from the curbside roadway. Slopes 5% and smaller are not considered ramps. The north end of the entry point to the terminal is slightly to the north of the existing pedestrian crossing from the west parking lot. In order to minimize rework to the existing roadway direction was received to maintain this walkway location. In the future, a direct pedestrian connection from the new parkade may be considered that directly aligns the walkway with the north entry to the Domestic Arrivals facility.


BAG DROP
LOADING DOCK
LOADING & WASTE ACCESS
EXISTING PARKING
EXISTING PARKING
MUNICIPAL BUS STOP
FUTURE TOUR BUS FACILITY
ALTERNATE POTENTIAL RAPID TRANSIT STOP
POTENTIAL RAPID TRANSIT STOP
C.N.R
N

SITE PLAN

3.4 Curbside

The concept plan identifies a new Domestic Arrivals Facility to the south of the project, separate from the International Arrivals Facility to the north. This has an obvious impact on the design of curbside operations with demand for drop off and pick up now in two locations. The following drawing indicates the available pick-up/drop-off positions. The number will increase from the existing as the bus lay by will be removed. Specific allocations for taxi, personal vehicles will be determined in later phases of the design.

3.5 Tour Bus Loading Facility

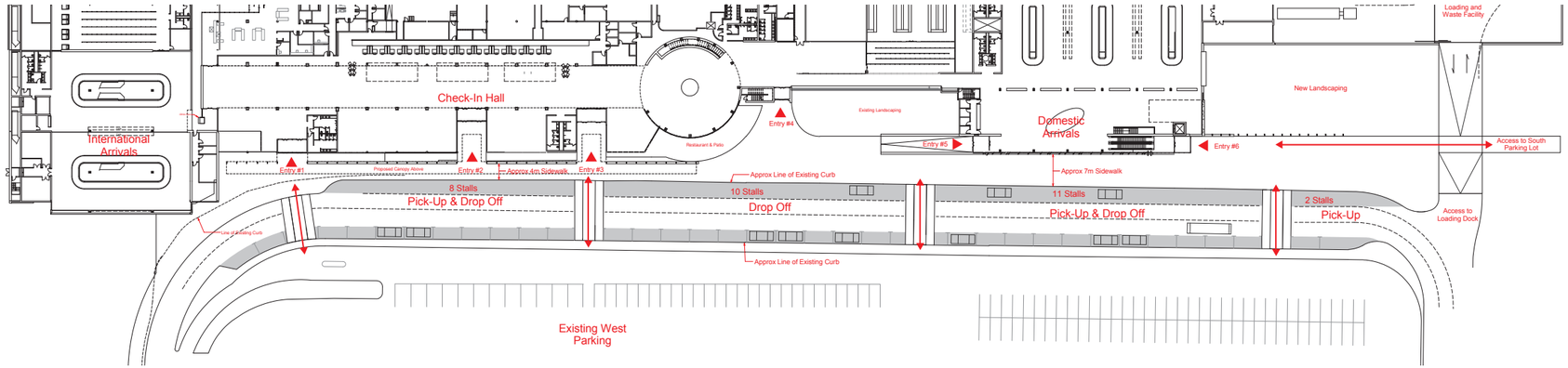
The existing bus lay by on the curbside roadway will be removed at the time of construction of the Domestic Arrivals facility. The opposite site plan indicates a location for tour bus loading directly to the south of the south curbside access road with capacity for six full size coaches. Space has been provided for safe queuing of passengers and for the provision of a roofed shelter. The shelter can also serve city busses stopping at a proposed bus stop just to the north of the Tour Bus area.

3.6 Rapid Transit Connection

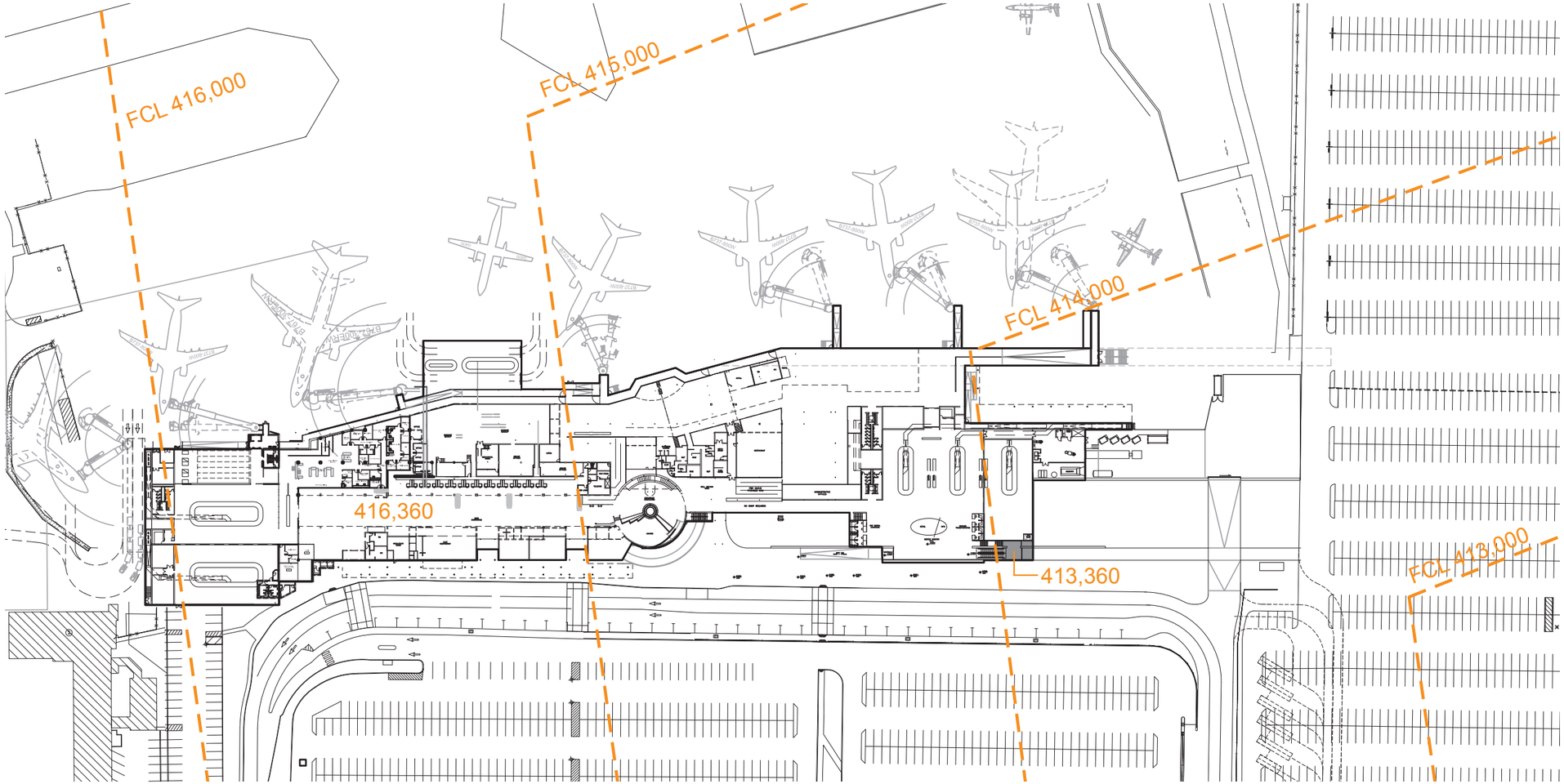
It is recognized that there is a long term potential to connect the air terminal with a rapid transit system. It is understood that the system would utilize the existing rail corridor running along the western edge of the west parking lot. The Schematic Design identifies a potential location for a future rapid transit stop directly to the west of the tour bus loading area. There are advantages to co-locate the bus, rail and pedestrian access to the terminal in the same general location. Future study will be required to understand the implication of the vehicle access to the south parking area in the same area on pedestrian movement, safety, and potential congestion for vehicles accessing the parking lot. It may be desirable to locate the rail stop further to the north away from the parking access to segregate pedestrians from the intersection.

3.7 Traffic Study

The current site and curbside master plan has not been confirmed by a specialized traffic consultant. To ensure appropriate access and movement control throughout the site that anticipates proposed development, further study by a traffic consultant is recommended.



CURBSIDE DRAWING



FLOOD CONSTRUCTION LEVEL DRAWING

3.8 200 Year Flood Plain

The Province of British Columbia has mandated that all municipalities develop provisions within their bylaws to protect buildings built within the 200 year flood plain. The City of Kelowna is in the process of preparing a bylaw to comply. A final copy of the bylaw is not yet available and the boundary drawing with defined Flood Construction Levels (FCL) is in draft form only. The consultant team has determined that the air terminal lands are within the boundary controlled by this bylaw and that the existing main floor level of the terminal is above the 200 year level. However, the existing grade drop toward the south has implications for built elements at the south end of the project area that require grade access or have floor levels below the defined FCL. Further, elements such as conveyor tunnels may require special construction considerations.

4.0 AIRSIDE PLANNING

4.1 Aircraft Parking Layout / Gate Matrix

The Aircraft Parking Layout was developed for the Kelowna International Airport by Jacobs Engineering. The full study entitled “Aircraft Parking Layout, Kelowna International Airport, May 27, 2010 was included in the Concept Design submission, May 31, 2010 for reference. The following is a summary of the study provisions:

The 2016 Schematic Design provides a total of 8 gates plus one future gate(titled gate 0). Gates 1,2,4,5,6, and 7 are equipped with Passenger Boarding Bridges. While all Gates have ground loading capability, Gates 3 and 8 are ground load only positions. The attached matrices (labelled figures 1.2 and 1.3 from the May 27th Aircraft Parking Layout Report) indicate the aircraft gauge that can be accommodated at each position, whether the bridge is new or relocated; and, fixed link lengths needed to connect to the ATB.

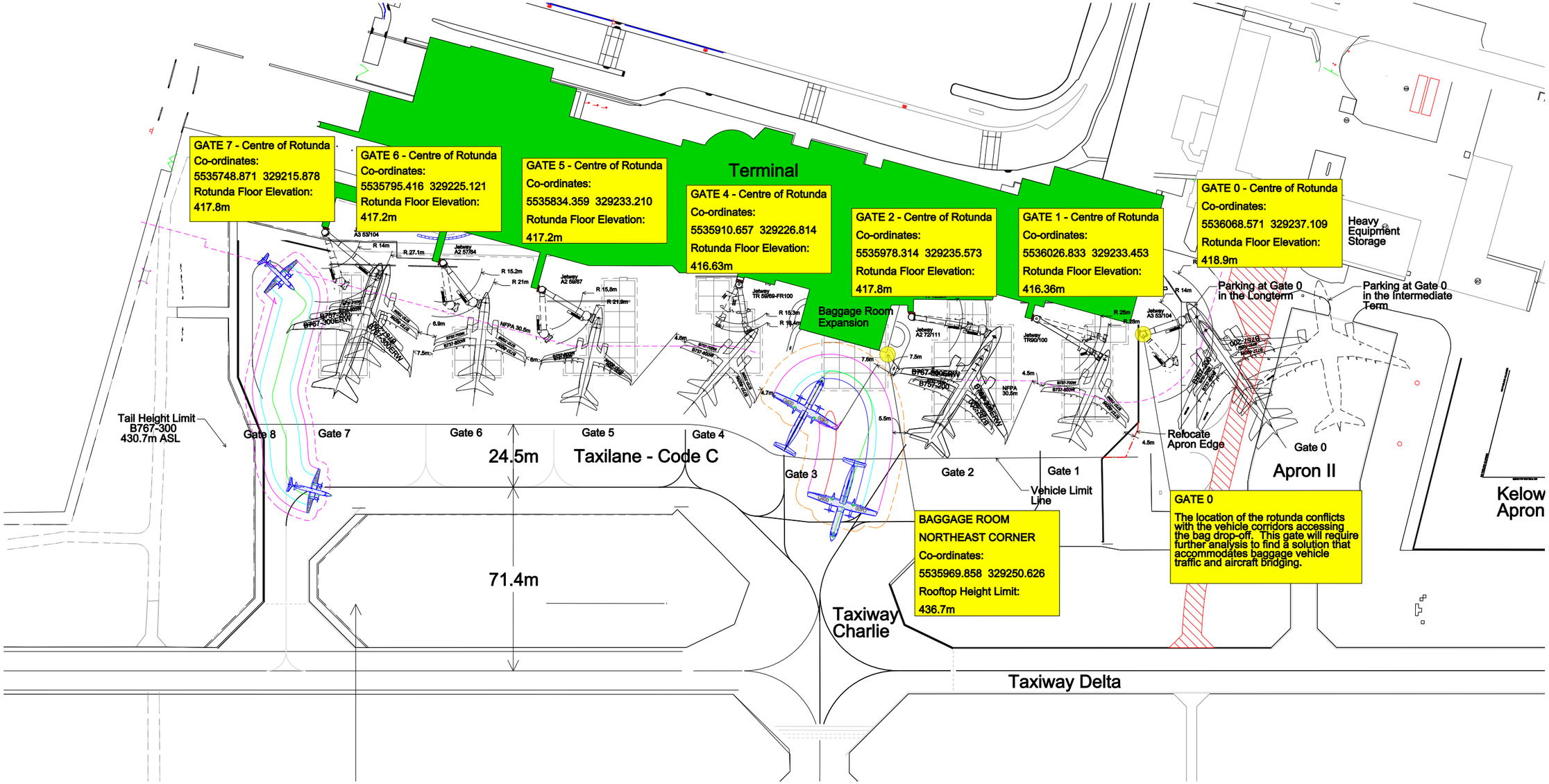
New Passenger Boarding Bridges (PBBs) will be required to service Gates 0 and 7. All other gates will re-use existing bridges.

To achieve the proposed layout, adjustments to bridge placement, rotunda locations and elevations are required. Design Rotunda elevations required to service the planned aircraft at Gate are indicated on the attached plans.

A future gate expansion is anticipated in the long term to the North for Gate 0 and South to accommodate 2025 master plan requirements. A future Gate 0 to the north could accommodate code E aircraft. As indicated on the diagram, a high level loading corridor is anticipated to span the access to baggage loading area.

GATE MATRIX

AIRCRAFT	0	1	2	3	4	5	6	7	8
1	Future			Non Bridged					Non Bridged
A310-300 (Widebody)			x					x	
B767-200 (Widebody)			x					x	
B767-300/300W (Widebody)			x					x	
B757-200/200W			x					x	
A318		x	x			x	x	x	
A319		x	x			x	x	x	
A320		x	x			x	x	x	
B737-600		x	x		x	x	x	x	
B737-700/700W		x	x		x	x	x	x	
B737-800/800W		x	x		x	x	x	x	
EMB190		x	x		x	x	x	x	
CRJ100		x	x		x	x	x	x	
CRJ200		x	x		x	x	x	x	
CRJ705		x	x		x	x	x	x	



AIRCRAFT PARKING LAYOUT

EXHIBIT I-2: BRIDGE SLOPES (%)							
AIRCRAFT	**GATE 0**	**GATE 1**	**GATE 2**	**GATE 4**	**GATE 5**	**GATE 6**	**GATE 7**
A318	-0.81	-4.92	-3.59	-11.47	-7.54	-7.90	-3.52
A319	-0.85	-4.95	-3.63	-11.52	-7.58	-7.95	-3.56
A320	-0.90	-5.06	-3.73	-11.69	-7.71	-8.08	-3.68
B737-600	+2.61	-2.26	-1.14	-7.55	-4.39	-4.98	-0.19
B737-700/700W	+2.61	-2.26	-1.14	-8.00	-4.39	-4.98	-0.19
B737-800/800W	+2.61	-2.26	-1.16	-8.00	-4.56	-4.98	-0.19
EMB190	+2.56	-2.17	-0.99	-7.78	-4.19	-4.79	-0.22
CRJ 100/200	+6.95	+2.00	+3.07	-2.05	+0.99	+1.02	+3.77
CRJ705	+5.35	+0.64	+1.74	-3.03	-0.73	-0.91	+2.34
B757-200 L1 Door	-4.44	N/A	-5.64	N/A	N/A	N/A	-5.96
B757-200 L2 Door	-3.47	N/A	-5.46	N/A	N/A	N/A	-4.83
A310-300	-7.44	N/A	-7.69	N/A	N/A	N/A	-7.98
B767-200	-6.71	N/A	-7.35	N/A	N/A	N/A	-8.12
B767-300 L1 Door	-6.86	N/A	-7.13	N/A	N/A	N/A	-8.26
A330-200 L1 Door	-7.88	N/A	N/A	N/A	N/A	N/A	N/A
A330-200 L2 Door	-7.43	N/A	N/A	N/A	N/A	N/A	N/A
A330-300 L1 Door	-7.45	N/A	N/A	N/A	N/A	N/A	N/A
A330-300 L2 Door	-6.60	N/A	N/A	N/A	N/A	N/A	N/A

Source: Jacobs Consultancy 2010

FIGURE 1.2

EXHIBIT I-3: PRELIMINARY FIXED LINK LENGTHS				
GATE	**ROTUNDA FLOOR ELEVATION (METRES ASL)**	**BRIDGE MODEL**	**FIXED LINK LENGTH (METRES)**	**COMMENTS**
0	418.9	Jetway A3 53/104 125R (Proposed)	To be determined	Switchback recommended
1	416.36	Jetway TR 90/100 FR100 (Relocated)	4.6	-
2	417.8	Jetway A2 72/111 125R (Relocated)	37.7	Switchback recommended
4	416.63	Jetway TR 59/69- FR100 (Existing)	4.07	Existing location
5	417.2	Jetway A2 59/87 125R (Relocated)	11.0	-
6	417.2	Jetway A2 57/84 125R (Relocated)	11.0	-
7	417.8	Jetway A3 53/104 125R (Proposed)	15.5	-

Source: Jacobs Consultancy 2010

FIGURE 1.3

4.2 Gate Flexibility / Sector Segregation

YLW operates three sectors; Domestic Departures and Arrivals, International Departures and Arrivals and Transborder Departures. YLW does not operate a Pre Clearance Facility, nor is there one planned in the foreseeable future. Transborder outbound passengers are screened with all other Domestic and International outbound passengers and arrive in the US as International Arrivals and process through Customs and Immigration in the US.

Recent events required YLW (and all other Tier 2 Airports in Canada) to construct a temporary Transborder Hold room to segregate passengers immediately post Pre Board Screening, and to maintain that segregation in the airside corridor. Early design studies identified a position for a completely separate Transborder screening facility however this is not currently a requirement. Should it be deemed necessary in the future, that plan as indicated on the approved Concept Plan could be implemented. Requirements for a fully segregated hold room have similarly been relaxed.

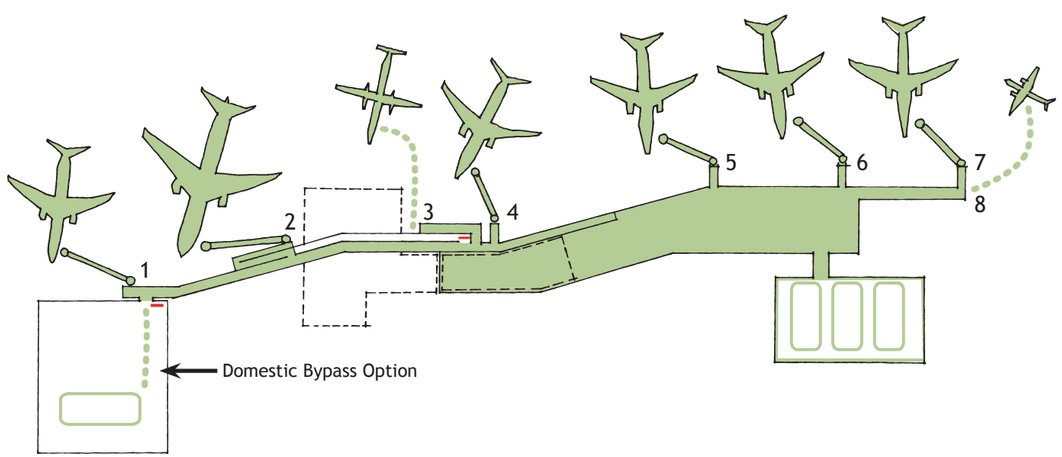
Current regulations for Tier 2 terminals call for a dedicated Full Body Scanner to be available adjacent to the Transborder Boarding Podiums in the hold room. Passengers identified to require this screening procedure will be pulled out of the boarding line prior to boarding the aircraft. A fully segregated hold room is not required. To anticipate the potential of a changing security environment, the Schematic Design includes a moveable partition that could segregate the hold room with 100 seats available for Transborder passengers. Provisions for more washroom facilities that would accompany a fully segregated hold room scenario have not been included at this time and would require further study.

Elsewhere in this document a description is provided of the development of a new Domestic Arrivals Facility to the south of the terminal, with International Arrivals facilities maintained at the north end. It is therefore for proximity reasons that Gates 1, 2, 3 and 4 are available for International Arrivals, with Domestic operations focused at the south. Transborder operations will share gates 1,2,3 and 4 in order to facilitate turns for International Arriving aircraft to depart Transborder.

The following diagrams demonstrate the ability of the facility to accommodate:

- A Maximum of 8 Simultaneous Domestic/International departures and Domestic arrivals Gates
- A maximum of 4 Simultaneous Transborder Departures Gates
- A maximum of 4 Simultaneous International Arrivals Gates

A desire was expressed early in the design process to eliminate the airside corridor to reduce confusion for passengers moving in opposite directions within the corridor. To that end the airside corridor was deleted between Gates 4, 5 and 6 when operating in Domestic modes. Domestic arrivals will transit through the hold room to domestic bag claim. For Gates 1, 2, 3 and 4, the airside corridor remains a requirement due to the location of the boarding podiums relative to the gate position, and in order to maintain segregation between international arriving passengers from Domestic / International / Transborder departures. Segregation is achieved through the use of doors within the corridor that “switch” the corridor between sectors.



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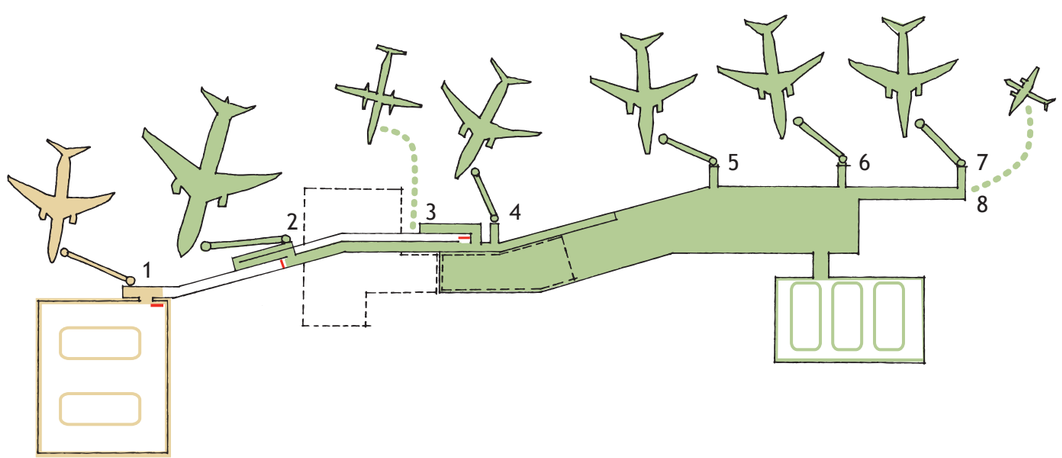
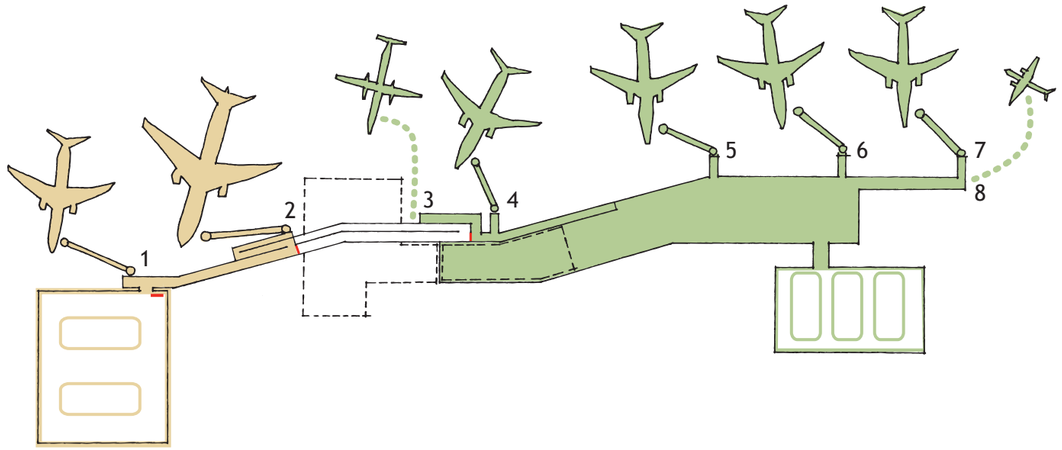


Configuration 2



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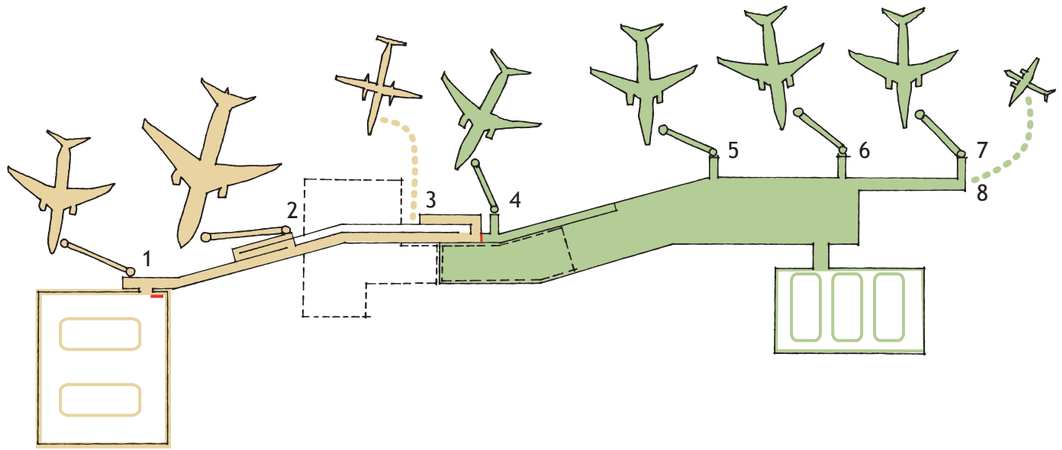


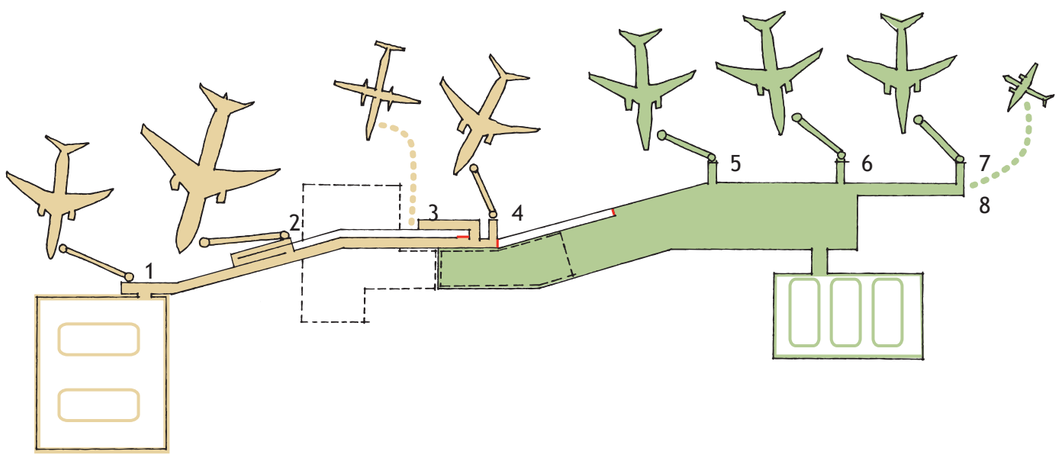
Configuration 4

FLEXIBILITY DIAGRAMS

Domestic Inbound + Domestic / International Outbound

Transborder Outbound

International Inbound



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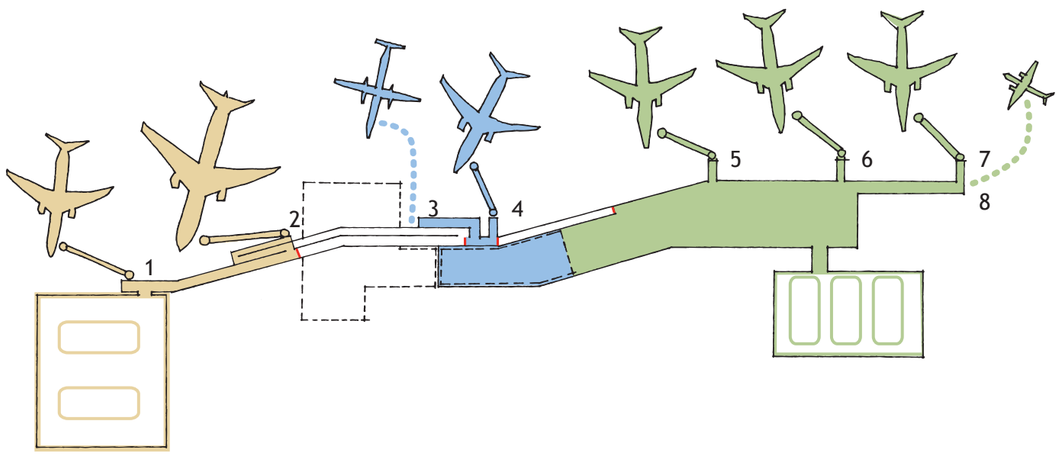
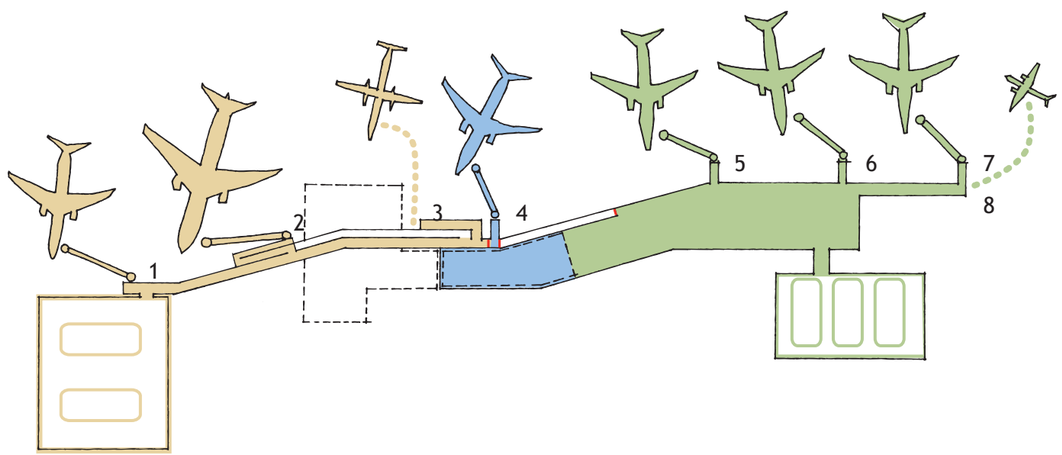


Configuration 7



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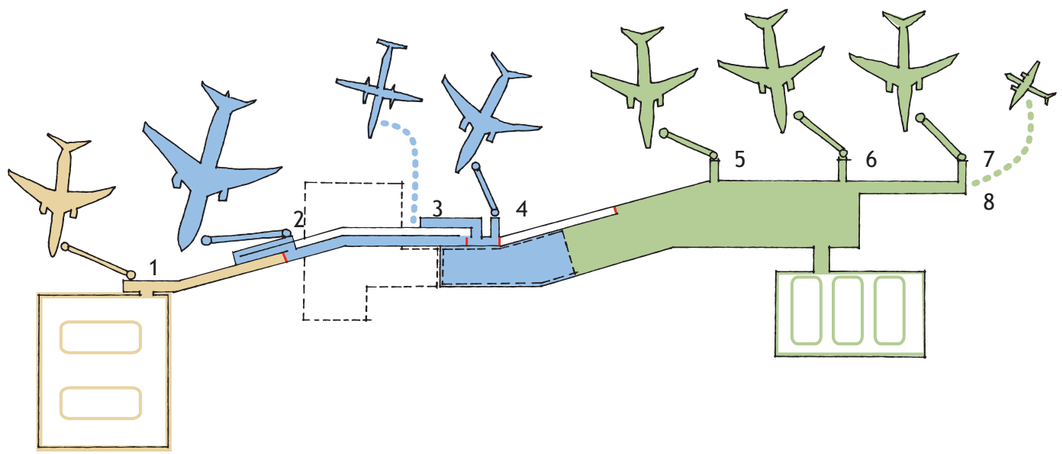


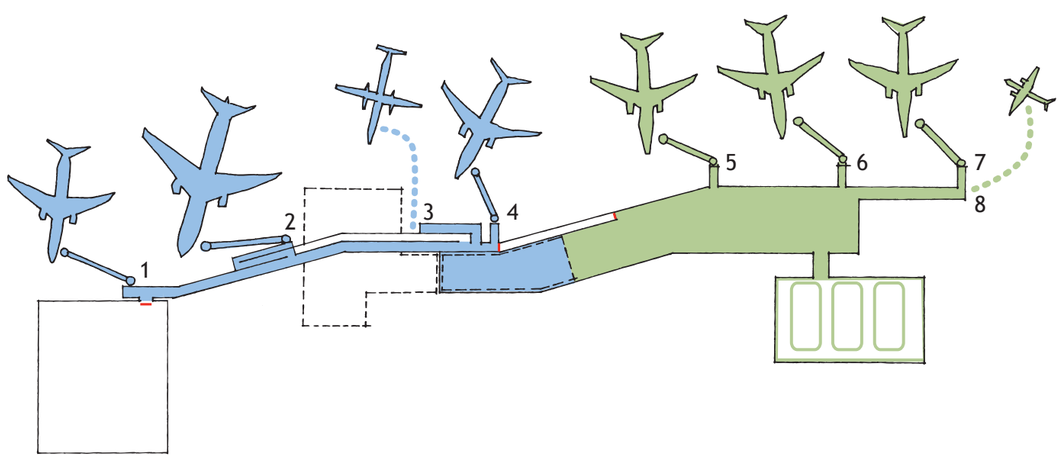
Configuration 8

FLEXIBILITY DIAGRAMS

Domestic Inbound + Domestic / International Outbound

Transborder Outbound

International Inbound



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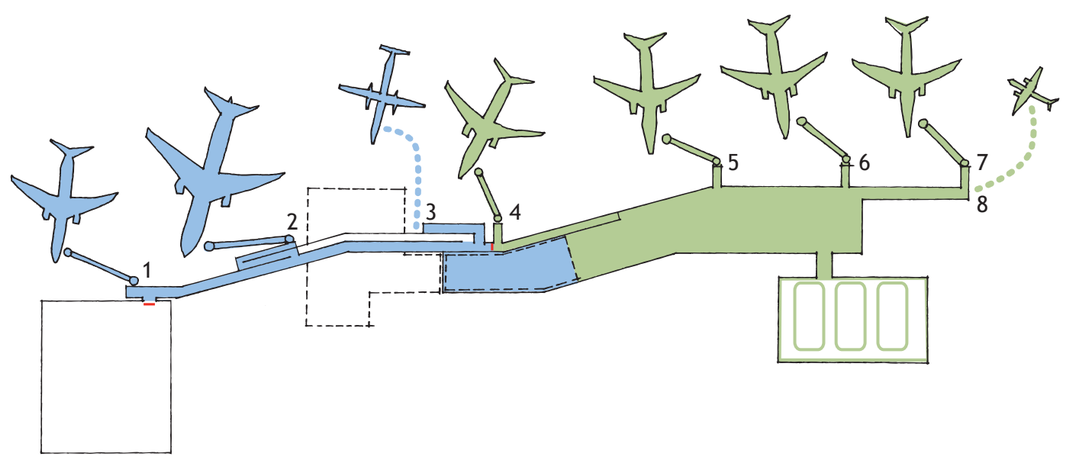

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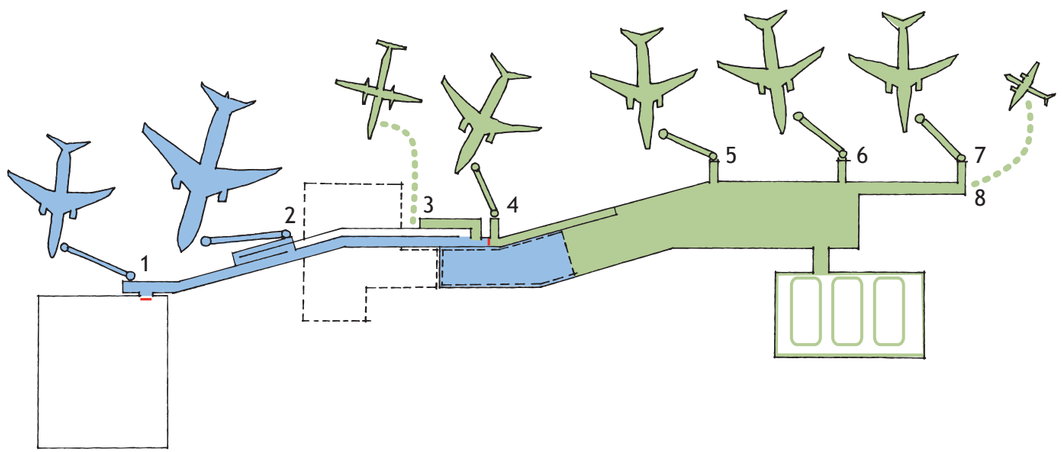

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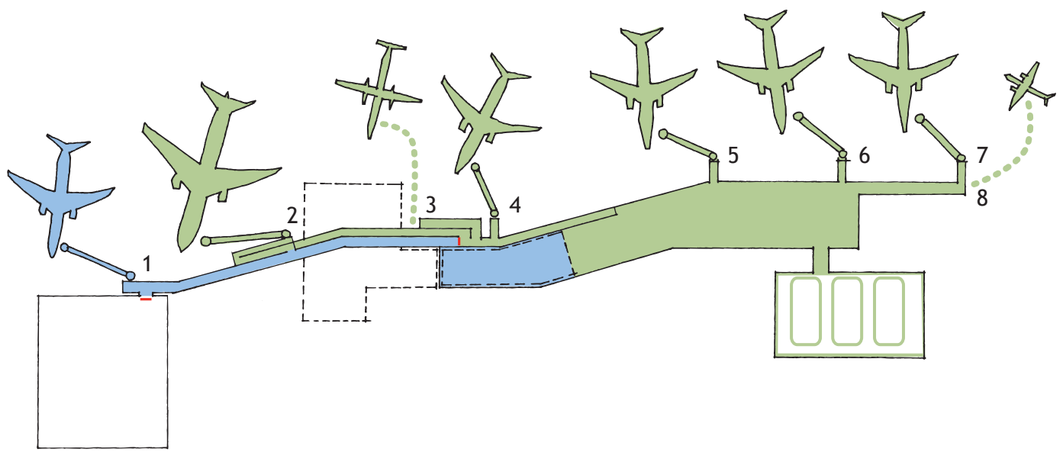


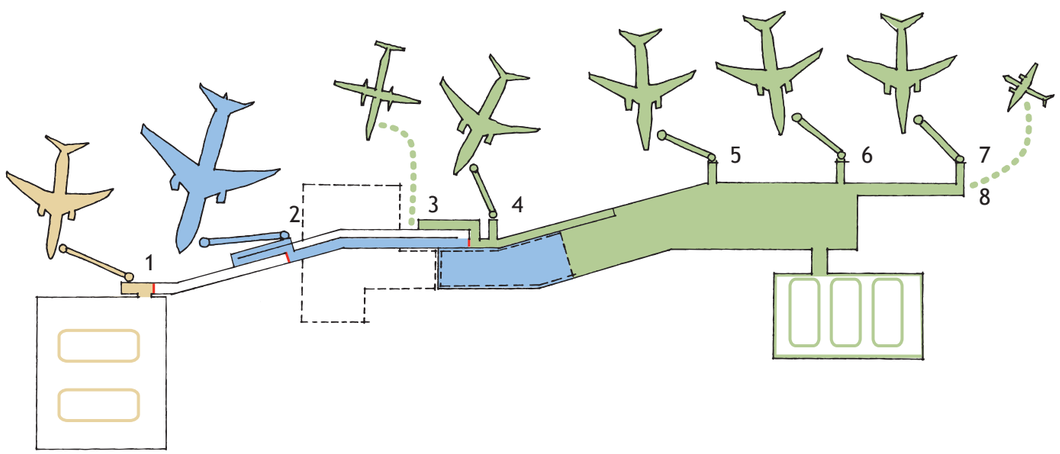
Configuration 12

FLEXIBILITY DIAGRAMS

Domestic Inbound + Domestic / International Outbound

Transborder Outbound

International Inbound



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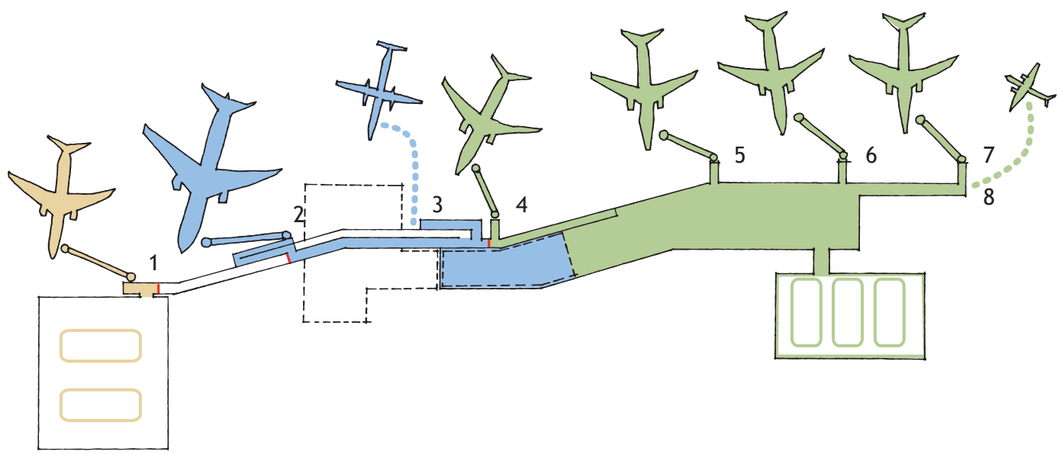
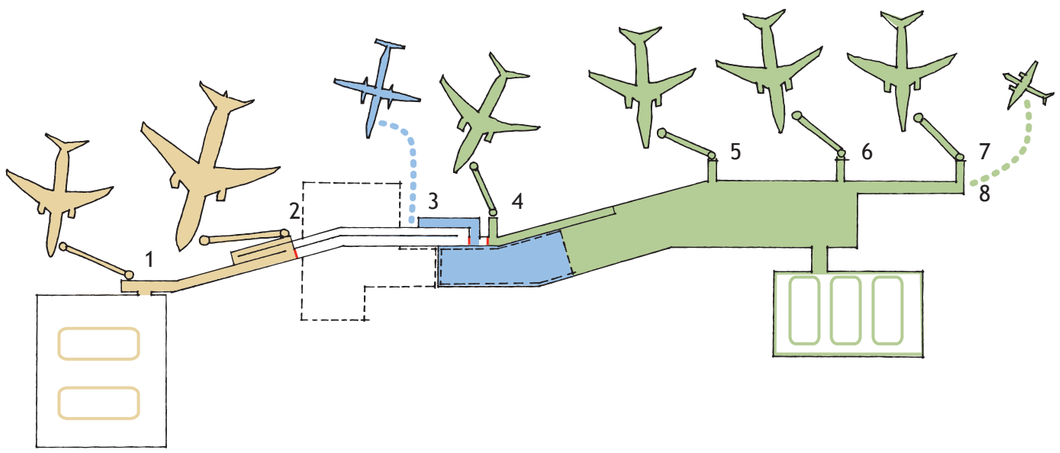


Configuration 13



Configuration 14

FLEXIBILITY DIAGRAMS

Domestic Inbound + Domestic / International Outbound

Transborder Outbound

International Inbound

5.0 ARCHITECTURAL DESIGN PHILOSOPHY

5.1 The Importance of Identity

Air terminals serve a special purpose within their communities. They are commonly described as the modern gateway to the city - as the first and last point of contact with a particular place. It is here that the first impressions and last memories of a place are made. In Kelowna, where tourism is a significant economic driver, establishing a "sense of place" that is specific, identifiable and unique within the airport is of even greater significance.

Kelowna and the Okanagan region have historically been recognized as a unique geographical area within Canada. Scenic, rich in recreational and cultural activities, blessed with a good climate and quality of life, the region has long been a four season tourism destination and is increasingly becoming a full time residence for many. The combination of all of these assets and its unusual geography is what makes the area desirable and unique. Visitors have an expectation that their experience of the area will begin with their first steps in the airport; residents, business leaders and the airport authority have an expectation that their airport present an inviting, positive and memorable image of the Okanagan. Establishing this identity will differentiate Kelowna International Airport, making it part of the positive experience of being in the Okanagan.

The architectural tools that will be used to establish identity are:

- material selection that is based on local geographic materials, textures and colour palettes
- an architectural language representative of central British Columbia
- a built form that is responsive to the local climate
- a retail programme that promotes and highlights regional products and services
- landscaping that uses indigenous plants and landscape forms
- theme works incorporated throughout the project representative of themes specific to the Okanagan Valley
- rotatable theme works programme that is able to emphasize the best of each season

5.2 Themes

In June, 2010, a workshop was held with Airport Advisory Committee, airport authority officials and the design team to identity the key themes to be used to establish a unique Okanagan identity within the air terminal design.

The design team presented a series of precedents from other Canadian air terminals and significant Okanagan building examples to illustrate how architecture and theming work together to establish identity. The participants were then provided with several hundred images and asked to each choose three that spoke to them about their community. The following collage was created using the images chosen by the participants. The group then discussed the significance of the images and developed the following themes to be used to establish a unique Okanagan identity within the terminal expansion.

In no particular order:

- **Quality of Life**
- **Place names**
- **First Nations**
- **Climate - Four Season Lifestyle**
- **Wildlife**
- **Arts and Culture**
- **Geography**
- **History of Travel**
- **Diversity in Agriculture**
- **Regional Landscape**
- **Lake Okanagan**

Workshop Participants

Mayor Sharon Shepherd, City of Kelowna (Chair)

Mayor Marty Bootsma, City of Salmon Arm

Meryle Corbett, Kelowna Chamber of Commerce

Brian Wills, Greater Vernon Chamber of Commerce

Councillor David Knowles, District of West Kelowna

Colin Day, Kelowna City at Large

Len Novakowski, Westbank & District Chamber of Commerce

Mayor Wayne Lippert, City of Vernon

Terry Condon

Councillor Robert Hobson, Regional District of Central Okanagan (City of Kelowna)

Janice Liebe, Project Architect, DIALOG

Jim Slavin, Leigh Fischer

City of Kelowna Staff: Ron Mattiussi, City Manager

Paul Macklem, GM, Corporate Sustainability

Sam Samaddar, Airport Director

Henry Castorf, Airport Development Manager

Arlene McClelland, Recording Secretary















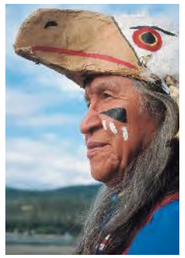
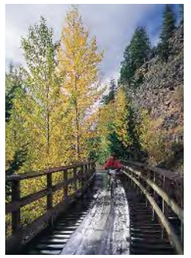











5.3 Architecture and Geography: Building a distinct Sense of Place

During the research for this project the design team reviewed thousands of images and culled it down to one photo that is most representative of the geography of the area. It contains four elements that are essential to a description of Okanagan geography:

Sand

Sand of course for the many beaches, but also for the sand cliffs that are seen along the lake, and in the ground of the dry hills and mountains. The palette of the colours found in the sandy soils establishes a base of beiges, pinks, greys and terracottas. These colours shift in intensity up and down the valley but the general palette is the same.

Wood

The Okanagan forests are distinctive for the Ponderosa pine. Tall, singular and sculptural, they are instantly recognizable.

Lake

Okanagan, Skaha, Kalamalka, Wood, Osoyoos, Vaseaux; the valley is always in view of water - and water of many colours. One can often distinguish a lake in the Okanagan simply by its hue.

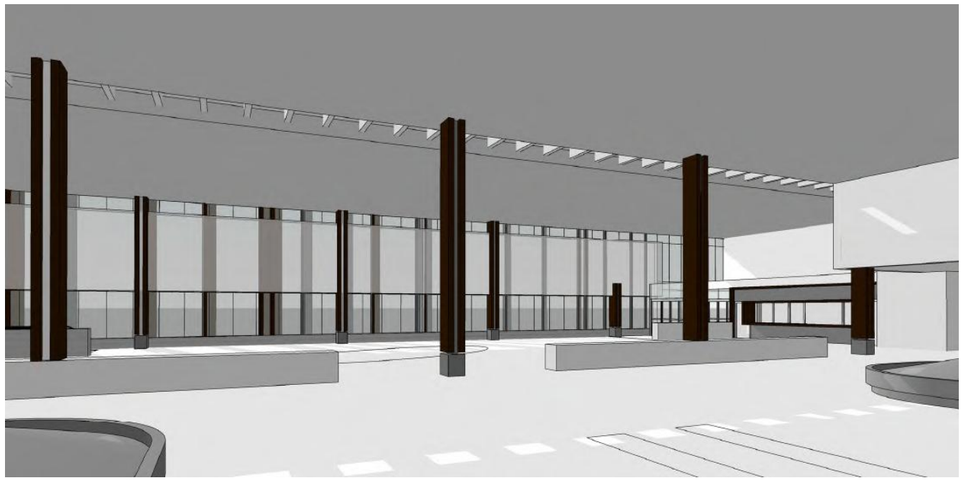
Sun

And of course the quality of light. In the summer it is the heat of the sun on the lake, in the winter the bright clarity of sun at the top of Big White. Without it the Okanagan would not be the place that it is.

Base Building Design Architecture is the base, or the frame for the rest of the project. It is a stage set, establishing a tone over which many other elements are layered. The establishment of this base is critical to tying the terminal to this particular place on the planet. For these reasons, the architecture will be based on the four distinctive Okanagan geographical elements described above:

Sand will be represented in distinctive feature walls of rammed earth. This type of construction is not actually soil, but pigmented concrete that is hand tamped into concrete forms, giving it a distinctive layered quality. It has the texture of sand and the colour palette will be specifically tuned to be of the colours found in the natural soil in Kelowna. To our knowledge it has never been used in an airport. The largest example of rammed earth construction is in the Okanagan, at the N'kMip Desert Cultural Center.

The iconic quality of the Ponderosa pine will be represented by the structural columns clad with timber. Wood will be used only in a vertical format, in a scale and weight that is similar to the singular pines. The front façade of the domestic arrivals hall will feature a "forest" of columns in an irregular rhythm, casting shadows light and shade into the interior.

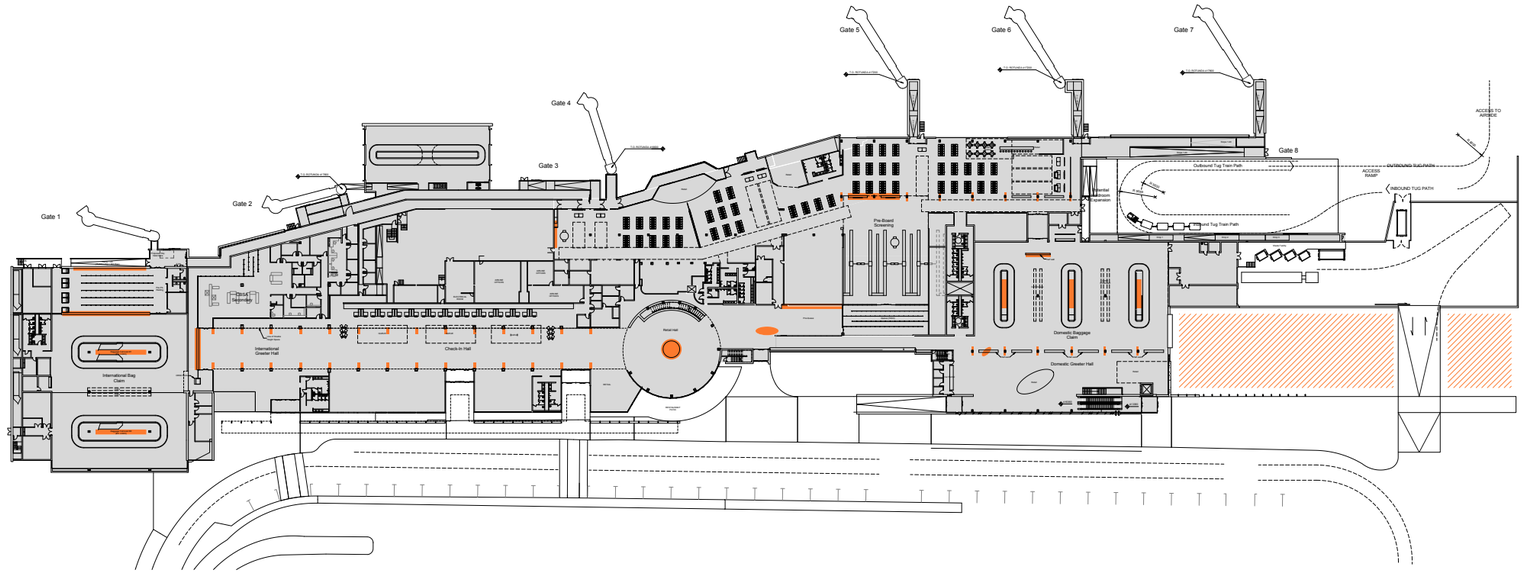


Lake blue, or rather the many hues of Lake blue will form a significant part of the palette. Blue is already in use in the flooring tile and carpet of the terminal, and in the etched glass of the Polaris sculpture in the centre of the Rotunda. Blue will be the focus of the flooring materials, will change and merge from north to south, representing the many lakes in the Okanagan.

Sunlight will be a central theme in the design. The lighting strategy using clerestory windows in the original terminal will be maintained and extended into the new areas. Some clerestory windows may be re-instated in the original where they have been closed over time. Letting in light can also mean letting in heat. Architectural strategies for controlling excessive solar heat are often defining features to warm climate architecture. Deep overhangs, punched windows in solid facades, bolder solid forms are some of the features one finds in desert architecture. These will be found in the design of the terminal as well.

Layered overtop of the architecture are many other elements, some more literal themed devices. The Kelowna International Airport already has some significant pieces that will be maintained in the future expansions, such as the Polaris sculptures and the Gallery Wall at the entry to pre-board screening. The design for the expansion has established key locations within the design for future thematic pieces.

Some of these may be fixed items that are part of the architecture. Others may change overtime, such as a rotating banner display that emphasizes the distinct attributes of the Okanagan seasons. The specifics of the theming programme will be developed in detail with the next phases of design and will be considered as part of each phase and each discipline including retail, signage and wayfinding, architecture and landscape design.



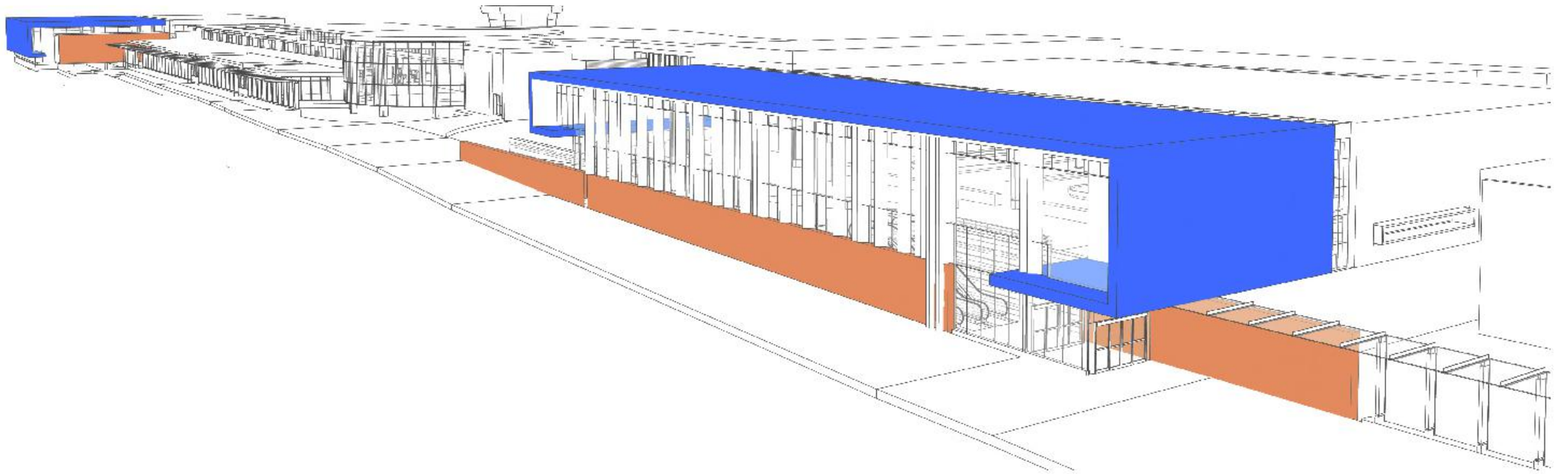
THEMEWORK POTENTIAL LOCATION PLAN

Cohesion The existing terminal building has been built over time and in a number of phases. The first additions were relatively similar to the original building using similar materials and building forms. Later additions are distinctly different in scale, form and material. As a result, the exterior view of the terminal clearly indicates at least five different of phases of work and architectural language.

The expansion project described in this document will approximately double the terminal in size with expansions on all sides of the existing terminal and will retrofit many of the existing areas. It is a goal of this project to establish a sense of cohesion between the various phases of the terminal.

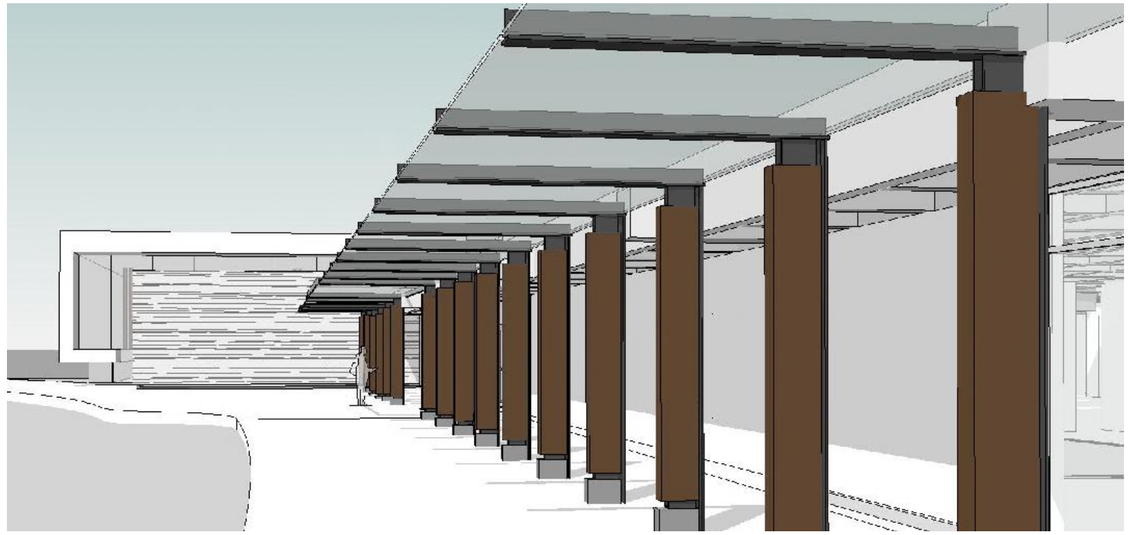
The expansions to the north and south are designed to be of similar form. It is intended that they form “book ends” to the terminal, and are the first step at drawing the terminal architectural language together. As these forms are also similar uses (a domestic arrivals hall at the south end and an international arrivals hall at the north) the form gives an architectural clue to terminal’s internal organization.

The scale of the new arrivals halls is similar to the rotunda and existing south entry ramp enclosure. The scale of these forms is more suitable to the scale of the expanded airport.



The exterior elevation of the original terminal and the first expansion are more challenged due mechanical grilles and other utilitarian items placed directly at curbside. The existing canopy is very light in scale and presents some challenges with two rows of columns on the curbside and snow melt falling to the curb from its curved form.

The Schematic Design proposes that the canopy be replaced by a new design that is heavier in scale more in keeping with the scale of the newer forms, and one that has a single row of columns on the building side of the sidewalk. The canopy will tie the two ends of the terminal together creating a cohesive face across the many phases of expansion.



6.0 SCHEMATIC DESIGN DESCRIPTION OF KEY INTERIOR AREAS

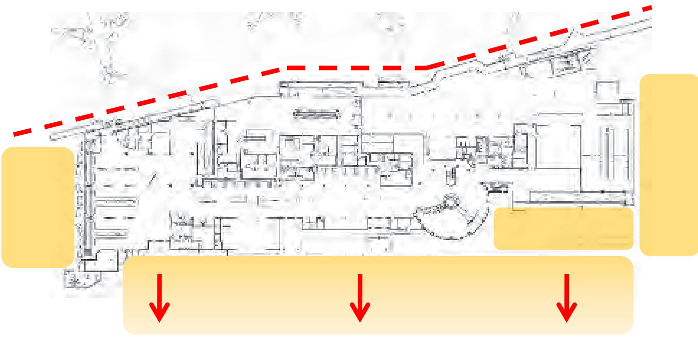
▸ 6.1 Design Principles

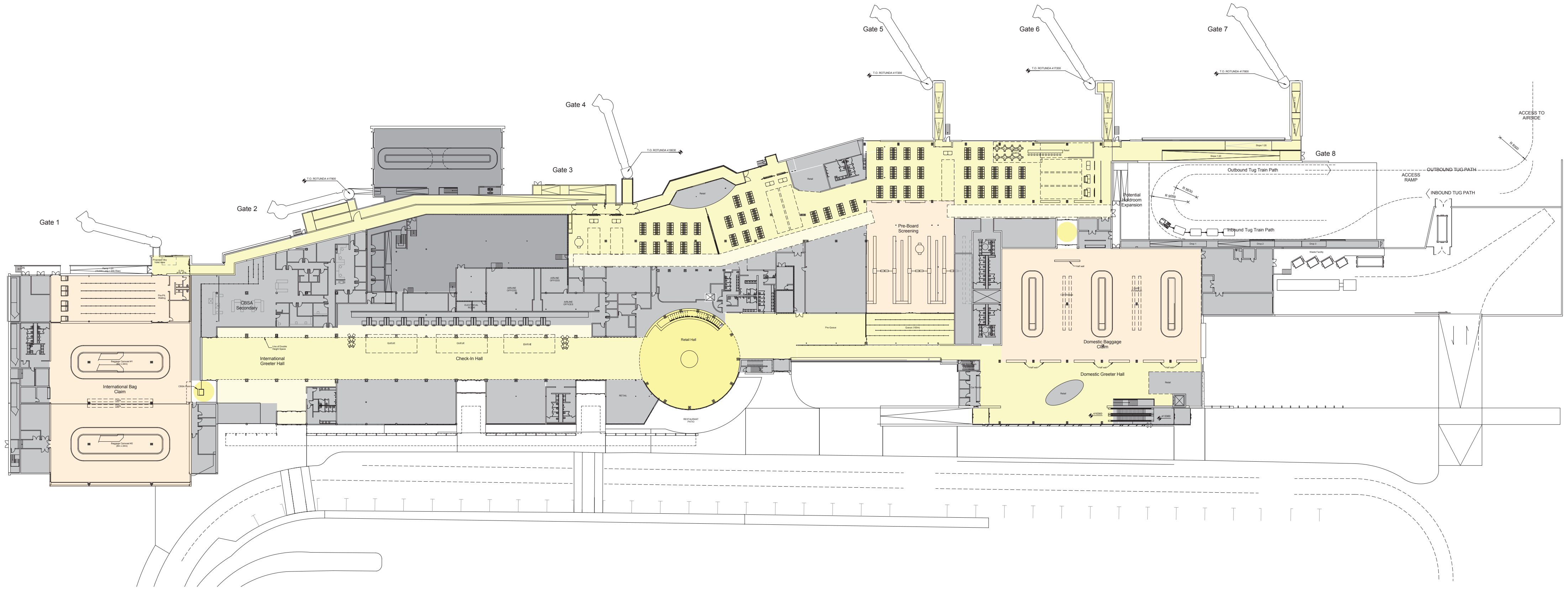
Spatial Clarity

The existing terminal has a clear organizational structure. Currently, the check in hall, the rotunda, the holdrooms all have distinctive volumes and forms. With the considerable change the terminal will undergo with the growth to separated International and Domestic Arrivals facilities, it is important that the original clarity remains and is strengthened. By designing each "process" area with a clear architectural form, passengers will have an intuitive sense of the organization of the terminal.

Preserving Beyond Plan Growth Opportunities

Key to the long term flexibility of the Kelowna International Airport is the preservation of growth areas beyond the current building footprint. The Schematic Design identifies space available for expansion of both the international and domestic claim halls for additional carousels and space to the west for additional pre security retail. These areas have been studied and included in the Phase 5 – Beyond Plan.





Flexibility

Air terminals experience significant change over time whether due to growth, changes in processes or regulation. The only certainty is that what is known today is likely to change sometime in the future. The design will takes this into account by planning for the most likely future expansions and ensuring no impediments to that expansion are placed in the current layout. Objects such as structure, mechanical/electrical rooms and vertical circulation elements will be carefully placed to reduce the number of immoveable objects in functional areas. Areas such as check in that are most likely to experience churn are provided with flexible access to power and data to allow for multiple plan changes in the same space.

Intuitive Wayfinding

Travelling can be stressful. Passengers are often in unfamiliar surroundings and most often simply want to know where they must go next. Being able to see the next step reduces anxiety and gives the passenger a sense of how much time is necessary to complete the process. It is a design principle to provide clear lines of sight and to view the design from the pasenger perspective.

Sustainability and Integrated Design

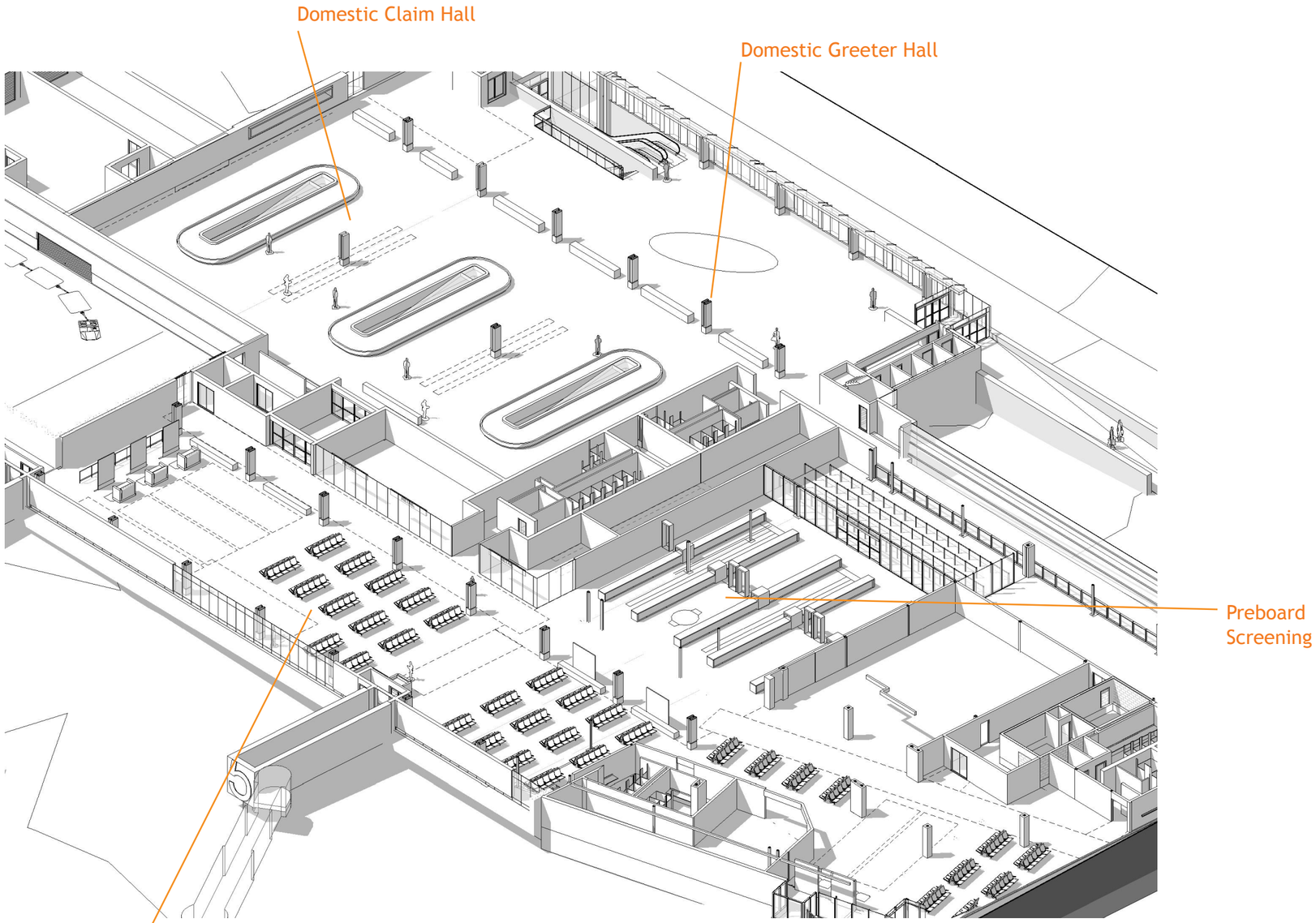
The building design is considered as a fully integrated system. Architectural, Structural, Mechanical and Electrical design decisions are made jointly. The goal is to design a sustainable development with the smallest carbon footprint possible within the budget objectives for the project. An example of this integration is the careful study of the amount of glazing to put into each elevation to ensure that there is enough light to allow for day lighting and access to views balanced with the impact of solar gain on the mechanical systems. This one decision involves input from the architect and, the mechanical and electrical engineers to ensure each system is in balance.

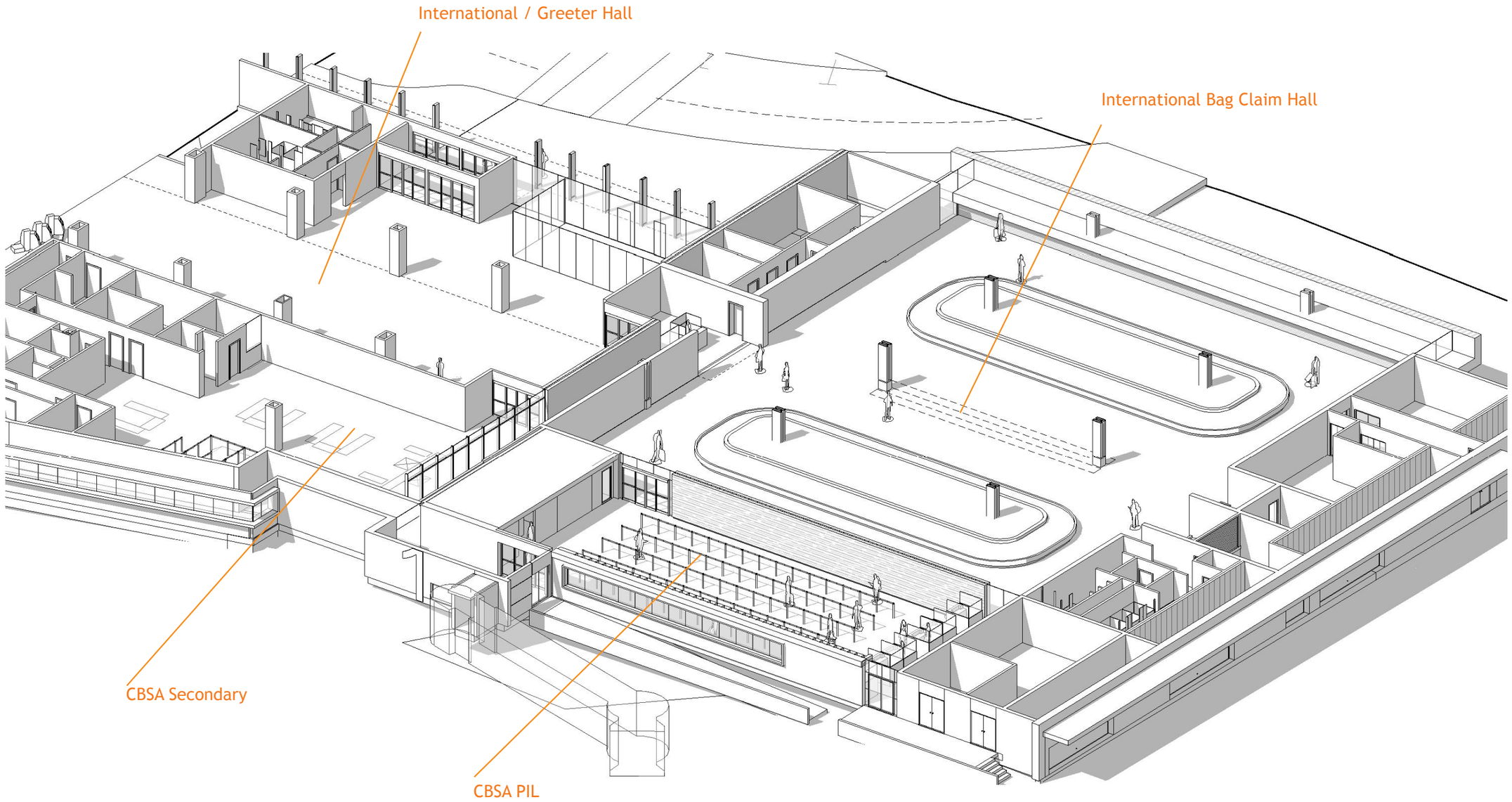
Passenger Flow and Vertical

Circulation Even minor changes in floor levels can be difficult for some passengers to navigate and may add time to the process. All expansions to the air terminal are provided on the same level as the existing main floor of the terminal. Only the new south entry to the domestic arrivals area which is three meters below the main floor will require a vertical transition and is provided with two escalators, an elevator and stairs. The schematic design provides for the levelling of the airside corridor. Further study is ongoing for the expansion options of the outbound baggage make up hall that may prove to be a challenge to the intent to level the airside corridor.

Universal Design

Air Terminals serve everyone in the community. While the most common considerations are for persons with sight, mobility or hearing impairments, the design team takes a universal approach and considers age distinctions, language and cultural challenges as well as person size and cognitive abilities as conditions equally important for consideration in the design. Many of these challenges are not sufficiently addressed by codes. The team will incorporate designs that meet best practices that in many cases exceed code requirements in consultation with the Accessible Advisory Committee.


Domestic Claim Hall
Domestic Greeter Hall
Preboard
Screening
Holdroom Expansion


International / Greeter Hall
International Bag Claim Hall
CBSA Secondary
CBSA PIL

6.2 Schematic Design

Domestic Claim and Greeter Hall

The new Domestic Arrivals facilities will significantly change the look, feel and function of the terminal building. Once complete, it will transform the operation of the airport with a new domestic claim hall and greeter hall at the south end of the terminal, freeing up much needed space for an international facilities expansion at the north.

The claim hall is a large volume with high ceilings and a view through the greeter hall to the exterior view of the hills to the west. A large “punched” window to the south overlooks a xeriscaped garden using regional plants and land formations.

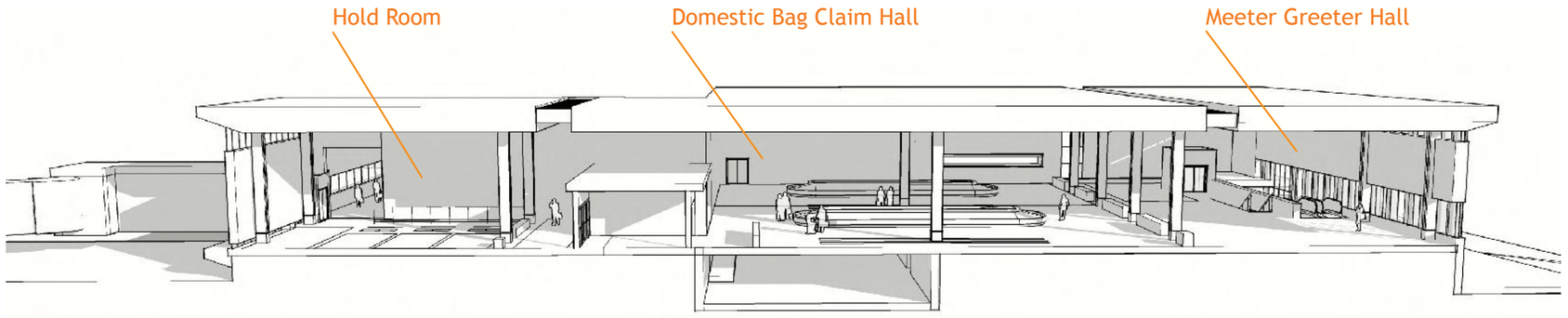
Access for arriving domestic passengers is via the expanded hold room. Walking distances for domestic passengers will be greatly reduced from the existing paths as the primary domestic gates are at the south end of the facility – in proximity to the new domestic claim hall.

The bag claim will provide two sloped plate carousels in its first phase with sufficient space for cart storage and passengers waiting to collect bags. And additional carousel will be added when demand requires. Baggage conveyors will feed the carousels from below leaving the ceiling volume clear.

The greeter hall is directly to the west of the claim hall. Low walls will define the boundary between the two spaces, encouraging greeters to remain outside of claim hall. Rental car counters define the north face and a large retail outlet the south. Space is available for an information counter and additional retail at the centre.

On the exterior, the south location of the domestic facilities will transform the appearance of the airport as it will be the first part of the building one approaches from the curbside roadway. As described in the previous section, this phase will establish an architectural language for the terminal that is specific to the Okanagan region with rammed earth walls in colours of the local environment, large wood columns representing the ponderosa forests and other architectural elements that will compliment and tie to the palette of the existing terminal.

Both spaces are largely day lit with strategically placed and sized windows and clerestory windows that are reflective of the existing terminal.


Hold Room
Domestic Bag Claim Hall
Meeter Greeter Hall

E ⟷ W


Domestic Bag Claim Hall
Mechanical Penthouse

S ⟷ N

Holdroom Expansion

The hold room expansion will be built at the same time as the domestic facilities noted previously. The expansion essentially doubles the size of the existing and includes a greatly expanded retail offering.

One characteristics of the new hold room that is distinct from the existing is an unimpeded view to the airfield and mountains to the east. The existing hold room view is compromised by the airside corridor and bridges folded against the terminal face. Further, the ceiling height of the new space is much higher creating a volume more comfortable and appropriate for this area.

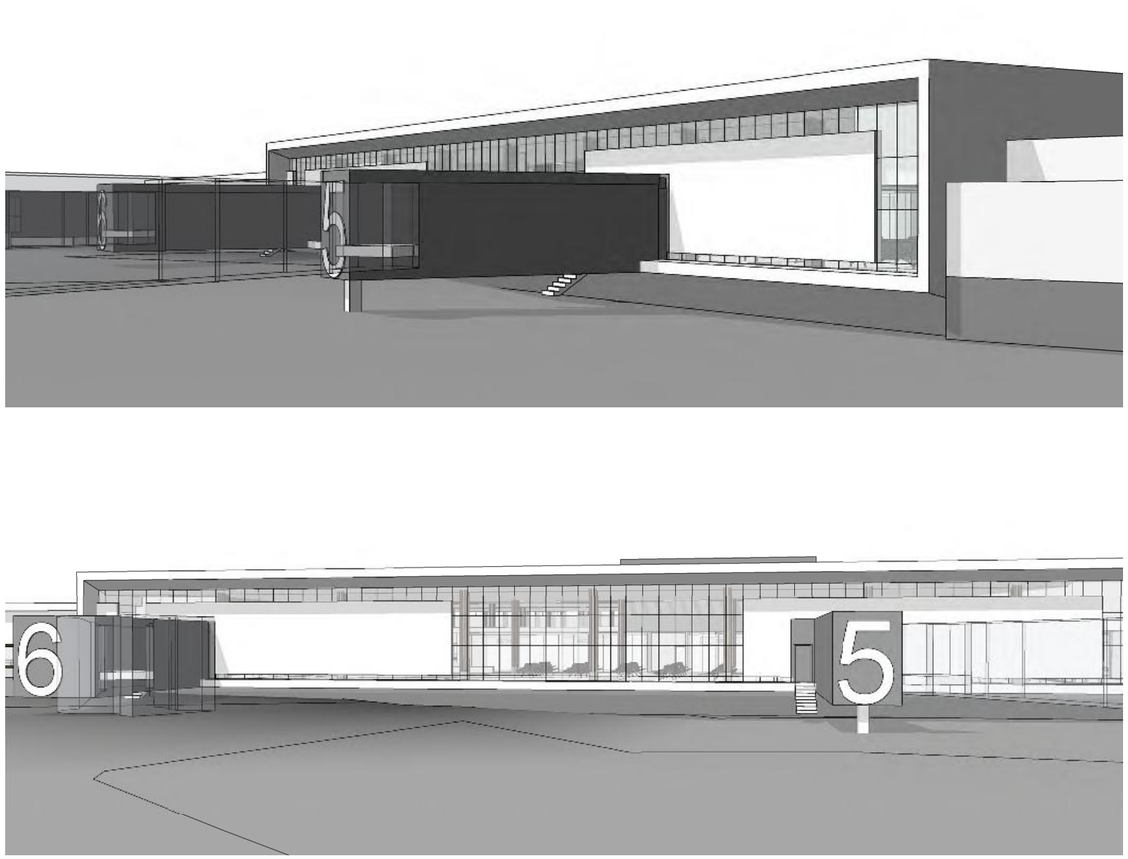
Glazing on the exterior of the hold room is strategically sized and placed. The largest window is located adjacent to the largest seating area and key food and beverage unit. Opaque surfaces are provided primarily at gate boarding areas. The overall proportion of glazing to solid surface is engineered to provide sufficient daylight and view without overly heating the space. A skylight runs along the ceiling of the concourse providing daylight to the center of the space and high lights the circulation route below.

Pre board screening will exit at the centre of the expanded space, with a pausing area defined for passengers to check FIDS monitors, re-stow items removed for screening and determine in which direction they may find their gate.

Retail / food and beverage outlets are clearly visible and distributed throughout. A key new food and beverage unit will be located on the glass of the new hold room where passengers can enjoy the view.

Fittings and furniture will be coordinated and upgraded as required for the entire hold room, including the existing at this time.

The volume and architecture of this expansion will be clearly identifiable from the airfield and to arriving passengers. This creates an understanding of the organization of the terminal on this elevation which was previously lacking. Branding opportunities on this elevation will be considered in the next design phase for the Kelowna International Airport. The architectural form of the roof and overhang is intentionally complimentary to the bold forms on the front of the domestic arrivals facility.




7
6
5

International Arrivals Facilities

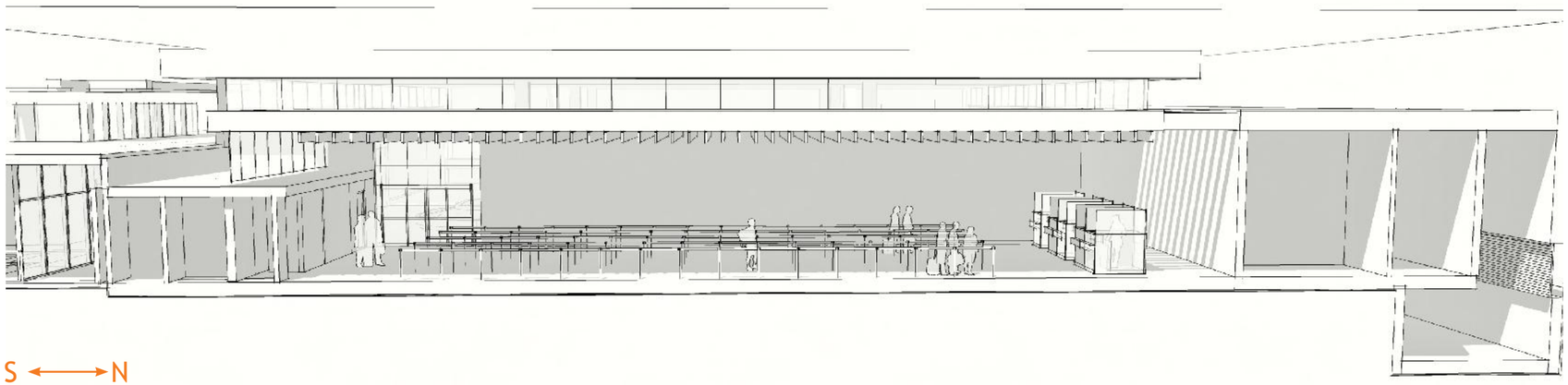
The first phase of expansion delivers a new CBSA PIL facility, changing the flow of arriving passengers to be screened prior to having access to their baggage in compliance with CBSA regulations. This functional area is new to the terminal and will be the first impression of the Okanagan to international visitors. As one of the best views from the terminal is directly to the east of this space, a large window is aligned along the queue. The opposite wall is intended to be a distinctive rammed earth construction reflecting the sandy, dry and rounded mountain geography visible from the windows. This type of construction is unique and rarely used in Canada. It is seen most often in the Okanagan making it a signature piece for the terminal and one that reflects the special geography of the valley.

As the bag claim hall is not constructed until a later date, passengers will flow from the PIL counters back to the existing claim devices. The corridor will be segregated from the queue by a temporary glazed wall. This wall will be removed once the International Claim Hall is constructed, leaving expansion space for two additional PIL counters. Passengers at that time will flow directly from the PIL counters to the Bag Claim hall.

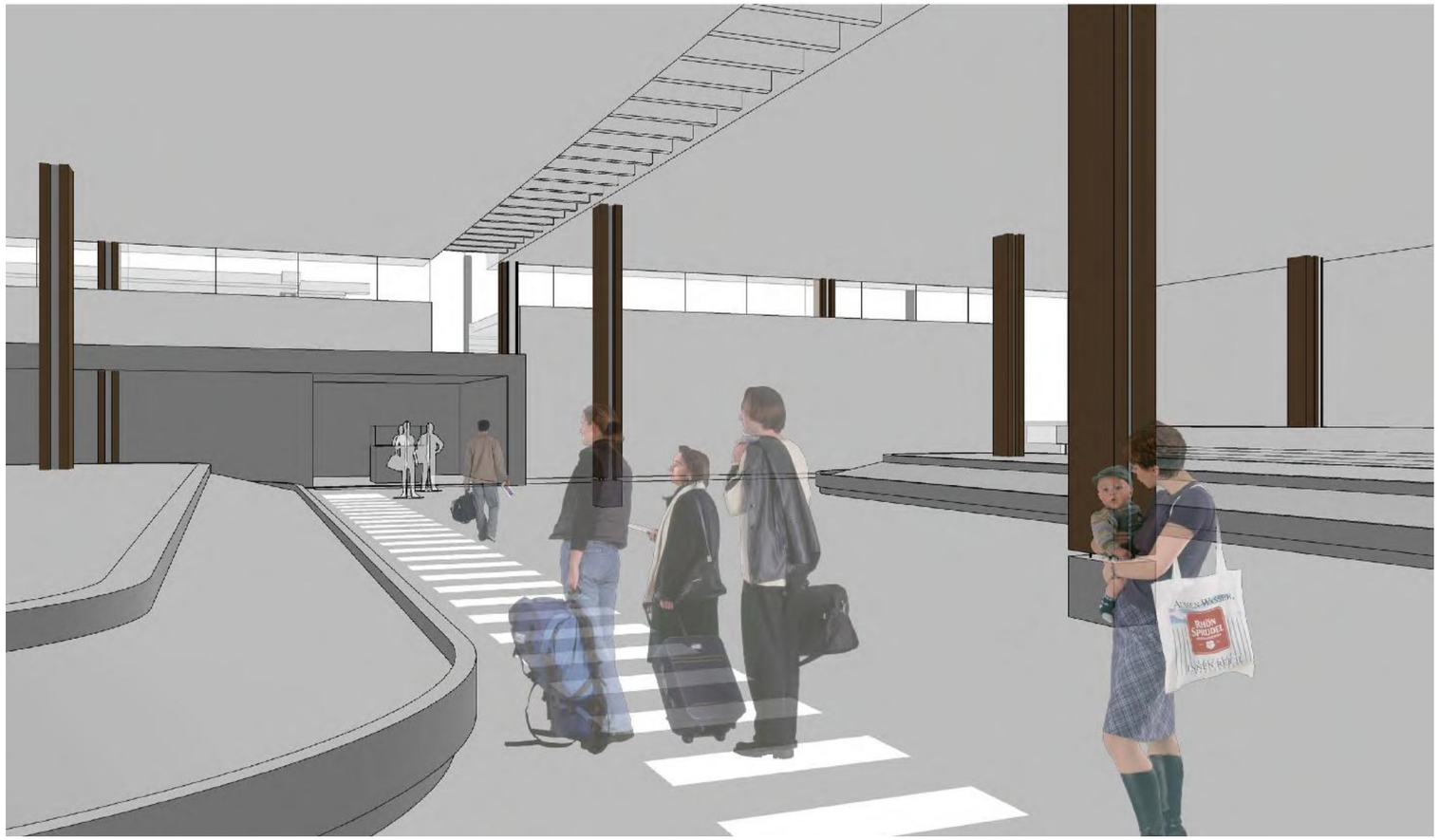
The International Claim hall will initially have one large sloped plate carousel, with baggage delivery from below. A Beyond Phase plan adds one additional carousel.

The rammed earth wall of the CBSA PIL which was an exterior wall in the first phase, becomes an interior wall of the International Claim area, adding its character to this space. Skylights introduce daylight, and in the final expansion, windows to the curbside will allow passengers a glimpse of their destination. At this stage, the architectural form and massing of the complete claim hall creates a “book end” to the terminal, as its form mirrors that of the Domestic Claim area to the south.

E ⟷ W



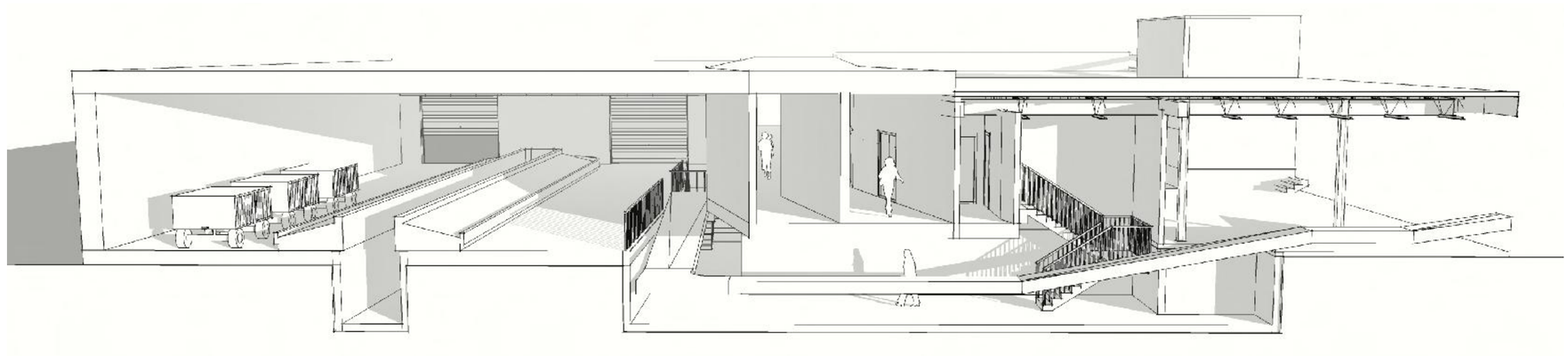
S ⟷ N



Outbound Baggage Make-up Hall

The new outbound baggage make-up hall expansion will provide for a two lane drive through facility for bag make up, leaving the existing hall available for an expanded baggage screening area - significant improvements for a currently congested function. As the only expansion area available is airside, these two spaces will be transected by the airside corridor.

There is a desire to level the airside corridor which currently ramps up and over the access doors to the baggage make up hall. In order to achieve this, conveyors would have to either move up and over the leveled airside corridor, or be tunneled slightly underneath. The Schematic Design illustrates the latter option as the up and over solution would require a much taller addition and has challenges with lengths of conveyor runs required to make the vertical transition. A version to maintain the airside corridor in its current ramped configuration has not been studied, but may prove to provide benefits for the access between the two components of the baggage make up hall and would be less costly to construct. This option will be reviewed at a later date.

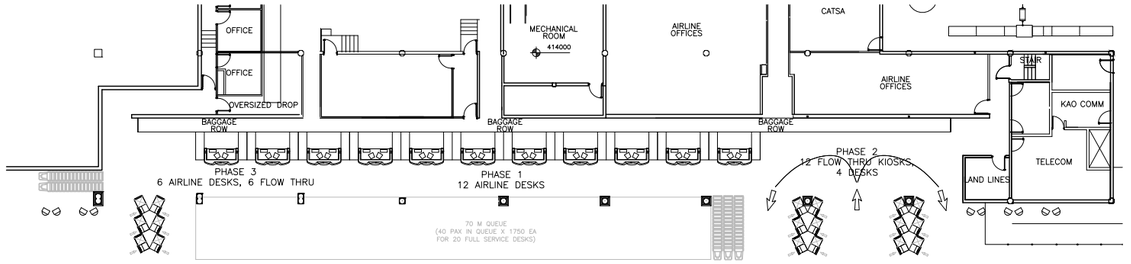


Check-in Hall Expansion

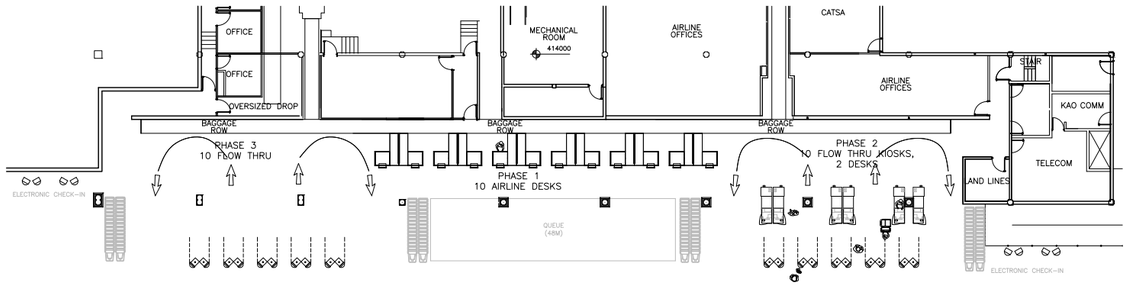
The existing check in hall experiences congestion in large part due to the proximity of the domestic arrivals ramp, the meeter greeter area and the claim carousels. This condition will be greatly improved with the provision of the domestic arrivals facility to the south and the movement of the claim devices into a new international claim hall to the north.

Expansion for more check in counters is not anticipated to be needed until after 2016. The Beyond Plan Phase of this report indicates the removal of the washrooms in the center of the check in counters to provide expansion space for more counters. Work completed in previous phases clears the way for the counters to be aligned with the West Jet counters, increasing queue space within the check in hall.

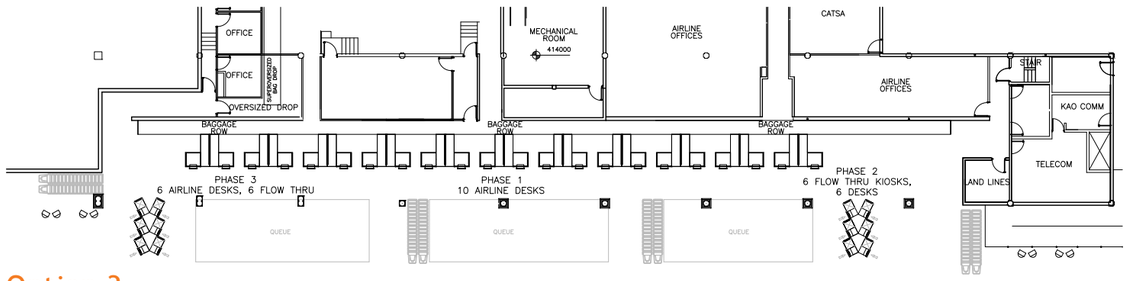
Check in processing is evolving, with arrangements of counters, bag drops, self serve kiosks ever changing. The following diagrammes illustrate options for layout that can be achieved within the expanded space.



Option 1



Option 2



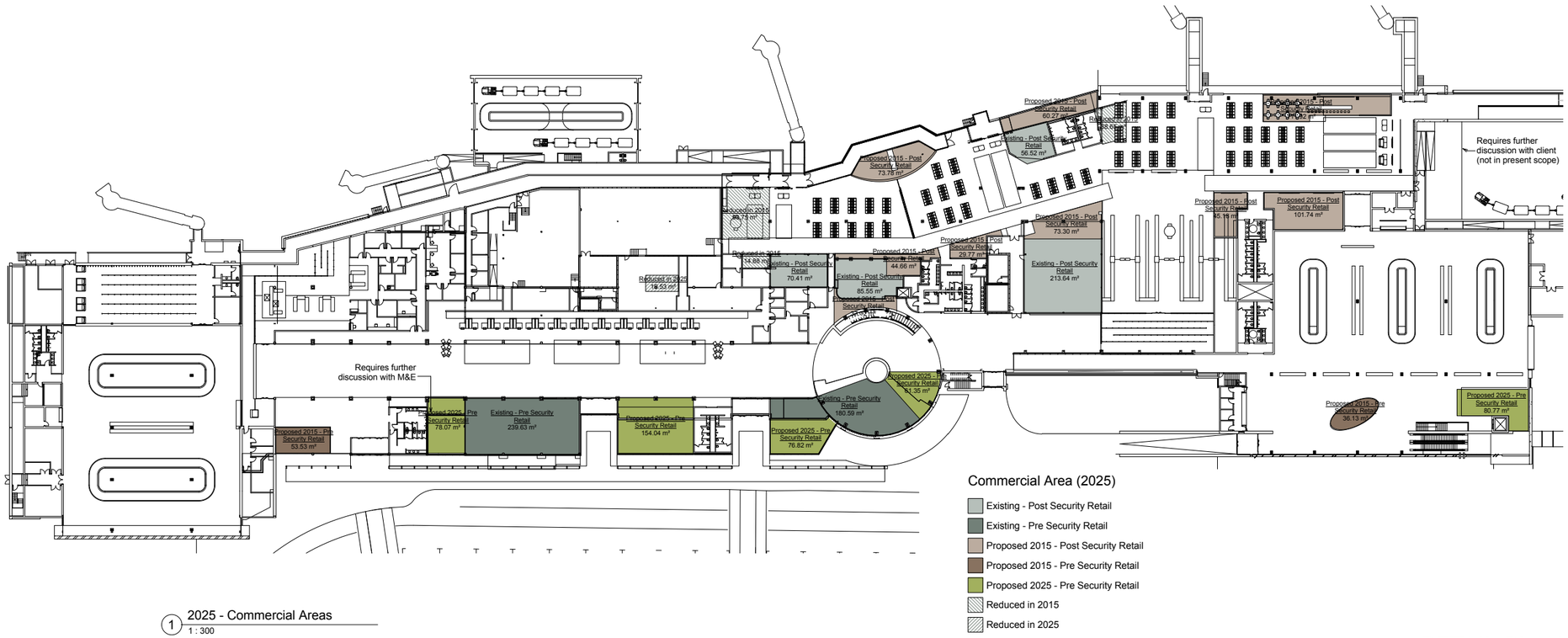
Option 3

Retail

A preliminary review of the existing terminal areas allocated to retail was undertaken by Leigh Fischer. This was followed by a review of the approved Concept Plan with recommendations for the distribution, size and retail type for each area of the terminal. These areas were then incorporated into the Schematic Design. Areas were achieved to the extent possible without expansion of the building footprint. The following plan indicates the retail area locations and their footprint sizes, and the chart compares the targeted retail sizes with the current allocations on the plans.

The key points of the retail review found the following:

- The Rotunda will become a central focus within the pre security terminal plan. It will be strategically located between the International and Domestic facilities and in the path of passenger flow between check in and pre board screening. Preliminary thoughts are that it could become an “Okanagan Market” themed area. Phase 5 design plans include the leveling of the rotunda floor and revisions to the feature stair to open up the space available to retail / food and beverage. Landscape plans are for an outdoor patio accessible from the rotunda to increase seating areas available and to provide the opportunity for an outdoor café environment.
- Retail offerings should focus on Okanagan regional products and services.
- The hold room expansion will allow for key exterior views to the mountains and airfield to the east. This is a desirable area for waiting passengers, and for a key food and beverage unit to be located while preserving and enjoying the views described above.



1 2025 - Commercial Areas
1 : 300

RETAIL PLAN

RETAIL AREAS

LOCATION	PROVIDED 2015	RECOMMENDED 2015	DIFFERENCE	PROVIDED 2025	RECOMMENDED 2025	DIFFERENCE
Pre Security Retail (Total)	691.43 sm	831 sm	-139.57 sm	960.93 sm	1245 sm	-284.07 sm
- Landside Check-In	521 sm	622 sm	-101 sm	790.5 sm	934 sm	-143.5 sm
- International Arrivals	53.53 sm	19 sm	+34.53 sm	53.53 sm	27 sm	+26.53 sm
- Domestic Arrivals	116.9 sm	190 sm	-73.1 sm	116.9 sm	284 sm	-167.1 sm
Post Security Retail (Total)	1003.86 sm	784 sm	+219.86 sm	1003.86 sm	1178 sm	-174.14 sm
- Domestic & International Departures	729.23 sm	697 sm	+32.23 sm	729.23 sm	1,048 sm	-318.77 sm
- Transborder Departures	274.63 sm	87 sm	+187.63 sm	274.63 sm	130 sm	+144.63 sm

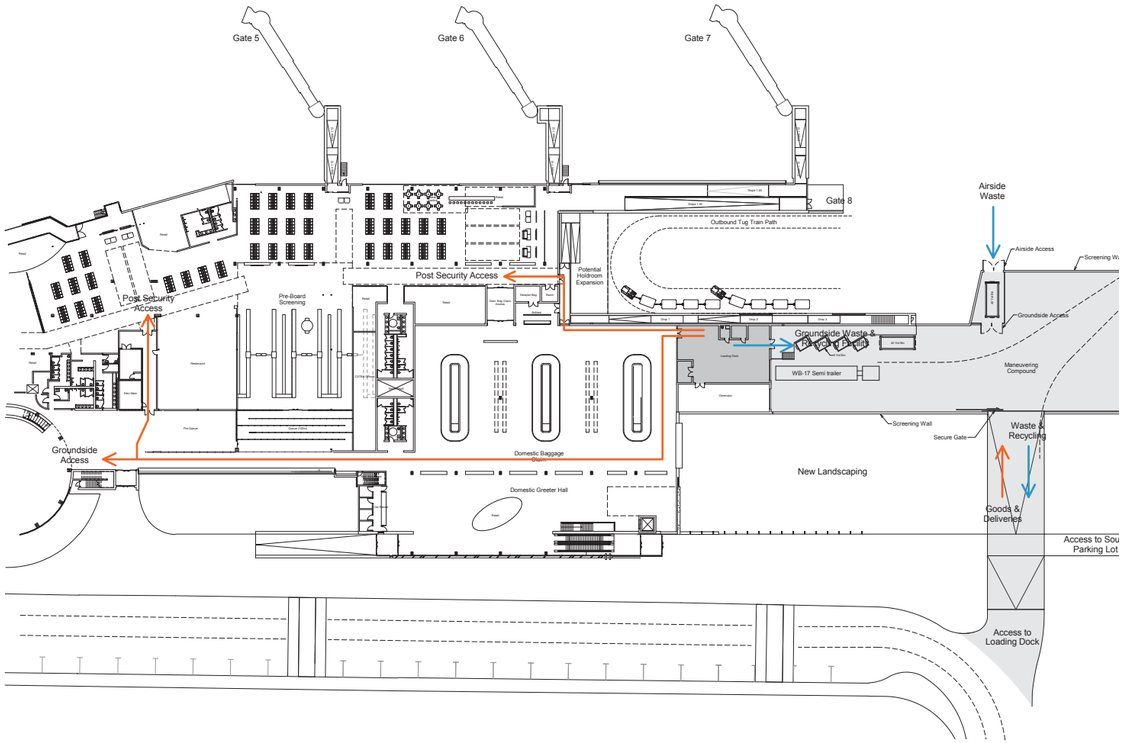
Material Management

The existing terminal does not have a dedicated loading or waste handling facility. Movement of goods and waste is via the curbside and directly through the main passenger entry doors.

The schematic design provides for an interior loading facility with one truck dock and an exterior area for waste bins, all within a new material management area to the south of the terminal expansion. An airside waste bin is strategically located along the airside fence. International waste will continue to use a bin on the north side of the terminal airfield. Truck access is off the curbside access roadway, removing movement of material away from the front entry doors.

Access doors to the loading and waste facility are at the south wall of the domestic claim hall. Movement of goods will be arranged for off peak times.

These facilities are to be provided over time. All exterior facilities and access to the terminal are planned to occur coincident with the Phase 3 expansion of the holdroom, domestic claim and meeter greeter facilities. The interior dock is included in the beyond phase plans.



6.3 Materials and Finishes Matrix

Durability will be considered a guiding design principle. The number of passengers using the facility mandates the performance of all materials be maximized. Material durability, ease of maintenance and long-term management are important to the success of an airport environment. Sustainability, Cost, obsolescence, acoustic and aesthetic characteristics are strong factors and will be carefully considered.

An Interior Finishes Matrix has been developed and is included on the following pages. The intent of this matrix is to systematically categorize numerous finish options and strategically apply them to meet the functional needs of particular spaces. This will allow viable materials to be explored in the design, performance, budgeting and specification phases. The process will involve as need testing on an area-by-area basis … ultimately to arrive at an optimum solution.

In addition to the aforementioned considerations, particularly durability, the following will be explored:

Flooring

- Incorporation of safe, non slip surfaces
- Implementation of appropriate acoustic attenuation for movement of carts and personal baggage
- Consideration of navigation for the physically challenged

Baseboards

- Establishment of optimum and consistent heights to accept day-to-day bumps and reduce marring
- Consideration of the butting of adjacent horizontal and vertical surfaces

Partitions

- Development of wall protection to better accept traffic abuse, reduce marring and control vandalism
- Application of textures, particularly in the context of the Regional vocabulary
- Utilization of softening materials strategically place for sound deadening
- Use of glazing units to maximize light transference, yet respectful of security and safety mandates

Ceilings

- Application of acoustic panels for sound softening and attenuation
- Develop appropriate finishes to reduce obvious visual buildup of dust

Fittings

- Utilization of safe, solid, vandal proof materials (i.e. Washroom accessories and cubicles)
- Consideration of personal hygiene at ‘touch’ zones
- Appropriate use of hooks, ledges, shelves for passenger convenience and care of infants

Colour

- Use of ‘response appropriate’ colours (quiet vs. active, warm vs. cool, directional vs. decorative, cautionary vs. neutral)
- Consideration of navigation for the visually challenged
- Sensitivity to art, graphics and signage colours and appropriate placement to maximize impact
- Use of natural colour in natural materials … not applied or tacit decoration

INTERIOR FINISHES MATRIX – A

LEGEND

SDT	Static Dissipative Tile
SF	Safety Flooring
GL	Glazing
SPF	Sports Flooring
ISP	Integral Safety Strip
MIR	Mirrors
EPX	Epoxy Flooring
DP	Demountable Partitions
HPP	High Performance Paint
MG	Metal Grate
AWT	Acoustic Wall Treatment
PB	Painted Base
•	Environmentally Preferred
FRW	Fire Rated Wood Backing

								Base					Wall				Ceiling			
			Porcelain Tile (Calibrated Rectified Edge)	Resilient Flooring: Linoleum	Resilient Flooring: Rubber Flooring	Resilient Flooring: Decorative	Carpet: 1.8m with Structured Backing	Specialty Material for Public Areas	Stainless Steel Base	Porcelain Tile/ Stone Base (Calibrated Rectified Edge)	Integral Resilient Base: With adjacent flooring	Applied Resilient Base: Rubber Cove Base	Specialty Material for Public Areas	Paint	Porcelain/ Ceramic Tile	Wall Protection	Specialty Material for Public Areas	Paint	Lay-in Acoustic Ceiling Tile	Exposed Structure	Specialty Material for Public Areas
TYPICAL ROOMS AND AREAS	**1.0**	**PUBLIC AREAS – FRONT OF HOUSE**																			
	1.1	Departures/ Arrivals Concourse	•						•				•	•		•	•	•	•	•	•
	1.2	Meeter Greeter Hall	•				•		•	•			•	•		•	•	•	•	•	•
	1.3	Concourses within Hold Rooms	•						•				•	•		•	•	•	•	•	•
	1.4	Public Washrooms	•						•	•					•				•		
	1.5	Elevators (Public)	•						•				•								
	1.6	Baggage Claim	•						•					•		•	•		•		•
	1.7	Holdrooms	•				•		•					•	•	•	•	•	•		•
	2.0	**PUBLIC AREAS – BACK OF HOUSE**																			
	2.1	Processing Corridors			•				•					•		•		•	•		
	2.2	Fixed Links/ Boarding Zones			•				•					•		•					
	3.0	**PUBLIC AREAS - AGENCY**																			
	3.1	CBSA Primary	•						•					•		•	GL	•	•		•
	3.2	CBSA Secondary	•						•					•		•		•	•		
	3.35	CATSA Pre-Board Screening	•						•					•		•	GL	•	•		
	4.0	**BASE BUILDING – FIT UP ONLY**																			
	4.1	Retail (Fit- up by Retailer)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4.2	Food Services (Fit-up by Retailer)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Exterior Finishes

- **Glazing** - Double Glazed High Performance Coatings High Visibility on Clear
- **Rammed Earth Construction** - Pigmented Concrete hand tamped in layers
- **Fibre Cement Panels** - Non-exposed fasteners
- **Roofing** - Single Ply Membrane TPO high albedo

INTERIOR FINISHES MATRIX – B

LEGEND

SDT	Static Dissipative Tile	DP	Demountable Partitions
SF	Safety Flooring	HPP	High Performance Paint
GL	Glazing	MG	Metal Grate
SPF	Sports Flooring	AWT	Acoustic Wall Treatment
ISP	Integral Safety Strip	PB	Painted Base
MIR	Mirrors	•	Environmentally Preferred
EPX	Epoxy Flooring	FRW	Fire Rated Wood Backing

			Floor						Base					Wall				Ceiling			
			Concrete: Sealed	Porcelain Tile (calibrated Recti-fied Edge)	Resilient Floor: Rubber Flooring	Carpet: 1.8m with Structured Backing	VCT/ Sheet Flooring	Speciality Materials	Stainless Steel Base	Porcelain Tile (calibrated Recti-fied Edge)	Integral Resilient Base: With adjacent Flooring	Applied Resilient Base: Rubber Cove Base	Speciality Materials	Paint	Porcelain/ Ceramic Tile	Wall Protection	Specialty Material	Paint	Lay-in Acoustic Ceiling Board	Exposed Structure	Specialty Material
TYPICAL ROOMS AND AREAS	**5.0**	**AGENCY OFFICE AREAS**																			
	5.1	Private Offices				•						●		●				●	•		
	5.2	General Offices/Clerical Workstations				•						●		●				●	•		
	5.3	File/Supply/Workrooms			●		•					●		●				●	•		
	5.4	Coffee Stations/ Lunchrooms			●		•					●		●	•	•		●	•		
	5.5	Meeting Rooms/ Conference Rooms				•						●		●			AWT	•	•		
	5.6	Staff Lounges			●	•						●		●					•		
	5.7	Staff Lockers/ Showers/ Washrooms		•						•				●	•			•			
	6.0	**SERVICE**																			
	6.1	Loading Dock/Shipping/ Receiving	•									●		●						•	
	6.2	Janitorial Rooms	•									●		●	•	•		•			
	6.3	Electrical	•									●		●			FRW	•		•	
	6.4	Mechanical	•									●		●				•		•	
	6.5	IT Data	•				•	SDT				●		●			FRW	•	•		
	6.6	Exit Stairs	•					ISP						●				●		•	
	6.7	Service/ Utility Corridors	•										PB	●		•		●	•	•	
	7.0	**BAGGAGE HANDLING**																			
	7.1	Baggage Handling	•										PB	●		•		●		•	

7.0 PHASING

The Schematic Design is intended to be built in 5 phases of construction, the first four of which are currently scheduled to be complete by 2016. The fifth phase of development will be built as demand requires. The following drawings indicate the scope for each phase, as well as interim phases that will be required to accommodate continuing operations and sequencing of construction. A brief description of each phase is as follows:

Phase 1 – CBSA PIL / TRANSBORDER HOLDROOM
(Schedule to be determined following CBSA acceptance of concept design)

This first phase provides for an expansion to accommodate CBSA PIL. This is the first step in meeting regulatory requirements and will provide for passengers to be screened prior to accessing their baggage. This phase also includes minor retrofits to the hold room to remove the existing segregated Transborder hold room, install a moveable partition to position transborder passengers at the north end of the hold room, adjustments to the locations of some boarding podiums and one retail location.

Phase 2 – Outbound Bag Make -up Hall and Airside Corridor Retrofit
(tentative delivery 2012)

This phase expands the outbound baggage make up hall to the east of the airside corridor and provides for a drive through facility. Security screening systems for baggage will be located in the existing outbound bag hall. At the same time the airside corridor will be renovated to remove the ramp and provide a level corridor*. This phase will also see the inclusion of a new generator to the south of the terminal.

**See comment under 6.1 Passenger Flow and Vertical Circulation*

Phase 3 – Domestic Arrivals Facilities
(tentative delivery 2013)

This phase will be a major expansion to provide for a new and separate domestic arrivals facility. An expansion to the holdroom, a new domestic baggage claim hall, new domestic meeter greeter hall and the leveling of the existing ramp to the south parking lot as well as a new second floor mechanical room are the major components to this phase. Significant associated site work will be done to the south of the expansion to provide for a domestic bag drop area and a loading and waste pick up zone.

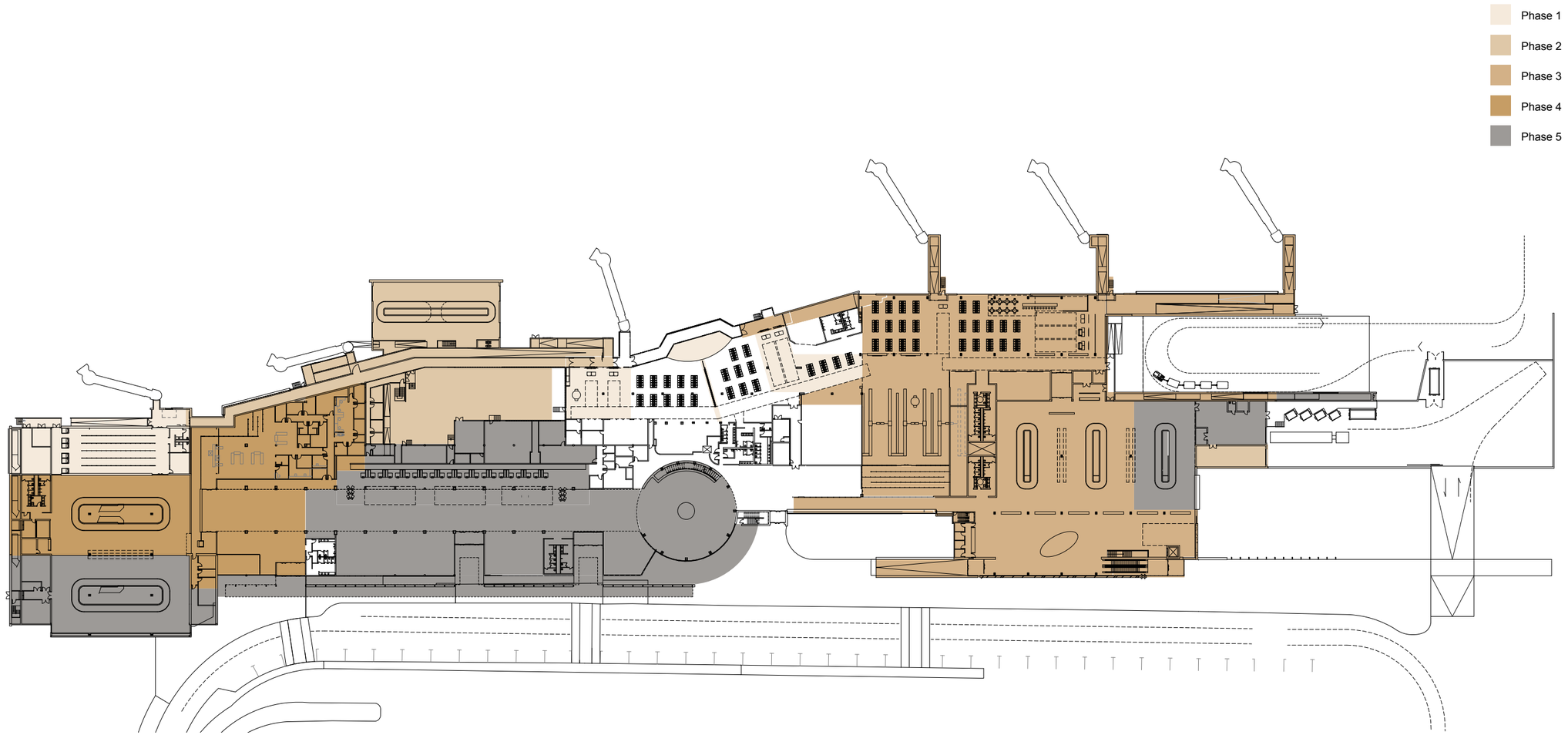
Phase 4 - International Arrivals Facilities
(tentative delivery 2015)

Once the domestic arrivals facility is complete and domestic passengers are no longer using the north bag claim area, it is possible to build a new international baggage claim hall, expanded CBSA secondary and dedicated meeter greeter facility.

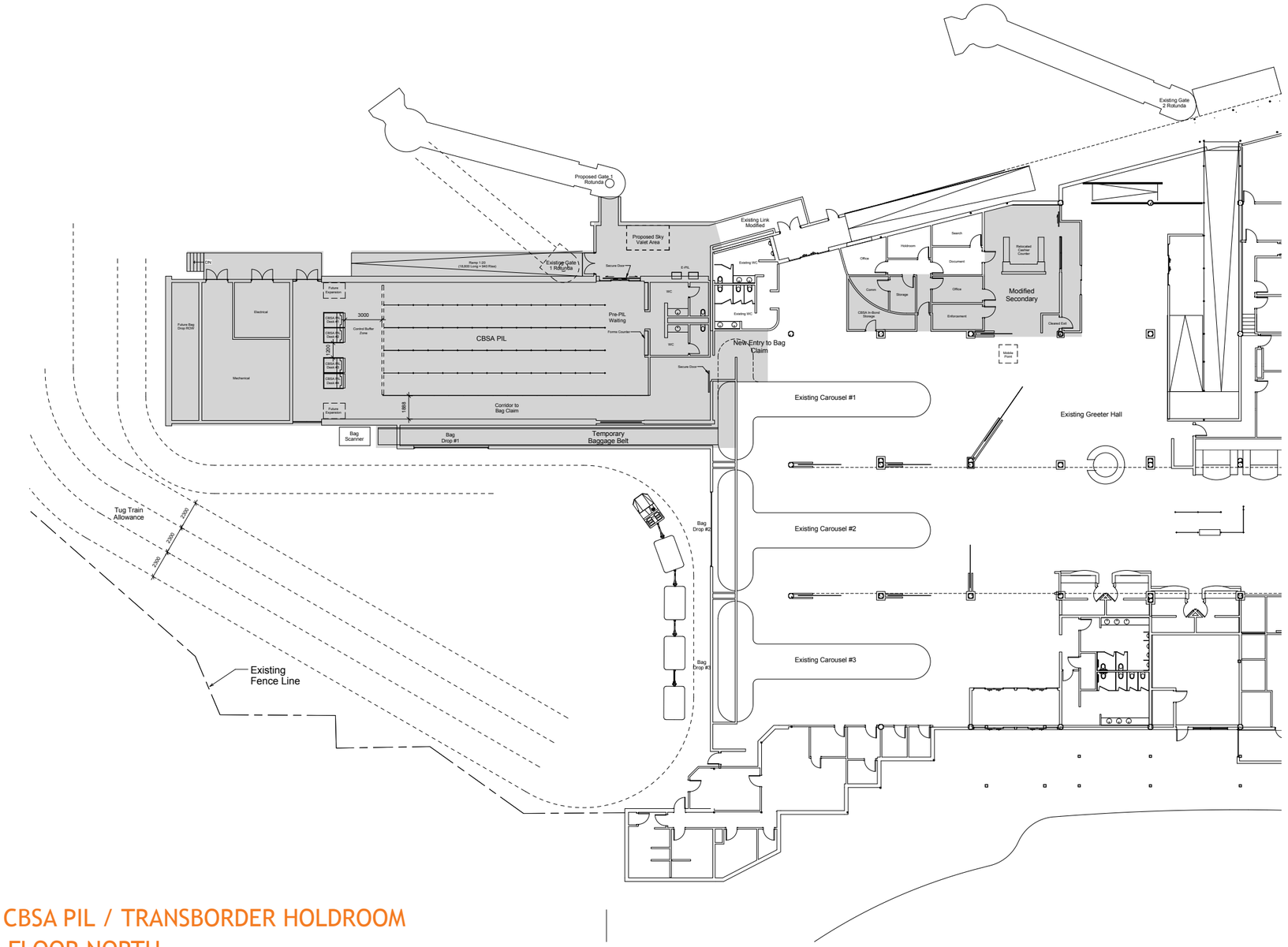
Phase 5 - Check In Hall / International Meeter Greeter Retrofits / Claim Hall Expansions
(delivery to be determined by demand)

Long term plans look to expanding the Check in Hall by moving the existing washrooms and providing more check in counter space. Desks will be moved to align with the existing West Jet counters. Retail will be expanded to the west and into the rotunda with retrofits to level the floor in the rotunda and revising the stair to the observation deck. Both International and Domestic baggage claim halls are expanded to receive one more carousel each.

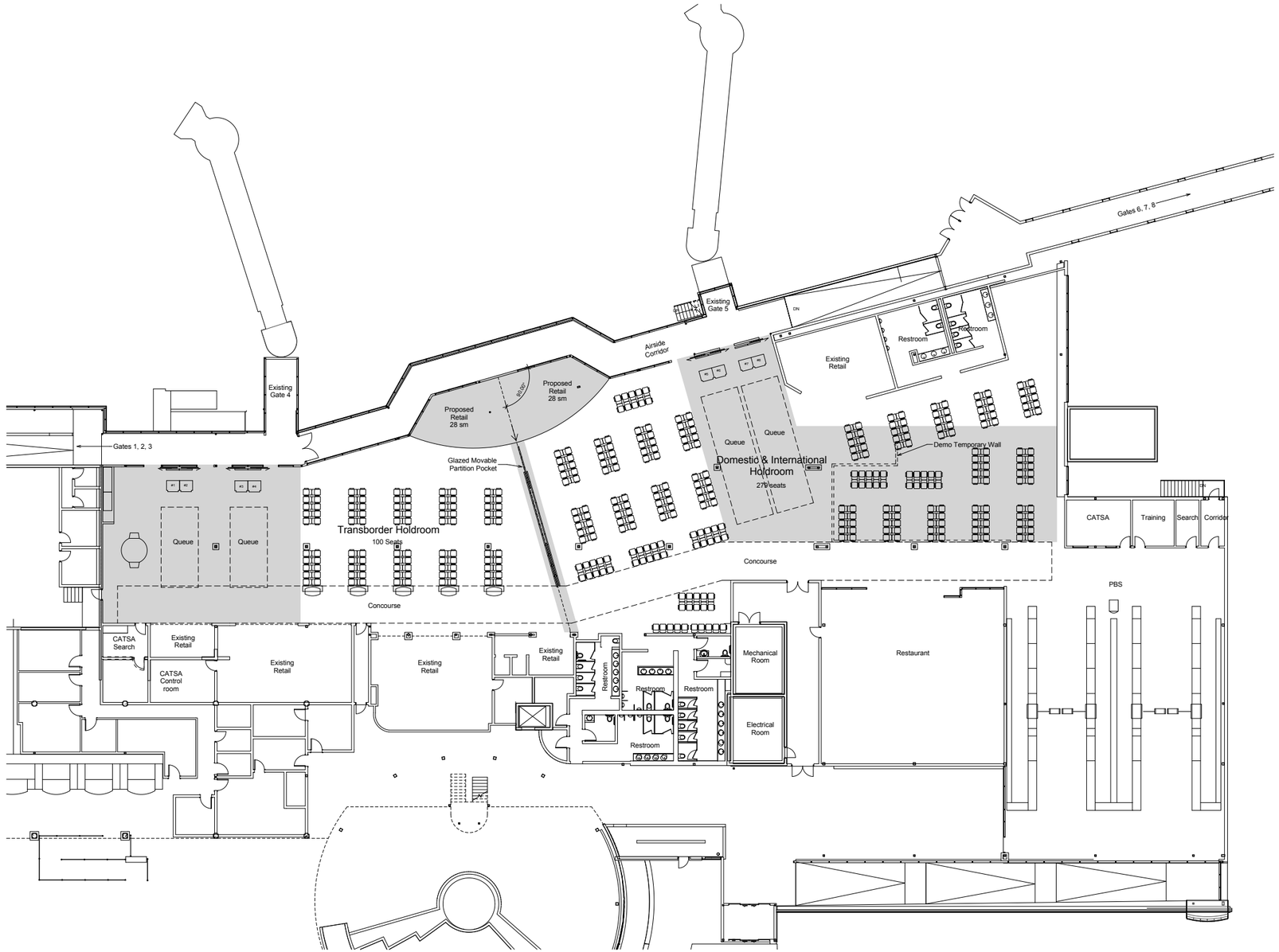
During the Design Development Phase the consultant team and the airport and airline operations teams will review and prepare detailed phasing plans for each of these five planned phases to ensure seamless continuing operations. These plans will take into account seasonal airline travel peaks; access to critical areas and constructor access.



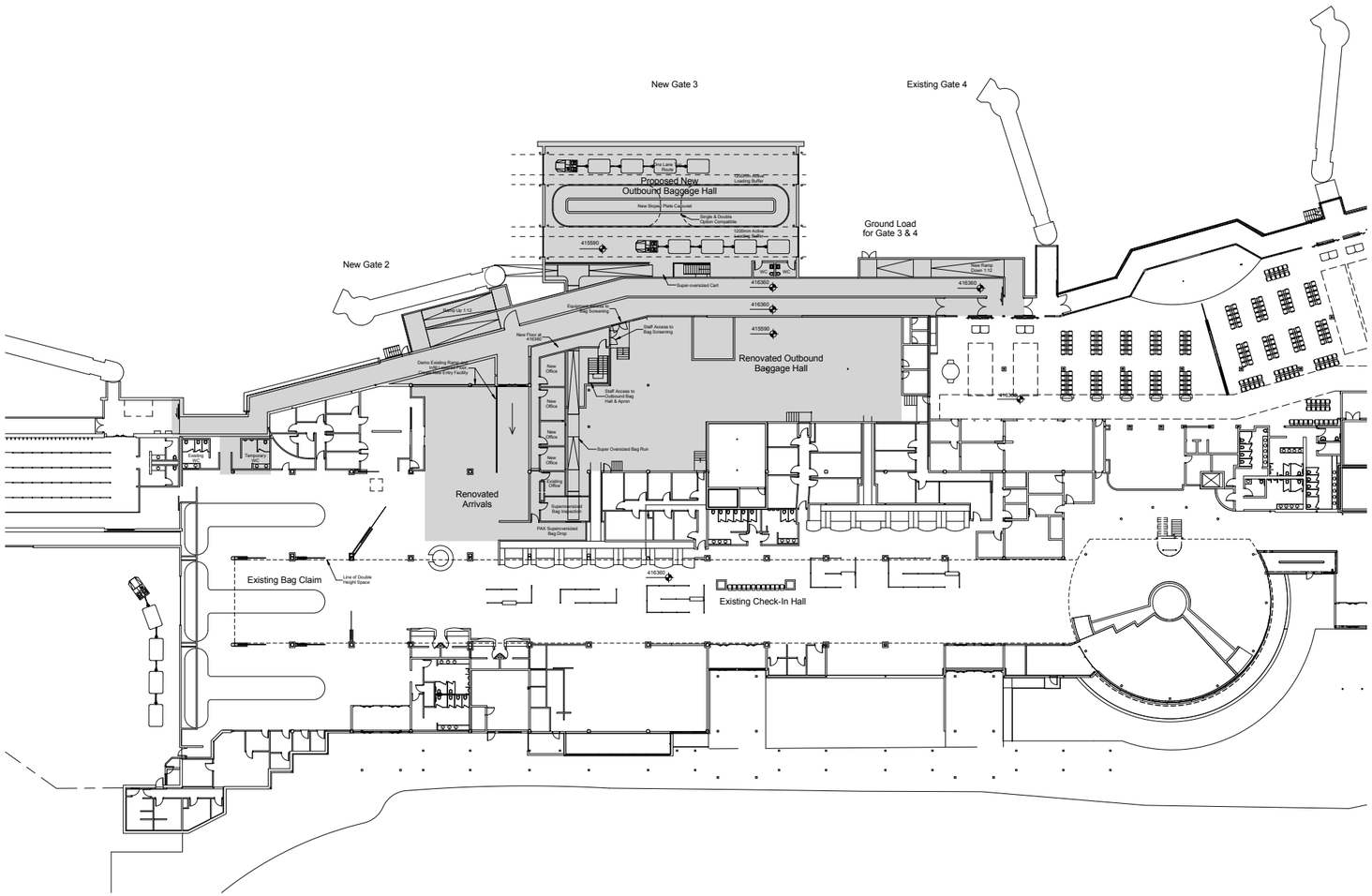
PHASING DIAGRAMME



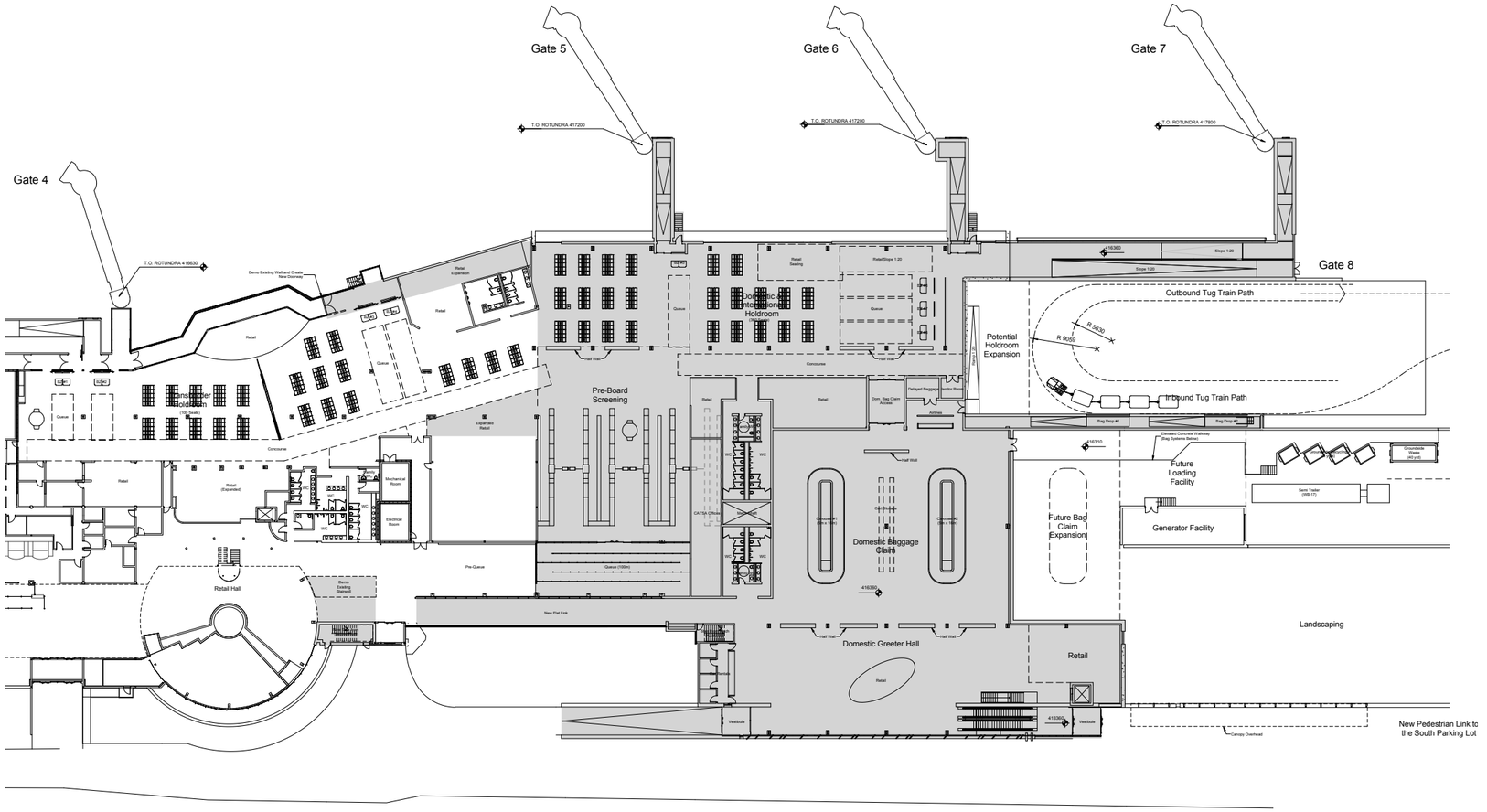
PHASE 1 CBSA PIL / TRANSBORDER HOLDROOM
GROUND FLOOR NORTH



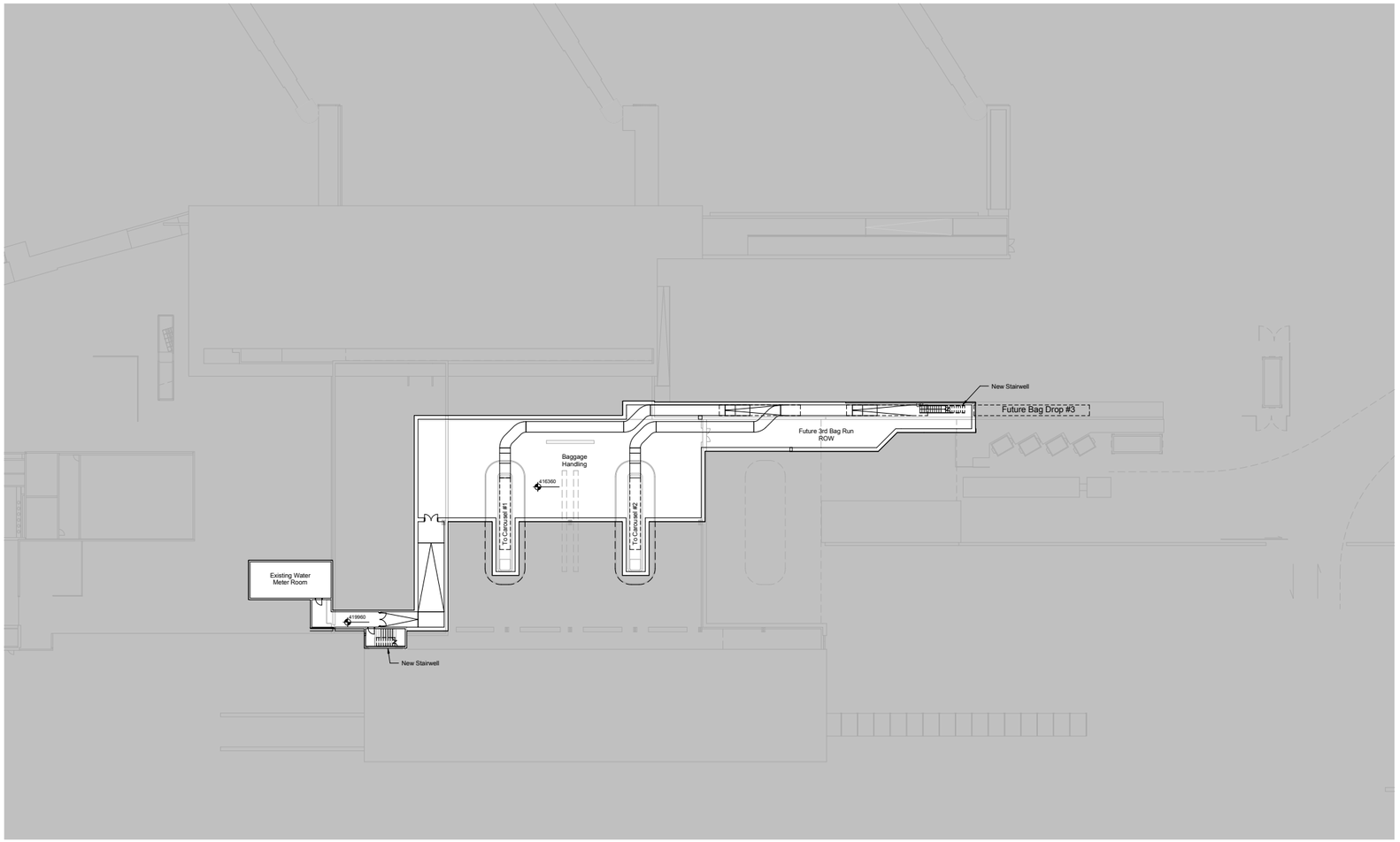
PHASE 1 CBSA PIL / TRANSBORDER HOLDROOM
GROUND FLOOR SOUTH



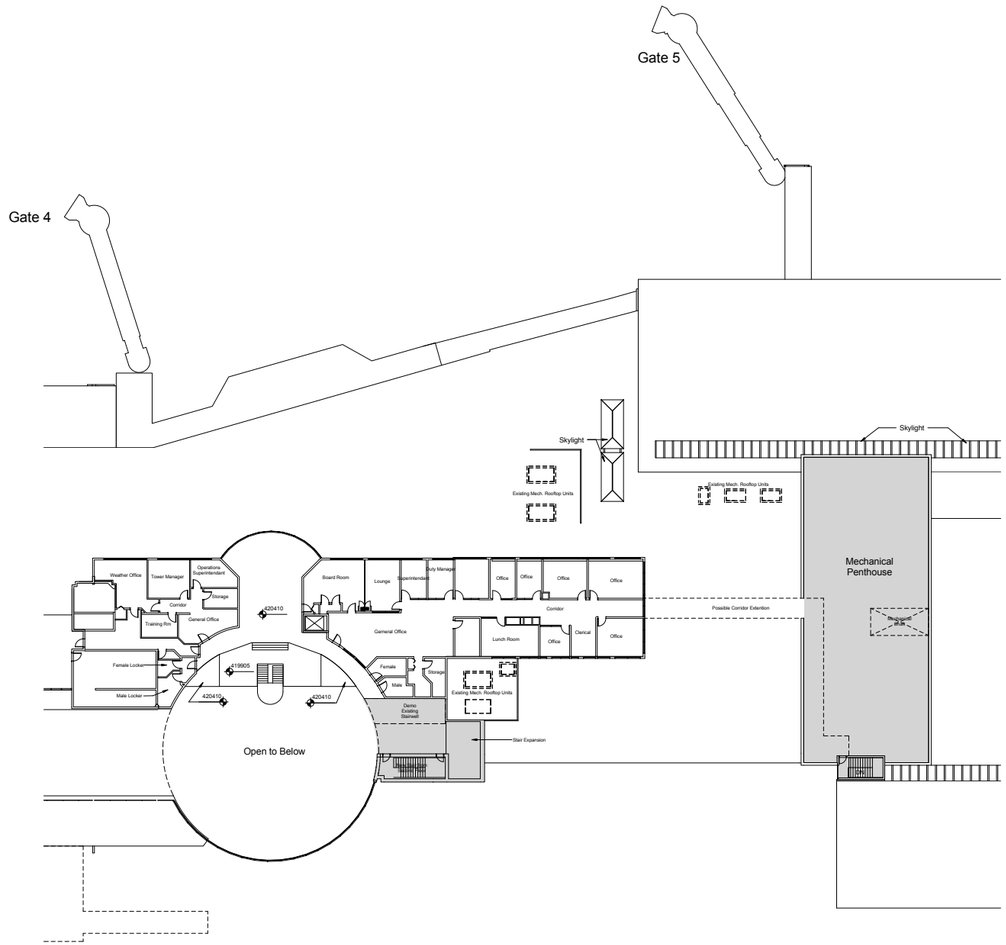
PHASE 2 OUTBOUND BAGGAGE MAKE UP HALL / AIRSIDE CORRIDOR
GROUND FLOOR



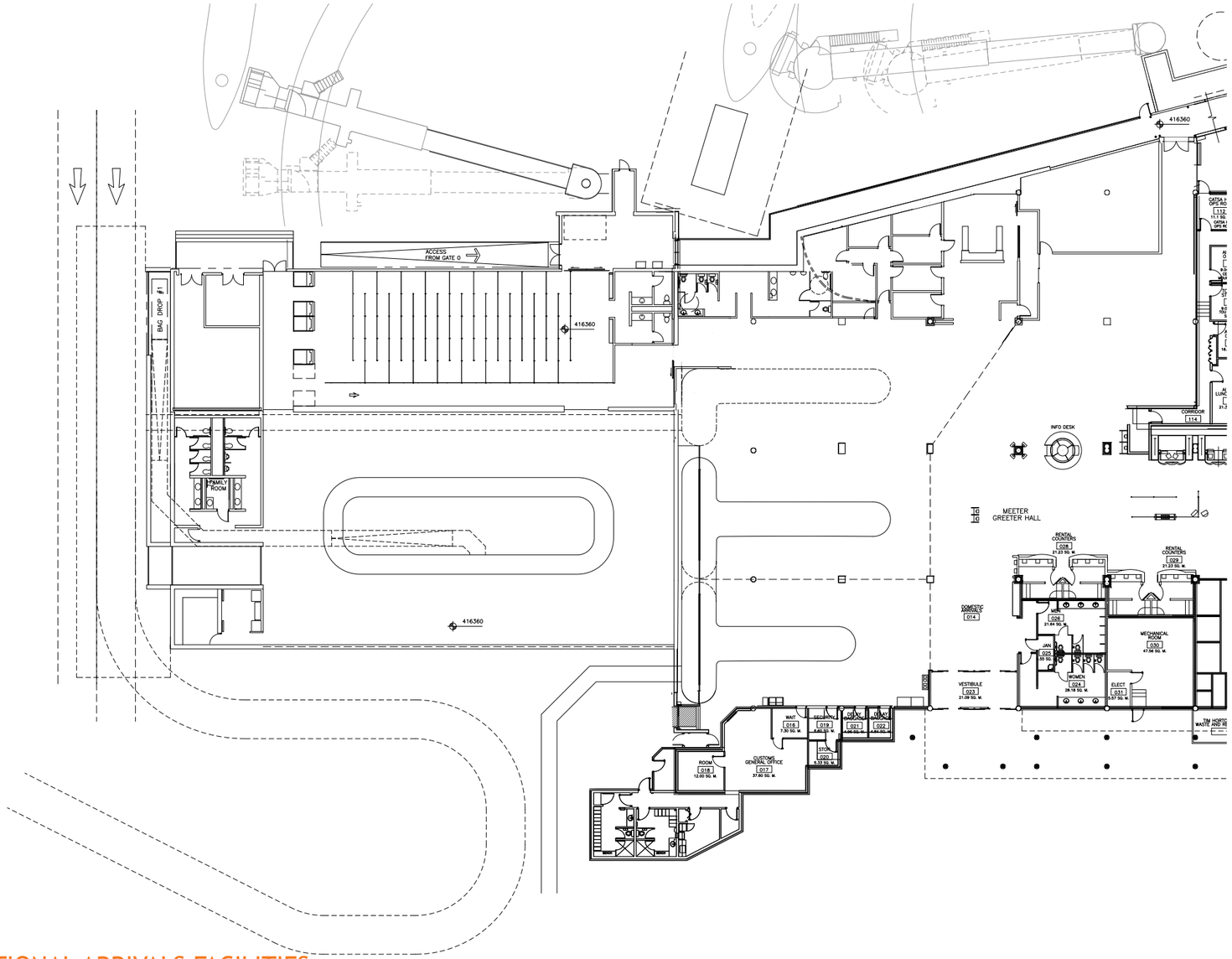
PHASE 3 DOMESTIC ARRIVALS FACILITIES
GROUND FLOOR



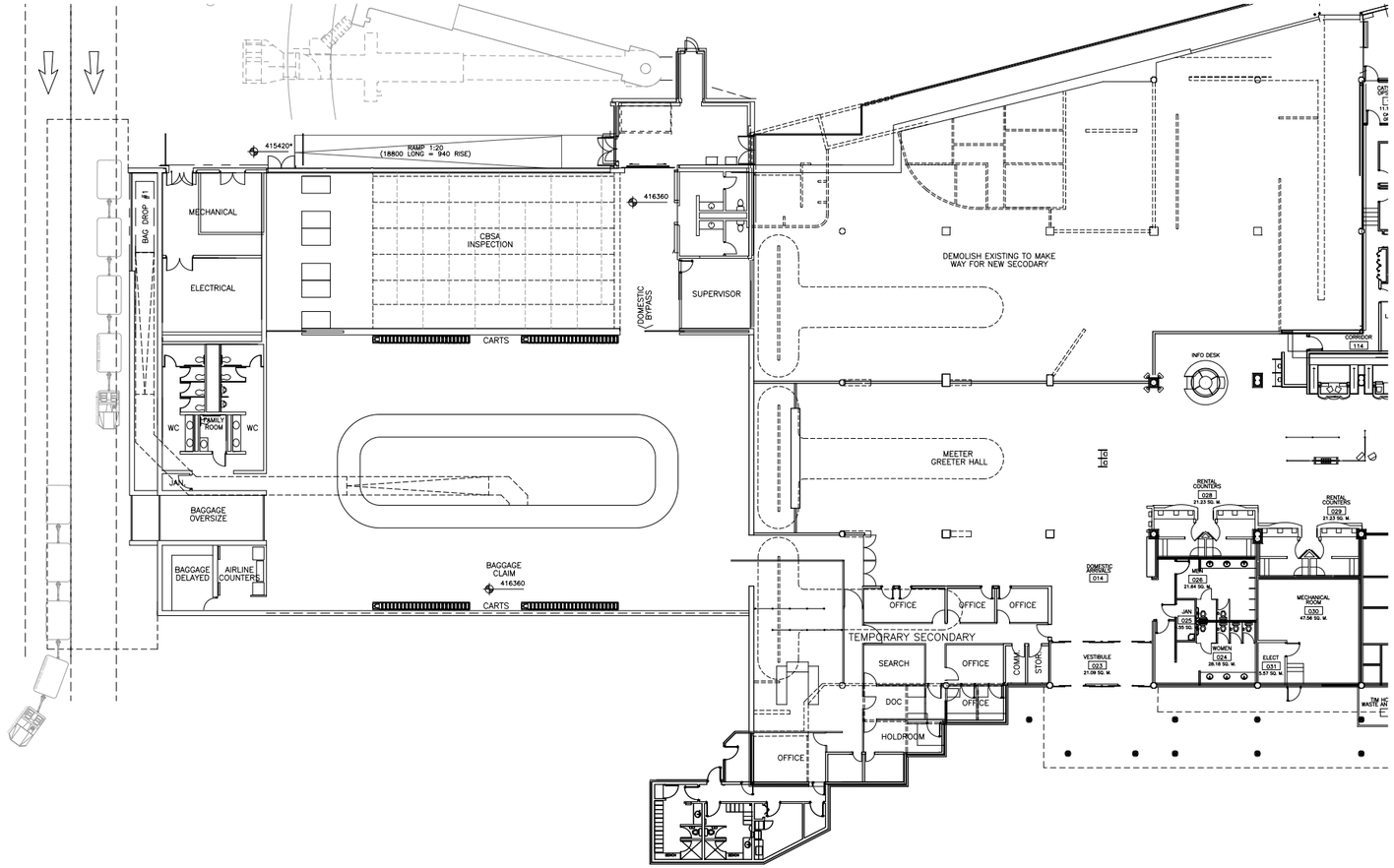
PHASE 3 DOMESTIC ARRIVALS FACILITIES
BASEMENT



PHASE 3 DOMESTIC ARRIVALS FACILITIES
SECOND FLOOR



PHASE 4 INTERNATIONAL ARRIVALS FACILITIES
GROUND FLOOR - STEP 1



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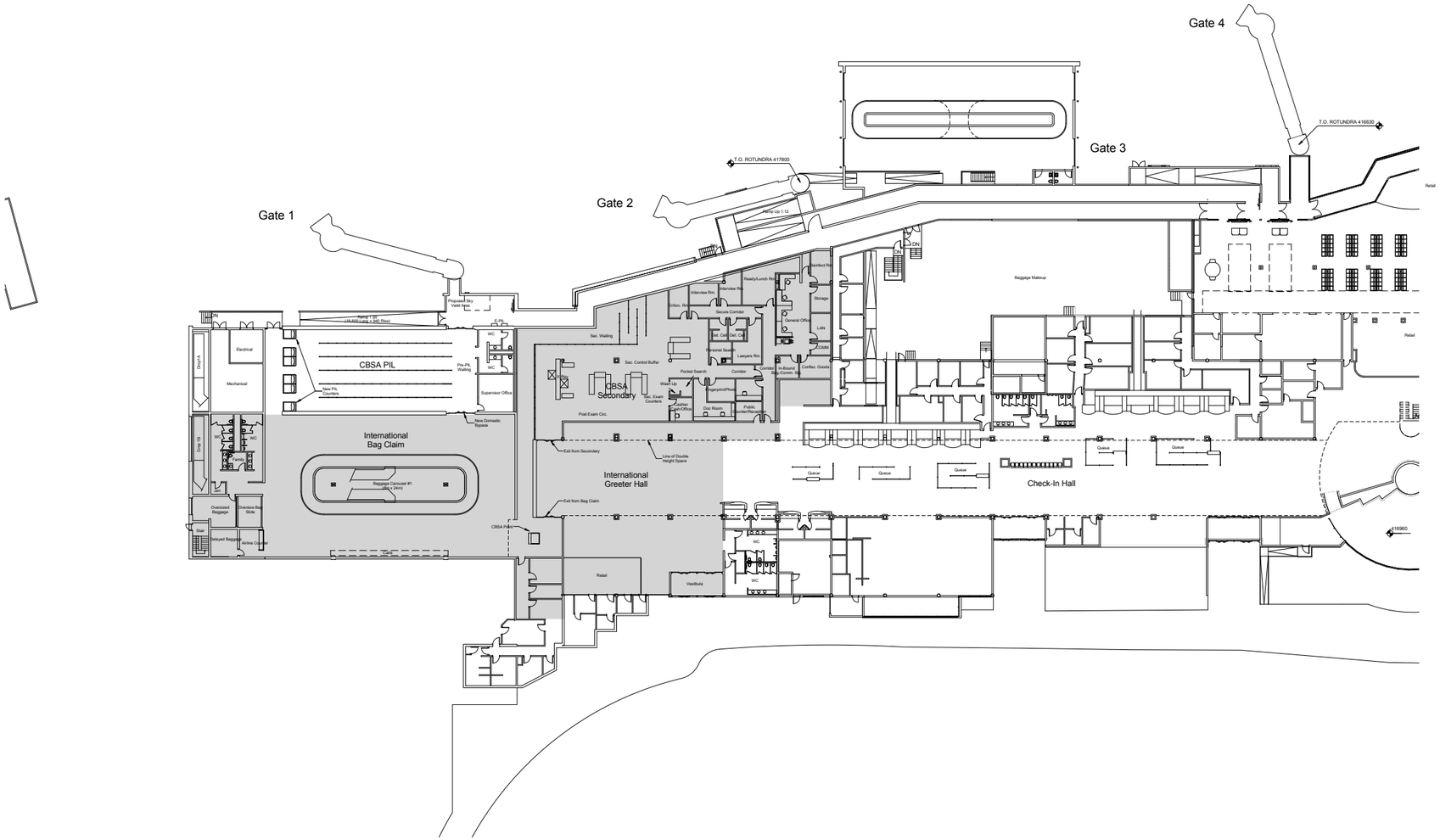

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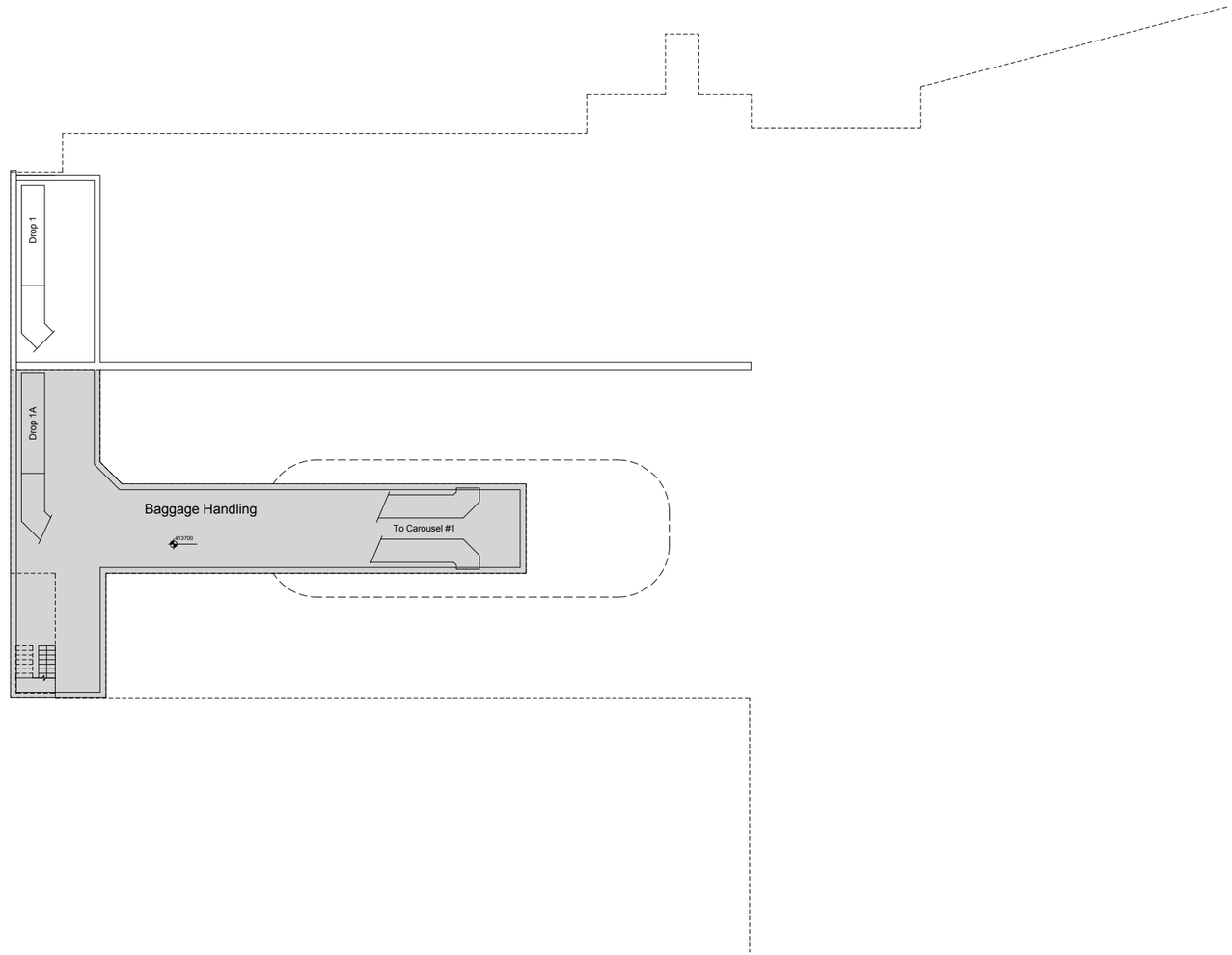
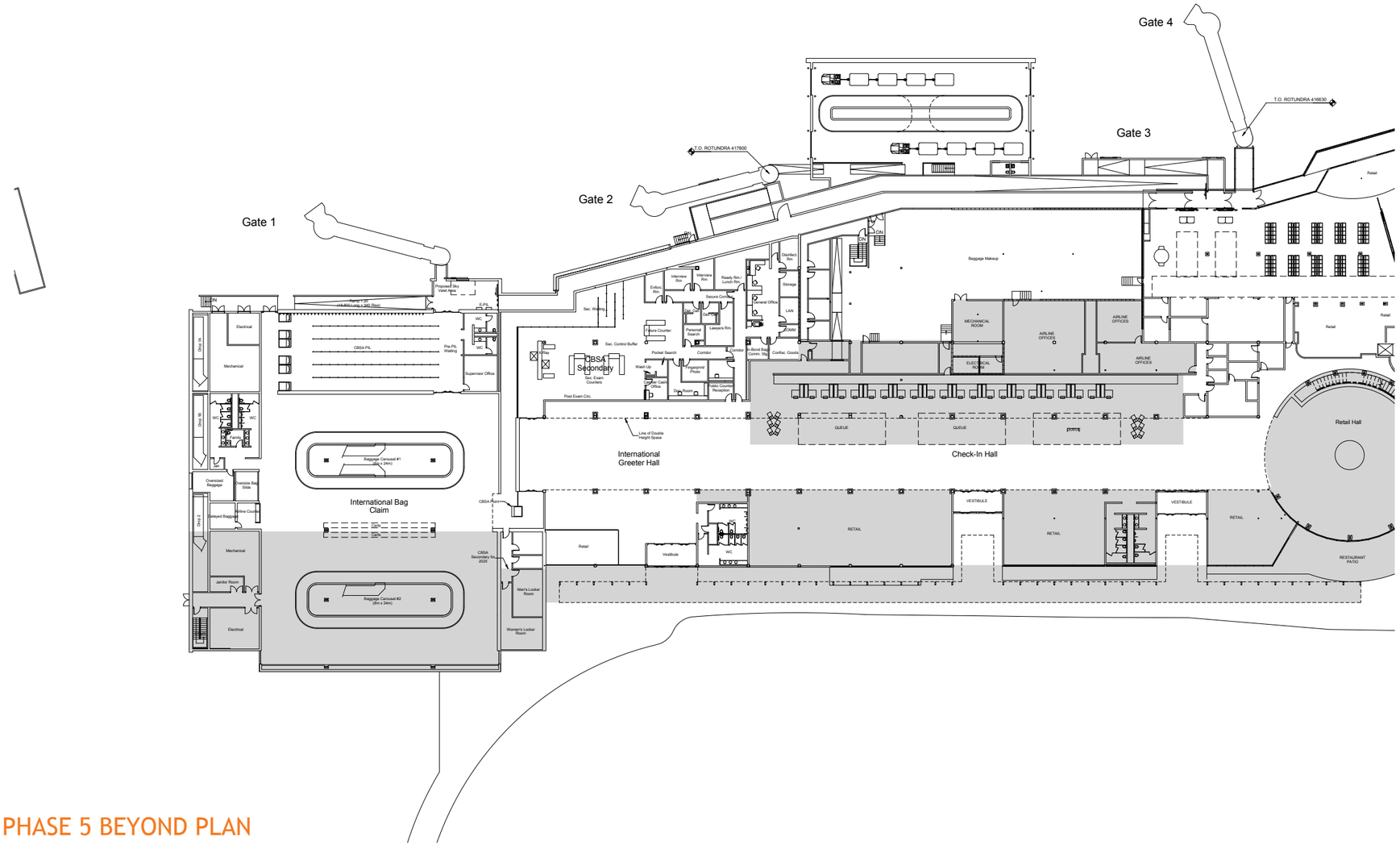
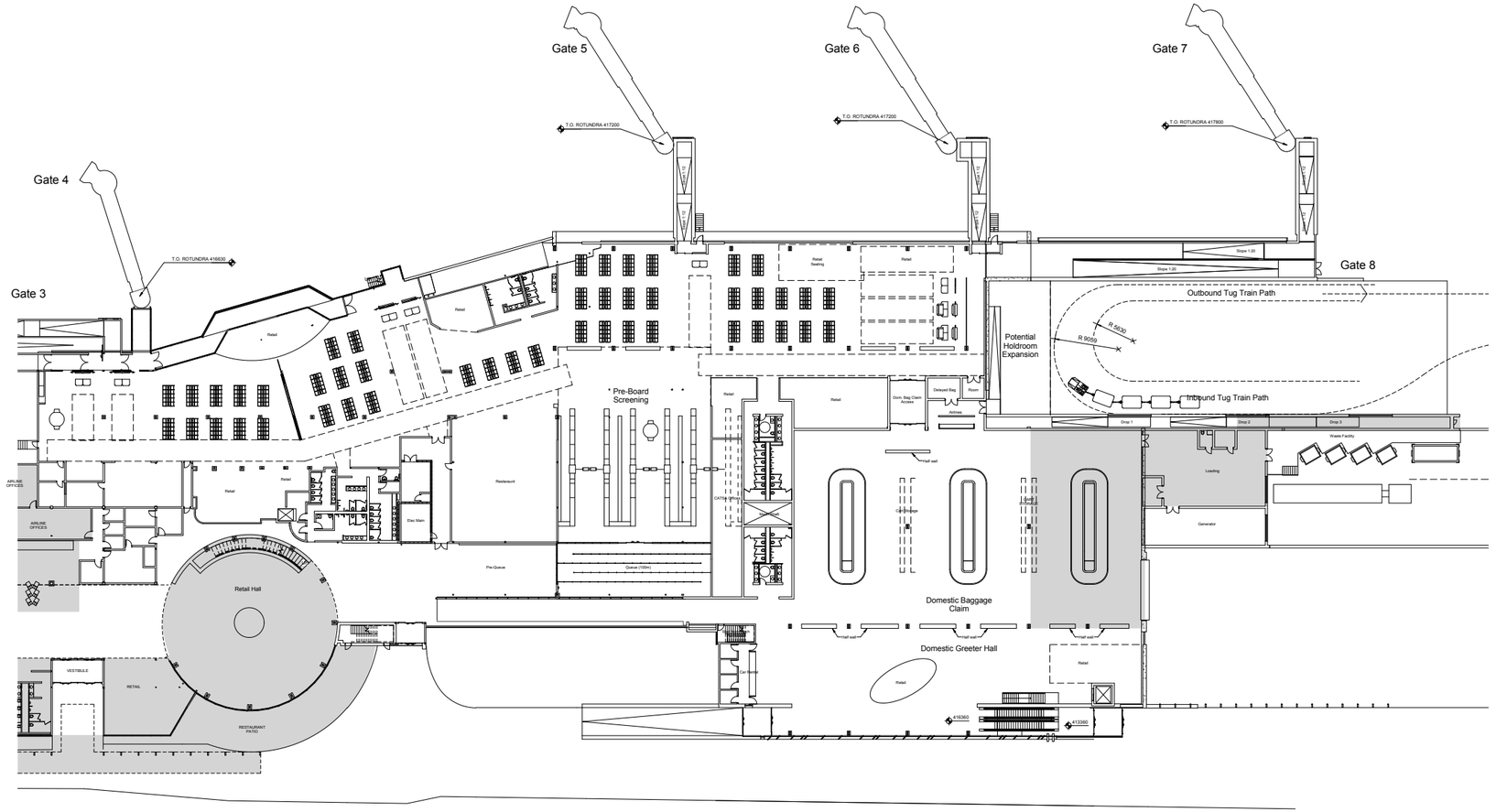
GROUND FLOOR – STEP 3



PHASE 4 INTERNATIONAL ARRIVALS FACILITIES
BASEMENT



PHASE 5 BEYOND PLAN
GROUND FLOOR NORTH



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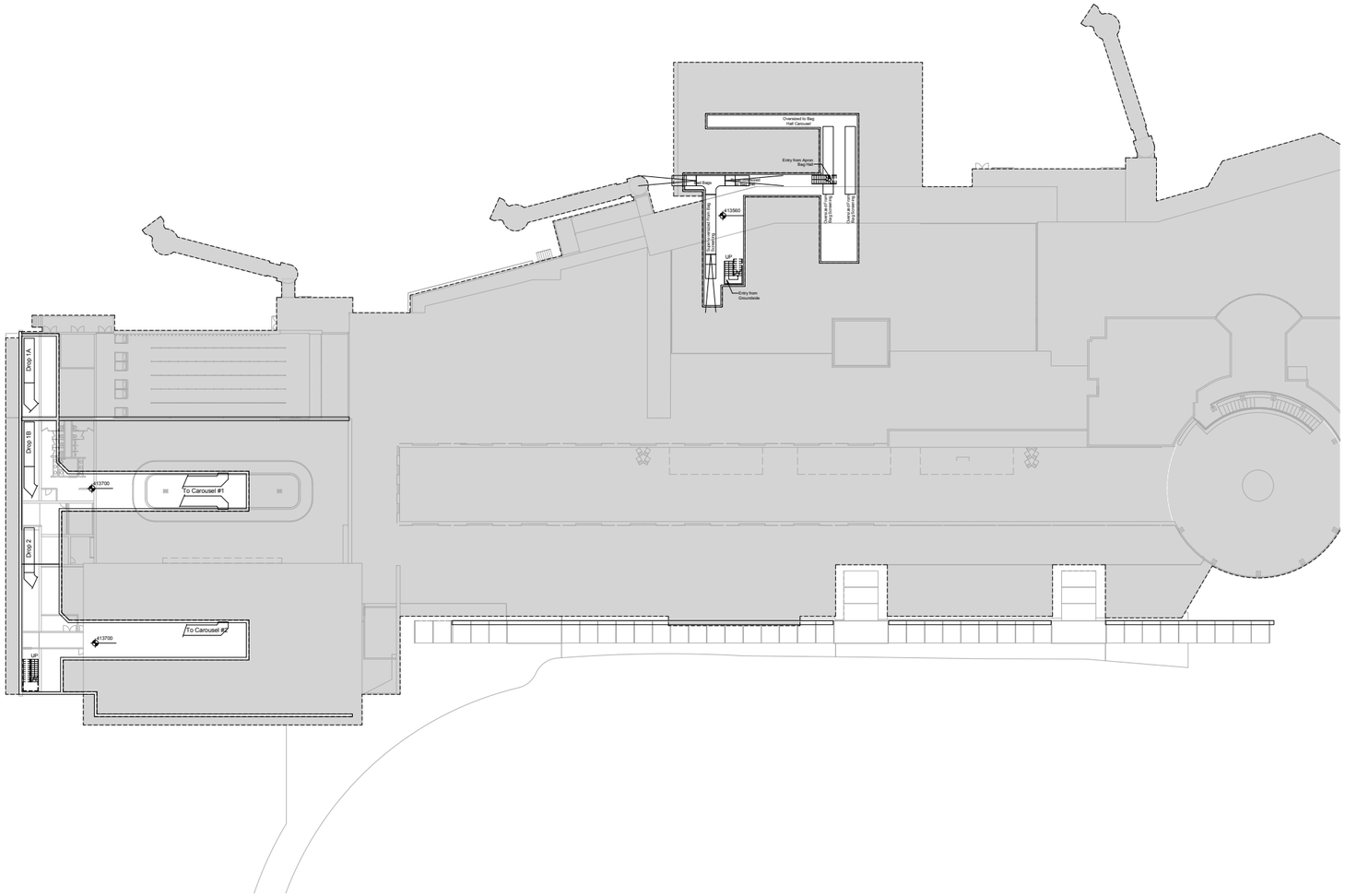
GROUND FLOOR SOUTH



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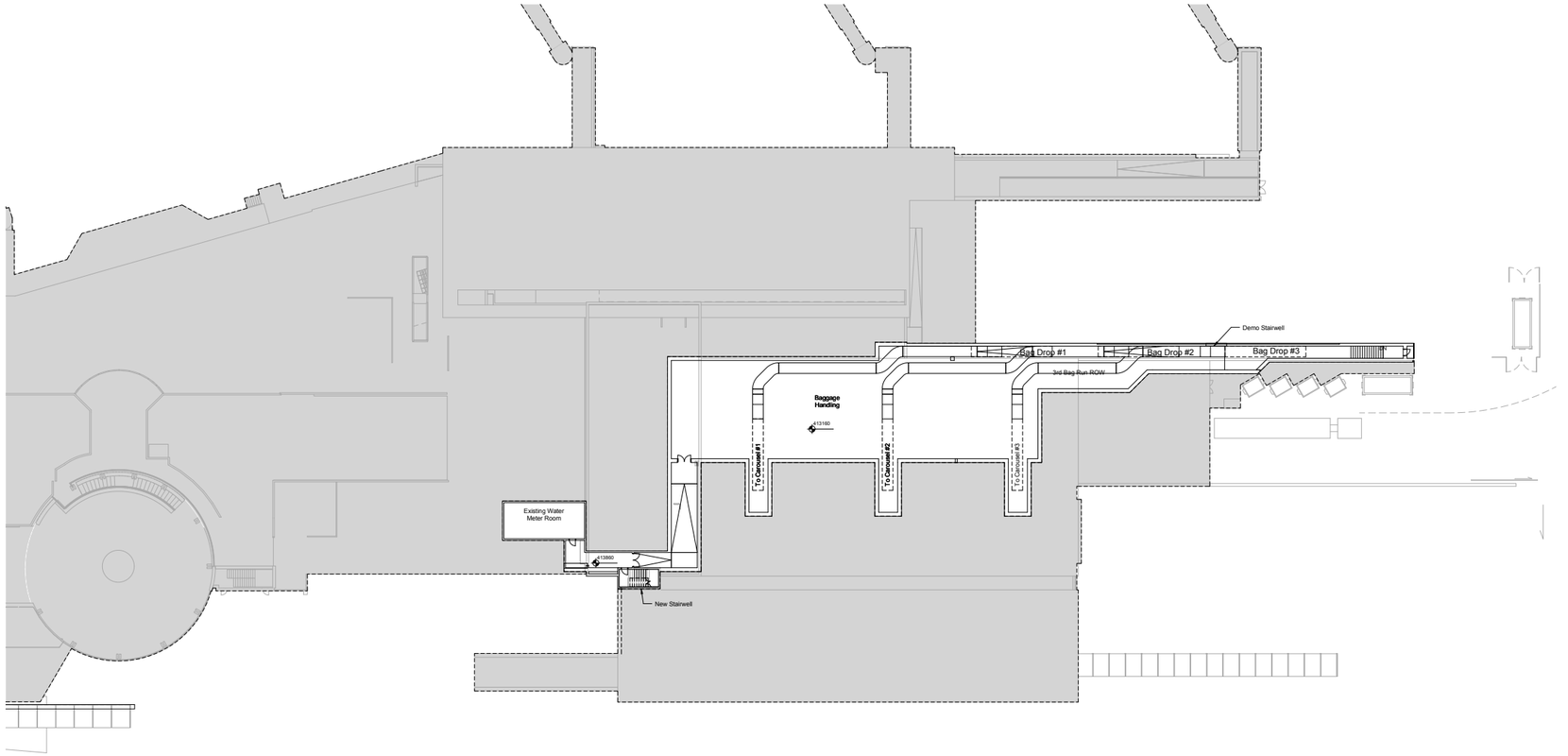
BASEMENT NORTH



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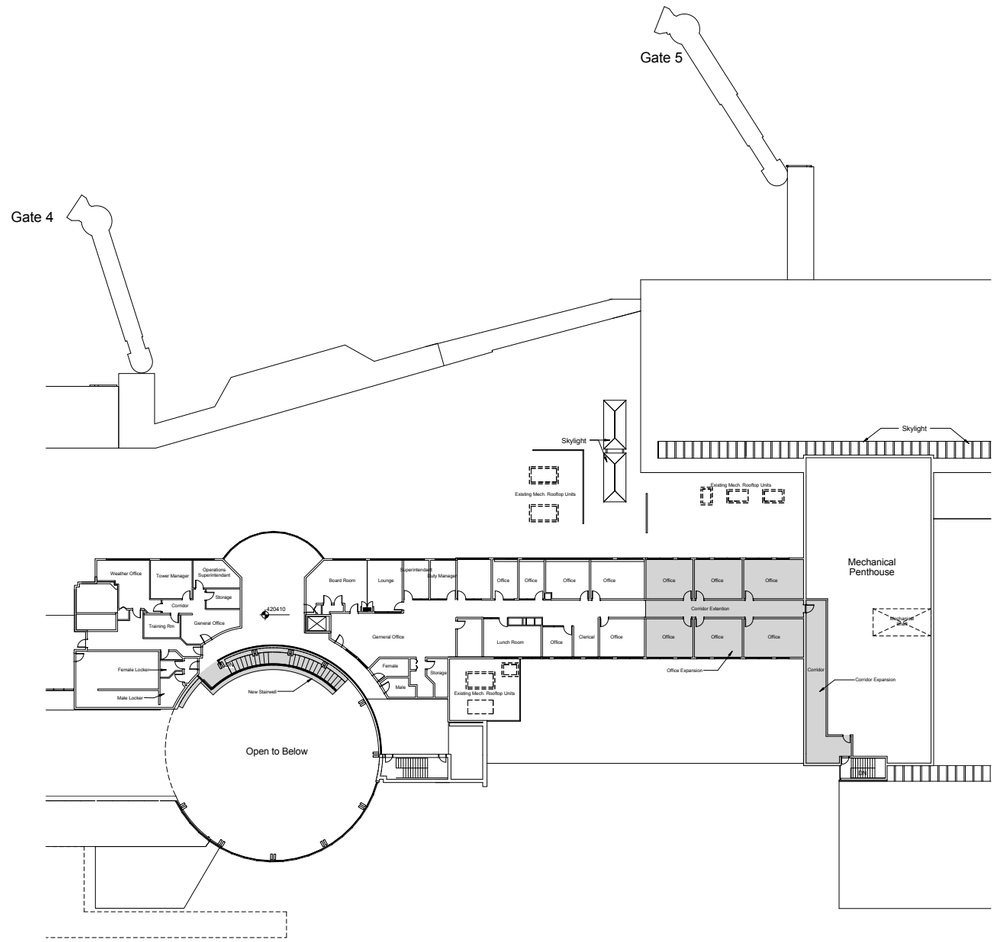
BASEMENT SOUTH



PHASE 5 BEYOND PLAN
SECOND FLOOR

8.0 MECHANICAL SYSTEMS

GENERAL OVERVIEW

Introduction

This report defines the proposed HVAC, controls and BMS, plumbing, fire protection and life safety systems for the YLW Kelowna Airport Expansion. Mechanical systems have been selected to address the service needs generated by airport passenger traffic projections and realignment of international and domestic gates.

Estimates of mechanical system capacities have been based on preliminary cooling and heating load calculations and preliminary architectural layouts. System capacities will be finalized with detailed heating and cooling load calculations through the design development phase and in conjunction with the details of the building envelope construction to be developed by the architectural team.

General Mechanical Design Criteria are as follows;

- Cost Effective Design for the Mechanical Systems. This is particularly important to obtain the best mechanical value in terms of life cycle while meeting the budget constraints.
- High ventilation effectiveness for increased indoor air quality. The general mechanical HVAC design concept of Airport Facilities is to provide sufficient ventilation to support high occupant loads that vary depending on flight schedules, security processing, holding, and baggage claim requirements. It is undesirable, however, to continue to supply high outdoor air rates to unoccupied areas. At the Kelowna Airport, there may be long time periods with minimal occupancy in some areas.
- Utilize hydronic based systems wherever possible to save fan energy utilized by continuously operated fan systems.
- Limit water use in the new facility while maintaining important characteristics such as maintainability and performance for plumbing fixtures.
- Reduce energy usage wherever possible to provide long term sustainable performance from the facility.
- Flexibility in servicing common spaces to allow for future renovations.
- Elegance and simplicity of design to allow ease of operation of the mechanical systems.
- Reduction of the Carbon footprint for the existing and new airport expansion to levels below the existing condition today, even with a substantial increase in floor area.

Design Criteria

Design Criteria for the typical room types has followed BC Building Code and ASHRAE Guidelines as follows:

- Heating and Cooling capacities will be based on the following criteria for peak winter design conditions, and defined in the BC Building Code.
  - Outdoor design temperature: -20°C 1% winter design condition, 33°C DB/20°C WB 2.5% summer design conditions as prescribed in the BC Building Code. The percentages indicate for example that 99% of the time the temperature will be above -20°C and 97.5% of the time the temperature will be below 33°C.
  - In addition, ASHRAE weather data will be used to determine dehumidification conditions for the space. Therefore, the 1% dehumidification condition for Kelowna is 14.6°C dewpoint at 20.7°C dry bulb, which is the most humid outdoor condition.
  - Indoor space temperature: 21°C winter, 24°C summer.
  - Indoor space relative humidity to be maintained at a maximum of 60% in summer and will not be controlled in the winter. The intent is not to provide humidification for the air handling units.
  - Elevation = 350 m, Rainfall = 10 mm in 15 minutes
  - Seismic Data Sa(0.2)=0.28, Sa(0.5)=0.17, Sa(1.0)=0.094, Sa(2.0)=0.056, PGA=0.14

- Load calculations have been carried out to determine the building envelope heat loss. Overall thermal resistance values in walls, roof and glazing have been calculated using catalogued data and methods in ASHRAE. This work has been closely coordinated with the rest of the design team and represents recommended values from the Energy Analysis.
- Overall "R" values for the building envelope exceed those prescribed in the National Energy Code. The assumed R values for the walls are RSI 4.07 (R23.1), roofs are RSI 5.42 (R30.8), and the windows are high performance with an USI 0.99 (R5.75) with a Solar Heat Gain Coefficient SHGC = 0.30 (shading coefficient of 0.26). The windows are currently selected as triple glazed, this is to be confirmed during value analysis. This may drop the window performance, which will have to be compensated by the mechanical heating and cooling systems.
- High thermal massing has been assumed utilizing the concrete floor as the primary mass element (Note: without carpet), as well as utilizing rammed earth walls strategically placed in the space, and block walls that would typically be provided for some rooms. The added thermal mass tends to lower the peak heating and cooling loads and even out the heating and cooling loads in the space over the day.

Code and Code-Referenced Standards

The mechanical system design will be in accordance with all applicable codes and regulations of the local inspection authorities having jurisdiction, and City of Kelowna requirements.

- BC Building Code 2006
- BC Fire Code 2006
- BC Building Code – Plumbing Services Part 7 2006
- National Plumbing Code of Canada current edition
- ASHRAE 55 – Thermal Environmental Conditions for Human Occupancy
- ASHRAE 62.1 – Ventilation for Acceptable Indoor Air Quality
- CSA B51 Boiler, Pressure Vessel and Pressure Piping Code.
- CSA B52 Mechanical Refrigeration Code.
- CSA B64.10 Manual for the Maintenance and Field Testing of Backflow Prevention Devices
- CSA B149.1 Natural Gas Installation Code
- National Fire Protection Association (NFPA) Standards:
  - NFPA 10: Portable Fire Extinguishers
  - NFPA 13: Installation of Sprinkler Systems
  - NFPA 14: Installation of Standpipe and Hose Systems
  - NFPA 90A: Installation of Air Conditioning and Ventilation Systems
  - NFPA 96: Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
- SMACNA Standards for Ductwork and IAQ During Construction

Standards and Guidelines

The Mechanical Systems will be designed to meet the following Standards and Guidelines:

- Model National Energy Code of Canada current edition
- ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings
- LEED NC 1.0 – New Construction

Ventilation Calculations

Ventilation rates to the spaces have been calculated based on ASHRAE 62.1, assumed occupancy rates, and space type. The intent of the mechanical system design is to de-couple ventilation requirements from cooling loads, therefore the assumed ventilation rates determine air handling unit sizes.

The International CBSA and Bag Claim will be all new and will require a dedicated air handling unit to provide ventilation to all of the new spaces. The Domestic expansion is a mixture of new areas and renovation to existing areas. Therefore, some of the areas are partly served by existing equipment such as existing Screening Areas noted in bold.

NORTH SIDE	ZONE INFO						
	ASHRAE 62.1 AIR FLOW RATES						
	Area(sq ft)	People	cfm/ person	cfm/ft²	Max cfm	Min	Exhaust
CBSA	3,500	250	7.5	0.06	2,085	210	
CBSA Washroom	330			2.00			660
Bag. Claim North Int 1	6,600	200	7.5	0.06	1,896	396	
Bag. Claim North Int 2	8,400	200	7.5	0.06	2,004	504	
W2	688			2			1,376
Bag Delayed 1	363	2	5.0	0	32	22	
Mech Elec 1							
Mech Elec 2							
Total:	19,881				6,017 cfm	1,132 cfm	2,036 cfm

SOUTH SIDE	ZONE INFO						
	ASHRAE 62.1 AIR FLOW RATES						
	Area(sq ft)	People	cfm/ person	cfm/ft²	Max cfm	Min	Exhaust
Hallway7	2,860	0		0.06	172	172	
hold room east (new)	10,691	416	7.5	0.06	3,761	641	
Bag./Jen	244	0		0.06	15	15	
Office Area 12	388	2	5.0	0.06	33	23	
Entrance 1	419	0		0.06	25	25	
Retail 6	1,073	35	7.5	0.06	327	64	
W7	1,107			2.00			2,214
Retail 11	387	13	7.5	0.06	121	23	
Office Area 11	1,254	6	5.0	0.06	105	75	
W8	815			2.00			1,630
Office Area 10	438	2	5.0	0.06	36	26	
bag claim domestic	25,697	874	7.5	0.06	8,097	1,542	
Bag Drop 2	1,262	0	7.5	0.06	76	76	
Screening Old	5,062	600	7.5	0.06	4,804	304	
Scrennning (new)	919	24	7.5	0.06	235	55	
Loading Dock	2,898	0		0.06	174	174	
Total:					17,981 cfm	3,216 cfm	3,844 cfm

PLUMBING SYSTEMS

Storm Drainage

Storm drainage will consist of internally mounted rainwater leaders connected to storm water piping below grade. The roof drains will either provide storm water retention on the roof or will be a full flow design, depending on the final site servicing plan to meet City of Kelowna storm water management guidelines. This will be determined by the Civil consultant.

Storm drainage will consist of cast iron piping with MJ fittings above ground and PVC piping below ground. There will be new storm connections required on the north end expansion and the south end expansion.

Sanitary Drainage

Sanitary drainage will be provided for new washrooms located in the International Bag Claim expansion. A new main washroom group will be provided in Phase 4 for International Bag Claim, therefore a new main sanitary line will be provided to support this washroom group and will be sized to support additional washroom groups added in the future. The new 150 mm sanitary line will be connected to the street connection in the front of the airport.

Sanitary drainage will be provided for new large washrooms located in Phase 3 expansion. A new main sanitary line will be provided to support this washroom group and will be sized to support additional washroom groups added in the future. The new 150 mm sanitary line will be connected to the street connection in the front of the airport.

Miscellaneous sanitary connections will be required to support retail areas, mechanical rooms, and janitor/support rooms. The main sanitary lines will be coordinated with radiant slab piping to ensure sanitary is accessible and expandable to future loads.

Trap primers will be provided for all floor drain traps to ensure a positive seal is maintained on the trap, primer lines in concrete slabs will be plastic.

Sanitary drainage will consist of cast iron piping with MJ fittings above ground and PVC piping below ground (except for mechanical room areas).

Domestic Water Supply

Domestic water will be supplied from the City of Kelowna piped utility distribution system. Domestic water quality will be evaluated during Design Development to determine if the existing micro-filtration system is necessary for the proposed expansions.

Domestic water for the PIL and International Bag Claim washrooms will be extended from existing domestic water mains. Existing domestic water mains will be evaluated for sizing and upgraded as required.

Domestic water for the Domestic Bag Claim washrooms will be connected to the existing water meter room. The main water supply line from the City supply in the street will be upgraded if required to supply the existing airport and the new Phase 3 expansion. This will eliminate repetition of water meters and backflow prevention. Determination of existing DCW tie-in points to the street is to be verified by the Civil consultant.

Double-check valves will be provided for premises isolation between the Airport and City of Kelowna utility services.

Domestic water piping will consist of Type L copper minimum with Type K copper on domestic hot water recirculation lines. Two 150 mm domestic water supply lines will be provided to the building to serve domestic water and fire protection. A 50 mm takeoff for irrigation supply will be provided where required to serve landscaped areas.

Domestic Hot Water

Domestic hot water will be supplied to serve plumbing fixtures such as lavatories and sinks. The hot water system must typically be maintained at 60˚C minimum, which is mandated by CSA codes, to prevent the growth of Legionella bacteria. New domestic hot water heaters will be provided in the North mechanical room and South Penthouse to support the new washroom groups. Individual plumbing fixtures will typically tempered to a single supply temperature at the fixture through a below counter mixing valve.

Domestic hot water will be distributed to the washroom groups through the mechanical room. Domestic hot water recirculation piping will be provided to each washroom group. Automatic balancing valves will be provided on each individual vertical riser to ensure flow is balanced between risers and excessive velocities don't occur. A domestic hot water recirculation pump will be located back in the mechanical room.

Domestic hot water piping will consist of Type L copper minimum with Type K copper on domestic hot water recirculation lines.

Plumbing Fixtures

Plumbing fixtures will be selected based on the following criteria:

- Provision of high performance fixtures capable of performing the required service at lower water flows. Therefore, all water closets must have a Maximum Performance Test (MAP) rating of 1000 to ensure high performance. This testing is undertaken to verify manufacturer claims of high performance using test media.
- Provision of hands free infra-red plumbing fixtures throughout all public washrooms. Theses fixtures will provide low water consumption and reliable operation is an important characteristic for the high loading of these washrooms.
- Provide wall hung toilets and a substantial service chase for the toilets to allow ease of servicing. The toilets can utilize an exposed infrared flushometer as shown or a completely concealed flushometer located flush with the wall, depending on Owner preferences.

Examples of typical plumbing fixtures proposed are as follows:

HEATING, VENTILATION AND AIR CONDITIONING (HVAC)

Heating

Introduction

The primary methodology for providing energy efficiency for the heating system is to provide a combination of ground-source geothermal heat pumps and condensing boilers.

Ground source geothermal heat pumps utilize the relatively constant ground temperature to provide heat in the winter and reject heat in the summer. Ground source geothermal heat pumps are one of the most effective methodologies for reduction of green-house gases such as carbon dioxide, particularly in hydro-electric dominated areas. The intent is to provide a closed loop heat pump system to vertical bore fields located in fixed areas of the airport site. Vertical bore fields typically extend 60-90 m below the ground and utilize a non-freeze solution to extract and reject heat to the ground. Ground bore field piping is typically installed in a 100 mm well and sealed with a thermally conductive grout, then routed to a header for connection to the main pumps. It is intended that the headers be located in remote concrete header boxes to allow the use of main supply and return pipes from the Airport.

Ground source heat pumps can provide a Coefficient of Performance (COP) in heating mode of 4.1 – 4.9, which is much more efficient than even condensing boilers when ground temperatures are favorable. The determining factor in sizing the external geothermal field is the difference between electric and natural gas energy rates, and source energy carbon content.

Condensing boilers recover up to 15% of the energy contained in the flue gases that is normally lost up the chimney, and is one of the most efficient energy savings methodologies in a heating dominated climate. It is recommended that all new boiler installations utilize condensing boilers to provide this additional efficiency.

The mechanical terminal systems must be designed to force the boilers to condense, which requires low temperature return back to the boilers. Therefore, all mechanical distribution systems will be designed to lower the return water temperature as low as possible.

Primary Source

The primary heating source for the new PIL expansions and International Bag Claim will be two (2) 116 kW wall mount condensing boilers and one (1) 30 ton heat pump. This hybrid system utilizes primary heat pump operation to provide a minimum of 20-25% of the peak heating load, which will form a substantial portion of the annual heating load. The condensing boilers will be utilized on extreme peak days or when the geothermal heat pump is not operable. The condensing boilers will utilize low temperature return water to condense flue gases.

The primary heating source for the new Domestic Bag Claim will be two (2) 234 kW floor mount condensing boilers and two (2) 30 ton heat pumps. This hybrid system utilizes primary heat pump operation to provide a minimum of 20-25% of the peak heating load, which will a substantial portion of the annual heating load. The condensing boilers will be utilized on extreme peak days or when the geothermal heat pump is not operable. The condensing boilers will utilize low temperature return water to condense flue gases.

The condensing boilers and geothermal heat pumps will require a small constant speed boiler pump to maintain constant flow. These pumps will only operate when the associated equipment is required to operate.

Building Distribution

The building distribution system will be structured to provide heating to perimeter heating loads first to serve radiation and cabinet unit heaters. Hot water will be the primary heating medium for the perimeter heating system. The intent is to provide a maximum of 71.1°C supply water temperature to the radiation and hot water terminal units. The return water from the radiation will be 60°C or less, which will then be used for slab heating and air handling unit heating coils.

The slab heating and air handling unit heating coils will further drop the return water temperature down to as low as 43°C prior to returning the water to the boilers. This will create condensing in the boilers and increase boiler efficiency to approximately 92%. The control system will automatically reset the maximum supply water temperature based on outdoor air temperature to obtain even better boiler efficiency at partial load, up to 95% at 32.2°C. The design hot water temperatures will be optimized to provide the lowest possible hot water temperature at all times.

Propylene Glycol at a concentration of 40% will be provided in air handling unit heating coils to prevent freeze-up concerns, particularly in 100% outdoor air units. Variable speed drives will be provided for the glycol pre-heat pumps serving 2-way control valves on the pre-heat coils.

Heating Terminal Units

Radiation will be provided below perimeter windows and clerestory windows. Radiant floor heating will be utilized in large open spaces in conjunction with radiant floor cooling. The floor slabs close to the perimeter will be switchable between heating and cooling. Unit heaters will be provided for support spaces such as baggage hall and baggage loading areas.

The design intent is to minimize the required hot water temperature by providing a more insulated and sealed building envelope, reducing heating requirements. This can be accomplished by increasing the wall and glazing RSI values and providing high performance glazing and frames. The radiation maximum hot water temperature will be limited to 71.1˚C instead of a typical design temperature of 93.3˚C.

Force flow units, cabinet unit heaters, and unit heaters will be provided in support spaces, entrances, stairways, and unoccupied areas to provide heating.

Cooling

Introduction

Cooling for the new expansion will be provided by a combination of ground source geothermal heat pumps and centrifugal chillers. Approximately 20-25% of the cooling load will be supplied by geothermal heat pumps with the remainder provided by the centrifugal chillers. This will provide the best balance between external borehole field size, energy consumption, and initial capital cost.

Primary Source

The primary cooling source for the new PIL and International Bag Claim will be a single 105 kW (30 ton) geothermal heat pump with R-410A refrigerant. The geothermal heat pump will provide a cooling coefficient of performance (COP) of 5.2-5.4 by utilizing the ground for heat rejection. The future phases will include a new 421 kW (120 ton) centrifugal chiller and closed circuit fluid cooler to provide cooling to the new expansion and a portion of the existing building.

The primary cooling source for the new Domestic Bag Claim will be two 105 kW (30 ton) geothermal heat pumps with R-410A refrigerant. The geothermal heat pumps will provide a cooling coefficient of performance (COP) of 5.2-5.4 by utilizing the ground for heat rejection. The future phases will include a new 738 kW (210 ton) centrifugal chiller and two closed circuit fluid coolers to provide cooling to the new expansion and a portion of the existing building. The intent is to replace the existing centrifugal chiller and reroute the chilled water to the new penthouse. This will open up much needed electrical room space on the main floor.

The centrifugal chiller will be selected for maximum efficiency and in compliance with energy code requirements. New centrifugal chillers with sophisticated controls, variable speed drives, and increased surface area can provide a COP of 5.5 and Integrated Part Load Value of 5.9 which can exceed the performance of geothermal heat pumps. This performance requires a water cooled centrifugal chiller with an associated cooling tower.

Closed circuit fluid coolers will be provided to allow the use of glycol through the cooling tower circuit and to allow cross connection with the geothermal heat pumps. The closed circuit fluid coolers will utilize evaporative sprays during peak conditions to provide heat rejection.

Building Distribution

The building cooling distribution will consist of variable speed primary chilled water pumps supplying a 2-way control valves on the cooling coils. The primary distribution medium will be chilled water for the fan coils, chilled slabs, and chilled beams.

Various sensible cooling solutions can be adapted to use in high load spaces to augment the cooing provided by displacement. Fan coils are a poor solution for most spaces as are chilled beams because they disrupt floor to ceiling temperature stratification necessary for acceptable displacement performance. Radiant cooling technology can provide additional cooling and is compatible with displacement. Radiant ceiling, floor or panel systems are all compatible systems for displacement. Radiant floor system capacity varies based on type but typical capacity is shown below.

- Radiant Ceiling Panels 90W/m2
- Radiant Concrete Ceiling 75W/m2
- Radiant Concrete Floor (without carpet) 75W/m2
  (note: 100 W/m2 in sunlit areas)

Radiant cooling and the accompanying higher comfort levels for occupants rely on good view factors to the cooling surfaces. Studies completed by the Centre for Built Environment in Berkeley indicated that overhead radiant panels/slabs are as effective as floor radiant systems in providing proper comfort in low ceiling areas. High ceiling areas (over 5 meters) perform better with floor based systems. Sedentary occupant foot temperature must be limited (when applying radiant floor) with a warmer surface temperatures than overhead system explaining the higher ceiling cooling capacities for overhead. The cooling limits to ceiling system capacities are controlling surface temperatures above room dewpoint to avoid sweating. Cooling mode for radiant floors in direct sunlight can be 2.5 to 3 times the capacity listed above due to the floor acting as a solar sponge also making it highly effective in daylit atria spaces. Typical radiant floor as installed in a similar application, the University of Calgary EEEL project is shown below:

Radiant slab systems can provide heating duty but in spaces with highly variable loads, radiant heated slabs can be slow to respond. Radiant panels both in cooling and heating mode can provide quick response to space load changes. Radiant slab systems provide a self regulating capacity, idling at low load and absorbing loads as required up to their design loads as the loads “appear” in the space.

Radiant slabs can be developed into a concept known as a Thermally Active Building Systems (TABS). Developing the building with high thermal mass, radiant slabs can be “charged” at night using more favourable cool night conditions, this enables the space conditioning systems to be downsized and also take advantage of charged thermal slabs to allow the spaces to flywheel through the next day’s loads with reduced energy use. Kelowna’s high diurnal temperature swings and the building’s primary daytime use patterns are ideal for implementing this concept. Self learning night time purge algorithms will be necessary to fine tune this concept during the first year of occupancy. A balance of slab charging and stopping short of overcooling the space for early morning conditions is the largest challenge for effective use of the system but the technologies and control sequences are well established.

It is proposed that the base mechanical concept for the project be ventilation using a 100% outdoor air system, primarily delivered by displacement techniques, augmented with radiant cooling/heating as required. There are several types of spaces characterized by their individual load and use patterns. Based on preliminary cooling load calculations the following configurations are proposed.

Ventilation

Air Supply – General Description

Ventilation systems will provide adequate ventilation air to meet minimum air changes required by ASHRAE 62.1. The intent is to reduce airflow to unoccupied or lightly occupied spaces from the minimum ventilation volumes by utilizing carbon dioxide demand control. For example, baggage hall areas are lightly occupied most of the day and may be completely empty at night. The carbon dioxide sensors would provide variable volume between the area ventilation rate and the occupant ventilation rate. Occupancy sensors will be used in office spaces to reduce air volumes in unoccupied spaces.

An innovative solution for the large common areas is to decouple the ventilation and cooling loads by the use of Displacement Ventilation and Chilled Slabs. Displacement Ventilation provides supply airflow at a low level at a higher temperature. This provides several advantages for the Airport as follows:

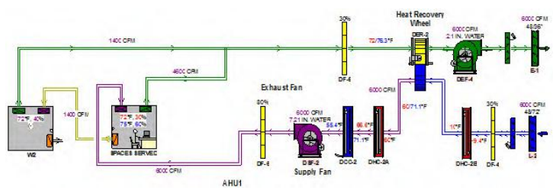
- Improved ventilation effectiveness in open areas. Air is supplied at low level and contaminants are directed upwards towards return/exhaust grilles.
- Provision of higher temperature supply air, minimizing reheat and maximizing free-cooling capabilities from the air handling units. Free-cooling hours are extended by approximately 1000 hours/year.
- More effective cooling at higher supply air temperatures. The rooms can be effectively cooled with minimal cooling energy.
- Fan power relatively lower than conventional systems
- System compatible with lower grade cooling sources such as geothermal heat pumps, allowing higher chilled water supply water temperatures.

Displacement is the favoured choice to ventilate the majority of the large open spaces, which is the primary space type for the expansion. Displacement ventilation is well adapted to being coupled with a room based sensible cooing system for high load spaces. This would allow the air supply system to be 100% outdoor air and simplify the building systems by avoiding an extensive return air duct systems such as required for VAV systems. Typical displacement diffusers are shown below, but custom made solutions can also be utilized for low velocity air supply.

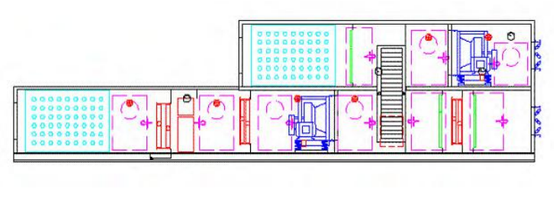
Air Supply Equipment

Air handling units will be indoor units supplied with glycol heating coils and chilled water cooling coils. Vertical duct shafts will facilitate ducted supply, return and exhaust air to the floors. Typical air supply units will be custom construction with 100 mm insulated walls, multiple split sections, and configurations to suite the mechanical room requirements.

- AHU-1 – PIL/International Bag Claim: The air handler for the PIL/International Bag Claim area will be a 2830 l/s, variable volume, 100% outside air complete with supply and exhaust fans, glycol cooling coil, glycol heating coils, heat recovery wheel, and with Dynamic air filtration. The air handling unit will be zoned to allow demand reduction based on carbon dioxide sensors. Low pressure ductwork will supply low wall mounted displacement diffusers or custom diffusers integrated with architectural features such as ticket booths, thermal mass walls, and baggage carousels. Return fans on the units will in fact be exhaust fans as all return air will be exhausted after heat recovery. The heat wheels will provide both sensible and latent recovery, which will save substantial heating energy and provide some humidification in the winter.
- AHU-2 – Domestic Bag Claim: The air handler for the Domestic Bag Claim area will be a 5660 l/s, variable volume, 100% outside air complete with supply and exhaust fans, glycol cooling coil, glycol heating coils, heat recovery wheel, and with Dynamic air filtration. The air handling unit will be zoned to allow demand reduction based on carbon dioxide sensors. Low pressure ductwork will supply low wall mounted displacement diffusers or custom diffusers integrated with architectural features such as ticket booths, thermal mass walls, and baggage carousels. Return fans on the units will in fact be exhaust fans as all return air will be exhausted after heat recovery. The heat wheels will provide both sensible and latent recovery, which will save substantial heating energy and provide some humidification in the winter. A typical schematic air handling layout with heat wheel for the CBSA PIL/International Bag Claim is shown below:



The air handling unit physical configuration is as shown below:



Air Distribution

Air distribution will be provided through medium pressure ductwork to VAV boxes and low pressure ductwork to displacement diffusers. Outdoor air will be distributed to the inlet of fan coils and chilled beams where utilized in retail and smaller high load spaces.

Exhaust Systems

Exhaust from individual washrooms and common spaces in the will be ducted back to central locations adjacent to the roof mounted air handlers where it will be directed through heat recovery wheels prior to discharging to the outside. Remote washrooms which will be difficult to return back to the air handling unit will be individually exhausted.

CONTROLS

General

The control system for the new YLW Kelowna Airport Expansion will be a full direct digital control (DDC) system capable of monitoring all equipment, providing remote dial-out, and capable of energy saving scheduling and setback sequences. All control valves and damper actuators will be low voltage electric units to avoid the requirement for an air compressor. The new DDC will be BACNet compatible to allow communication with the existing Airport Base Building control system. The intent is to provide a coordinated control system operable from a single operator work station.

The control system will be provided with an operator's workstation complete with intuitive operator graphics to allow ease of operation of the systems. The control system will provide full PID control of each system which will be tuned during the commissioning process. The control system will also have trending and energy management capabilities to ensure energy use is monitored.

FIRE PROTECTION AND LIFE SAFETY PROTECTION

Fire Protection

The facility will be fully sprinklered throughout with exposed sprinkler heads in common areas. Fire extinguishers will be located in flush mounted cabinets located at exits and intermediate locations where required.

SUSTAINABILITY CONSIDERATIONS

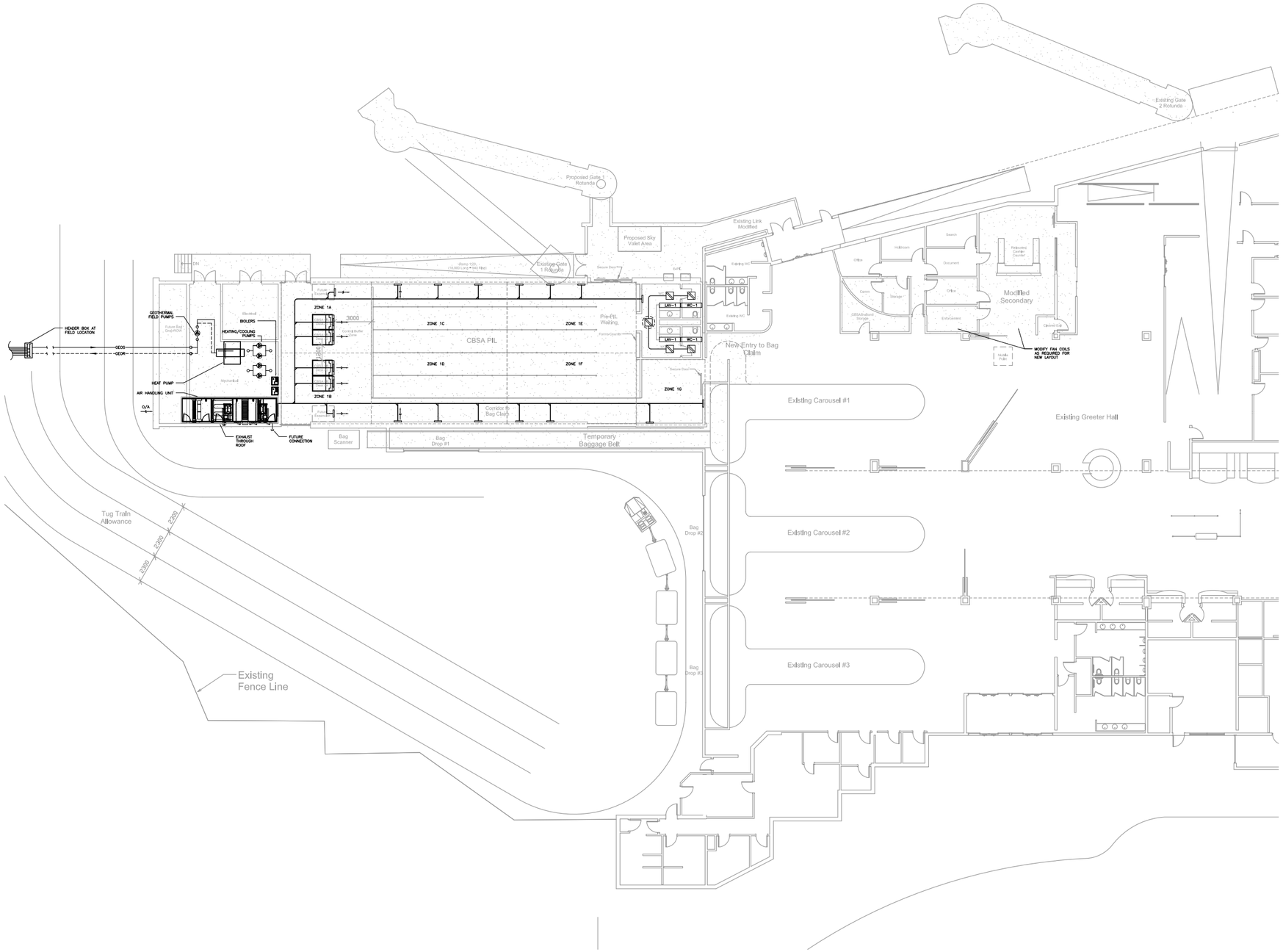
Mechanical Sustainable initiatives for this facility to meet City of Kelowna and YLW goals are as follows:

- Incorporation of total energy heat recovery wheels on the air handling systems.
- Ground Source Geothermal Heat Pumps
- Central water cooled chillers.
- Low flow plumbing fixtures
- High efficiency condensing boilers
- Cooling and Heating slabs located in large open areas.
- Variable speed drives on all variable hydronic loops.
- Occupancy sensors in variable occupancy rooms.
- Reduced air flow volumes in unoccupied times.
- Displacement ventilation to provide better ventilation effectiveness and provide extended free-cooling hours.
- Use of thermal mass and night purge cycles in the large open areas such as baggage claim areas and holding areas.

DRAWINGS

Mechanical Drawings

Preliminary mechanical drawings provide general layout information, mechanical room layouts, and general routing of mechanical services.



1 MAIN FLOOR NORTH VENTILATION PLAN
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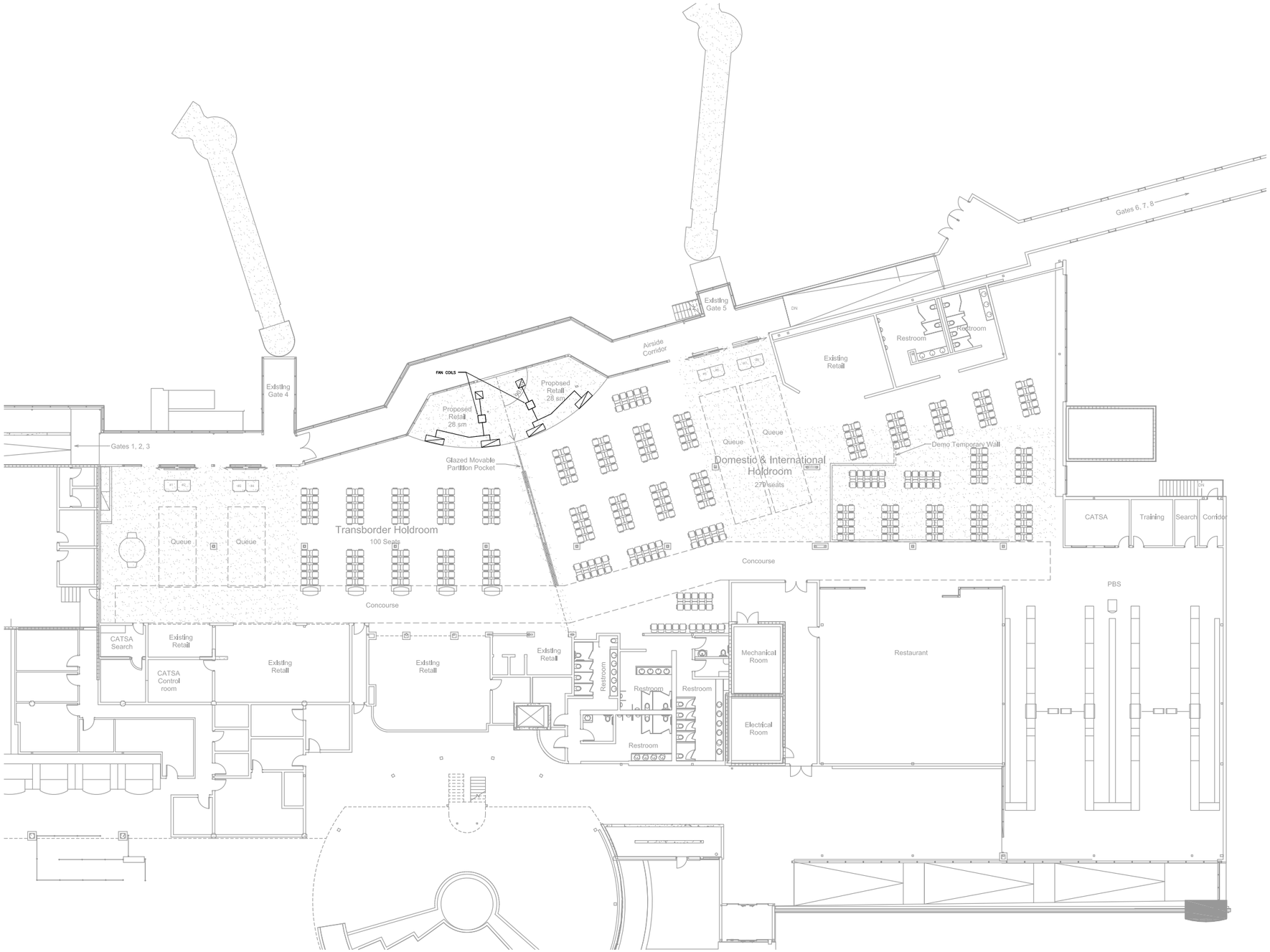

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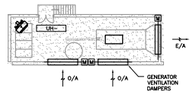

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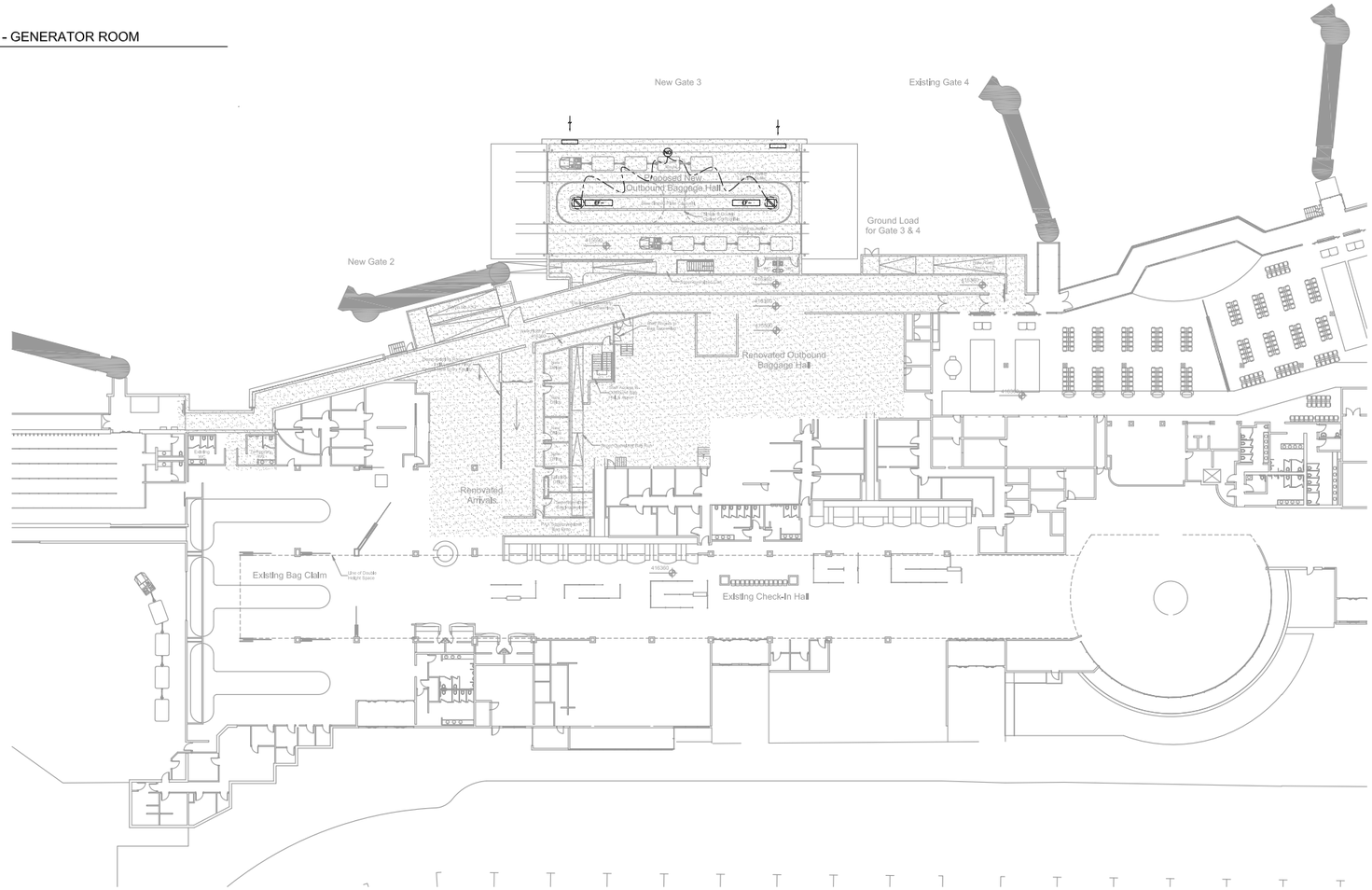

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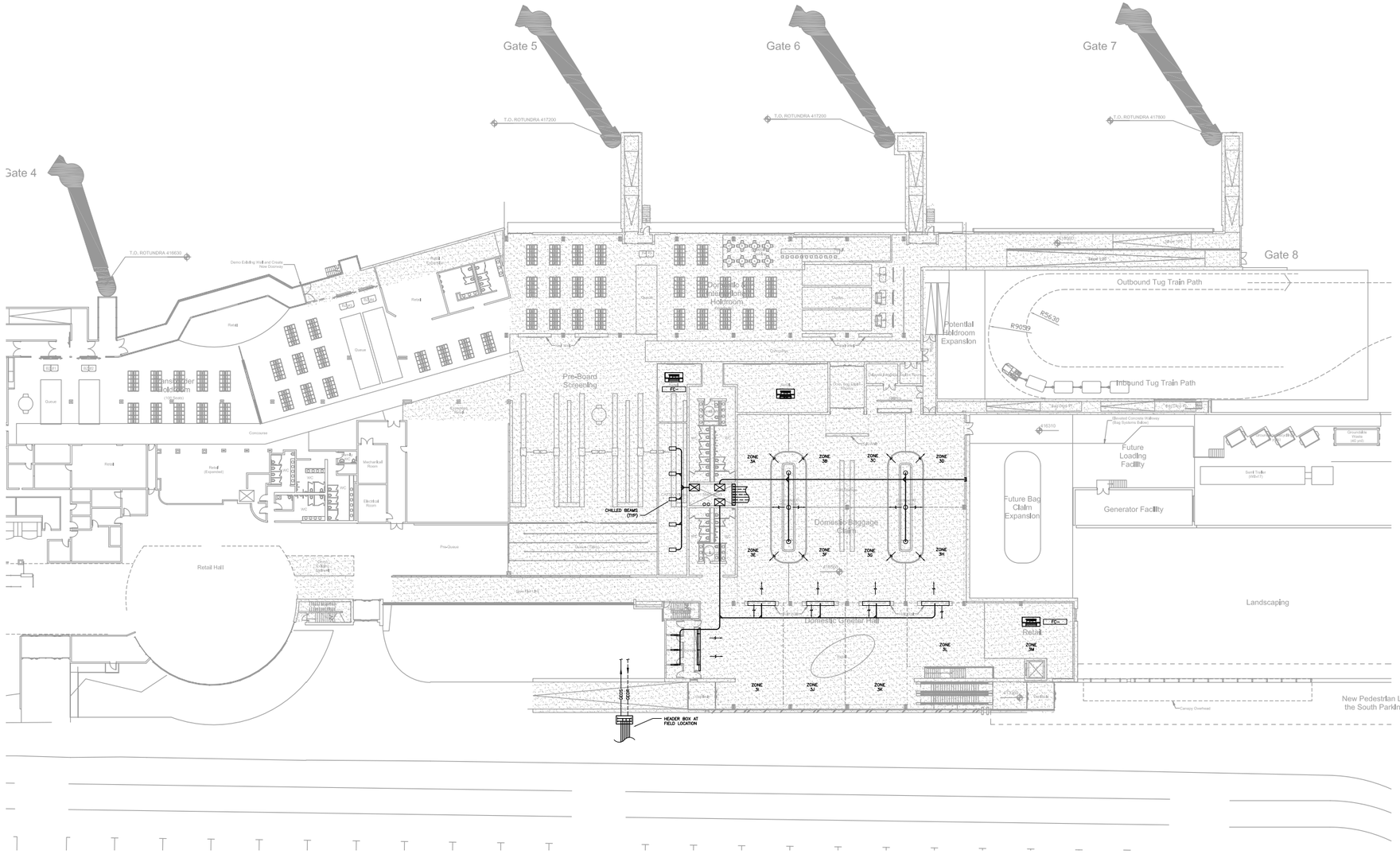

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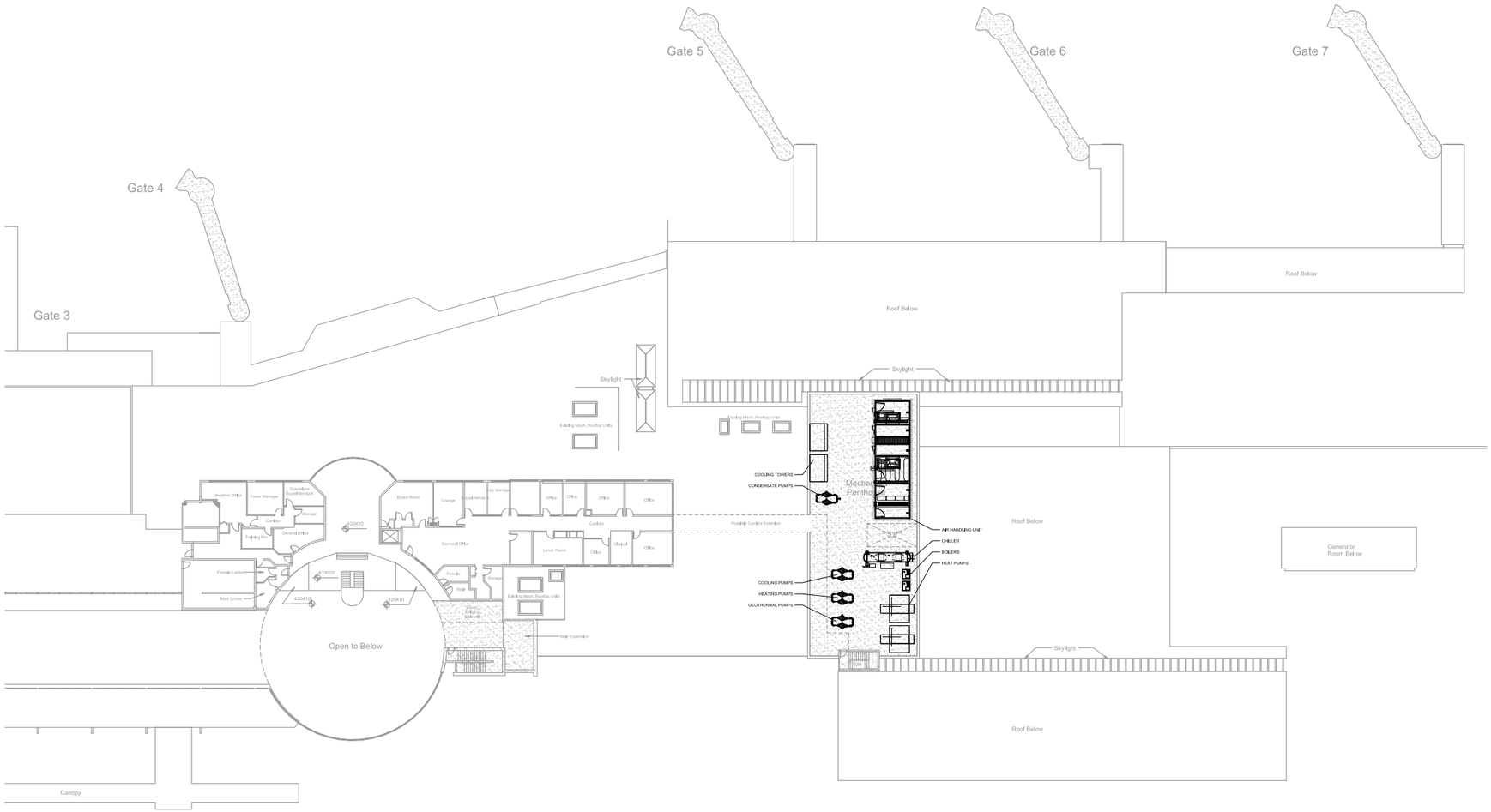

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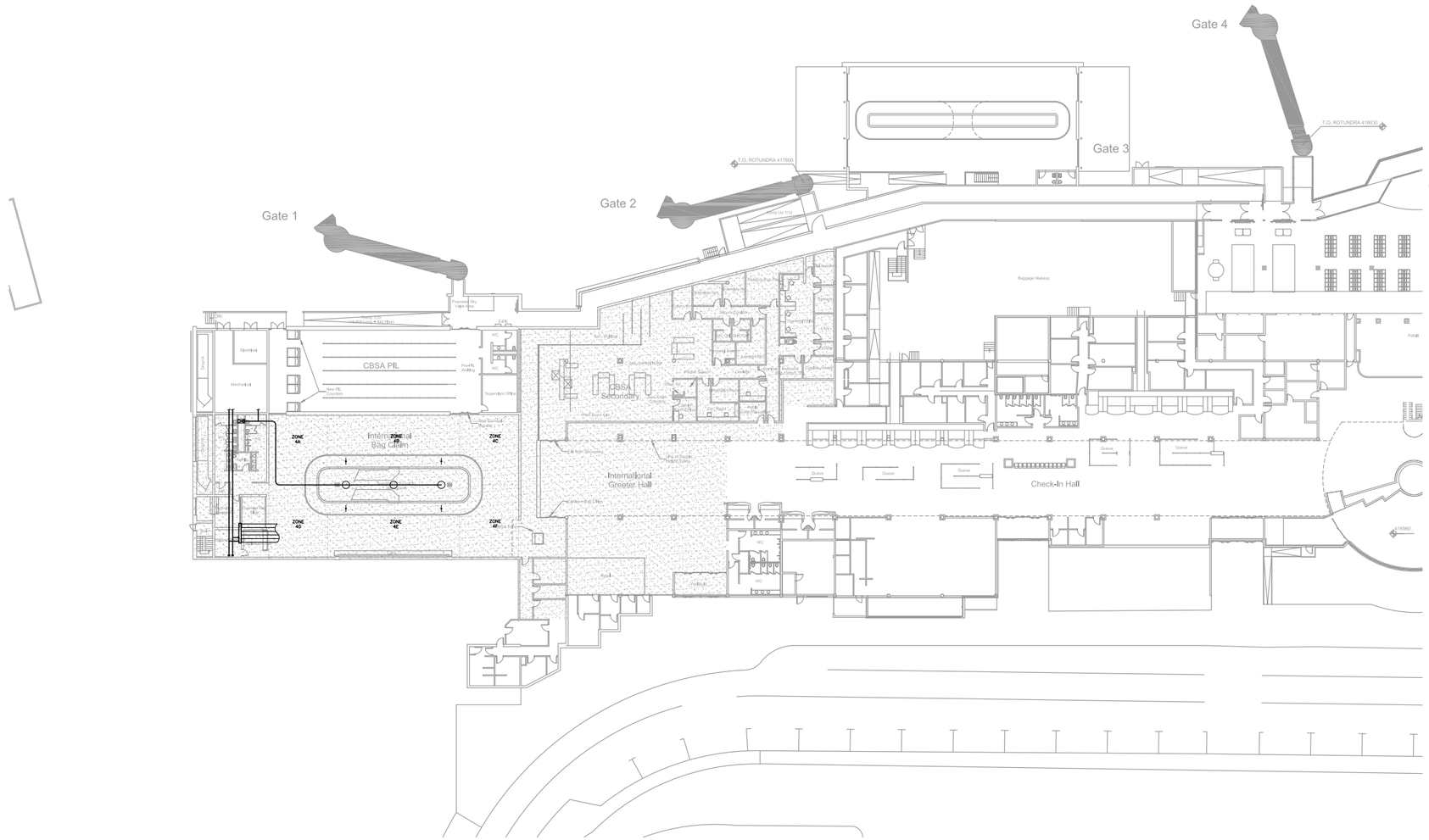

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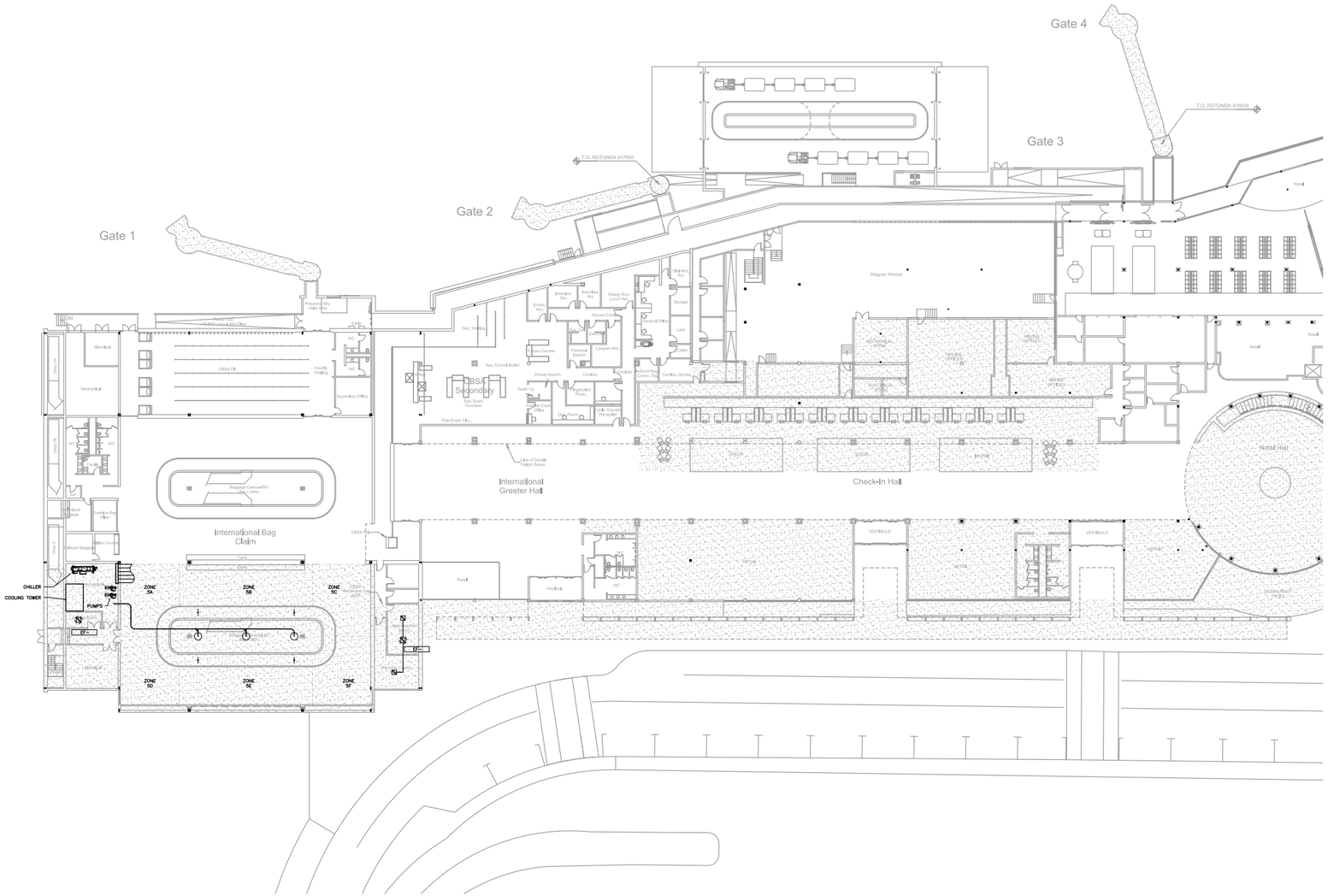

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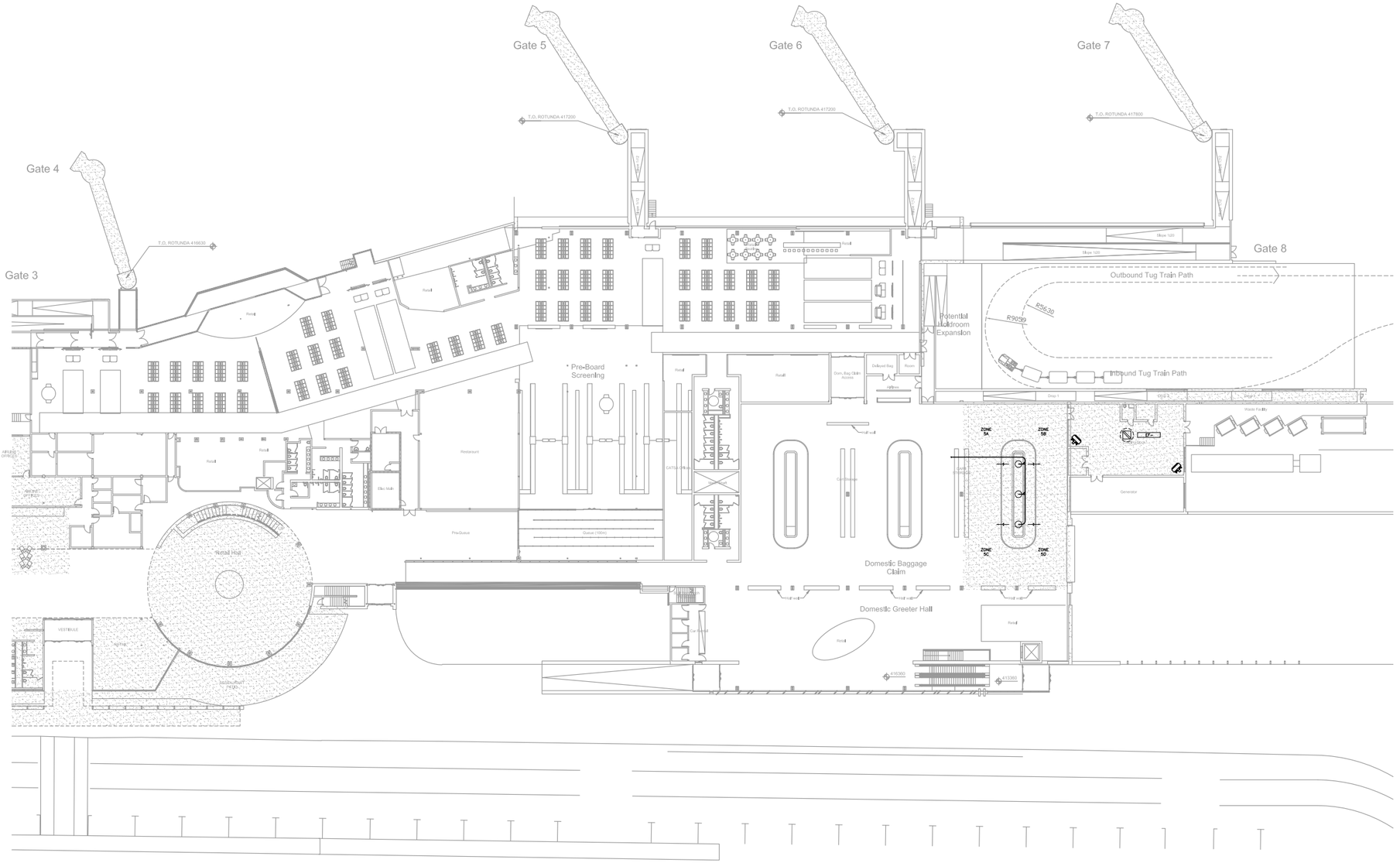


1 MAIN FLOOR SOUTH - VENTILATION PLAN
1 : 200

9.0 ELECTRICAL SYSTEMS

INTRODUCTION

This report outlines the early design strategies for power distribution, lighting, fire alarm, communication and security systems at the Kelowna Airport Terminal Building (ATB). The general design philosophy is to provide higher electricity system reliability, superior lighting, future proofing with an extensible data network, sustainability through “right-sizing” and a high degree of maintainability. Consistency in lighting design, lighting control, fire alarm safety and security will be achieved between new and renovated spaces. After review by the Kelowna Airport and the City of Kelowna, this report is intended to form the basis for the further development of the detailed design.

PERFORMANCE CRITERIA

The design will use current technology while giving due consideration to safety, ease of maintenance, energy efficiency, and cost. The electrical design will utilize affordable sustainability criterion where they can be applied to lower the carbon footprint of the project, enhance maintainability and improve the experiences of both the traveling public and staff. The equipment, light fixtures, and other electrical components specified will be based on readily available, standardized products.

Codes and Regulations

- The design for the Kelowna Airport renovation and expansion will be in accordance with the British Columbia and National Building Codes. In addition, illumination level requirements for the interior will be comply with IESNA and IATA recommended practices.
- Security systems will be designed in accordance with CATSA, CBSA and Airport Authority requirements.
- Fire Alarm systems will be designed in accordance with the Building Code and will be verified to CAN/ULC-S537 (Verification of Fire Alarm Systems) standards.

DESIGN CONDITIONS AND PHASING

Design Goals

The following design goals will be incorporated into electrical systems designs for the ATB:

- Provide emergency power to all ATB operations.
- Reduce energy consumption from lighting substantially. The amount of power savings that can be achieved have been documented in the Dialog Energy Audit report.
- Minimize electrical system disruptions and shutdowns. Airport operations must be maintained during air operations hours.
- Integrate the quality and sustainability of electrical options chosen for new construction into renovated areas. There should be no jarring changes in lighting, control, safety systems or power availability between similar functional areas in the ATB at the conclusion of the project. Lighting systems upgrades in areas not directly affected by construction as outlined in phases 1 - 4 will be under a separate contract.
- Improve the operational safety of the fire alarm system and ensure that the quality of devices, wiring and annunciation is uniformly high throughout the ATB. All older fire alarm systems will be replaced.

Phasing

The ATB expansion and renovation will be accomplished in 5 phases. The first 4 phases form the basis of design through to the year 2016. A fifth phase which would encompass planning through to 2025 is included in order to provide context.

Phasing diagrams, with notes, have been provided as sketches in an addendum with this electrical report. They immediately follow the report text.

From an electrical standpoint, key phasing milestones are as follows:

Phase 1

- All new, lower power lighting in new construction areas with new power, fire alarm and comms to suit the PIL requirements.
- Installation of a 1600 A cable bus from the new north electrical room to the south main electrical room. A temporary connection of the cable bus to the south main switchgear will be required.
- Undertake re-lamping, mock-ups and re-fixturing on north side of ATB to improve lighting efficiency. (Under separate contract)
- Stub out and cap a duct bank suitable for a 1600 A load from the new north electrical room to an area at least 2 meters north of the future ATB northern extents.
- Renovate lighting in domestic and international hold rooms.
- Upgrade fire alarm system with all new 2 stage, addressable system suitable for use on the full 2025 area of the ATB. Replace all old fire alarm wiring with new. Replace all analog devices with addressable devices.

Phase 2

- New 1500 KVA generator and transfer switch installed in dedicated structure.
- New 1500 KVA transformer installed to replace existing transformer
- New duct banks from new transformer to transfer switch and from transfer switch to south main electrical room
- Provide power and service to suit the new Baggage Facility from the north electrical room. Risks in building the Baggage Facility include unforeseen relocation or replacement costs for underground conduit and services that may be running through or adjacent to the new facility's footprint. Provide new Fire Alarm devices as required.
- Provide new fixturing and control strategies for lighting in the main concourse area (under separate contract).

PHASE 3

- Expand the south main electrical room to allow for relocation of telecommunications services, improve equipment access and maintainability, make room for new gear. Make permanent connection to the 1600 A cable bus.
- Provide power, lighting, comms, fire alarm for the new ATB expansion.

PHASE 4

- All new, lower power lighting in new construction areas with new power, fire alarm and comms to suit the PIL requirements.

PHASE 5

- Abandon and relocate old northwest electrical room to north electrical room to make way for new retail space.
- Add second transformer at north end along with new emergency power to allow for bridge PCA and power pack improvements. Re-balance power loading of transformers in the system. Make improvements to allow for bi-directional power transfer in ATB.

▸ SYSTEMS

Utility Supply

The ATB is currently powered from a single 1000 KVA transformer. Distribution voltage is 600 V. Average peak demand in a month is approximately 750 KVA however it can peak in the 830 KVA range during hot months and be in the 600 KVA range in off-peak months. The actual operating demand of the ATB is in the 300-500 KVA range, depending on air-side operations intensity (ie: time of day) and the time of year.

The ATB main breaker is rated at 1200 A, while the main switchgear is 1600 A rated. By phase 2, we plan to replace the main breaker with a 100% rated, 1600 A unit. This will coincide with the installation of a new 1500 KVA transformer and generator.

Late phase 1 power demand will increase load by about 100 to 150 A. Some of this demand will be offset by energy saving measures for lighting and power usage in the existing ATB space. Demand at the new baggage hall will increase power use by the end of phase 2 but this will be offset by the increased capacity of the main service.

Emergency Power

The electrical systems will feature improvements to the emergency power capacity of the ATB. This will be achieved by way of an emergency generator upgrade. The goal of the upgrade is to ensure that most equipment or Utility supply failures will not cause a sustained interruption to any ATB operations. This would include; adversely affecting the processing of arriving or departing passengers, baggage flow or arrivals and departures of aircraft from the gates.

To effect a whole ATB back-up, a new 1500 KVA generator complete with transfer switch will be installed in a purpose built building during phase 2. By phase 5, the generator building will be incorporated into the ATB expansion at the south end of the building. As part of the emergency power upgrade, the existing, end-of-life 75 KW generator that supplies emergency power for the air field lighting will be removed from service. The 125 KW generator that provides emergency power to the ATB will be re-tasked to provide air field emergency power.

There is a cost and installation risk attendant with the upgrading of the emergency power system. CEC Rule 46-108(4) requires that conductors associated with life safety systems and exit signs shall be kept entirely independent of all other conductors. This is probably not the case at the ATB given the age of the building. We would seek an advance ruling from the electrical inspection authority in advance of construction on phase 2. If the Code rule is applied literally and no grandfathering of existing systems is allowed, considerable conduit re-work and re-wiring would be required along with a second transfer switch to fulfill the requirements of the Rule.

Power

Switchgear and Distribution

A key challenge of early expansion is to provide power to the phase 1 Primary Inspection Line (PIL) addition for CBSA. None of the existing electrical rooms have adequate permanent capacity or available space to power a new north end addition. We propose the installation of a 1600 A cable bus between a new north end electrical room and the south main electrical room. As well as providing a new power feed to the north end, this cable bus will serve as a power backbone between the newer, and much longer, ATB that will exist after phase 3.

The cable bus backbone can be used to route power during unusual emergency situations. For instance, in the event of generator maintenance or failure, a temporary truck-mounted generator could be situated on the north side of the ATB and back-feed the ATB through the north electrical room. By phase 5, this cable bus becomes a key pathway for bi-directional load-sharing and shifting. An additional transformer can be added to the ATB and load could then be added from new PCA and power pack units.

Sub-Distribution

All building wiring, unless noted otherwise, will be 98% conductivity copper with minimum 600 volt insulation. Branch circuit wiring will use #12 AWG as the minimum size conductor. Wiring for receptacles will have a dedicated neutral and ground wire. Lighting circuits may utilize shared ground and neutral wires. Shared neutrals shall be minimum #10 AWG. Ground wires shall be minimum #12 AWG.

All wiring will be installed in conduit or cable tray. Electrical metallic tubing (EMT) will be used for the majority of conduit in the building. Empty conduit will have pull cables installed to facilitate future cable installations. Where cable trays and conduit pass through floors and fire-rated walls, they will be sleeved and fire-stopped.

Typically, power utilization will be as follows:

Fluorescent Lighting	347 volts
HID Lighting	347 volts
Convenience receptacles	120 volts
Motorized loads up to and including .37 kW (½ hp)	120 volts
3 Phase motorized loads greater than .37 kW (½ hp)	600 volts

Duplex receptacles will be commercial, specification grade, complete with lamicoid nametags indicating the circuit and panel number. Where possible, data, voice and power receptacles will be housed in a single, multi-device housing.

Connections for Mechanical Equipment

Motor control centers (MCCs) will be provided for the majority of mechanical equipment, complete with starters (where not integral to the equipment). Small motors (½ hp and less) will generally operate on single-Phase 120-volt power, with larger motors operating on three-Phase, 600 V power. In cases of large motor loads not controlled with variable frequency drives (VFDs), power factor correction capacitors will be incorporated.

Starters in the MCC will generally be combination starters, complete with a molded case circuit breaker, a contactor with an adjustable overload relay and single-Phase protection, holding coil, LED pilot light, HOA switch, and two normally open and one normally closed auxiliary holding contacts. Where VFDs are specified the MCC will house a molded case circuit breaker for the device, along with overload protection. Variable frequency drives will be fitted with iron core reactors where larger motor size current harmonics could impact voltage bus stability.

Hand-wash and sanitary fixtures that utilize infra-red sensing will be hardwired.

Grounding

A complete building grounding and bonding network will be provided derived from Earth Ground Electrodes as per the CEC and the requirements of the local electrical inspection authority.

Copper ground busses mounted on insulated stand-offs will be provided in each electrical closet/room and beside all voice/data patch panel racks.

Pre-Conditioned Air and 400 Hz Power

Aircraft pre-conditioned air (PCS) and 400 Hz power are currently provided from portable diesel powered units on the apron. This strategy will continue through the 2016 expansion. Peak power needed to provide stand-by PCA and power to a full complement of aircraft at the gates from bridge attached units could be in the range of an additional 400-600 KW. This would require the installation of much larger transformer during the phase 2 build (with attendant replacement of the main switchgear) or the installation of a second transformer near the north electrical room sometime during phases 2 to 4.

Dialog believes that preparing now for the staging of an additional transformer after 2016 (ie: “phase 5”) provides the most cost effective solution for expansion of the electrical system. In effect, the Phase 1-4 expansion and renovation improves internal building power reliability and capacity, while Phase 5 provides additional power expansion to service future new external power requirements.

Lighting

Interior Lighting

Lighting Power Density Targets

All spaces within the ATB will be designed to meet or exceed ASHRAE 90.1. ASHRAE 90.1 compliance is a pre-requisite of the Building Code, however exceeding the ASHRAE targets will deliver significant energy and carbon emission savings.

The target lighting average power density (LPD) is approximately 0.9 watts per square foot. Areas requiring hire visual acuity will require significantly hire lighting power but these will be offset by lower power requirements in hallways and infrequently occupied areas. In general the LPD's will be 0.6 w/ft2 for back of house or service locations, 0.6 w/ft2 for concourse areas, 0.9 w/ft2 for offices and lobbies, 1.2 w/ft2 for retail areas. The current lighting power density at the Kelowna ATB is 1.31 w/ft2; so the target LPD represents a 31.3% improvement in operational efficiency.

Lighting Strategies

Lighting strategies for typical areas of the ATB are described in the following sections. To provide an idea of the type of fixtures that can be used, a number of lighting fixture cut-sheets have been provided as an appendix to this report. Consider these fixtures as "suggested" or "typical" for the basis of design.

Mid to Lower Ceiling Lighting

Lighting in mid to lower ceiling areas will utilize suspended T5 fluorescent with Acrylic Lenses or recessed T5 troffer lighting depending on the ceiling treatment and height. T5's represent a superior feature over basic T8 lighting. Suspended fixtures will help to provide a more amenable space by utilizing indirect/direct lighting.

Daylight will be harvested using photocell devices to turn off as many luminaires in an area as possible. Photocells coupled with occupancy sensors will ensure that small space lighting is off while unoccupied.

Office and Administrative Areas

Offices, and Administrative Areas will use T5 fluorescent deep cell parabolic luminaires to control display glare. These spaces will be controlled by occupancy sensors to ensure energy conservation and by photocell where practical to harvest daylight. Illuminance levels for these spaces are targeted at 400 lux in agreement with IES levels. Provision to boost lighting levels in these spaces to 500 lux can be accommodated with the existing lighting concept.

High Bay Service Spaces

High Bay areas will use T5 High Output Fluorescent (T5HO) High Bay luminaires. These luminaires will feature clear polycarbonate sealed lenses to improve luminaire efficiency and mitigate lumen depreciation while protecting the lamps.

Central Corridors, Rotunda and Concourse Areas

The concourse and feature common areas will use T5 recessed and pendant fluorescent luminaires depending on ceiling treatments. Wall mounted linear fluorescent fixtures will be used along spaces where there is no ceiling to reduce the need for ceiling suspended high bay fixtures. Interior Light Poles may be provided in vaulted spaces to project light further into the space and provide indirect/direct lighting for aesthetic qualities. Lighting will be controlled to harvest available daylight where possible.

Exterior Lighting

Architectural details will be lit as is appropriate for the application and will be determined as the design progresses. Security lighting will be located as required in consultation with the Airport.

Exterior lighting should be controlled using a combination of daylight sensors and timers. Daylight sensors will keep the lighting off during day-lit hours, while the timers can be used to schedule lights to provide a decreased light level after normal working hours. The existing external lighting control system will be audited to determine its sufficiency. Should a new system be able to require greater efficiency and low payback period, we will recommend replacing it under separate contract as part of Operations and Maintenance Improvements.

There is currently no scope in this project for major roadway, apron or parking lot lighting upgrades. No consideration to additional external lighting beyond the immediate confines of the ATB has been considered for this report.

Emergency and Exit Lighting

Emergency lighting will be mounted in key locations to provide suitable egress lighting as per the Building Code. Exit lights will be provided as required to give exit guidance in accordance with CEC requirements. Emergency and exit lighting will be powered from the emergency generator and may also include battery packs in some areas depending on the safety requirements of the illuminated area.

Sustainable Energy Options

Solar and wind generation, were investigated for their current economics. Airport operations and prevailing wind conditions are not suitable for wind generation.

Solar energy, could be installed on site but not in an economical fashion. The Dialog energy model roadmap indicates that there are better, more economical options for reducing the carbon footprint and improving the energy efficiency of the ATB.

Fire Alarm

A new microprocessor-based, addressable, monitored, annunciated detection and fire alarm system will be installed. Annunciation for this system will be installed in the current west “main” entrance. Due to the size and strategic nature of the ATB a second annunciator should be installed for increased safety. The location of this annunciator is currently planned for an entrance to the building at the north end of the ATB.

Fire alarm initiating devices such as manual pull stations, smoke detectors and heat detectors will be located where required by Code. Signaling devices will be located throughout public, support, and service areas to give alarm signals at the decibel levels required by Code. Fire alarm sprinkler flow valves and tamper switches will be connected to the fire alarm system.

All smoke doors will close on alarm. All fans on air handling units will shut down and smoke dampers will close on alarm and the sprinkler system will be monitored.

Communications

A data /security network will be expanded in the building utilizing a CAT 6 cabling system. In addition, the existing voice network will be extended utilizing the same CAT 6 cabling. The network cabling will serve as a data network for IT equipment and can be used for the security network utilizing addressable digital security cameras. Optical fiber back-bones meeting the multimode requirements of the client Agencies and the Airport will be between communications rooms and where distance is a factor in delivering high speed data. In addition:

- A 300mm wide low voltage cable tray or basket tray system will run in corridors for use with the telephone, data and other low voltage wiring. All runs from the cable tray to zone boxes or devices will be in conduit, which will minimize mechanical damage. Cross-over points will be carefully controlled to comply with EIA/TIA standards.
- The system will be full Category 6 Cabling, outlet jacks, and terminations will be provided in accordance with EIA/TIA standards. Where older cable needs to be replaced, it will be replaced with CAT 6 cable.

Security

This system will interact with the Building Automation Systems, Lighting Controls and Fire Alarm in order to provide intrusion and lock-down protection. Additional interfaces to Agency based systems will be provided where required. It is the intent of this design to migrate new security cameras to a fully digital IP-based system. The current ATB camera system is a high quality analogue system however it will become more expensive to maintain over time and will not have the expansion flexibility of a digital system. A bridge will be required from the new digital cameras to be used in the new construction to the analogue systems's back-end. This will allow the 2 systems to work as a single system.

The Airport has indicated a preference to continue utilizing Chubb security systems and components. This would maximize the investment in security devices that are currently installed in the ATB. Security design will include the Airport's preferred vendor during the next phase of design (Design Development).

Commissioning

To ensure that all electrical systems are installed as designed and are fully operational at the time of operation, a comprehensive commissioning and start-up program will be part of the construction process. The program shall insure that the electrical systems are operational at the time of take-over and that maintenance staff is fully trained in its operation.

The commissioning process will include design analysis, installation monitoring, testing and correction of deficiencies for at the following systems:

- Electrical power and distribution, including a coordination study of the newly installed service
- Emergency lighting operation, light levels and battery packs
- Lighting and switching
- Voice and data testing to Cat 6 standards, and correction of deficiencies
- Fire Alarm Verification and Inspection
- Functional testing of security and card access systems
- Integrated systems testing involving mechanical and electrical system coordination

▸ TYPICAL INTERIOR FIXTURE TYPES

Drawing List

- Electrical Phase 1A Construction Sketch
- Electrical Phase 1B Construction Sketch
- Electrical Phase 2 Construction Sketch
- Electrical Phase 3 Construction Sketch
- Electrical Phase 4 Construction Sketch
- Electrical Phase 5 Construction Sketch

FLUORESCENT

PARABOLICS

Recessed Luminaires Parabolic

Deepcel Series 2' x 4' (DPA)

3" Deep Cells • Air Handling/Static Luminaires

Lightolier Deepcel is the industry standard 3" parabolic louver troffer with features that offer value above the industry standard. Deepcel housings have a clean white interior without holes or bends. Black painted exteriors reduce heat build-up within the lamp/ballast compartment(s) for optimum lamp and ballast efficiency. 24 cell configuration meets IES RP-1 recommended (basic) criteria for VDT areas.

Features

- Only 5" deep.
- Vertical grain on louver eliminates reflected lamp image on cross baffle.
- Spring-loaded latches.
- Mitered aluminum louver flange.
- 3 lamp, 18 cell (77.7% efficient).
- 1.6 spacing to mounting height ratio.
- Snap-in ballast cover.
- Louver has polyethylene dust guard.
- Black exterior finish for cooler ballast operation.
- 24 cell louver configuration meets IES RP-1 recommended (basic) for VDT applications (3-T8 only).
- Built-in Hold-Down clip.
- 3" deep aluminum parabolic louver.
- Available in in T8, T5 and T5HO combinations.

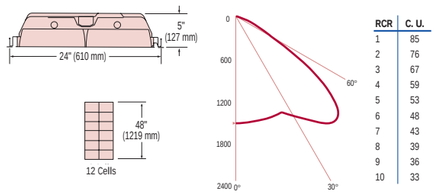
Options pages 150-156

Ballast Specify voltage (120, 277 or 347) and add suffix, e.g. 120SO.

Magnetic	Electronic	PowerSpec Dimming
T8: **OC**	T8: **SO**	T8: **PS**
	T5/T5HO: **PG**	
	3 LPB T5/T5HO: **PU**	(not avail. in 347V)
	4 LPB T5/T5HO: **PV**	

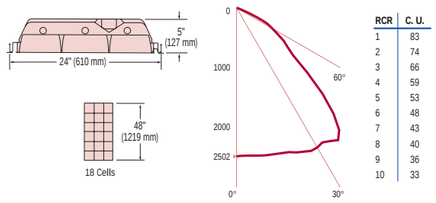
LPB : Number of lamps per ballast.
Drywall Kit For plaster frames, order Cat. No.: **FK92X4** (2' x 4').
Radio Interference Filter 120, 277 or 347 volt, 50 or 60 Hz. Suffix: **R.**
Emergency Lighting System Suffix: **O** (e.g. DPA2G12LS232120SO**O**). Emergency battery pack with charger.
(90 minutes at 15% of lumens for 1 lamp).
Louver Finish Low iridescence semi-specular is standard. Except **DPA** 24 cells : Low iridescence specular. Consult factoy for other finishes.
Air Pattern Control and Air Slot Closure For horizontal and vertical air supply and to balance return air. Suffix: **S.**
Static For static luminaires, replace **A** in the basic catalogue number by **S.**

DPA 2'x 4' — **DPA2G12LS232120SO (Data)**



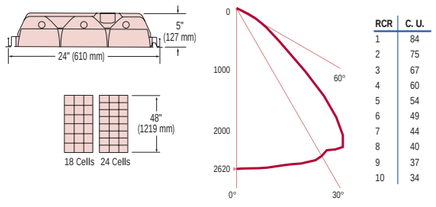
RCR	C. U.
1	85
2	76
3	67
4	59
5	53
6	48
7	43
8	39
9	36
10	33

DPA 2'x 4' — **DPA2G18LS33212003 (Data)**



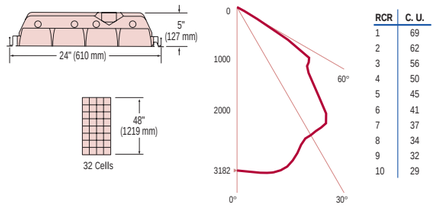
RCR	C. U.
1	83
2	74
3	66
4	59
5	53
6	48
7	43
8	40
9	36
10	33

DPA 2'x 4' — **DPA2G18LP33212003 (Data)**



RCR	C. U.
1	84
2	75
3	67
4	60
5	54
6	49
7	44
8	40
9	37
10	34

DPA 2'x 4' — **DPA2G32LS43212004 (Data)**



RCR	C. U.
1	69
2	62
3	56
4	50
5	45
6	41
7	37
8	34
9	32
10	29

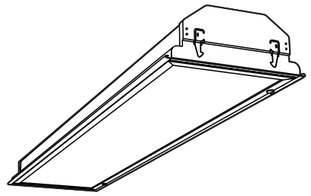
LITHONIA LIGHTING®

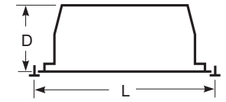
Catalog Number	
Notes	Type **A2**

Specification Premium T5 Troffer

SP5 1'X4'

1 or 2 Lamps





Specifications

Length: 48 (1218)
Width: 12 (305)
Depth: 4-1/2 (114)
Weight: 17 lbs (7.7 kg)

All dimensions are inches (millimeters) unless otherwise specified.

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

Guaranteed for one year against mechanical defects in manufacture.

Specifications subject to change without notice.

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: SP5 G 1 54T5HO A12 MVOLT GEB10PS

SP5 — Series: **SP5**

G — Trim type:
- **G Grid**
- F Overlapping flanged

1 — Number of lamps:
- **1**
- **2**
- 3

28T5 — Lamp type:
- **28T5 28W T5 (46")**
- **54T5HO 54W T5HO (46")[1]**

- — Door frame:
- (blank) **Flush steel, white**
- FN Flush aluminum, natural
- FM Flush aluminum, matte black
- FW Flush aluminum, white
- RN Regressed aluminum, natural
- RM Regressed aluminum, matte black
- RW Regressed aluminum, white

A12 — Diffuser type:
- **A12 #12 pattern acrylic, reverse apex**
- RA125 #12 pattern acrylic, reverse apex 0.125" thick
- A12125 #12 pattern acrylic 0.125" thick
- A19 #19 pattern acrylic 0.156" thick

347 — Voltage:
- **MVOLT[2]**
- 120
- 277
- 347[3]
- Others available.

GEB10PS — Ballast:
- **GEB95 0.95 ballast factor[4,6]**
- **GEB10PS 1.00 ballast factor**
- GEB95S 0.95 ballast factor, step dimming[4,6]
- **GEB115 1.15 ballast factor[4,6]**
- GEB115S 1.15 ballast factor, step dimming[4,6]

Options:
- **EL14 Emergency battery pack[5,7]**
- **GLR Internal fast-blow fuse[5]**
- **GMF Internal slow-blow fuse[5]**
- LP835 3500K
- LPM835P Premiere 3500K[6]
- LP841 4100K
- **PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires**
- PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires
- JP Palletized and stretch-wrapped without individual cartons
- CSA CSA Certified
- NOM NOM Certified

NOTES:
1 For T5HO applications use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347, use GEB95S or GEB10PS.
4 Use with 2-lamp only.
5 Must specify voltage 120 or 277.
6 Use with 28T5 only.
7 Not available with 3-lamp configurations.

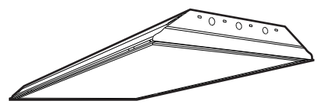
LITHONIA LIGHTING®

Catalog Number	
2SP5-G-3-28T5-A12-347-GEB10PS	
Notes	Type A3

Specification Premium T5 Troffer

SP5 2'X4'

T5 and T5HO Lamps
2, 3 or 4 Lamps



Specifications

Length: 48 (1218)
Width: 24 (609)
Depth: 3-11/16 (94)
Weight: 22 lbs (9.9 kg)

All dimensions are inches (millimeters).

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

Guaranteed for one year against mechanical defects in manufacture.

Specifications subject to change without notice.

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: 2SP5 G 2 28T5 A12 MVOLT GEB95

2SP5	G	3	28T5	-	A12	347	GEB10PS	
Series		Number of lamps		Door frame		Voltage	Ballast	Options
2SP5		**2**		(blank) **Flush steel, white**		**MVOLT**[2]	**GEB95 0.95 ballast factor**[4,5]	1/3 One three-lamp ballast (T5HO only)
		3		FN Flush aluminum, natural		120	**GEB10PS 1.00 ballast factor**	1/4 One four-lamp ballast (T5HO only)
		4		FM Flush aluminum, matte black		277	GEB95S 0.95 ballast factor, step dimming[4,5]	**EL14 Emergency battery pack**[7,9]
Trim type		Lamp type		FW Flush aluminum, white		347[3]	GEB115 1.15 ballast factor[4,5]	**GLR Internal fast-blow fuse**[7]
G Grid		**28T5 28W T5 (46")**		RN Regressed aluminum, natural		Others available.	GEB115S 1.15 ballast factor, step dimming[4,5]	**GMF Internal slow-blow fuse**[7]
F Overlapping flanged		**54T5HO 54W T5HO (46")**[1]		RM Regressed aluminum, matte black			S5 0.95 ballast factor, SIMPLY5 system[5,6]	LP835 3500K
MT Modular fit in				RW Regressed aluminum, white				LPM835P Premiere 3500K[5]
					Diffuser type			LP841 4100K
					A12 #12 pattern acrylic, reverse apex			**PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires**
					RA125 #12 pattern acrylic, .125" thick, reverse apex			PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires[8]
					A12125 #12 pattern acrylic .125" thick			JP Palletized and stretch-wrapped without individual cartons
					A19 #19 pattern acrylic .156" thick			CSA CSA Certified
								NOM NOM Certified

NOTES:
1 For T5HO applications, use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347V, use GEB95S or GEB10PS.
4 Available with two- or four-lamp configurations only.
5 28T5 lamps only.
6 SIMPLY5 system includes 13' S5 RELOC wiring system. Specify voltage unless HW (hardwire) or PWS1836 is ordered. For two-lamp 28T5 only.
7 Must specify voltage: 120V or 277V.
8 Use with GEB95S or GEB115S.
9 Not available with three- or four-lamp 28T5 configurations.

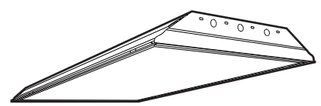
LITHONIA LIGHTING®

Catalog Number	
2SP5-G-2-28T5-A12-347-GEB10PS	
Notes	Type A4

Specification Premium T5 Troffer

SP5 2'X4'

T5 and T5HO Lamps
2, 3 or 4 Lamps



Specifications

Length: 48 (1218)
Width: 24 (609)
Depth: 3-11/16 (94)
Weight: 22 lbs (9.9 kg)

All dimensions are inches (millimeters).

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

Guaranteed for one year against mechanical defects in manufacture.

Specifications subject to change without notice.

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: 2SP5 G 2 28T5 A12 MVOLT GEB95

2SP5	G	2	28T5	-	A12	347	GEB10PS	
Series		Number of lamps		Door frame		Voltage	Ballast	Options
2SP5		**2**		(blank) **Flush steel, white**		**MVOLT**[2]	**GEB95 0.95 ballast factor**[4,5]	1/3 One three-lamp ballast (T5HO only)
		3		FN Flush aluminum, natural		120	**GEB10PS 1.00 ballast factor**	1/4 One four-lamp ballast (T5HO only)
		4		FM Flush aluminum, matte black		277	GEB95S 0.95 ballast factor, step dimming[4,5]	**EL14 Emergency battery pack**[7,9]
Trim type		Lamp type		FW Flush aluminum, white		347[3]	GEB115 1.15 ballast factor[4,5]	**GLR Internal fast-blow fuse**[7]
G Grid		**28T5 28W T5 (46")**		RN Regressed aluminum, natural		Others available.	GEB115S 1.15 ballast factor, step dimming[4,5]	**GMF Internal slow-blow fuse**[7]
F Overlapping flanged		**54T5HO 54W T5HO (46")**[1]		RM Regressed aluminum, matte black			S5 0.95 ballast factor, SIMPLY5 system[5,6]	LP835 3500K
MT Modular fit in				RW Regressed aluminum, white				LPM835P Premiere 3500K[5]
					Diffuser type			LP841 4100K
					A12 #12 pattern acrylic, reverse apex			**PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires**
					RA125 #12 pattern acrylic, .125" thick, reverse apex			PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires[8]
					A12125 #12 pattern acrylic .125" thick			JP Palletized and stretch-wrapped without individual cartons
					A19 #19 pattern acrylic .156" thick			CSA CSA Certified
								NOM NOM Certified

NOTES:
1 For T5HO applications, use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347V, use GEB95S or GEB10PS.
4 Available with two- or four-lamp configurations only.
5 28T5 lamps only.
6 SIMPLY5 system includes 13' S5 RELOC wiring system. Specify voltage unless HW (hardwire) or PWS1836 is ordered. For two-lamp 28T5 only.
7 Must specify voltage: 120V or 277V.
8 Use with GEB95S or GEB115S.
9 Not available with three- or four-lamp 28T5 configurations.

LITHONIA LIGHTING®

Catalog Number	
2SP5-G-2-28T5-A19-347-GEB10PS	
Notes	Type
	A5

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

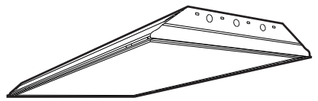
Guaranteed for one year against mechanical defects in manufacture.

Specifications subject to change without notice.

Specification Premium T5 Troffer

SP5 2'X4'

T5 and T5HO Lamps
2, 3 or 4 Lamps



Specifications

Length: 48 (1218)
Width: 24 (609)
Depth: 3-11/16 (94)
Weight: 22 lbs (9.9 kg)

All dimensions are inches (millimeters).

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: 2SP5 G 2 28T5 A12 MVOLT GEB95

2SP5	G	2	28T5	-	A19	347	GEB10PS	
Series	Trim type	Number of lamps	Lamp type	Door frame	Diffuser type	Voltage	Ballast	Options
2SP5	**G Grid** F Overlapping flanged MT Modular fit in	**2** **3** **4**	**28T5 28W T5 (46")** **54T5HO 54W T5HO (46")[1]**	(blank) **Flush steel, white** FN Flush aluminum, natural FM Flush aluminum, matte black FW Flush aluminum, white RN Regressed aluminum, natural RM Regressed aluminum, matte black RW Regressed aluminum, white	**A12 #12 pattern acrylic, reverse apex** RA125 #12 pattern acrylic, .125" thick, reverse apex A12125 #12 pattern acrylic .125" thick A19 #19 pattern acrylic .156" thick	**MVOLT[2]** 120 277 347[3] Others available.	**GEB95 0.95 ballast factor[4,5]** **GEB10PS 1.00 ballast factor** GEB95S 0.95 ballast factor, step dimming[4,5] GEB115 1.15 ballast factor[4,5] GEB115S 1.15 ballast factor, step dimming[4,5] S5 0.95 ballast factor, SIMPLY5 system[5,6]	1/3 One three-lamp ballast (T5HO only) 1/4 One four-lamp ballast (T5HO only) **EL14 Emergency battery pack[7,9]** **GLR Internal fast-blow fuse[7]** **GMF Internal slow-blow fuse[7]** LP835 3500K LPM835P Premiere 3500K[5] LP841 4100K **PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires** PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires[8] JP Palletized and stretch-wrapped without individual cartons CSA CSA Certified NOM NOM Certified

NOTES:
1 For T5HO applications, use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347V, use GEB95S or GEB10PS.
4 Available with two- or four-lamp configurations only.
5 28T5 lamps only.
6 SIMPLY5 system includes 13' S5 RELOC wiring system. Specify voltage unless HW (hardwire) or PWS1836 is ordered. For two-lamp 28T5 only.
7 Must specify voltage: 120V or 277V.
8 Use with GEB95S or GEB115S.
9 Not available with three- or four-lamp 28T5 configurations.

LITHONIA LIGHTING®

Catalog Number	
2SP5-G-2-28T5-A19-347-GEB10PS	
Notes	Type
	A5

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

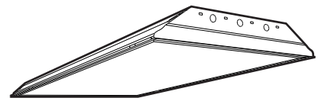
Guaranteed for one year against mechanical defects in manufacture.

Specifications subject to change without notice.

Specification Premium T5 Troffer

SP5 2'X4'

T5 and T5HO Lamps
2, 3 or 4 Lamps



Specifications

Length: 48 (1218)
Width: 24 (609)
Depth: 3-11/16 (94)
Weight: 22 lbs (9.9 kg)

All dimensions are inches (millimeters).

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: 2SP5 G 2 28T5 A12 MVOLT GEB95

2SP5	G	2	28T5	-	A19	347	GEB10PS	
Series	Trim type	Number of lamps	Lamp type	Door frame	Diffuser type	Voltage	Ballast	Options
2SP5	**G Grid** F Overlapping flanged MT Modular fit in	**2** **3** **4**	**28T5 28W T5 (46")** **54T5HO 54W T5HO (46")[1]**	(blank) **Flush steel, white** FN Flush aluminum, natural FM Flush aluminum, matte black FW Flush aluminum, white RN Regressed aluminum, natural RM Regressed aluminum, matte black RW Regressed aluminum, white	**A12 #12 pattern acrylic, reverse apex** RA125 #12 pattern acrylic, .125" thick, reverse apex A12125 #12 pattern acrylic .125" thick A19 #19 pattern acrylic .156" thick	**MVOLT[2]** 120 277 347[3] Others available.	**GEB95 0.95 ballast factor[4,5]** **GEB10PS 1.00 ballast factor** GEB95S 0.95 ballast factor, step dimming[4,5] GEB115 1.15 ballast factor[4,5] GEB115S 1.15 ballast factor, step dimming[4,5] S5 0.95 ballast factor, SIMPLY5 system[5,6]	1/3 One three-lamp ballast (T5HO only) 1/4 One four-lamp ballast (T5HO only) **EL14 Emergency battery pack[7,9]** **GLR Internal fast-blow fuse[7]** **GMF Internal slow-blow fuse[7]** LP835 3500K LPM835P Premiere 3500K[5] LP841 4100K **PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires** PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires[8] JP Palletized and stretch-wrapped without individual cartons CSA CSA Certified NOM NOM Certified

NOTES:
1 For T5HO applications, use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347V, use GEB95S or GEB10PS.
4 Available with two- or four-lamp configurations only.
5 28T5 lamps only.
6 SIMPLY5 system includes 13' S5 RELOC wiring system. Specify voltage unless HW (hardwire) or PWS1836 is ordered. For two-lamp 28T5 only.
7 Must specify voltage: 120V or 277V.
8 Use with GEB95S or GEB115S.
9 Not available with three- or four-lamp 28T5 configurations.

Fluorescent **Sheet #: SP5-2x4** STAT-230

CAPRI® C1
8" Diameter Compact Fluorescent

OPTION MATRIX

Catalogue Number & Lamp Designations	Ballast Options (choose one)				Radio Filter	Fuse	Emergency Options[3] (choose one)	
	Electronic		Dimming					
	120V-277V	347V	120V	277V			Integral	Remote
	U	**S3**	**D1**	**D2**	**RI**	**FS2**[1]	**E**[2]	**ER**
FV13 (1) CFQ13W/G24q	•				•	•	•	•
FV18 (1) CFQ18W/G24q (1) CFM18W/GX24q	•	•	•	•	•	•	•	•
FV26/32/42 (1) CFQ26W/G24q (1) CFM26W/GX24q (1) CFM32W/GX24q (1) CFM42W/GX24q	•	•			•	•	•	•
FV26 (1) CFQ26W/G24q (1) CFM26W/GX24q			•	•	•	•	•	•
FV32 (1) CFM32W/GX24q			•	•	•	•	•	•
FV42 (1) CFM42W/GX24q			•	•	•	•	•	•

[1] FS2 fuse kits are field installed (see page 574 for details). For large projects, consult factory for information on factory installation.
[2] For use with emergency trim options only.
[3] Emergency options are not available for use with sloped ceiling systems or remodel systems.

TRIMS (For finishes see pages 578-579)

Catalogue #	Description
V83	Gold Reflector
V83SL	Gold Reflector, Self-lipped
V84	Black Reflector
V84SL	Black Reflector, Self-lipped
V85	Low Iridescent Reflector
V85SL	Low Iridescent Reflector, Self-lipped
V86	White Reflector
V86SL	White Reflector, Self-lipped
V87	Wheat Reflector
V87SL	Wheat Reflector, Self-lipped
V83E	Gold Reflector, Emergency
V84E	Black Reflector, Emergency
V85E	Low Iridescent Reflector, Emergency
V86E	White Reflector, Emergency
V87E	Wheat Reflector, Emergency
V85BE	Low Iridescent Refl., Black Baffle, Emerg.
V85WBE	Low Iridescent Refl., White Baffle, Emerg.
V85BC	Black Baffle, Clear lens Insert ♦
V85BF	Black Baffle, Fresnel lens Insert ♦
V85BP	Black Baffle, C73 Prismatic lens Insert ♦
V85B	Low Iridescent Reflector, Black Baffle
V85WB	Low Iridescent Reflector, White Baffle
V85WBC	White Baffle, Clear lens Insert ♦
V85WBF	White Baffle, Fresnel lens Insert ♦
V85WBP	White Baffle, C73 Prismatic lens Insert ♦
VW83	Gold Reflector, Single Wall Wash
VWD83	Gold Reflector, Double Wall Wash
VW85	Low Iridescent Refl., Single Wall Wash
VWD85	Low Iridescent Refl., Double Wall Wash
NEW **VW87**	Wheat Reflector, Single Wall Wash
NEW **VWD87**	Wheat Reflector, Double Wall Wash
V85C	Clear Cone, Clear lens Insert ♦
V85F	Clear Cone, Fresnel lens Insert ♦
V85P	Clear Cone, C73 Prismatic lens Insert ♦
V86C	White Splay, Clear lens Insert ♦
V86F	White Splay, Fresnel lens Insert ♦
V86P	White Splay, C73 Prismatic lens Insert ♦
V85SR10	Accommodates, 5° - 15° Slope
V85SR20	Accommodates, 16° - 25° Slope
V85SR30	Accommodates, 26° - 35° Slope
V85XB	Clear Low Iridescent Cross Baffle Reflector
NEW **V85SWR**	Shower Trim ♦

To create a catalogue number

Start with the plaster frame ▼ **CM8S**

Choose an electrical system ▼ CM8S-**FV26/32/42U**

Choose a 8" trim ▼ CM8S-FV26/32/42U-**V85SR20**-CH24[4]

[4] See page 573 for bar hanger options.

♦ Denotes cUL wet location listing. Emergency trims are dry location listed only.

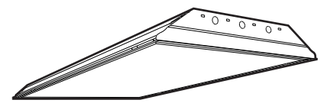
LITHONIA LIGHTING®

Catalog Number	
2SP5-G-2-28T5-A19-347-GEB10PS	
Notes	Type A8

Specification Premium T5 Troffer

SP5 2'X4'

T5 and T5HO Lamps
2, 3 or 4 Lamps



Specifications

Length: 48 (1218)
Width: 24 (609)
Depth: 3-11/16 (94)
Weight: 22 lbs (9.9 kg)

All dimensions are inches (millimeters).

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

Guaranteed for one year against mechanical defects in manufacture.
Specifications subject to change without notice.

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: 2SP5 G 2 28T5 A12 MVOLT GEB95

2SP5 G 2 28T5 - A12 347 GEB10PS

Series
2SP5

Trim type
G Grid
F Overlapping flanged
MT Modular fit in

Number of lamps
2
3
4

Lamp type
28T5 28W T5 (46")
54T5HO 54W T5HO (46")[1]

Door frame
(blank) **Flush steel, white**
FN Flush aluminum, natural
FM Flush aluminum, matte black
FW Flush aluminum, white
RN Regressed aluminum, natural
RM Regressed aluminum, matte black
RW Regressed aluminum, white

Diffuser type
A12 #12 pattern acrylic, reverse apex
RA125 #12 pattern acrylic, .125" thick, reverse apex
A12125 #12 pattern acrylic .125" thick
A19 #19 pattern acrylic .156" thick

Voltage
MVOLT[2]
120
277
347[3]
Others available.

Ballast
GEB95 0.95 ballast factor[4,5]
GEB10PS 1.00 ballast factor
GEB95S 0.95 ballast factor, step dimming[4,5]
GEB115 1.15 ballast factor[4,5]
GEB115S 1.15 ballast factor, step dimming[4,5]
S5 0.95 ballast factor, SIMPLY5 system[5,6]

Options
1/3 One three-lamp ballast (T5HO only)
1/4 One four-lamp ballast (T5HO only)
EL14 Emergency battery pack[7,9]
GLR Internal fast-blow fuse[7]
GMF Internal slow-blow fuse[7]
LP835 3500K
LPM835P Premiere 3500K[5]
LP841 4100K
PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires
PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires[9]
JP Palletized and stretch-wrapped without individual cartons
CSA CSA Certified
NOM NOM Certified

NOTES:
1 For T5HO applications, use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347V, use GEB95S or GEB10PS.
4 Available with two- or four-lamp configurations only.
5 28T5 lamps only.
6 SIMPLY5 system includes 13' S5 RELOC wiring system. Specify voltage unless HW (hardwire) or PWS1836 is ordered. For two-lamp 28T5 only.
7 Must specify voltage: 120V or 277V.
8 Use with GEB95S or GEB115S.
9 Not available with three- or four-lamp 28T5 configurations.

Fluorescent **Sheet #: SP5-2x4** STAT-230

LITHONIA LIGHTING®

Catalog Number	
SP5-G-1-28T5-A19-347-GEB10PS	
Notes	Type
	A9

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

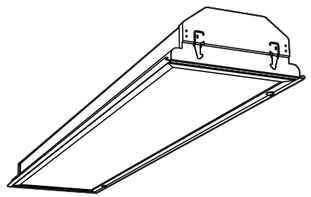
WARRANTY

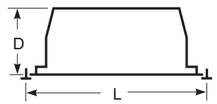
Guaranteed for one year against mechanical defects in manufacture.
Specifications subject to change without notice.

Specification Premium T5 Troffer

SP5 1'X4'

1 or 2 Lamps





Specifications

Length: 48 (1218)
Width: 12 (305)
Depth: 4-1/2 (114)
Weight: 17 lbs (7.7 kg)

All dimensions are inches (millimeters) unless otherwise specified.

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: SP5 G 1 54T5HO A12 MVOLT GEB10PS

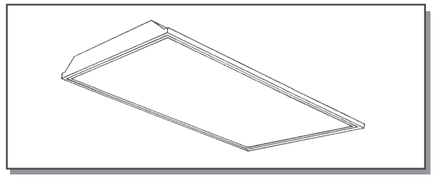
SP5	G	1	28T5	-	A12	347	GEB10PS	
Series		Number of lamps		Door frame	Diffuser type	Voltage	Ballast	Options
SP5		1		(blank) **Flush steel, white**	**A12 #12 pattern acrylic, reverse apex**	**MVOLT**[2]	**GEB95 0.95 ballast factor**[4,6]	**EL14 Emergency battery pack**[5,7]
		2		FN Flush aluminum, natural	RA125 #12 pattern acrylic, reverse apex 0.125" thick	120	**GEB10PS 1.00 ballast factor**	**GLR Internal fast-blow fuse**[5]
		3		FM Flush aluminum, matte black	A12125 #12 pattern acrylic 0.125" thick	277	GEB95S 0.95 ballast factor, step dimming[4,6]	**GMF Internal slow-blow fuse**[5]
Trim type		Lamp type		FW Flush aluminum, white	A19 #19 pattern acrylic 0.156" thick	347[3]	**GEB115 1.15 ballast factor**[4,6]	LP835 3500K
G Grid		**28T5 28W T5 (46")**		RN Regressed aluminum, natural		Others available.	GEB115S 1.15 ballast factor, step dimming[4,6]	LPM835P Premiere 3500K[6]
F Overlapping flanged		**54T5HO 54W T5HO (46")**[1]		RM Regressed aluminum, matte black				LP841 4100K
				RW Regressed aluminum, white				**PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires**
								PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires
								JP Palletized and stretch-wrapped without individual cartons
								CSA CSA Certified
								NOM NOM Certified

NOTES:
1 For T5HO applications use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347, use GEB95S or GEB10PS.
4 Use with 2-lamp only.
5 Must specify voltage 120 or 277.
6 Use with 28T5 only.
7 Not available with 3-lamp configurations.

Fluorescent **Sheet #: SP5-1x4** STAT-250

2' x 4' TG

Day-Brite® Lighting



2, 3, or 4 Lamp
T5 or T8
Prismatic Acrylic Lens

CONSTRUCTION/FINISH

- A quality low-profile troffer with specification features for NEMA "G" grid, or NEMA "F" flange ceiling types.
- 3" nominal housing depth, 3-3/16" maximum depth.
- Smooth rolled edges on all four sides for easy handling.
- Die-formed one piece housing includes stiffening embosses and provides increased rigidity.
- Housing is multi-stage phosphate treated for maximum corrosion resistance and finish coat is high reflectance baked white enamel.
- Lamp pin openings in housing ends for easier relamping (can be relamped without using openings).
- Integral baffling system to prevent light leaks.
- 2 sets of integral grid clips (wraparound and fold out) for maximum mounting flexibility.
- Integral wire hanger holes for independent wire suspension.
- Embosses with holes provided in housing end for screwing to T-bar if desired.
- On T8 models, a single lamp can be changed without disturbing other lamps or wireway cover.
- 7/8" K.O.'s provided in each end cap for through wiring.
- Factory installed access plate in housing top includes 7/8" hole with rolled edge and 7/8" K.O.

ELECTRICAL

- Class P, HPF ballasts comply with © Federal Ballast Law (Public Law 100-357,1988).
- cUL certified.
- Self-contained fluorescent emergency power packs can be incorporated.
- Rotating ring locking lampholder is standard for secure and positive retention of lamps.

ENCLOSURES

- Full "C" channel door frames for improved lens support and reduced shipping damage.
- Flat steel door frame features smooth rolled edges inside and outside.
- All door frames have mitered corners.
- All door frames use T-hinges and can be hinged and latched from either side.
- Opposable spring loaded latches are standard for easy operation and consistent retention.

CATALOG NUMBER

2				–			–		–	
WIDTH		NO. OF LAMPS			DOOR FRAME	LENS	DOOR FINISH			OPTIONS
2 – 2'		(not included)			**BLANK** – Flat Steel	**01** – Pattern 12 prismatic acrylic	**BLANK** – White Door			SI - Silverado Insert
		2			**FA** – Flat Alum.	**12** – DB-12, .125" nominal	**B** – Black Door			1/2 - One 2-lamp ballast (electronic or non-standard)
		3			**RA** – Regr. Alum.	**19** – DB-19, .156" nominal				1/3 - One 3-lamp ballast (electronic or non-standard)
		4				**21** – Pattern 12, .125" nominal				1/21- 2-lamp & 1-lamp ballasts (electronic or non-standard)
						32 – 1/2" x 1/2" x 1/2" silver louver				1/4 - One 4-lamp ballast (electronic or non-standard)
						36 – 1-1/2" x 1-1/2" x 1-1/2" silver louver				1W - 1-way gasketing, between lens & door frame
FIXTURE FAMILY		LAMP TYPE/WATTAGE						VOLTAGE		2W - 2-way gasketing, 1W + gasketing between door frame & housing
TG8 – TG8 Troffer, Grid		**28** – 28wT5 (46")						**120**		3W - 3-way gasketing, 2W + gasketing for field installation between housing & ceiling
TF8 – TG8 Troffer, Flange		**32** – 32wT8 (48")						**277**		
		54HO – 54wT5HO (46")						**347**		See section C1600-OA for other options.
								UNV – Universal voltage, 120-277		

Accessory:
FMA24 - 2' x 4' "F" mounting frame for NEMA

Job name:

Type:

C425.3-SR

189 Bullock Drive, Markham, Ontario L3P 1W4
Tel: 905-294-9570
Fax: 905-294-9811 or 1-800-268-0003
www.thomaslightingcanada.com

THOMAS LIGHTING CANADA
a Genlyte company

PINNACLE ARCHITECTURAL LIGHTING™

EDGE 4A

T5 LFL

1T5 and 2T5 RECESSED LINEAR DIRECT / Acrylic Lens

CONSTRUCTION Formed cold rolled steel housing. Highly reflective die-formed white painted steel reflector, .125" diffuse snap-in acrylic lens with matte finish, removable for lamp replacement.

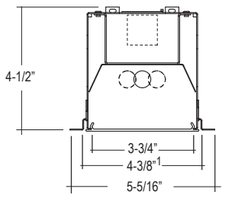
ELECTRICAL Standard programmed start UL listed Class P, T5 electronic, Sound Rated A, thermally protected, high power factor ballasts less than 10% THD, Universal voltage (120/277) with 50/60Hz operation. Through wiring with quick connects standard. Standard single circuit. Integral battery packs with remote test switch are provided with 1B and 2B options. Each ballast provided with disconnects to meet luminaire disconnect code requirement.

MOUNTING Edge is designed to install into acoustical grid and inaccessible ceilings. Specify GXG, FLF, SFS, NFN for Individual, unjoinable units (individual units will fall on-grid). Specify GX, FL, SF, NF for continuous rows (Rows fall on-grid). Consult factory for detailed installation instructions.

FINISH Standard powder-coat textured white painted finish on exposed trim, consult factory for custom colors.

LABELS UL and cUL Listed, approved for dry/damp location unless otherwise noted.

Quick Ship Product[7]



[1]Rough-in width is 4-5/8" for inacessible ceilings. Must mount through top of fixture. See installation instructions for further details. Specification Sheets should not be used for installation.

LUMINAIRE SPECIFICATION

Sample Catalog #: E4A-1T5-24'-FL-120-1C-W

E4A- 1T5__- ___'- ___- ___- __- __- ____

HOUSING

E4A- Edge 4 recessed with Acrylic Lens

LAMPS

1T5- (1) T5
1T5HO- (1) T5HO
2T5- (2) T5
2T5HO- (2) T5HO

LENGTH

Individual Units[2]

2-	2'	T5: 1 or 2-14W	T5HO: 1 or 2-24W
3-	3'	T5: 1 or 2-21W	T5HO: 1 or 2-39W
4-	4'	T5: 1 or 2-28W	T5HO: 1 or 2-54W
6-	6'	T5: 2 or 4-21W	T5HO: 2 or 4-39W
8-	8'	T5: 2 or 4-28W	T5HO: 2 or 4-54W

Continuous Runs[3]

xx'- Specify nominal overall row length in 1' increments

MOUNTING[1]

VOLTAGE

120- 120 V
277- 277 V
347- 347 V[5]
UNV- UNV[5] (120/277)

CIRCUITING

1C- Single Circuit
2C- Dual Circuit[6]
1D- Single Circuit Dimming[6]
2D- Dual Circuit Dimming[6]
1B- Single Circuit with Battery Pack[6,12]
2B- Dual Circuit with Battery[6,12]
1E- Single Circuit with Emergency Circuit[6]
2E- Dual Circuit with Emergency Circuit[6]

FINISH

W- Matte White
CC- Custom Color

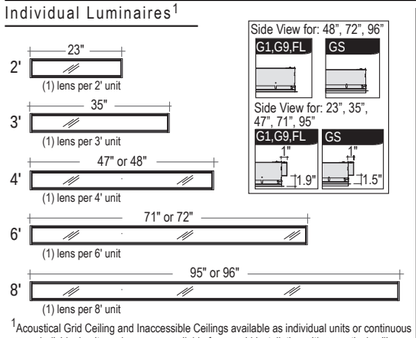
OPTIONS

QS- Quick Ship[7]
PM- Perimeter Mount[8]
RC- Rotating Crossbar[9]
M___- MR16 Lamp[10]
CP- Chicago Plenum
CL- Illuminated Connector[11]

INDIVIDUAL UNITS (CANNOT BE JOINED)[2]		CONTINUOUS RUNS (JOINABLE)[3]	
Acoustical Grid Ceiling	Inaccessible Ceiling	Acoustical Grid Ceiling	Inaccessible Ceiling
G1G- 1" Ceiling Grid	FLF- Standard 1/2" Flange	G1- 1" Ceiling Grid	FL- Standard 1/2" Flange
G9G- 9/16" Ceiling Grid	SFS- Spackle Flange	G9- 9/16" Ceiling Grid	SF- Spackle Flange
GSG- Screw Slot Ceiling Grid	NFN- Flangeless[4]	GS- Screw Slot Ceiling Grid	NF- Flangeless[4]

[1]See below for mounting detail. Consult factory for tegular edged tiles.
[2]Individual units cannot be joined. All end trims are factory installed and cannot be removed in the field. Individual fixtures designed to fall on-grid.
[3]Continuous runs are designed to fall on-grid with acoustical grid ceilings.
[4]NF and NFN to be utilized for metal pan / millwork ceiling.
[5]347 volt and UNV not available with MR16 and battery packs.
[6]Some Edge configurations will not accommodate all electrical options. Consult factory.
[7]Includes 4 ft individual unjoinable units, G1G, FLF mounts, Universal voltage, std white finish, single and dual circuit.
[8]Available for acoustical grid ceilings. Wall rail painted white unless otherwise specified.
[9]1/2" to 5/8" drywall thickness. Available for standard 1/2" flange (FL).
[10]See back page for Layout and Ordering Information.
[11]Add CL to all fixture types involved in the connector layout. See back page for additional information.
[12]Integral battery packs with remote test switch are provided with 1B and 2B options.

Individual Luminaires[1]

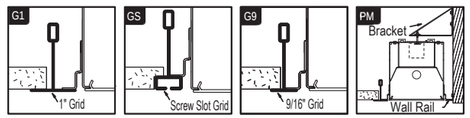


[1]Acoustical Grid Ceiling and Inaccessible Ceilings available as individual units or continuous rows. Individual units and rows are available for on-grid installation with acoustical ceilings.

Mounting Detail

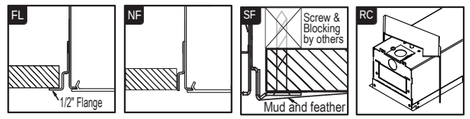
Acoustical Grid Ceiling Options

1" Grid Lay-In (G1), Screw Slot Grid Lay-In (GS), 9/16" Grid Lay-In (G9), Perimeter Mount (PM)



Inaccessible Ceiling Options

Flanged (FL), Flangeless (NF), Spackle Flange (SF), Rotating Crossbar (RC)



PINNACLE ARCHITECTURAL LIGHTING™ 12655 East 42nd Avenue, Suite 50 Denver, Colorado 80239 Ph 303.322.5570 Fax 303.322.5568 www.pinnacle-ltg.com
December 2009
Specifications and dimensions subject to change without notice. Specification sheets that appear on pinnacle-ltg.com are the most recent version and supersede all other previous printed or electronic versions.

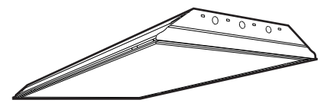
LITHONIA LIGHTING®

Catalog Number	
2SP5-G-2-28T5-A12-347-GEB10PS	
Notes	Type
	A4

Specification Premium T5 Troffer

SP5 2'X4'

T5 and T5HO Lamps
2, 3 or 4 Lamps



Specifications

Length: 48 (1218)
Width: 24 (609)
Depth: 3-11/16 (94)
Weight: 22 lbs (9.9 kg)

All dimensions are inches (millimeters).

FEATURES & SPECIFICATIONS

INTENDED USE

Specification premium, high performance, static T5 luminaires provide general illumination for recessed applications; ideal for restricted plenum spaces.

ATTRIBUTES

Designed specifically for use with high-efficiency T5 lamps, electronic ballasts and rotary sockets.

CONSTRUCTION

Smooth hemmed sides and smooth, inward formed end flanges for easy handling. Lighter weight fixture allows safe, easy installation.

Standard steel door frame has superior structural integrity with premium extruded appearance and precision flush mitered corners. Steel door allows easy lens replacement without frame disassembly (for lenses up to .156" thick). Powder-painted, steel latches provide easy, secure door closure.

Superior mechanical light seal requires no foam gasketing. Integral T-bar clips secure fixture to T-bar system. Housing formed from cold-rolled steel. Acrylic shielding material 100% UV stabilized. No asbestos is used in this product.

US PATENTS: 6,210,025; 6,231,213; 6,213,625; 2,288,471.

FINISH

Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with highly reflective matte white enamel.

OPTICAL

A12 lens features reverse apex technology for superior lamp obscuration and improved visual comfort.

ELECTRICAL SYSTEM

Standard ballast is electronic programmed rapid start, thermally protected, resetting, Class P, HPF, non-PCB, UL Listed, CSA certified ballast, universal voltage and sound rated A.

Luminaire is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

Standard: UL. Optional: Canada — CSA or cUL; Mexico — NOM.

WARRANTY

Guaranteed for one year against mechanical defects in manufacture.

Specifications subject to change without notice.

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: 2SP5 G 2 28T5 A12 MVOLT GEB95

Series

2SP5

Trim type

G Grid
F Overlapping flanged
MT Modular fit in

Number of lamps

2
3
4

Lamp type

28T5 28W T5 (46")
54T5HO 54W T5HO (46")[1]

Door frame

(blank) **Flush steel, white**
FN Flush aluminum, natural
FM Flush aluminum, matte black
FW Flush aluminum, white
RN Regressed aluminum, natural
RM Regressed aluminum, matte black
RW Regressed aluminum, white

Diffuser type

A12 #12 pattern acrylic, reverse apex
RA125 #12 pattern acrylic, .125" thick, reverse apex
A12125 #12 pattern acrylic .125" thick
A19 #19 pattern acrylic .156" thick

Voltage

MVOLT[2]
120
277
347[3]
Others available.

Ballast

GEB95 0.95 ballast factor[4,5]
GEB10PS 1.00 ballast factor
GEB95S 0.95 ballast factor, step dimming[4,5]
GEB115 1.15 ballast factor[4,5]
GEB115S 1.15 ballast factor, step dimming[4,5]
S5 0.95 ballast factor, SIMPLY5 system[5,6]

Options

1/3 One three-lamp ballast (T5HO only)
1/4 One four-lamp ballast (T5HO only)
EL14 Emergency battery pack[7,9]
GLR Internal fast-blow fuse[7]
GMF Internal slow-blow fuse[7]
LP835 3500K
LPM835P Premiere 3500K[5]
LP841 4100K
PWS1836 6' prewire, 3/8" dia., 18-gauge, 3 wires
PWS1846 6' prewire, 3/8" dia., 18-gauge, 4 wires[8]
JP Palletized and stretch-wrapped without individual cartons
CSA CSA Certified
NOM NOM Certified

NOTES:
1 For T5HO applications, use GEB10PS.
2 MVOLT (120-277 volts), 50-60HZ.
3 For 347V, use GEB95S or GEB10PS.
4 Available with two- or four-lamp configurations only.
5 28T5 lamps only.
6 SIMPLY5 system includes 13' S5 RELOC wiring system. Specify voltage unless HW (hardwire) or PWS1836 is ordered. For two-lamp 28T5 only.
7 Must specify voltage: 120V or 277V.
8 Use with GEB95S or GEB115S.
9 Not available with three- or four-lamp 28T5 configurations.

Fluorescent **Sheet #: SP5-2x4** STAT-230

Verge™

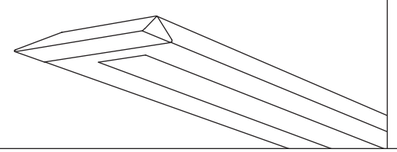
LEDALITE

Suspended

Direct/Indirect

2 T5

RESPONSE® mesoOptics® airwave™



Project Name

Spec Type

Notes

Order Guide

Some combinations of product options may not be available. Consult factory for assistance with your specification.

7606	F02	Q	G	–		–		–		–		–	

Product Series & Type
Verge Direct/Indirect

Lamping
2 T5

Lower Optics
Q MesoOptics® Lens

Upper Optics
N None
G 80% Down Kit
J 100% Down Kit

See details on reverse

Run Length
Enter the total run length in feet (4ft increments)

See details on reverse

Wiring
1 1 cct
2 2 cct
3 1 cct w/ Emergency cct
4 2 cct w/ Emergency cct
5 1 cct w/ Battery Pack
6 2 cct w/ Battery Pack
7 1 cct Dimming

Consult website for complete list of standard wiring options

Voltage
1 120V
2 277V

Ballast
E Standard Ballast

Consult website for ballast manufacturer information

Color & Finish
W Standard White
C Factory Color
X Custom Color

Consult website for color and finish options

Mounting Hardware

Mount Type	Suspension Length
Consult separate mounting spec sheet for mount type options	*Enter distance from ceiling to top of fixture in inches*

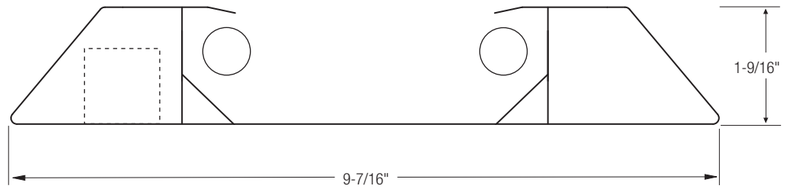
Upgrades & Accessories

Please indicate with check mark.

☐ Lamps Included

☐ Response Daylight (Integrated Controls)
For details visit www.ledalite.com/response

☐ Dust Cover



 Phone: 604.888.6811 Fax: 800.665.5332 Web: www.ledalite.com

Filename 7606F02QG.pdf Rev 1.2

Ledalite is a Philips group brand

PHILIPS

Verge™

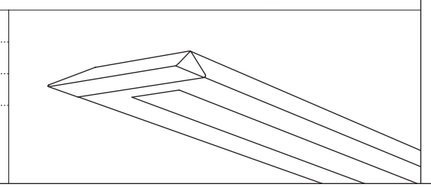
LEDALITE

Suspended

Direct/Indirect

2 T5HO

RESPONSE® mesoOptics® airwave™



Project Name

Spec Type

Notes

Order Guide

Some combinations of product options may not be available. Consult factory for assistance with your specification.

7606	H02	Q	G	–		–		–		–		–	

Product Series & Type
Verge Direct/Indirect

Lamping
2 T5HO

Lower Optics
Q MesoOptics® Lens

Upper Optics
N None
G 80% Down Kit
J 100% Down Kit

See details on reverse

Run Length
Enter the total run length in feet (4ft increments)

See details on reverse

Wiring
1 1 cct
2 2 cct
3 1 cct w/ Emergency cct
4 2 cct w/ Emergency cct
5 1 cct w/ Battery Pack
6 2 cct w/ Battery Pack
7 1 cct Dimming

Consult website for complete list of standard wiring options

Voltage
1 120V
2 277V
3 347V

Ballast
E Standard Ballast

Consult website for ballast manufacturer information

Color & Finish
W Standard White
C Factory Color
X Custom Color

Consult website for color and finish options

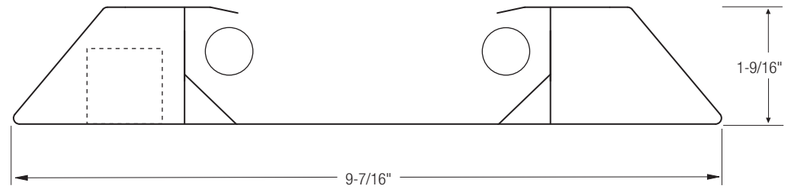
Mounting Hardware

Mount Type	**Suspension Length**
Consult separate mounting spec sheet for mount type options	*Enter distance from ceiling to top of fixture in inches*

Upgrades & Accessories

Please indicate with check mark.

- ☐ Lamps Included
- ☐ Response Daylight (Integrated Controls)
  For details visit www.ledalite.com/response



 Phone: 604.888.6811 Fax: 800.665.5332 Web: www.ledalite.com Filename 7606H02QG.pdf Rev 1.2

Ledalite is a Philips group brand

PHILIPS

DAY-BRITE®

CLDW

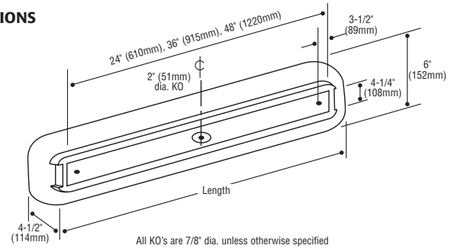
CLOUDLINE BRACKET

A functional and attractive wall luminaire.

DESIGN FEATURES

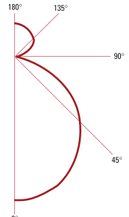
- These fixtures are primarily used for wall mounting; however they may also be surface mounted to ceilings.
- Housing is multi-stage phosphate treated for maximum corrosion resistance and finish coat is high reflectance baked white enamel.
- For individual mounting only.
- Lens is one piece smooth opal acrylic.
- Lens is retained by a thumb screw on each end.
- cUL certified.

DIMENSIONS



All KO's are 7/8" dia. unless otherwise specified

CLDW232A-120-1/2-EB -- IES File: D19743.IES



Coefficients of Utilization

RF	20%		RC	80%	
RW	70	50	30	10	
RCR					
0	77	77	77	77	
1	68	64	61	57	
2	61	55	50	45	
3	56	48	42	37	
4	51	42	36	31	
5	46	37	31	26	
6	43	33	27	22	
7	39	30	24	20	
8	37	27	21	17	
9	34	25	19	15	
10	32	23	17	14	

SAMPLE CATALOGUE NUMBER: CLDW232-120-1/2-EB

FAMILY

CLDW – Cloudline Wall Bracket

NO. OF LAMPS

(not included)
1
2

LAMP TYPE/WATTAGE

14 – 14wT5 (22")
17 – 17wT8 (24")
20 – 20wT12 (24")
24HO – 24wT5HO (22")
21 – 21wT5 (34")
39HO – 39wT5HO (34")
25 – 25wT8 (36")
28 – 28wT5 (46")
32 – 32wT8 (48")
54HO – 54wT5HO (46")

VOLTAGE

120
277
347
UNV – Universal voltage, 120-277 volt (with T8 electronic ballast option only)

OPTIONS

See pages 145 to 149 for options information.

CLOUDLINE BRACKETS —PRODUCT AVAILABILITY

Size	Family	Lamps/ Fixture	Lamp Type
2'	1, 2	14, 17, 20, 24HO	26-3/4"(679)
3'	1, 2	21, 25, 39HO	38-3/4"(984)
4'	1, 2	28, 32, 54HO	50-3/4"(1289)

DAY-BRITE®

CLDW

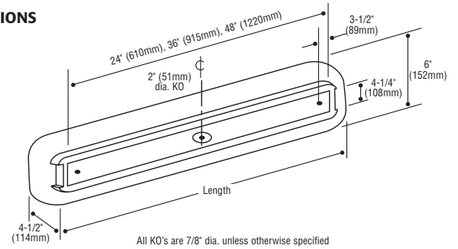
CLOUDLINE BRACKET

A functional and attractive wall luminaire.

DESIGN FEATURES

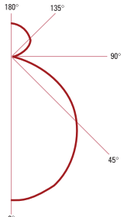
- These fixtures are primarily used for wall mounting; however they may also be surface mounted to ceilings.
- Housing is multi-stage phosphate treated for maximum corrosion resistance and finish coat is high reflectance baked white enamel.
- For individual mounting only.
- Lens is one piece smooth opal acrylic.
- Lens is retained by a thumb screw on each end.
- cUL certified.

DIMENSIONS



All KO's are 7/8" dia. unless otherwise specified

CLDW232A-120-1/2-EB -- IES File: D19743.IES



Coefficients of Utilization

RF	20%		RC	80%	
RW	70	50	30	10	
RCR					
0	77	77	77	77	
1	68	64	61	57	
2	61	55	50	45	
3	56	48	42	37	
4	51	42	36	31	
5	46	37	31	26	
6	43	33	27	22	
7	39	30	24	20	
8	37	27	21	17	
9	34	25	19	15	
10	32	23	17	14	

SAMPLE CATALOGUE NUMBER: CLDW232-120-1/2-EB

FAMILY

CLDW – Cloudline Wall Bracket

NO. OF LAMPS

(not included)
1
2

LAMP TYPE/WATTAGE

14 – 14wT5 (22")
17 – 17wT8 (24")
20 – 20wT12 (24")
24HO – 24wT5HO (22")
21 – 21wT5 (34")
39HO – 39wT5HO (34")
25 – 25wT8 (36")
28 – 28wT5 (46")
32 – 32wT8 (48")
54HO – 54wT5HO (46")

VOLTAGE

120
277
347
UNV – Universal voltage, 120-277 volt (with T8 electronic ballast option only)

OPTIONS

See pages 145 to 149 for options information.

CLOUDLINE BRACKETS —PRODUCT AVAILABILITY

Size	Family	Lamps/ Fixture	Lamp Type
2'	1, 2	14, 17, 20, 24HO	26-3/4"(679)
3'	1, 2	21, 25, 39HO	38-3/4"(984)
4'	1, 2	28, 32, 54HO	50-3/4"(1289)

106 www.thomaslightingcanada.com THOMAS LIGHTING CANADA

COOPER LIGHTING - METALUX®

DESCRIPTION

The HB series is an outstanding solution for high mounting height industrial or retail applications. The HB optic has been optimized to provide maximum performance from either the T5 or T8 lamps. Optional uplight component is provided to enable excellent ceiling uniformity. HB's high lumen package allows the benefits of fluorescent to be applied at high mounting heights that were traditionally exclusive to H.I.D. The primary benefits include exceptional color rendering, high system efficacy, 95% lumen maintenance, long lamp life, instant on/instant re-strike, economical dimming, and uniform brightness control. Primary applications include "big box" retail, shopping malls, light industrial, gymnasiums, etc.

		Type
Catalog #		B5
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

A ... Construction
Full bodied steel housing utilizes captive fasteners to protect optical assembly and assure structural integrity. The housing features an integral ballast channel that adds strength and provides numerous KOs for easy installation. Optional Top Access Plate allows service in electrical compartment without removal of lamps. Die formed internal reflectors are available in both high reflectance specular material or in painted after fabrication white enamel.

B ... Electrical
Class "P" ballasts are positively secured by mounting bolts. Roto-lock lampholders. Optional modular power receptacle meets UL2459 and NEC 410.73 and is UL/cUL rated for make and break under load from outside the luminaire to speed maintenance. Thermally optimized for environments up to 149°F (65°C) when used with high temperature ballasts in open uplight configurations. UL/CUL listed. Suitable for damp locations.

C ... Finish
White enamel finish preceded by a multistage cleaning cycle, iron phosphate coating with rust inhibitor to protect against contaminants and oxidation.

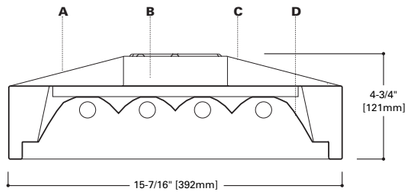
D ... Downlight/Uplight Optics
Die formed reflectors are faceted with two optical distributions: medium and wide. Medium beam optical modules utilize 95% specular aluminum while the wide distribution utilizes a high performance 95% reflective polyester powder coated finish. Gasketed door frame and lens assembly is optional for more demanding environments. Uplight option provided to enable ceiling uniformity.

Mounting
The HB series is suited for surface, suspension mounting with optional wire hook and chain set, stem or cable mounting. Top connector box mounting is also available.

Options
Integral Occupancy Sensor available and provides from 600 sq. ft. (MS) up to 1250 sq. ft. (MSO) of coverage in a maximum mounting height of 40'.

F-BAY
HB SERIES

15" x 4' High-Bay
4 Lamp
HIGH-BAY INDUSTRIAL LUMINAIRE



F-BAY FLUORESCENT HIGH-BAY

ENERGY DATA

Input Watts:
EB Ballast
432 (109)
EB/Plus Ballast
432 (147)
ER Ballast
432 (112)
454 (229)
ER/Plus Ballast
432 (144)
Luminaire Efficacy Rating
LER = 66 (White)
LER = 70 (Specular)
Catalog Number: HB-454T5-UPL
Yearly Cost of 1000 Lumens, 3000 hrs. at .08 KWH = $3.42

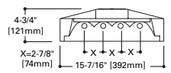
* Reference the lamp/ballast data in the Tecnical Section for specific lamp/ballast requirements

** Consult Pre Sales Technical Support.

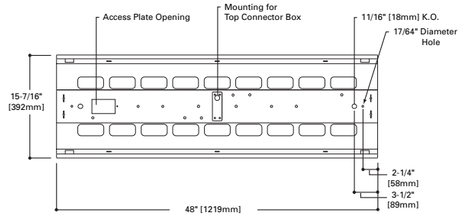
LAMPS CONTAIN MERCURY. DISPOSE ACCORDING TO LOCAL, STATE OR FEDERAL LAWS

LINEAR DISCONNECT
Safe and convenient means of disconnecting power

LAMP CONFIGURATIONS



DIMENSION TOP VIEW



COOPER Lighting
www.cooperlighting.com

Specifications and Dimensions subject to change without notice.
Consult your representative for additional options and finishes.

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COOPER LIGHTING - METALUX®

DESCRIPTION

The HB series is an outstanding solution for high mounting height industrial or retail applications. The HB optic has been optimized to provide maximum performance from either the T5 or T8 lamps. Optional uplight component is provided to enable excellent ceiling uniformity. HB's high lumen package allows the benefits of fluorescent to be applied at high mounting heights that were traditionally exclusive to H.I.D. The primary benefits include exceptional color rendering, high system efficacy, 95% lumen maintenance, long lamp life, instant on/instant re-strike, economical dimming, and uniform brightness control. Primary applications include "big box" retail, shopping malls, light industrial, gymnasiums, etc.

		Type
Catalog #		B6
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

A ... Construction
Full bodied steel housing utilizes captive fasteners to protect optical assembly and assure structural integrity. The housing features an integral ballast channel that adds strength and provides numerous KOs for easy installation. Optional Top Access Plate allows service in electrical compartment without removal of lamps. Die formed internal reflectors are available in both high reflectance specular material or in painted after fabrication white enamel.

B ... Electrical
Class "P" ballasts are positively secured by mounting bolts. Roto-lock lampholders. Optional modular power receptacle meets UL2459 and NEC 410.73 and is UL/cUL rated for make and break under load from outside the luminaire to speed maintenance. Thermally optimized for environments up to 149°F (65°C) when used with high temperature ballasts in open uplight configurations. UL/CUL listed. Suitable for damp locations.

C ... Finish
White enamel finish preceded by a multistage cleaning cycle, iron phosphate coating with rust inhibitor to protect against contaminants and oxidation.

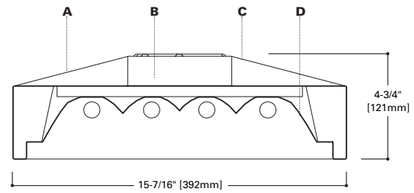
D ... Downlight/Uplight Optics
Die formed reflectors are faceted with two optical distributions: medium and wide. Medium beam optical modules utilize 95% specular aluminum while the wide distribution utilizes a high performance 95% reflective polyester powder coated finish. Gasketed door frame and lens assembly is optional for more demanding environments. Uplight option provided to enable ceiling uniformity.

Mounting
The HB series is suited for surface, suspension mounting with optional wire hook and chain set, stem or cable mounting. Top connector box mounting is also available.

Options
Integral Occupancy Sensor available and provides from 600 sq. ft. (MS) up to 1250 sq. ft. (MSO) of coverage in a maximum mounting height of 40'.

F-BAY
HB SERIES

15" x 4' High-Bay
4 Lamp
HIGH-BAY INDUSTRIAL LUMINAIRE



F-BAY FLUORESCENT HIGH-BAY

ENERGY DATA

Input Watts:
EB Ballast
432 (109)
EB/Plus Ballast
432 (147)
ER Ballast
432 (112)
454 (229)
ER/Plus Ballast
432 (144)
Luminaire Efficacy Rating
LER = 66 (White)
LER = 70 (Specular)
Catalog Number: HB-454T5-UPL
Yearly Cost of 1000 Lumens, 3000 hrs. at .08 KWH = $3.42

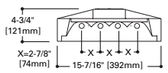
* Reference the lamp/ballast data in the Tecnical Section for specific lamp/ballast requirements

** Consult Pre Sales Technical Support.

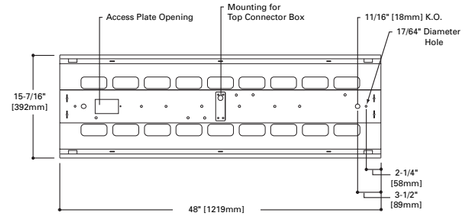
LAMPS CONTAIN MERCURY. DISPOSE ACCORDING TO LOCAL, STATE OR FEDERAL LAWS

LINEAR DISCONNECT
Safe and convenient means of disconnecting power

LAMP CONFIGURATIONS



DIMENSION TOP VIEW



COOPER Lighting
www.cooperlighting.com

Specifications and Dimensions subject to change without notice.
Consult your representative for additional options and finishes.

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METALUX®

DESCRIPTION

The HB series is an outstanding solution for high mounting height industrial or retail applications. The HB optic has been optimized to provide maximum performance from either the T5 or T8 lamps. Optional uplight component is provided to enable excellent ceiling uniformity. HB's high lumen package allows the benefits of fluorescent to be applied at high mounting heights that were traditionally exclusive to H.I.D. The primary benefits include exceptional color rendering, high system efficacy, 95% lumen maintenance, long lamp life, instant on/instant re-strike, economical dimming, and uniform brightness control. Primary applications include "big box" retail, shopping malls, light industrial, gymnasiums, etc.

Catalog #		Type
Project		B7
Comments		Date
Prepared by		

SPECIFICATION FEATURES

A···Construction
Full bodied steel housing utilizes captive fasteners to protect optical assembly and assure structural integrity. The housing features an integral ballast channel that adds strength and provides numerous KO's for easy installation. Center access plate location allows for easy access to ballast leads on all new and retrofit projects regardless of mounting type.

B···Electrical
Class "P" ballasts are positively secured by mounting bolts. Roto-lock lampholders. Optional modular power receptacle meets UL2459 and NEC 410.73 and is UL/cUL rated for make and break under load from outside the luminaire to speed maintenance. UL/CUL listed. Suitable for damp locations. Thermally optimized for environments up to 149°F (65°C) when used with high temperature ballasts in an open uplight configuration.

C···Finish
White enamel finish preceded by a multistage cleaning cycle, iron phosphate coating with rust inhibitor to protect against contaminants and oxidation.

D···Downlight/Uplight Optics
Die formed reflectors are faceted with two optical distributions –medium and wide. Medium beam optical modules utilize 95% specular aluminum while the wide distribution utilizes a high performance 95% reflective polyester powder coated finish. Gasketed door frame & lens assembly is optional for more demanding environments. Uplight option provided to enable ceiling uniformity.

Mounting
The HB series is suited for surface, suspension mounting with optional wire hook and chain set or cable mounting.

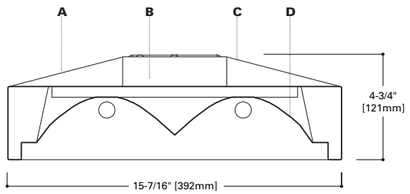
Options
Integral Occupancy Sensor available and provides from 600 sq. ft. (MS) up to 1250 sq. ft. (MSO) of coverage in a maximum mounting height of 40'.

F-BAY HB SERIES

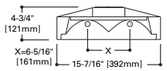
15" x 4' High-Bay 2 Lamp

HIGH-BAY INDUSTRIAL LUMINAIRE

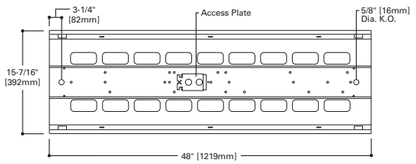
F-BAY FLUORESCENT HIGH-BAY



LAMP CONFIGURATIONS



DIMENSION TOP VIEW



ENERGY DATA

Input Watts:
EB Ballast
232 (58)

EB/Plus Ballast
232 (73)

ER Ballast
232 (57)
254 (117)

ER/Plus Ballast
232 (74)

Luminaire Efficacy Rating
LER = 72
Catalog Number: HB-254T5-UPL

Yearly Cost of 1000 Lumens, 3000 hrs. at .08 KWH = $3.33

* Reference the lamp/ballast data in the Technical Section for specific lamp/ballast requirements

** Consult Pre Sales Technical Support.

LAMPS CONTAIN MERCURY. DISPOSE ACCORDING TO LOCAL, STATE OR FEDERAL LAWS

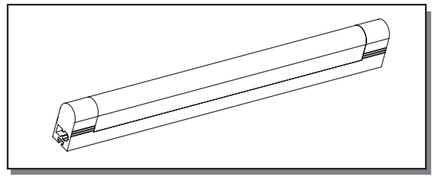
LINEAR DISCONNECT
Safe and convenient means of disconnecting power.

ADF030117

COOPER LIGHTING

Day-Brite® Lighting

MICRO UNDERCABINET



T5
14", 23", 36", or 48"
1 Lamp
An extremely small undercabinet luminaire using T5 lamps

CONSTRUCTION/FINISH

- Lens removable without tools for easy maintenance and cleaning.
- Rocker switch standard.
- Low profile (only 7/8" deep) provides neat, trim appearance.
- Mounting brackets included for mounting parallel or perpendicular to the mounting surface.
- Up to three units can be "daisy-chained" together using the supplied connectors.

ELECTRICAL

- UL listed.
- Electronic ballast is standard.
- Lamp included.
- Power cord with standard wall plug included, no wiring necessary.
- Available in 120 volt only.

ENCLOSURE

- High impact lens.
- Lens easily removable without tools.
- Linear prisms in lens for glare control.

CATALOG NUMBER

MUC | 1 | [ ] | – | 120

FAMILY
MUC - Micro Undercabinet

LAMP WATTS/ LUMINAIRE LENGTH
8 - 8wT5 (13-5/8")
13 - 13wT5 (22-7/8")
21 - 21wT5 (35-3/6")
28 - 28wT5 (47-5/8")

NO. OF LAMPS
1

VOLTAGE
120

JOB INFORMATION 1240-WU

Job Name:□
Type:

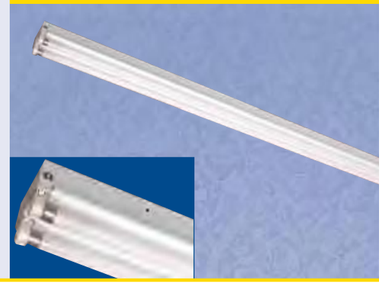
T5 STRIPS

Uses latest technology T5 ballasts and lamps. Ideal for most fluorescent lighting applications including general illumination, cove lighting and display cases.

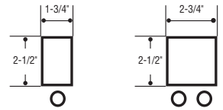
DESIGN FEATURES

- Designed for ceiling mount, wall mount or chain hung.
- Highly reflective baked white enamel.
- Suitable for individual or continuous row mounting.
- Only 2-1/2" deep.
- Uses efficient T5 lamps or H.O. lamps for up to 70% more light output.
- CSA/cUL certified.

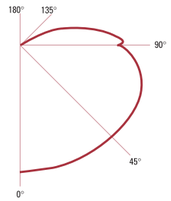
DAY-BRITE®
STRIPL



DIMENSIONS



STRIPL148-120 -- IES File: C8493.JES



Coefficients of Utilization

RF	20%	RC	80%		
RW	70	50	30	10	
RCR					
0	1.081	1.081	1.081	1.081	
1	95	89	84	79	
2	85	76	68	61	
3	77	65	57	50	
4	70	57	48	41	
5	63	50	41	34	
6	58	44	35	29	
7	53	40	31	25	
8	49	35	27	21	
9	45	32	24	18	
10	42	29	21	16	

SAMPLE CATALOGUE NUMBER: STRIPL114-120

FAMILY
STRIPL – T5 Strip
TSTRIPL – Tandem

NO. OF LAMPS PER CROSS SECTION
1 (not included)
2

LAMP TYPE/WATTAGE
14/24HO – 22"
21/39HO – 34"
28/54HO – 46"
35/80HO – 58"

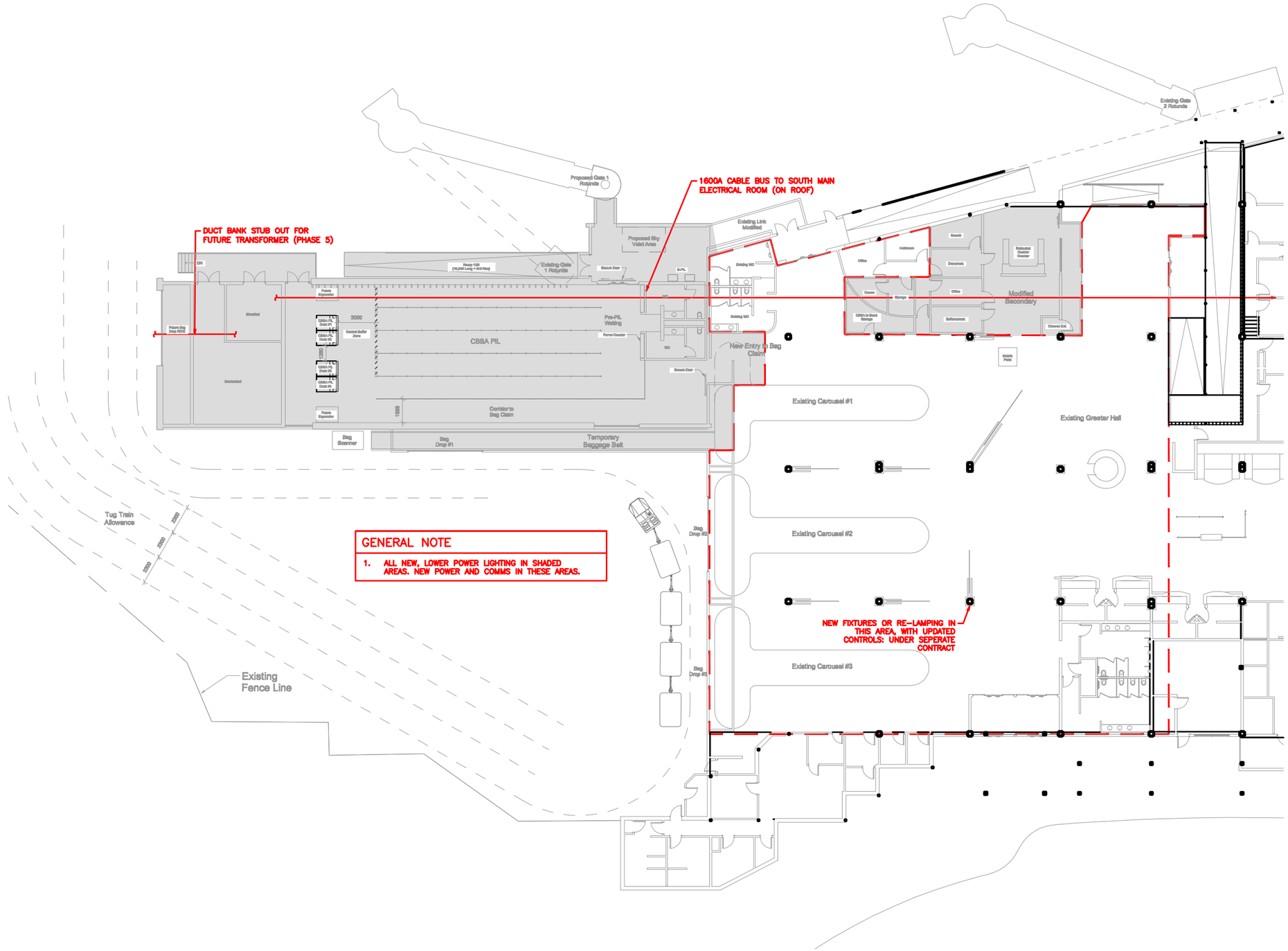
VOLTAGE
120
277
347

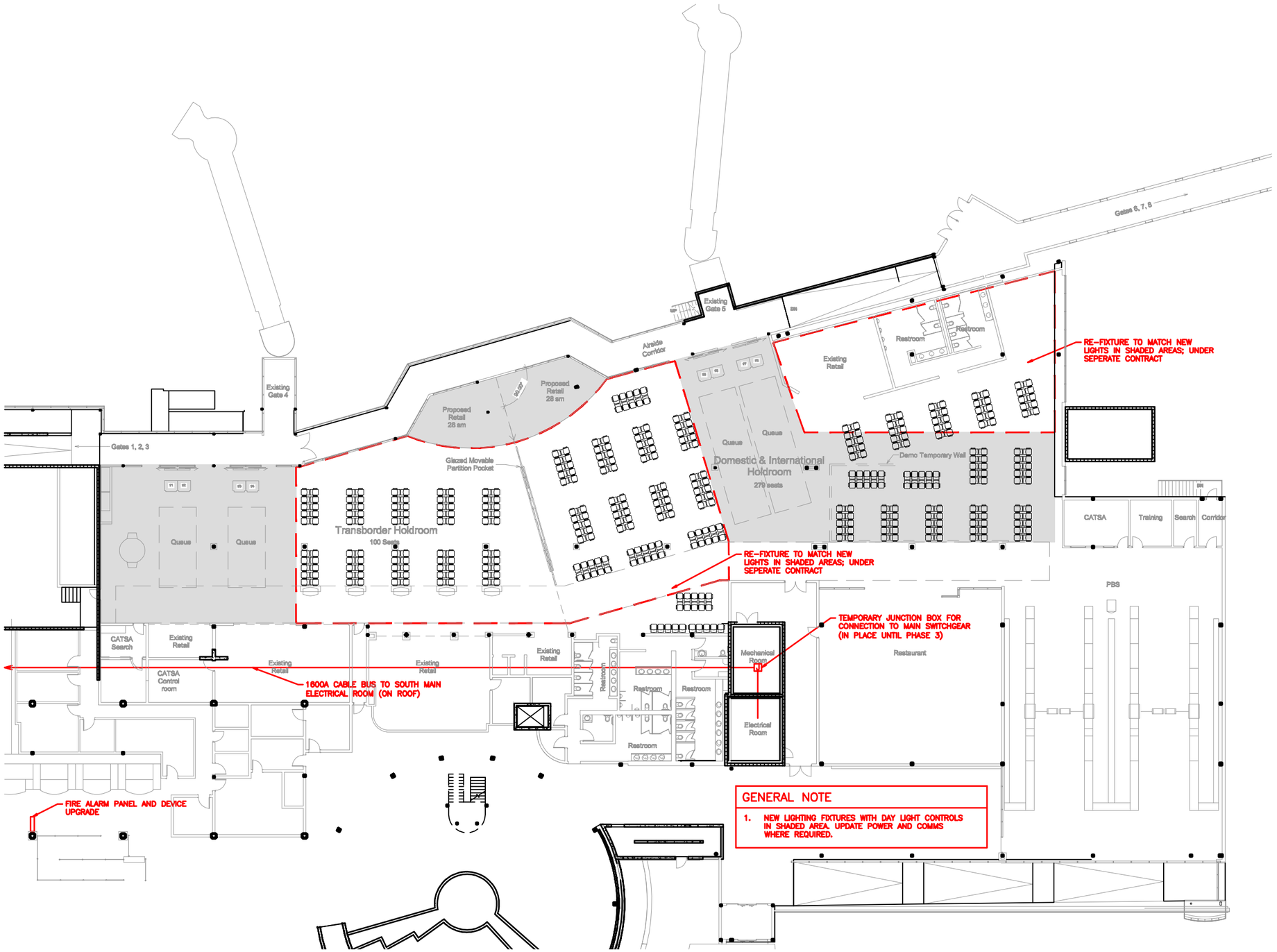
OPTIONS
See pages 145 to 149 for options and accessories information.

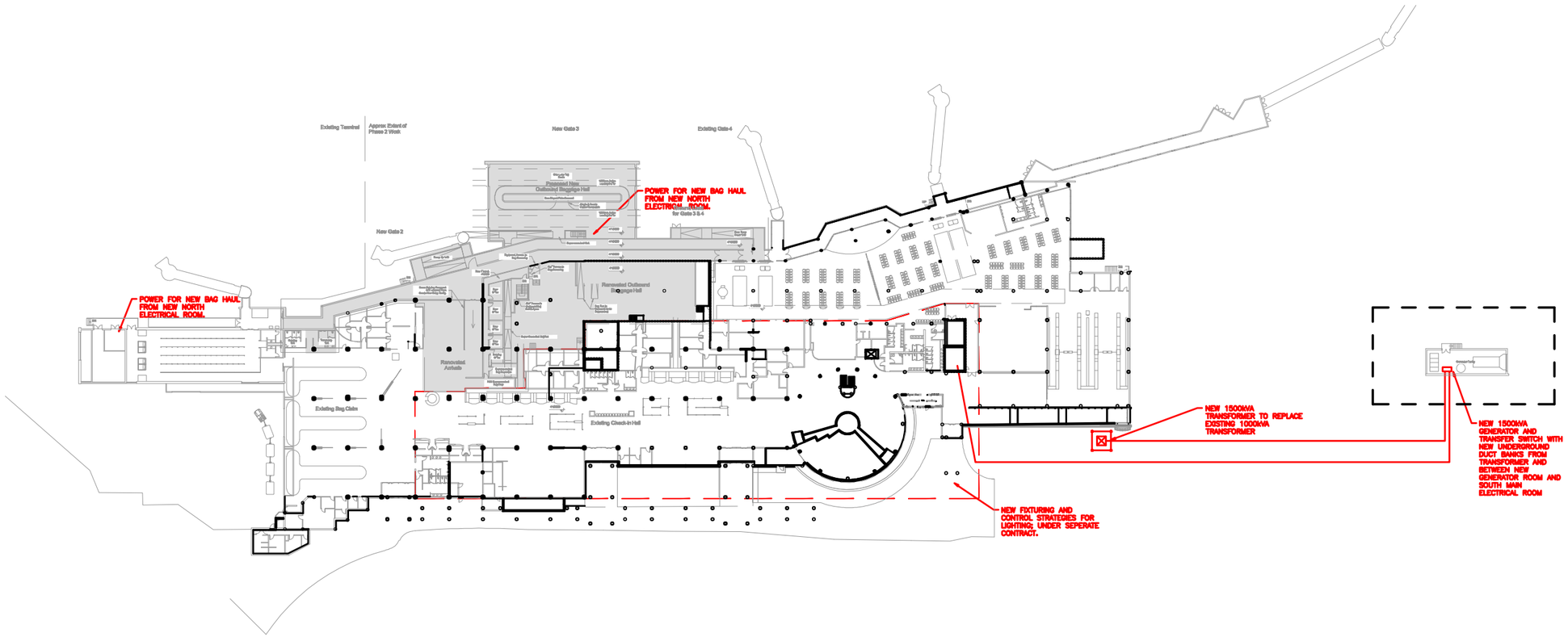
STANDARD STRIPLIGHT—PRODUCT AVAILABILITY

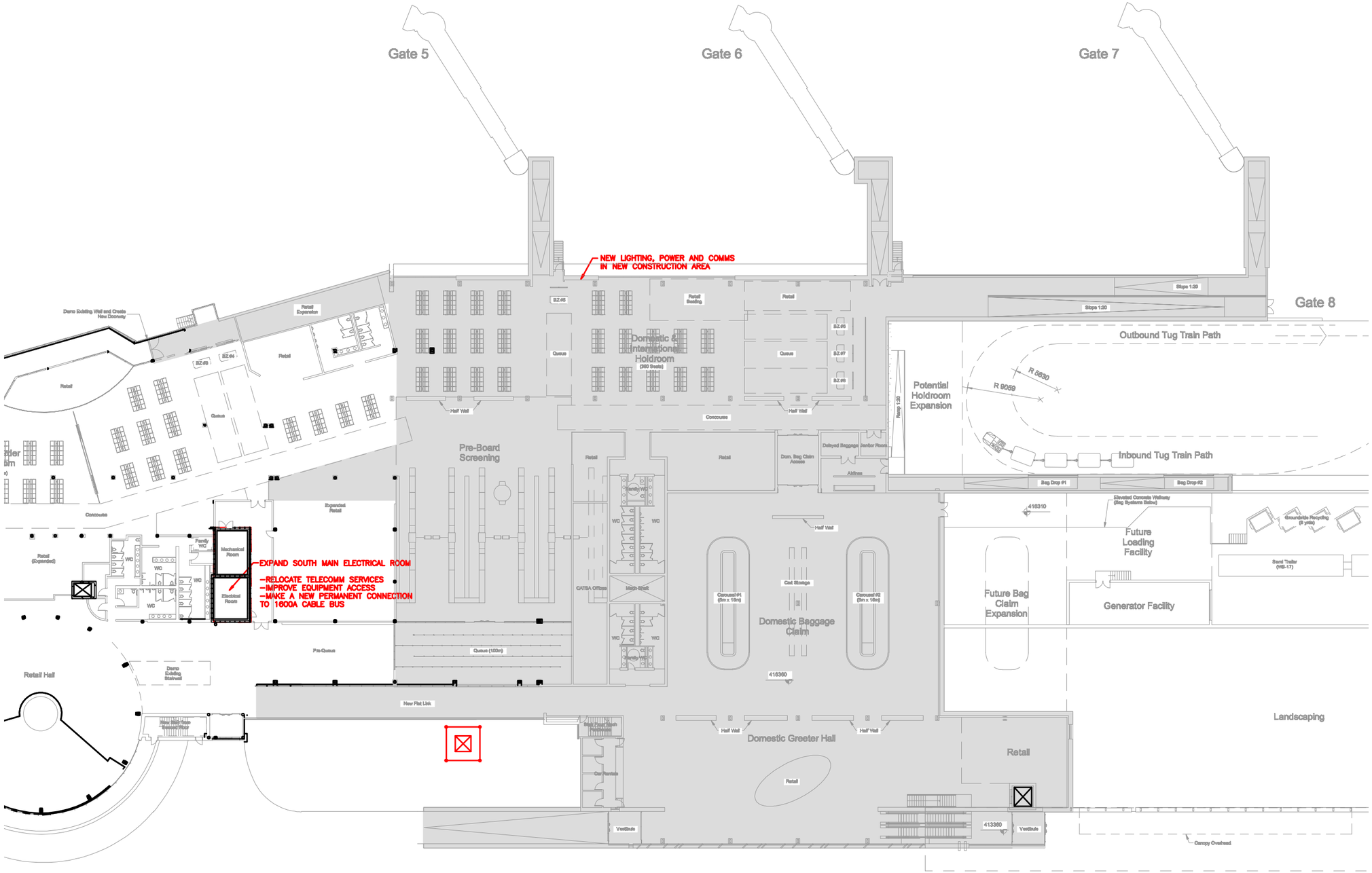
Size	Family	Lamps Cross-Sect	Lamps/ Fixture	Lamp Type	Length in. (mm)
22"	STRIPL	1 or 2	1/2	14/24HO	22 3/8"(570)
34"	STRIPL	1 or 2	1/2	21/39HO	34 1/4"(870)
46"	STRIPL	1 or 2	1/2	28/54HO	46"(1170)
58"	STRIPL	1 or 2	1/2	35/80HO	57 7/8"(1470)
92"	TSTRIPL	1 or 2	2/4	28/54HO	92"(2340)

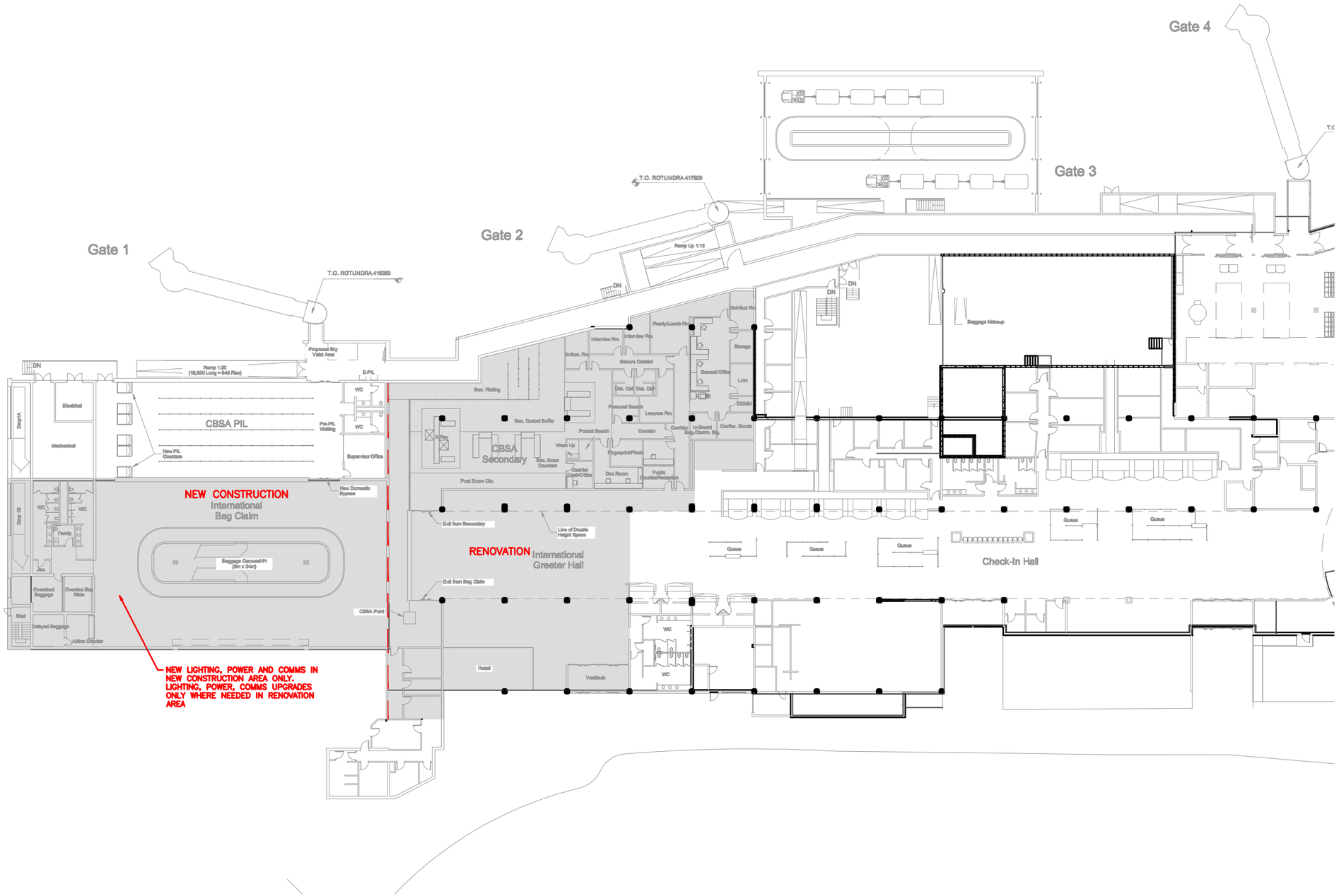
Accessories (ordered separately):
- **WG-T5** – Strip-1LP (must specify length)
- **WG-T5** – Strip-2LP (must specify length)

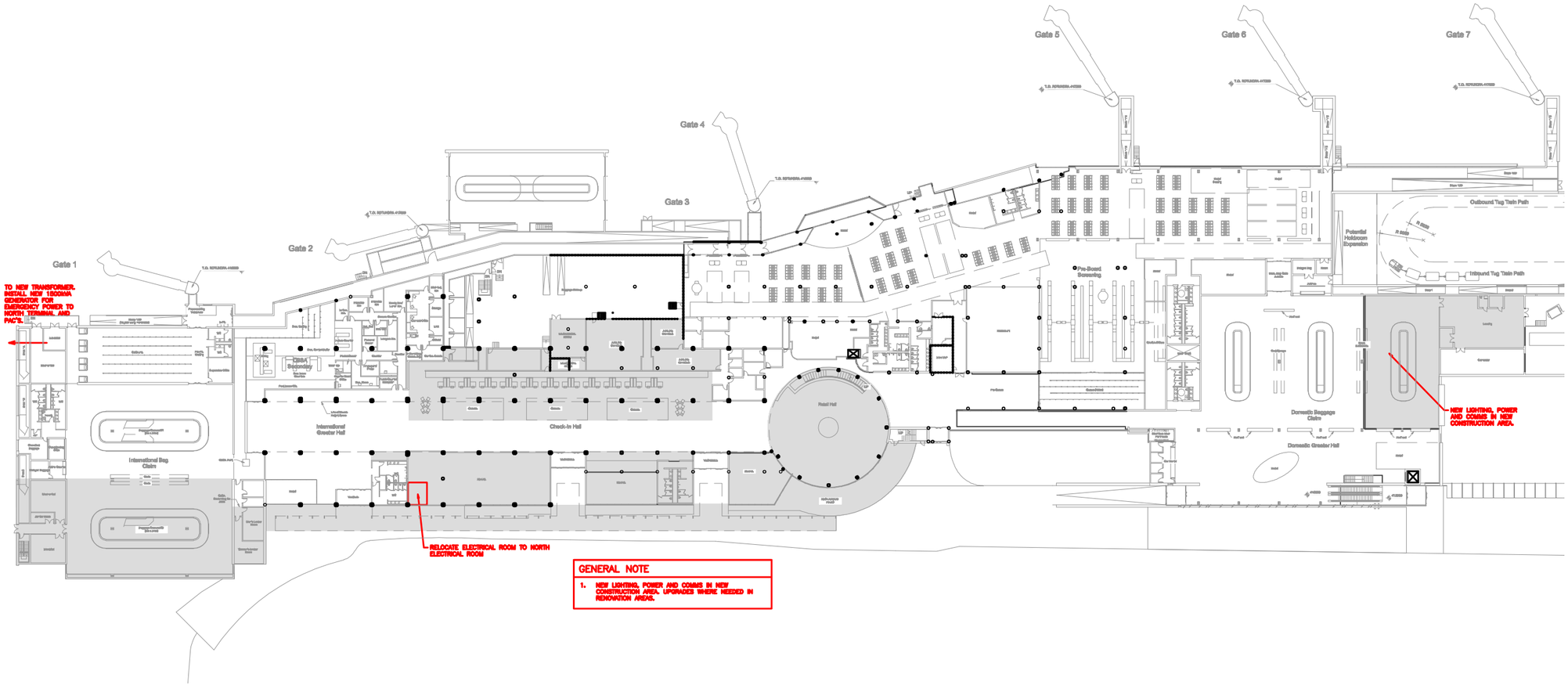

DUCT BANK STUB OUT FOR FUTURE TRANSFORMER (PHASE 5)
1600A CABLE BUS TO SOUTH MAIN ELECTRICAL ROOM (ON ROOF)
GENERAL NOTE
1. ALL NEW, LOWER POWER LIGHTING IN SHADED AREAS. NEW POWER AND COMMS IN THESE AREAS.
NEW FIXTURES OR RE-LAMPING IN THIS AREA, WITH UPDATED CONTROLS: UNDER SEPERATE CONTRACT
Proposed Gate 1 Rotunda
Existing Gate 2 Rotunda
Existing Gate 1 Rotunda
Proposed Big Valet Area
Existing Link Modified
Ramp 1:20 (16,000 Long x 840 Rise)
Secure Door
S-PIL
Existing WD
Future Expansion
Electrical
Mechanical
Future Big Drop RDR
CBSA PIL Dock #1
CBSA PIL Dock #2
CBSA PIL Dock #3
CBSA PIL Dock #4
3000
Central Baffle Zone
CBSA PIL
Pre-PIL Waiting
Purse/Counter
WD
New Entry to Bag Claim
Secure Door
1600
Corridor to Bag Claim
Bag Scanner
Bag Drop #1
Temporary Baggage Belt
Existing Carousel #1
Existing Greeter Hall
Modified Secondary
Relocated Counter/ Counter
Middle Point
Ethernet Rm
Holdroom
Offices
Records
Document
Offices
Counter
Storage
CBSA In-Board Storage
Enforcement
Bag Drop #2
Existing Carousel #2
Bag Drop #3
Existing Carousel #3
Tug Train Allowance
2500
2500
2500
Existing Fence Line


Gates 6, 7, 8
Existing Gate 5
Airside Corridor
Existing Gate 4
Gates 1, 2, 3
Proposed Retail 28 sm
Proposed Retail 28 sm
Glazed Movable Partition Pocket
Transborder Holdroom
100 Seats
Queue
Queue
Queue
Queue
Domestic & International Holdroom
279 seats
Existing Retail
Restroom
Restroom
Demo Temporary Wall
RE-FIXTURE TO MATCH NEW LIGHTS IN SHADED AREAS; UNDER SEPERATE CONTRACT
CATSA
Training
Search
Corridor
PBS
RE-FIXTURE TO MATCH NEW LIGHTS IN SHADED AREAS; UNDER SEPERATE CONTRACT
TEMPORARY JUNCTION BOX FOR CONNECTION TO MAIN SWITCHGEAR (IN PLACE UNTIL PHASE 3)
Restaurant
CATSA Search
Existing Retail
CATSA Control room
Existing Retail
Existing Retail
Existing Retail
1600A CABLE BUS TO SOUTH MAIN ELECTRICAL ROOM (ON ROOF)
Restroom
Restroom
Restroom
Restroom
Mechanical Room
Electrical Room
FIRE ALARM PANEL AND DEVICE UPGRADE
GENERAL NOTE
1. NEW LIGHTING FIXTURES WITH DAY LIGHT CONTROLS IN SHADED AREA. UPDATE POWER AND COMMS WHERE REQUIRED.


Existing Terminal
Approx. Extent of Phase 2 Work
New Gate 3
Existing Gate 4
New Gate 2
Proposed New Outbound Baggage Hall
POWER FOR NEW BAG HAUL FROM NEW NORTH ELECTRICAL ROOM.
for Gate 3 & 4
Renovated Outbound Baggage Hall
Renovated Airside
Existing Bag Claim
Existing Check-In Hall
POWER FOR NEW BAG HAUL FROM NEW NORTH ELECTRICAL ROOM.
NEW 1500kVA TRANSFORMER TO REPLACE EXISTING 1000kVA TRANSFORMER
NEW 1500kVA GENERATOR AND TRANSFER SWITCH WITH NEW UNDERGROUND DUCT BANKS FROM TRANSFORMER AND BETWEEN NEW GENERATOR ROOM AND SOUTH MAIN ELECTRICAL ROOM
NEW FIXTURING AND CONTROL STRATEGIES FOR LIGHTING; UNDER SEPERATE CONTRACT.


Gate 5
Gate 6
Gate 7
Gate 8
NEW LIGHTING, POWER AND COMMS IN NEW CONSTRUCTION AREA
Demo Existing Wall and Create New Doorway
Retail Expansion
Retail
Retail Seating
Queue
Domestic & International Holdroom
(360 Seats)
Half Wall
Concourse
Pre-Board Screening
Expanded Retail
Retail (Expanded)
Family WC
WC
Mechanical Room
Electrical Room
EXPAND SOUTH MAIN ELECTRICAL ROOM
–RELOCATE TELECOMM SERVICES
–IMPROVE EQUIPMENT ACCESS
–MAKE A NEW PERMANENT CONNECTION TO 1600A CABLE BUS
Pre-Queue
Queue (100m)
Demo Existing Stairwell
Retail Hall
New Flat Link
CATSA Offices
Mech Shaft
Dom. Bag Claim Access
Delayed Baggage
Janitor Room
Airlines
Ramp 1:20
Potential Holdroom Expansion
Slope 1:20
Outbound Tug Train Path
R 8630
R 8059
Inbound Tug Train Path
Bag Drop #1
Bag Drop #2
416310
Elevated Concrete Walkway (Bag Systems Below)
Groundside Recycling (8 yrds)
Future Loading Facility
Sand Trailer (WB-17)
Generator Facility
Future Bag Claim Expansion
Carousel #1 (5m x 18m)
Carousel #2 (5m x 18m)
Domestic Baggage Claim
Cart Storage
416300
Domestic Greeter Hall
Car Rentals
Retail
413360
Vestibule
Landscaping
Canopy Overhead


Gate 1
Gate 2
Gate 3
Gate 4
T.O. ROTUNDRA 417830
T.O. ROTUNDRA 417800
T.C
Ramp Up 1:12
DN
Proposed Sky Valet Area
Ramp 1:20
(18,000 Long = 840 Rise)
E-PIL
WC
CBSA PIL
Pre-PIL Waiting
New PIL Counters
Supervisor Office
Elevator
Mechanical
Dep'rt A
Sec. Waiting
Sec. Control Buffer
CBSA Secondary
Sec. Exam Counters
Post Exam Circ.
Pocket Search
Wash Up
Fingerprint/Photo
Cashier Cash/Offline
Duo Room
Public Counter/Reception
Corridor
In-Bound Sec./Comm. Sh.
Confisc. Goods
Interview Rm.
Enforc. Rm.
Secure Corridor
Det. Cell
Personal Search
Lawyers Rm.
Ready/Lunch Rm.
Disinfect Rm.
Storage
General Office
LAN
COMM
Baggage Makeup
NEW CONSTRUCTION
International
Bag Claim
New Domestic Bypass
Dep'rt B
Family
Jan.
Baggage Carousel #1
(9m x 34m)
Oversized Baggage
Oversize Bag Slide
Stair
Delayed Baggage
Airline Counter
CBSA Point
Exit from Secondary
Line of Double Height Space
RENOVATION International
Greater Hall
Exit from Bag Claim
Retail
Vestibule
Queue
Check-In Hall
NEW LIGHTING, POWER AND COMMS IN NEW CONSTRUCTION AREA ONLY. LIGHTING, POWER, COMMS UPGRADES ONLY WHERE NEEDED IN RENOVATION AREA



GENERAL NOTE

1. NEW LIGHTING, POWER AND COMMS IN NEW CONSTRUCTION AREA. UPGRADES WHERE NEEDED IN RENOVATION AREAS.

10.0 ENVIRONMENT AND SUSTAINABLE DESIGN

Executive Summary

The Kelowna Airport has identified energy efficiency as a priority for this project. As part of the City of Kelowna, the Airport needs to comply with the City's climate change commitments and the design team was tasked with evaluating the greenhouse gas impact of the expansion. The design team also created several options to reduce airport green house gas emissions. An energy audit was performed at an early stage of the project to assess potential energy saving in the existing building. Data from this energy audit has been integrated into this document to show energy and green house gas savings associated with the recommended upgrades. The energy audit report can be found in the Appendix.

As part of an integrated design process, energy modeling is also being used to guide the design of the Kelowna Airport Expansion. Different types of analyses were performed: peak heating and cooling load, solar angles, glare, room temperature, and energy consumption. Outputs from those studies help the design team understand how to improve energy efficiency and sustainability. Important factors regarding energy efficiency can be analyzed in detail to provide energy cost savings necessary to support return on investment calculations.

The results from this integrated design process has been summarized in a tabular format presenting six options for the airport expansion ranging from building to Code to the incorporation of best design practices including a hybrid geothermal heating and cooling system. Due to the increased building area after the expansion, just building to current Building Code will increase the airport's carbon footprint by 87%. The various upgrades and energy audit initiatives can reduce the airport carbon footprint substantially as shown in the table to the right. The addition of geothermal has a significant effect on reducing greenhouse gas emissions as it replaces natural gas consumption for heating with electricity consumption to drive the heat pumps. Electricity production in British Columbia is nearly entirely produced with green house gas neutral hydro electric power.

	V0	V1	V2A	V2B	V3	V4	V5	V6
	Existing ATB only	New Building Code compliant	Envelope upgrade and energy audit	V2a +triple glazing	Mech&Elec system Upgrade 1	Mech&Elec system Upgrade 2	V3 plus Geothermal	V4 plus Geothermal
Total CO2 (tCo2)*	502	939	794	786	558	464	247	220
% overall carbon change	0%	87%	58%	56%	11%	-8%	-51%	-56%

BACKGROUND

British Columbia Climate Action Charter

Kelowna carbon reduction goals have been formalized trough the British Columbia Climate Action Charter. The City of Kelowna Green Gas Emission Inventory explains the commitment of the city toward reducing carbon emission as follows:

"In 2001, Kelowna joined the Partners for Climate Protection Program. Municipal Council then endorsed the Kyoto Protocol in March of 2002 and adopted the Federation of Canadian Municipalities resolution towards the reduction of greenhouse gas emissions (GHG) in September of 2002. On September 21st, 2007 the City signed on to the Climate Action Charter (Appendix 1). In signing the Charter, the City committed to being carbon neutral in respect to City operations by 2012, as well as to measuring and reporting community greenhouse gas emissions and creating a complete, compact, more energy efficient community. In 2008, the provincial government adopted Bill 27 - Local Government (Green Communitie Statutes Amendment Act. Bill 27 requires municipalities to identify a numeric target for greenhouse gas and to amend their Official Community Plans (OCP) to reflect this target by May 31st, 2010. Eager to show leadership on greenhouse gases, the Province committed to a very ambitious 33% reduction from 2007 levels, by 2020. The target set by the Province (for the Province as a whole) establishes a starting point for communities such as the City of Kelowna in setting municipal community emissions targets. It should be noted that, in addition to targeting a 33% reduction by 2020, the Province is also targeting an 80% reduction by 2050. This report focuses on what would be required to achieve the 2020 reductions. The Provincial targets, although not at this point legally imposed on local jurisdictions, cannot be achieved without the cooperation of communities such as Kelowna.

To achieve a 33% reduction of greenhouse gas emissions by 2020, a significant change will be required of all Kelowna residents and businesses including the corporation of the City of Kelowna. In the simplest terms, by 2020, each Kelowna resident will need to generate less than half the greenhouse gas emissions they generated in 2007. Achieving those reductions

Sustainability Goals and objectives

The design team is using Kelowna's target for reducing carbon emission by 33% as a target for the airport. Several design options were developed to better understand what is required to meet the target. This report provides an estimate of the energy consumption and green house gas emissions for different design options.

ENERGY MODELING METHODOLOGY AND ASSUMPTIONS

Methodology

The IES Virtual Environment Software was used to test energy use, day lighting strategies, mechanical system options and to calculate energy consumption. IES software was selected for its ability to model the advanced systems that are being considered for the airport. IES has been identified as the “most comprehensive, most rigorous, and best integrated suite of tools for building energy design and analysis on the world market today.” (Cadalyst Labs Review)

IES VE calculates energy consumption on an hourly basis, based on a detailed set of inputs that include the following:

- 3D building information
- Type of glazing
- Type of building materials and construction
- Internal and external shading
- Shading from other buildings (or in our case, the surrounding mountains)
- Internal lighting types and schedules
- Heating and cooling loads and schedules
- Zone temperature set point and schedules
- Terminal equipment characteristics and performance
- Central system characteristics and performance
- Energy type (natural gas, electricity, etc.)

It is important to recognize that energy modeling is a tool best used to evaluate different design options as part of a design process. Building operations and occupant behaviour have a significant impact on actual energy consumption that is not effectively considered by the energy model. The existing building was modeled to take into account impact of the existing building on the new expansion, but energy simulation was not performed for the existing building. Real energy consumption was used instead for greater accuracy.

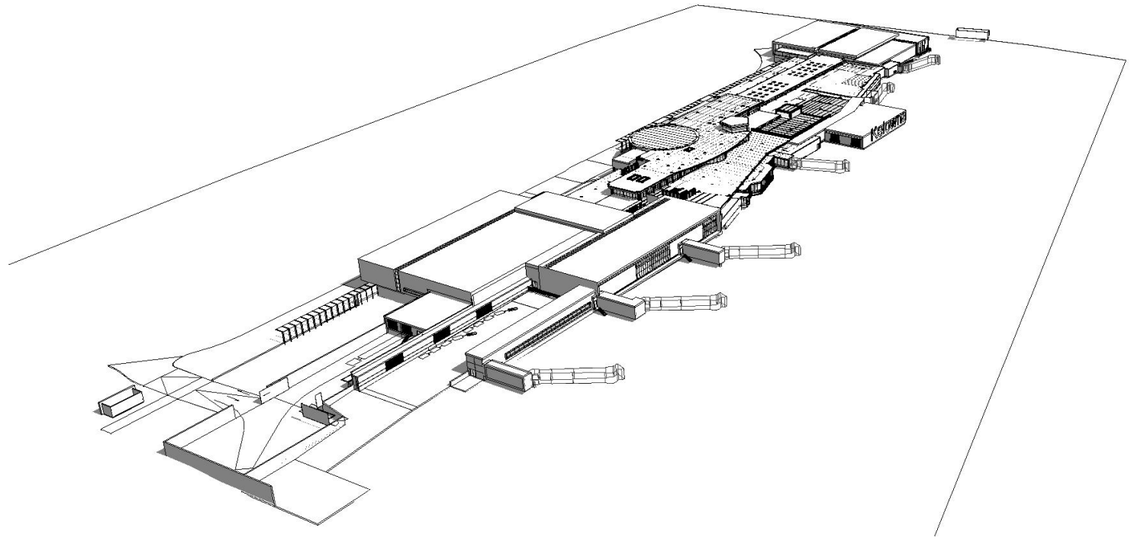


Figure 1 – 3D View of the Revit Model

Climate Data

The Kelowna, BC CWEC climate data used for this analysis describes a typical meteorological year and includes hourly values for many parameters including:

- Dry bulb temperature
- Dew point temperature
- Relative Humidity
- Solar Radiation
- Wind speed and direction
- Cloud cover

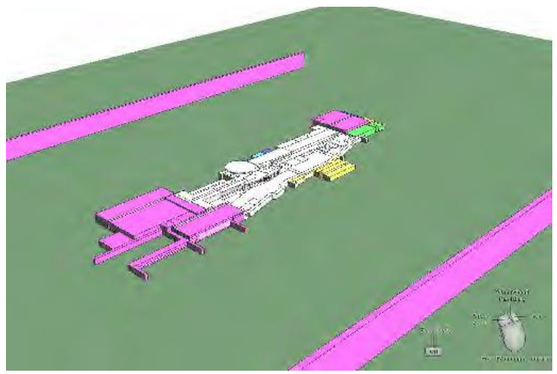


Figure 2 - 3D view of the IES model

Occupancy and Schedules

The following maximum occupancy numbers were used in the model:

CBSA	250
International Baggage Claim 1	202
International Baggage Claim 2	202
Domestic Baggage Claim	874
International/Domestic Hold Room Expansion	416

The maximum occupancy was adjusted according to the following time of day schedule. This schedule is based on the anticipated aircraft arrivals and departures predicted by the J. Suehiro March 2010 YLW Facilities Program Analysis:

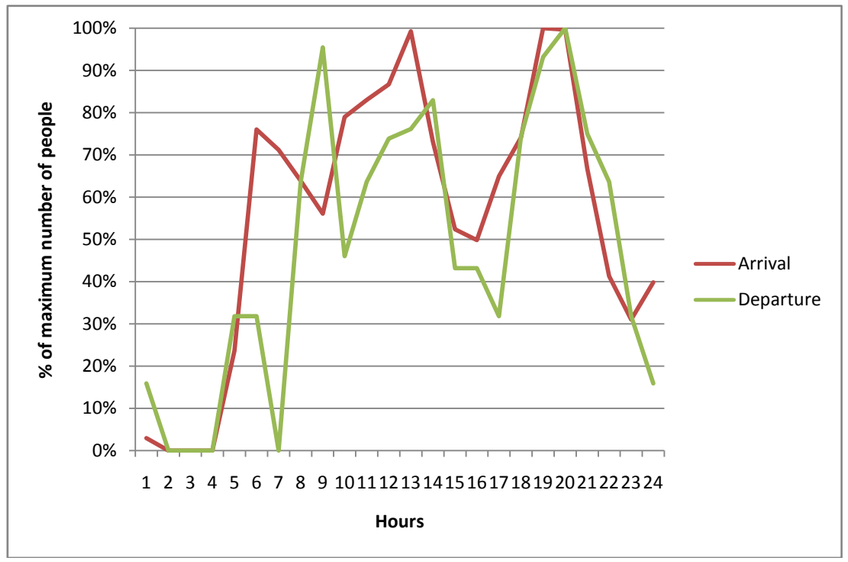


Figure 3 - Occupancy schedule for arrival and departure

Fans are considered to run from 5am to 11pm and light are assumed to operate from 6am to 11pm with a residual lighting power of 15% during the night.

Mechanical and Electrical

New construction mechanical and electrical system energy efficiency is based on the ASHRAE 90.1 2004 standard. Lighting power densities are defined for the different space types. Mechanical system types are defined in the ASHRAE 90.1 2004 Appendix G and equipment performance in section 6. The Design Option section gives details about the mechanical systems modeled.

Radiant floor areas

Radiant floor cooling was considered as a design option. Pipe imbedded in the concrete slab are not practical in certain area of the building where flexibility is required. For this reason, not all the areas were modeled with radiant floor.

Thermal mass elements

Concrete walls and slab where model in some areas to give the building more thermal inertia.

Impact of surrounding mountains on building shading

Mountain range East and West of the Airport have an impact on the solar gain. Mountains shade the building at sun rise and sun set. This has an impact on the energy consumption of the building.

A topographical map was analysed to determine horizon line angle with elevation and distance take-off.

A shading surface with the same height and distance from the airport was modeled in the software. A flat shading surface was used to model the horizon line instead of a mountain surface as it would have the same shading effect without requiring the significant computer processing time required to analyze a complex shape.

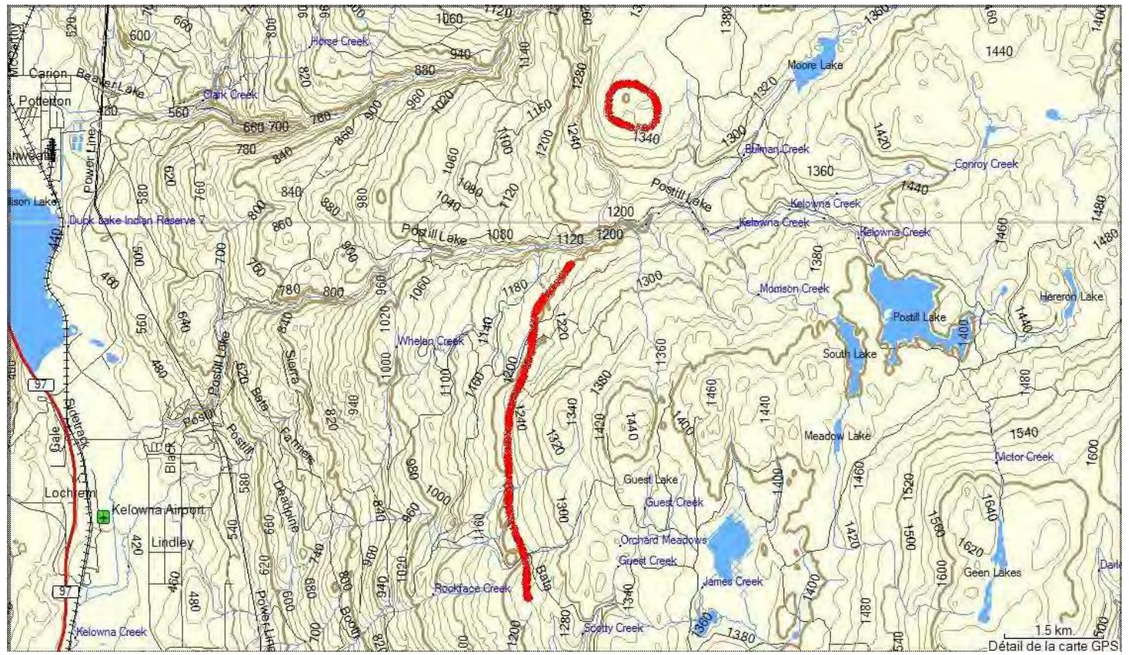


Figure 4 – Topographical map of Kelowna's airport surrounding (East side) identifying the mountain ridge and elevation that shades the airport

The horizon line is at an angle of 10 degrees from the horizontal on the West side and 7 degrees on the East side. This information can be incorporated in a sun path diagram to understand the impact of the mountains. A sun path diagram shows the path of the sun through the sky. This chart shows that the mountains are blocking the sun for the first hour of the day and for the last 40min of the day.

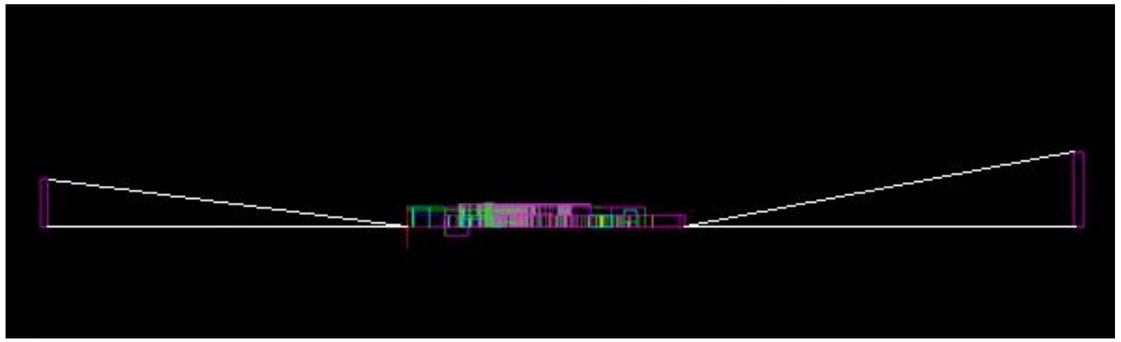


Figure 5 - Horizon line modeled in IES

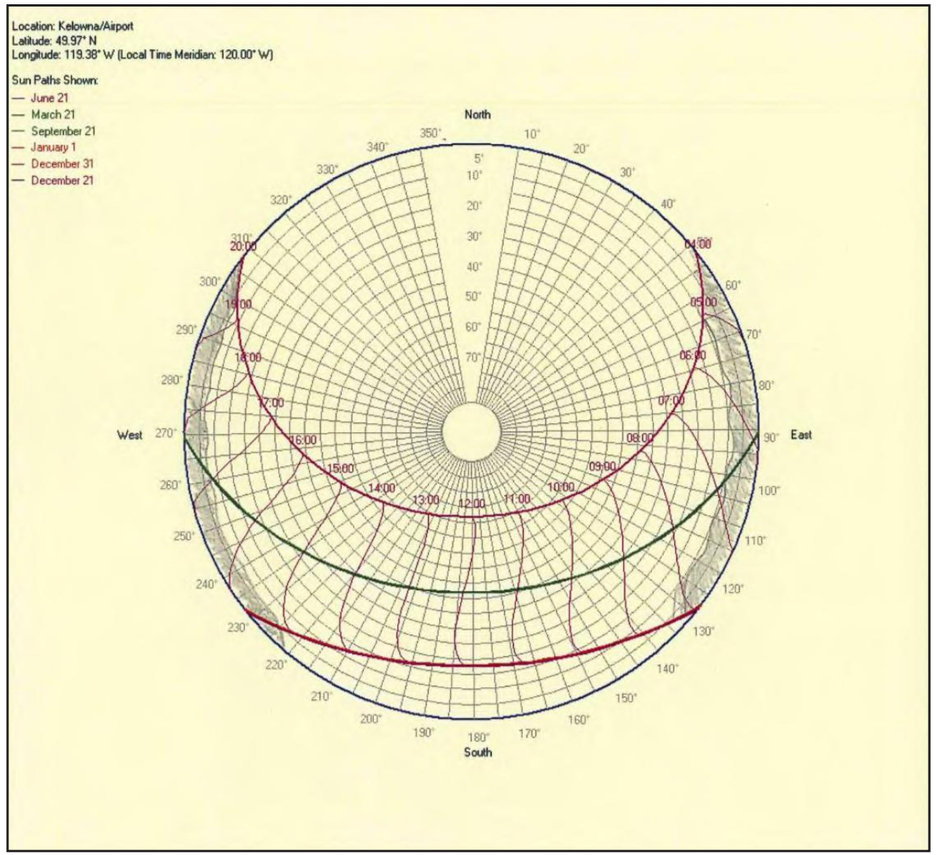


Figure 6 – Sunpath chart for Kelowna showing approximate shading from the mountain in gray

Utility Cost

Base on current utility bills, utility rates are 6.9¢/kWh for electricity and $11.18/GJ for natural gas. These rates include all demand and distribution charges. Designing this building for 2025, future rates need to be used in the analysis. Predicting future energy rates is difficult and subject to great debate. Natural gas is actively traded on the financial markets and can be purchased 5 years in advance. Looking at those future rates, we can identify a trend that can be extrapolated to predict 2025 rates. For this analysis we are being very conservative and are using the following values:

Commodity

Average Commodity price in the last year	Average BC gas supplier rates for fixed 5 year rate	2025 commodity rates used in the analysis
6.83$/GJ	7.9$/GJ	9$/GJ

Distribution Charge

Average distribution charge in the last year	2025 distribution charge used in the analysis
2.27$/GJ	3.7$/GJ

Other Charges

Other charge in the last year	2025 distribution charge used in the analysis
2.08$/GJ	2.08$/GJ

Total Natural gas price used is the sum of the commodity, distribution charge and other charges; 13.7$/GJ.

Future electricity rates are harder to determine due to the fact that the electricity market is regulated in BC. British Columbia government is keeping the rate as stable as possible and price follows the inflation rates. For this reason, electricity rates were kept the same as current rates in the energy simulation.

In our opinion, these rates are quite conservative (low). Higher gas rates were encountered in the last decade and could return particularly if the economy heats up again increasing demand, or if supply is constrained.

Energy Source Carbon Emissions

The following factors were used to convert utility consumption into green house gas emissions:

Electricity: 0.02kg/kWh1F

Gas: 0.181kg/kWh2F

Process Energy

Process energy related to aircraft operation such as the baggage handling systems, bridge powered units and any other aircraft operation were not included in the analysis. The impact of these processes should be done in a separate study to assess the carbon performance of the airport operations. Several opportunities exist to reduce process energy that the airport should consider to help meet their carbon reduction target. Efficient baggage handling systems, a policy to reduce aircraft powered unit use, and efficient apron lighting are a few ideas to be considered.

Integrated design approach

Optimization of facades

The energy model was used in the facade design process to help the design team understand the amount of heat gained from the sun shining through the windows. This is an important design consideration as uncontrolled solar gains can exceed the cooling capacity of efficient HVAC systems such as displacement ventilation and chilled slabs.

Solar and internal gains was analysed for each design option. The significant east and west facades require special attention as the low sun at sunrise and sunset will shine in through the east and west facades causing glare and temperature control challenges. A typical strategy to address these concerns is to reduce the east and west facade glazing ratio. This strategy was in tension with a desire to provide significant views to the apron, runway and mountains. Views are also important at the drop off and pick up areas. The design team balanced these considerations with an approach that varied the glazing ratio and sun shading to respond to the primary considerations for each space.

The IES Energy simulation software was also used to assess daylight performance. This information was used by the design team to adjust the glazing to provide daylight levels that will enhance the occupant experience. The electrical design was able to utilize this day lighting simulation information to inform their design. Lighting controls and systems will allow the electrical lighting to dim or turn off when sufficient day light is available to save on lighting energy.

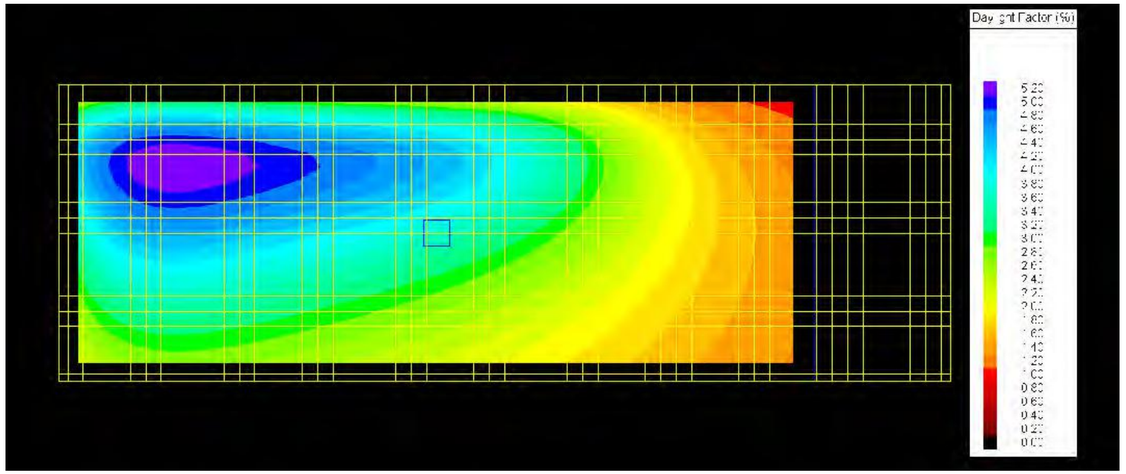


Figure 7 – Daylight analysis in the CBSA area

2 Environment Canada, http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=EAF0E96A-1
3 US Energy Information Administration, http://www.eia.doe.gov/oiaf/1605/coefficients.html

▸ Design Options

		V0	V1	V2A	V2B	V3	V4	V5	V6	
		Existing ATB only	Base Case	Envelope upgrade	Envelope upgrade plus Triple Glazing	Mec&Elec system Upgrade 1	Mec&Elec system Upgrade 2	V3 plus Geothermal	V4 plus Geothermal	Comment
Architecture	Insulation Values to Code		x							Roof R15, Wall R12, Glass Usi=3.2 w/frame
	Upgrade Insulation Values			x	x	x	x	x	x	Roof R30, Wall R24, Glass Usi=1.8 w/ frame
	High Performance Triple Glazing				x	x	x	x	x	Usi=1.1 with frame
	Additional Thermal Mass			x	x	x	x	x	x	
Mechanical	ASHRAE 90.1 mechanical system		x	x	x					Sys 5 VAV DX cooling, hot water coil, boiler 80%
	VAV Supply Units - Wet Coils					x		x		Sys 7 w/ heat recovery , boiler 87%
	Displacement Ventilation - Wet Coils						x		x	DOAS w/heat recovery, boiler 92%
	Geothermal							x	x	
Electrical	ASHRAE 90.1 compliant		x	x	x					
	Light Power Density reduced by 20%					x	x	x	x	
	Daylight sensor						x	x	x	
Existing Building	Existing building with no change	x	x							
	Implement Energy Audit Items without geothermal			x	x	x	x			Reduction as per audit report
	Implementing Energy audit with geothermal							x	x	

Figure 8 – Design Options

V0 represents the existing building without any expansion. CO2 and energy consumption are obtained from real data.

V1 represents the existing with no change with the addition of the expansion built to code. Insulation values, Lighting power density and mechanical system efficiencies meet ASHRAE90.1-2004 minimum requirements. The mechanical system is a VAV system with hot water coils and DX cooling. This is based on ASHRAE90.1-2004 appendix G assumptions that define baseline system types based on building floor area and the number of floors.

V2a is a first upgrade where the energy audit recommendations are implemented in the existing building with the exception of geothermal. Envelope insulation values are upgraded compared to code values.

V2b adds triple glazing to option V2a.

V3 is an upgrade to the mechanical and electrical systems. The mechanical system is a VAV system with hot and chilled water coils, heat recovery and high efficiency boilers. Lighting is upgraded with more efficient fixtures allowing a 20% Lighting Power Density reduction.

Detailed Results

		V0	V1	V2A	V2B	V3	V4	V5	V6
CO2	C02 Production (existing building) (tco2)	502	502	411	411	411	411	196	96
	C02 Production (new building) (tco2)	0	437	383	374	147	53	51	24
	Total CO2 (tCo2)*	502	939	794	786	558	464	247	220
	% overall carbon change	0%	87%	58%	56%	11%	-8%	-51%	-56%
Energy	Annual electricity consumption (MWh)		1160	1152	1146	1133	805	1251	847
	Annual natural gas consumption (MWh)		2289	1989	1942	688	201	142	39
	equivalent kwh/ft2 (new only)		37.8	34.4	33.8	20.0	11.0	15.3	9.7
	Annual electricity consumption (MWh) existing	4244	4244.0	3115.0	3115.0	3115.0	3115.0	3535.0	3535.0
	Annual natural gas consumption (MWh) existing	2354.0	2354.0	1981.0	1981.0	1981.0	1981.0	371.0	371.0
	equivalent kwh/ft2 (new only) existing	61.4	61.4	47.4	47.4	47.4	47.4	36.4	36.4
Cost	Annual electricity Cost ($) new building		$80,040	$79,513	$79,071	$78,201	$55,577	$86,304	$58,438
	Annual natural gas Cost ($) new building		$112,882	$98,098	$95,777	$33,941	$9,933	$6,994	$1,940
	Annual Energy Cost new building		$192,922	$177,611	$174,848	$112,142	$65,510	$93,298	$60,378
	Annual Energy savings		$0	-$15,310	-$18,074	-$80,780	-$127,412	-$99,624	-$132,543
	Annual electricity Cost ($) (existing)		$292,836	$214,936	$214,936	$214,936	$214,936	$243,916	$243,916
	Annual natural gas Cost ($) (existing)3F		$116,099	$97,703	$97,703	$97,703	$97,703	$18,298	$18,298
	Annual Energy Cost (existing)		$408,935	$312,639	$312,639	$312,639	$312,639	$262,214	$262,214
	Annual Energy savings (existing)		$0	-$96,296	-$96,296	-$96,296	-$96,296	-$146,722	-$146,722

Figure 9 - Design options - Results for 2025 building

4 Annual Energy cost uses future rates (see Utility Cost section)

V4 is a second upgrade to the mechanical and electrical systems. In this option, ventilation is decoupled from the cooling by using displacement ventilation and chilled slabs. Heat recovery is still included in the air systems and condensing boilers are used. Lighting is upgraded with daylight and occupancy sensors.

V5 is the same system as V3 with ground source heat pumps acting as the primary source of heating and cooling. The gas boilers are required to meet heating needs on very cold days. Ground source heat pumps are also providing heat to the existing building.

V6 is the same system has V4 with ground source heat pumps acting as the primary source of heating and cooling. The gas boilers are required to meet heating needs on very cold days. Ground source heat pumps are also providing heat to the existing building.

2016 building

		V0	V1	V2A	V2B	V3	V4	V5	V6
CO2	C02 Production (existing building) (tco2)	502	502	411	411	411	411	196	196
	C02 Production (new building) (tco2)		348	305	298	117	42	40	19
	Total CO2 (tCo2)*		850	716	709	528	453	237	216
	% overall carbon change		69%	43%	41%	5%	-10%	-53%	-57%
Energy	Annual electricity consumption (MWh)		923	917	912	902	641	996	674
	Annual natural gas consumption (MWh)		1822	1583	1546	548	160	113	31
	equivalent kwh/ft2 (new only)		38	34	34	20	11	15	10
	Annual electricity consumption (MWh) existing	4244.0	4244.0	3115.0	3115.0	3115.0	3115.0	3535.0	3535.0
	Annual natural gas consumption (MWh) existing	2354.0	2354.0	1981.0	1981.0	1981.0	1981.0	371.0	371.0
	equivalent kwh/ft2 (new only) existing	61.4	61.4	47.4	47.4	47.4	47.4	36.4	36.4
Cost	Annual electricity Cost ($) new building		$63,712	$63,292	$62,940	$62,248	$44,239	$68,698	$46,517
	Annual natural gas Cost ($) new building		$89,854	$78,086	$76,239	$27,017	$7,906	$5,567	$1,545
	Annual Energy Cost new building		$153,566	$141,379	$139,179	$89,265	$52,146	$74,265	$48,061
	Annual Energy savings		$0	-$12,187	-$14,387	-$64,301	-$101,420	-$79,301	-$105,504
	Annual electricity Cost ($) (existing)		$292,836	$214,936	$214,936	$214,936	$214,936	$243,916	$243,916
	Annual natural gas Cost ($) (existing)4F		$116,099	$97,703	$97,703	$97,703	$97,703	$18,298	$18,298
	Annual Energy Cost (existing)		$408,935	$312,639	$312,639	$312,639	$312,639	$262,214	$262,214
	Annual Energy savings (existing)		$0	-$96,296	-$96,296	-$96,296	-$96,296	-$146,722	-$146,722

Figure 10 – Design options - Results for 2025 building

5 Annual Energy cost uses future rates (see Utility Cost section)

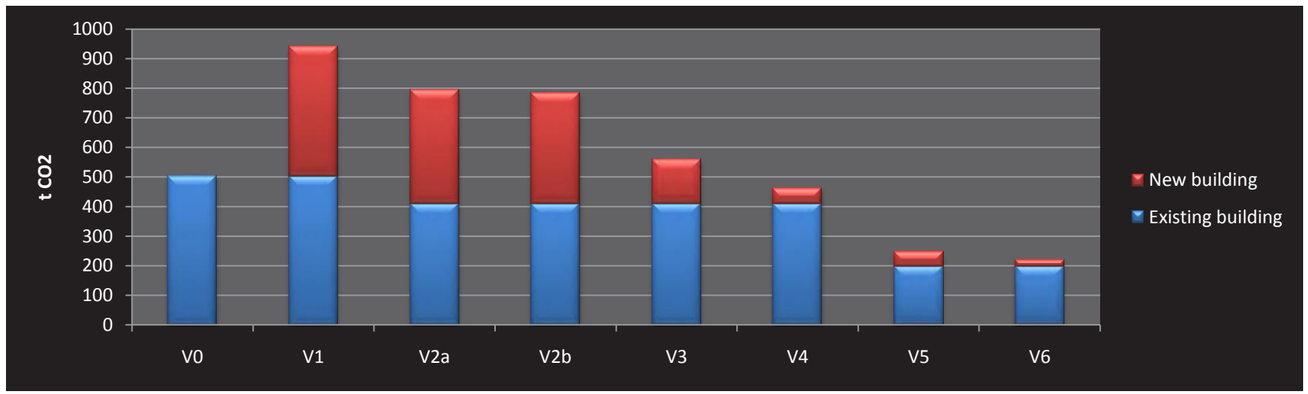


Figure 11 – Design option carbon emissions (2025 building)

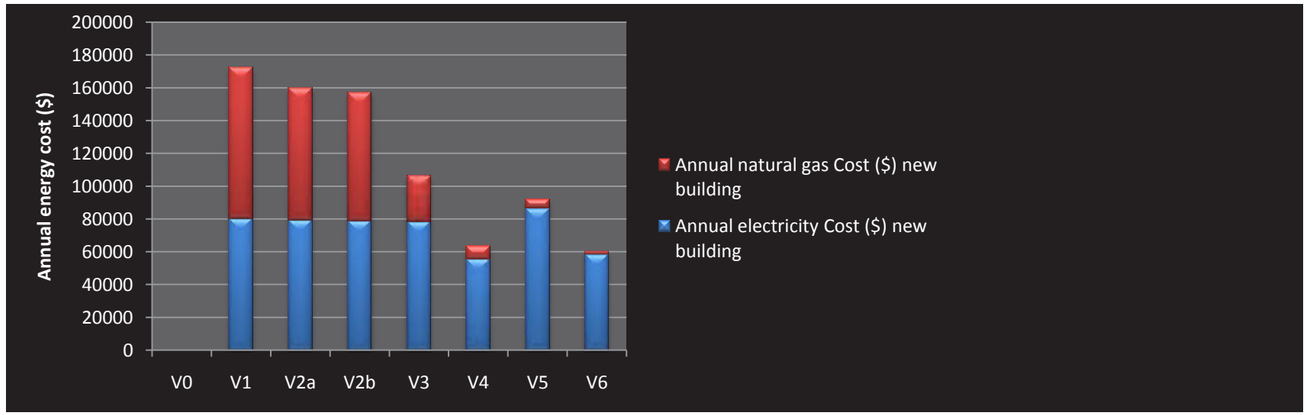


Figure 12 – Design Option annual energy costs (2025 building)

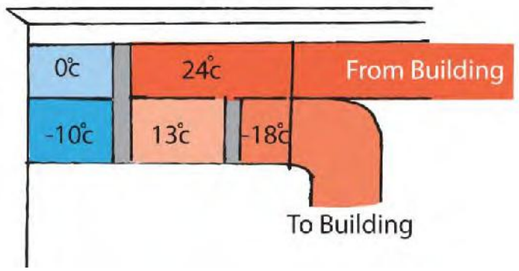
Proposed Energy Conservation Measures

Upgraded Insulation Values

Upgrades to the building envelope are most cost effective at the time of construction. The significant roof area will allow improvements to roof insulation to generate considerable cost effective savings. Wall and glass performance is also important. Further analysis can be performed in the design development phase to find the optimum insulation values for each building component to maximize return on investment. This analysis will confirm the cost effectiveness of the triple glazing option.

Air-to-Air Heat Recovery

Air-to-air heat recovery devices recover heat from the exhaust air to preheat the air intake. In most case return on investment are around 2-3 years.



Decoupling Ventilation and Cooling

Decoupling cooling from the ventilation allows different energy saving opportunities. With a chilled slab system cooling comes from cold surface fed by cold water instead of coming from cold air. Due to the fact that water can carry more energy than air, delivering cooling is more efficient and fan power is reduced. Displacement systems do not require reheat air at terminal boxes, as is often required in VAV systems. Displacement systems are smaller as they only provide air to meet ventilation requirements, instead of both ventilation and cooling needs as required by VAV systems. The cost savings from the reduced displacement air handling systems are often sufficient to pay for the hydronic cooling systems..

Displacement Ventilation

Displacement ventilation supplies air at temperature slightly lower than air temperature at low level to create an air curtain. When this air reaches a source of heat like a person or equipment, it rises as it picks up the heat creating temperature stratification in the room. The higher the ceiling, the more effective displacement systems are at removing heat gain. It has also the advantages of delivering air close to the occupants as opposed to high at the ceiling increasing ventilation effectiveness thereby allowing lower outside air volumes. By coupling this system with a chilled slab, the airport will be able to lower air volumes significantly.

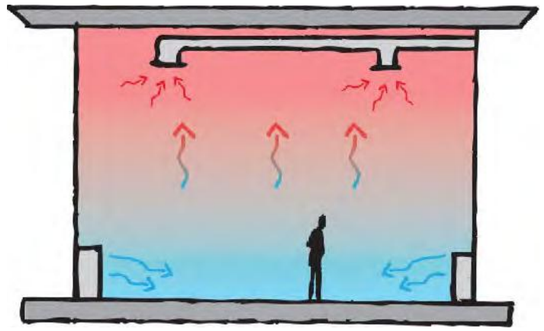


Figure 13 – Displacement ventilation

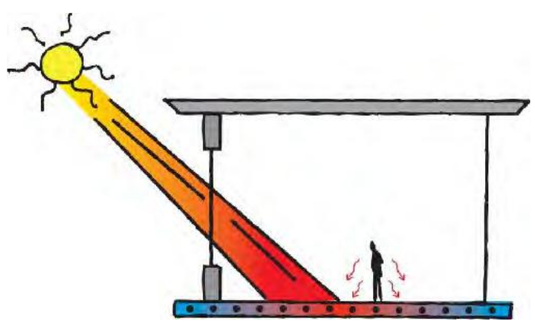
Radiant Floor/Chilled Slab

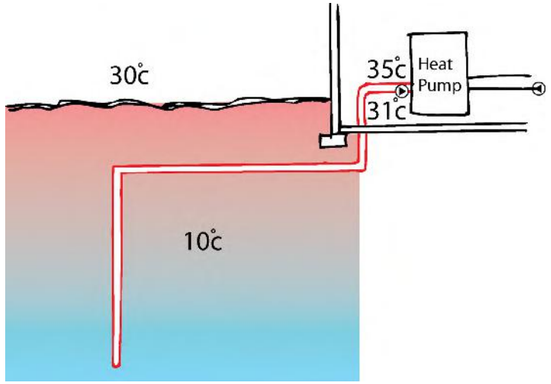
Chilled slab uses the radiant effect of a cold surface to absorb heat gain. Cool water runs inside the slab to maintain the floor surface at 18˚C. At 18˚C, the floor is only a few degrees cooler than room temperature – a difference that will be likely unnoticed by most occupants. This concept offers several advantages. Fan power is reduced by using a water based system for cooling. Space temperature can be a few degrees higher because of the radiant effect of the slab on the occupant. One concern with chilled slab system is that they cannot provide sufficient cooling to offset very high heat loads. For this reason, successful chilled slab design requires careful attention to sources of heat gains such as solar gains from nearby windows.

Ground Source Heat Pump

Ground source heat pumps extract heat from the ground using heat pumps. Heat pumps are similar to chillers, but the cycle is reversible. In winter mode, the ground is cooled and the heat is rejected into the building. In summer operation, the building is cooled and the heat is rejected into the ground. Since the ground temperature remains constant year round, geothermal cooling is more efficient than a typical cooling system. Source of energy is also different, instead of burning natural gas, electricity runs heat pump compressors and the pumps feeding the geothermal system. Switching the heating energy source from natural gas to electricity will reduce carbon emissions.

In order to make the geothermal system cost effective, the system is coupled with a boiler that serves the heating peak. Heating loads for a complete year were analyzed to determine optimal sizing. By sizing the system for 20% of the peak heating load, 80% of the energy can be supplied from the geothermal field. By combining the geothermal system with a boiler system, the return on investment for this system will be in the 10 year range. Once costs are confirmed by a cost consultant, the analysis can be updated to provide more accurate return on investment information.





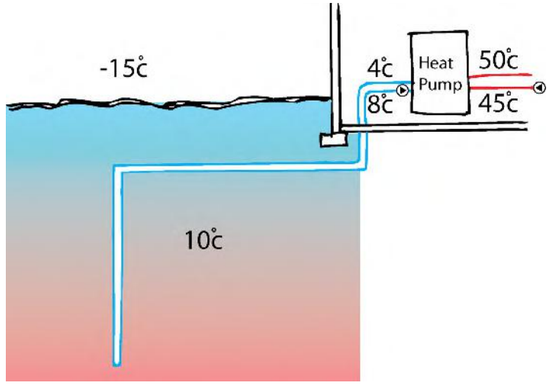


Figure 14 – Chilled slab

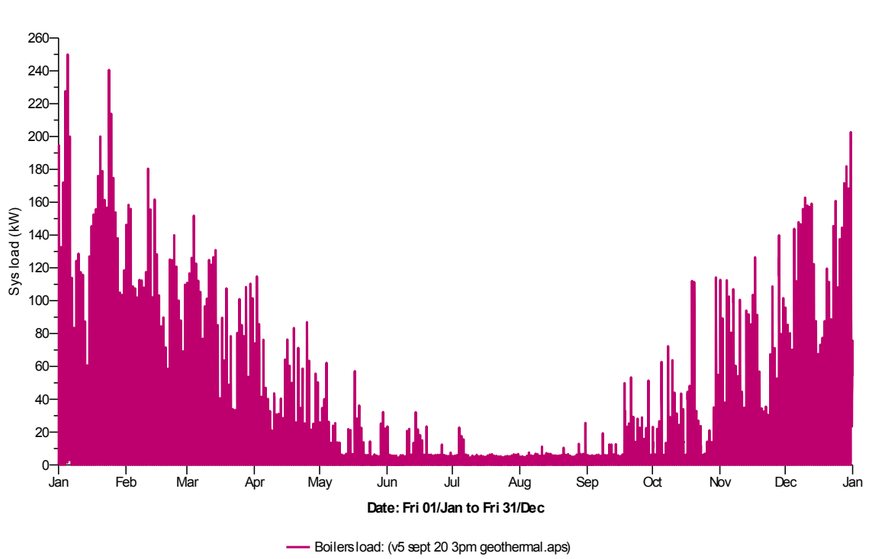


Figure 15 – Cooling load profile for the expansion

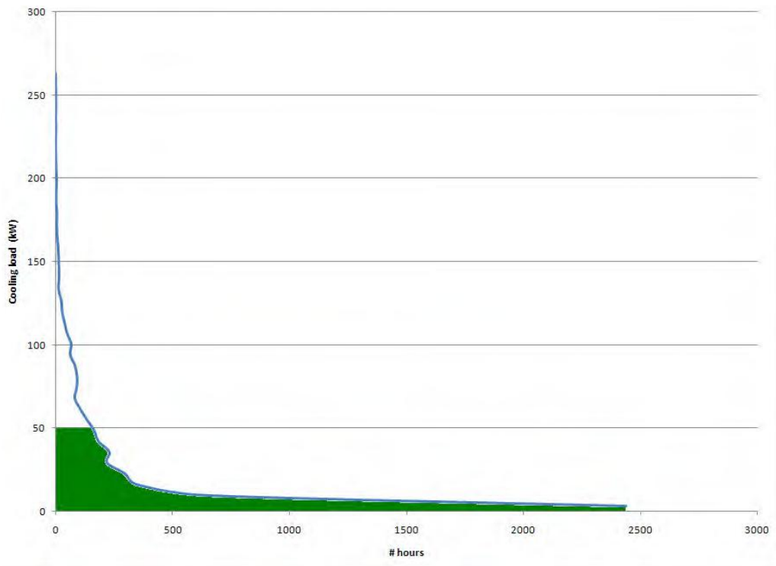


Figure 16 – Cooling load frequency

11.0 STRUCTURAL SYSTEMS

INTRODUCTION

General

The purpose of the Structural Schematic Design Report is to:

- Present the preliminary schemes considered for the structural systems
- Describe the structural systems proposed for the expansion
- Provide the architectural, mechanical, and electrical disciplines with information that will allow the design of the facility to progress, and
- Provide structural information for project costing.

The structural design presented is under development and will be revised and supplemented to meet project expectations, satisfy functional and aesthetic requirements, accommodate the needs of the mechanical and electrical disciplines, and meet cost objectives as the project proceeds.

Project Description

Briefly the Kelowna YLW Expansion comprises several additions to the existing two-storey air terminal building structure, including the trans-border holdroom and international arrivals facilities, domestic arrivals facilities, and outbound bag make-up hall. Phasing of these additions is described earlier in this report. These additions are generally single-storey, with a small two-storey component and a partial basement level beneath the domestic arrivals facility.

Structural Selection Criteria

As the project design develops, we will consider the following:

- **Integration of building systems.** The configuration of the structural roof and floor framing members and lateral load resisting elements will be coordinated closely with the mechanical and electrical systems to provide an efficient and compact integrated building system.
- **Adaptability.** Over time, there may be some desire or need to reconfigure the internal spaces of the air terminal building; the structural systems chosen will allow for future changes to the internal building layout.
- **Safety.** Design loads have been selected that are appropriate for the use and occupancy of the building.
- **Value for money.** Preference will be given to structural systems that provide economy for the project as a whole, taking into account the interdependence of costs between the architectural, structural, mechanical, and electrical systems.
- **Structural serviceability.** The potential for excessive structural deflections or movements will be carefully evaluated
- **Durability and long-term maintenance costs.** Structural materials will be selected that are robust and durable to reduce ongoing maintenance costs, particularly in areas exposed to public view.
- **Appearance.** Exposed structural systems are part of the architectural approach to the design; careful consideration will be given to the appearance of the structure in these areas.

DESIGN CRITERIA

Codes, Standards and Guidelines

Structural systems for the facility will be designed in accordance with the British Columbia Building Code 2006 and the National Building Code 2005 Structural Commentaries (Part 4 of Division B).

Structural components and materials will be proportioned in accordance with the requirements of the following design standards:

- CSA A23.1/A23.2-09 Concrete Materials and Methods of Concrete Construction / Methods of Test and Standard Practices for Concrete
- CAN/CSA A23.3-04 (R2010) Design of Concrete Structures
- CAN/CSA-S16.1-09 Design of Steel Structures
- CAN/CSA-O86-01 Engineering Design in Wood, including CAN/CSA-O86S1-05 Supplement #1
- CSA S304.1-04 Masonry Design for Buildings (Limit States Design).

The engineering design, preparation of related documents and contract administration for the air terminal building will be carried in accordance with the "Guidelines for Structural Engineering Services for Building Projects" published by the Association of Professional Engineers and Geoscientists of British Columbia. An independent concept review of the structural design will be performed by another engineer in accordance with the "Guidelines for Professional Structural Concept Review" published by the Association of Professional Engineers and Geoscientists of British Columbia.

Importance Category

The Building Code requires that an Importance Category be assigned to the facility based on the intended use and occupancy. Kelowna YLW will be designed assuming that the facility is a post-disaster control centre for air transportation.

The following importance factors will be applied to loads:

Load	Ultimate Limit State	Serviceability Limit State
Snow	1.25	0.9
Wind	1.25	0.75
Earthquake	1.5	Not applicable

Design Gravity Loads

Floor and roof areas, unless noted otherwise, will be designed for the following gravity loads:

Main Floor Areas

- Live 4.8 kN/m2
- Concentrated live 9.0 kN
- Super-imposed dead 1.5 kN/m2

Second Floor Areas

- Live 3.0 kN/m2
- Concentrated live 9.0 kN
- Super-imposed dead 1.5 kN/m2

Mechanical Rooms

- Live 3.6 kN/m2
- Equipment Actual weights
- Super-imposed dead 2.0 kN/m2

Roof Areas

- Basic snow and rain (not including drifting or ponding) 3.0 kN/m2
- Live 1.0 kN/m2
- Concentrated live 1.3 kN
- Super-imposed dead 1.0 kN/m2

Lateral Loads from Wind and Earthquake on Primary Structural Members

The lateral load resisting elements will be designed using the following parameters:

Wind

- Reference velocity pressure, 1 in 50 probability of being exceeded in any one year 0.47 kN/m2

Earthquake

- 5% damped spectral response acceleration, expressed as a ratio to gravitational acceleration
- Acceleration and velocity site coefficients
  - » Refer to Geotechnical and Foundation section of the report below
- Structural configuration Irregular
- Seismic Force Resisting System
  Structural steel, moderately ductile concentrically braced frames
  - » Ductility-related force modification factor 3.0
  - » Overstrength-related force modification factor 1.3

Period, T (s)	Spectral Acceleration Sa(T)
0.2	0.28
0.5	0.17
1.0	0.094
2.0	0.056

The seismic restraints for mechanical equipment and services, electrical equipment and services, and architectural components of the air terminal building will be designed by specialist engineers engaged directly by the sub-contractors.

Cladding support elements and attachments to the building structure will be designed for earthquake loads to satisfy the requirements of Article 4.1.8.17 of the British Columbia Building Code 2006

Vertical and Horizontal Deflections

Horizontal components of the structure, floors and roofs, generally deflect downward as a result of gravity loads. Excessive vertical deflections can create concerns, including cracking or crushing of non-structural components, lack of fit for doors and windows, out-of-plumb walls, and water ponding.

Structural members for YLW will be sized to limit deflections that occur after the attachment of non-structural components, including elastic and creep deflections due to sustained load, and immediate deflections due to live or snow load. Deflection limits used in the design are tabulated below, expressed as either an absolute value or as a ratio of span length:

Live Load Deflections	
Roof Members	
Perimeter, smaller of	25 mm L/360
Interior	L/360
Floor members	
Perimeter, smaller of	20 mm L/480
Interior	L/360

Open web steel floor and roof joists will be cambered by an amount equal to the anticipated dead load deflection of the joist. The intent is for the floors to be relatively flat and level, and roofs to have the required slopes for drainage in the long-term under dead loads.

As a result of normal construction procedures and material behavior, it is not possible to achieve perfectly flat and level floors. The project specifications will provide tolerances for floor flatness.

Structural members spanning horizontally, such as girts supporting a curtain wall, will be designed to limit horizontal movements to L/360.

Fire Rating

As discussed in the architectural section of the report, the suspended floors, the supporting columns, and all stair and elevator walls will be designed for a 1 hour fire resistance rating to conform to the required building classification. The roof construction is not required to have a fire resistance rating.

The fire resistance rating for structural steel members is achieved by providing fire retardant spray or other fireproofing on the open web steel joists and structural steel beams, girders, and columns.

CONSTRUCTION MATERIALS

Material Strengths

The following materials are proposed for the YLW expansion:

- Concrete, conforming to CSA-A23.1, made with Type GU Portland cement, as follows:

Application	28 day strength (MPa)	Exposure Class
Foundations	30	N
Interior slab-on-grade	25	N
Exterior slabs	32	C2
Concrete topping on metal deck	25	N

- Grade 400 deformed bar reinforcing steel conforming to CAN/CSA-G30.18
- Structural steel conforming to CAN/CSA-G40.20/G40.21, grade 350W for W shapes and hollow structural sections, grade 300W for other structural shapes and plate
- Open web steel joists conforming to CAN/CSA-S16.1
- Metal decking conforming to the requirements of CAN/CSA-S136
- Timber construction will conform to materials standards referenced in CAN/CSA O86, glulam bending grades 24f-E or 24f-EX and compression grade 16c-E.

Sustainable Design

The sustainable design attributes of the structural systems include:

- **Recycled steel.** Structural steel and reinforcing steel used in expansion of the air terminal building will have a recycled materials content greater than 90%.
- **Re-use of waste materials.** The specifications will require that a portion of the cementitious material used for reinforced concrete members be fly-ash, a waste by product of the coal fired power generation industry. For cast-in-place concrete foundation elements, up to 40% of the total cementitious materials content can be fly ash. For flatwork, fly-ash content is limited to 10% as fly-ash impedes the setting of the concrete and makes slab finishing more difficult.
- **Control of dust and water during construction.** The specifications for the project will be prepared so that the contractor is required to control dust and the erosion of soil from wind and water during construction.
- **Timber framing.** Where practical, portions of the expansion framing will utilize timber harvested from British Columbia forests.

GEOTECHNICAL ISSUES AND FOUNDATIONS

A report titled *"Preliminary Geotechnical Engineering Report, Air Terminal Building (ATB) Expansion, Kelowna International Airport"*, dated February 25, 2010, was prepared by Levelton Consultants Ltd. A second report titled *"Preliminary Geotechnical Engineering Report, Baggage Make-Up Facility Expansion, Kelowna International Airport"*, dated February 23, 2010, was also prepared by Levelton.

The Levelton reports indicate that the soil stratigraphy generally consists of a surface layer of asphalt pavement 100-150 mm thick, underlain by approximately 0.6-1.3 m of compact to dense granular fill, underlain by a layer of firm to stiff clayey silt / silty clay / silt, underlain by interlayered, generally loose to compact sand / silty sand and stiff silt /clay / silty clay.

Groundwater elevations were reported to be between 1.3 and 3.0m below grade.

Recommended site preparation includes removal of the existing asphalt pavement and excavation to the required foundation grade. The anticipated foundation subgrade is existing granular fill, which is recommended to be compacted with vibratory equipment to re-densify any disturbed soils prior to commencing foundation construction. Where excavation exposes fine grained sols, a geotextile will be required as a separator over the subgrade prior to placement of engineered fill.

Levelton recommend that foundations bearing on the existing granular fill or on compacted engineered fill can be designed based on a serviceability limit state (SLS) soil bearing resistance of 125 kPa ,and a factored ultimate limit state (ULS) soil bearing resistance of 190 kPa. Spread and strip footings designed in accordance with these recommendations will be utilized for the facility expansion.

Sulfate concentrations in the collected soil samples range from less than 0.05 and 0.15%, indicating a moderate degree of sulfate attack, and necessitating the use of sulphate-resistant concrete.

Analysis by Levelton of the information gained from cone penetration testing and seismic cone penetration in the area of the expansion indicates that layers of loose sand / silty sand deposits located below the water table are liquefiable during a design-magnitude earthquake. Accordingly, Levelton recommend that design of the structure be based on Site Class 'F' conditions. The results of site-specific analysis undertaken by Levelton indicate that acceleration and velocity site coefficients of 1.78 and 3.64 respectively should be used for earthquake design of the air terminal building.

Levelton also recommends the installation of a perimeter foundation drainage system comprised of rigid, perforated PVC pipe placed within a drain rock surround, wrapped with a non-woven geotexile.

A slab-on-grade floor is considered feasible for this site; this is consistent with the existing construction.

Retaining walls with heights of up to 2.4 m may be required to accommodate the existing grades. These walls will be designed to resist the applied lateral soil pressures.

SUPERSTRUCTURE

Construction Materials

The primary construction materials considered for the superstructure of the expansion are structural steel, concrete and timber.

Cast-in-place concrete was used for a previous portion of the air terminal building superstructure; the exposed structure is prominent in the existing public areas. Concrete construction is site labour intensive, requiring several skilled trades including formwork crews, rebar installers, and concrete placing and finishing crews. The higher labor and material cost, the increased mass of concrete construction (resulting in increased foundation and lateral load resisting systems for sites like Kelowna) do not favor concrete superstructure construction. Consequently, we do not recommend cast-in-place concrete construction for the air terminal building expansion.

The use of structural steel reduces the vertical and lateral loads to be resisted by the structure (as compared to concrete), and also reduces reliance on site labour. Structural steel is anticipated to be the most economical system for the spans and building volumes of the type proposed.

Timber construction has been used on a number of similar projects, allowing the structure to be expressed as part of the architectural design, highlighting the timber that is harvested in British Columbia. Fire rating requirements will suggest timber be limited to roof construction only, although other uses may be possible.

In arriving at the recommended structural systems for the Chilliwack Secondary School we have given close consideration to both structural steel and timber alternatives.

Suspended Floor Construction

Suspended floors for the expansion will comprise concrete topping over composite metal deck, supported on open web steel joists and structural steel beams, consistent with the existing second floor areas.

Roof Framing

The functional needs of the various portions of the expansion, whether the arrival / departure lounges or the bag make-up hall, dictate the structural bay sizes; the structural design must economically accommodate these requirements. The structure may be exposed to view as part of the architectural design in portions of the facility.

After carefully balancing project costs and function with architectural appearance, we recommend that structural steel framing be used for expansion, with possibly some use of timber framing. Preliminary framing plans for the various roof areas are shown in the drawings on this page and the following page.

Roof framing will be sloped to drains.

Lateral Load Resisting System

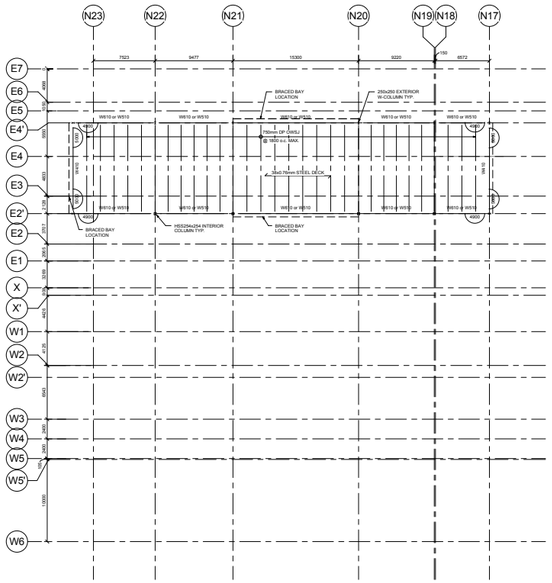
Lateral load resisting elements will be required to stabilize the facility under wind loads and seismic inertial forces. Lateral loads and forces acting on the building will be transferred horizontally through the floor and roof diaphragms to the vertical lateral load resisting elements. The vertical elements that transfer these loads and forces to the foundation will consist of structural steel cross, chevron and V bracing.

In the final design, we will analyze the structure for lateral loads and forces using the ETABS computer program.

Building Control Joints

To reduce stresses that develop due to concrete shrinkage and thermal movements, structures are typically subdivided by building control joints spaced at approximately 70 m centres. As well, large structures are often separated by expansion joints at structural discontinuities or irregularities to reduce thermal, shrinkage and diaphragm stresses. Further, seismic separation of additions from the existing structure may reduce the extent of required seismic upgrading.

The expanded YLW air terminal building is very long in the north-south direction and somewhat irregular in plan. The international arrivals facilities, the domestic arrivals facilities, and the bag make-up hall each will be separated from the existing structure. The expansion joints are not required within the slab on grade.



1 PHASE 1 EXPANSION PLAN
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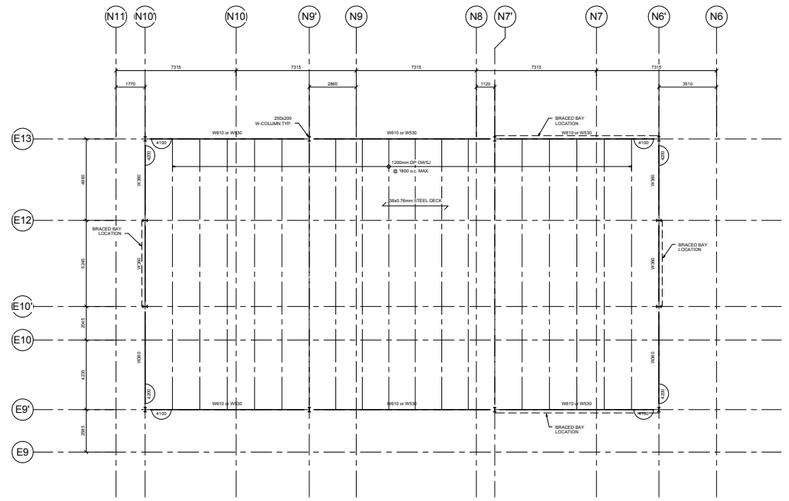
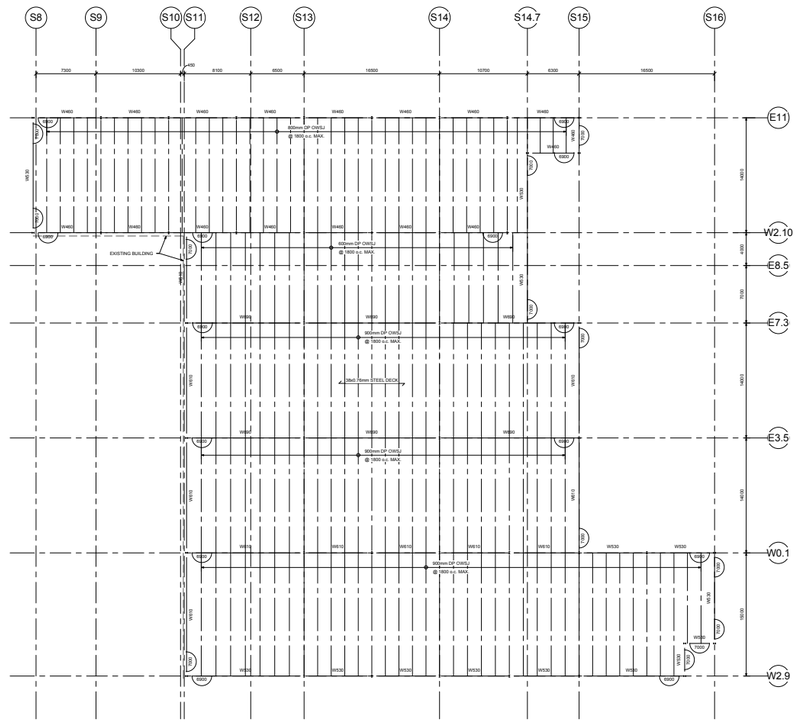


2 PHASE 2 EXPANSION PLAN
1 : 100



5 PHASE 3 PARTIAL EXPANSION PLAN
1 : 200

NOTE:
1. TOP OF STEEL ELEVATION BASED ON TOP OF FINISHED FLOOR VARIANCE SHOWN THUS: Xxx/x
BEAM ELEVATIONS BASED ON 100mm JOIST SEAT. CONTRACTOR TO ADJUST ELEVATIONS AS REQUIRED FOR JOIST SEAT VARIANCE.

COSTING

In determining overall building costs from the information presented in this report, appropriate allowances must be made for atypical geometry, heavily loaded areas, and special framing required to suit the functional requirements of the other disciplines.

Project costs must include allowances for the following:

- The geotechnical requirements for site preparation, granular fill beneath slabs-on-grade and the like, including potential increased structural fill depths due to unanticipated soil conditions.
- Excavation shoring and dewatering requirements
- Structural framing for mechanical and electrical rooms, including pads, curbs, equipment supports, special framing around mechanical and electrical service penetrations, and the like.
- Structural steel framing for stairs, guards, railings and handrails.
- Roof ladders and cages.
- Steel framing for elevator support beams, rail and ladders.
- Framing for overhead doors.
- Structural steel for perimeter metal deck support, diaphragm chords, drag struts and the like.
- Cast-in plates for connections.
- Additional steel or timber framing to provide support for significant suspended loads.
- Miscellaneous structural framing for the support of exterior cladding, glazing, louvers, and screens not accommodated by the steel stud framing.
- Exterior structures such as retaining walls, planters, walks, curbs, and so forth.
- Exterior structural slabs adjacent to entries.
- Fire protection for structural steel and timber members.
- Window washing requirements.

12.0 SIGNAGE AND WAYFINDING

13.0 CIVIL

Information to be provided at a later date.

14.0 CODE

General Project Description

The proposed Kelowna International Airport (KIA) is located in Kelowna BC.

Applicable Building Code

This report identifies building code requirements based upon compliance with the current British Columbia Building Code 2006 (BCBC 2006). References stated herein are to the BC Building Code 2006 unless otherwise indicated

Fire separation assemblies will be based upon Underwriters' Laboratories of Canada List of Equipment and Materials, Fire Resistance (ULC), unless otherwise noted.

AUTHORITY HAVING JURISDICTION

The authority having jurisdiction for the project is the City of Kelowna.

BUILDING HEIGHT AND AREA (APPROXIMATE)

The building area as defined by the BCBC for purposes of determining the classification of the building will be approximately 16,975 m^2.

BUILDING CLASSIFICATION

Occupancy classifications are determined in accordance with the requirements of Subsection 3.1.2.

The majority of the airport expansion will be used for pedestrian circulation, queuing, and waiting areas associated with processing aircraft passengers, and for service areas associated with baggage handling. Therefore, the applicable major occupancy classifications for the main floor are Group A, Division 2, Assembly, Group F, Division 3, Medium Hazard Industrial (baggage areas) and Group D (second floor). To be discussed and confirmed with City of Kelowna.

The KIA will also include ancillary office and retail areas, intended for the use of occupants of the building and interspersed throughout the floor areas on each level. In accordance with Sentence 3.2.2.8.(1), occupancies that constitute more than 10% of the floor area of the storey in which they are located are considered major occupancies. There are no office or retail occupancies that are over 10% of the total floor area located on the main floor.

CONSTRUCTION AND SPRINKLERING REQUIREMENTS

Subsection 3.2.2 describes applicable construction requirements to prevent fire spread and collapse based on building size and occupancy and the provision of automatic sprinklering. For a building containing multiple major occupancies

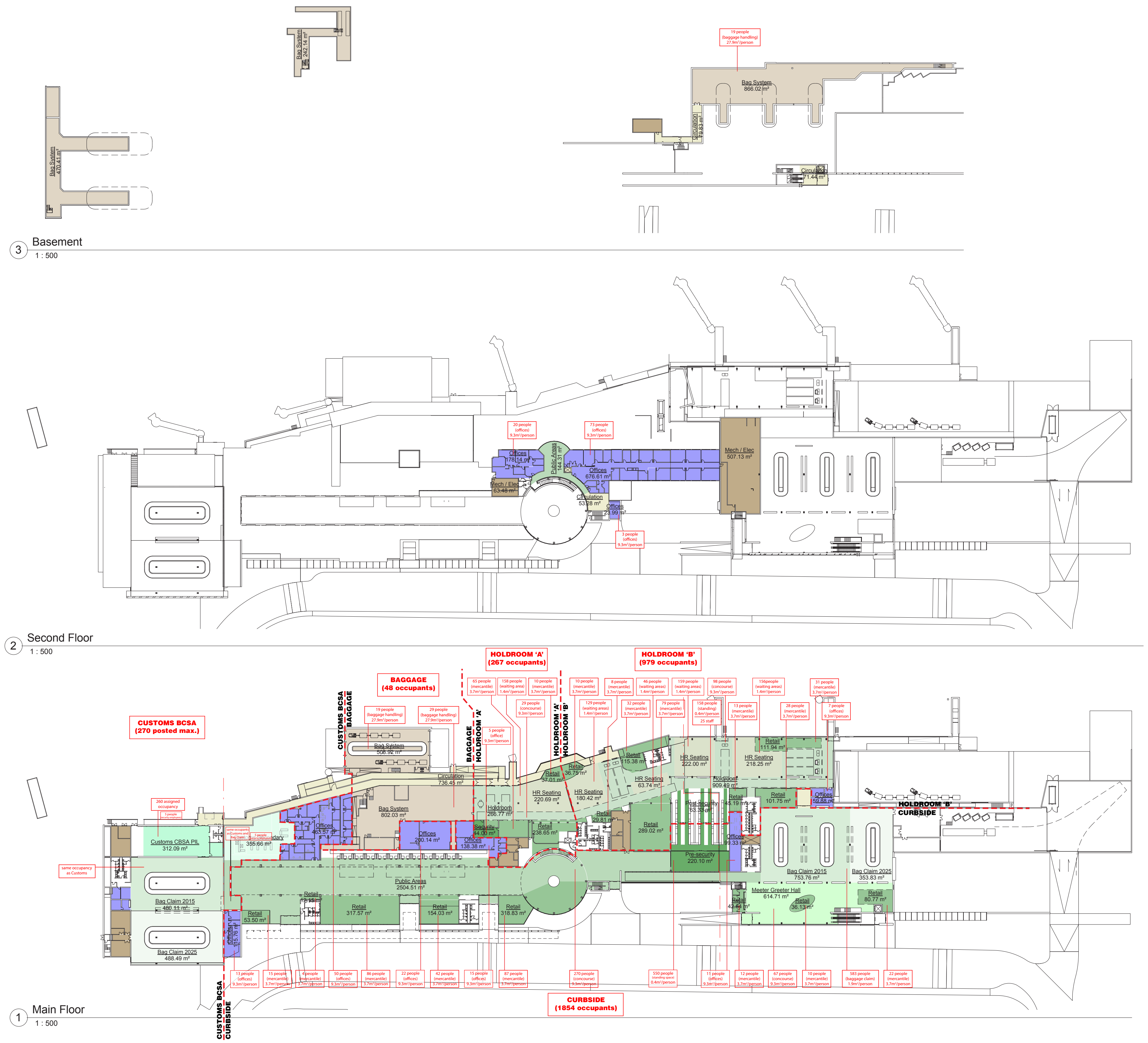
- Article 3.2.2.6., requirements for the most restrictive major occupancy shall apply to the whole building, and
- Article 3.2.2.7., where one major occupancy is located entirely above another, it is permissible to apply the requirements of Subsection 3.2.2. to each portion of the building separately (while considering the height and area of the whole building), except that the fire-resistance rating of the floor assembly between the major occupancies shall be determined based on the lower occupancy.

Applicable requirements of Subsection 3.2.2., based on the major occupancies within the KIA are as follows.

- Article 3.2.2.24. Group A, Division 2, Assembly, up to 6 Storeys, Any Area, Sprinklered for the Arrivals and Departures level.
- Article 3.2.2.67. Group F, Division 3, Any Height, Any Area, Sprinklered for the areas used for baggage handling
- Article 3.2.2.49. Group D, Any Height, Any Area, Sprinklered for the second floor office area. As the entire second floor is used for office use, it will be considered a major occupancy.

The requirements of 3.2.2.24 and 3.2.2.67 are the most restrictive and will be applied throughout. In summary, construction requirements for the Kelowna Airport expansion are as follows.

- The building will be of non-combustible construction.
- The building will be sprinklered throughout
- For the Arrivals and Departures Levels, floor assemblies will be fire separations with a fire-resistance rating not less than 1 hour. Interconnections will be provided as per requirements listed in 3.2.8.2.(6).
- For the F3 occupancies, floor and wall assemblies between that area and the remainder of the building will be fire separations with a fire-resistance rating not less than 2 hours.
- Loadbearing walls, columns and arches will have a fire-resistance rating not less than that required for the supported assembly.
- Article 3.1.3.1.(3), In a building conforming to the requirements of Articles 3.2.8.2. to 3.2.8.9., the requirements of Sentence (1) for fire separations between major occupancies do not apply at the vertical plane around the perimeter of an opening through the horizontal fire separation. Therefore, no fire separation will be required between the main and second floor (as long as the requirements of Articles 3.2.8.2. to 3.2.8.9. are maintained).



Basement floor - Code Compliance - Area Schedule	
Name	Area
Bag System	1,579 m²
Circulation	151 m²
Mech / Elec	51 m²

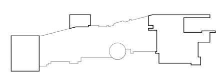
Second floor - Code Compliance - Area Schedule	
Name	Area
Circulation	59 m²
Mech / Elec	571 m²
Offices	879 m²
Public Areas	144 m²
RestRooms	23 m²

Main floor - Code Compliance - Area Schedule	
Name	Area
Bag Claim 2015	1,234 m²
Bag Claim 2025	842 m²
Bag System	1,311 m²
Circulation	773 m²
Customs CBSA PIL	312 m²
Customs Secondary	356 m²
Holdroom	1,176 m²
HR Seating	905 m²
Mech / Elec	422 m²
Meeter Greeter Hall	615 m²
Offices	1,139 m²
Public Areas	2,505 m²
RestRooms	618 m²
Retail	2,021 m²
Security	704 m²

YLW
Kelowna International Airport

SCHEMATIC DESIGN

KEYPLAN



LEGEND

- Bag Claim 2015
- Bag Claim 2025
- Bag System
- Circulation
- Customs CBSA PIL
- Customs Secondary
- Holdroom
- HR Seating
- Mech / Elec
- Meeter Greeter Hall
- Offices
- Public Areas
- RestRooms
- Retail
- Security

CODE PLANS

INTERCONNECTED FLOOR AREAS

There will be a central Atrium in the building. This interconnected floor space need not conform to the requirements of articles 3.2.8.3. to 3.2.8.9. because:

- The interconnected floor space is open only to the ground and second floors.
- The building is fully sprinklered.
- The building consists of only Group A, Division 1 and 2 occupancies.
- The allowable building area is unlimited.

ADDITIONAL CONSTRUCTION REQUIREMENTS

- Janitor rooms will be separated from the remainder of the building by fire separations having no required fire-resistance rating (3.3.1.21.).
- Exit stairs will be separated from the remainder of the building by fire separations having a 1 hour fire-resistance rating (3.4.4.1.(1)).
- Elevator hoistways will be separated from the remainder of the building by fire separations having a 1 hour fire-resistance rating (Table 3.5.3.1.). Elevator machine rooms will be separated from the remainder of the building (except from the elevator hoistways) by fire separation having a fire-resistance rating of 1 hours (3.5.3.3.).
- Service rooms containing fuel-fired appliances will be separated from the remainder of the building by fire separations having a 1 hour fire-resistance rating (3.6.2.1.(1)).
- A room for the storage of combustible refuse will be separated from the remainder of the building by a fire separation having a fire-resistance rating of 1 hour (3.6.2.5.).
- Vertical service spaces will be separated from the remainder of the building by fire separations having a 45 minute fire-resistance rating (Table 3.6.3.1.), or will be dampered at each floor level.

HIGH BUILDING CONSIDERATIONS

The height of the building from grade to the floor level of the highest storey is approximately 6.9 m. Therefore, the building will not incorporate requirements for high buildings (3.2.6.1.(1)(a)).

SITE ACCESS FOR FIRE FIGHTING

- Because the building area is greater than 600 m2, access for fire department vehicles is required to be provided between 3 m and 15 m of a principle entrance of the building (3.2.5.4. & 5.). The City of Calgary Fire Department, in a meeting dated June 26, 2008, granted approval to provide fire truck access to within 30 m of the main entrance, provided hard surfaces capable of supporting a fire truck were constructed between the roadway and the main entrance.
- The site roadway access route will:
  - Have a clear width not less than 6m.
  - Have a centerline radius not less than 12 m.
  - Have an overhead clearance not less than 5 m.
  - Have a change of gradient no greater than 1 in 12.5.
  - Be designed to support fire-fighting equipment in all climatic conditions.
  - Have no dead-end portions longer than 90 m.
  - Be connected to a public thoroughfare.

OCCUPANT LOADS

The occupant load of a building is used to determine the number and width of exit facilities that must be provided and the width of access routes leading to exits from within floor areas. BCBC 2006 acceptable solutions require occupant load to be determined based on the occupant density factors prescribed in Table 3.1.17.1., and, if not based on those values, a sign indicating an alternative occupant load is required to be posted in a conspicuous location. The occupant load should represent a realistic approximation of the largest number of people who can reasonably be expected to occupy a given floor area.

Additionally, Annex material to NFPA 101 Life Safety Code provides suggested occupant load factors specific to airport floor areas as follows:

NFPA 101 TABLE A.7.3.1.2 AIRPORT TERMINAL OCCUPANT LOAD FACTORS

AIRPORT TERMINAL AREA	M2 / PERSON (GROSS)
Concourse	9.3
Waiting Areas	1.4
Baggage Claim	1.9
Baggage Handling	27.9

Occupant loads in non-public areas of the KIA will be calculated based on application of Table 3.1.17.1., except where NFPA 101 provides factors that are specific to airports.

For the purposes of occupant loads, the Airport has been divided into multiple areas:

The occupant load has been calculated as follows:

MAIN FLOOR

Curbside:

• Office:	1017.17 sq.m. @ 9.3 sq.m.:	110 persons
• Mercantile:	1015.62 sq.m. @ 3.7 sq.m.:	275 persons
• Concourse:	3119.22 sq.m. @ 9.3 sq.m.:	336 persons
• Standing (pre-security)	220.10 sq.m. @ 0.4 sq.m.:	550 persons
• Baggage Claim	1107.59 sq.m. @ 1.9 sq.m.:	583 persons

Total: 1854 persons

Customs:

• Posted Occupancy	270 persons

Total: 270 persons

Holdroom 'A':

• Office:	4.00 sq.m. @ 9.3 sq.m.:	5 persons
• Mercantile:	275.66 sq.m. @ 3.7 sq.m.:	75 persons
• Concourse:	266.77 sq.m. @ 9.3 sq.m.:	29 persons
• Waiting Areas	220.69 sq.m. @ 1.4 sq.m.:	158 persons

Total: 267 persons

Holdroom 'B':

• Office:	59.88 sq.m. @ 9.3 sq.m.:	7 persons
• Mercantile:	729.84 sq.m. @ 3.7 sq.m.:	198 persons
• Concourse:	909.49 sq.m. @ 9.3 sq.m.:	98 persons
• Waiting Areas	684.41 sq.m. @ 1.4 sq.m.:	489 persons
• Standing (pre-security)	63.33 sq.m. @ 0.4 sq.m.: + 25 staff	184 persons

Total: 976 persons

Baggage:

• Baggage Handling:	508.92 sq.m. @ 27.9 sq.m.:	19 persons
• Baggage Handling:	802.03 sq.m. @ 27.9 sq.m.:	29 persons

Total: 48 persons

SECOND FLOOR		
• Office:	178.14 sq.m. @ 9.3 sq.m.:	20 persons
• Office:	676.61 sq.m. @ 9.3 sq.m.:	73 persons
• Office:	23.99 sq.m. @ 9.3 sq.m.:	3 persons
		Total: 96 persons
BASEMENT FLOOR		
Baggage Handling:	866.02 sq.m. @ 27.9 sq.m.:	31 persons
		Total: 31 persons

EGRESS AND EXIT CAPACITIES

As prescribed by BCBC 2006 Article 3.3.1.17. and Sentence 3.4.3.2.(1), the minimum aggregate width of exits serving floor areas intended for occupancy is to be determined by multiplying the occupant load of the area served by 6.1 mm per person for horizontal routes such as ramps, doorways and corridors, and 8 mm per person for most stairs.

Additionally, for interconnected floor spaces in the KIA, in accordance with Sentence 3.4.3.2.(6), widths are required to be cumulative for the areas served unless the cumulative occupant load can be accommodated within exit stairs or protected floor spaces.

- Every room or suite having an occupant load greater than 60 persons, a travel distance greater than 25 m to a door, or an area greater than 200 m2 will have two egress doors leading from the room or suite (3.3.1.5.).
- The minimum width of corridors used by the public will be 1100 mm (3.3.1.9.(2)).
- Dead end corridors will not exceed 3 m in length (3.3.1.9.(7)).
- Travel distance to at least one exit will not exceed:
  - » 45 m in a floor area that contains an occupancy other than a high-hazard industrial occupancy, provided it is sprinklered throughout,
  - » 105 m in any floor area served by a public corridor, in which rooms and suites are not separated from the remainder of the floor area by a fire separation, provided the public corridor is not less than 9 m wide, the ceiling height is not less than 4 m, the building is sprinklered throughout, and not more than one half of the required doorways from a room or suite open into the public corridor if the room or suite is required to have more than one egress doorway, and
  - » 30 m in any floor area other than those referred to above.
- Guards on stairs will be 920 high at flights, and 1070 high at landings. They shall not have openings greater than 100 mm, nor shall they facilitate climbing (3.4.6.5.).
- Stair Configuration – No flights of stairs will have a vertical rise of more than 3.7 m between floors or landings (3.4.6.3.(1)). Treads for stairs will have a run of not less than 280 mm between successive steps, and risers will be not more than 180 mm (3.4.6.7.(1&2)). The leading edge of each stair tread will have a radius or bevel between 6 and 10 mm in horizontal dimension (3.4.6.7.(4)).
- One exit stair may exit through a lobby in conformance with 3.4.4.2.:
  - » The lobby will not be more than 4.5 m above grade.
  - » The path through the lobby to the exterior will not exceed 15 m.
  - » Service rooms and storage rooms will not open directly into the lobby.
  - » The lobby will be separated from adjacent spaces by a fire separation having no required fire-resistance rating.

The required exit widths are as follows:

MAIN FLOOR

Curbside: 1854 persons x 6.1mm/person = **11,310 mm of exit width**

Customs: 270 persons x 6.1mm/person = **1,647 mm of exit width**

Holdrooms: 267+976 = 1243 persons x 6.1mm/person = **7,582 mm of exit width**

Baggage Handling: 48 persons x 6.1mm/person = **293 mm of exit width**
*(2 exits required at minimum widths required by code)

SECOND FLOOR

Office: 96 persons x 8.0mm/person = **768 mm of exit width**
*(2 exits required at minimum widths required by code)

BASEMENT FLOOR

Baggage Handling: 31 persons x 6.1mm/person = **293 mm of exit width**
*(2 exits required at minimum widths required by code)

BARRIER-FREE CONSTRUCTION

- A barrier-free path of travel will be provided to not less than 50% of the pedestrian entrances to the building and throughout all normally occupied spaces (3.8.1.2.(1) & 3.8.2.1.(1)). At least one door at each barrier free entrance will be provided with a power door operator (3.8.3.3.(5)(c)).
- Controls intended for operation by occupants will be mounted between 400 mm and 1200 mm above the floor (3.8.1.5.).
- Barrier-free parking spaces will be provided in accordance with Table 3.8.2.2.
- The exterior passenger loading zone will have an access aisle and curb ramp (3.8.2.2.(3)).
- Appropriate signs will be provided indicating locations of barrier free facilities (3.8.3.).
- Exterior walks that form part of a barrier-free path of travel will be at least 1100 wide and designed as a ramp if the slope exceeds 1 in 20 (3.8.3.2.).
- Every door in a barrier-free path of travel will have a clear width of not less than 800 mm in the open position (3.8.3.3.(1)). Door hardware in a barrier-free path of travel will be of a design that does not require tight grasping and twisting of the wrist as the only means of operation (3.8.3.3.(3)). Closers on interior doors in a barrier free path of travel will include a delayed (3 second) closing time (3.8.3.3.(9)). Except within suites or where power door operators are used, doors in a barrier free path of travel will have a clear space beyond the latch side of 600 mm where the door swings toward the approach side, and 300 mm where the door swings away (3.8.3.3.(10)). Vestibules in a barrier-free path of travel will be at least 1200 mm long in addition to the door swing of any door swinging into the vestibule (3.8.3.3.(11)).
- Ramps in a barrier-free path of travel will be minimum 870 wide between handrails, and will have a maximum slope of 1 in 12 (3.8.3.4.).
- Elevators will comply with Appendix E of CAN/CSA-B44, Safety Code for Elevators (3.8.3.5.). At least one elevator serving each storey will have clear inside cab dimensions of 2032 mm x 1295 mm, and a door width of 1067 mm (Appendix A-3.5.4.1.(1)).
- All assembly areas with an area greater than 100 m2 will be provided with assistive listening devices in accordance with 3.8.3.7.
- Public washrooms will include at least one barrier free water closet stall with an open space having a diameter of not less than 1500 mm. The water closet seat heights, urinal opening heights, lavatory heights and clearances, grab bars, counter heights and mirrors will comply with 3.8.3.8. to 3.8.3.11.
- Counters more than 2 m long that serve the public will have at least one barrier free section not less than 760 mm wide (3.8.3.14.).

PLUMBING SERVICES

PLUMBING SERVICES - Utilizing the occupant loads noted in Section 11, the KIA requires the following washroom fixtures.

LEVEL	DESCRIPTION	OCCUPANT LOAD	NUMBER OF WATER CLOSETS		NUMBER OF URINALS	NUMBER OF LAVATORIES	
			M	F		M	F
1	Curbside	1854	8	19	5	7	10
1	Customs	270	1	6	2	2	3
1	Holdroom 'A'	267	1	6	2	2	3
1	Holdroom 'B'	976	3	14	5	4	7
1	Bag System	48	1	2	1	1	1
2	Office	96	1	2	1	1	1
B	Bag System	19	1	1	0	1	1

15.0 COST ESTIMATE

APPENDICES

▸ Appendices

Energy Audit

Concept Plan Area Reconciliation

Primary Security Line

KELOWNA INTERNATIONAL AIRPORT

Energy Audit Study

City of Kelowna

October 2010

Project Number: 03048C0400

Prepared by:

Grant Kidd, P.Eng., **LEED® AP**
Mechanical Associate

COHOS EVAMY
integratedesign™

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