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TECHNICAL MEMORANDUM NO. 4 – ALTERNATIVES

MASTER PLAN UPDATE
PORTLAND INTERNATIONAL AIRPORT

Prepared for
Port of Portland
Portland, Oregon

November 2009

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1. INTRODUCTION AND SUMMARY

This Technical Memorandum summarizes the alternative concepts considered for satisfying facilities requirements at Portland International Airport (the Airport or PDX) through 2035, as presented in *Technical Memorandum No. 3 – Facility Requirements,* December 2008. Alternative concepts were developed for the airfield (i.e., the runways and taxiways), the passenger terminal, ground transportation and parking, air cargo, and general aviation. The potential cost and aircraft noise impacts of the recommended long-term development concept are summarized in the appendices of this Technical Memorandum.

1.1 Planning Activity Levels

Recognizing the uncertainties associated with long-range aviation demand forecasting, five planning activity levels (PALs) were identified to represent future levels of activity at which key Airport improvements will be necessary. Because, for any number of reasons, activity levels could occur at different periods from those anticipated when the forecasts were prepared, the use of PALs allows for facilities planning that is realistically tied to milestone activity levels as they occur, rather than arbitrary years. PAL 1, PAL 2, PAL 3, PAL 4, and PAL 5 correspond to the 50th percentile aviation demand forecasts for 2012, 2017, 2022, 2027, and 2035, respectively. The aviation demand associated with each PAL is summarized in Table 1-1.

Table 1-1

AVIATION DEMAND FORECASTS

		Aviation Demand Forecasts *(a)*				
	Actual 2007	PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035
Enplaned passengers (thousands)	7,332	7,489	8,992	10,312	11,825	13,393
Total air cargo (thousands of short tons) *(b)*	280	322	414	496	594	732
Aircraft operations						
Passenger airline	191,554	180,400	207,000	228,000	250,600	275,000
All-cargo airline	33,324	37,980	41,240	44,840	48,760	52,320
General aviation	27,623	26,100	28,200	29,500	30,900	32,500
Military	3,707	6,000	6,000	6,000	6,000	6,000
Other *(c)*	8,310	8,000	9,100	10,100	11,100	12,000
Total Airport aircraft operations	264,518	258,480	291,540	318,440	347,360	377,820

(a) Forecasts are shown for planning activity levels (PALs) and their corresponding years.
(b) A short ton equals 2,000 pounds.
(c) Includes nonscheduled and empty flights.

Sources: Actual 2007 demand from Port of Portland records. Forecast demand from Jacobs Consultancy, *Technical Memorandum No. 2 – Aviation Demand Forecasts*, September 2008.

1.2 Summary of Requirements

The most significant findings reported in *Technical Memorandum No. 3 – Facility Requirements* were that (1) a third parallel runway will not be required during the planning period and (2) terminal and ground access requirements can continue to be satisfied within the existing terminal envelope. Continued Airport development within the planning period will be required; however, it will not be necessary to implement a new Airport development concept (e.g., the centralized or decentralized development concept) as envisioned at the conclusion of the *2000 Airport Master Plan*.

The detailed requirements, which form the basis for the alternatives presented in this Technical Memorandum, are summarized in Table 1-2 from *Technical Memorandum No. 3 – Facility Requirements*, which is reproduced in Appendix A.

1.3 Emerging Development Concepts

This section provides an overview of how future development may occur at the Airport through a series of illustrations depicting the locations where recommended development concepts (hereafter referred to as "projects") will be implemented. The overview is organized by PAL and includes descriptions of the significant projects that will be needed to satisfy major functional requirements.

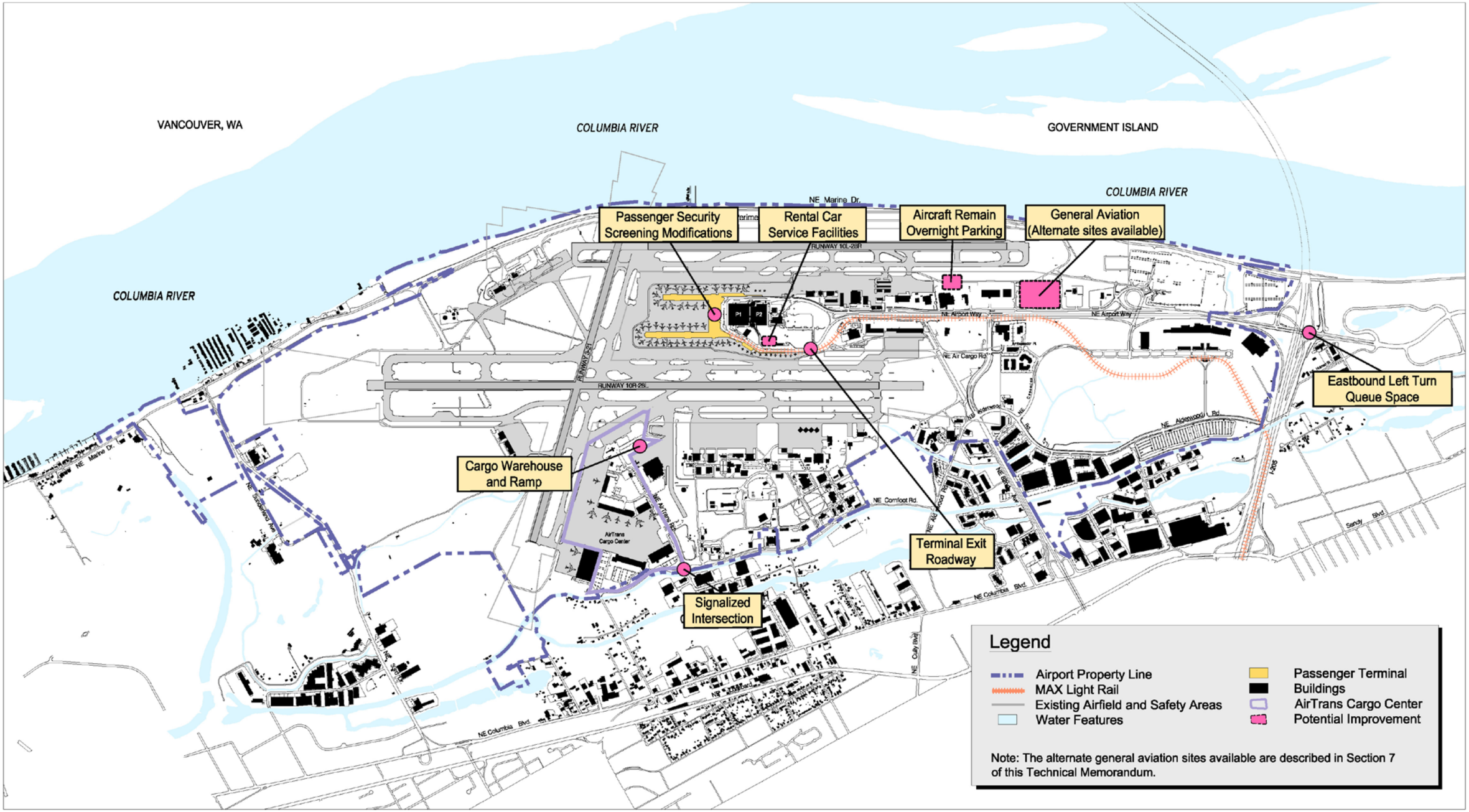
PAL 1 through PAL 5 correspond with the enplaned passengers, air cargo, and aircraft operations demand forecast to occur in 2012, 2017, 2022, 2027, and 2035, respectively. The functional requirements were developed based on activity, not time. Therefore, if activity does not occur as quickly as anticipated, the projects remain valid although the timing of their implementation may change.

It should be noted that sustainability planning principles, as developed during this Master Plan, were used extensively in developing the recommended concepts. These principles are discussed in detailed later in this Technical Memorandum.

1.3.1 Development by Planning Activity Level 1

PAL 1 demand is approximately 15 million total annual passengers, 322,000 short tons of cargo, and 258,000 aircraft operations. The locations of potential Airport development required to accommodate activity at PAL 1 are shown on Figure 1-1.

The most significant project is the remain overnight (RON) aircraft parking ramp, located immediately to the north of NE Airport Way and the hotel properties. This project will enable increased productivity of the aircraft gates located at the terminal.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 2,100'
Scale: 1" = 2,100'

Source: Jacobs Consultancy, November 2009

Figure 1-1

Planned Development at PAL 1
(15 million annual passengers; approximately 2012)
Master Plan Update
Portland International Airport

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Supplemental at-grade rental car service facilities, which include fuel positions, car wash bays, and car storage, will be provided to the east of the existing rental car service facilities. One alternative being considered is that the existing and new rental car service facilities would be connected by a bridge that passes over the ramp leading to rental car facilities inside the P1 garage.

Projects to improve roadway and intersection performance will occur on the terminal exit roadway (a lane addition), the intersection of NE AirTrans Road and Cornfoot Road (a signalized intersection), and the intersection of NE Airport Way and I-205 (the addition of space to accommodate queues of eastbound traffic turning to the north).

Multiple sites have been identified for a second general aviation fixed-base operation, should that be required. For illustrative purposes, the site to the northeast of the intersection of NE Airport Way and NE 82nd Avenue is shown on Figure 1-1. For this project, the Port's costs would be limited to those associated with providing site access, utilities and aircraft ramp. Development costs would be borne by a developer or operator.

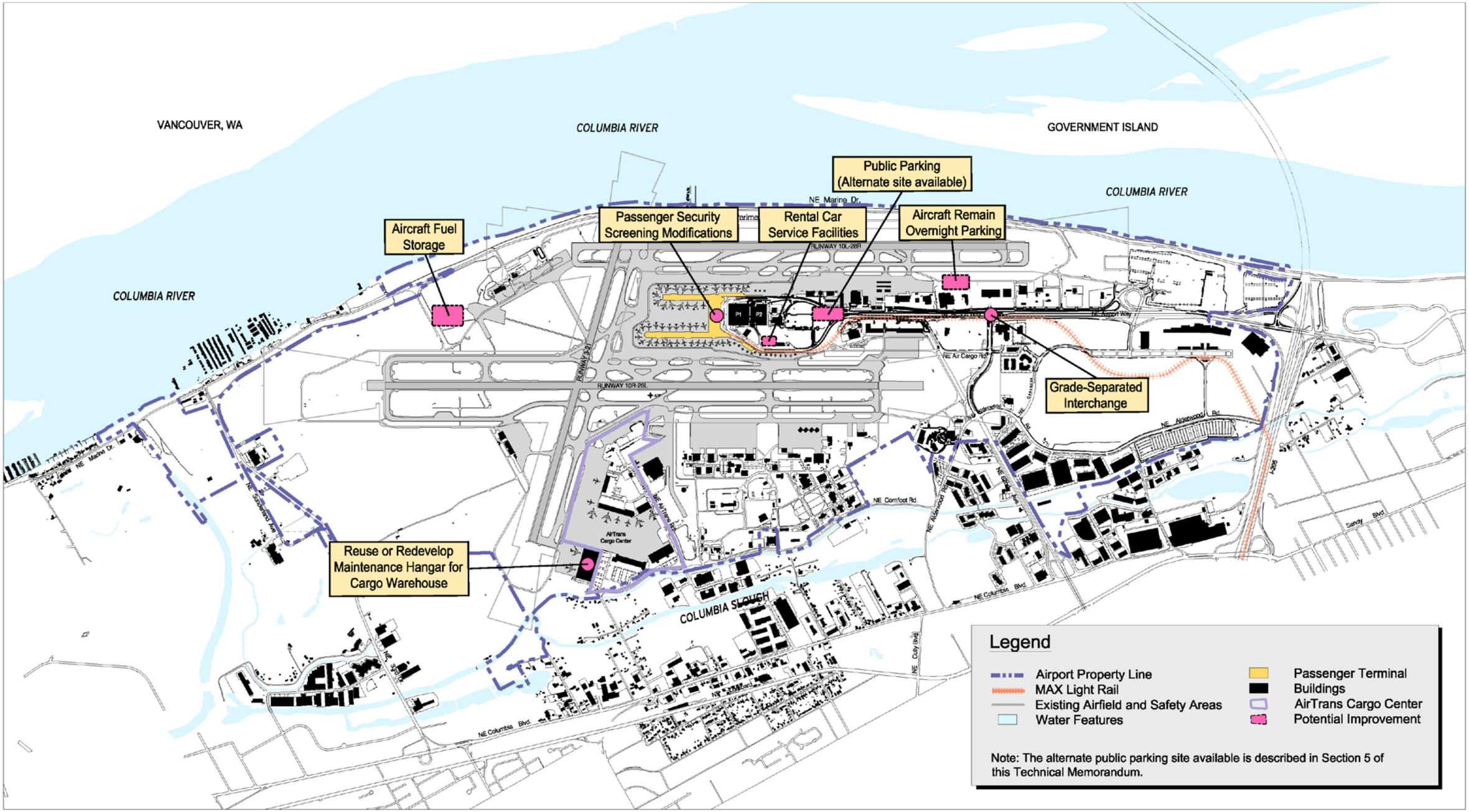
Undeveloped parcels located in the northern part of AirTrans Cargo Center would be improved as appropriate for development for all-cargo/maintenance use by a developer or operator.

Minor projects are expected within the passenger terminal related to security screening. As the Transportation Security Administration changes its equipment and procedures associated with passenger security screening, the space associated with the equipment and passenger processing will be rearranged accordingly. These projects are expected to continue throughout the planning period.

1.3.2 Development by Planning Activity Level 2

PAL 2 demand is approximately 18 million total annual passengers, 414,000 short tons of cargo, and 292,000 aircraft operations. The locations of potential Airport development required to accommodate activity at PAL 2 are shown on Figure 1-2.

Significant projects required to accommodate PAL 2 include the construction of a third public parking garage (approximately 2,060 spaces) and a grade-separated interchange at the intersection of NE Airport Way and NE 82nd Avenue. Although the location of the garage will be decided subsequent to the completion of the Master Plan Update, the current consensus is that it would be located immediately to the east of the central utility plant and Federal Aviation Administration (FAA) airport traffic control tower (ATCT) as shown on Figure 1-2. This site is referred to as the P3 site; the alternate site is referred to as the P4 site.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

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Scale: 1" = 2,100'

Source: Jacobs Consultancy, November 2009

Figure 1-2

Planned Development at PAL 2
(18 million annual passengers; approximately 2017)
Master Plan Update
Portland International Airport

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The RON aircraft parking ramp and supplemental rental car service facilities added for PAL 1 activity would be expanded and minor projects related to passenger security screening, as described above, would be completed. The existing aircraft fuel storage facilities would be expanded.

All-cargo warehouse and ramp requirements would be met by either reusing or redeveloping the aircraft maintenance hangar located in the southwest corner of the AirTrans Cargo Center or by other redevelopment opportunities that may arise during the planning period.

1.3.3 Development by Planning Activity Level 3

PAL 3 demand is approximately 21 million total annual passengers, 496,000 short tons of cargo, and 318,000 aircraft operations. The locations of potential Airport development required to accommodate activity at PAL 3 are shown on Figure 1-3.

The public parking garage, RON aircraft parking ramp, and supplemental rental car service facilities constructed at PAL 1 and expanded at PAL 2 would be further expanded.

The existing commercial vehicle area, located between the lower level public roadways and the P1 garage, would be reconfigured to provide supplemental deplaning curbside and roadway capacity. Additional minor projects related to passenger security screening, as described previously, would be completed and the existing aircraft fuel storage facilities would be further expanded.

Roadway projects would include the addition of a westbound lane to NE Airport Way and the addition of queuing space for traffic on NE Alderwood Road traveling northbound and turning left on NE Cornfoot Road.

When all-cargo activity reaches the level forecast for PAL 3, AirTrans Cargo Center will be at capacity and additional all-cargo development will occur in the Southwest Quadrant, unless other suitable development opportunities have arisen.

1.3.4 Development by Planning Activity Level 4

PAL 4 demand is approximately 24 million total annual passengers, 594,000 short tons of cargo, and 347,000 aircraft operations. The locations of potential Airport development required to accommodate PAL 4 are shown on Figure 1-4.

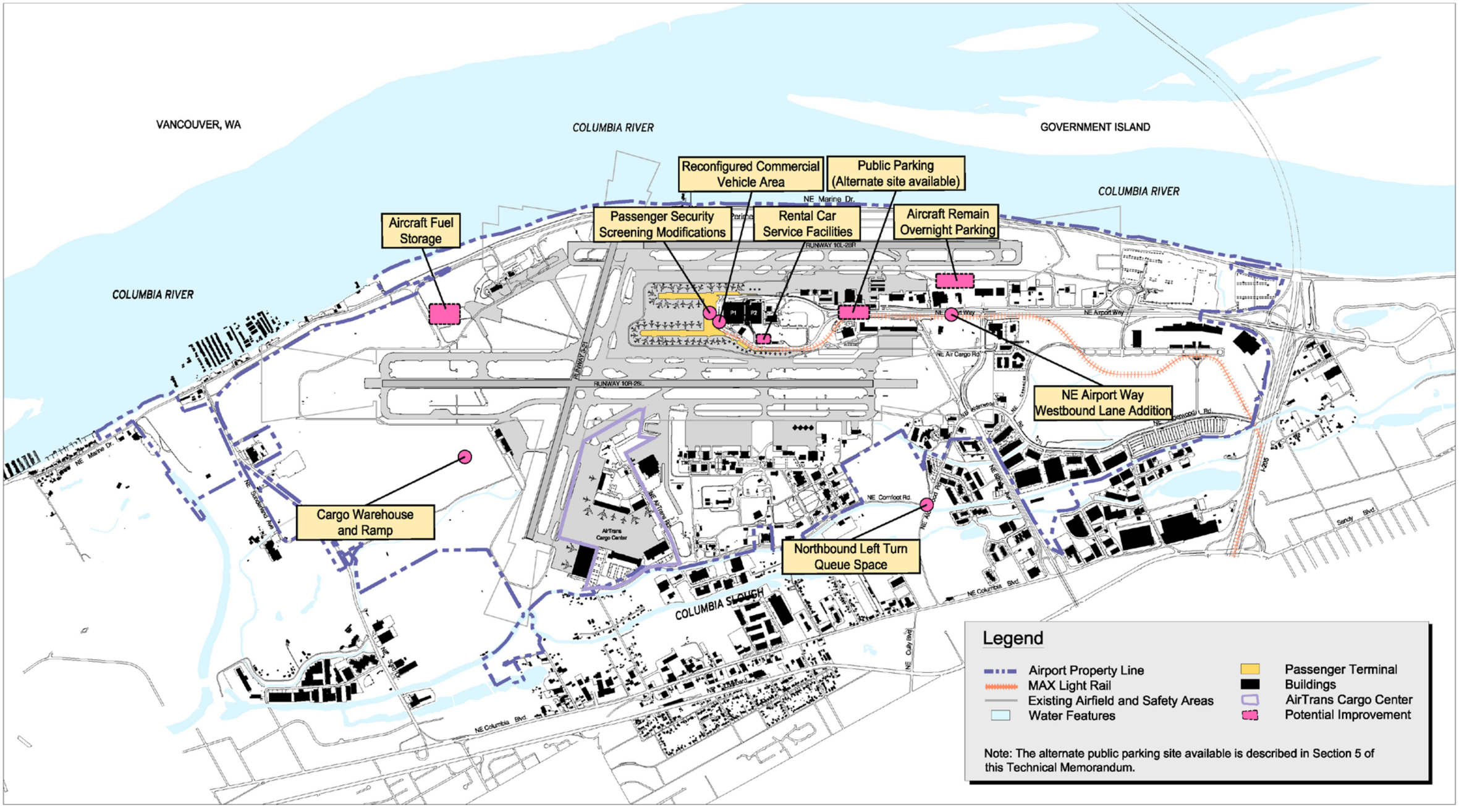

Figure 1-3

Planned Development at PAL 3
(21 million annual passengers; approximately 2022)
Master Plan Update
Portland International Airport

Source: Jacobs Consultancy, November 2009

November 2009

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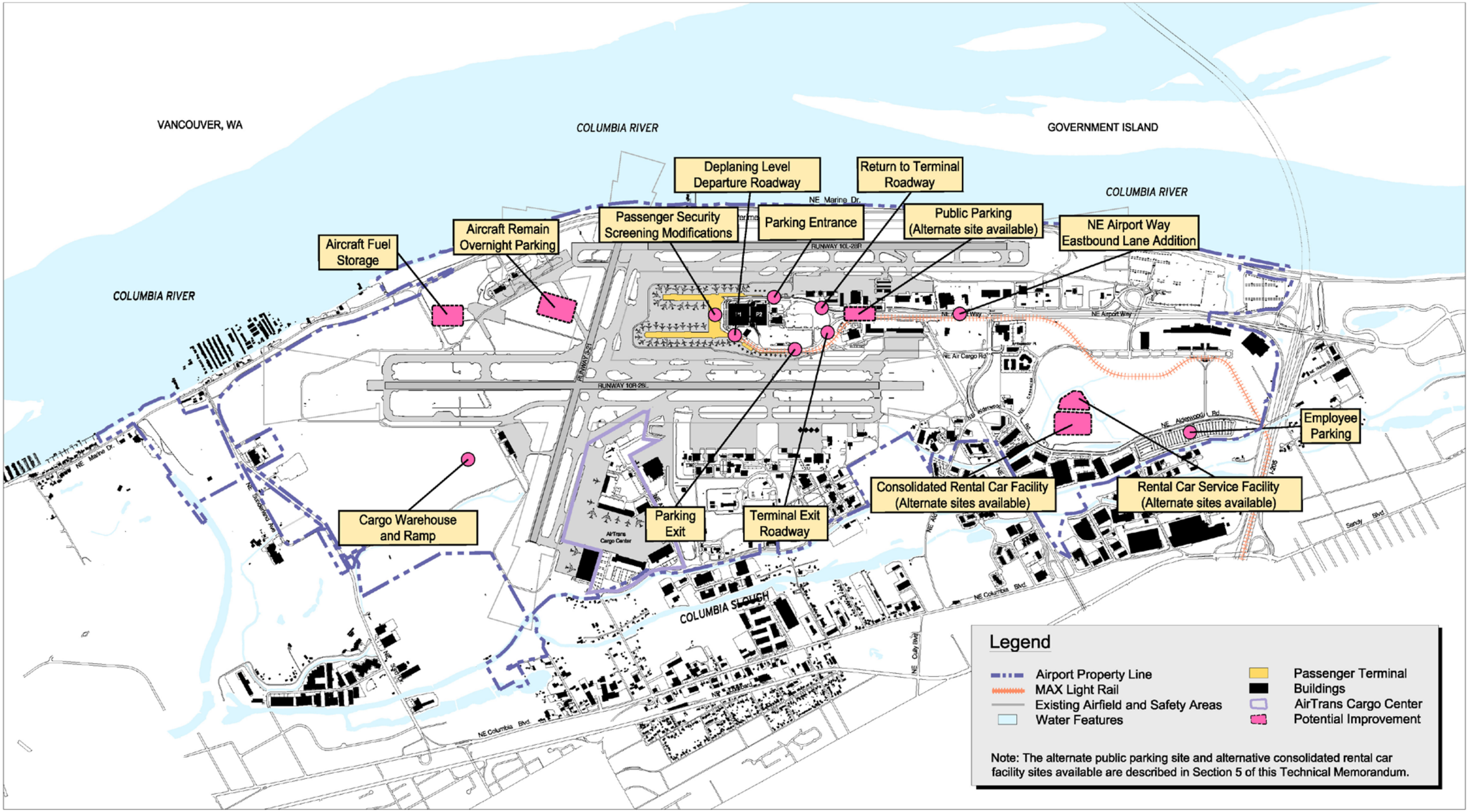

AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 2,100'
Scale: 1" = 2,100'

Source: Jacobs Consultancy, November 2009

Figure 1-4
Planned Development at PAL 4
(24 million annual passengers; approximately 2027)
Master Plan Update
Portland International Airport

November 2009

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The public parking garage, constructed for PAL 2 and expanded for PAL 3, would be expanded. In addition, a consolidated rental car facility would be constructed at one of five potential locations—the P1 and P2 garages, P3 site, P4 site, the rental car storage area to the north of NE Airport Way, or east of 82nd Avenue and north of NE Alderwood Road. A preferred location for the consolidated rental car facility was not identified. However, for illustrative purposes, the location shown on Figure 1-4 is east of 82nd Avenue and north of NE Alderwood Road. With the construction of the consolidated rental car facility, the rental car facilities located in the P1 and P2 parking garages would be converted to public parking spaces.

With the relocation of the rental cars from the P1 parking garage, the commercial vehicle area, which was reconfigured at PAL 3, would be reorganized. Taxicabs and other commercial vehicles would be relocated to the P1 parking garage space vacated by the rental cars and the space vacated by the taxicabs and commercial vehicles would accommodate rental car shuttle vehicles. The customer service center vacated by the rental car companies would be converted to a waiting area and service center for commercial vehicle customers.

Roadway projects would include lane additions to NE Airport Way, the P1 parking garage entrance and exit, the terminal exit roadway, return-to-terminal road, and the deplaning level departure roadway.

Additional RON aircraft parking will be provided to the west of Runway 3-21.

Additional minor projects related to passenger security screening, as described previously, would be completed and the existing aircraft fuel storage facilities would be expanded.

Additional all-cargo development will occur in the Southwest Quadrant, unless other suitable development opportunities have arisen.

1.3.5 Development by Planning Activity Level 5

PAL 5 demand is approximately 27 million total annual passengers, 732,000 short tons of cargo, and 378,000 aircraft operations. Potential Airport development required to accommodate activity at PAL 5 is shown on Figure 1-5.

Additional structured public parking would be provided by expanding parking garage P3.

The RON aircraft parking ramp constructed at PAL 4 will be expanded to provide additional capacity. Additional minor projects related to passenger security screening, as described previously, would be completed and the aircraft fuel storage facilities would be expanded.

At the intersection of NE 82nd Avenue and NE Alderwood Road, queuing space would be added for eastbound traffic turning right on NE 82nd Avenue.

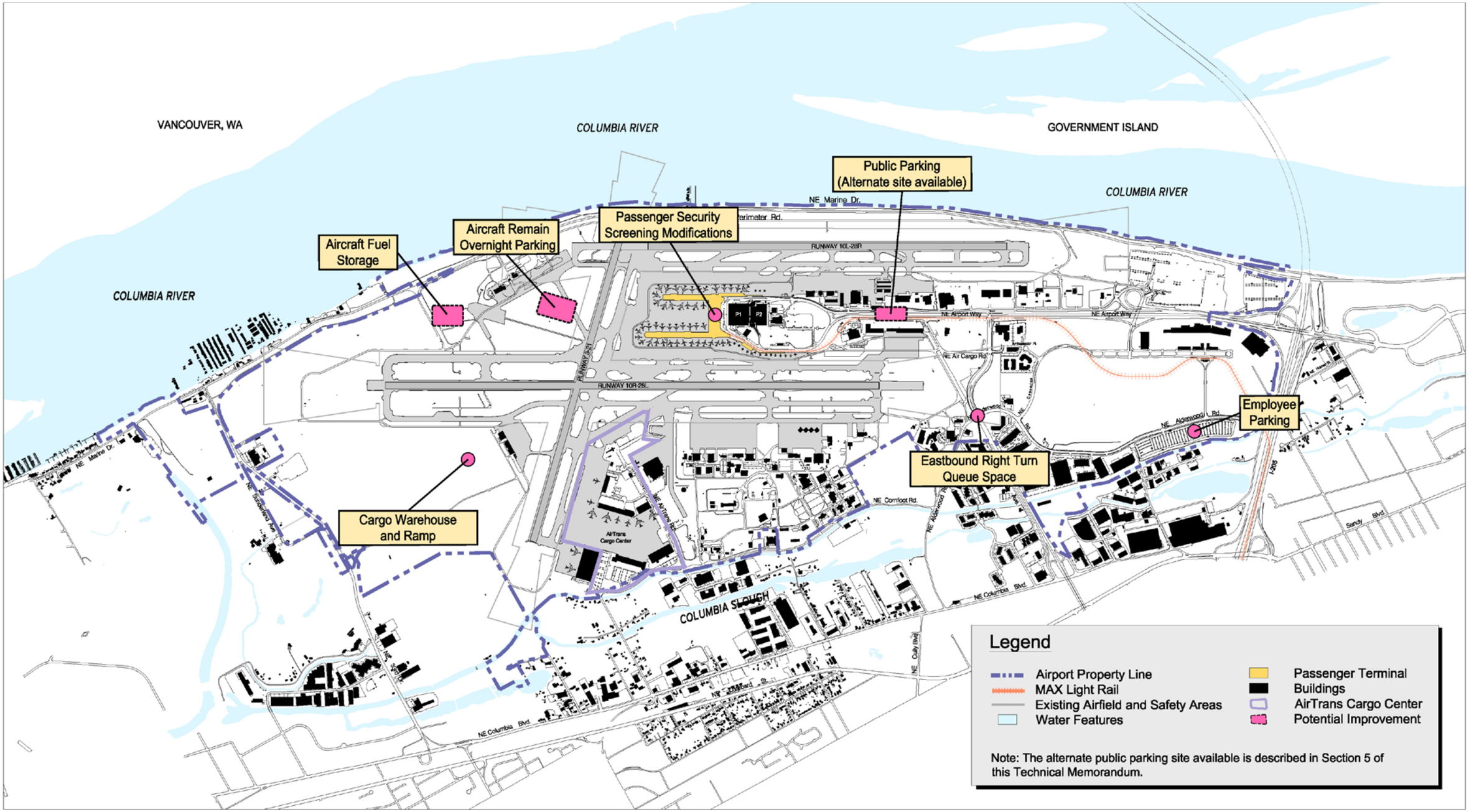


Figure 1-5

Planned Development at PAL 5

(27 million annual passengers; approximately 2035)

Master Plan Update

Portland International Airport

Source: Jacobs Consultancy, November 2009

November 2009

All-cargo development will continue in the Southwest Quadrant, unless other suitable development opportunities have arisen.

1.4 Background, Process, and Key Assumptions

The process for identifying and evaluating Airport development alternatives involved the planning team (the planning team consists of consultant, Port, and City staff), the Planning Advisory Group (PAG), the PAG combined Master Plan Alternatives and Sustainability subcommittee, and the PAG Land Use/Transportation subcommittee. The following sections summarize the evolution of the work plan, approach, and key assumptions that resulted in the recommended Airport facility improvements shown on Figures 1-1 through 1-5. Taken together, these facility improvements constitute the master plan for airport development.

1.4.1 Initial Work Plan

When the Master Plan Update process began in September 2007, it was with the understanding that decisions would be made related to two passenger terminal concepts and a third parallel runway. The two concepts, referred to as the Centralized Concept and the Decentralized Concept, were developed during the *2000 Airport Master Plan* and are illustrated on Figures 1-6 and 1-7.

The Centralized Concept includes a satellite concourse located to the west of the existing passenger terminal. The Decentralized Concept includes a second access roadway and a second passenger terminal and concourses located south of the existing terminal, where the military facilities are currently located. Both the Centralized and Decentralized concepts include an 11,925-foot-long, 200-foot-wide, third runway parallel to and located to the south of existing Runway 10R-28L.

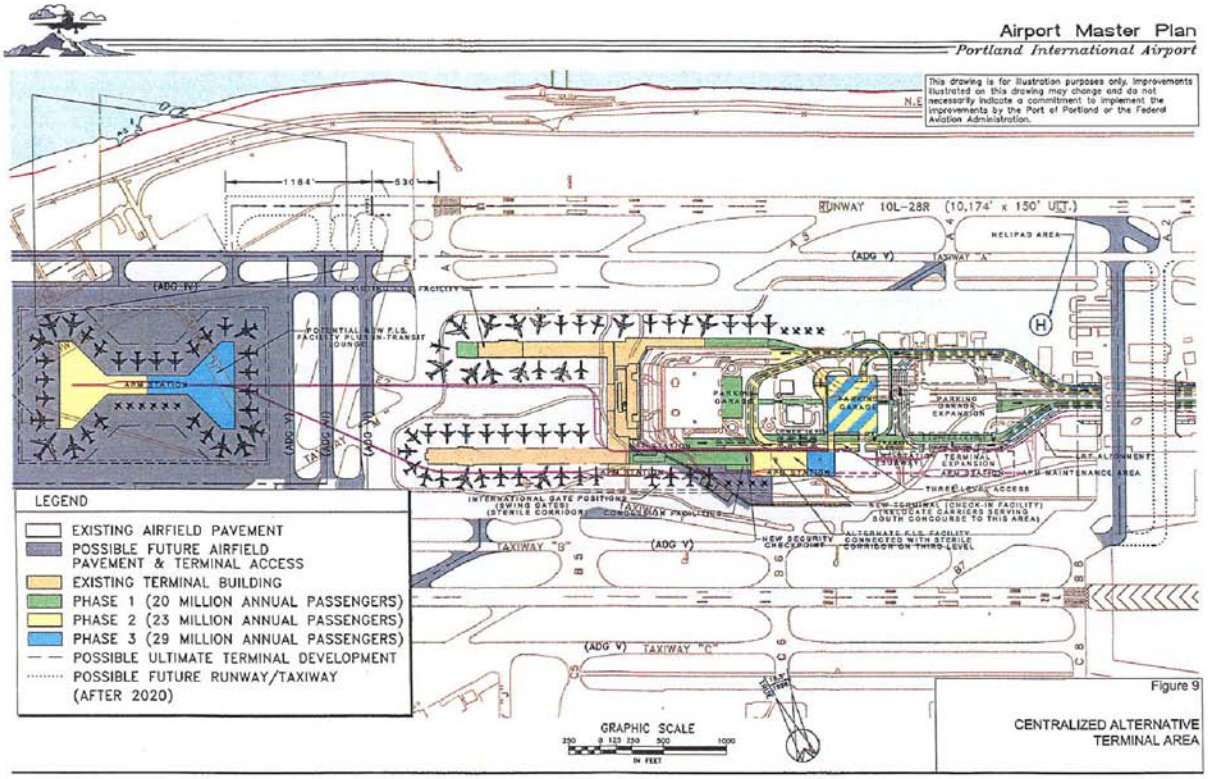
The expectation was that the PAG would analyze the Centralized and Decentralized concepts and recommend the one that would meet the Region's air transportation needs without compromising the livability and quality of life for future generations.

Furthermore, the master plan process began with the understanding that the need for a third parallel runway was likely beyond the planning period (i.e., beyond 2035). However, it was also generally acknowledged that the 2035 demand would likely reach a level at which preparations for a third parallel runway would be appropriate, given the long lead time for runway implementation.

The Port agreed that it would not seek City Council approval to build a third parallel runway in the City Land Use Plan being developed by the City through Airport Futures. The City and Port agreed that a planning-level review of the potential impacts of a third parallel runway, including noise, height, and natural resources, needed to be completed and that the City Land Use Plan would detail a land use review process for a potential third parallel runway.

Figure 1-6

CENTRALIZED AIRPORT DEVELOPMENT CONCEPT



Source: Portland International Airport Master Plan, 2000.

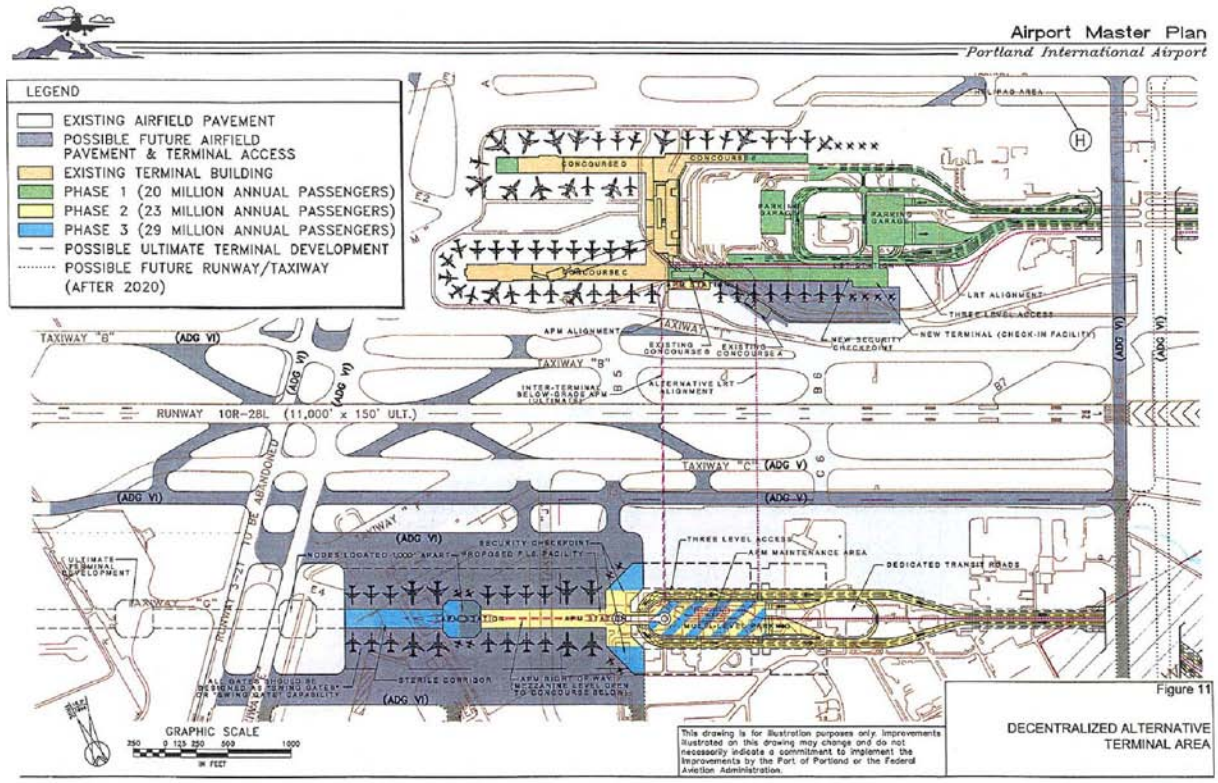
1.4.2 Evolution of Initial Work Plan

Early in the master plan update process, the planning team, working closely with the full PAG and the Forecast Subcommittee, developed probabilistic forecasts of aviation demand, which were adopted by the PAG for use in the subsequent planning. The 2035 50th percentile forecasts for passengers and aircraft operations are 27 million annual passengers and 378,000 annual operations, respectively. While 27 million annual passengers is similar to the 2020 passenger demand forecast from the *2000 Airport Master Plan*, 378,000 aircraft operations is substantially lower than the 2020 operations forecast from the *2000 Airport Master Plan*.

The aviation industry has changed considerably since the *2000 Airport Master Plan* was completed. These changes are reflected in the aviation demand forecasts (please refer to *Technical Memorandum No. 2 – Aviation Demand Forecasts*). Converting the 50th percentile forecasts for passenger, cargo, and aircraft demand into facilities needed to accommodate those demands resulted in requirements for this Master Plan Update that are significantly lower than the requirements estimated in the *2000 Airport Master Plan*.

Figure 1-7

DECENTRALIZED AIRPORT DEVELOPMENT CONCEPT



Source: Portland International Airport Master Plan, 2000.

It was concluded that the 50th percentile forecast of 378,000 annual aircraft operations for 2035 can easily be accommodated with the Airport's existing airfield. This is in contrast to the 2000 Airport Master Plan, which had forecast 485,000 aircraft operations in 2020. Accordingly, a decision to build the third parallel runway is not required for this Master Plan Update.

Furthermore, it was concluded that with some strategic investments and operational and technological enhancements, the existing passenger terminal will likely serve the 50th percentile forecast 2035 passenger demand without the need to build outside the existing passenger terminal envelope. Therefore it is not necessary to choose between the Centralized and Decentralized concepts.

At the October 21, 2008 PAG meeting, all but one member present voted to continue the planning process using the Master Plan Update's then-current facility requirements and assumptions provided that there was a chance to revaluate them relative to PAG's sustainability criteria before reaching a final decision to recommend, modify, or reject them. The agreed-upon process provided for that opportunity.

1.4.3 Approach for Moving Forward

The approach for moving forward involved planning for a sustainable future; identifying investment decisions needed at PALs 1 through 5; and evaluating assumptions related to the Centralized Concept, the third parallel runway, and the military. This approach is described below.

Planning for a Sustainable Future. At a meeting of the combined Master Plan Alternatives and Sustainability subcommittee on November 18, 2008, it was concluded that from a sustainability perspective, it is prudent to consider levels of activity that are both greater and less than the 50th percentile demand forecasts when developing the Master Plan Update. The consideration of additional activity levels is particularly important for the City's long-term land use planning for land adjacent to the Airport.

Accordingly, although the majority of the planning work was based on the 50th percentile or "most likely" demand forecasts, key facilities were evaluated to determine their ability to accommodate demand ranging from the 90th percentile to the 10th percentile. The purpose of this analysis was to ensure that options remain open and the plan has sufficient flexibility to respond to an ever-changing region, economy, and aviation industry.

One concern was that any potential adoption of height and noise standards in the City's land use plan related to a possible third parallel runway could imply tacit approval of that runway. The process adopted addressed this issue directly. It was agreed that at the end of Airport Futures, the PAG would be asked:

> *Should the Planning Advisory Group's recommendation to the Port and City include policies and decisions that preserve the options for a third runway and both the Centralized and Decentralized concepts for future generations to decide? If yes, what are those recommendations? (Any such recommendation will not imply even tacit approval of a third parallel runway or terminal concept.)*

Port and City staff believes the PAG should make recommendations that preserve the options for future generations to decide based on principles of sustainability. This is particularly important for the City's long term land use planning for land adjacent to the Airport. The Port and City staff also believes the remainder of the planning process should incorporate the Centralized Concept and no third runway assumptions.

In moving forward, the planning team was urged to determine if there are decisions that might be made differently to maintain flexibility for the future. An important part of sustainability is not making decisions that will leave future planners with no choices or only very expensive or impractical choices. All participants in the planning process were mindful that the aviation industry is dynamic. Further, the participants recognized that this will not be the last Master Plan Update undertaken by the Port, and the City's Land Use Plan will evolve over time.

Investment Decisions Needed at Planning Activity Levels 1 through 5. The existing airfield and passenger terminal envelope will continue to satisfy the aviation demand forecast through the planning period with operational and technological enhancements; however continued investment in Airport facilities to build terminal and access improvements outside the existing terminal envelope will be required. Examples of important investment decisions that will need to be made before the next master plan include those related to:

- A grade-separated interchange at the intersection of NE 82nd Ave and NE Airport Way
- The appropriate site for additional automobile parking
- The appropriate location for additional general aviation facilities

These types of investment decisions have long-term implications related to the phasing and cost of other Airport improvements and the ability to maintain future flexibility. Therefore, these decisions require forward thinking.

Assumptions Related to the Centralized Concept. The Master Plan Alternatives and Sustainability Subcommittee, the Land Use/Transportation Subcommittee, and the planning team recommended that plans for facility improvements in PALs 1 through 5 should be based on the assumption that the Airport will be developed consistent with the Centralized Concept. This recommendation was based on the following considerations.

- **Cost**—The cost differential between the two development concepts has widened since completion of the *2000 Airport Master Plan*, in which the Decentralized Concept was estimated to cost at least $1 billion more than the Centralized Concept in 1997 dollars (of this amount, approximately $400 million was the estimated cost to relocate the military).
- **Phasing**—Construction of the Decentralized Concept would be difficult, as it would require relocation of the military facilities to build access roadways, parking, and the terminal building. The complexity of phasing contributes to the high cost, the long lead time for development, and difficult financing.
- **Environmental impact**—The Centralized Concept would have a less impervious surface, fewer associated air emissions, and a generally reduced overall impact to natural resources than would the Decentralized Concept.
- **Operational efficiency**—The Centralized Concept can be operated more efficiently with the existing two parallel runway configuration than can the Decentralized Concept.

- **Viability—**The Centralized Concept is sufficiently flexible to accommodate the 90th percentile demand, should it occur. The challenges of accommodating this level of demand are understood and manageable, and potential solutions have been identified. Moreover, the ability to switch to the Decentralized Concept will exist for years.

While the Decentralized Concept is acknowledged to offer some long term capacity advantages over the Centralized Concept, its advantages are not great enough to overcome its significant cost differential, phasing difficulties, and greater environmental impacts.

Assumptions Related to the Third Parallel Runway. Planning began with the assumption that the third parallel runway would not be required to accommodate the forecast demand, and this assumption was tested throughout the planning process. The advantages and disadvantages of doing nothing, either on- or off-Airport, to either obligate or preclude the future consideration of a third parallel runway were considered.

There will not be a decision to permit or build the third parallel runway at the end of this Master Plan Update. However, this planning process will explore how a future decision on the third runway might be made within the context of the City's land use approval process, even though it may not be implemented for a very long time. Among other things, this exploration would include a discussion of noise, natural resource, and height impacts, on and off the Airport, and a discussion of strategies as to how these impacts might be avoided, minimized, or mitigated. There will also be a discussion of the National Environmental Policy Act (NEPA) process that would be undertaken by the FAA for a third parallel runway, and how the NEPA process would be coordinated with the City land use approval process.

Assumptions Related to the Military. The space occupied by the military is not needed for development to accommodate PALs 1 through 5. Currently, the cost to relocate the military is high. If the military's situation should change, for example if the military were to leave the Airport, receive approval to substantially update or expand its facilities, or begin operating the F22 aircraft, the Port should undertake a new master plan or reconsider the then-existing plan. Any new lease should include provisions that would allow the parties (i.e., the Port and the Oregon Air National Guard) to reopen negotiations to address any major changes. In the meantime, given the uncertainty and lack of demand for the military's space within the planning period, it is reasonable to assume the military will remain at its present location.

1.4.4 Sustainability Criteria for Facilities Planning

Consistent with the commitment to Airport Futures' Vision and Values, shown on Figure 1-2 in *Technical Memorandum No. 3 – Facility Requirements*, the planning team has carefully considered sustainability in identifying and evaluating the development alternatives for each functional area of the Airport. The application of new technologies,

changes in passenger behavior, and changes in the airline industry are among the many uncertain factors that will influence the capacity, design, use, and reuse of the Airport's facilities in the future. While the impact of these factors cannot be known with certainty, the Port embraces the notion, discussed at numerous PAG and PAG Subcommittee meetings, that some future changes have the potential to significantly increase the utilization of existing facilities and the efficiency of operations, thus extending the life of Airport facilities and ultimately postponing the development of new facilities.

The approach employed to ensure that the alternatives reflect the PAG's vision and values was to carefully evaluate the alternatives against criteria that were developed through collaborative discussions regarding sustainability. The sustainability criteria for facilities planning are as follows:

- Preserve future flexibility and options
  - Preserve options for enhanced premium light rail and other transportation modes to access the terminal
  - Preserve the flexibility to adapt to changes in requirements and emerging technologies (e.g., mode split changes, smaller cars, alternative fuels, new multi-party modes, changes in passenger processing)
- Minimize greenhouse gas emissions and impacts to natural resources, air quality, and water quality
- Maximize land use efficiencies
  - Cluster like and dependent uses
  - Promote compact development
  - Prioritize redevelopment over new development
- Maximize operational efficiencies
  - Maximize shared/common use opportunities
  - Substitute operational solutions (e.g., demand management) for new facilities, where possible
  - Minimize congestion
  - Enhance customer service (e.g., simplify passenger way finding and minimize mode changes and travel distances within the terminal environment)
  - Maximize the utilization of existing facilities

- Phase projects effectively

  – Minimize the impact of construction on the public
  – Expand facilities in reasonable increments
  – Ensure financially feasibility

- Comply with FAA airport design criteria (e.g., criteria related to height restrictions, tower line-of-sight, and aircraft movement)

The evaluation of alternatives against the sustainability criteria is described in subsequent sections of this Technical Memorandum.

2. VIABILITY OF THE CENTRALIZED CONCEPT

As described in Section 1.4.3 of this Technical Memorandum, the Centralized Concept is preferred to the Decentralized Concept based on considerations related to cost, phasing, environmental impact, operational efficiency, and viability. The concept would be considered viable if (1) it is sufficiently flexible to accommodate the 90th percentile demand forecast for 2035, should it occur, and (2) the challenges of accommodating this level of demand are understood and manageable, and potential solutions have been identified. This section summarizes the analyses that led to the conclusion the Centralized Concept is viable.

2.1 Approach

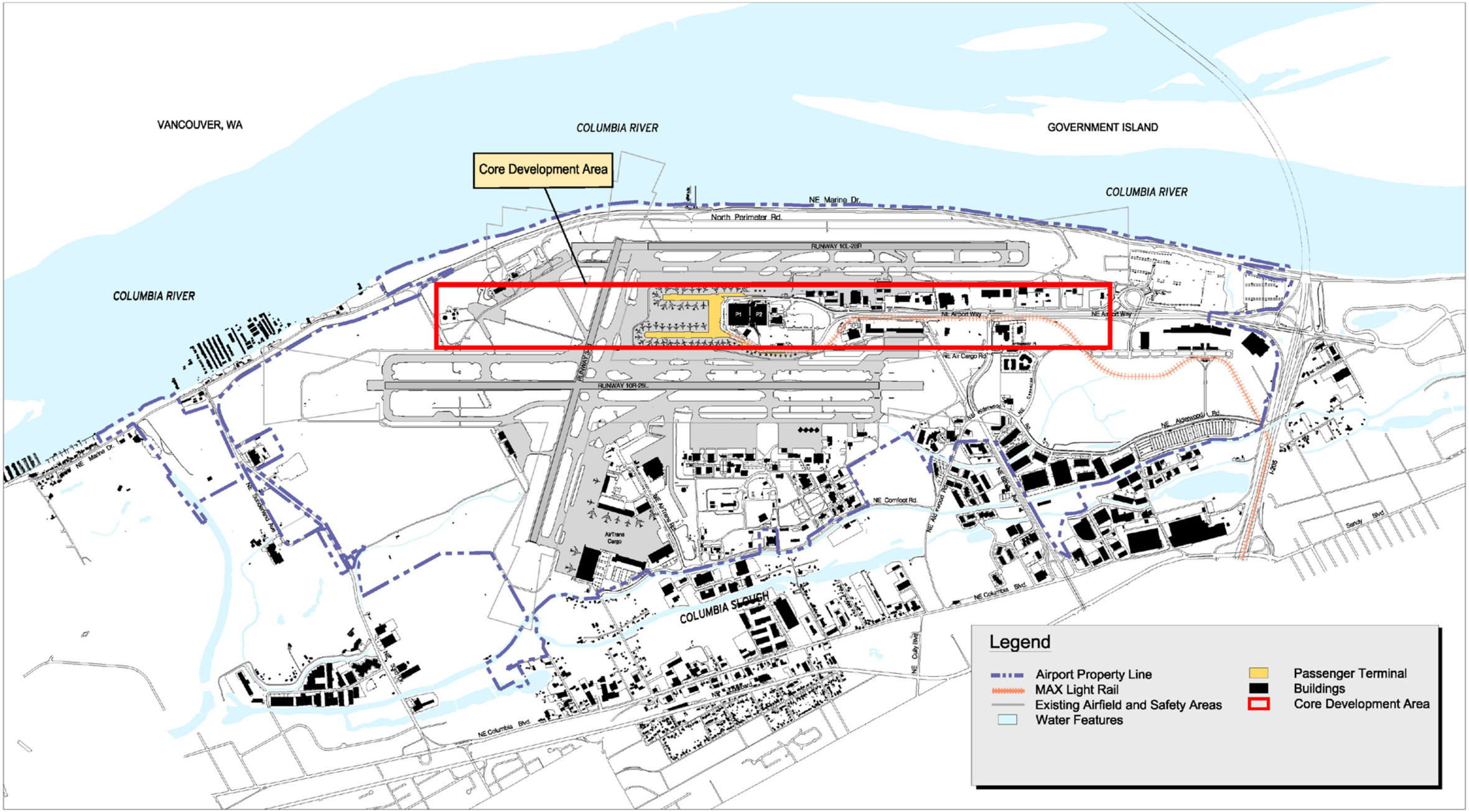
Although the master plan requirements were based on the 50th percentile demand, the PAG and planning team agreed the Centralized Concept would be considered viable only if it has the flexibility to accommodate aviation activity beyond the 50th percentile demand for PAL 5. For the purposes of testing the viability of the concept, the 90th percentile demand was determined to be appropriate.

From the analyses described in Section 2 of *Technical Memorandum No. 3 – Facility Requirements,* it was concluded that at the 90th percentile demand for PAL 5, a third parallel runway is needed. Furthermore, the Airport has sufficient land to accommodate a third parallel runway, which was included in the Centralized Concept developed in the *2000 Airport Master Plan*.

To assess the viability of the Centralized Concept, the analyses focused on the ability of the relatively narrow core development area and other major elements of the Airport to accommodate the 90th percentile demand. The core development area is bounded by the airfield and is shown on Figure 2-1. A three-part assessment was completed in which key terminal and landside elements were evaluated to determine if (1) the 90th percentile demand can be accommodated within the core development area and (2) displaced facilities can be accommodated elsewhere on the Airport. The results of this assessment are summarized in the following sections.

2.2 Terminal Elements

The terminal elements assessed were the passenger terminal, aircraft parking positions (i.e., gates), and RON aircraft parking. These elements were selected because they are the primary drivers of the overall land envelope required. The assessments were generalized to determine if these elements could be expanded and modified within the core development area to reasonably accommodate the 90th percentile demand for PAL 5.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 2,100'
Scale: 1" = 2,100'

Source: Jacobs Consultancy, November 2009

Figure 2-1

Core Development Area

Master Plan Update
Portland International Airport

November 2009

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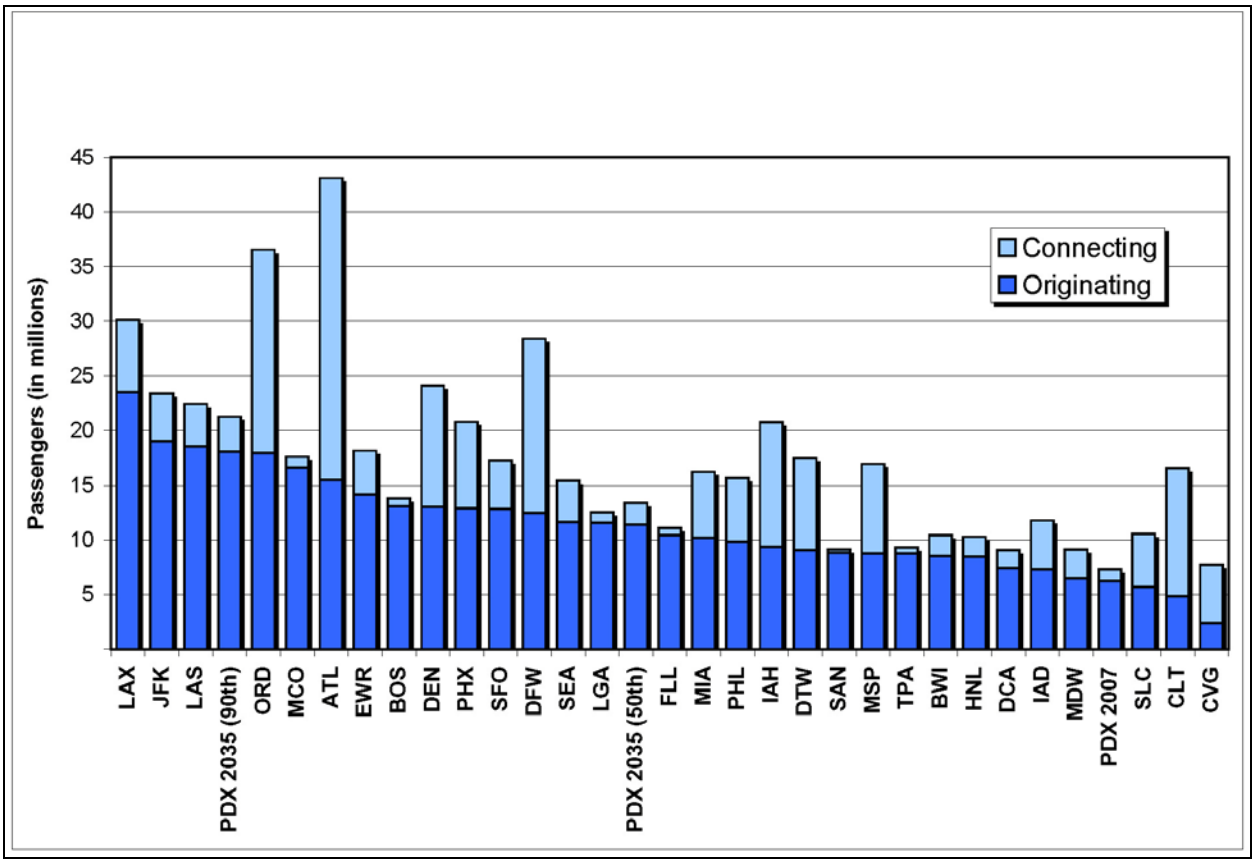
To provide some perspective regarding the magnitude of the 90th percentile demand for PAL 5, both the 50th and 90th percentile demand for PAL 5 were compared with passenger demand in 2007 at all large-hub airports in the United States. From this comparison, shown on Figure 2-2, it can be seen that at the 90th percentile level of demand, the number of originating passengers at PDX would be similar to the number of originating passengers at Chicago O'Hare International Airport in 2007. This observation underscores not only the magnitude of the 90th percentile passenger forecast, but also its probabilistic nature—there is only a 10% chance this level of activity would occur by PAL 5 (2035).

Figure 2-2

COMPARISON OF PASSENGER DEMAND FUTURE PDX VS. LARGE-HUB AIRPORTS IN 2007



Source: Jacobs Consultancy, November 2009.

An originating passenger begins his or her trip at PDX; a connecting passenger begins his or her trip elsewhere, and changes planes at PDX. The distinction between originating and connecting passengers is significant for facilities. For example, originating passengers require processing facilities within the terminal (e.g., ticketing,

security screening, and baggage claim facilities) whereas connecting passengers require facilities on the concourses (e.g., aircraft gates, concessions, and passenger holdrooms). The approximate requirements for passenger terminal, aircraft parking positions, and RON aircraft parking positions are shown in Table 2-1.

Table 2-1

PRIMARY TERMINAL REQUIREMENTS FOR 50TH AND 90TH PERCENTILE PAL 5 DEMAND

	Existing	50th Percentile	90th Percentile
Passenger terminal	~1.2 million sq. ft.	No change	Double existing
Aircraft parking positions	67	67	92 -107
Aircraft remain overnight parking positions	8	31	42 - 49

Source: Jacobs Consultancy, November 2009.

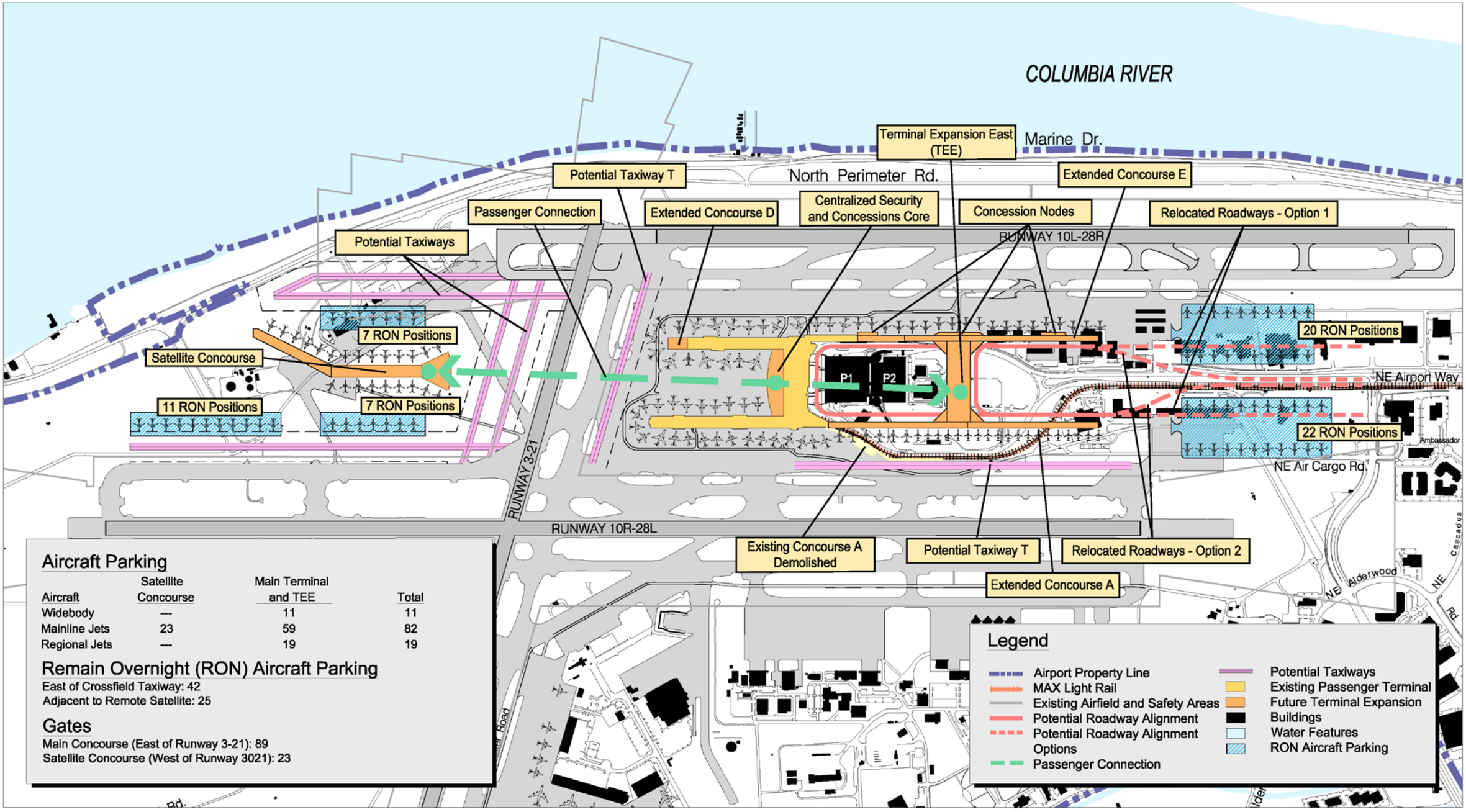
From the facilities assessments, the following conclusions were reached regarding the ability of passenger processing, aircraft parking, and RON aircraft parking facilities to be expanded and modified within the core development area to reasonably accommodate the 90th percentile demand for PAL 5.

1. Passenger processing requirements can be met by constructing an additional facility such as Terminal Expansion East (TEE), which has been the subject of past studies by the Port and its staff.

2. Aircraft parking requirements can be met by constructing a satellite concourse and extending Concourse E. Aircraft parking requirements cannot be met without a satellite concourse—even if both Concourse A and Concourse E are extended and reduced aircraft wingtip clearances are assumed.

3. Satisfying RON aircraft parking requirements in the core development area would be expensive because of the need to displace existing facilities.

One potential concept for developing facilities within the core development area—if the 90th percentile demand were to occur—is shown on Figure 2-3.



Aircraft Parking

Aircraft	Satellite Concourse	Main Terminal and TEE	Total
Widebody	—	11	11
Mainline Jets	23	59	82
Regional Jets	—	19	19

Remain Overnight (RON) Aircraft Parking

East of Crossfield Taxiway: 42
Adjacent to Remote Satellite: 25

Gates

Main Concourse (East of Runway 3-21): 89
Satellite Concourse (West of Runway 3021): 23

Legend

- Airport Property Line
- MAX Light Rail
- Existing Airfield and Safety Areas
- Potential Roadway Alignment
- Potential Roadway Alignment Options
- Passenger Connection
- Potential Taxiways
- Existing Passenger Terminal
- Future Terminal Expansion
- Buildings
- Water Features
- RON Aircraft Parking

AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 1,000'
Scale: 1" = 1,000'

Source: Jacobs Consultancy, November 2009

Figure 2-3

Concept for Developing Passenger Terminal Facilities to Accommodate 90th Percentile Demand

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2.3 Landside Elements

Seven key landside elements were assessed:

- Access and circulation roadways
- Curbsides (enplaning, deplaning, commercial)
- Parking (public, employee)
- Rental car facilities
- MAX light rail
- Ground transportation providers hold lot
- Cell phone lot

These elements were selected because they are the primary drivers of the overall land envelope required for landside facilities. Similar to the terminal elements, the assessments were generalized, with the objective to determine if these landside elements can be expanded and modified within the core development area to reasonably accommodate the 90th percentile demand for PAL 5. The significant assumptions for the assessments included the following:

- TEE will be constructed
- Both Concourse A and Concourse E will be extended
- The intersection of NE Airport Way and NE 82nd Avenue will be grade-separated
- Secondary functions will be relocated as required (e.g., general aviation and hotels)
- ATCT line-of-sight and Federal Aviation Regulations Part 77 height restrictions will govern the height of structures in the core development area

A four-part method was employed to assess the landside elements:

1. The primary landside requirements were estimated as shown in Table 2-2.
2. Facilities sizes, locations, and alignments were identified on concept sketches.
   - The number of individual parking facilities was minimized.

- Structured parking located to the west of the future cross-field taxiways was maximized.

- Four new parking structures were identified in the existing economy lot.

3. Appropriate corridors (e.g., for MAX light rail, pedestrians, bicycles, and automated people mover [APM] system) were preserved.

4. Parking and rental car requirements were allocated among the facilities.

Table 2-2

PRIMARY LANDSIDE REQUIREMENTS FOR 50TH AND 90TH PERCENTILE PLANNING ACTIVITY LEVEL 5 DEMAND

	Existing	50th Percentile	90th Percentile
Close-in parking (spaces)	7,380	10,500	17,300
Remote parking (acres)	67	146	240
Employee parking (spaces)	2,544	3,100	5,100
Rental cars (spaces)	1,481	2,700	4,300
Commercial vehicle hold lot (acres)	0.8	1.6	2.5

Source: Jacobs Consultancy, November 2009.

The following conclusions were reached regarding the ability of key landside facilities to be expanded and modified within the core development area to reasonably accommodate the 90th percentile demand for PAL 5.

1. The primary challenge is the narrow core development area.

2. Curbside requirements could be met by encouraging changes in behavior, for example, by:

   - Reducing the use of curbsides by private vehicles

   - Encouraging the use of alternate curbsides during peak periods

   - Requiring some commercial vehicles to pick up/drop off passengers at the same location

   - Relocating selected commercial vehicle services to an alternate location

   - Considering an APM to serve rental car and public parking facilities

One potential concept for developing landside facilities within the core development area—if the 90th percentile demand were to occur—is shown on Figure 2-4.

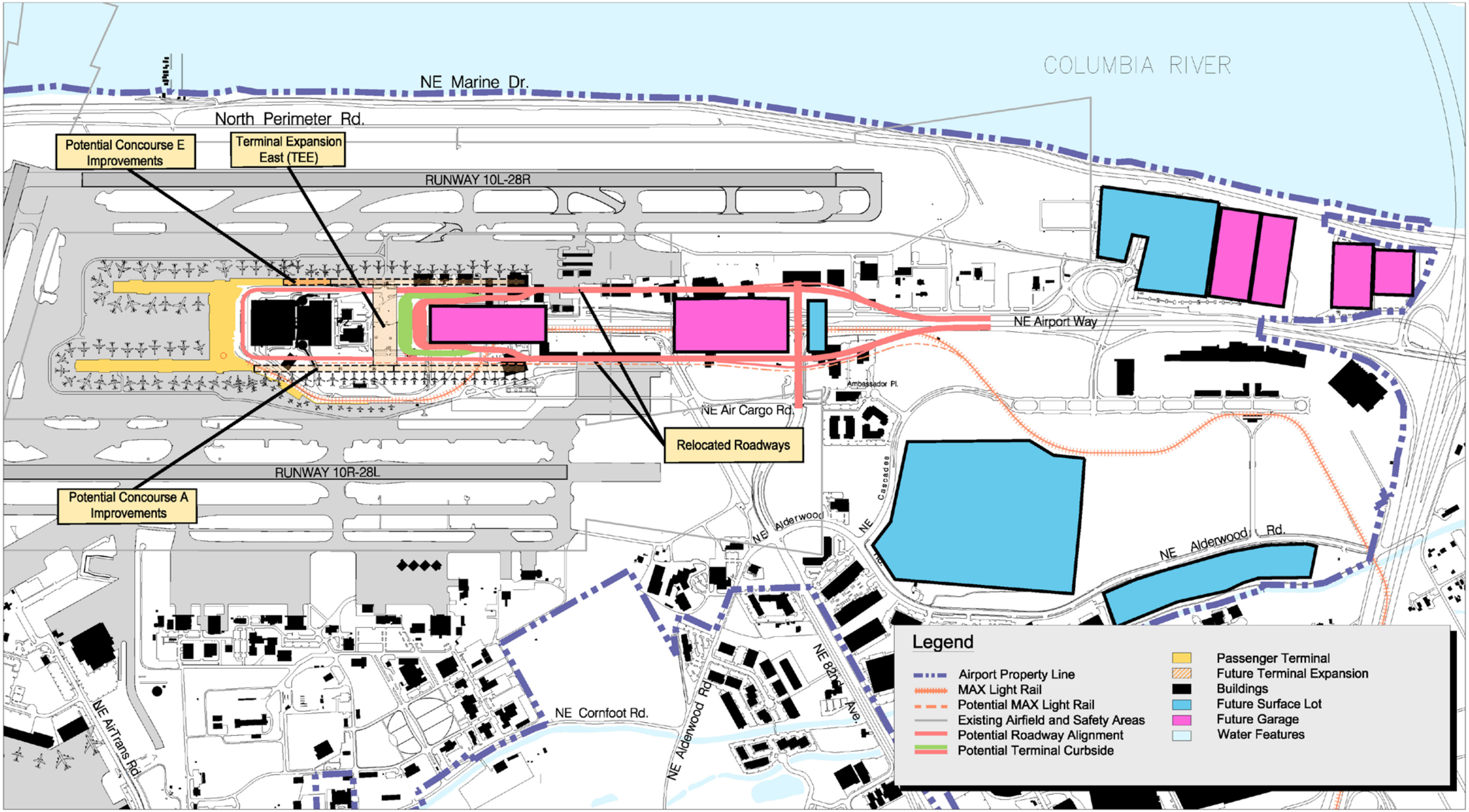
2.4 Land Available for Displaced Facilities

From the concepts illustrated on Figures 2-3 and 2-4, it is apparent that should the 90th percentile demand materialize, the potential exists for many facilities currently located in the core development area to be relocated. The Airport land available to accommodate these facilities, as well as to accommodate growth for other functions, is illustrated on Figure 2-5.

2.5 Summary and Conclusions

The key observations from the assessments of major terminal and landside facilities relative to the 90th percentile demand for PAL 5 (2035) were as follows:

- **Passenger terminal**—Adequate passenger terminal facilities could be provided.
- **Aircraft parking positions**—An adequate number of aircraft parking positions could be provided by realigning and extending Concourse A, extending Concourse E, and constructing a satellite concourse.
- **RON aircraft parking**—It is not likely that all the needs for RON aircraft parking could be met in ideal locations; however, this is not a fatal flaw.
- **Taxiways**—Taxiway T must be extended to the east.
- **Roadways**—On-airport roadways can meet the requirements with modifications. The most significant concern is with off-Airport roadways, which are beyond the scope of this Master Plan Update.
- **Curbsides**—Requirements could be met by implementing operational strategies.
- **Parking**—Parking demand could be served; however, the percentage of parking provided close in would not be as great as exists today.
- **Travel distances**—An APM system may be appropriate.
- **Land use**—Sufficient Airport land exists to accommodate facilities displaced from the core development area.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 1,000'
Scale: 1" = 1,000'

Source: Jacobs Consultancy, November 2009

Figure 2-4

Concept for Developing Landside Facilities in Response to 90th Percentile Demand

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VANCOUVER, WA

COLUMBIA RIVER

COLUMBIA RIVER

GOVERNMENT ISLAND

COLUMBIA RIVER

NE Marine Dr.

North Perimeter Rd.

Terminal Area

RUNWAY 10L-28R

RUNWAY 3-21 DECOMMISSIONED

RUNWAY 10R-28L

P1

P2

Terminal Area Functions
(54 acres)

Transportation
&
Parking

NE Air Cargo Rd.

Commerical
&
Industrial

Rental Car
(69 acres)

Potential Development
(264 acres)

Military
(246 acres)

NE Cornfoot Rd.

NE Alderwood Rd.

NE 82nd Ave

I-205

Sandy Blvd

NE Marine Dr.

NE Sandifur Ave

Third Parallel Runway

COLUMBIA SLOUGH

NE Columbia Blvd

NE 33rd Dr.

NE Lombard St.

NE Columbia Blvd

NE Cully Blvd

Legend

- Existing Airfield
- Potential Future Airfield Addition
- Passenger Terminal
- Ground Transportation / Parking
- Military
- Area for Development
- Airport / Airline Support
- Rental Car
- Commercial / Industrial
- Mitigation Site
- Natural Resources
- Buildings
- Primary Study Area Boundary
- Existing Airport Property Line
- MAX Light Rail
- Existing Airfield and Safety Areas
- Potential Roadway Realignment

AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 2,100'
Scale: 1" = 2,100'

Source: Jacobs Consultancy, November 2009

Figure 2-5

Land Use Plan to Accommodate 90th Percentile Demand

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From the assessments, it was concluded that the Centralized Concept could accommodate the 90th percentile level of demand and the challenges would be manageable, is flexible and can provide reasonable levels of service, and can be effectively phased.

Furthermore, the ability to modify development concepts will likely exist for many years. Such a change could be dictated by changes in circumstances (e.g., advances in technology or modified passenger behavior). Therefore, the Centralized Concept is a viable concept.

3. AIRFIELD

3.1 Background

The capacity of the existing airfield and airspace system was assessed in the facility requirements phase of the Master Plan Update to determine if and when additional airfield capacity improvements will be required to meet aviation demand forecast through PAL 5 (2035). The primary conclusions from that assessment were:

- Delay levels will remain low even with the forecast increase in aircraft operations. Consequently, there is no immediate need for significant capacity enhancements at the Airport, such as a new runway.

- As planned, the airfield has an adequate supporting taxiway system for aircraft circulation and the queuing of departures and arrivals. However, as traffic increases, the taxiway system should be modified to facilitate the movement of taxiing aircraft between the parallel runways and the passenger terminal.

- The airfield has reached 60% of its annual service volume of 425,000 operations. (In 2007, 264,518 operations, equal to 62% of annual service volume were processed.) As recommended by the FAA, appropriate planning related to capacity enhancements should be initiated.

During the past several years, several projects have been constructed or designed with the objective of improving the taxiway system. These projects and designs include the Taxiway T and Concourse D Pavement Rehabilitation project (completed in 2006), the Runway 10L-28R Extension Feasibility Study (completed in 2006), and the South Runway Rehabilitation Study (currently under way). Accordingly, no airfield projects are recommended during the planning period as part of the Master Plan Update.

However, two issues related to projects anticipated beyond the planning period—the cross-field taxiway location and the required length of the third parallel runway—were assessed because of their relevance to long-range planning. The results of the assessment of these issues are described in the following sections.

3.2 Cross-field Taxiway Location

At current traffic levels, air traffic controllers have the flexibility to minimize aircraft taxiing distances by assigning aircraft arrivals and departures to the runway closest to the requisite aircraft parking position at the passenger terminal. In the future with increased levels of operations, this flexibility is expected to be restricted and runways will most likely be assigned based on airspace considerations rather than aircraft parking position. Consequently, a cross-field taxiway system will be needed to facilitate the anticipated increase in aircraft taxiing between the parallel runways and the passenger terminal.

As stated, the level of aircraft operations that would warrant an improved cross-field taxiway system is not anticipated to occur within the planning period. However, the planned location and geometry of the cross-field taxiways will influence the potential size of certain facilities (e.g., the P3 garage) that will be constructed in the core development area, shown on Figure 2-1, during the planning period. Therefore, the location and geometry of the cross-field taxiways was considered at a concept level.

3.2.1 Prior Planning

Dual Airplane Design Group (ADG) VI cross-field taxiways were shown on the 2006 Airport Layout Plan (ALP). One cross-field taxiway was aligned with the threshold of Runway 28L and the other cross-field taxiway was located approximately 324 feet to the east of the Runway 28L threshold.

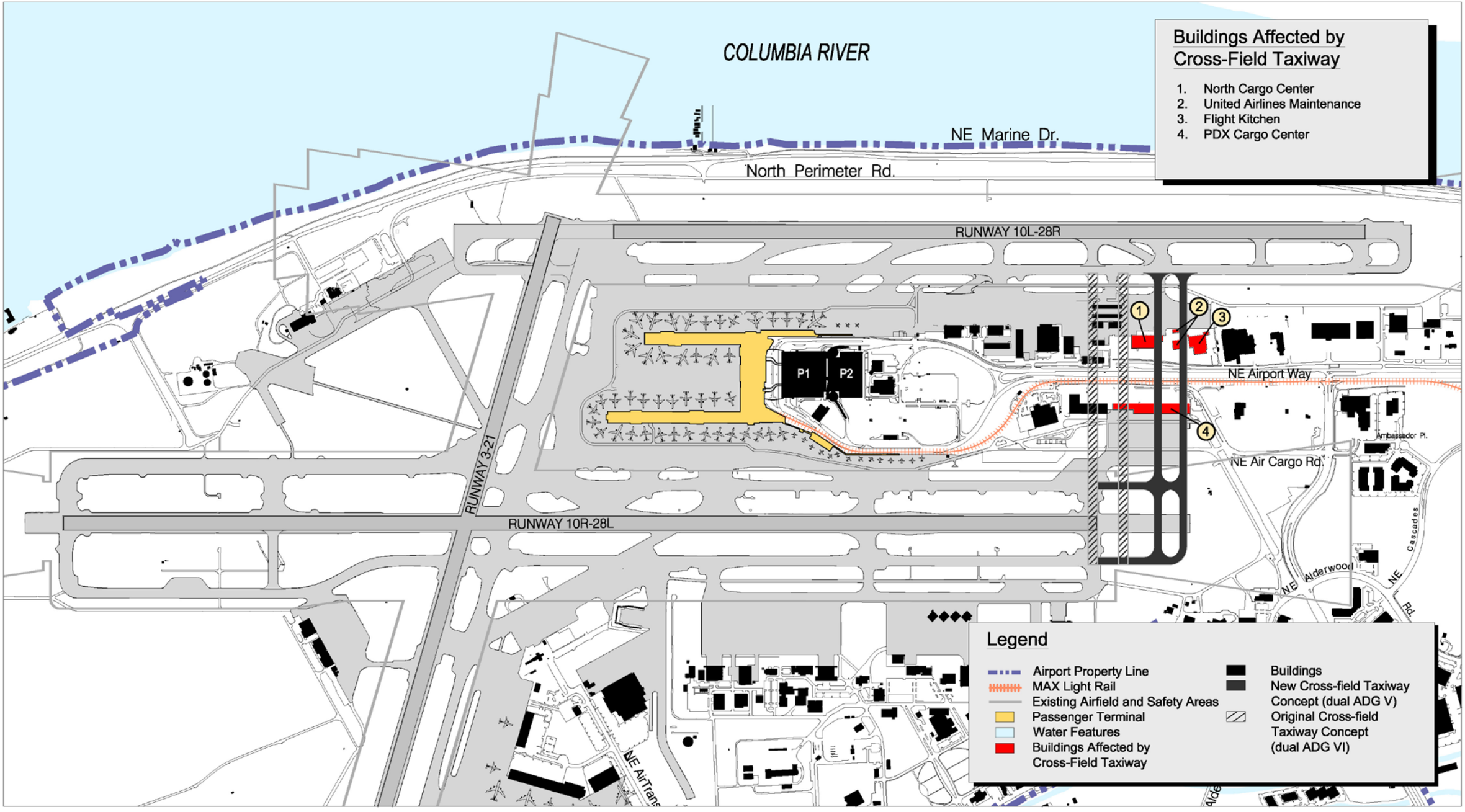
3.2.2 Alignment

To maximize the area available for development, the ability to shift the cross-field taxiways to the east was assessed, which resulted in the conceptual alignment shown on Figure 3-1. The location and geometry were developed based on the three factors described below.

1. **Airplane Design Group.** No ADG VI aircraft are forecast in the 2035 fleet mix at the Airport. Consequently, the cross-field taxiways were planned based on ADG V design standards.

2. **Operational Capability.** The new location and geometry of the cross-field taxiways shown on Figure 3-1 were discussed with Portland ATCT staff, who expressed the belief that shifting the taxiways to the east would increase operational flexibility by decreasing the dependence between aircraft arriving on Runway 28L and aircraft using the cross-field taxiways. The change in alignment of the cross-field taxiways would not cause a significant change in taxiing distances from the alignment shown on the previous ALP. Other technical details (e.g., the functionality with navigational aids, obstacle clearance surfaces, and precision obstacle free zones) should be evaluated in follow-on studies.

3. **Area for On-Airport Development.** Shifting the taxiways to the east increases the area available for Airport development within the central core of the terminal area. The size of planned parking garage P3 is governed by the Portland ATCT line-of-sight to the cross-field taxiways. By shifting the cross-field taxiways to the east, the P3 parking garage size and height can be increased. The easternmost limit for the taxiways was considered to be the P4 parking garage site, shown on Figure 5-2, at the intersection of NE Airport Way and NE Air Cargo Road. The alignment shown resulted from shifting the taxiways to the east so that the taxiway object free area borders the site of the P4 parking



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 1,000'
Scale: 1" = 1,000'

Source: Jacobs Consultancy, November 2009

Figure 3-1

Concept for the Planned Cross-field Taxiways

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garage. The alignment of NE Airport Way was analyzed from the planned interchange at NE 82nd Avenue, and it was confirmed that the NE Airport Way grade would be feasible.

3.3 Third Parallel Runway

The concept for a third parallel runway was originally conceived in the *2000 Airport Master Plan,* and it is identified as Runway 10R-28L on the current ALP. As shown on the ALP, the *2000 Airport Master Plan* recommended that the runway be constructed 3,250 feet to the south of existing Runway 10R-28L (centerline-to-centerline separation) at a length of 11,925 feet and width of 200 feet.

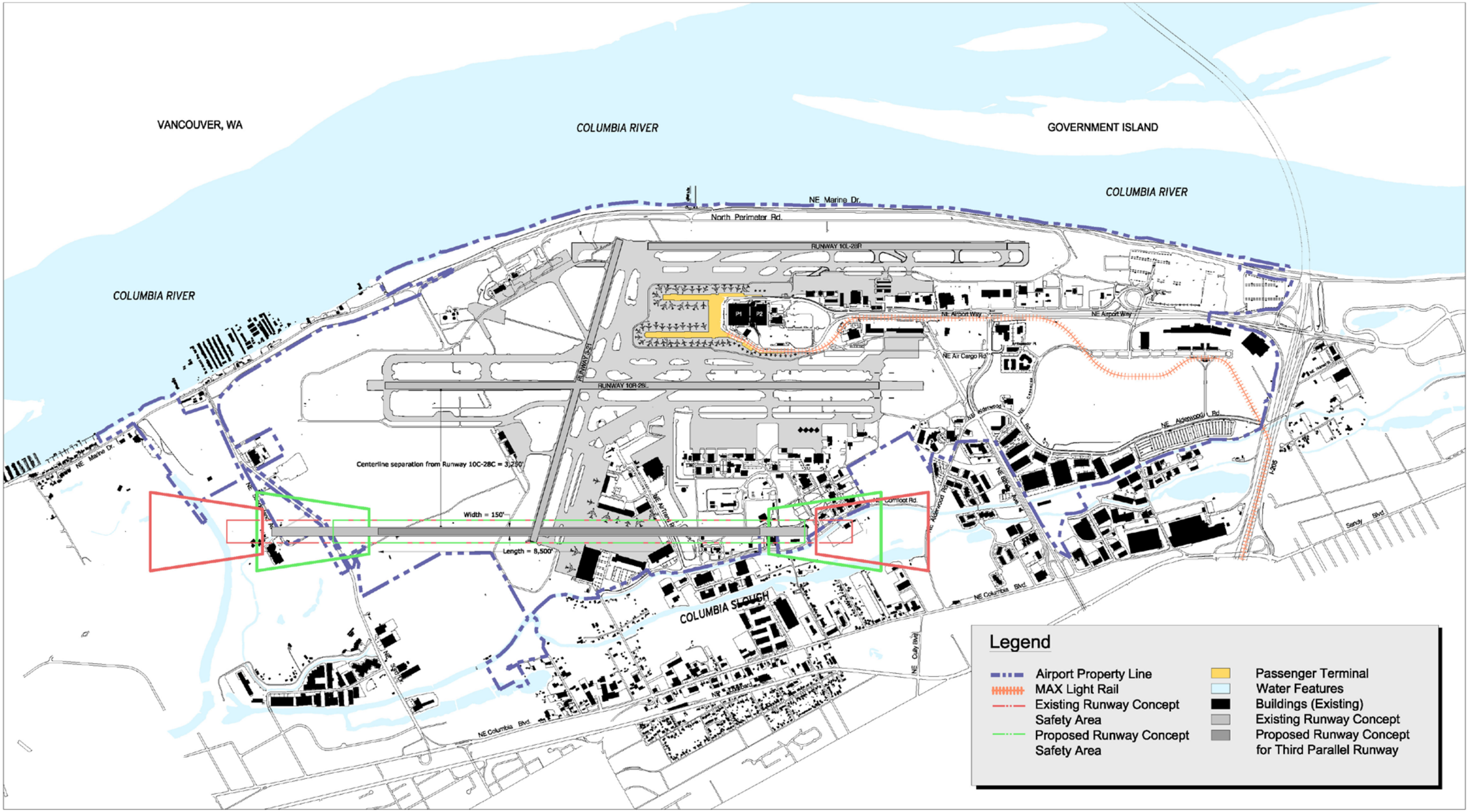
Although the third parallel runway will not be needed during the planning period, the planning team evaluated its functionality if the length were reduced to 8,500 feet and the width were reduced to 150 feet. The reduced length and width were hypothesized based on the PAG's sustainability criteria—in particular, the desire to minimize the potential environmental impact of the runway while maximizing operational and land use efficiency.

The revised concept, shown on Figure 3-2, is for a third parallel runway that is 8,500 feet long, 150 feet wide, and located 3,250 feet to the south of existing Runway 10R-28L (centerline-to-centerline separation).

Based on discussions with Portland ATCT staff, the third parallel runway would be used primarily for aircraft arrivals. With three parallel runways in operation, the ATCT staff estimated that the north, center, and south parallel runways would be assigned 34%, 20%, and 46% of annual aircraft arrivals, respectively. Similarly, the ATCT staff estimated that the north, center, and south parallel runways would be assigned 37%, 53%, and 10% of annual aircraft departures. Accordingly, the new runway would be assigned nearly half of annual arrivals, and only 10% of annual departures.

Based on operating experience at the Airport, it is known that a runway 8,500 feet long is adequate for aircraft arrivals—existing Runway 10L-28R is 8,000 feet long and has functioned effectively for the last 20 years. Furthermore, there are no aircraft forecast to use the Airport that would require landing length greater than that required currently. Therefore, if a third parallel runway, 8,500 feet long, were constructed, its length would be adequate for arriving aircraft.

For purposes of evaluating the 8,500-foot-long third parallel runway for aircraft departures, the aircraft were divided into the following categories: military, general aviation, and air carrier (both passenger and all-cargo). Military aircraft were excluded from the analysis. Further, current operating experience at the Airport has proven that 8,500 feet is adequate for departures by general aviation aircraft. Accordingly, the detailed analysis of runway length required for aircraft departures was limited to air carrier (passenger and all-cargo) aircraft.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 2,100'
Scale: 1" = 2,100'

Source: Jacobs Consultancy, November 2009

Figure 3-2

Concept for 8,500-Foot Long Third Parallel Runway

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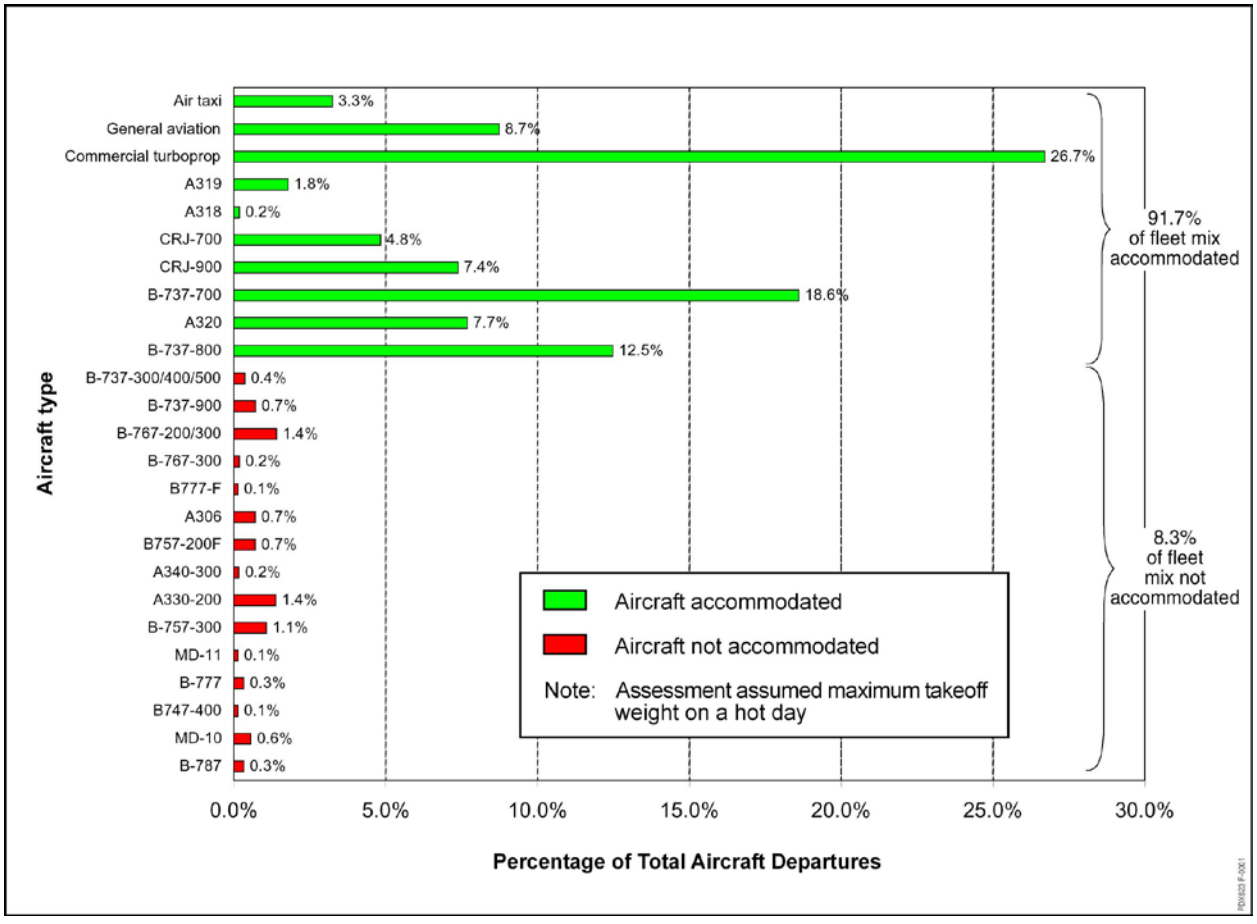
The analysis was performed using: the air carrier aircraft included in the PAL 5 (2035) fleet mix; data provided by the aircraft manufacturers; and the conservative assumption that all aircraft would depart at maximum allowable takeoff weight in high temperature conditions. High temperature conditions for the Airport are defined as 86 degrees Fahrenheit.

The results of the analysis, summarized on Figure 3-3, indicate that approximately 91.7% of the aircraft departures forecast for PAL 5 (2035) could be accommodated on an 8,500-foot-long runway. A small portion of the aircraft departures forecast for PAL 5 (2035), approximately 8.3% (consisting mainly of wide body cargo and passenger aircraft), could not be accommodated on an 8,500-foot-long runway.

Figure 3-3

AIRCRAFT DEPARTURES ACCOMMODATED ON AN 8,500-FOOT-LONG THIRD PARALLEL RUNWAY, BY TYPE



Source: Jacobs Consultancy, November 2009.

As stated, the third parallel runway's secondary use would be for aircraft departures. Departure runway length requirements vary depending on payloads, fuel loading, and temperature. The assumptions made in this analysis (high temperature day, maximum gross takeoff weight) are conservative, yet over 90% of the departures forecast for the Airport would be able to use the runway. Stated differently, fewer than 1% of all aircraft departures that Portland ATCT staff would ideally assign to the third parallel runway at planning activity level 5 (2035), would be unable to use the new runway for departure (10% of all departures that Portland ATCT staff would assign to the third parallel runway multiplied by 8.3% of the aircraft types not accommodated equals 0.83%). These departing aircraft could easily be accommodated on the existing runways.

The benefits of shortening the third parallel runway from 11,925 to 8,500 feet—reducing cost, minimizing environmental impacts, and maximizing land use efficiency—offset any loss of operational capability. In conclusion, 8,500 feet is an adequate length for a third parallel runway at the Airport. The runway's primary use would be for aircraft arrivals and virtually all aircraft could be accommodated.

4. PASSENGER TERMINAL

4.1 Background

The information presented in this section is based on conclusions described previously in Sections 1 and 2 of this Technical Memorandum and in *Technical Memorandum No. 3 – Facility Requirements.* The four primary elements of the long-range plan for passenger terminal facilities are:

- **Passenger terminal concourses**—Multiple facilities within the passenger terminal concourses may need to be modified to meet future requirements, including: the holdrooms on Concourse A; the regional airline holdroom on Concourse E; and the federal inspection services (FIS) facilities on level 1 of Concourse D. However, these projects are either deferrable or, in the case of the FIS facilities, market-driven. Moreover, the identification and assessment of alternatives for these facilities is not appropriate for the Master Plan Update and should occur in follow-on studies.

- **Main passenger terminal**—With upgrades and modifications that should reasonably be anticipated through PAL 5 (2035), the existing passenger terminal is capable of accommodating the demand associated with the 50th percentile forecasts for PAL 5. There is no need to develop alternative concepts to accommodate this level of activity; appropriate upgrades and modifications should be assessed in follow-on studies.

- **Terminal Expansion East**—Considerable planning was completed prior to this Master Plan Update to develop the TEE concept. TEE would provide passenger processing facilities to supplement the existing passenger terminal when it reaches capacity, which is not anticipated within the planning period for this Master Plan Update. However, projects will be constructed during the master planning period for which the design is closely related to the TEE, including the P3 garage. Therefore, prudent planning dictates that the TEE be evaluated and, if appropriate, confirmed to be the best long-range terminal development concept.

- **Remain overnight aircraft parking**—The highest priority project related to meeting terminal requirements is RON aircraft parking. RON aircraft are aircraft whose flight itinerary is completed upon arrival to the Airport, typically late in the evening. If a convenient location to park the aircraft (i.e., a nearby parking apron) is available, it can be towed from the terminal concourse and parked at the RON position, thus making the position at the terminal concourse available for a subsequent arriving flight. This process is reversed the following morning with the effect of increasing the productivity of the concourse holdrooms and aircraft parking positions.

Accordingly, this section describes (1) alternative long-range terminal development concepts, (2) alternatives for providing additional RON aircraft parking, and (3) the recommended strategy for maintaining terminal effectiveness.

4.2 Long-Range Terminal Development Concepts

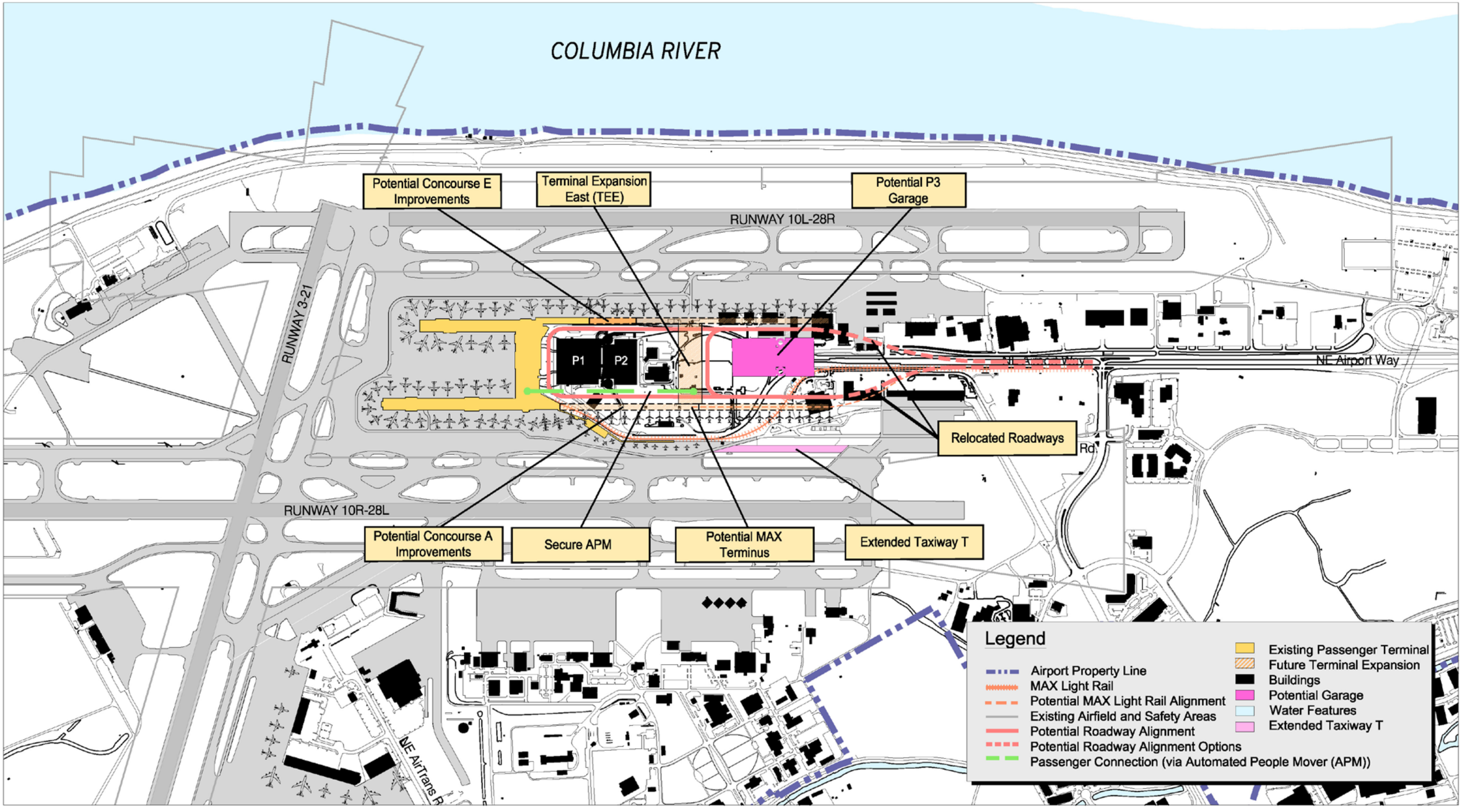
4.2.1 Alternatives

Four alternative concepts for developing terminal facilities beyond PAL 5 were identified and assessed. Each is consistent with the Centralized Concept from the previous master plan, described in Section 1.4, and capable of accommodating the 90th percentile passenger demand at PAL 5. The primary considerations used to "size" the alternatives were the requirements for passenger processing facilities (i.e., ticketing lobby, passenger security screening), aircraft parking, and RON aircraft parking. These requirements are approximately double the area of the existing main terminal, 92 to 107 aircraft parking positions, and 42 to 49 RON aircraft parking positions, respectively. It was assumed that existing facilities would be modified, relocated, or demolished as required to implement the concepts. Concept 3 and Concept 4 were developed at a more fundamental level of detail than was developed for Concept 1 and Concept 2. Thus, the figures included for Concept 3 and Concept 4 are hand-drawn sketches.

The four long-range terminal development concepts are described below.

Concept 1 – Terminal Expansion East. The TEE concept, illustrated on Figure 4-1, features a new passenger terminal located to the east of the existing P1 and P2 parking garages and assumes:

- Existing Concourse A would be demolished, reconstructed on a new alignment, and extended so that it would connect to TEE. In the long-term, Concourse A will be demolished to enable the extension of Taxiway T to the east for better airfield circulation.
- Concourse E would be similarly extended to the east on its existing alignment.
- Additional ticketing lobby, baggage claim, and security screening functions would be provided in TEE similar to the existing passenger terminal.
- The P3 garage, located immediately to the east, would provide convenient, close-in, parking.
- Upper and lower level terminal roadways would be located between the TEE and P3 garage.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

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Scale: 1" = 1,000'

Source: Jacobs Consultancy, November 2009

Figure 4-1

Concept 1 - Terminal Expansion East (TEE)

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Passengers could walk from the TEE to gates located on Concourses A and E or be transported to Concourses C and D on a secure APM system. Airline ticketing and baggage claim facilities would be split between the TEE and the existing terminal facilities to provide balance for arriving and departing passengers.

Concept 2 – Terminal Expansion Central. The Terminal Expansion Central (TEC) concept, illustrated on Figure 4-2, features all passenger processing functions in one central location and assumes:

- The existing passenger terminal would be expanded to the east, across the space currently occupied by the upper and lower level roadways.
- The existing upper and lower level roadway system would be demolished, and a new upper and lower lever roadway system would be constructed.
- The existing P1 parking garage would be demolished.

Similar to the TEE concept, the TEC concept includes the realignment and extension of Concourse A to the east and the extension of Concourse E to the east, to provide the needed aircraft parking positions.

Concept 3 – Replacement Terminal East. Concept 3, illustrated on Figure 4-3, separates airside functions from landside functions, with all passenger processing functions occurring in a replacement passenger terminal located in the eastern portion of the core development area. Concept 3 assumes:

- All existing landside facilities between the passenger terminal and 82nd Avenue (e.g., existing upper and lower level roadways, P1 and P2 parking garages, and general aviation) would be demolished. Concourses A, B, and E would also be demolished.
- New passenger processing facilities and parking garages would be constructed in the vicinity of the intersection of NE 82nd Avenue and NE Airport Way.
- The existing passenger terminal would be converted to airside facilities and new aircraft parking and RON positions would be constructed to the east.

Passengers would be transported between the passenger terminal and airside concourses on a secure APM system.

COLUMBIA RIVER

North Perimeter Rd.

Potential TEC Location

Potential Demolished P1 Structure

Potential Concourse E Improvements

Potential P3 Garage

RUNWAY 10L-28R

RUNWAY 3-21

RUNWAY 10R-28L

Potential MAX Terminus

Potential Concourse A Improvements

Relocated Roadways

NE Airport Way

Ambassador Pl.

Rd.

Cascades

NE Alderwood

NE Rd.

NE AirTrans

NE Cornfoot Rd.

Legend

- Airport Property Line
- MAX Light Rail
- Potential MAX Light Rail
- Existing Airfield and Safety Areas
- Potential Roadway Alignment
- Potential Roadway Alignment Options
- Existing Passenger Terminal
- Future Terminal Expansion
- Buildings
- Potential Garage
- Water Features
- Extended Taxiway T

AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 1,000'
Scale: 1" = 1,000'

Source: Jacobs Consultancy, November 2009

Figure 4-2

Concept 2 - Terminal Expansion Central (TEC)

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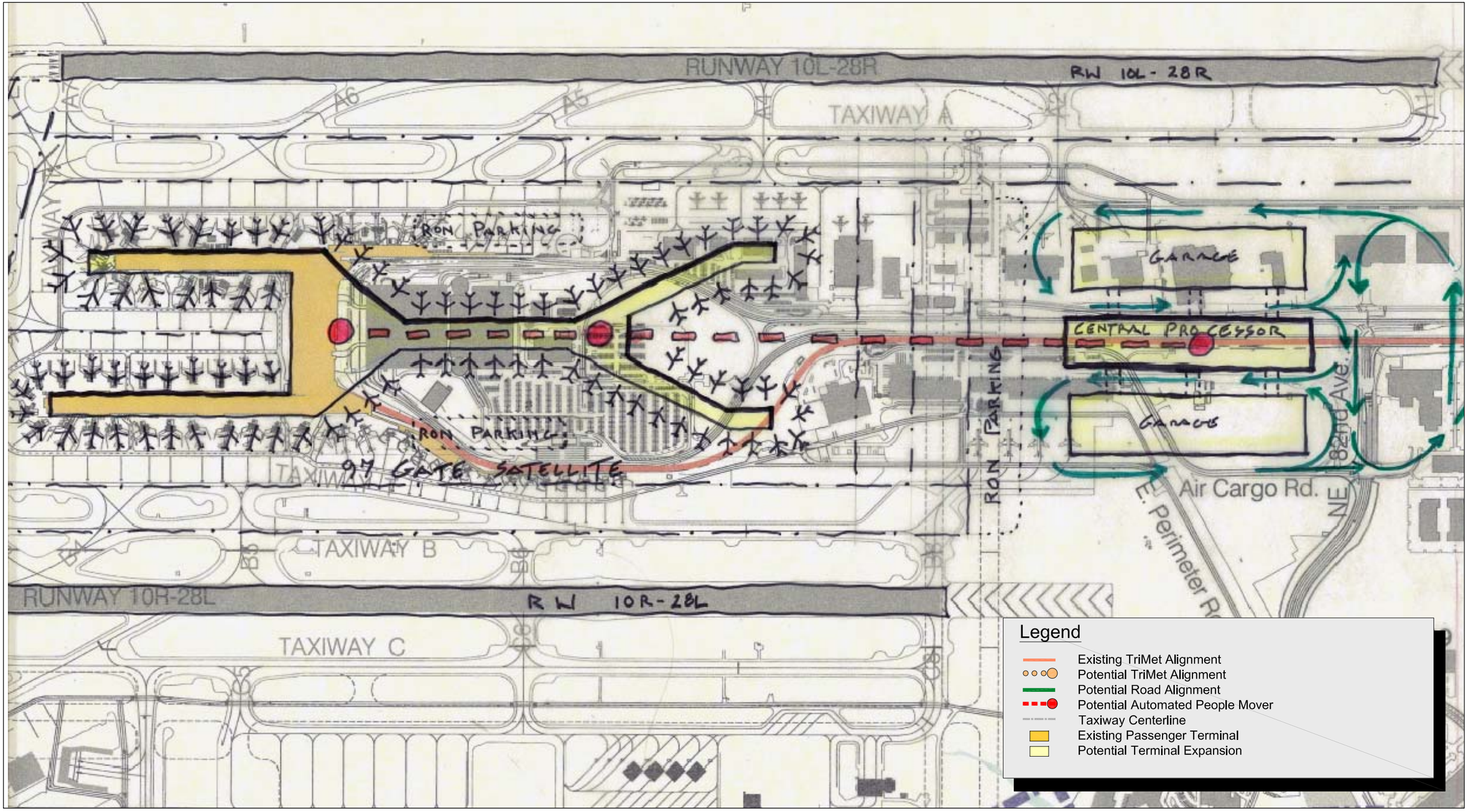

AIRPORT FUTURES
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NOT TO SCALE

Source: HNTB Corporation, November 2009

Figure 4-3

Concept 3 - Replacement Terminal East

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Concept 4 – Supplemental Terminal East. Concept 4, illustrated on Figure 4-4, features a supplemental passenger terminal with contiguous aircraft parking located approximately at the intersection of NE Airport Way and NE 82nd Avenue. Concept 4 assumes:

- A new upper and lower level roadway system and parking garage would be constructed adjacent to the supplemental passenger terminal.
- Most of the landside facilities located to the north and south of NE Airport Way would be relocated.
- Two parallel airside concourses would be constructed between the existing and supplemental passenger terminals.
- A tunnel would be constructed to accommodate NE Airport Way, which would be reconstructed beneath the supplemental passenger terminal and new airside concourses.
- Concourse A would be reconstructed and extended to the east and Concourse E would be extended to the east.

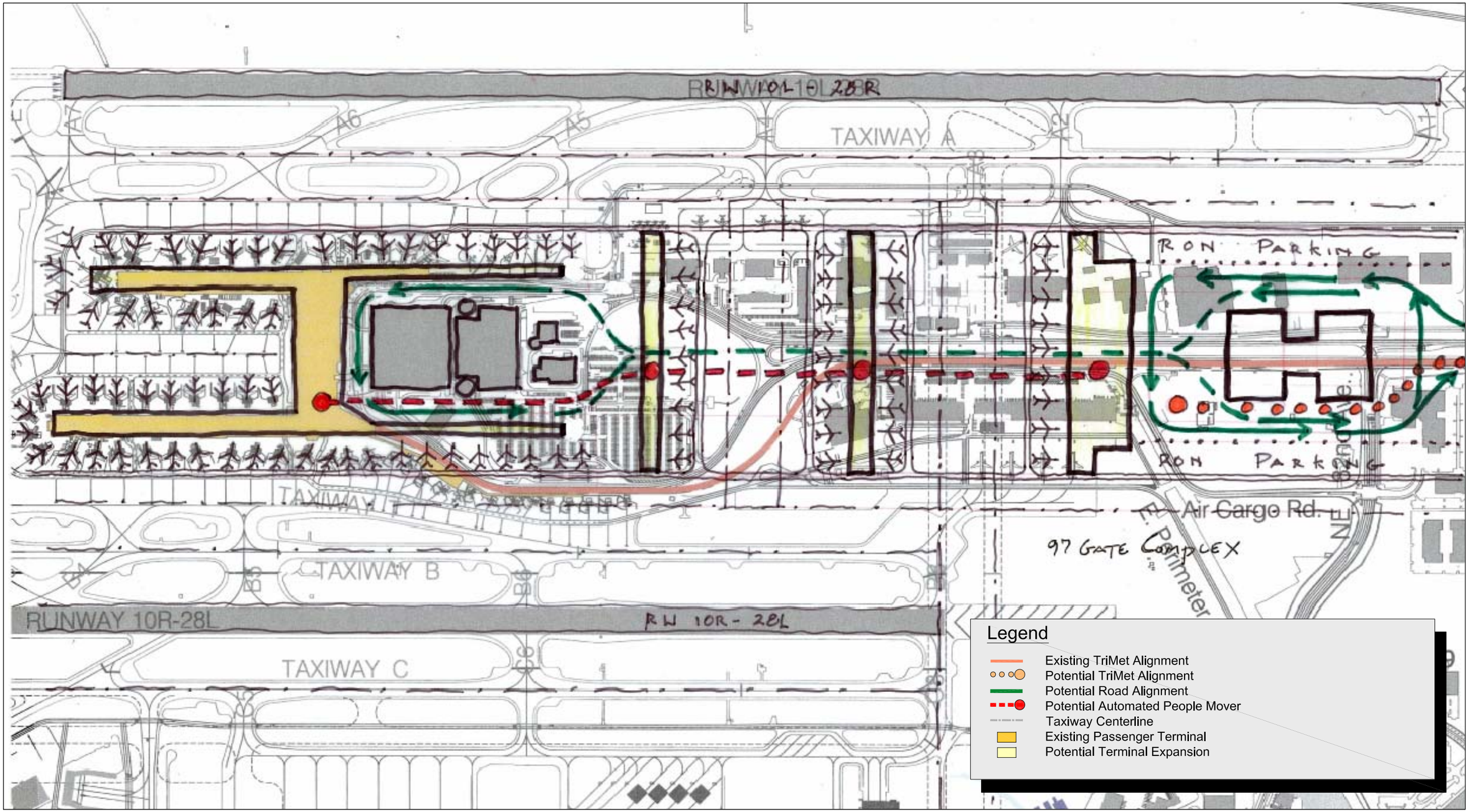
Passengers would be transported between the two passenger terminals on an APM system.

4.2.2 Identification of Preferred Concept

The four alternative long-range terminal development concepts were qualitatively assessed relative to potential cost and the PAG's sustainability criteria, which are described in Section 1.4.4.

Alternative Concept 3 and Concept 4 were rejected for the following reasons:

- Given the amount of demolition and construction involved, and the amount of impervious surface that would be created, the concepts do not minimize environmental impacts.
- Given the existing facilities that would be demolished and replaced, the concepts would not use land resources efficiently.
- The concepts would be difficult to implement in an incremental manner; phasing would be extremely difficult and likely involve considerable inconvenience to customers.
- The cost of Concepts 3 and 4 would be considerably greater than the cost of Concepts 1 and 2.



AIRPORT FUTURES
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Source: HNTB Corporation, November 2009

Figure 4-4

Concept 4 - Supplemental Terminal East

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Alternative Concept 2, Terminal Expansion Central, was rejected because of two significant flaws:

- The concept does not appear to be capable of meeting the enplaning and deplaning roadway requirements in the space available.
- The concept would be very difficult to phase and likely involve considerable inconvenience to customers.

As stated in the Section 4.1, considerable planning was completed prior to this Master Plan Update to develop the TEE concept. The assessment conducted for this master plan update supported the results from these previous planning efforts and resulted in the conclusion that TEE best meets the sustainability criteria set forth by the PAG. Therefore, Concept 1 – Terminal Expansion East was confirmed to be the preferred long-range terminal development concept.

4.3 Remain Overnight Aircraft Parking

4.3.1 Remain Overnight Requirements

For planning purposes, it was assumed that the demand for RON aircraft parking would be met incrementally at each PAL; in other words, additional RON aircraft parking would be constructed as it is needed. Although there may be reasons to phase the construction of new RON aircraft parking differently (e.g., economies of scale), construction as needed permits a simple graphic depiction, shown on Figure 4-5. Figure 4-5 shows the number of RON aircraft positions that will be added during each PAL, and the total number of positions that will exist at the end of each period. As shown, approximately 23 additional RON aircraft positions will be required through PAL 5, for a total of 31.

4.3.2 Remain Overnight Alternatives

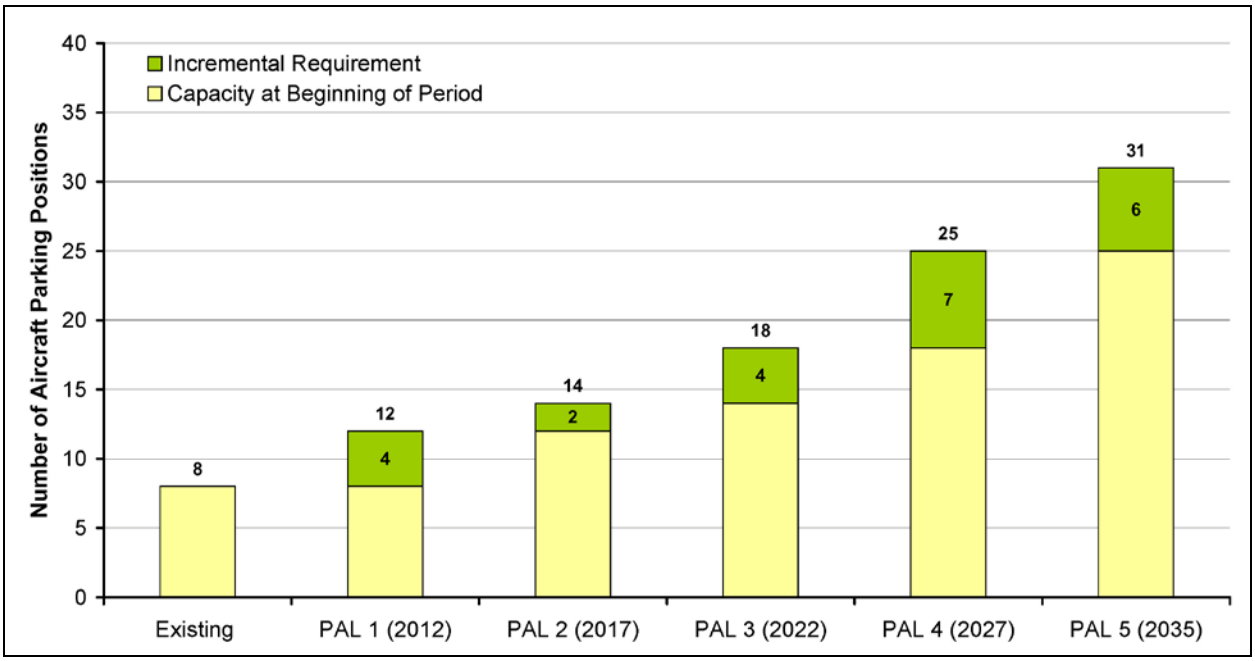
Three alternative concepts were developed to provide RON parking to the north of Runway 10R-28L and as close to the passenger terminal concourses as possible. The alternative concepts are illustrated on Figure 4-6 and described below.

- RON Concept 1, phase 1, is to provide as much RON aircraft parking as is appropriate between the Sheraton and Hampton Inn and Taxiway A. Phase 2 would be to expand RON parking further by using the site currently occupied by the PDX Cargo Center for RON aircraft parking.
- RON Concept 2, phase 1, is the same as for RON Concept 1—to provide as much RON aircraft parking as is appropriate in the area bounded by the Sheraton and Hampton Inn to the south and Taxiway A to the north. Phase 2 would be to expand RON parking further by using the sites currently occupied by general aviation and the North Cargo Center for RON aircraft parking.

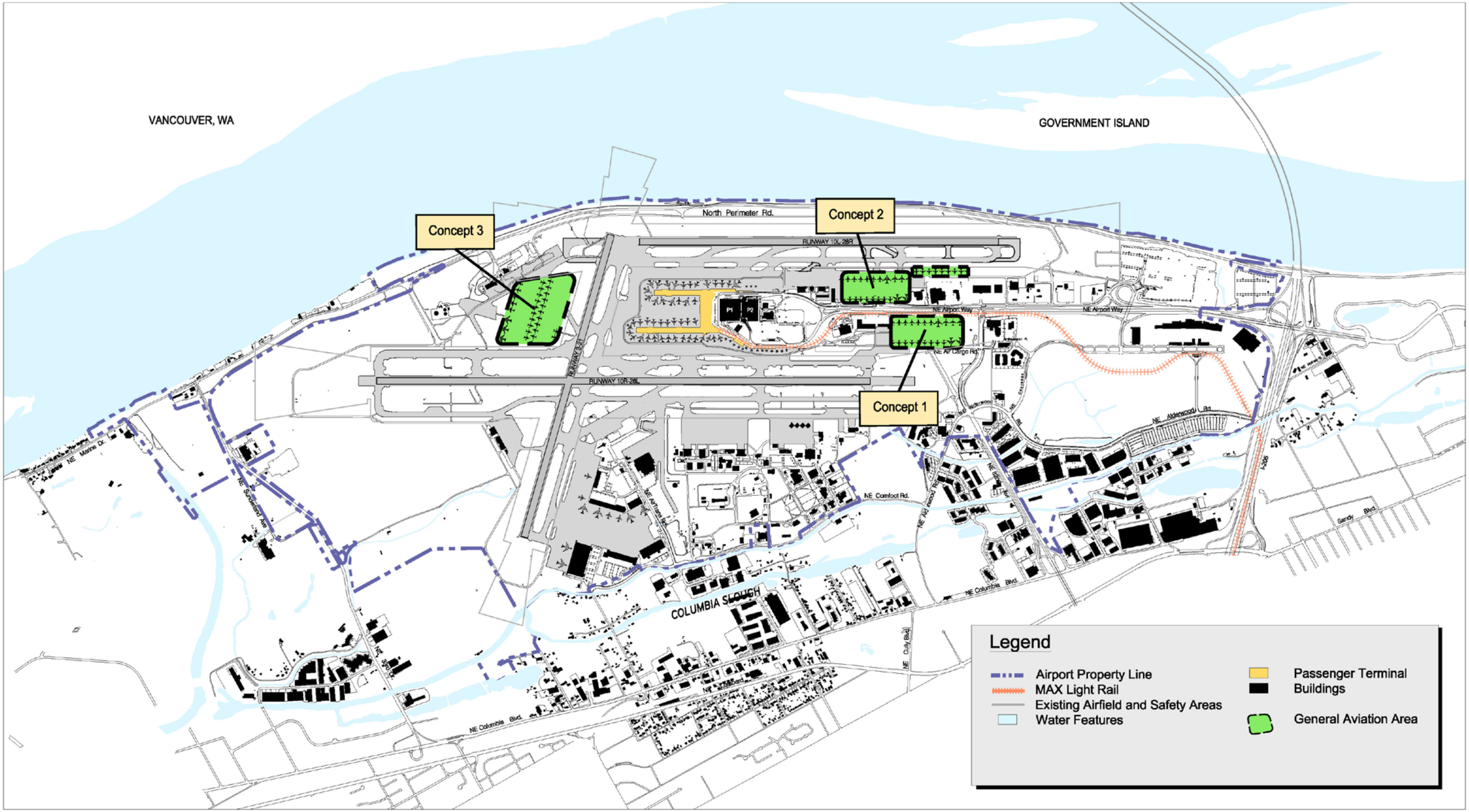
- RON Concept 3 is to construct a new apron area for RON aircraft parking to the west of Runway 3-21.

Figure 4-5

PLANNED REMAIN OVERNIGHT PARKING CAPACITY FOR EACH PLANNING ACTIVITY LEVEL



Source: Jacobs Consultancy, *Technical Memorandum No. 3 – Facility Requirements*.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

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Source: Jacobs Consultancy, November 2009

Figure 4-6

Alternative Concepts for Locating RON Aircraft Parking

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4.3.3 Evaluation of Alternatives

Based on the evaluation of the three RON concepts, the following conclusions were reached:

- Concept 3 is the best concept for RON aircraft parking. Runway 3-21 is not heavily used; therefore, towing aircraft across Runway 3-21 would not result in significant delays to arrivals or departures. However, utilization of the area to the west of Runway 3-21 would require relocation of an existing navigation aid (the very-high frequency omni-directional range station, or VOR) and there is no current viable site for its relocation. Over time it is expected that the aging VOR will become obsolete and be replaced by another navigation aid. The removal of the VOR would permit construction of RON aircraft parking to the west of Runway 3-21. Accordingly, it was concluded that the best strategy for providing additional RON aircraft parking is to employ a hybrid of Concepts 1 and 2, with Concept 3 being implemented in the later PALs.

- Adding RON aircraft parking in the area bounded by the Sheraton and Hampton Inn to the south and Taxiway A to the north is the best alternative available in the short term—it is an efficient use of the land, will not affect adjacent functions, and is the lowest cost alternative.

- Expanding RON aircraft parking by using the site currently occupied by the PDX Cargo Center is not a viable option. As will be described in Section 6, the PDX Cargo Center is the preferred site for belly-cargo functions during the planning period. The belly-cargo facilities are in good condition and expensive to replace. Furthermore, there is no other suitable site. Also, expanding the RON aircraft parking at the PDX Cargo Center (the ramp currently provides eight RON aircraft parking positions) would exacerbate an existing problem caused by having a single taxiway, Taxiway T, between the PDX Cargo Center ramp and the passenger terminal. Frequently, it is time consuming to tow aircraft from the ramp westward to the terminal because these movements conflict with aircraft taxiing eastward to depart on Runway 28L. The only option for eliminating these conflicts is to provide a second taxiway by extending Taxiway A to the east, which requires the demolition and relocation of Concourse A.

- Expanding RON aircraft parking in the sites occupied by general aviation and the North Cargo Center is not appropriate unless all other options have been exhausted. As described below, adding RON aircraft parking in the area bounded by the Sheraton and Hampton Inn to the south and Taxiway A to the north will meet requirements through PAL 3.

Given these considerations, the recommended concept for providing RON aircraft parking is a hybrid of Concepts 1 and 2—continue using the PDX Cargo Center apron for aircraft RON parking and supplement that capacity by constructing additional RON

parking during each PAL. PAL 1 requirements can be met with phase 1 of an aircraft apron located to the north of the Sheraton and Hampton Inn. The layout of the apron would accommodate four ADG III (e.g., the Boeing 737-800) aircraft as shown on Figure 4-7.

PAL 2 (2017) requirements can be met by implementing phase 2 of the project completed during PAL 1. Phase 2 consists of expanding the phase 1 aircraft apron to the east, to accommodate an additional two ADG III aircraft. This expansion is also shown on Figure 4-7.

PAL 3 (2022) requirements can be met by expanding the phase 1 and 2 aircraft apron further to the east. This phase 3 expansion would be approximately the size of the phase 1 project; the aircraft parking layout would likely be changed and the resulting apron could accommodate a total of 10 ADG III aircraft. At this point, no further expansion is recommended as Taxiway A provides the only path between either the RON apron or Runway 28R and the terminal—a situation for RON aircraft analogous to the situation currently experienced by RON aircraft at the PDX Cargo Center.

PAL 4 (2027) and PAL 5 (2035) requirements should be met with Concept 3, described above, by constructing a RON aircraft parking apron to the west of Runway 3-21. Concept 3 would provide 13 additional RON aircraft parking positions on the Airport, satisfying the PAL 5 demand of 31 positions.

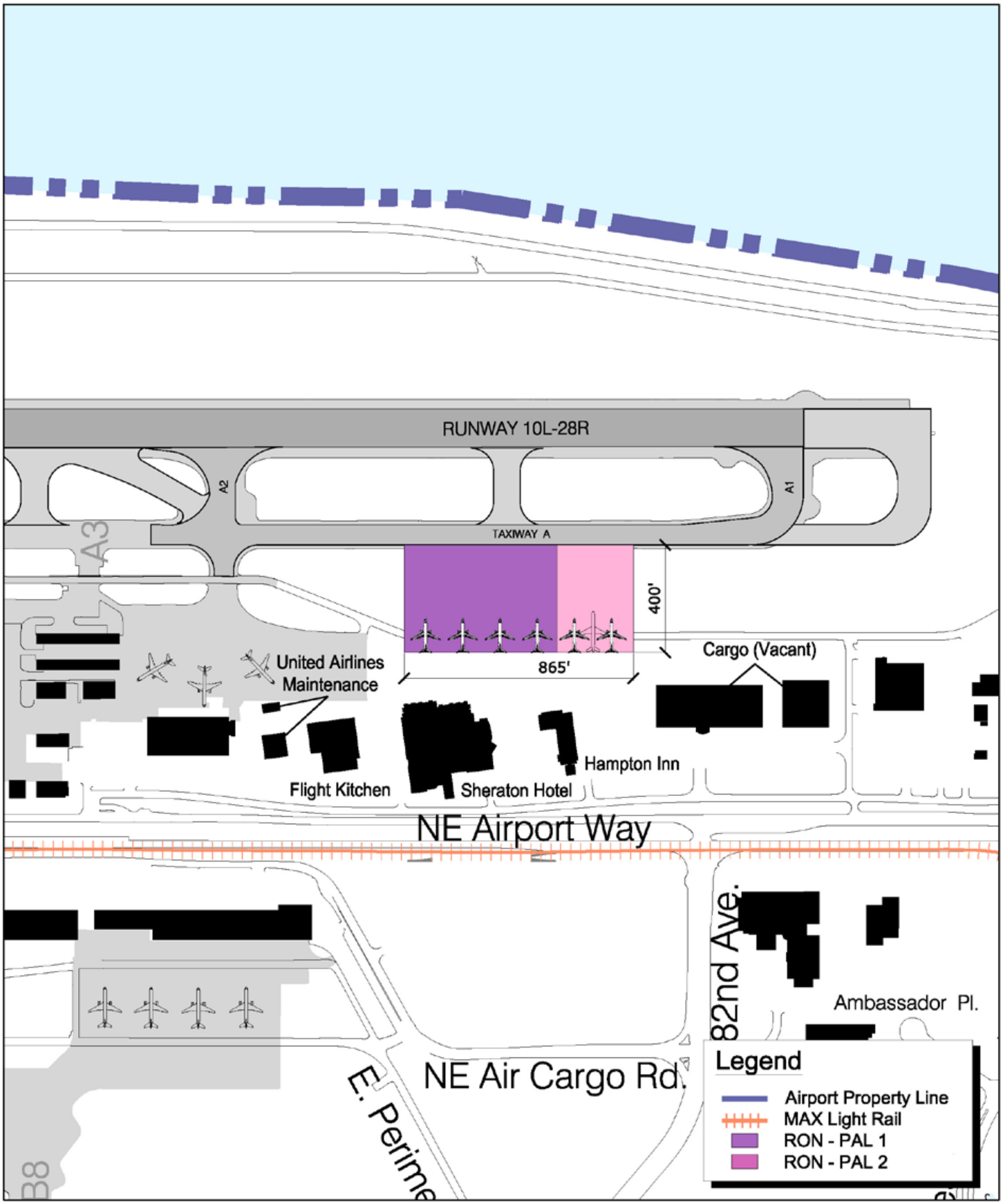
4.4 Strategy for Maintaining Terminal Effectiveness

Although no immediate or urgent requirements to modify passenger terminal facilities exist (modest improvements are not necessary until approximately PAL 2), concepts for maintaining their effectiveness will involve investing in opportunities related to six key elements:

- **Ticketing—**The layout of the existing passenger ticket counters is based on outdated procedures and technology (e.g., procedures that assumed most passengers check-in for flights at the ticket counters rather than at home or at common-use kiosks). Although the layout continues to be effective, there may be better alternatives.

- **Ticketing lobby—**The arrangement of the ticketing lobby to accommodate passenger queuing and circulation functions is based on the outdated procedures and technology that resulted in the existing ticket counter concept and layout.

- **Airline ticket office space—**Many of the functions that airline ticket offices, located behind the ticket counters, were originally designed to accommodate have been overtaken by new processes and technology; therefore, the space is underutilized and represents an opportunity for increasing terminal productivity.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

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Scale: 1" = 500'

Figure 4-7

Recommended Concept for PAL 1 and PAL 2 RON Aircraft Parking

Source: Jacobs Consultancy, November 2009

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- **Concessions—**The concessions program at the Airport is among the best in the United States and should continue to evolve based on the Port's strategy for satisfying changing passenger needs and enhancing revenue. Any future terminal changes should be carefully coordinated with the overall concessions strategy.

- **Passenger security screening—**As noted in *Technical Memorandum No. 3 – Facility Requirements*, as passenger security screening equipment and procedures continue to evolve, it is likely that the layout of the space and equipment dedicated to passenger security screening will change. Moreover, a more effective layout may exist.

- **Mezzanine office space—**With the completion of the Port's new headquarters, atop the P2 parking garage, much of the Port's office space on the mezzanine of the passenger terminal will be vacant. This represents a potential revenue opportunity.

It is possible to significantly enhance the terminal's future effectiveness and improve level of service through a comprehensive remodeling program. Therefore, it is recommended that a passenger terminal master plan be completed to develop a comprehensive strategy and plan to reconfigure level 1 and the mezzanine. A comprehensive plan and strategy would avoid a piecemeal approach to improvements and ensure: (1) preserving future development options, (2) the most effective use of terminal resources, (3) the most efficient possible passenger processing and the best possible passenger experience, and (4) the maximum possible concessions revenues. This recommended follow-on study is further described in Section 8 of this Technical Memorandum.

5. GROUND TRANSPORTATION AND PARKING

This section (1) describes the alternatives that were considered for meeting the Airport's ground transportation and parking requirements through PAL 5 (2035), (2) summarizes the approach to evaluating the alternatives and the results, and (3) identifies key conclusions, recommended alternatives and development strategies. The five major ground transportation and parking elements:

- Parking
- Rental cars
- Enplaning and deplaning curbside roadways
- Terminal area roadways and intersections
- Access roadway intersections

5.1 Parking

For planning purposes it was assumed that during each PAL, the total requirement for close-in and remote public parking would be met incrementally during that period. Additional parking would be constructed as it is needed. Although there may be numerous reasons to phase the construction of new parking facilities differently (e.g., economies of scale), construction as needed permits a simple graphic depiction, shown on Figure 5-1. Figure 5-1 shows the number of parking spaces that will be added during each PAL and the total number of spaces that will exist at the end of each period. Approximately 12,400 additional public parking spaces will be required through PAL 5, resulting in a total of approximately 27,540 spaces.

An analysis was completed to identify and evaluate various future parking locations at the Airport. The primary assumptions used in the analysis were:

- A mix of parking products (i.e., short-term, long-term, and economy) will continue to be offered.

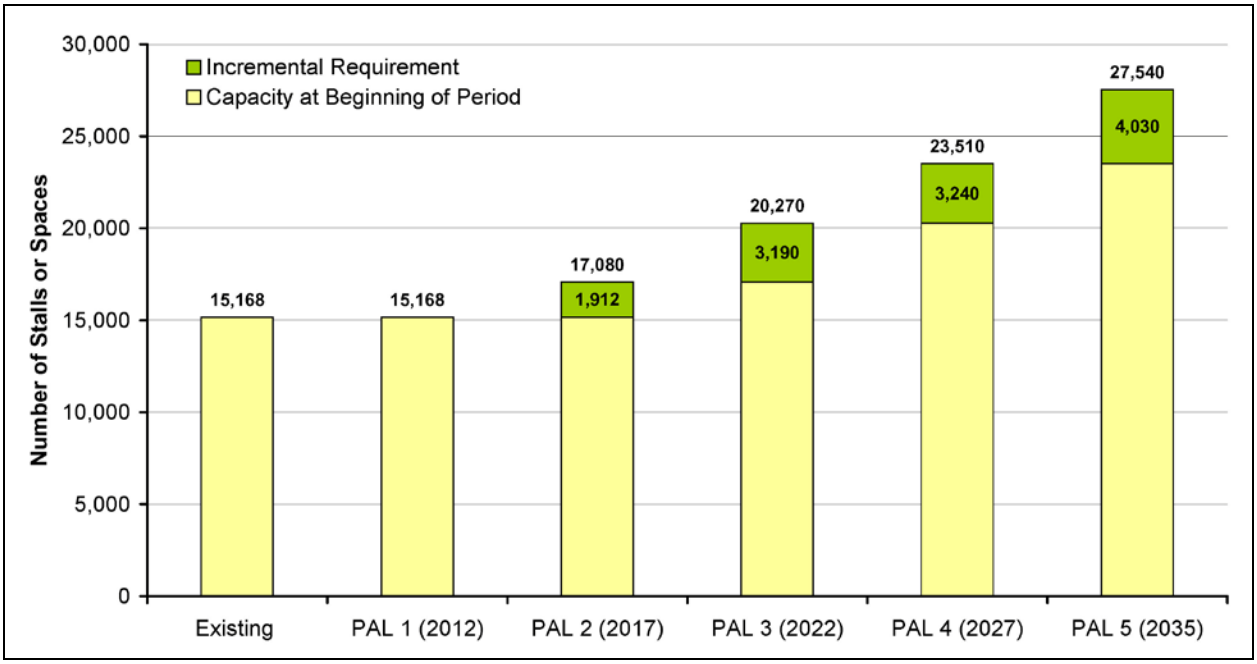
- The long-term and economy lots will remain in their existing locations.

- The size of the long-term lot will contract and expand through the PALs as the facilities in the core development area are developed and modified.

- Structured parking (i.e., garages) can be provided at both the P3 location (between the future terminal expansion east and cross-field taxiways) and the P4 location (at the southwest corner of the intersection of NE Airport Way and NE 82nd Avenue). The garages could accommodate both public parking and rental cars. This ensures that future development options are preserved, as recommended by the PAG. The locations of the TEE and the P3 and P4 garages are shown on Figure 5-2.

Figure 5-1

PLANNED PUBLIC PARKING CAPACITY AT THE END OF EACH PLANNING ACTIVITY LEVEL

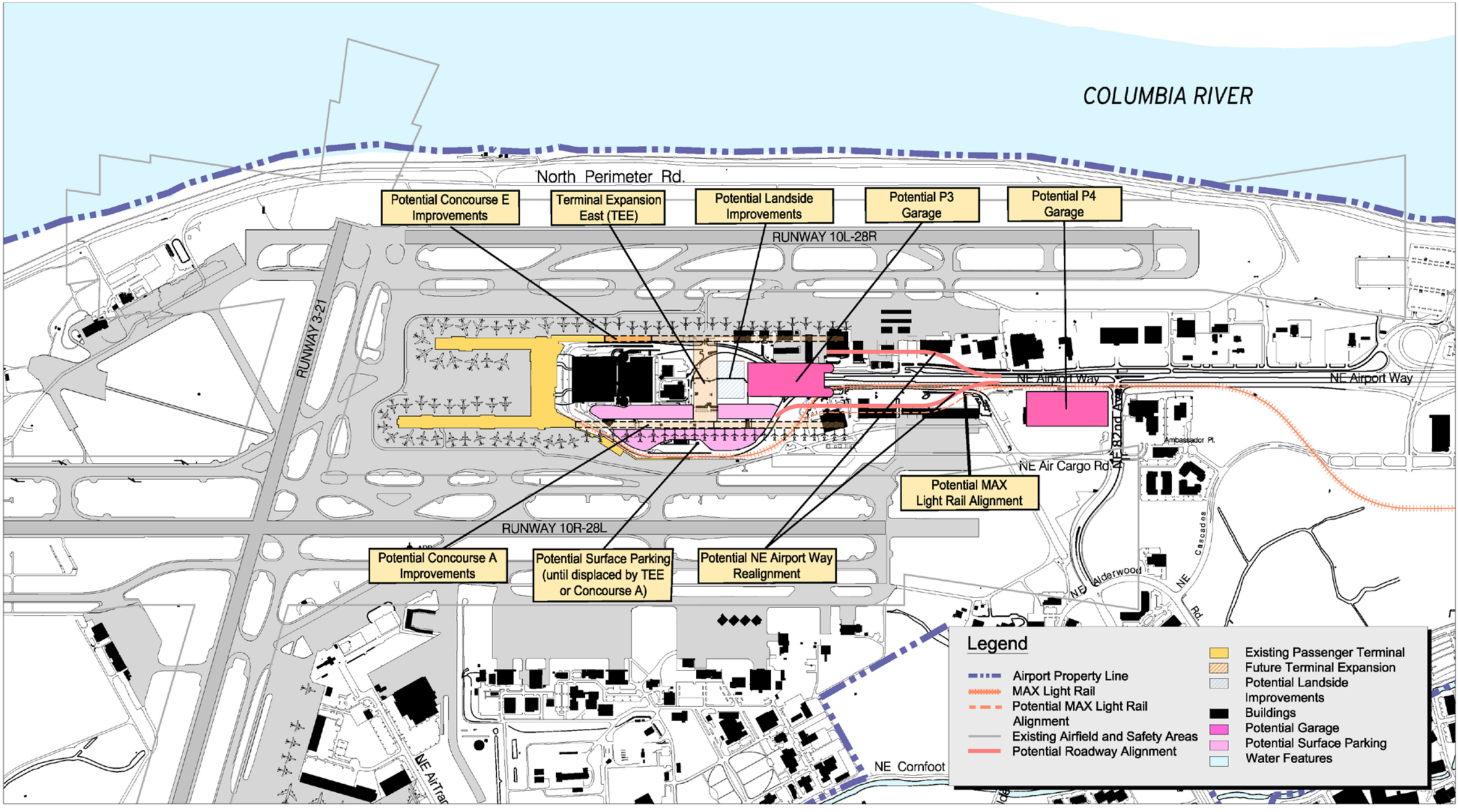


Source: Jacobs Consultancy, *Technical Memorandum No. 3 – Facility Requirements*.

- The area available for construction of the P3 garage assumes the cross-field taxiways will be constructed to the east of the locations shown on the existing ALP. Please refer to discussion in Section 3.2 of this Technical Memorandum.

- Total public parking requirements can be met during each PAL by allocating parking demand among the facilities.

- To ensure that sufficient land will be available for public parking, the alternatives are based on consideration of the most demanding facility requirements (i.e., requirements resulting from the continuation of existing driving and parking trends). The Port continually reviews its policies related to parking operations and terminal access and future policies (e.g., policies related to LRT ridership and other transportation modes) could reduce parking demand. The objective of this analysis was to ensure that the most demanding requirements can be met; if the demand does not materialize, the facilities would not be built.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

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Source: Jacobs Consultancy, November 2009

Figure 5-2

Locations of the P3 and P4 Parking Garages and Other Potential Long-Term Development

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The alternatives for providing structured parking at the P3 and P4 sites are shown on Figure 5-2, which illustrates the garages at full build out and shows the spatial relationship of these garages to TEE. The next increment of parking required, which will drive the construction of another garage, is associated with PAL 2 (approximately 2012). Therefore, the Port must decide in the relative near term where to locate the next garage.

Each alternative location has strengths and weaknesses. For example, a strength of the P3 location is its proximity to the passenger terminal, and a weakness is that its construction will trigger the relocation of several adjacent facilities, as illustrated in Figure 5-3. These strengths and weaknesses are summarized in Table 5-1 according to the applicable planning criteria. Unless future studies indicate that postponing the relocation of adjacent facilities outweighs the benefits related to preserving future flexibility, minimizing environmental impact, and maximizing land use and operational efficiency, the next parking garage should be constructed on the P3 site.

As described in *Technical Memorandum No. 3 – Facility Requirements*, additional employee parking will not be required until PALs 4 and 5.

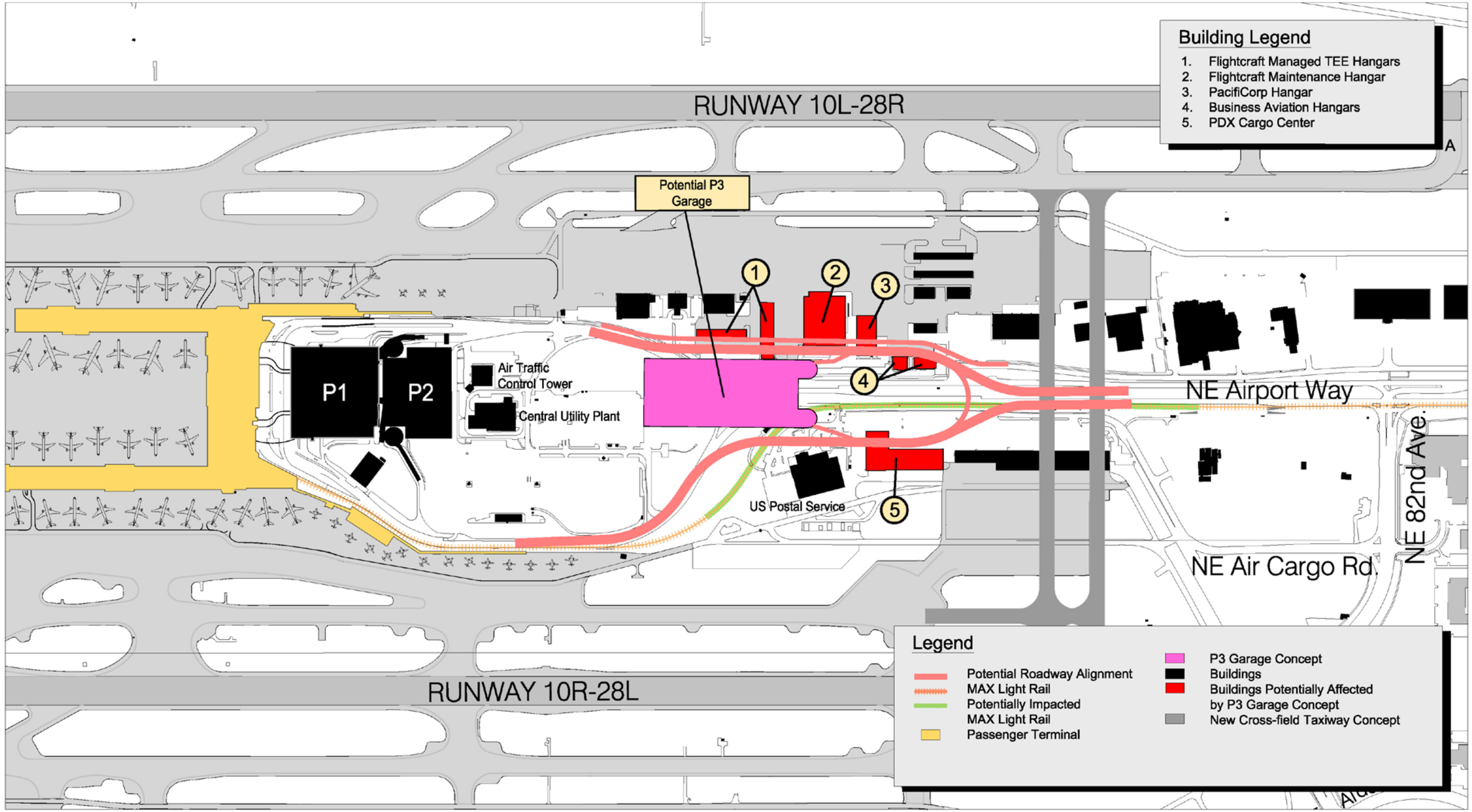
5.2 Rental Cars

The analysis of the rental car element included (1) considering customer service, ready/return, and service facilities requirements as well as the convenience of customer access to rental cars relative to other means of transportation and (2) identifying and evaluating alternative modes for transporting customers to and from the terminal.

5.2.1 Customer Service, Ready / Return, and Service Facilities

The rental car customer service center and automobile ready and return facilities are currently located in the P1 parking garage. Based on considerable prior analysis, the Port has concluded that by providing additional automobile ready/return facilities in the P2 parking garage (planned to open in 2010) and expanding the existing at-grade rental car service facilities (i.e., fuel, wash, and storage), rental car facilities will be adequate until PAL 4 (2027). At that time, a consolidated rental car facility capable of accommodating 100% of the market would be provided. As currently planned, the facilities provided at the P1 and P2 garages will accommodate about 80% of the market; the remaining 20% of the market is composed of those rental car companies currently located off the Airport.

The rental car ready/return parking capacity and service facilities requirements, by PAL, are shown on Figures 5-4 and 5-5, respectively.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

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Source: Jacobs Consultancy, November 2009

Figure 5-3

Facilities Potentially Impacted by the P3 Garage

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Table 5-1

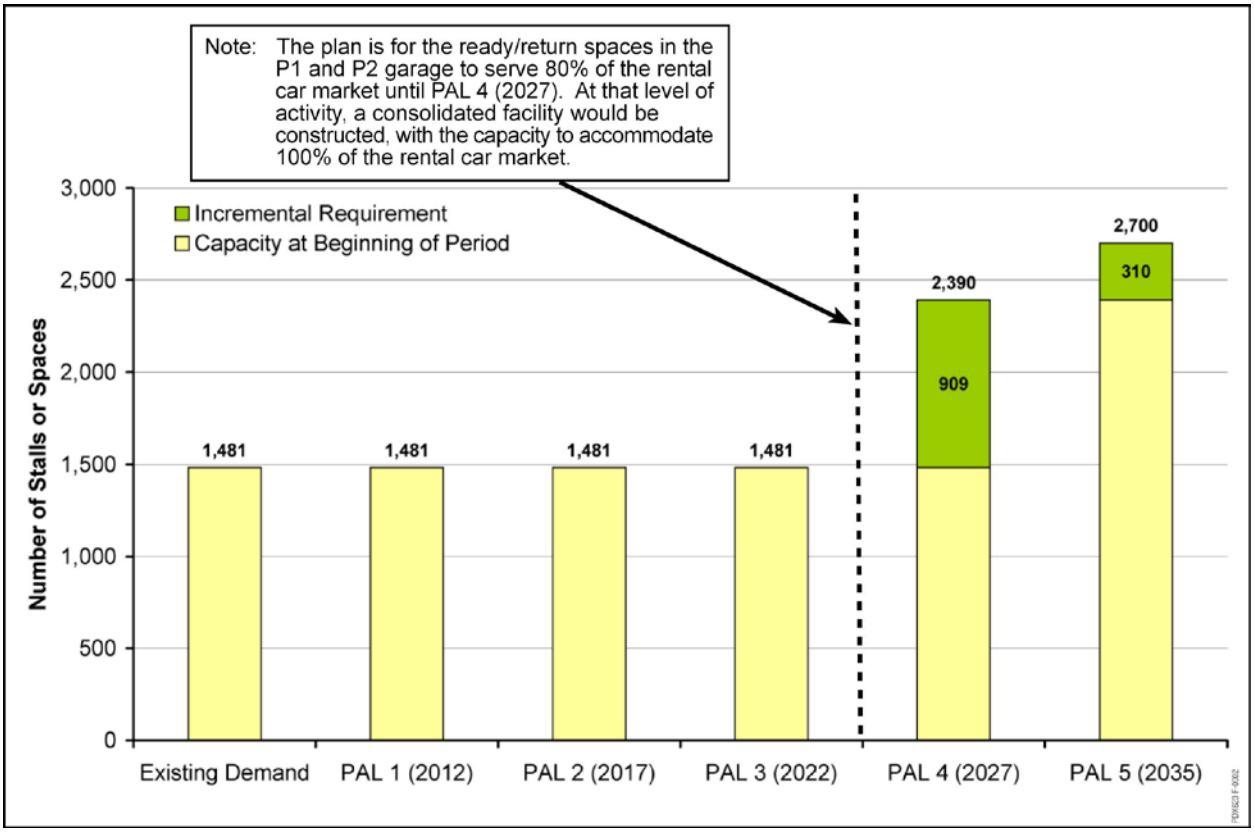
COMPARISON OF THE P3 AND P4 ALTERNATIVE PARKING GARAGE SITES

Sustainability criteria	P3 Site	P4 Site
Preserve future flexibility and development options	• Large enough to meet parking and rental car needs through PAL 5 (2035) • Allows incremental development • Retains P4 as vacant site longer (good construction staging area) • Synergy with extended Concourse E	Not large enough to meet all parking needs on one site; therefore, selecting P4 as first location is an early commitment to build parking on both P3 and P4 sites
Minimize environmental impact	Energy consumption for transporting passengers to and from terminal: better	Energy consumption for transporting passengers to and from terminal: good
Maximize land use efficiency	Clusters dependent functions (TEE, roadways, and P3 garage) in compact location	Loss of airside property and convenient construction staging area
Maximize operational efficiency	• Time to terminal: 1 - 3 min (MAX light rail - bus) • Wayfinding: better	• Time to terminal: 5 - 6 min (MAX light rail- bus) • Wayfinding: good • As P3 expands to the east, it may become less efficient. Therefore, by developing P4 to supplement P3, overall operational efficiency may be maximized.
Maximize effective phasing	• Requires design coordination with TEE • Potential early relocations: NE Airport Way, MAX light rail, PDX Cargo Center, and general aviation facilities	Requires design coordination with the grade-separated interchange at NE 82nd Avenue and NE Airport Way

Source: Jacobs Consultancy, November 2009.

Figure 5-4

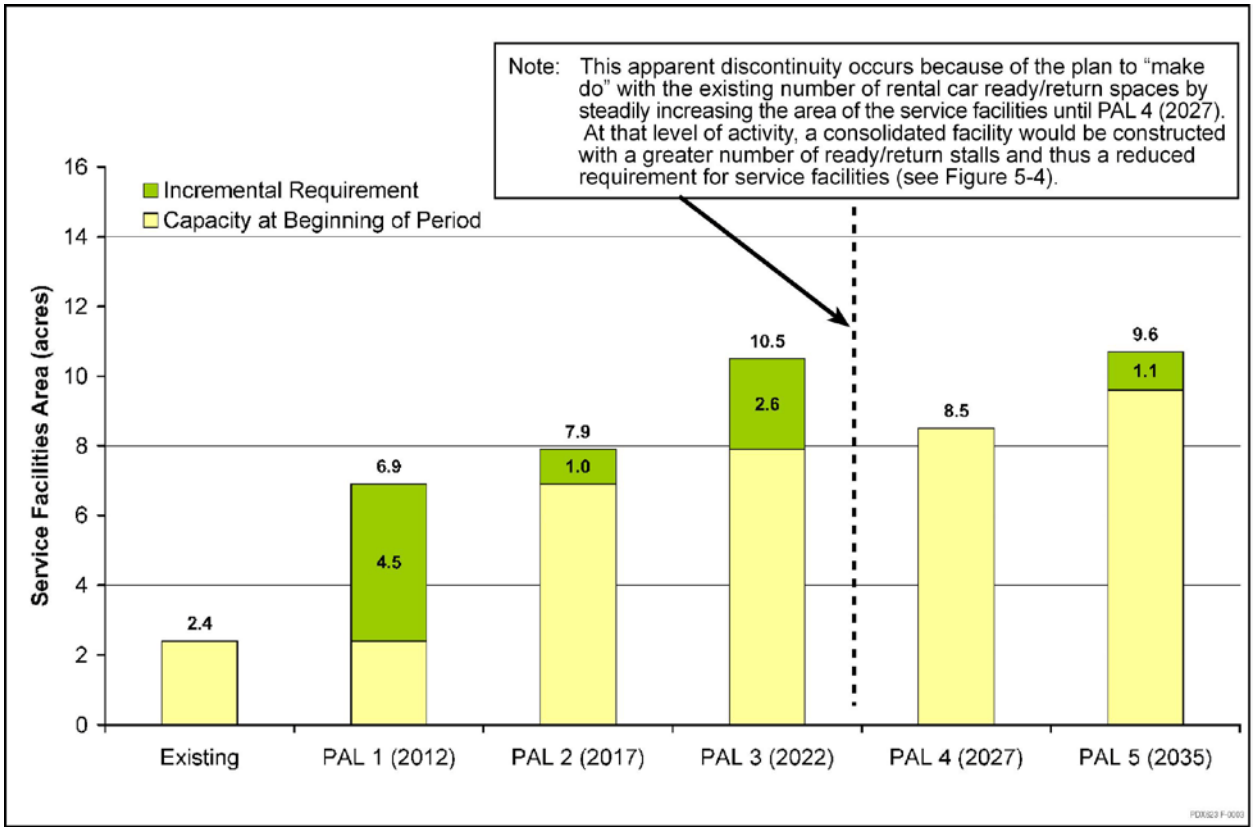
PLANNED RENTAL CAR READY/RETURN PARKING CAPACITY AT THE END OF EACH PLANNING ACTIVITY LEVEL



Source: Jacobs Consultancy, *Technical Memorandum No. 3 – Facility Requirements*.

Figure 5-5

PLANNED RENTAL CAR SERVICE FACILITY AREA AT THE END OF EACH PLANNING ACTIVITY LEVEL



Source: Jacobs Consultancy, *Technical Memorandum No. 3 – Facility Requirements*.

An analysis was completed to identify and evaluate alternative concepts for locating a future consolidated rental car facility at the Airport. Five alternative concepts were considered:

- Concept 1—the P1 and P2 garages (status quo)
- Concept 2—the P3 garage
- Concept 3—the P4 garage
- Concept 4—a garage located in the existing rental car storage area, to the west of the intersection of NE Mount Hood Avenue and NE Airport Way
- Concept 5—a garage located to the east of 82nd Avenue and north of NE Alderwood Road, in Portland International Center (PIC)

The alternative concepts are shown on Figure 5-6. Each concept assumes an adjacent at-grade service center. Concepts 1, 2, and 3 assume a garage that provides a mix of rental car and public parking spaces. Concepts 4 and 5 assume a garage that accommodates rental cars only.

Given that the consolidated rental car facility is not needed until PAL 4 (2027), a decision regarding the preferred location for the facility is not needed for the purposes of the Master Plan Update. Furthermore, pending a decision regarding the location of the next public parking garage, which will not be made until a follow-on study is completed, such a decision would be premature. Nonetheless, the major factors bearing on the decision are addressed below, including operating expenses and customer convenience.

Rental car companies have a strong preference for combined ready/return areas where the spaces can be flexibly allocated to meet peak demand and minimize operating expenses. Split ready/return areas are inefficient and expensive to operate. All the alternatives considered have combined ready/return areas.

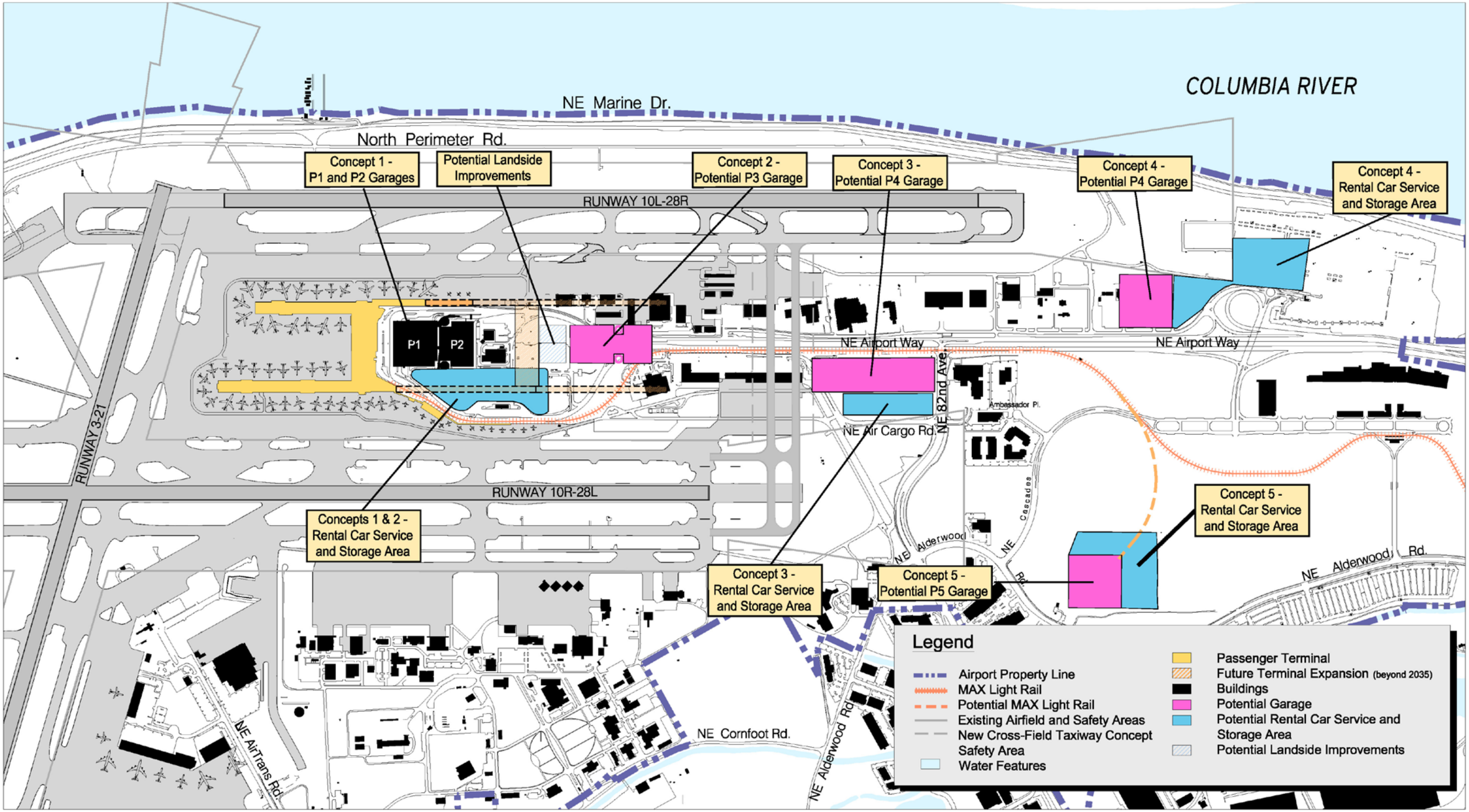
The convenience of customer access to rental cars relative to other means of transportation (e.g., cabs, limos, and MAX light rail) affects the number of customers who choose to use a rental car, which, in turn, affects Airport revenues. In the matter of convenience, perceived differences may be as important as the actual differences. Accordingly, rental car companies prefer to be located in the core terminal area if possible, where customers can conveniently walk to the rental car ready/return area. If customers must be transported to the rental car ready/return area, the focus of the rental car companies changes to (1) efficiency of operations, (2) way finding—can customers easily find their way to and from the Airport, and (3) transportation between the service center and terminal—is it affordable, convenient, and timely.

5.2.2 Identifying Alternative Transportation Modes

Considering the relevance of customer convenience and cost, three alternatives were identified for transporting customers between the consolidated rental car facility and the passenger terminal—an APM, MAX light rail, and busing.

Automated People Mover. Four alternatives for an APM system that would transport customers between the passenger terminal and consolidated rental car facility were considered. These alternatives are illustrated on Figure 5-7 and described below.

1. **Alternative 1 (the P3 line)**—This alternative assumes that in PAL 4 (2027), the APM system is constructed between the P3 garage and the existing passenger terminal with the ability to extend it to the P4 garage and add a stop at the TEE beyond PAL 5 (2035).



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

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Source: Jacobs Consultancy, November 2009

Figure 5-6

Alternative Concepts for Locating a Consolidated Rental Car Facility

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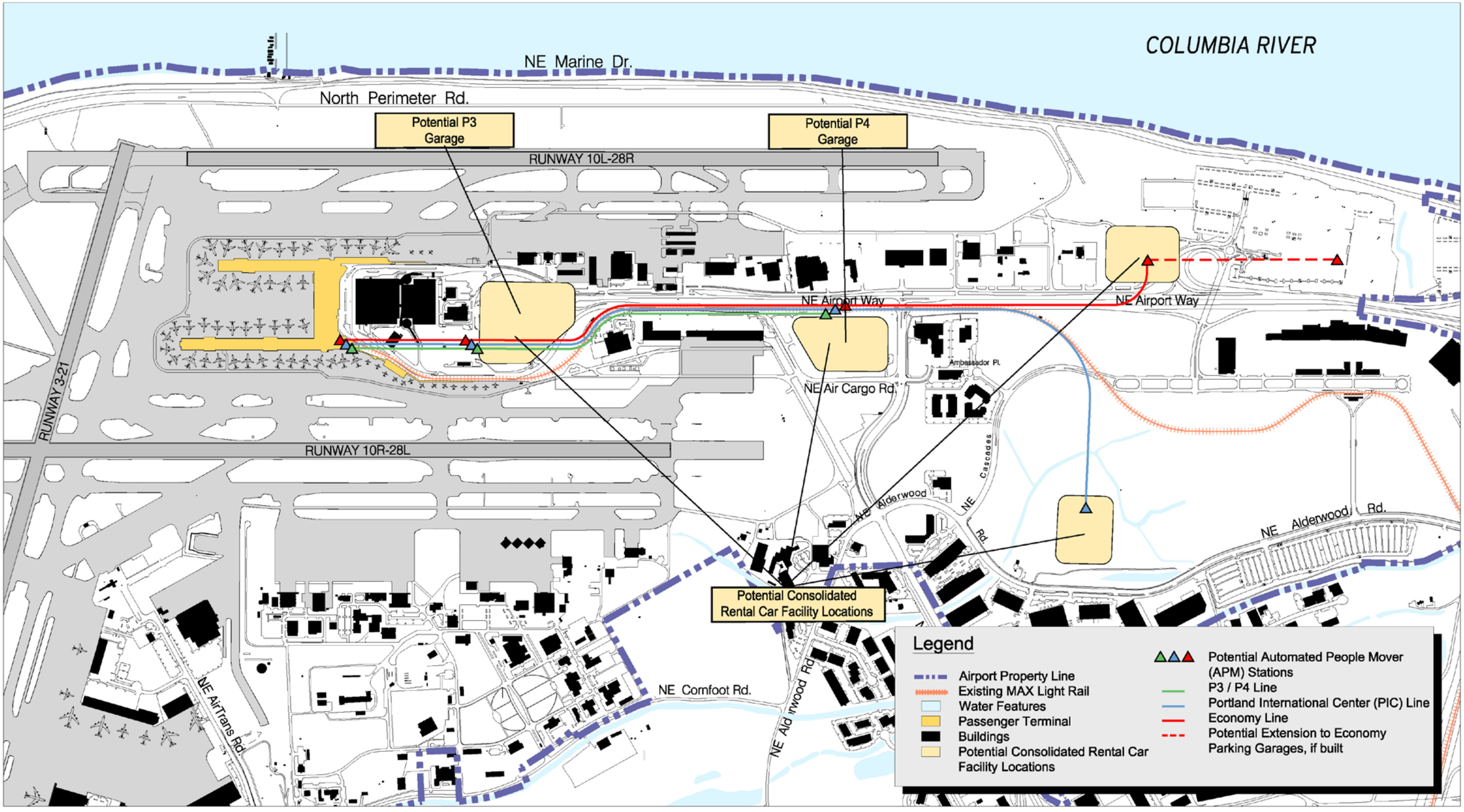

AIRPORT FUTURES
CHARTING A COURSE FOR PDX

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Figure 5-7

Concepts for an Automated People Mover System Between the Passenger Terminal and Consolidated Rental Car Facility

Master Plan Update
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Source: Jacobs Consultancy, November 2009

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2. **Alternative 2 (the P4 line)**—This alternative assumes that in PAL 4, the APM system is constructed between the P4 garage and the existing passenger terminal, with a stop at the P3 garage and with the ability to add a stop at the TEE beyond PAL 5 (2035).

3. **Alternative 3 (the Economy line)**—This alternative assumes that in PAL 4, an APM system is constructed between a consolidated rental car facility located near the economy parking lot and the existing passenger terminal, with stops at the P4 and P3 garages. The system would be designed with the ability to add a stop at the TEE beyond PAL 5 (2035) and to be extended to the east to public parking garages located in the existing economy lot, should they be required.

4. **Alternative 4 (the Portland International Center line)**—This alternative assumes that in PAL 4, the APM system is constructed between a consolidated rental car facility located in PIC and the existing passenger terminal, with stops at the P3 and P4 garages. The system would be designed with the ability to add a stop at the TEE beyond PAL 5 (2035).

The APM concepts were developed based on the following assumptions:

- The consolidated rental car facility, APM system, and the P3 and P4 parking garages would be in place by PAL 4 (2027).

- The APM system would have stations at the consolidated rental car facility, the P3 garage, the P4 garage, and the passenger terminal.

- The APM system should allow for a station at the TEE.

- It should be possible to extend the "economy line" to the east to pick up customers at garages located in the existing economy parking lot, should such garages be required beyond the planning period.

- The APM track would be depressed so that it will pass beneath the cross-field taxiways that will be constructed between the parallel runways after PAL 5 (2035).

MAX Light Rail. Three alternatives for modifying the existing MAX light rail system to transport customers between the passenger terminal and consolidated rental car facility were considered. These alternatives are illustrated on Figure 5-8 and described below.

1. **Alternative 1 (the P3 line)**—This alternative assumes that in PAL 4 (2027), the MAX light rail system is modified so that it can transport customers between the P3 garage and the existing passenger terminal. The ability to add a stop at TEE beyond PAL 5 (2035) would be preserved.

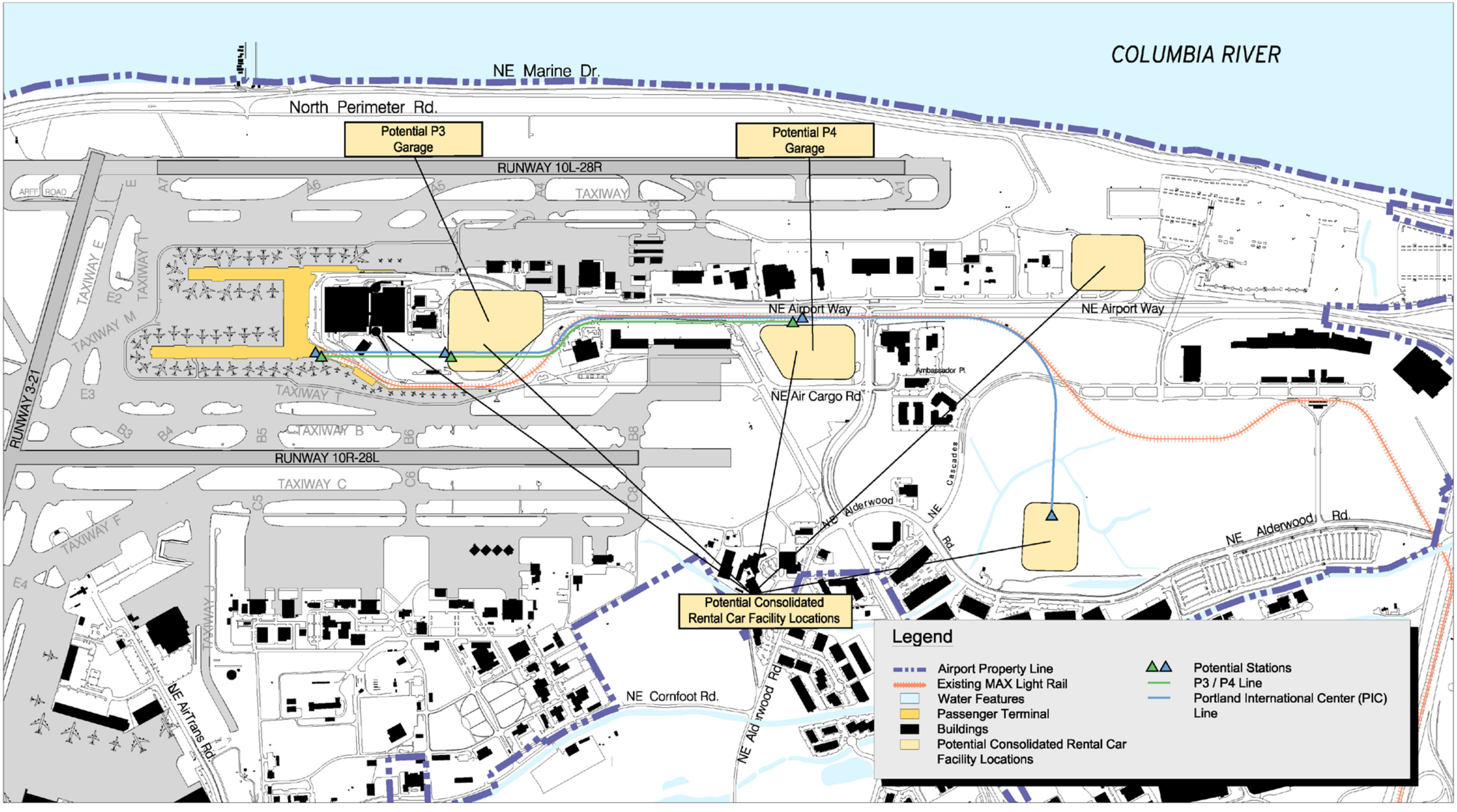

Figure 5-8

Concepts for MAX Light Rail between the Passenger Terminal and Consolidated Rental Car Facility

Master Plan Update
Portland International Airport

Source: Jacobs Consultancy, November 2009

November 2009

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2. **Alternative 2 (the P4 line)**—This alternative assumes that in PAL 4 (2027), the MAX light rail system is modified so that it can transport customers between the P4 garage and the existing passenger terminal. The ability to add a stop at the P3 garage or TEE beyond PAL 5 (2035) would be preserved.

3. **Alternative 3 (the Portland International Center line)**—This alternative assumes that in PAL 4 (2027), the APM is constructed between a consolidated rental car facility located in PIC and the existing passenger terminal, with stops at the P4 and P3 garages. The ability to add a stop at TEE beyond PAL 5 (2035) would be preserved.

All the alternatives assume that that the light rail system providing transportation between the rental car system and the terminal would be free of charge to the customers and independent of the MAX light rail system serving off-Airport destinations.

Busing. This alternative assumes that the Port would provide a consolidated shuttle bus, funded by the rental car companies, for transportation between the consolidated rental car facility, regardless of its location, and the passenger terminal.

5.2.3 Evaluating Alternative Transportation Modes

The three alternative modes for transporting customers between the consolidated rental car facility and the passenger terminal were assessed and compared relative to five criteria. The criteria are explained below and the results of the comparison—for the alternative of placing the consolidated rental car facility in the P3 garage—are summarized in Table 5-2.

- **Life-cycle cost**—A 20-year life-cycle cost analysis was performed for each alternative mode and accounted for both capital and operating costs. The life-cycle cost analyses are explained in Appendix B.

- **Time to terminal**—The time required for a customer to be transported between the rental car facility and passenger terminal was estimated for each transportation mode.

- **Travel-time risk**—This criterion reflects the difference between a system that is independent of another transportation system (i.e., the APM and MAX light rail) and a system that is dependent on another transportation system (i.e., the busing system, which is dependent on the roadway system and its traffic condition).

- **Potential terminal impacts**—This criterion qualitatively reflects the physical terminal modifications that could be required to ensure the transportation mode and terminal are compatible. For example, the potential impact of the busing system is low, because the buses would pick up and drop off passengers at the existing commercial vehicle curbside. The potential impact of MAX light rail is medium, requiring the addition of double tracks at the terminal. By comparison,

the impact of an APM is relatively high, requiring a station platform and potentially an elevator and escalators.

- **Convenience at the terminal**—This criterion reflects differences in walking distance among the various airline customers. Busing is rated as equitable because the commercial vehicle curbside the buses would use is centrally located. By comparison, the MAX light rail system would discharge passengers at the south end of the terminal; thus passengers using Concourses A, B, and C would have less distance to walk than passengers using Concourses D and E and the system would be inequitable with respect to convenience at the terminal. The APM system also would be inequitable with respect to convenience at the terminal because the terminal platform would likely be located at either the south end or the north end of the terminal, not in the middle (a mid-terminal location would be too expensive and disruptive to construct).

From the results summarized in Table 5-2, it is clear that based on life-cycle costs, busing is the preferred transportation mode between the consolidated rental car facility and terminal.

Table 5-2

COMPARISON OF ALTERNATIVE MODES FOR TRANSPORTING CUSTOMERS BETWEEN THE P3 GARAGE AND THE PASSENGER TERMINAL

Transportation mode	20-year life-cycle cost ($ millions)	Time to terminal (min)	Travel-time risk	Potential terminal impacts	Convenience at terminal
Automated people mover	$111	1	Limited	High	Inequitable
MAX light rail	$62	1	Limited	Medium	Inequitable
Bus	$33	3	Roadway congestion	Low	Equitable

Source: Jacobs Consultancy, November 2009.

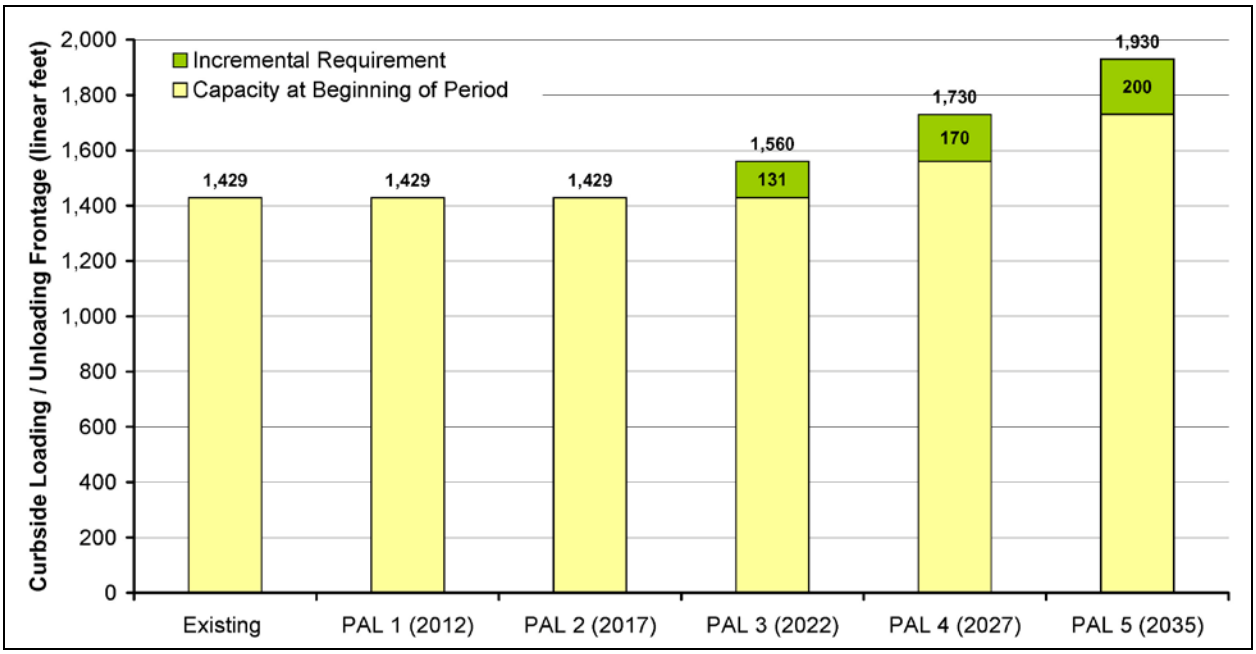
5.3 Enplaning and Deplaning Curbside Roadways

As indicated in Table 1-2 of *Technical Memorandum No. 3 – Facility Requirements*, the enplaning curbside roadway, as currently configured, will be adequate until PAL 4 and PAL 5 and an additional lane will be required for each of those PALs. The deplaning curbside roadway will be adequate until PAL 3, when an additional lane will be required; this addition will satisfy the deplaning curbside roadway requirements through PAL 5 (2035).

The combined enplaning and deplaning curbside capacity and requirements, by PAL, are shown graphically on Figure 5-9. As indicated in Table 1-2, the enplaning and deplaning curbsides represent about 54% and 46% of the total curbside requirement, respectively.

Figure 5-9

PLANNED ENPLANING AND DEPLANING CURBSIDE CAPACITY AT THE END OF EACH PLANNING ACTIVITY LEVEL

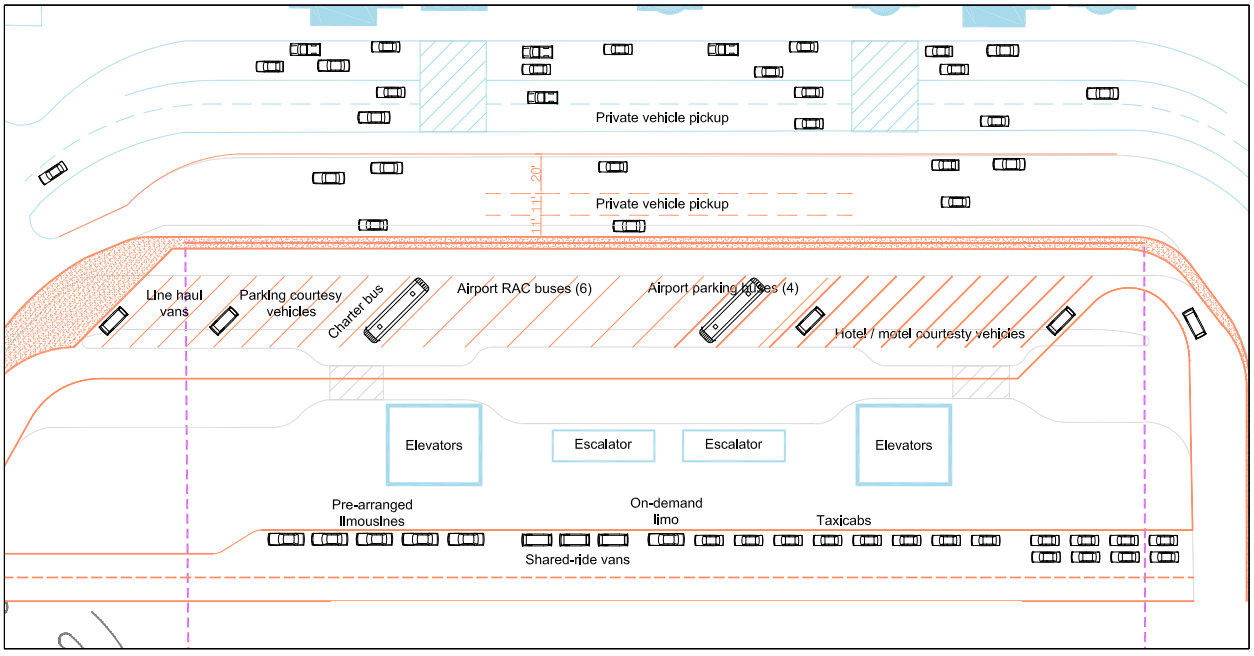


Source: Jacobs Consultancy, *Technical Memorandum No. 3 – Facility Requirements*.

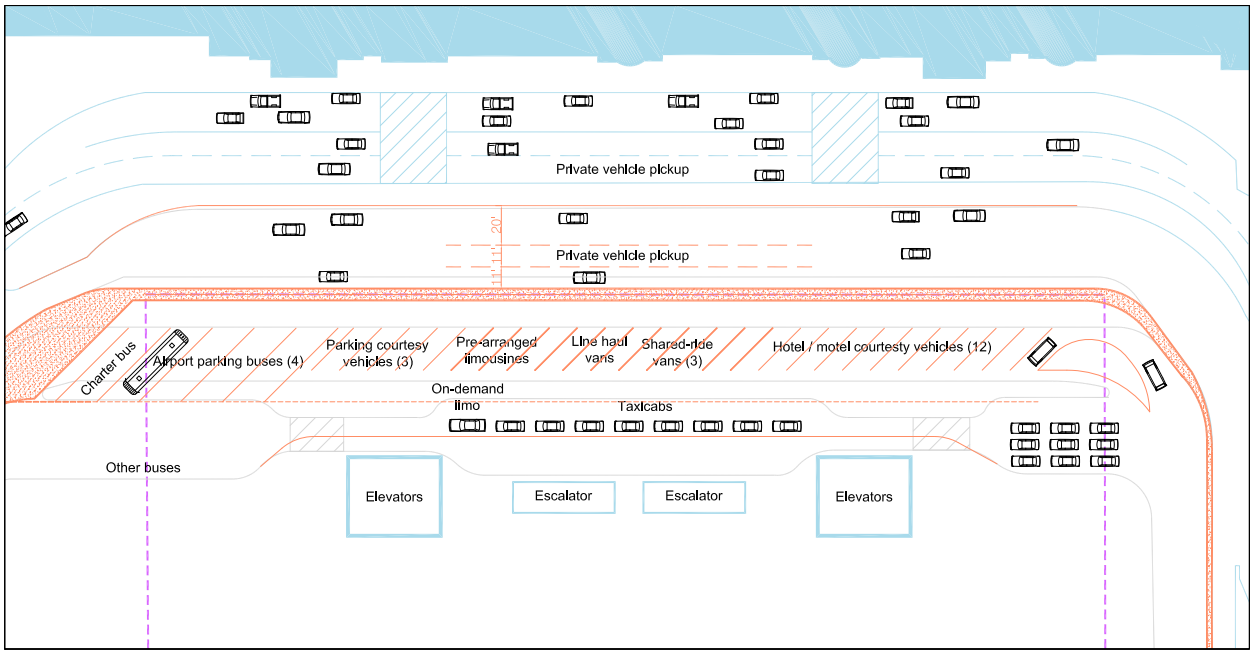
The enplaning curbside roadway and unloading area requirements may be satisfied by reallocating the outer roadway area reserved for non-curbside functions and encouraging drivers to use the outer roadway for passenger unloading.

Two alternatives were identified for satisfying the requirements for deplaning curbside roadways and loading areas. Alternative 1, illustrated on Figure 5-10, involves reconfiguring the commercial vehicle area (located on level 1 between the lower public roadways and P1 garage) to provide supplemental deplaning roadway and curbside loading capacity. Alternative 1 would be implemented in two phases. Phase 1, at PAL 3, would involve:

- Converting the 2nd traffic island and associated traffic lanes for private vehicle pickup (i.e., deplaning curbside and roadway)
- Removing the 3rd traffic island (the island closest to the P1 garage) and restriping the area for use by commercial vehicles



Phase 1 - Planning Activity Level 3 (2022)



Phase 2 - Planning Activity Level 4 (2027)

Figure 5-10

Curbside Alternative 1 - Reconfigured Commercial Vehicle Area

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Source: Jacobs Consultancy, November 2009

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- Redirecting customers desiring to reach the commercial vehicle area to use the underground walkways located beneath the deplaning level roadways and constructing a physical barrier to prevent passengers from walking across the roadways to reach the commercial vehicle area

Phase 2, at PAL 4, would occur when a new consolidated rental car facility is constructed and the existing rental car service center, located in the P1 garage, would be vacated. Phase 2 would involve:

- Reusing the vacated rental car service center as a waiting area for commercial vehicle passengers
- Restriping the outside commercial vehicle area to accommodate the rental car shuttle buses
- Restriping the interior of the garage, adjacent to the new commercial vehicle passenger waiting area, to accommodate taxicabs, shared ride vans, and pre-arranged limousines

Alternative 2, illustrated on Figure 5-11, involves constructing new ramps to level 3 of the P1 parking garage, displacing public parking spaces, and creating a new curbside inside the garage. At the same time, as with Alternative 1, the 2nd traffic island and lanes would be converted for private vehicle pickups.

Alternative 1 is the preferred alternative based on the sustainability criteria—its relative costs are lower, the reuse of existing facilities is emphasized and changes to operational procedures are favored over construction.

5.4 Terminal Area Roadways and Intersections

Improvements to terminal area roadway lanes and intersections are discussed below.

5.4.1 Terminal Area Roadways

As indicated in Table 1-2 of *Technical Memorandum No. 3 – Facility Requirements*, roadway lane improvements will be required in PALs 1 through 5 as described below (the links referred to in the descriptions are identified on Figure 5-12).

- PAL 1 (2012)—An additional lane will be required for the enplaning level departure roadway (link F) and the terminal exit (link I).
- PAL 2 (2017)—An additional lane will be required for the terminal area exit roadway (link K).
- PAL 3 (2022)—An additional lane will be required for westbound NE Airport Way (link A) and the enplaning level approach roadway (link D).

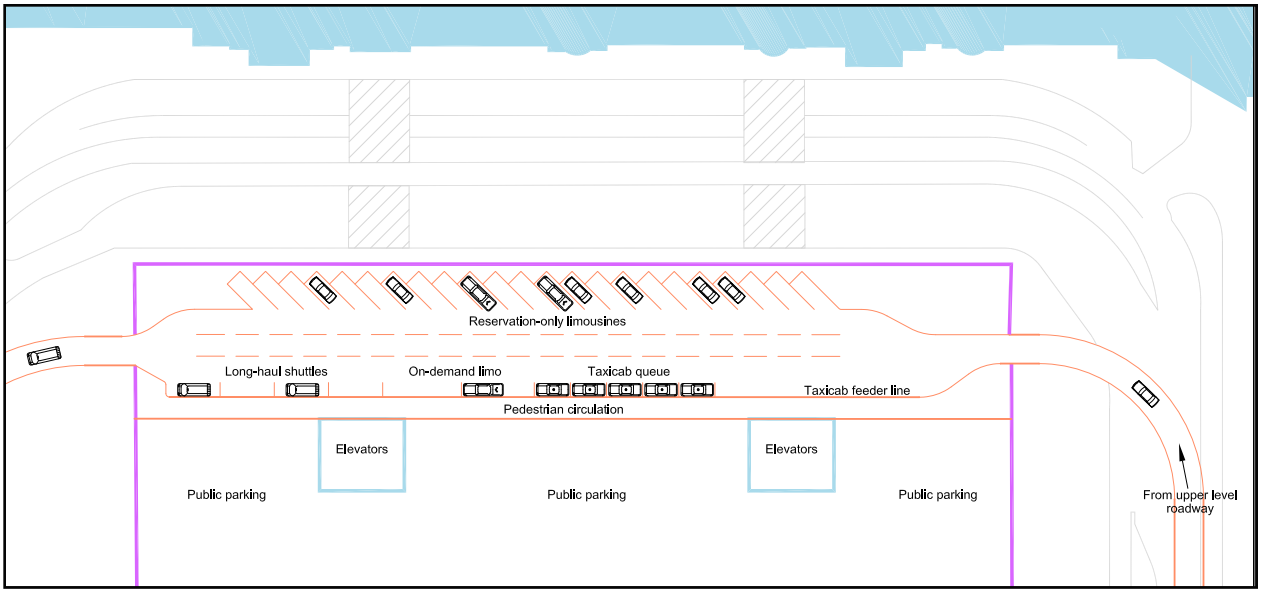

Figure 5-11

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Curbside Alternative 2 - Potential New Curbside on Level 3 of P1 Garage

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Source: Jacobs Consultancy, November 2009

November 2009

RUNWAY 10L-28R

RUNWAY 10R-28L

NE Airport Way

NE Air Cargo Rd.

NE

ARP

D

C

E

P1

P2

G

F

H

I

J

K

A

B

Enplaning Level

Deplaning Level

Deplaning Level

Enplaning Level

Legend

- Airport Property Line
- MAX Light Rail
- Existing Airfield and Safety Areas
- Roadway Vehicular Flows
- Passenger Terminal
- Buildings
- Water Features
- A — Link Identifier (see Appendix A)

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Source: Jacobs Consultancy, November 2009

Figure 5-12

Roadway Links Where Improvements are Needed

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- PAL 4 (2027)—An additional lane will be required for eastbound NE Airport Way (link B), the P1 and P2 parking entrance (link C), the enplaning level departure roadway (link F), the deplaning level departure roadway (link G), the P1 and P2 parking exit (link H), the terminal exit (link I), the return-to-terminal road (link J), and the terminal area exit (link K).

If demand cannot be reduced, the practical alternatives for each of the needed roadway improvements include adding a lane to the roadway or accepting a lower level of service. It should be noted that having a lower level of service could be counter to the sustainability criteria, particularly as increased air emissions associated with roadway congestion would have negative environmental impacts. With the exception of the enplaning level departure and approach roadways (links D and F), it is assumed a lane would be added to each of these roadway segments. The enplaning level departure and approach roadways are elevated and adjacent to Concourses E and A; the feasibility of widening these roads to permit an additional departure lane and approach lane should be determined in a follow-on study.

5.4.2 Terminal Area Intersections

Terminal area intersection improvements will be required in PALs 1, 2, and 5, as indicated in Table 1-2 and described below (the intersection numbers referred to in the descriptions are identified on Figure 5-13).

- PAL 1 (2012)—Additional capacity will be required on eastbound NE Airport Way for traffic attempting to turn left to northbound I-205 (intersection no. 5). This intersection is not on Airport property.

- PAL 2 (2022)—A grade-separated interchange will be required at the intersection of NE 82nd Avenue and NE Airport Way (intersection no. 1). Depending on its design, this project will have varying levels of impact on facilities in the four quadrants surrounding the intersection with potential impacts on the P4 garage site, NE Airport Way, MAX Light Rail, the Sheraton Hotel, the Hampton Inn, and the Northeast Cargo Complex. These potential impacts are illustrated on Figure 5-14, which depicts one potential planning concept for the intersection. The alternative planning and design concepts for this intersection are beyond the scope of the master plan and are important objectives of follow-on studies.

- PAL 5 (2035)—Additional capacity will be required at the intersection of NE 82nd Avenue and NE Alderwood Road (intersection no. 7). The alternatives for increasing capacity will be identified during design. The most likely solution would be to provide additional queuing space (i.e., a “turn pocket”) for eastbound traffic on Alderwood Road turning right onto 82nd Avenue.

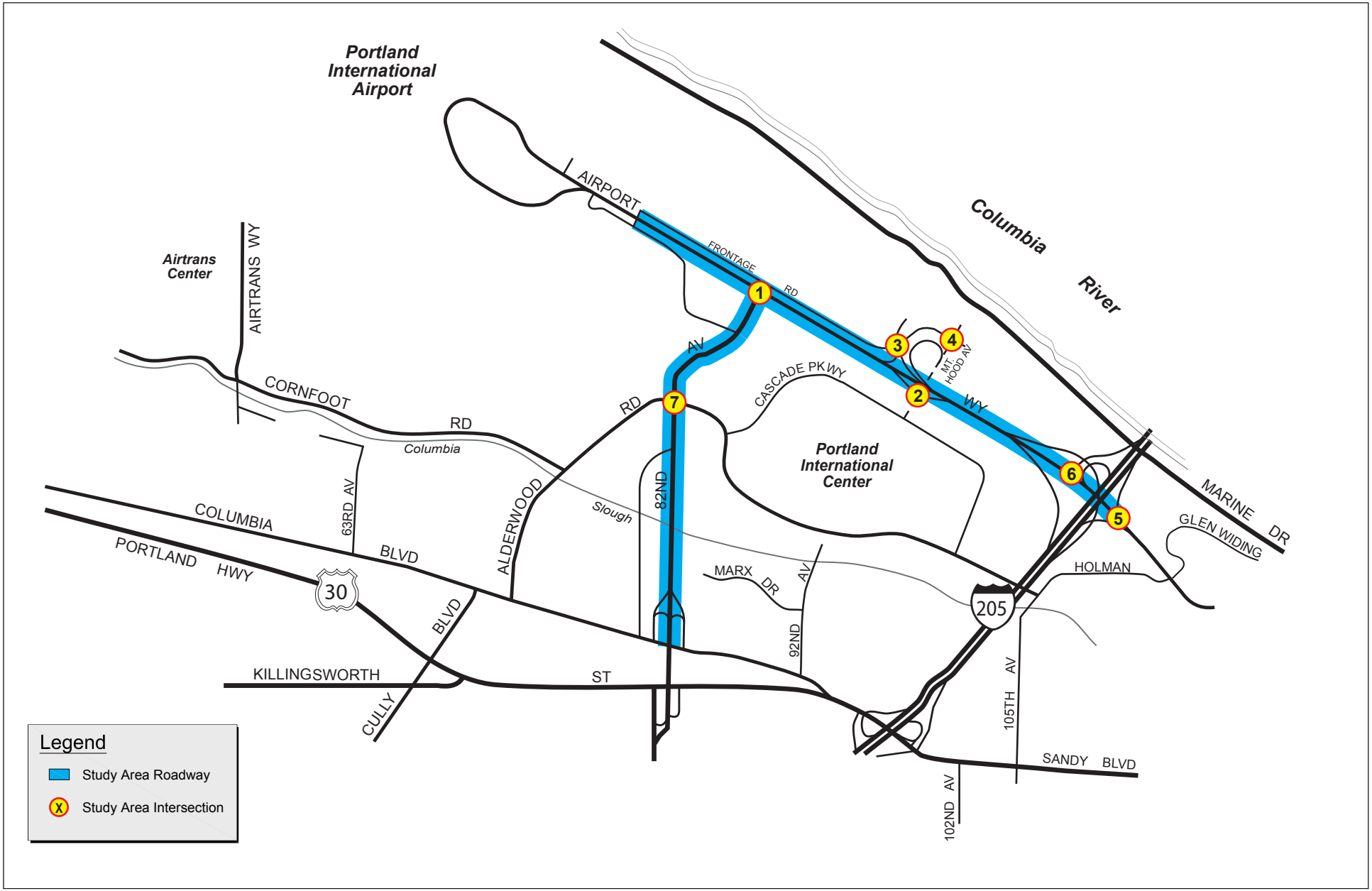

Figure 5-13

Terminal Area Intersections Assessed

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Source: Jacobs Consultancy, November 2009

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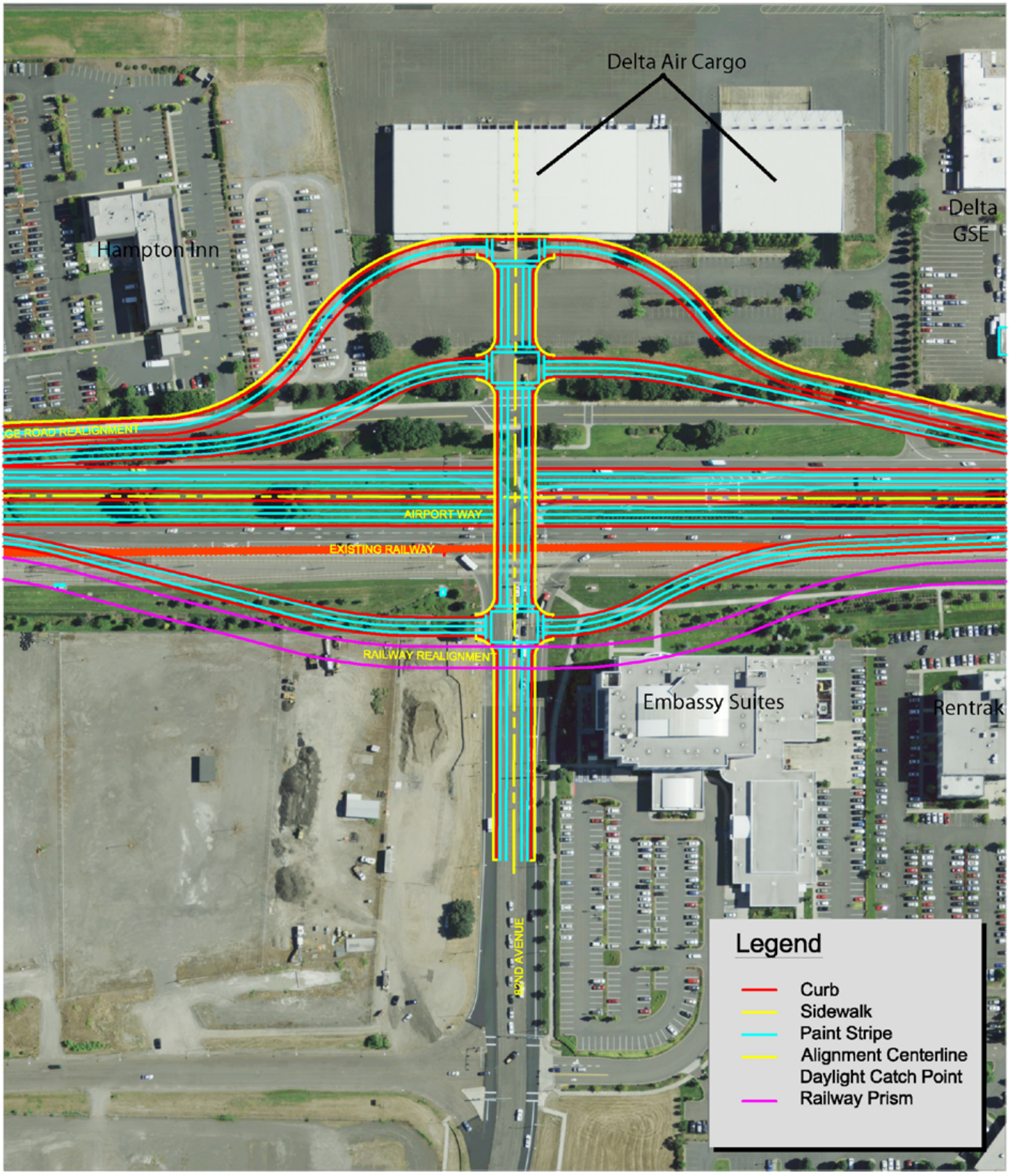

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Figure 5-14

Concept for Grade-Separated Intersection of NE 82nd Avenue and NE Airport Way

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Source: Harper, Hough, Peterson, Righellis Inc., November 2009

November 2009

5.5 Access Roadway Intersections

Access-roadway intersection improvements will be required in PALs 1 and 3 as indicated in Table 1-2 of *Technical Memorandum No. 3 – Facility Requirements* and described below (the intersection numbers referred to in the descriptions are identified on Figure 5-15).

- PAL 1 (2012)—The intersection of NE AirTrans Way and NE Cornfoot Road will need to be signalized (intersection no. 9).

- PAL 3 (2022)—Additional capacity will be required at the intersection of NE Alderwood Road and NE Cornfoot Road (intersection no. 8). The alternatives for increasing capacity will be identified during design. The most likely solution would be to provide additional queuing space (i.e., a "turn pocket") for northbound traffic on Alderwood Road desiring to turn left onto NE Cornfoot Road.

It should be noted that these improvements are not recommended as mitigations in the Airport Futures Traffic Impact Analysis (TIA). This difference is primarily because a different methodology was employed. The mitigations identified in the TIA were based on a significance threshold between a no-build and build scenario. The improvements identified in the Master Plan Update analysis demonstrate what is needed to meet the jurisdictional performance standard.

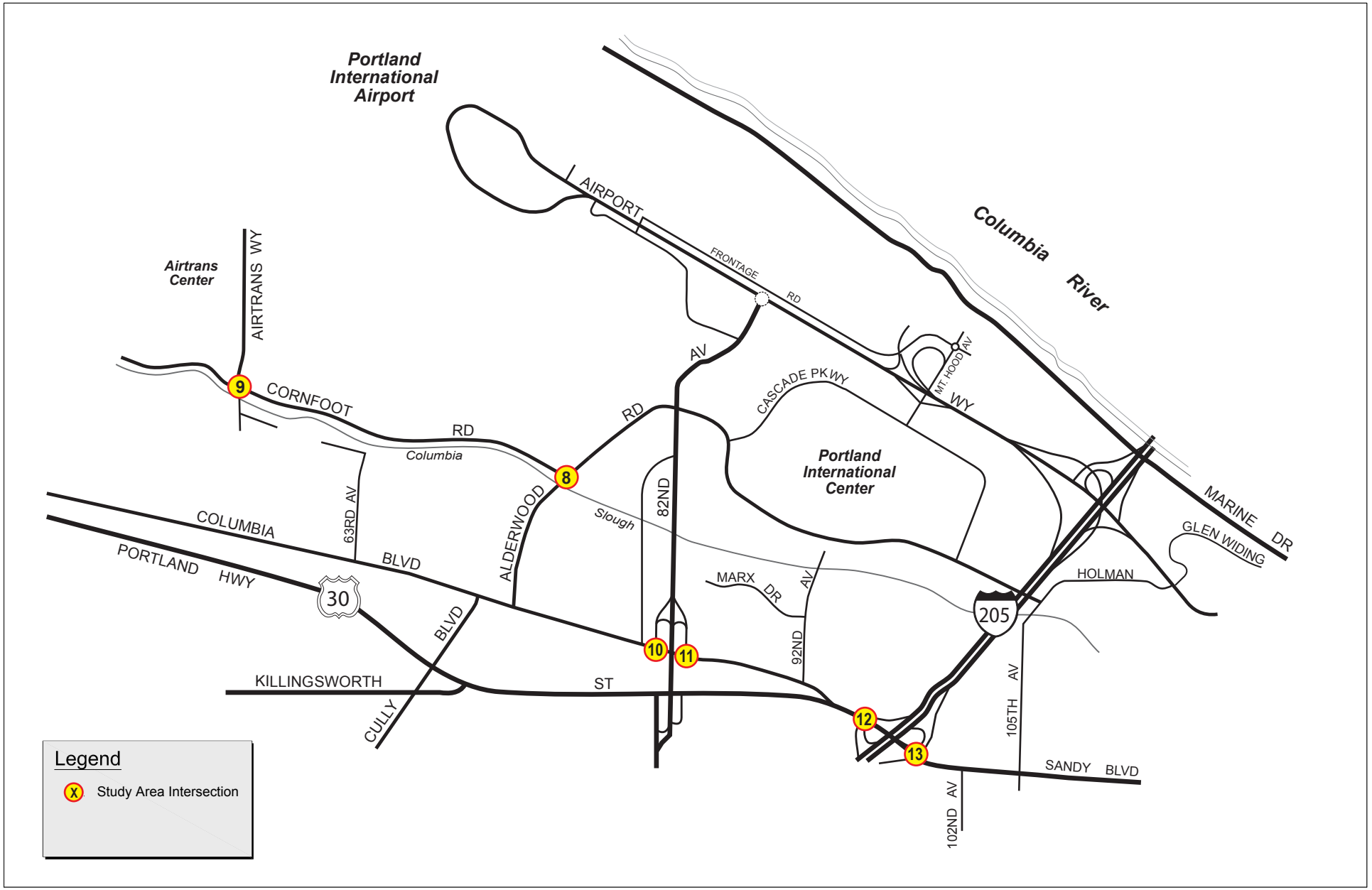

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Figure 5-15

Other Airport Intersections Assessed

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Source: Jacobs Consultancy, November 2009

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6. AIR CARGO

This section describes the alternatives considered and the recommended strategy for developing the Airport's air cargo facilities through PAL 5 (2035).

6.1 Background

There are two general types of air cargo facilities at the Airport. The first type is primarily related to air freight distributors and passenger airlines that carry cargo within the belly of the airplane. Collectively, the air cargo facilities related to air freight distributors and passenger airlines are referred to in this Technical Memorandum as belly-cargo facilities.

The second type of air cargo facilities is primarily related to air freight distributors, integrated carriers (such as FedEx and United Parcel Service that provide complete door-to-door cargo services), and all-cargo carriers (all-cargo carriers provide airport-to-airport service using all-cargo aircraft). Collectively, the air cargo facilities related to air freight distributors, integrated carriers, and all-cargo carriers are referred to in this Technical Memorandum as all-cargo facilities.

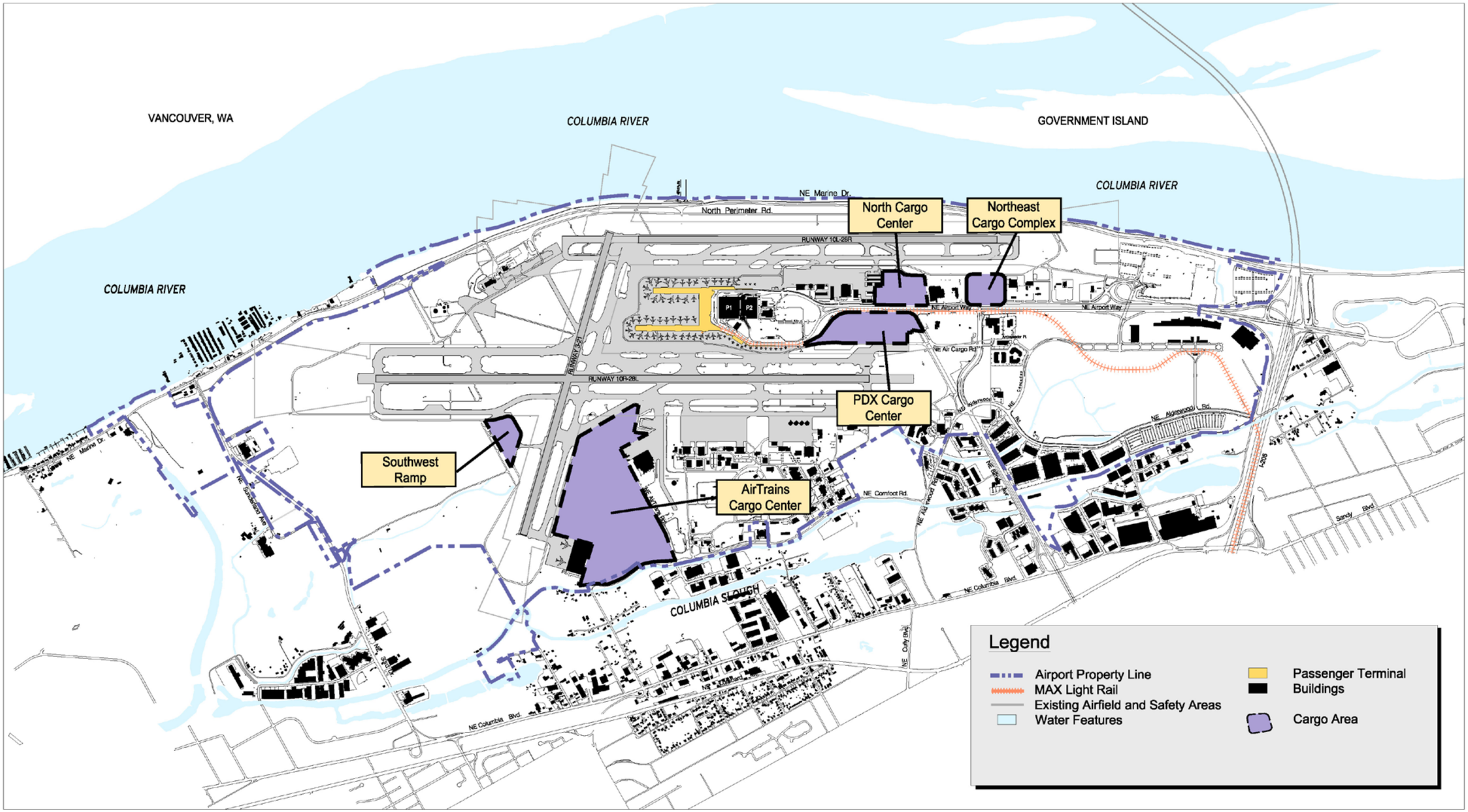
The Airport's belly-cargo facilities are located to the north of Runway 10R-28L in the PDX Cargo Center, the Northeast Cargo Complex, and the North Cargo Center as shown on Figure 6-1. All-cargo facilities are located to the south of Runway 10R-28L, in the AirTrans Cargo Center and the Southwest Ramp, also shown on Figure 6-1.

The relationship between capacity and demand, and therefore the requirement for additional facilities, is very different for belly-cargo facilities than for all-cargo facilities. These relationships and the recommended alternatives and strategy for meeting the requirements for belly-cargo and all-cargo facilities are described in the following sections.

6.2 Belly-Cargo Facilities

The requirements for belly-cargo facilities (i.e., warehouse space), by PAL, are shown on Figure 6-2.

The PDX Cargo Center, the North Cargo Center and the Northeast Cargo Complex currently provide a capacity of approximately 236,000 square feet of processing and warehousing space. As shown on Figure 6-2, this capacity far exceeds the requirement for belly-cargo facilities, even at PAL 5 (2035), when the total requirement is estimated at 93,000 square feet.



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Source: Jacobs Consultancy, November 2009

Figure 6-1

Cargo Areas

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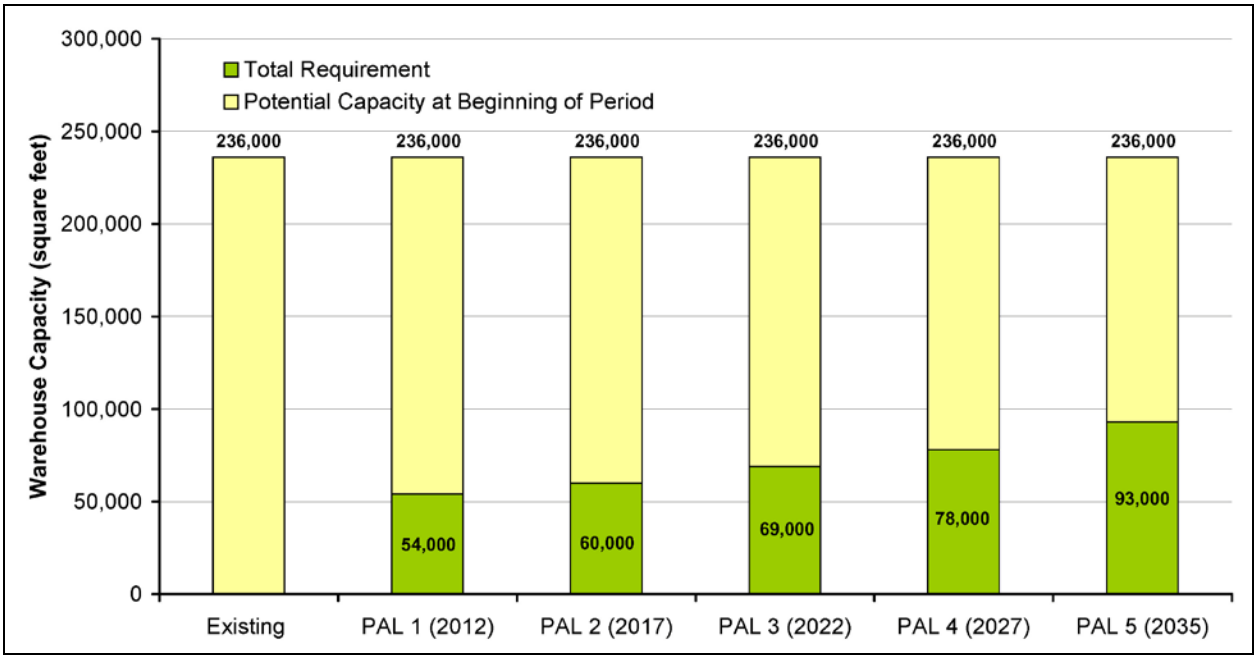
Figure 6-2

PLANNED BELLY-CARGO WAREHOUSE CAPACITY BY PLANNING ACTIVITY LEVEL



Source: Jacobs Consultancy, *Technical Memorandum No. 3 – Facility Requirements*.

However, during the planning period and beyond, it is expected that some of these belly-cargo facilities will be demolished to make way for other development. For example:

- Depending on the design, the relocation of NE Airport Way to permit construction of a P3 garage could result in the demolition of the PDX Cargo Center (west building; refer to Figure 5-3)—this construction could occur at PAL 2 (2017).

- Construction of a grade-separated interchange at the intersection NE 82nd Avenue and NE Airport Way may result in the demolition of facilities in the Northeast Cargo Complex (refer to Figure 5-14)—this construction could occur at PAL 2 (2017).

Construction of the cross-field taxiways will result in the demolition of the PDX Cargo Center (east building) and the North Cargo Center as shown on Figure 3-1—this construction may not occur until activity beyond that envisioned for PAL 5 (2035). Accordingly, the recommended strategy for belly-cargo facilities is as follows:

- Initiate cargo-specific follow-on studies to confirm that:
  - The realignment of NE Airport Way to construct the P3 parking garage can avoid the demolition of the west building in the PDX Cargo Center—this would ensure that the PDX Cargo Center (east and west buildings) would remain viable until the cross-field taxiways are constructed.
  - The grade-separated interchange at NE 82nd Avenue will require the demolition of all or part of the Northeast Cargo Complex.
  - The best use of the properties to the north of NE Airport Way includes retention of the North Cargo Center (also confirm the duration of its retention).
- Pending the results of the follow-on studies, do not invest further in the PDX Cargo Center (west building), Northeast Cargo Complex, or the North Cargo Center.
- Encourage the consolidation of the belly-cargo facilities within the PDX Cargo Center over time. The PDX Cargo Center (east and west buildings) appears adequate for accommodating all belly-cargo requirements until construction of the cross-field taxiways results in the demolition of the east building.
- If the U.S. Postal Service should vacate its facility, reserve the space to allow the partial replacement of the PDX Cargo Center east building when the cross-field taxiways are constructed.

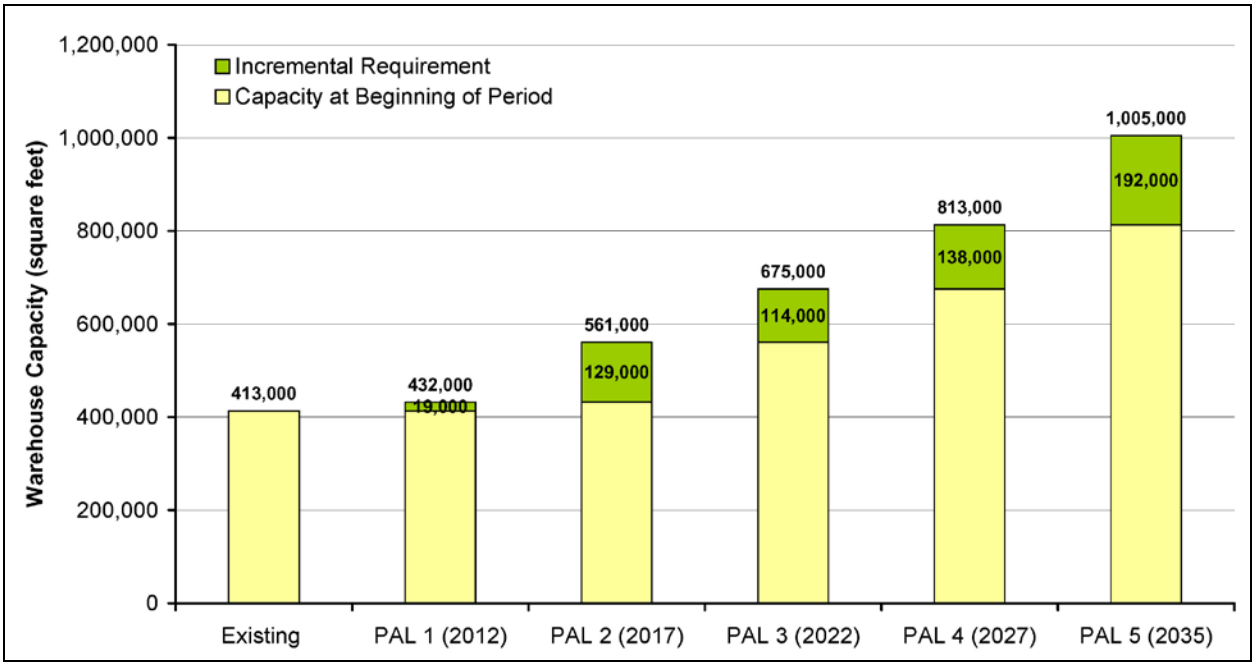
6.3 All-Cargo Facilities

Three principal components constitute the all-cargo facilities at the Airport—warehouse and office, aircraft ramp, and landside facilities (i.e., shipping and receiving docks as well as employee and customer parking). For the purposes of assessing alternatives and developing a recommended development strategy, it has been assumed that (1) these components will be developed concurrently, as appropriate for the available sites, and (2) the timing of the need for these three components is indicated by the timing of the requirements for warehouse facilities.

The requirements for all-cargo warehouse facilities, by PAL, are shown on Figure 6-3 (the estimated requirements for all-cargo ramp are shown in Appendix A). As indicated, additional all-cargo facilities will be required in every PAL, beginning with PAL 1 (2012).

Figure 6-3

PLANNED ALL-CARGO WAREHOUSE CAPACITY BY PLANNING ACTIVITY LEVEL



Source: Jacobs Consultancy, *Technical Memorandum No. 3 – Facility Requirements*.

The recommended strategy for developing all-cargo facilities is as follows:

- The AirTrans Cargo Center is well designed with excellent landside access for trucking cargo to and from the Airport and excellent airside access for aircraft. Therefore, the AirTrans Cargo Center should continue to be utilized as the Airport's primary all-cargo processing area.

- The land available in the AirTrans Cargo Center to the north of the Horizon Maintenance Center and west of the ground run-up enclosure should be developed as necessary to satisfy the all-cargo requirements through PAL 1 (2012). A follow-on study is needed to define the remaining development area, the development potential, and the site layout.

- Following the full build-out of the remaining undeveloped area of the AirTrans Cargo Center, a decision will be needed regarding the best use of the area occupied by the Boeing aircraft maintenance hangar. This facility is currently leased to Boeing and is used for painting commercial aircraft. It is assumed that the all-cargo facilities requirements for PAL 2 (2017) will be met either by converting the aircraft maintenance hangar for use as a cargo warehouse or demolishing it and constructing a new warehouse. Whether the aircraft

maintenance hangar should be converted or replaced should be the subject of a follow-on study. The aircraft ramp associated with the aircraft maintenance hangar is in excellent condition and should be reused.

- When the AirTrans Cargo Center is fully developed, which is expected at PAL 2 (2017), there are two alternatives for locating subsequent development—the Southwest Quadrant or some portion of the existing military area, should it become available. The military area is preferred because it has the same strengths as the AirTrans Cargo Center, the potential environmental impact associated with reuse and redevelopment of an existing developed site is assumed to be lower than that of an undeveloped site, land resources would be used efficiently, and operational efficiency would be maximized.

- However, the military area is under long-term lease; therefore, for planning purposes it was assumed that all-cargo development at PALs 3 through 5 will occur in the Southwest Quadrant.

7. GENERAL AVIATION

This section describes the alternatives considered and the recommended strategy for developing the Airport's general aviation facilities through PAL 5 (2035).

7.1 Background

The requirements and alternatives for general aviation development at the Airport were developed based on two considerations:

- **Policy and management philosophy**—The Port's policy is to comply with assurances given the FAA that exclusive rights for the use of Airport property will not be offered to a single fixed-base operator. Accordingly, the management philosophy is that in addition to the approximately 30 acres currently occupied by general aviation facilities, 10 to 20 acres of land should be reserved to accommodate an additional fixed-base operator (i.e., a general aviation service provider), should the demand materialize. More discussion regarding the requirements for general aviation is in Section 6 of *Technical Memorandum No. 3 – Facility Requirements*.

- **Land use priorities**—The land currently used for general aviation facilities will ultimately be needed to accommodate higher priority facilities, e.g., the extension of Concourse E. Although the extension of Concourse E will not be needed by PAL 5 (2035), P3 parking garage construction could occur by PAL 2 (2017). Depending on its design, the construction of the P3 garage could trigger the relocation of NE Airport Way and require the demolition of many existing general aviation facilities, as shown previously on Figure 5-3.

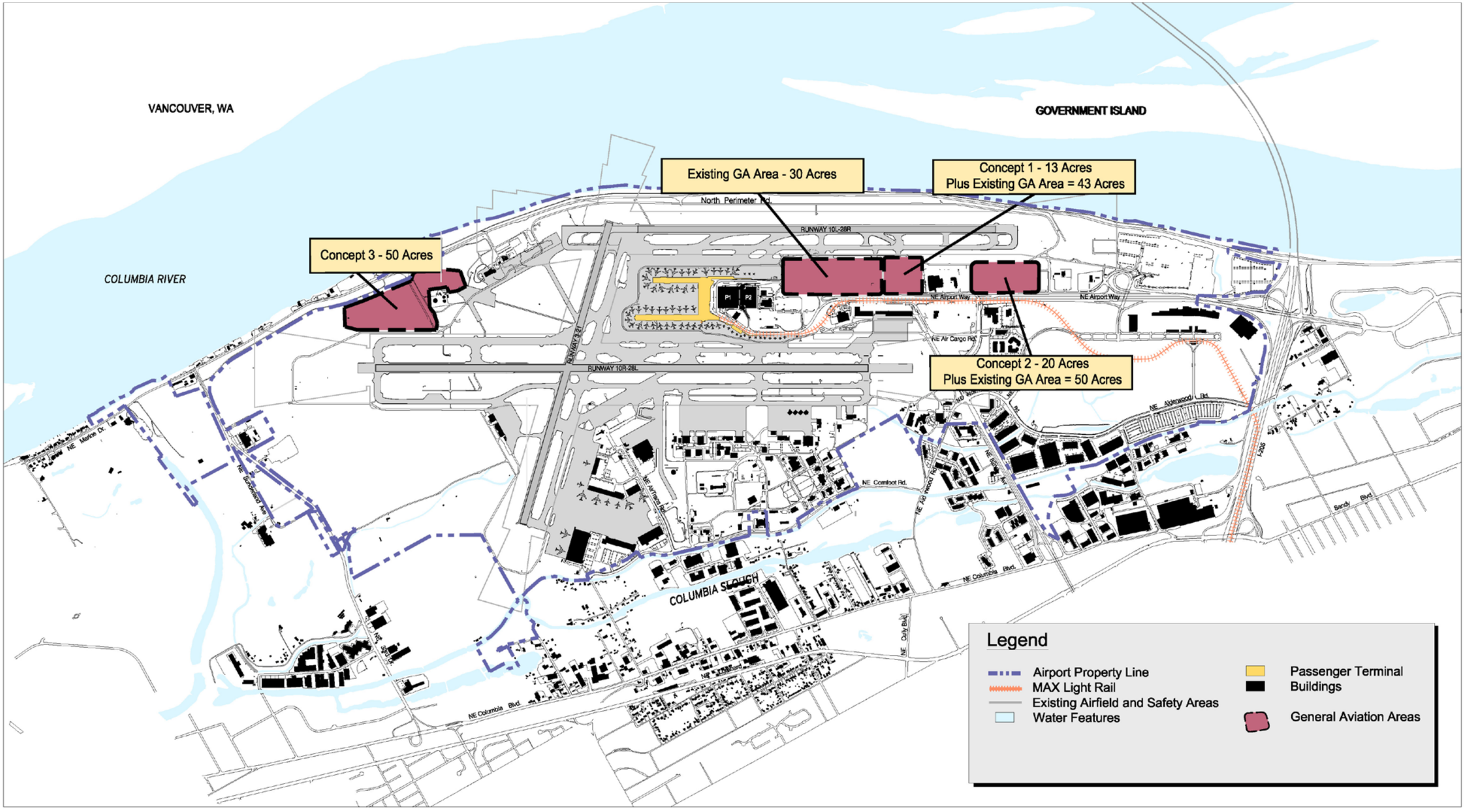
Thus, alternative locations were considered both for the relocation of existing and the provision of additional general aviation facilities.

7.2 Alternatives

Three alternative concepts for accommodating general aviation facilities were identified. The locations of the concepts are shown on Figure 7-1.

- Concept 1 is to maintain the existing 30-acre general aviation area and expand it to include a 13-acre area immediately to its east for a potential second fixed base operator. Concept 1 provides a total of 43 acres.

- Concept 2 is to maintain the existing 30-acre general aviation area and provide, in addition, 20 acres immediately to the south of the end of Runway 28R for a potential second fixed-base operator. Concept 2 provides a total of 50 acres.



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Scale: 1" = 2,100'

Source: Jacobs Consultancy, November 2009

Figure 7-1

Alternative Concepts for Locating General Aviation

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- Concept 3 is to prepare a 50-acre site, located in the northwest quadrant of the Airport adjacent to the fuel farm and Marine Drive. This site would accommodate the relocated existing general aviation facilities and if demand warranted, a second fixed-base operator. Concept 3 provides a total of 50 acres.

The preferred concept depends on market-driven conditions such as the following:

- Proposals received from businesses desiring to develop a second fixed-base operation—If no such proposal is received or if none is judged to be acceptable, no additional land would be needed for general aviation facilities.

- The timeframe in which demand for a second fixed-base operator materializes and the improvements that have occurred or are planned to occur on the sites identified within the Master Plan Update—If at the time of the proposal from a second fixed base operator, there is a higher and better use for the land or if the site would not be usable for a period long enough to justify the required investment, the alternative concept would be selected. For example, the additional 13-acre area in Concept 1 is available only until the cross-field taxiways are constructed through the site.

- The timing and design of the P3 parking garage—As explained Section 5.1 and illustrated on Figure 5-3, the construction of the P3 garage may require the relocation of several existing general aviation facilities.

Therefore, in the short term, it is recommended that the existing general aviation facilities be maintained in their current location. Further investment in the existing general aviation area should be curtailed pending completion of a follow-on study to determine the timing and impact on facilities adjacent to the P3 site.

8. RECOMMENDED FUTURE STUDIES

This Technical Memorandum describes alternatives, strategies, and recommended concepts for development through PAL 5 (2035). Equally important, it identifies future studies that will be required to develop the technical details required to finalize key development decisions. This section summarizes the background, objective, scope, and timing for each of fourteen recommended future studies. The recommended timing of the studies is identified in Table 8-1.

8.1 Passenger Terminal Master Plan

8.1.1 Background

It was concluded from the Master Plan Update that although no urgent requirements to modify passenger terminal facilities exist, it is possible to significantly enhance the passenger terminal's future effectiveness through a comprehensive study.

8.1.2 Objective

The objective of a passenger terminal master plan would be to study the terminal in its entirety and develop a comprehensive strategy and plan to reconfigure level 1 and the mezzanine, thus avoiding a piecemeal approach to improvements and ensuring (1) the most effective possible passenger processing, (2) the best possible passenger experience, and (3) the maximum possible concessions revenues.

This objective meets the sustainability criteria to preserve future development options and maximize operational efficiency while minimizing the environmental impacts associated with building new facilities. Also, it would result in an effective phasing plan.

8.1.3 Scope

The scope of the passenger terminal master plan would include the following elements.

Ticketing. The layout of existing passenger ticketing and check-in facilities is based on obsolete procedures and technology. Although the layout continues to be effective, there may be more effective alternatives. The passenger terminal master plan should identify alternative facility layouts to leverage evolving technology and passenger processing strategies.

Ticketing Lobby. The arrangement of the ticketing lobby to accommodate passenger queuing and circulation functions is based on the obsolete procedures and technology that resulted in the existing ticket counter concept and layout. The passenger terminal master plan should explore all elements comprehensively to identify the best configuration and use of all space (e.g., space currently occupied by x-ray equipment).

Table 8-1

TIMING OF RECOMMENDED FUTURE STUDIES
BASED ON 50TH PERCENTILE FORECASTS

		Complete within two years	Initiate within Two years	Initiate within Four years	Other
1.	Passenger Terminal Master Plan		X		
2.	Terminal Expansion East (TEE) Project Definition		X		
3.	North Side Properties Redevelopment Study		X		
4.	P4 Parking Garage Project Definition		X		
5.	All-Cargo Development Study				X *(a)*
6.	Gate Management and Operations Study				X *(b)*
7.	Concourse A Improvements Study				X *(c)*
8.	Concourse E Regional Airline Holdroom Improvements				X *(d)*
9.	Aircraft Rescue and Firefighting Facilities Siting Study				X *(e)*
10.	82nd Avenue Grade-Separated Interchange Project Definition	X *(f)*			
11.	High-Speed Rail Study				X *(g)*
12.	Remain Overnight Aircraft Parking Ramp Design Study		X		
13.	Commercial Vehicle Roadway Redevelopment Study				X *(h)*
14.	Enplaning Roadway Study		X		

Note: Timing indicated is relative to completion of Master Plan Update and assumes increases in passengers, cargo and aircraft operations in accordance with the 50th percentile forecasts. The need for all future studies will be monitored and their timing adjusted consistent with demand.

(a) Consistent with activity and before further development within AirTrans Cargo Center.
(b) When improvements would be beneficial and study is justified.
(c) When justified by activity and input from Horizon Air.
(d) When justified by holdroom utilization and input from United Airlines and SkyWest Airlines.
(e) When FAA requirements cannot be met with existing facilities.
(f) Should be completed before or in conjunction with study #3 and study #4.
(g) Consistent with region's high-speed rail plans.
(h) Consistent with activity and need to accommodate PAL 3 requirements.

Airline Ticket Office Space. The functions that airline ticket offices, located behind the ticket counters, were originally designed to accommodate have been overtaken by new processes and technology; therefore, the space is underutilized. The passenger terminal master plan should explore how, through remodeling, this and other underutilized space can be redistributed for more productive use.

Concessions. The concessions program at the Airport is among the best in the United States and will continue to evolve based on the Port's strategy for satisfying changing passenger needs and enhancing revenue. The passenger terminal master plan and concessions strategy and plan should be developed jointly. Mutually dependent issues, such as pre-security and post-security concessions and the concept of "force-feeding" passengers through concessions spaces, should be explored.

Passenger Security Screening. As noted in Section 10 of *Technical Memorandum No. 3 – Facility Requirements*, as passenger security screening equipment and procedures continue to evolve, it is likely that the layout of the space and equipment dedicated to passenger security screening will change. The passenger terminal master plan should consider alternatives other than the status quo. For example, the passenger terminal master plan might consider the advantages and disadvantages of a single central passenger screening checkpoint that converges all passengers into a central concessions mall.

Mezzanine Office Space. With the completion of the Port's new headquarters, atop the P2 parking garage, much of the Port's office space on the mezzanine of the passenger terminal will be vacant. The passenger terminal master plan should consider the potential use(s) for this space and the modifications required for its effective use. The location of the space may be ideal for revenue-generating airline clubs and/or post-security concessions.

8.1.4 Timing

The passenger terminal master plan should be initiated within two years of the Master Plan Update.

8.2 Terminal Expansion East (TEE) Project Definition

8.2.1 Background

TEE will provide supplemental passenger processing facilities when the existing passenger terminal reaches its potential. Although this is not expected within the time frame considered in the Master Plan Update, TEE is within the Airport's core development area and affects or is affected by other facilities that must be modified or constructed in the relatively near term. The ultimate success of TEE depends on the extent to which the operation of these dependent facilities is effectively integrated through thoughtful planning and design.

8.2.2 Objective

The objective of a TEE project definition study would be to complete a sufficient amount of preliminary design for TEE and its related facilities to understand and document the (1) concept of operation for TEE and major related facilities (e.g., how origin, destination, and transfer passengers and baggage will be processed and how ground transportation functions will work), (2) program and vertical and horizontal dimensional requirements for TEE and major related facilities, and (3) likely construction sequence for facilities related to TEE and the timing of and impact to existing facilities.

8.2.3 Scope

The scope of TEE Project Definition would include the following elements.

Terminal Expansion East. Although the TEE passenger processor will perhaps be one of the last physical elements of the core development area and not be built until passenger demand reaches approximately 28 million annual passengers, considerable knowledge about the facility and its potential dimensions must be known to effectively plan, design, and construct the related facilities. This review of the terminal should include an assessment of the potential location and circulation associated with a new light rail station.

P3 Parking Garage. The P3 site has been identified as one of two likely sites (the other is the P4 site) for construction of the next parking garage, likely to be needed when passenger demand reaches approximately 18 million annual passengers. It is essential that the P3 parking garage be designed to function effectively with TEE—even though 15 or more years could separate the construction of TEE and the P3 parking garage.

NE Airport Way. The eastbound and westbound lanes of NE Airport Way must be separated to permit the construction of the P3 parking garage and, ultimately, TEE. Thus, the planning and design of TEE, the P3 parking garage, NE Airport Way, and the roadway system linking NE Airport Way with TEE and the P3 Garage are inextricably linked.

Adjacent Facilities. For the purposes of TEE project definition, adjacent facilities include the following:

- The planned cross-field taxiways to the east—these future taxiways define the land envelope for TEE and its supporting facilities
- The P2 parking garage, FAA ATCT, and central utility plant to the west— these facilities would not be relocated but define the land envelope for TEE and its supporting facilities

- General aviation facilities, Cargo Center West, and the future Concourse E extension to the north
- The MAX light rail line, the U.S. Post Office, the PDX Cargo Center, and the future Concourse A extension to the south

During TEE project definition, the extent and timing of relocations of adjacent facilities must be determined.

Consolidated Rental Car Facility. Inasmuch as the P3 parking garage remains an option for the location of the consolidated rental car facility (i.e., the P3 garage could be shared by public parking and rental car functions), the requirements of the consolidated rental car facility must be considered during TEE project definition.

8.2.4 Timing

TEE project definition should be initiated within two years of the Master Plan Update. TEE project definition must be completed before commencing additional planning or design related to the P3 parking garage.

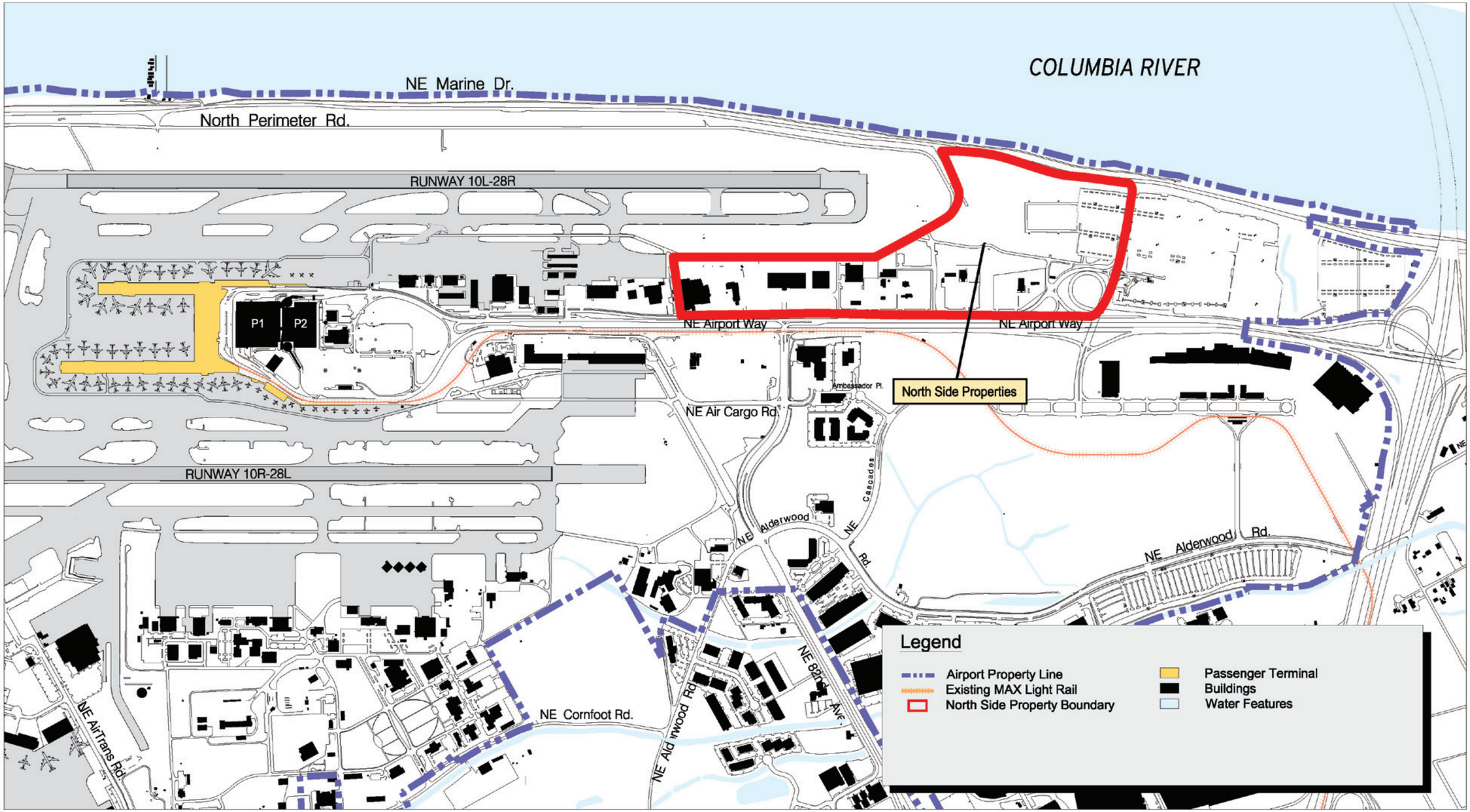
8.3 North Side Properties Redevelopment Study

8.3.1 Background

The north side properties are those properties located to the north of NE Airport Way, between Concourse E and Mt. Hood Avenue, as identified on Figure 8-1. Some of the properties are fully utilized (e.g., those used by general aviation), some are underutilized (e.g., the North Cargo Center), and at least one is vacant (the Delta Cargo facilities). All are subject to future relocation or redevelopment as required for higher and better use (e.g., the extension to the east of Concourse E).

8.3.2 Objectives

The objectives of the redevelopment study are to define (1) how the land envelope for the north side properties will be impacted by adjacent short- and long-term development, such as TEE and the P3 parking garage, the cross-field connector taxiways, and the grade-separated interchange at NE Airport Way and 82nd Avenue; (2) appropriate land uses, both interim and permanent, for the north side properties; (3) investments or facilities modifications that could permit maximum utilization of these valuable north side properties, and (4) the plan for additional RON aircraft parking positions to be constructed by the time PAL 1 activity (2012) is achieved.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 1,000'
Scale: 1" = 1,000'

Figure 8-1

North Side Properties

Master Plan Update
Portland International Airport

Source: Jacobs Consultancy, November 2009

November 2009

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8.3.3 Scope

The scope of the north side properties redevelopment study should include the following elements.

Cross-Field Taxiways. When constructed, these taxiways will require the demolition of several facilities, potentially including the North Cargo Center, the United Airlines maintenance facility, and the flight kitchen immediately to the east of the United Airlines maintenance facility.

Potential Extension of Taxiway T. The extension of Taxiway T to the east may become necessary to serve the additional RON aircraft parking or other redevelopment.

General Aviation. The existing general aviation facilities can remain in their existing location until they are displaced by higher priority facilities (e.g., extended Concourse E) or until their relocation is economically justified. The redevelopment study should consider both existing and supplemental general aviation facilities.

North Cargo Center. This belly-cargo facility is underutilized. The redevelopment study should consider modifications to make it more attractive for interim use as a belly-cargo facility or other potential uses.

United Airlines Maintenance. As terminal area development continues to the east, the highest and best use for this maintenance facility must be determined.

Hotels. The redevelopment study should consider the impact of the grade-separated interchange at NE Airport Way and 82nd Avenue on the hotels, whether either or both hotels can remain viable businesses after the interchange is completed, and if, not, the best use of the parcels.

Delta Cargo. This belly-cargo facility is vacant. The redevelopment study should consider modifications to make it more attractive for interim use as a belly-cargo facility or other potential uses. Also, the redevelopment study should consider demolition, the facility and redeveloping the site in a way that is better suited to the future configuration of the interchange proposed at the intersection of NE Airport Way and NE 82nd Avenue.

Flight Kitchens. The north side properties include two flight kitchens, one of which is vacant. The redevelopment study should consider all options including relocation of the remaining food-service business, reuse of the existing facilities, and redevelopment.

Delta Ground Service Equipment. As terminal area development continues to the east, the highest and best use for property must be determined.

Rental Car Facilities. As terminal area development continues to the east, the highest and best use for property must be confirmed. If rental car facilities are appropriate, the amount of land allocated to rental car facilities should be confirmed.

Remain Overnight Aircraft Parking. Land to the north of the Sheraton and Hampton Inn has been identified as a potential location for the development of an apron to accommodate RON aircraft parking. The plans for this parking should be completed within the context of the north side properties redevelopment study.

8.3.4 Timing

The north side properties redevelopment study should be initiated within two years of the Master Plan Update—it should be completed before commencing additional planning or design related to RON aircraft parking. The 82nd Avenue grade-separated interchange project definition study, described in Section 8.10, should be completed before or in conjunction with the north side properties redevelopment study.

8.4 P4 Parking Garage Project Definition

8.4.1 Background

The P4 parking garage site is located immediately to the northwest of the intersection of NE Airport Way and 82nd Avenue. Both the P3 site and the P4 site have been identified as potential locations for the next increment of on-Airport structured parking. In addition, it is believed that either could accommodate the consolidated rental car facility.

8.4.2 Objectives

The objectives of P4 parking project definition are to:

1. Define the utility of the P4 site as a construction staging and lay down area and recommend whether this utility is sufficiently great to justify delaying development of the site until after the P3 site is developed.

2. Prepare a drawing illustrating the area available for development considering completion of the grade-separated interchange at NE Airport Way and NE 82nd Avenue.

3. Determine the size and layout of the garage if it were to accommodate public parking only or both public parking and a consolidated rental car facility.

4. Evaluate the differences if rental car hold and staging facilities are at grade and outside the garage vs. inside the garage.

5. Identify the number of public parking spaces available for the two optional configurations defined in objective 3, above.

6. Develop a P4 access/egress plan that provides clear public access while not compromising the operations of NE Airport Way, 82nd Avenue, and the light rail system.

8.4.3 Scope

The scope of P4 parking project definition would include the P4 site and the grade-separated interchange at the intersection of NE Airport Way and NE 82nd Avenue.

8.4.4 Timing

P4 parking project definition should be initiated within two years of the Master Plan Update and before commencement of additional planning or design related to the next parking garage.

8.5 All-Cargo Development Study

8.5.1 Background

At PAL 2 (2017) when all-cargo activity reaches 384,000 short tons per year, an additional 129,000 square feet of warehouse space will be required. The AirTrans Cargo Center is the preferred location for the development of future all-cargo facilities; however, its capacity is limited.

8.5.2 Objectives

The objectives of the all-cargo development study are to:

1. Determine if the existing aircraft maintenance hangar should be converted for use as a cargo warehouse, demolished and replaced with a new cargo warehouse, or retained as is.

2. Identify the site or sites remaining within the AirTrans Cargo Center for all-cargo development.

3. Identify sites within AirTrans Cargo Center that could be redeveloped to permit more efficient use of the area.

4. Prepare plans illustrating the incremental all-cargo development potential of the sites remaining in the AirTrans Cargo Center and the actions required to complete the development. Account for the potential impact of criteria such as Federal Aviation Regulations Part 77.

5. Identify the potential for all-cargo development or redevelopment of some portion of the property currently leased by the military, should that property become available. Account for the potential impact of criteria such as Federal Aviation Regulations Part 77.

6. Prepare plans illustrating the potential for phased all-cargo development in the Southwest Quadrant.

8.5.3 Scope

The all-cargo development study would include the aircraft maintenance hangar and vacant or underutilized facilities within the AirTrans Cargo Center, a portion of the military leasehold immediately to the east of the AirTrans Cargo Center, and the Southwest Quadrant.

8.5.4 Timing

The all-cargo development study should be completed in a timeframe consistent with the growth of cargo activity at the Airport and need for additional cargo facilities—it must be completed before commencing additional planning or design related to development within the AirTrans Cargo Center.

8.6 Gate Management and Operations Study

8.6.1 Background

The Port's long-term strategy is to increase gate use from approximately four daily turns (a turn is the arrival and departure of a single aircraft) per gate to approximately six daily turns. This strategy, which assumes the implementation of common-use gate practices, when combined with the somewhat limited area available for ground service equipment staging and storage, may increase the difficulty of managing and operating the aircraft gates.

8.6.2 Objectives

The objectives of the gate management and operations study are to (1) document the amount of ground service equipment associated with airline passenger aircraft currently at the Airport by owner/operator, where that equipment is stored and staged, how it is managed, and current management issues; (2) assess how and why these management issues may be exacerbated in the future by increased gate utilization through increased common use; and (3) identify alternatives to facilitate the management and operation of the gates with respect to staging and storing ground service equipment.

This study would emphasize the Port's commitment to sustainability by maximizing operational efficiency.

8.6.3 Scope

The scope of the gate management and operations study would include the current and potential future aircraft and ground service equipment parking areas, an existing and potential future inventory of ground service equipment, the potential use of electric

ground service vehicles and associated infrastructure, and technological solutions (e.g., radio-frequency identification tags and monitoring systems) to assist in the management of ground service vehicles.

8.6.4 Timing

The gate management and operations study should be undertaken in the future when operations increase to the point that Port staff believes improvements would be beneficial and the study is justified.

8.7 Concourse A Improvements Study

8.7.1 Background

Holdroom space on Concourse A is currently deficient and will become further deficient in the future as larger capacity aircraft (e.g., the Q-400) enter service. This deficiency is partially mitigated by adjacent concession spaces that provide passengers with additional seating area. Although Concourse A will ultimately be demolished and reconstructed to permit the extension of Taxiway T, interim improvements may be justified.

8.7.2 Objective

The objectives of the Concourse A improvements study are to identify (1) alternatives for increasing passenger comfort and convenience in Concourse A, and (2) the timing of the improvements to ensure minimal inconvenience to customers and the tenant.

8.7.3 Scope

The scope of the Concourse A improvements study would include holdrooms, concessions, circulation, and restrooms.

8.7.4 Timing

The timing of the Concourse A improvements study should be based on (1) current and future utilization of Concourse A gates, and (2) input from Horizon Air.

8.8 Concourse E Regional Airline Holdroom Improvements

8.8.1 Background

The lower level holdroom on Concourse E that serves commuter aircraft at Gates E6 through E13 is currently deficient and will remain so in the future. To the extent that the number of commuter aircraft served from this holdroom increases, or the size of the aircraft increases, the level of service will deteriorate.

8.8.2 Objectives

The objectives of the Concourse E regional airline holdroom improvements study are to identify (1) alternatives for increasing passenger comfort and convenience in the holdroom to a level equivalent to that provided at other holdrooms, and (2) the timing of the improvements to ensure minimal inconvenience to customers and SkyWest Airlines.

8.8.3 Scope

The scope of the Concourse E regional airline holdroom improvements study would include holdroom seating, concessions, vertical and horizontal circulation, and restrooms.

8.8.4 Timing

The timing of the Concourse E regional airline holdroom improvements study should be based on (1) current and future utilization of the holdroom, and (2) input from United Airlines and SkyWest Airlines.

8.9 Aircraft Rescue and Firefighting Facilities Siting Study

8.9.1 Background

The FAA's requirements for aircraft rescue and firefighting (ARFF) facilities may change in the future. Should it not be possible to meet the new requirements with the Airport's existing ARFF facilities, a new siting study would be needed.

8.9.2 Objectives

The objective of the ARFF facilities siting study would be to identify and evaluate alternatives for meeting the new requirements and recommend the preferred alternative.

8.9.3 Scope

The scope of the ARFF facilities siting study would include the new FAA requirements and all services required of the Airport's firefighting personnel and equipment.

8.9.4 Timing

The timing of the ARFF facilities siting study would coincide with the publication of new requirements by the FAA that cannot be met with existing ARFF facilities.

8.10 82nd Avenue Grade-Separated Interchange Project Definition

8.10.1 Background

It is anticipated that the intersection of NE 82nd Avenue with NE Airport Way will become capacity-constrained by PAL 2 (2017). According to prior Port access studies,

the solution is a grade-separated interchange to provide for unimpeded travel east-bound and westbound on NE Airport Way while northbound and southbound traffic on NE 82nd Avenue would use the signalized interchange ramps.

8.10.2 Objectives

The objectives of the grade-separated interchange project definition would be to identify the (1) the preferred design concept for the interchange, (2) extent of Airport property required to accommodate the concept, and (3) the impacts on existing facilities and land parcels as well as the timing of those impacts.

8.10.3 Scope

The scope of the grade-separated interchange project definition study would include, but not necessarily be limited to, the following elements:

- NE Airport Way
- NE 82nd Avenue
- MAX Light Rail
- Facilities to the northeast of the intersection
  - Delta Cargo
  - Flight kitchen
  - Frontage road
- Facilities to the northwest of the intersection
  - Sheraton
  - Hampton Inn
  - Frontage road
- Facilities to the southeast of the intersection
  - Embassy Suites
  - Rentrak Corporation
- Vacant parcel to the southwest of the intersection

8.10.4 Timing

The grade-separated interchange project definition study should be completed in a timeframe consistent with the growth of automobile traffic at the Airport and prior to or in conjunction with the north side properties redevelopment study and the P4 parking garage project definition study.

8.11 High-Speed Rail Study

8.11.1 Background

The effective integration of the Airport with the region's future high-speed rail service requires additional study.

8.11.2 Objectives

The objectives of the high-speed rail study would be to (1) confirm the region's expectations and plans for high-speed rail service and facilities, (2) define the range of policy and facilities issues that must be resolved to integrate air transportation at the Airport with high-speed rail transportation, (3) identify a range of potential Airport-related policy and facilities alternatives, and (4) prepare a preliminary long-range plan for integrating air and high-speed rail transportation.

8.11.3 Scope

The high-speed rail study would be completed in cooperation with appropriate regional transportation organizations and be consistent with the Master Plan Update. Potential facilities alternatives would be limited to those facilities located on-Airport to expedite the transfer of passengers between aircraft and railcars.

8.11.4 Timing

Assuming transportation between the Airport and the high-speed rail system will be provided by bus or light rail (an assumption that should be verified), the timing of the high-speed rail study will be determined by the region's high-speed rail plans. In other words, the high-speed rail study should be completed when the region's plans are decided.

8.12 Remain Overnight Aircraft Parking Ramp Design Study

8.12.1 Background

To meet the Port's objective to achieve higher gate utilization, thereby avoiding the expansion of passenger concourses to add aircraft gates, 23 additional remain overnight RON positions will be required by PAL 5 (2035). The requirements also include four additional RON positions by PAL 1 (2012) and two additional RON positions by PAL 2 (2017).

8.12.2 Objectives

The objectives of the RON aircraft parking ramp design study are to:

1. Confirm the preferred location for a supplemental RON aircraft parking.

2. Complete the design for the aircraft ramp(s) required through PAL 2 (i.e., ramp(s) to accommodate up to six RON aircraft.

3. Recommend how the project should be phased.

4. Determine the maximum number of RON aircraft parking positions that should be constructed in the immediate terminal area, before proceeding with development to the west of Runway 3-21.

5. Prepare a concept plan showing how RON aircraft parking positions can be developed to the west of Runway 3-21 to meet the Airport's needs through PAL 5 (2035).

8.12.3 Scope

The RON aircraft parking ramp design study should be limited to the area to the north of NE Airport Way and east of Runway 3-21, consistent with the recommendation presented in Section 4 of this Technical Memorandum. The study should be coordinated with the north side properties redevelopment study.

8.12.4 Timing

The study should be completed within two years of the Master Plan Update to accommodate PAL 1 (2012) requirements.

8.13 Commercial Vehicle Roadway Redevelopment Study

8.13.1 Background

By PAL 3 (2022), the deplaning curbside loading area will be deficient. By PAL 4 (2027), the deplaning curbside loading area deficiency will increase and another deplaning roadway lane will be needed. The preferred alternative for correcting both the loading area and roadway lane deficiencies involves reconfiguring the existing commercial vehicle service area in a two-phase process. In phase 1, which will occur at PAL 3, the existing commercial vehicle area will be reconfigured for use by automobiles associated with deplaning passenger activity. This reconfiguration will allow both the PAL 3 and PAL 4 needs to be met. Phase 2, which will occur at PAL 4, involves relocating some of the commercial vehicles into the P1 garage (into the space to be vacated when the rental car service center moves to the consolidated rental car facility)

and restriping the commercial vehicle area to accommodate rental car buses to and from the consolidated rental car center.

8.13.2 Objectives

The objectives of the study would be to develop detailed plans showing (1) how the space to be vacated by the rental cars will be used by commercial vehicles, and (2) how the space vacated by the commercial vehicles will be used for supplemental deplaning curbside and roadway lanes.

8.13.3 Scope

The study would include the entire lower level curbside and roadway system, the commercial vehicle area, the entrance and exit serving the rental car service center in the P1 garage, and the rental car service center.

8.13.4 Timing

The study should be completed in a timeframe consistent with the growth of rental car activity at the Airport and the need to accommodate PAL 3 (2022) requirements.

8.14 Enplaning Roadway Study

8.14.1 Background

Deficiencies have been identified in the enplaning level departure and approach roadways by PAL 1 (2012) and PAL 3 (2022), respectively. Because these roadways are elevated and adjacent to Concourses A and E, the feasibility of widening them to permit an additional departure and approach lanes requires further study.

8.14.2 Objectives

The objectives of the study would be to:

1. Determine the feasibility of widening the enplaning level departure and approach roadways to permit the addition of one departure lane and one approach lane.

2. Identify other alternatives for resolving the deficiency, including operating at a lower level of service.

3. Evaluate the alternatives using modeling to quantify the operational merits of each alternative.

4. Recommend the preferred alternative, considering factors such as construction difficulty and phasing, potential customer inconvenience, level of service, and estimated cost.

Appendix A

FACILITY REQUIREMENTS

Table A-1 (page 1 of 4)
FACILITIES REQUIREMENTS SUMMARY
Master Plan Update
Portland International Airport

Functional Element	Existing	Estimated total requirements					Estimated surplus (deficiency) compared with existing					Period-over-period (i.e., incremental) requirement				
		PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035	PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035	PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035
BASIS FOR REQUIREMENTS (DEMAND FORECASTS)																
Total annual passengers (millions)	14.7	15.0	18.0	20.6	23.7	26.8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cargo in belly of psngr acft (thousands of short tons)		36	40	46	52	62										
Cargo in all-cargo acft (thousands of short tons)	280	288	374	450	542	670	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Aircraft operations (thousands)	265	258	292	318	347	378	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
AIRFIELD																
Number of runways		2 parallels plus crosswind	2 parallels plus crosswind	2 parallels plus crosswind	2 parallels plus crosswind	2 parallels plus crosswind	-	-	-	-	-	-	-	-	-	-
Critical aircraft		B-747-400 (ARC D-V)	B-747-400 (ARC D-V)	B-747-400 (ARC D-V)	B-747-400 (ARC D-V)	B-747-400 (ARC D-V)	-	-	-	-	-	-	-	-	-	-
Runway length (feet)																
Runway 10L-28R		9,827	9,827	9,827	9,827	9,827	-	-	-	-	-	-	-	-	-	-
Runway 10R-28L		11,000	11,000	11,000	11,000	11,000	-	-	-	-	-	-	-	-	-	-
Runway 3-21		6,000	6,000	6,000	6,000	6,000	-	-	-	-	-	-	-	-	-	-
Instrument approach capability		CAT III	CAT III	CAT III	CAT III	CAT III	-	-	-	-	-	-	-	-	-	-
PASSENGER TERMINAL COMPLEX																
Aircraft gates and parking																
Domestic gates																
Widebody	3	1	2	2	3	2	2	1	1	-	1	-	-	-	-	-
Narrowbody - ADG IV (e.g., B-757-300)	22	1	8	10	3	4	21	14	12	19	18	-	-	-	-	-
Narrowbody - ADG III (e.g., B-737-800)	15	34	29	27	33	32	(19)	(14)	(12)	(18)	(17)	-	-	-	-	-
Regional jet / turboprop	21	19	19	19	21	21	2	2	2	-	-	-	-	-	-	-
Total domestic gates	61	55	58	58	60	59	6	3	3	1	2	-	-	-	-	-
FIS gates																
Widebody	5	3	4	4	5	6	2	1	1	-	(1)	-	-	-	-	-
Narrowbody - ADG IV (e.g., B-757-300)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Narrowbody - ADG III (e.g., B-737-800)	1	2	3	2	3	2	(1)	(2)	(1)	(2)	(1)	-	-	-	-	-
Regional jet / turboprop	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total FIS gates	6	5	7	6	8	8	1	(1)		(2)	(2)	-	-	-	-	-
Total domestic + FIS gates																
Widebody	8	4	6	6	8	8	4	2	2	-	-	-	-	-	-	-
Narrowbody - ADG IV (e.g., B-757-300)	22	1	8	10	3	4	21	14	12	19	18	-	-	-	-	-
Narrowbody - ADG III (e.g., B-737-800)	16	36	32	29	36	34	(20)	(16)	(13)	(20)	(18)	-	-	-	-	-
Regional jet / turboprop	21	19	19	19	21	21	2	2	2	-	-	-	-	-	-	-
Total domestic + FIS gates	67	60	65	64	68	67	7	2	3	(1)	-	-	-	-	-	-
Remote / RON parking																
Widebody	3	-	-	-	-	3	3	3	3	3	-	-	-	-	-	-
Narrowbody - ADG IV (e.g., B-757-300)	5	4	1	2	-	3	1	4	3	5	2	-	-	-	-	-
Narrowbody - ADG III (e.g., B-737-800)	-	7	12	15	25	24	(7)	(12)	(15)	(25)	(24)	-	-	-	-	-
Regional jet / turboprop	-	1	1	1	-	1	(1)	(1)	(1)	-	(1)	-	-	-	-	-
Total Remote / RON parking	8	12	14	18	25	31	(4)	(6)	(10)	(17)	(23)	4	2	4	7	6
Holdrooms (area in square feet)																
Concourse A	6,004	9,953	9,953	11,076	10,417	10,766	(3,949)	(3,949)	(5,072)	(4,413)	(4,762)	3,949	-	1,123	-	-
Concourse B	4,701	4,182	4,308	4,308	2,914	2,633	519	393	393	1,787	2,068	-	-	-	-	-
Concourse C	40,267	24,407	29,316	28,464	30,748	31,629	15,860	10,951	11,803	9,519	8,638	-	-	-	-	-
Concourse D	26,117	27,341	31,930	34,321	37,129	36,838	(1,224)	(5,813)	(8,204)	(11,012)	(10,721)	1,224	4,589	2,391	2,808	-
Concourse E	11,212	10,611	9,914	9,759	8,868	8,984	601	1,298	1,453	2,344	2,228	-	-	-	-	-
Total holdroom area	88,301	76,494	85,421	87,928	90,076	90,850	11,807	2,880	373	(1,775)	(2,549)	-	-	-	1,775	774

Table A-1 (page 2 of 4)
FACILITIES REQUIREMENTS SUMMARY
Master Plan Update
Portland International Airport

Functional Element	Existing	Estimated total requirements					Estimated surplus (deficiency) compared with existing					Period-over-period (i.e., incremental) requirement				
		PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035	PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035	PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035
BASIS FOR REQUIREMENTS (DEMAND FORECASTS)																
Total annual passengers (millions)	14.7	15.0	18.0	20.6	23.7	26.8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cargo in belly of psngr acft (thousands of short tons)		36	40	46	52	62										
Cargo in all-cargo acft (thousands of short tons)	280	288	374	450	542	670	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Aircraft operations (thousands)	265	258	292	318	347	378	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Airline Check-in																
Number of processors																
Agent counters	87	50	57	64	64	68	37	30	23	23	19	-	-	-	-	-
Kiosks w/bag check	56	36	42	49	47	52	20	14	7	9	4	-	-	-	-	-
Kiosks w/out bag check	23	24	23	25	28	32	(1)	-	(2)	(5)	(9)	1	-	1	3	4
Curbside	24	24	24	24	24	24	-	-	-	-	-	-	-	-	-	-
Total	190	134	146	162	163	176	56	44	28	27	14	-	-	-	-	-
Lobby queue area (square feet)												-	-	-	-	-
@ IATA level of service B	13,565	11,296	12,944	14,528	14,832	16,704	2,269	621	(963)	(1,267)	(3,139)	-	-	963	304	1,872
@ IATA level of service C	13,565	9,884	11,326	12,712	12,978	14,616	3,681	2,239	853	587	(1,051)					
Passenger Security Screening																
Number of screening lanes																
South	8	8	9	9	10	13	-	(1)	(1)	(2)	(5)	-	1	-	1	3
North	8	6	6	7	8	8	2	2	1	-	-	-	-	-	-	-
Total	16	14	15	16	18	21	2	1	-	(2)	(5)	-	-	-	2	3
Queue area (square feet)																
Document check																
@ IATA level of service B																
South	1,660	1,170	3,458	3,692	3,536	4,602	490	(1,798)	(2,032)	(1,876)	(2,942)	-	1,798	234	-	910
North	1,504	1,118	2,301	2,301	2,470	2,704	386	(797)	(797)	(966)	(1,200)	-	797	-	169	234
Total	3,164	2,288	5,759	5,993	6,006	7,306	876	(2,595)	(2,829)	(2,842)	(4,142)	-	2,595	234	13	1,300
@ IATA level of service C																
South	1,660	990	2,926	3,124	2,992	3,894	670	(1,266)	(1,464)	(1,332)	(2,234)	-	1,266	198	-	770
North	1,504	946	1,947	1,947	2,090	2,288	558	(443)	(443)	(586)	(784)	-	443	-	143	198
Total	3,164	1,936	4,873	5,071	5,082	6,182	1,228	(1,709)	(1,907)	(1,918)	(3,018)	-	1,709	198	11	1,100
Primary queue																
@ IATA level of service B																
South	2,003	2,860	3,367	4,082	4,082	4,953	(857)	(1,364)	(2,079)	(2,079)	(2,950)	857	507	715	-	871
North	2,044	2,223	2,288	2,483	2,951	3,250	(179)	(244)	(439)	(907)	(1,206)	179	65	195	468	299
Total	4,047	5,083	5,655	6,565	7,033	8,203	(1,036)	(1,608)	(2,518)	(2,986)	(4,156)	1,036	572	910	468	1,170
@ IATA level of service C																
South	2,003	2,420	2,849	3,454	3,454	4,191	(417)	(846)	(1,451)	(1,451)	(2,188)	417	429	605	-	737
North	2,044	1,881	1,936	2,101	2,497	2,750	163	108	(57)	(453)	(706)	-	-	57	396	253
Total	4,047	4,301	4,785	5,555	5,951	6,941	(254)	(738)	(1,508)	(1,904)	(2,894)	254	484	770	396	990
Baggage Security Screening																
Number of primary EDS machines																
South	4	3	3	3	3	3	1	1	1	1	1	-	-	-	-	-
North	4	2	2	2	2	3	2	2	2	2	1	-	-	-	-	-
Total	8	5	5	5	5	6	3	3	3	3	2	-	-	-	-	-
Outbound Baggage Makeup																
Number of cart staging positions																
South	78	65	72	79	86	95	13	6	(1)	(8)	(17)	-	-	1	7	9
North	85	56	69	71	89	90	29	16	14	(4)	(5)	-	-	-	4	1
Total	163	121	141	150	175	185	42	22	13	(12)	(22)	-	-	-	12	10
Inbound Baggage Handling																
Total offload frontage (linear feet)	439	328	379	425	462	490	111	60	14	(23)	(51)	-	-	-	23	29
Baggage Claim -- Domestic																
Total presentation frontage (linear feet)	1,653	1,094	1,262	1,417	1,539	1,635	559	391	236	114	18	-	-	-	-	-
Total area for claiming baggage (square feet)	32,812	16,529	19,067	21,411	23,250	24,702	16,283	13,745	11,401	9,562	8,110	-	-	-	-	-

Table A-1 (page 3 of 4)
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Master Plan Update
Portland International Airport

Functional Element	Existing	Estimated total requirements					Estimated surplus (deficiency) compared with existing					Period-over-period (i.e., incremental) requirement				
		PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035	PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035	PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035
BASIS FOR REQUIREMENTS (DEMAND FORECASTS)																
Total annual passengers (millions)	14.7	15.0	18.0	20.6	23.7	26.8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cargo in belly of psngr acft (thousands of short tons)		36	40	46	52	62										
Cargo in all-cargo acft (thousands of short tons)	280	288	374	450	542	670	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Aircraft operations (thousands)	265	258	292	318	347	378	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
FIS Facilities																
Primary processing																
Number of primary screening modules	6	5	7	7	7	7	1	(1)	(1)	(1)	(1)	-	1	-	-	-
Primary queuing area (square feet)	5,037	4,313	6,038	6,038	6,038	6,038	724	(1,001)	(1,001)	(1,001)	(1,001)	-	1,001	-	-	-
Baggage Claim																
Per device																
Presentation frontage (linear feet)	145	210	210	210	210	210	(65)	(65)	(65)	(65)	(65)	65	-	-	-	-
Retrieval & peripheral area (square feet)	2,525	2,972	2,972	2,972	2,972	2,972	(447)	(447)	(447)	(447)	(447)	447	-	-	-	-
Total																
Number of devices	2	2	3	3	3	3	-	(1)	(1)	(1)	(1)	-	1	-	-	-
Presentation frontage (linear feet)	290	420	630	630	630	630	(130)	(340)	(340)	(340)	(340)	130	210	-	-	-
Retrieval & peripheral area (square feet)	5,800	5,945	8,917	8,917	8,917	8,917	(145)	(3,117)	(3,117)	(3,117)	(3,117)	145	2,972	-	-	-
Secondary processing																
Queuing area (square feet)	460	565	791	791	791	791	(105)	(331)	(331)	(331)	(331)	105	226	-	-	-
Referral waiting area (square feet)	1,015	275	400	400	400	400	740	615	615	615	615	-	-	-	-	-
Exam podiums w/ belts (units)	4	-	-	-	-	-	4	4	4	4	4	-	-	-	-	-
X-ray workstations (units)	1	1	1	1	1	1	-	-	-	-	-	-	-	-	-	-
Baggage security screening																
Number of primary EDS machines	1	3	4	4	4	4	(2)	(3)	(3)	(3)	(3)	2	1	-	-	-
Passenger security screening																
Number of screening lanes	4	2	2	2	2	2	2	2	2	2	2	-	-	-	-	-
GROUND TRANSPORTATION AND PARKING																
Public parking (spaces)																
Close-in parking	7,380	5,120	6,540	7,760	9,000	10,540	2,260	840	(380)	(1,620)	(3,160)	-	-	-	-	-
Remote parking	7,788	8,260	10,540	12,510	14,510	17,000	(472)	(2,752)	(4,722)	(6,722)	(9,212)	-	-	-	-	-
Subtotal	15,168	13,380	17,080	20,270	23,510	27,540	1,788	(1,912)	(5,102)	(8,342)	(12,372)	-	1,912	3,190	3,240	4,030
Holiday / overflow	-	650	840	990	1,150	1,350	(650)	(840)	(990)	(1,150)	(1,350)	-	-	-	-	-
Requirements currently accommodated off-Airport	1,300	1,400	1,800	2,100	2,500	2,900	(100)	(500)	(800)	(1,200)	(1,600)	-	-	-	-	-
Total, including holiday/overflow and off-Airport	16,468	15,430	19,720	23,360	27,160	31,790	1,038	(3,252)	(6,892)	(10,692)	(15,322)	-	-	-	-	-
Employee parking (spaces)	2,544	1,900	2,200	2,500	2,800	3,100	644	344	44	(256)	(556)	-	-	-	256	300
Curbside loading & unloading (linear feet)																
Enplaning curbside	929	720	840	960	1,080	1,200	209	89	(31)	(151)	(271)	-	-	31	120	120
Deplaning curbside	500	440	520	600	650	730	60	(20)	(100)	(150)	(230)	-	20	80	50	80
Subtotal	1,429	1,160	1,360	1,560	1,730	1,930	269	69	(131)	(301)	(501)	-	-	131	170	200
Curbside roadway (lanes)																
Enplaning curbside	4	4	4	4	5	6	-	-	-	(1)	(2)	-	-	-	1	1
Deplaning curbside	4	4	4	5	5	5	-	-	(1)	(1)	(1)	-	-	1	-	-
Commercial vehicle facilities																
Loading area (linear feet)	1,245	770	840	890	970	1,070	475	405	355	275	175	-	-	-	-	-
Hold / staging facility (acres)	0.8	0.9	1.0	1.2	1.4	1.6	(0.0)	(0.2)	(0.3)	(0.5)	(0.7)	0.0	0.2	0.2	0.2	0.2
Rental car facilities																
Ready / return parking (spaces)	1,481	910	1,090	1,250	2,390	2,700	571	391	231	(909)	(1,219)	-	-	-	909	310
Service facilities (acres)	2.4	6.9	7.9	10.5	8.5	9.6	(4.5)	(5.5)	(8.1)	(6.1)	(7.2)	4.5	1.0	2.6	0.0	1.1
Roadways																
NE Airport Way, westbound (link ID A--Fig 4-4)	3	3	3	4	4	4	-	-	(1)	(1)	(1)	-	-	1	-	-
NE Airport Way, eastbound (link ID B--Fig 4-4)	3	3	3	3	4	4	-	-	-	(1)	(1)	-	-	-	1	-
Parking entrance (link ID C--Fig 4-4)	1	1	1	1	2	2	-	-	-	(1)	(1)	-	-	-	1	-
Enplaning level approach (link ID D--Fig 4-4)	2	2	2	3	3	3	-	-	(1)	(1)	(1)	-	-	1	-	-
Deplaning level approach (link ID E--Fig 4-4)	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-
Enplaning level departure (link ID F--Fig 4-4)	1	2	2	2	3	3	(1)	(1)	(1)	(2)	(2)	1	-	-	1	-
Deplaning level departure (link ID G--Fig 4-4)	2	2	2	2	3	3	-	-	-	(1)	(1)	-	-	-	1	-
Parking exit (link ID H--Fig 4-4)	1	1	1	1	2	2	-	-	-	(1)	(1)	-	-	-	1	-
Terminal exit (link ID I--Fig 4-4)	2	3	3	3	4	4	(1)	(1)	(1)	(2)	(2)	1	-	-	1	-
Return-to-terminal road (link ID J--Fig 4-4)	1	1	1	1	2	2	-	-	-	(1)	(1)	-	-	-	1	-
Terminal area exit (link ID K--Fig 4-4)	2	2	3	3	4	4	-	(1)	(1)	(2)	(2)	-	1	-	1	-

Table A-1 (page 4 of 4)
FACILITIES REQUIREMENTS SUMMARY
Master Plan Update
Portland International Airport

Functional Element	Existing	Estimated total requirements					Estimated surplus (deficiency) compared with existing					Period-over-period (i.e., incremental) requirement				
		PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035	PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035	PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035
BASIS FOR REQUIREMENTS (DEMAND FORECASTS)																
Total annual passengers (millions)	14.7	15.0	18.0	20.6	23.7	26.8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cargo in belly of psngr acft (thousands of short tons)		36	40	46	52	62										
Cargo in all-cargo acft (thousands of short tons)	280	288	374	450	542	670	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Aircraft operations (thousands)	265	258	292	318	347	378	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Key intersections																
NE 82nd Ave/NE Airport Way		-	grade separated interchange	-	-	-	-	**grade separated interchange**		-	-	-	grade separated interchange		-	-
Mt. Hood interchange area (3 intersections)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NE Airport Way/I-205 interchange																
I-205 Southbound		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I-205 Northbound		e'bound to n'bound solution	-	-	-	-	**e'bound to n'bound solution**	-	-	-	-	e'bound to n'bound solution	-	-	-	-
NE 82nd Avenue/NE Alderwood Road		-	-	-	-	e'bound rt turn pocket	-	-	-	-	**e'bound rt turn pocket**	-	-	-	-	e'bound rt turn pocket
NE Alderwood Road/NE Cornfoot Road		-	-	n'bound lt turn pocket	-	-	-	-	**n'bound lt turn pocket**	-	-	-	-	n'bound lt turn pocket	-	-
NE Airtrans Way/NE Cornfoot Road		signalized intersection	-	-	-	-	**signalized intersection**	-	-	-	-	signalized intersection	-	-	-	-
NE Columbia Boulevard/NE 82nd Avenue (2 intersections)												-				
NE Killingsworth St./I-205 interchange area (2 intersections)												-				
AIR CARGO																
Belly Cargo																
Warehouse space (square feet)	236,000	54,000	60,000	69,000	78,000	93,000	182,000	176,000	167,000	158,000	143,000	-	-	-	-	-
Ramp (square yards)	67,000	4,000	4,000	5,000	6,000	7,000	63,000	63,000	62,000	61,000	60,000	-	-	-	-	-
Landside area (square feet)	-	54,000	60,000	69,000	78,000	93,000	-	-	-	-	-	-	-	-	-	-
Total area (acres)	-	3	4	4	5	6	-	-	-	-	-	-	-	-	-	-
All Cargo																
Warehouse space (square feet)	392,000	432,000	561,000	675,000	813,000	1,005,000	**(40,000)**	**(169,000)**	**(283,000)**	**(421,000)**	**(613,000)**	40,000	129,000	114,000	138,000	192,000
Ramp (square yards)	189,000	240,000	312,000	375,000	452,000	558,000	**(51,000)**	**(123,000)**	**(186,000)**	**(263,000)**	**(369,000)**	51,000	72,000	63,000	77,000	106,000
Landside area (square feet)	-	432,000	561,000	675,000	813,000	1,005,000	**(432,000)**	**(561,000)**	**(675,000)**	**(813,000)**	**(1,005,000)**	432,000	129,000	114,000	138,000	192,000
Total area (acres)		69	90	108	131	161	-	-	-	-	-	-	-	-	-	-
GENERAL AVIATION																
Total area (acres)	30	40 - 50	40 - 50	40 - 50	40 - 50	40 - 50	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	10 - 20	-	-	-
MILITARY																
Total area (acres)	246	246	246	246	246	246	-	-	-	-	-	-	-	-	-	-
AIRLINE SUPPORT																
Fuel storage																
Quantity (millions of gallons)	3,360	3,109	3,534	3,884	4,262	4,660	251	**(174)**	**(524)**	**(902)**	**(1,300)**	-	174	350	378	398
Land area (acres)	4	3.7	4.2	4.6	5.1	5.5	**0**	**(0)**	**(1)**	**(1)**	**(2)**	0.0	0.2	0.4	0.5	0.4
Airline maintenance and support (square feet)	339	339	339	339	339	339	-	-		-	-					
In-flight catering facilities (acres)	6.5	6.5	6.5	6.5	6.5	6.5	-	-		-	-					
AIRPORT SUPPORT																
Aircraft rescue and fire fighting (acres)	5.8	9	9	9	9	9	**(3)**	**(3)**	**(3)**	**(3)**	**(3)**	3	-	-	-	-
Airport maintenance (acres)	12.2	14.4	14.4	14.4	14.4	14.4	**(2)**	**(2)**	**(2)**	**(2)**	**(2)**	2	-	-	-	-

ADG = Airplane design group
ARC = Airplane reference code
CAT = Category
EDS = Explosives detection system
FIS = Federal Inspection Services
IATA = International Air Transport Association
n/a = Not applicable
RON = Remain overnight

a. Passenger terminal complex requirements were determined based primarily on simulation modeling using flight schedules for 2008, 2017, 2022, 2027 and 2035. A flight schedule was not developed for 2012 because the activity is forecast so be very similar to activity in 2008. Accordingly, requirements for the passenger terminal complex in 2012 were assumed to equal the requirements for 2008.

Sources: Jacobs Consultancy, DKS Associates, and HNTB Corporation; October 2008.

Appendix B

LIFE-CYCLE COST ANALYSIS OF ALTERNATIVES FOR TRANSPORTING RENTAL CAR CUSTOMERS TO AND FROM THE TERMINAL

Appendix B

LIFE-CYCLE COST ANALYSIS OF ALTERNATIVES FOR TRANSPORTING CUSTOMERS BETWEEN A CONSOLIDATED RENTAL CAR CENTER AND THE TERMINAL

Three alternatives modes were identified for transporting customers between a consolidated rental car facility and the passenger terminal—an automated people mover (APM) system, MAX light rail, and busing. These alternatives are described in Section 5.2.2 of this Technical Memorandum.

This appendix summarizes the results of the life-cycle cost analysis that was performed for each alternative mode and accounted for both capital and operating costs estimated to occur in each year over a 20-year period. The net present values of the life-cycle costs were estimated assuming a discount rate of 7%.

1. AUTOMATED PEOPLE MOVER SYSTEM

Capital and operating cost estimates for the APM system alternatives were provided by Lea + Elliott, Inc. and are shown in Table B-1. The life-cycle costs and their net present values for the APM system alternatives are shown in Table B-2.

2. MAX LIGHT RAIL

In June 2009, the planning team spoke with John Griffiths of TriMet (operator of Portland's MAX light rail system) to (1) explore the concept of modifying and expanding the MAX system at the Airport so that it might be used to transport customers between the passenger terminal and parking garages or a consolidated rental car facility, (2) learn if Griffiths believes the concept is sound, and if so, (3) obtain information on potential costs. Griffiths believes the concept is sound; the discussion and input provided are summarized in Table B-3. The capital and operations and maintenance costs estimated for the MAX light rail alternatives are summarized in Table B-4. The life-cycle costs and their net present values for the MAX light rail alternatives are shown in Table B-5.

3. BUS

The input required to estimate the life-cycle costs and their net present values for the busing alternatives are summarized in six tables as follows:

- Table B-6 - bus operations and maintenance costs
- Table B-7 - round-trip travel times

- Table B-8 - number of buses and operating hours required for service to public parking and rental car facilities
- Table B-9 - total number of buses required, including spares
- Table B-10 - annual operations and maintenance costs
- Table B-11 - net present value of life-cycle costs

Table B-1

ESTIMATED CAPITAL AND OPERATIONS AND MAINTENANCE COSTS FOR APM SYSTEM ALTERNATIVES

PDX Master Plan Update, ROM APM Costs (Preliminary)				
Item	Economy	P4	PIC	P3[3]
Max. Passenger Demand (2035)	2,676 pphpd	2,547 pphpd	2,676 pphpd	2,288 pphpd
Max. System Capacity	2,872 pphpd	2,857 pphpd	2,700 pphpd	4,186 pphpd
Guideway Length	8,600 ft.	5,800 ft.	9,900 ft.	2,400 ft.
No. of Stations	4	3	4	2
No. of Substations	2	1	2	1
No. of MSF	1	1	1	1
Roundtrip Time	9.5 min	6.5 min	10.0 min	3.0 min
Headway	3 .0 min	3.0 min	3.5 min	1.5 min
Trip Time (Wait Plus Travel)	6.5 min	4.5 min	6.5 min	2 min
No. of Trains	3	2	3	2
No. of Cars per Train	3	3	3	2
Spare Vehicles	2	1	2	0
Total Fleet Size	11 vehicles	7 vehicles	11 vehicles	4 vehicles
System Capital Cost (DBOM Contractor)[1]	$99 million	$70 million	$106 million	$40 million
Facilities Capital Cost (DBB Contractor)[2]	$112 million	$90 million	$123million	$39 million
Total Capital Cost Incl. Contingency	*$212 million*	*$160 million*	*$229 million*	*$79 million*
Annual O&M Cost	*$6.5 million*	*$4.5 million*	*$6.5 million*	*$3.0 million*

[1] includes 35% for design and PM plus 20% contingency
[2] includes 20% for design and PM plus 20% contingency
[3] dual lane shuttle

Assumptions:

1. Pinched loop operations (except P3) with maximum 50 mph train speed.
2. 50 passenger capacity per car (baggage conditions).
3. 30 second dwell time.
4. 24 hour operation.
5. Estimate in 3rd quarter 2009 dollars.
6. Self propelled vehicles for pinched loop and capacity issues (e.g. Bombardier, Mitsubishi, IHI).
7. Station and maintenance facility have minimal architectural finishes.
8. Estimate does not include owner soft costs.
9. Side platform stations.
10. P3 dual lane shuttle could be cable-propelled if not expanded in the future.

Source: Lea + Elliott, June 2009.

Table B-2

LIFE-CYCLE COSTS AND THEIR NET PRESENT VALUES FOR APM SYSTEM ALTERNATIVES

Year		Alternative 1 P3 Line	Alternative 2 P4 Line	Alternative 3 Economy Line	Alternative 4 PIC Line
Capital Costs ($millions)					
System		$40	$70	$99	$106
Facilities		39	90	112	123
Total		$79	$160	$211	$229
Annual O&M Cost ($millions)		$3.0	$4.5	$6.5	$6.5
Life-cycle Cost Analysis Year					
0	2026	$79	$160	$211	$229
1	2027	$3	$5	$7	$7
2	2028	$3	$5	$7	$7
3	2029	$3	$5	$7	$7
4	2030	$3	$5	$7	$7
5	2031	$3	$5	$7	$7
6	2032	$3	$5	$7	$7
7	2033	$3	$5	$7	$7
8	2034	$3	$5	$7	$7
9	2035	$3	$5	$7	$7
10	2036	$3	$5	$7	$7
11	2037	$3	$5	$7	$7
12	2038	$3	$5	$7	$7
13	2039	$3	$5	$7	$7
14	2040	$3	$5	$7	$7
15	2041	$3	$5	$7	$7
16	2042	$3	$5	$7	$7
17	2043	$3	$5	$7	$7
18	2044	$3	$5	$7	$7
19	2045	$3	$5	$7	$7
20	2046	$3	$5	$7	$7
	NPV *(a)*	$111	$208	$280	$298

(a) NPV is computed assuming a discount rate of 7%.

Note: Amounts shown are real values (i.e., in 2009 dollars). Capital cost is shown in year 0, recurring O&M is shown in Years 1-20.

Source: Jacobs Consultancy, June 2009.

Table B-3

SUMMARY OFLIGHT RAIL INPUT RECEIVED FROM TRIMET
ASSUMPTIONS AND GENERAL DISCUSSION

1. Single-station pick up (i.e., if MAX were to pick up customers at a consolidated rental car facility, the customers would be picked up from a single location).

2. Two tracks would likely be adequate for cars on 5-minute headways; less than 5 minute headways would likely require three tracks.

3. Two tracks would not be adequate at the terminal—four tracks would likely be required, two for local service and two for on-Airport service.

   Issue: Should we assume the on-Airport system could share one of the existing tracks (i.e., construct one additional track) or should we assume no sharing (i.e., construct two additional tracks)?

   Response: Assume the addition of only one track. But if the alignment changes, demolish the existing track and construct two new tracks at $50 million per mile.

4. Service to the P3 garage location would likely require a spur from the main line with a stub end, a pair of switches, a crossing, and a simple platform. (All these costs except the platform cost are included in the per mile track cost documented below.)

5. Service to the Portland International Center location would require the same equipment as for the P3 garage location (the spur would be longer).

6. Service to the P4 garage location would require parallel tracks (i.e., a siding).

7. About two minutes is required to turn a train (customers board during the turn).

8. Assume an average speed of 20 miles per hour assuming double tracks (this includes slow downs, etc.).

9. The cars providing on-Airport transportation would be different from the cars providing transportation off-Airport. No fares would be collected for on-Airport use.

10. Three to four vehicles could be required. If four vehicles were required, a spare would also be required.

11. Vehicle maintenance could be provided off-Airport at an existing TriMet maintenance facility. Assume the cost of support facilities for the vehicles at the yard and shop is $1.5 million per vehicle.

12. TriMet would operate the on-Airport system.

Table B-3 *(continued)*
SUMMARY OFLIGHT RAIL INPUT RECEIVED FROM TRIMET
ASSUMPTIONS AND GENERAL DISCUSSION

13. The minimum radius curve for the track is 82 feet. The track on minimum radius curves wears faster than track on larger radius curves and has to be replaced every 10 years.

14. The system for providing on-Airport transportation would be independent of the existing system.

POTENTIAL COSTS

Capital

1. Assume $50 million per mile to lay two tracks on open ground. This includes earthwork, roadway, overhead lines, new substations, signals and controls. This does not include right-of-way acquisition, stations (i.e., platforms), fare collection system, or station furniture. This unit cost is scalable.

2. Vehicles cost $4.5 million each and are equipped with 68 seats. TriMet assumes a maximum capacity of 133 persons with some standing and no luggage. Useful vehicle life is 35 years.

   A less expensive option would be to use streetcars instead of LRVs, which cost $3.5 million per vehicle. Passenger capacity would be 92 per streetcar.

3. Griffith believes a platform would cost $200,000. Port staff believes this cost is too low, based on what the Port spent on the existing platform.

O&M

1. Light rail vehicle (LRV) O&M cost is $250 per vehicle hour. This is all inclusive (i.e., includes maintenance, the cost of supervision, controllers, etc.). Griffiths stated we may want to assume a 10% higher O&M to account for overhead.

2. The use of streetcars would require a maintenance facility on site which could cost $1.5 million per vehicle, not including land and utility connections. Streetcar O&M is $135 per vehicle-hour.

Source: TriMet, June 2009.

Table B-4

ESTIMATED CAPITAL AND OPERATIONS AND MAINTENANCE COSTS FOR MAX LIGHT RAIL ALTERNATIVES

Cost elements	Unit Cost *(a)*		Units *(b)*		Alternative 1 P3 Line	Alternative 2 P4 Line	Alternative 3 PIC Line
CAPITAL ASSUMING LIGHT RAIL VEHICLE CARS							
Light rail vehicle (LRV) cars							
P3 service only	$4,500,000	per car	2		$9,000,000	$9,000,000	$9,000,000
P4 and P3 service (incremental cars)	$4,500,000	per car	4			$18,000,000	$18,000,000
PIC, P4 and P3 service (incremental cars)	$4,500,000	per car	9				$40,500,000
Spare LRV cars							
P3 service only	$4,500,000	per car	0		$0	$0	$0
P4 and P3 service (incremental cars)	$4,500,000	per car	1			$4,500,000	$4,500,000
PIC, P4 and P3 service (incremental cars)	$4,500,000	per car	2				$9,000,000
Vehicle and spares subtotal					$9,000,000	$31,500,000	$81,000,000
Additional track							
Segment 1: two additional tracks at terminal (ft)	$50,000,000	per mile	500	ft	$5,000,000	$5,000,000	$5,000,000
Segment 2: two additional tracks for service to P3	$50,000,000	per mile	1,500	ft	$14,000,000	$14,000,000	$14,000,000
Segment 3: two additional tracks for service to P4	$50,000,000	per mile	2,000	ft		$19,000,000	$19,000,000
Segment 4: one additional track for service to P4	$25,000,000	per mile	1,300	ft		$6,000,000	$6,000,000
Segment 5: one additional tracks for service to PIC	$25,000,000	per mile	2,200	ft			$10,000,000
Segment 6: two additional tracks for service to PIC	$50,000,000	per mile	1,900	ft			$18,000,000
Additional platforms							
Terminal platform	$1,500,000	each	1		$1,500,000	$1,500,000	$1,500,000
P3 platform	$1,000,000	each	1		$1,000,000	$1,000,000	$1,000,000
P4 platform	$1,000,000	each	1			$1,000,000	$1,000,000
PIC platform	$1,000,000	each	1				$1,000,000
Additional track and platforms subtotal					$21,500,000	$47,500,000	$76,500,000
Total capital cost (rough order of magnitude)					$30,500,000	$79,000,000	$157,500,000

Table B-4 *(page 2 of 2)*
ESTIMATED CAPITAL AND OPERATIONS AND MAINTENANCE COSTS FOR MAX LIGHT RAIL ALTERNATIVES

Cost elements	Unit Cost *(a)*	Units *(b)*	Alternative 1 P3 Line	Alternative 2 P4 Line	Alternative 3 PIC Line
CAPITAL ASSUMING OPTIONAL STREETCARS					
Streetcars					
P3 service only	$3,500,000 per car	2	$7,000,000	$7,000,000	$7,000,000
P4 and P3 service (incremental cars)	$3,500,000 per car	4		$14,000,000	$14,000,000
PIC, P4 and P3 service (incremental cars)	$3,500,000 per car	9			$31,500,000
Spare streetcars					
P3 service only	$3,500,000 per car	0	$0	$0	$0
P4 and P3 service (incremental cars)	$3,500,000 per car	1		$3,500,000	$3,500,000
PIC, P4 and P3 service (incremental cars)	$3,500,000 per car	2			$7,000,000
Streetcar subtotal			$7,000,000	$24,500,000	$63,000,000
Maintenance facility for streetcars					
P3 service only	$1,500,000 per car	2	$3,000,000	$3,000,000	$3,000,000
P4 and P3 service	$1,500,000 per car	4		$6,000,000	$6,000,000
PIC, P4 and P3 service	$1,500,000 per car	9			$13,500,000
Additional track and platforms (from page 1)			$21,500,000	$47,500,000	$76,500,000
Total capital cost (rough order of magnitude)			$31,500,000	$81,000,000	$162,000,000
ANNUAL O&M ASSUMING LRV CARS *(c)*					
Alternative 1--P3 Line	$275 per hour		$3,000,000		
Alternative 2--P4 Line	$275 per hour			$10,000,000	
Alternative 3--PIC Line	$275 per hour				$30,000,000
ANNUAL O&M ASSUMING OPTIONAL STREETCARS					
Alternative 1--P3 Line	$135 per hour		$2,000,000		
Alternative 2--P4 Line	$135 per hour			$5,000,000	
Alternative 3--PIC Line	$135 per hour				$12,000,000

(a) Unit costs provided by TriMet.
(b) Units estimated by Jacobs Consultancy.
(c) O&M cost estimated assuming regular and spare vehicles operate 16 and 4 hours per day, respectively, 365 days per year; O&M for LRV cars includes a 10% increase for overhead.

Source: Jacobs Consultancy based on input from TriMet, June 2009.

Table B-5

LIFE-CYCLE COSTS AND THEIR NET PRESENT VALUES FOR MAX LIGHT RAIL ALTERNATIVES

Year		Alternative 1 - P3 Line		Alternative 2 - P4 Line		Alternative 3 - PIC Line	
		LRV cars	Streetcars	LRV cars	Streetcars	LRV cars	Streetcars
0	2026	$30,500,000	$31,500,000	$79,000,000	$81,000,000	$157,500,000	$162,000,000
1	2027	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
2	2028	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
3	2029	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
4	2030	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
5	2031	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
6	2032	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
7	2033	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
8	2034	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
9	2035	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
10	2036	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
11	2037	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
12	2038	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
13	2039	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
14	2040	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
15	2041	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
16	2042	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
17	2043	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
18	2044	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
19	2045	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
20	2046	$3,000,000	$2,000,000	$10,000,000	$5,000,000	$30,000,000	$12,000,000
	NPV *(a)*	$62,000,000	$53,000,000	$185,000,000	$134,000,000	$475,000,000	$289,000,000

(a) NPV is computed assuming a discount rate of 7%.

Note: Amounts shown are real values (i.e., in 2009 dollars). Capital cost is shown in year 0, recurring O&M is shown in Years 1-20.

Source: Jacobs Consultancy, June 2009.

Table B-6

SUMMARY OF BUS INPUT RECEIVED FROM PORT

Operating Costs

The cost to operate one bus 24-hours is approximately $160,000 annually. Operating costs primarily includes the wages/salaries for contracted staff. A new parking facility will require one to two buses operating 24-hours, two or more buses operating 12-hours/day and an additional bus or two for peak periods. If the garage includes a consolidated rental car facility, the peak bus needs could total eight to 10 buses during the morning, noon and afternoon peak periods.

Capital Costs

In 2009, the Port purchased six 35' ElDorado buses for $321,614 per bus and now has a fleet of 18, 35' low-floor, CNG buses and eight Blue Bird 30' CNG buses. The Blue Bird buses are being removed from service by 2010 and anticipate increasing the number of 35' ElDorado buses to 22-24 buses. A new garage (P3 or P4) will require additional buses to maintain the 6-8 minute headway and accommodate both public and rental car customer activities.

Fuel

For FY08, fuel costs were $292,450; in FY07 fuel was $334,962 to operate 26 CNG buses and four diesel buses. The vast majority of the fuel used was CNG, my guess is more than 95% was CNG as the diesel buses only operate the international flights between the FIS and concourse.

Maintenance Costs

Maintenance costs, including labor, material and outside services was $468,878 in FY08, or approximately $15,630 per bus for a 30 bus fleet.

Depreciation

Finance assumes a 10 year life for depreciation. The Port's shuttle bus program recommends replacing buses at eight years due to accumulation of miles, and to keep up with the evolving technology (improvements/changes in CNG engines, multiplex wiring) and features (LED lights and destination signs, and body design).

Source: Port of Portland staff, June 2009.

Table B-7

ESTIMATION OF ROUND-TRIP TRAVEL TIMES FOR BUSING ALTERNATIVES

Alternative and Route segment	Distance (ft)	Speed (mph)	Time Required (sec) Travel	Dwell	
P3					
P3 plaza	570	10	39	180	
Inbound road	2,206	20	75		
CGT plaza	630	10	43	180	
outbound road	2,395	20	82		
Total travel and dwell time			599		
P4					
P4 plaza	800	10	55	180	
left to 82nd	0	20	0	30	
82nd	850	20	29		
left to AP Way	0	20	0	30	
inbound roadway	5,870	30	133		
CGT plaza	630	10	43	180	
outbound road	6,220	30	141		
right to 82nd	0	20	0	10	
82nd	560	20	19		
Right to plaza		20	0	10	
plaza and U-turn	800	10	55	10	<---u-turn
Total travel and dwell time			925		

Table B-7 *(page 2 of 2)*
ESTIMATION OF ROUND-TRIP TRAVEL TIMES FOR BUSING ALTERNATIVES

Alternative and Route segment	Distance (ft)	Speed (mph)	Time Required (sec) Travel	Dwell	
Economy					
RAC plaza	800	10	55	180	
Onramp to AP Way	240	15	11		
inbound roadway	8,714	30	198		
CGT plaza	630	10	43	180	
Outbound road	9,514	30	216		
LT to Mt. Hood	0	20	0	30	
Mt Hood	810	20	28		
Left to frontage		20	0	15	
Frontage	884	20	30		
Plaza and U-turn	800	10	55	10	<---u-turn
Total travel and dwell time			1,050		
PIC					
RAC plaza	826	10	56	180	
Rd to 82nd	950	20	32		
Rt to 82nd		25	0	10	
82nd	2,400	25	65	0	
Light at AP Way		25	0	15	
82nd	20	20	1		
LT to AP way		20	0	30	
Inbound roadway	5,870	30	133		
CGT plaza	630	10	43	180	
Outbound road	6220	30	141		
Rt to 82nd	0	20	0	10	
82nd	2,400	20	82		
Left to road		20	0	30	
Rd from 82nd	950	20	32		
Plaza and U-turn	826	10	56	10	<---u-turn
Travel time			1,108		

Source: Jacobs Consultancy, June 2009.

Table B-8

ESTIMATION OF NUMBER OF BUSES AND OPERATING HOURS REQUIRED FOR SERVICE TO PUBLIC PARKING AND RENTAL CAR FACILITIES

Public Bus

Shift Duration (hrs)	Shift Time	Trip time (min)	Headway (min)	Buses Required Computed	Buses Required Rounded	Bus Hours Per Shift
P3						
4	Midnight-4 a.m.	10.0	15	0.7	1	4
5	4 - 9 a.m.		2	5.0	5	25
7	9 a.m - 4 p.m.		7	1.4	2	14
4	4 p.m. - 8 p.m.		7	1.4	2	8
4	8 p.m. - midnight		2	5.0	5	20
	2-MIN headway is demand based				Annual	25,915
P4						
4	Midnight-4 a.m.	15.4	15	1.03	1	4
5	4 - 9 a.m.		5	3.08	3	15
7	9 a.m - 4 p.m.		7	2.20	3	21
4	4 p.m. - 8 p.m.		7	2.20	3	12
4	8 p.m. - midnight		5	3.08	3	12
	5-MIN headway is demand based				Annual	23,360
Economy						
4	Midnight-4 a.m.	Not Applicable				
5	4 - 9 a.m.					
7	9 a.m - 4 p.m.					
4	4 p.m. - 8 p.m.					
4	8 p.m. - midnight					
PIC						
4	Midnight-4 a.m.	Not Applicable				
5	4 - 9 a.m.					
7	9 a.m - 4 p.m.					
4	4 p.m. - 8 p.m.					
4	8 p.m. - midnight					

Rental Car Bus

Shift Duration (hrs)	Shift Time	Trip time (min)	Headway (min)	Buses Required Computed	Buses Required Rounded	Bus Hours Per Shift
P3						
4	Midnight-4 a.m.	10.0	15	0.7	1	4
5	4 - 9 a.m.		1.3	7.7	8	40
7	9 a.m - 4 p.m.		5	2.0	2	14
4	4 p.m. - 8 p.m.		5	2.0	2	8
4	8 p.m. - midnight		1.3	7.7	8	32
	1.3-min is demand based				Annual	35,770
P4						
4	Midnight-4 a.m.	15.4	15	1.0	1	4
5	4 - 9 a.m.		1.3	11.9	12	60
7	9 a.m - 4 p.m.		5	3.1	3	21
4	4 p.m. - 8 p.m.		5	3.1	3	12
4	8 p.m. - midnight		1.3	11.9	12	48
	1.3-min is demand based				Annual	52,925
Economy		17.5	Headway	Buses	Rounded	Bus-hrs
4	Midnight-4 a.m.		15	1.2	2	8
5	4 - 9 a.m.		1.3	13.5	14	70
7	9 a.m - 4 p.m.		5	3.5	4	28
4	4 p.m. - 8 p.m.		5	3.5	4	16
4	8 p.m. - midnight		1.3	13.5	14	56
	1.3-min is demand based				Annual	64,970
PIC		18.5	Headway	Buses	Rounded	Bus-hrs
4	Midnight-4 a.m.		15	1.2	2	8
5	4 - 9 a.m.		1.3	14.2	15	75
7	9 a.m - 4 p.m.		5	3.7	4	28
4	4 p.m. - 8 p.m.		5	3.7	4	16
4	8 p.m. - midnight		1.3	14.2	15	60
	1.3-min is demand based				Annual	68,255

Source: Jacobs Consultancy, June 2009.

Table B-9

ESTIMATION OF TOTAL BUSES REQUIRED

Alternative	Public Parking	RAC	Subtotal	Spares *(a)*	Total	Allocation of total buses for NPV assessment: Public Parking	Allocation of total buses for NPV assessment: RAC
P3	5	8	13	3	16	6.2	9.8
P4	3	12	15	3	18	3.6	14.4
Economy	n/a	14	14	3	17	n/a	17
PIC	n/a	15	15	3	18	n/a	18

(a) Assumes one spare bus for each five operating busses.

Source: Jacobs Consultancy, June 2009.

Table B-10

ESTIMATED ANNUAL OPERATIONS AND MAINTENANCE COSTS FOR BUSING ALTERNATIVES

Parameter	Units	Alternative							
		P3		P4		Economy		PIC	
		Rental Car	Public Parking	Rental Car	Public Parking	Rental Car	Public Parking	Rental Car	Public Parking
Assumed route distance	miles	1.1	1.1	3.0	3.0	4.2	not applicable	4.0	not applicable
Assumed bus circuit time	minutes	10.0	10.0	15.4	15.4	17.5		18.5	
Annual bus hours to meet headways	bus-hours	35,770	25,915	52,925	23,360	64,970		68,255	
Estimated annual busing cost									
Including fleet value		$ 1,571,618	$ 1,138,622	$ 2,325,354	$ 1,026,363	$ 2,854,572		$ 2,998,905	
Rounded value		$ 1,600,000	$ 1,100,000	$ 2,300,000	$ 1,000,000	$ 2,900,000		$ 3,000,000	
Excluding fleet value		$ 861,470	$ 624,126	$ 1,274,624	$ 1,026,363	$ 1,564,710		$ 1,643,825	
Rounded value		$ 900,000	$ 600,000	$ 1,300,000	$ 1,000,000	$ 1,600,000		$ 1,600,000	

Assumptions:

1. Separate bus routes for public parking and rental car patrons
2. Stops per route: 2 (1 at the parking / RAC facility and 1 at the Terminal)
3. Average dwell time per stop: 3 minutes
4. Headways, public parking: 15 minutes (Midnight to 4 a.m.); Demand-based (4 a.m. to 9 a.m., 8 p.m. to midnight); 7 minutes (9 a.m. to 8 p.m.)
5. Headways, rental cars: 15 minutes (Midnight to 4 a.m.); Demand-based (4 a.m. to 9 a.m., 8 p.m. to midnight); 5 minutes (9 a.m. to 8 p.m.)
6. Cost per bus-hour: Cost data from Port of Portland, based on bus value and cost of fuel, maintenance, management, and staff. Value is in 2009 dollars.
   - Including fleet value: $43.94
   - Excluding fleet value: $24.08

Source: Jacobs Consultancy and Port of Portland, June 2009.

Table B-11

LIFE-CYCLE COSTS AND THEIR NET PRESENT VALUE FOR BUSING ALTERNATIVES

		Alternative 1 - P3 Route			Alternative 2 - P4 Route			Alternative 4 - PIC Route			Alternative 3 - Economy Route		
Year		Rental car	Public parking	Total	Rental car	Public parking	Total	Rental car	Public parking	Total	Rental car	Public parking	Total
0	2026	$3,430,000	$2,170,000	$5,600,000	$5,040,000	$1,260,000	$6,300,000	$6,300,000	not applicable	$6,300,000	$5,950,000	not applicable	$5,950,000
1	2027	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
2	2028	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
3	2029	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
4	2030	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
5	2031	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
6	2032	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
7	2033	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
8	2034	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
9	2035	$3,430,000	$2,170,000	$5,600,000	$5,040,000	$1,260,000	$6,300,000	$6,300,000		$6,300,000	$5,950,000		$5,950,000
		$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
10	2036	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
11	2037	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
12	2038	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
13	2039	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
14	2040	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
15	2041	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
16	2042	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
17	2043	$3,430,000	$2,170,000	$5,600,000	$5,040,000	$1,260,000	$6,300,000	$6,300,000		$6,300,000	$5,950,000		$5,950,000
		$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
18	2044	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
19	2045	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
20	2046	$900,000	$600,000	$1,500,000	$1,300,000	$1,000,000	$2,300,000	$1,600,000		$1,600,000	$1,600,000		$1,600,000
	NPV (a)	$20,000,000	$13,000,000	$33,000,000	$29,000,000	$14,000,000	$43,000,000	$36,000,000		$36,000,000	$35,000,000		$35,000,000

(a) NPV is computed assuming a discount rate of 7%.

Note: Amounts shown are real values (i.e., in 2009 dollars). Capital cost is shown in year 0, recurring O&M is shown in Years 1-20. Busses cost $350,000.

Source: Jacobs Consultancy, June 2009.

Appendix C

AIRCRAFT NOISE ASSESSMENT

Appendix C

AIRCRAFT NOISE ASSESSMENT

C.1 BACKGROUND AND PURPOSE

This appendix documents the noise exposure analysis completed to inform the long-term land use planning process for Portland International Airport (the Airport). The purposes of the analysis were to (1) assess the potential noise exposure in areas surrounding the Airport through Planning Activity Level (PAL) 5 (corresponding to approximately 2035), and (2) compare the noise exposure in the potentially affected areas with that in areas in which the City of Portland has restricted the development of noncompatible uses (i.e., residential development).

The Federal Aviation Administration (FAA) has determined that residential land uses are not compatible with noise exposure above a threshold defined as day-night average sound level (DNL) 65 (expressed in A-weighted decibels, or dBA). DNL is a noise metric developed by the U.S. Environmental Protection Agency and used in most FAA-sponsored noise analyses. To help enforce its restrictions on noncompatible development around the Airport, the City has developed a boundary—referred to as the X-Overlay—that identifies where restrictions apply. The X-Overlay is based on the DNL 65 noise contour from a noise analysis completed for the Airport in 1990.

C.2 APPROACH

The noise analysis consisted of three primary elements: (1) use of the FAA's Integrated Noise Model (INM) to determine noise exposure, (2) definition of scenarios representing various levels of aviation demand, facilities, and procedures expected to be in use at the Airport at PAL 5, and (3) development of INM inputs based on those defined scenarios. In addition to the DNL contours, contours for two supplemental metrics, time-above (TA) and number of-events-above (NA), were produced for this analysis.

C.2.1 Integrated Noise Model

The noise analysis was completed using INM Version 7.0a. The model, developed by the FAA in the 1970s and updated and refined numerous times, contains sets of algorithms describing sound propagation and attenuation over distance traveled. The INM includes an extensive database of noise-thrust-distance relationships for most civil and many military aircraft operating in the United States. These relationships provide the best correlation between predictable aircraft operating characteristics and noise generation.

Noise exposure is typically shown as areas in which aircraft noise equals or exceeds defined levels; the boundaries of these defined levels are referred to as contours. The

INM is used to produce DNL noise contours centered around the Airport's runways. DNL is designed to represent the cumulative noise level in an area for a 24-hour period during any given year. The INM computes DNLs by summing the noise produced by all aircraft events during a 24-hour period, adding an extra 10 decibel weighting penalty to reflect the significance of nighttime noise—from aircraft operations between 10:00 p.m. and 7:00 a.m.

C.2.2 Noise Analysis Scenarios

In the calculation of DNL in the INM, a considerable number of variables are taken into account. Variables having the greatest effect on noise exposure are numbers of annual aircraft operations, the aircraft fleet mix serving the Airport, airfield geometry, time of operation, and expected flight paths. To estimate noise exposure for different combinations of activity (annual operations/time of operation), facilities (airfield geometry), and procedures (flight paths) at Portland International Airport, four scenarios were defined.

The highest level of annual aircraft operations identified in *Technical Memorandum 2: Aviation Demand Forecasts* is forecast to occur at PAL 5. Therefore, the four future scenarios were all developed for PAL 5 at two levels of forecast demand: the 50th and 90th percentiles. The forecasts also include future flight schedules used to determine time of operation.

Scenario 1 represents future Airport conditions at PAL 5, assuming the 50th percentile forecast level of activity. Scenario 2 represents future Airport conditions at PAL 5, at the 90th percentile forecast level of activity. Scenario 3 represents the same activity assumptions as Scenario 2, but incorporates modified jet aircraft departure flight paths, reflecting dual-stream operations.

Currently, the flight paths of jets departing from the Airport merge over the Columbia River, focusing noise exposure over the water. Changing to a dual-stream mode of operation, where jets would not converge into a single stream over the river, is a capacity-enhancing measure expected to be implemented if demand at the 90th percentile occurs at PAL 5.

Scenario 4 represents another capacity-enhancing measure likely to be implemented as a result of demand reaching the 90th percentile at PAL 5—the addition of a third parallel runway south of existing Runway 10R–28L. Additional information pertaining to each scenario is presented in Table C-1.

Table C-1

NOISE EXPOSURE ANALYSIS SCENARIOS
Portland International Airport

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Annual aircraft operations	377,820	567,140	567,140	567,140
Annual average day operations *(a)*	1,035	1,553	1,553	1,553
Departure restrictions	Yes	Yes	No	No
Runway configuration	Existing	Existing	Existing	Addition of third parallel runway

(a) Numbers may vary slightly from the forecasts because of rounding.

Source: Jacobs Consultancy, *Technical Memorandum 2: Aviation Demand Forecasts*, September 2008.

C.2.3 Integrated Noise Model Inputs

The variables for this noise analysis were derived from the INM databases for the future 2017 Noise Exposure Map (NEM) developed as part of the ongoing Federal Aviation Regulations (FAR) Part 150 Noise Exposure Map Update for the Airport. As identified earlier, the number of annual aircraft operations, aircraft fleet mix, time of operation, airfield geometry, and expected flight paths (flight tracks) have the greatest effect on the size and shape of the areas affected by aircraft noise. INM inputs for these variables are presented in Tables C-2 through C-7. Tables C-2 and C-4 present the fleet mix, time of operation, stage length, and number of annual average day (AAD) aircraft operations for each scenario. The AAD is calculated by dividing the total number of annual operations by the number of days in the year. Scenarios 2, 3, and 4 are based on the same forecast level of demand and future flight schedules and, therefore, have identical inputs with regard to those variables.

Tables C-3, C-5, C-6, and C-7 depict aggregate runway use percentages for each scenario, by aircraft category. At the Airport, runways are assigned by FAA Airport traffic control tower (ATCT) staff primarily based on minimizing taxiing distance from aircraft gates and parking positions. In consulting with ATCT staff, it was determined that, as the number of annual operations increases, runway assignments would tend toward equal use of the two parallel runways, rather than heavier use of one over the over because of taxiing distances. Assumed runway use percentages for the airfield configuration with three parallel runways were also developed using ATCT staff guidance.

Aircraft flight tracks for Scenarios 1 and 2 were derived from the 2017 NEM. The flight tracks in the 2017 NEM are generalized, created using radar data archived by Airport staff. In Scenario 3, jet aircraft departure restrictions are eliminated, and in Scenario 4, a third parallel runway is added; therefore, new flight tracks were developed for those scenarios. These flight tracks were developed using guidance provided by ATCT staff, as depicted on Figures C-1 and C-2, respectively. Generalized INM flight tracks derived from the 2017 NEM are located within the INM databases developed for this analysis, and are available upon request from Airport Noise Office staff.

C.2.4 Supplemental Metrics

In addition to DNL contours, TA and NA contours were also produced. The TA metric identifies the cumulative amount of time above a selected threshold of noise exposure, thereby describing the duration of noise exposure. For this analysis, 65 dBA—the threshold for "significant" noise as defined by the National Environmental Policy Act of 1969 (NEPA)—was used as the threshold.

The NA metric identifies the cumulative number of events above a selected threshold of noise exposure—in this case, 65 dBA. For this analysis, the NA metric represents the number of aircraft overflights during an annual average day whose maximum sound level exceeds 65 dBA over predetermined points on the ground. This metric describes the frequency of the noise exposure.

TA contours are produced by the INM. The NA contours presented in this appendix were created by software other than the INM using tabular output for each scenario calculated by the INM. As all metrics for this analysis were calculated in the INM, the inputs remain constant for each metric (DNL, TA, and NA).

Table C-2

AVERAGE DAILY AIRCRAFT OPERATIONS BY TYPE, TIME OF DAY, AND STAGE LENGTH – SCENARIO 1
Noise Exposure Analysis
Portland International Airport

					Departures																
			Arrivals		Stage 1 (0 - 500 nm)		Stage 2 (501 - 1,000 nm)		Stage 3 (1,001 - 1,500 nm)		Stage 4 (1,501 - 2,500 nm)		Stage 5 (2,501 - 3,500 nm)		Stage 6 (3,501 - 4,500 nm)		Stage 7 (4,501 - 5,500 nm)		Total operations		
Group	INM type	Aircraft type	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Total
Heavy jet	747400	Boeing 747-400	--	1.00	--	--	--	--	--	--	--	--	--	--	--	--	--	1.42	--	2.42	2.42
Heavy jet	757300	Boeing 757-200	0.89	--	0.89	--	--	--	--	--	--	--	--	--	--	--	--	--	1.78	--	1.78
Heavy jet	757PW	Boeing 757-200/PW2037	4.48	0.68	--	--	--	--	2.05	0.68	1.75	0.68	--	--	--	--	--	--	8.28	2.05	10.33
Heavy jet	757RR	Boeing 757-200/RB211-535E4	2.20	0.23	--	--	--	--	0.68	0.23	1.29	0.23	--	--	--	--	--	--	4.18	0.68	4.86
Heavy jet	767300	Boeing 767-300	--	0.71	--	--	--	--	--	--	0.71	--	--	--	--	--	--	--	0.71	0.71	1.42
Heavy jet	767CF6	Boeing 767-200	2.48	2.68	--	1.66	--	--	--	3.31	0.20	--	--	--	--	--	--	--	2.68	7.65	10.33
Heavy jet	777200	Boeing 777-200ER/GE90-90B	2.31	0.09	0.18	--	0.18	--	0.18	--	0.09	--	0.09	--	1.69	--	--	--	4.71	0.09	4.80
Heavy jet	A300-622R	Airbus 300F4-600	0.85	1.28	--	2.13	--	--	--	--	--	--	--	--	--	--	--	--	0.85	3.41	4.26
Heavy jet	A330-301	Airbus 330-200	3.38	--	--	--	--	--	--	--	--	--	--	--	3.38	--	--	--	6.76	--	6.76
Heavy jet	A330-343	Airbus 330-343/RR TRENT 772B	1.69	--	--	--	--	--	--	--	--	--	--	--	0.84	--	0.84	--	3.38	--	3.38
Heavy jet	A340-211	Airbus 340-300	1.21	--	0.36	--	--	--	--	--	--	--	--	--	--	--	0.84	--	2.41	--	2.41
Heavy jet	DC1030	McDonnell Douglas DC-10	4.97	0.71	1.42	--	1.42	--	1.42	--	0.71	--	0.71	--	--	--	--	--	10.65	0.71	11.36
Heavy jet	MD11GE	MD-11/CF6-80C2D1F	0.35	0.35	--	0.24	--	--	--	0.47	--	--	--	--	--	--	--	--	0.35	1.06	1.42
Helicopter	A109	AgustaWestland AW109	0.90	--	0.90	--	--	--	--	--	--	--	--	--	--	--	--	--	1.80	--	1.80
Helicopter	S70	Sikorsky S-70 Blackhawk (UH-60A)	0.11	--	0.11	--	--	--	--	--	--	--	--	--	--	--	--	--	0.21	--	0.21
Jet	7373B2	Boeing 737-300	0.91	--	0.46	--	--	--	--	0.46	--	--	--	--	--	--	--	--	1.37	0.46	1.82
Jet	737400	Boeing 737-400/CFM56-3C-1	0.91	--	0.46	--	--	--	--	0.46	--	--	--	--	--	--	--	--	1.37	0.46	1.82
Jet	737700	Boeing 737-700	79.32	15.49	41.00	6.38	33.71	2.73	4.56	--	4.56	1.82	--	--	--	--	--	--	163.15	26.43	189.57
Jet	737800	Boeing 737-800/CFM56-7B26	55.67	11.59	5.47	0.53	20.05	3.87	7.29	0.91	19.13	9.98	--	--	--	--	--	--	107.61	26.88	134.49
Jet	A319-131	Airbus 318	6.38	3.64	0.91	--	3.64	1.82	--	--	1.82	1.82	--	--	--	--	--	--	12.76	7.29	20.05
Jet	A320-211	Airbus 320	19.66	4.43	1.97	--	5.90	1.48	1.48	0.49	9.80	2.95	--	--	--	--	--	--	38.81	9.35	48.16
Jet	A320-232	Airbus 320-232/V2527-A5	14.99	3.77	1.68	--	5.03	1.26	1.26	0.42	6.60	2.52	--	--	--	--	--	--	29.55	7.96	37.51
Jet	CIT3	Cessna Citation III	2.04	0.05	1.96	0.13	--	--	--	--	--	--	--	--	--	--	--	--	4.00	0.18	4.18
Jet	CL600	Dassault Falcon 2000	1.28	0.03	1.24	0.07	--	--	--	--	--	--	--	--	--	--	--	--	2.52	0.09	2.61
Jet	CL601	Bombardier Challenger 300	2.01	0.02	1.98	0.05	--	--	--	--	--	--	--	--	--	--	--	--	4.00	0.07	4.07
Jet	CNA55B	Cessna Citation CJ3	14.53	0.33	14.05	0.80	--	--	--	--	--	--	--	--	--	--	--	--	28.58	1.13	29.71
Jet	CNA750	Cessna Citation X	1.19	0.03	1.14	0.07	--	--	--	--	--	--	--	--	--	--	--	--	2.33	0.11	2.44
Jet	FAL20	Dassault Falcon 20 (twin-jet)	1.08	--	1.08	--	--	--	--	--	--	--	--	--	--	--	--	--	2.16	--	2.16
Jet	GIIB	IAI Gulfstream 200	1.34	--	1.34	--	--	--	--	--	--	--	--	--	--	--	--	--	2.67	--	2.67
Jet	GIV	Dassault Falcon 900	1.86	0.03	1.81	0.07	--	--	--	--	--	--	--	--	--	--	--	--	3.67	0.11	3.78
Jet	GV	Canadair Regional Jet 200	60.57	1.98	58.72	3.79	--	--	--	--	--	--	--	--	--	--	--	--	119.28	5.77	125.05
Jet	IA1125	IAI Gulfstream 100	2.56	0.05	2.48	0.13	--	--	--	--	--	--	--	--	--	--	--	--	5.03	0.18	5.21
Jet	LEAR25	Learjet 25 (twin-jet)	1.19	0.03	1.14	0.07	--	--	--	--	--	--	--	--	--	--	--	--	2.33	0.11	2.44
Jet	LEAR35	Dassault Falcon 10 (twin-jet)	5.83	0.11	5.66	0.28	--	--	--	--	--	--	--	--	--	--	--	--	11.48	0.40	11.88

Table C-2 *(page 2 of 2)*
AVERAGE DAILY AIRCRAFT OPERATIONS BY TYPE, TIME OF DAY, AND STAGE LENGTH – SCENARIO 1
Noise Exposure Analysis
Portland International Airport

					Departures															
			Arrivals		Stage 1 (0 - 500 nm)		Stage 2 (501 - 1,000 nm)		Stage 3 (1,001 - 1,500 nm)		Stage 4 (1,501 - 2,500 nm)		Stage 5 (2,501 - 3,500 nm)		Stage 6 (3,501 - 4,500 nm)		Stage 7 (4,501 - 5,500 nm)		Total operations		
Group	INM type	Aircraft type	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Total
Military jet	C140	Lockheed JetStar	0.11	--	0.11	--	--	--	--	--	--	--	--	--	--	--	--	--	0.23	--	0.23
Military jet	C17	Globemaster III	0.34	--	0.34	--	--	--	--	--	--	--	--	--	--	--	--	--	0.68	--	0.68
Military jet	EA6B	Northrop Grumman EA-6B Prowler	0.36	--	0.36	--	--	--	--	--	--	--	--	--	--	--	--	--	0.72	--	0.72
Military jet	F15E20	F-15 Eagle	1.44	--	1.44	--	--	--	--	--	--	--	--	--	--	--	--	--	2.88	--	2.88
Military jet	F16PW9	F-16 Fighting Falcon	1.08	--	1.08	--	--	--	--	--	--	--	--	--	--	--	--	--	2.16	--	2.16
Military jet	F-18	McDonnell Douglas Hornet	1.44	--	1.44	--	--	--	--	--	--	--	--	--	--	--	--	--	2.88	--	2.88
Military prop	C-130E	Lockheed Hercules	0.45	--	0.45	--	--	--	--	--	--	--	--	--	--	--	--	--	0.91	--	0.91
Military prop	T34	T-34 Mentor (Single Prop Military Trainer)	0.36	--	0.36	--	--	--	--	--	--	--	--	--	--	--	--	--	0.72	--	0.72
Prop	BEC58P	Baron 58P	3.09	1.84	3.50	1.44	--	--	--	--	--	--	--	--	--	--	--	--	6.59	3.28	9.87
Prop	GASEPV	Grumman Tr2 (piston-single)	19.32	7.39	22.15	4.58	--	--	--	--	--	--	--	--	--	--	--	--	41.46	11.97	53.43
Small	CNA172	Cessna 120 (tail-wheel)	0.93	0.06	0.93	0.06	--	--	--	--	--	--	--	--	--	--	--	--	1.87	0.13	1.99
Small	CNA206	Cessna P210 (turbine) (single-turboprop)	1.29	0.14	1.29	0.14	--	--	--	--	--	--	--	--	--	--	--	--	2.58	0.29	2.86
Small	PA31	PA-31-350	12.68	4.06	12.67	4.06	--	--	--	--	--	--	--	--	--	--	--	--	25.35	8.12	33.47
Turboprop	1900D	Beech 1900D	0.99	0.43	0.24	--	0.99	--	--	--	--	--	--	--	--	--	--	--	2.22	0.43	2.65
Turboprop	CNA441	Rockwell Turbo Commander 680	5.77	0.39	6.06	0.10	--	--	--	--	--	--	--	--	--	--	--	--	11.83	0.49	12.32
Turboprop	DHC6	Piper Aerostar (twin-piston)	16.01	3.60	15.60	4.02	--	--	--	--	--	--	--	--	--	--	--	--	31.62	7.62	39.23
Turboprop	DHC8	Aerotécnica AC-14	1.42	--	1.42	--	--	--	--	--	--	--	--	--	--	--	--	--	2.84	--	2.84
Turboprop	DHC830	De Havilland Canada Dash 8-300	69.97	4.93	70.97	3.94	--	--	--	--	--	--	--	--	--	--	--	--	140.94	8.87	149.81
Turboprop	EMB120	Embraer 120 Brasilia	7.88	0.99	8.87	--	--	--	--	--	--	--	--	--	--	--	--	--	16.76	0.99	17.74
		Total	444.09	73.15	297.68	34.75	70.93	11.16	18.91	7.43	46.66	20.00	0.80	--	5.91	--	1.69	1.42	886.67	147.92	1,034.59

nm = nautical miles

Note: Columns and rows may not add to totals shown because of rounding.

Source: Jacobs Consultancy, INM input files, October 2009 based on the Airport's aviation demand forecasts approved by the FAA in 2008.

Table C-3

RUNWAY USE BY AIRCRAFT GROUP – SCENARIO 1
Noise Exposure Analysis
Portland International Airport

	Runway end						
Aircraft group	03	10L	10R	21	28L	28R	Total
Heavy jet	--%	26.5	25.9	--	23.4	24.2	100.0%
Jet	--%	26.8	25.0	--	24.9	23.4	100.0%
Military jet	--%	--	51.1	--	44.8	4.1	100.0%
Military prop	--%	51.2	--	--	--	48.8	100.0%
Prop	5.7%	18.9	27.5	1.9	4.6	41.2	100.0%
Small	5.8%	11.6	34.8	3.3	13.9	30.7	100.0%
Turboprop	0.5%	25.1	25.9	1.2	25.2	22.2	100.0%
Total use	0.7%	25.2	26.0	0.5	23.3	24.4	100.0%
Helicopter	16.9%	18.3	13.6	2.8	21.3	27.2	100.0%

Note: Rows may not add to totals shown because of rounding.

Source: Jacobs Consultancy, INM input files, October 2009, based on the analysis of data from the Port's Airport Noise and Operations Management System and discussion with Airport Control Tower staff.

Table C-4

AVERAGE DAILY AIRCRAFT OPERATIONS BY TYPE, TIME OF DAY, AND STAGE LENGTH – SCENARIO 2, 3, AND 4
Noise Exposure Analysis
Portland International Airport

					Departures															
			Arrivals		Stage 1 (0 - 500 nm)		Stage 2 (501 - 1,000 nm)		Stage 3 (1,001 - 1,500 nm)		Stage 4 (1,501 - 2,500 nm)		Stage 5 (2,501 - 3,500 nm)		Stage 6 (3,501 - 4,500 nm)		Stage 7 (4,501 - 5,500 nm)		Total operations		
Group	INM type	Aircraft type	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Total
Heavy jet	747400	Boeing 747-400	--	1.00	--	--	--	--	--	--	--	--	--	--	--	--	--	0.93	--	1.93	1.93
Heavy jet	757300	Boeing 757-200	1.07	--	1.07	--	--	--	--	--	--	--	--	--	--	--	--	--	2.14	--	2.14
Heavy jet	757PW	Boeing 757-200/PW2037	6.74	1.08	--	--	--	--	3.24	1.08	2.42	1.08	--	--	--	--	--	--	12.40	3.24	15.64
Heavy jet	757RR	Boeing 757-200/RB211-535E4	3.14	0.36	--	--	--	--	1.08	0.36	1.70	0.36	--	--	--	--	--	--	5.92	1.08	7.00
Heavy jet	767300	Boeing 767-300	--	1.12	--	--	--	--	--	--	1.12	--	--	--	--	--	--	--	1.12	1.12	2.25
Heavy jet	767CF6	Boeing 767-200	3.13	3.44	--	2.08	--	--	--	4.17	0.32	--	--	--	--	--	--	--	3.44	9.69	13.14
Heavy jet	777200	Boeing 777-200ER/GE90-90B	3.38	0.11	0.22	--	0.22	--	0.22	--	0.11	--	0.11	--	2.60	--	--	--	6.88	0.11	6.99
Heavy jet	A300-622R	Airbus 300F4-600	1.07	1.61	--	2.68	--	--	--	--	--	--	--	--	--	--	--	--	1.07	4.29	5.36
Heavy jet	A330-301	Airbus 330-200	5.21	--	--	--	--	--	--	--	--	--	--	--	5.20	--	--	--	10.41	--	10.41
Heavy jet	A330-343	Airbus 330-343/RR TRENT 772B	2.60	--	--	--	--	--	--	--	--	--	--	--	1.30	--	1.30	--	5.20	--	5.20
Heavy jet	A340-211	Airbus 340-300	1.66	--	0.36	--	--	--	--	--	--	--	--	--	--	--	1.30	--	3.32	--	3.32
Heavy jet	DC1030	McDonnell Douglas DC-10	6.25	0.89	1.79	--	1.79	--	1.79	--	0.89	--	0.89	--	--	--	--	--	13.40	0.89	14.29
Heavy jet	MD11GE	MD-11/CF6-80C2D1F	0.45	0.45	--	0.30	--	--	--	0.60	--	--	--	--	--	--	--	--	0.45	1.34	1.79
Helicopter	A109	AgustaWestland AW109	1.08	--	1.08	--	--	--	--	--	--	--	--	--	--	--	--	--	2.16	--	2.16
Helicopter	S70	Sikorsky S-70 Blackhawk (UH-60A)	0.11	--	0.11	--	--	--	--	--	--	--	--	--	--	--	--	--	0.21	--	0.21
Jet	7373B2	Boeing 737-300	1.44	--	0.72	--	--	--	--	0.72	--	--	--	--	--	--	--	--	2.16	0.72	2.88
Jet	737400	Boeing 737-400/CFM56-3C-1	1.44	--	0.72	--	--	--	--	0.72	--	--	--	--	--	--	--	--	2.16	0.72	2.88
Jet	737700	Boeing 737-700	125.28	24.49	64.79	10.09	53.27	4.32	7.20	--	7.20	2.88	--	--	--	--	--	--	257.74	41.78	299.52
Jet	737800	Boeing 737-800/CFM56-7B26	87.94	18.22	8.64	0.84	31.67	6.12	11.52	1.44	30.24	15.67	--	--	--	--	--	--	170.00	42.30	212.30
Jet	A319-131	Airbus 318	10.08	5.76	1.44	--	5.76	2.88	--	--	2.88	2.88	--	--	--	--	--	--	20.16	11.53	31.68
Jet	A320-211	Airbus 320	31.05	7.00	3.11	--	9.33	2.33	2.33	0.78	15.49	4.67	--	--	--	--	--	--	61.31	14.78	76.09
Jet	A320-232	Airbus 320-232/V2527-A5	23.67	5.96	2.65	--	7.95	1.99	1.99	0.66	10.42	3.98	--	--	--	--	--	--	46.68	12.59	59.27
Jet	CIT3	Cessna Citation III	2.78	0.07	2.68	0.18	--	--	--	--	--	--	--	--	--	--	--	--	5.47	0.25	5.72
Jet	CL600	Dassault Falcon 2000	1.53	0.03	1.49	0.08	--	--	--	--	--	--	--	--	--	--	--	--	3.02	0.11	3.13
Jet	CL601	Bombardier Challenger 300	2.64	0.03	2.60	0.08	--	--	--	--	--	--	--	--	--	--	--	--	5.24	0.11	5.35
Jet	CNA55B	Cessna Citation CJ3	18.90	0.44	18.27	1.07	--	--	--	--	--	--	--	--	--	--	--	--	37.16	1.51	38.67
Jet	CNA750	Cessna Citation X	1.65	0.04	1.59	0.11	--	--	--	--	--	--	--	--	--	--	--	--	3.24	0.15	3.39
Jet	FAL20	Dassault Falcon 20 (twin-jet)	1.08	--	1.08	--	--	--	--	--	--	--	--	--	--	--	--	--	2.16	--	2.16
Jet	GIIB	IAI Gulfstream 200	1.60	--	1.60	--	--	--	--	--	--	--	--	--	--	--	--	--	3.21	--	3.21
Jet	GIV	Dassault Falcon 900	2.45	0.04	2.39	0.11	--	--	--	--	--	--	--	--	--	--	--	--	4.84	0.15	5.00
Jet	GV	Canadair Regional Jet 200	97.57	3.20	94.65	6.10	--	--	--	--	--	--	--	--	--	--	--	--	192.23	9.30	201.53
Jet	IA1125	IAI Gulfstream 100	3.06	0.06	2.97	0.16	--	--	--	--	--	--	--	--	--	--	--	--	6.04	0.22	6.25
Jet	LEAR25	Learjet 25 (twin-jet)	1.65	0.04	1.59	0.11	--	--	--	--	--	--	--	--	--	--	--	--	3.24	0.15	3.39
Jet	LEAR35	Dassault Falcon 10 (twin-jet)	7.18	0.15	6.97	0.36	--	--	--	--	--	--	--	--	--	--	--	--	14.15	0.51	14.66

Table C-4 *(page 2 of 2)*
AVERAGE DAILY AIRCRAFT OPERATIONS BY TYPE, TIME OF DAY, AND STAGE LENGTH – SCENARIO 2, 3, AND 4
Noise Exposure Analysis
Portland International Airport

					Departures															
			Arrivals		Stage 1 (0 - 500 nm)		Stage 2 (501 - 1,000 nm)		Stage 3 (1,001 - 1,500 nm)		Stage 4 (1,501 - 2,500 nm)		Stage 5 (2,501 - 3,500 nm)		Stage 6 (3,501 - 4,500 nm)		Stage 7 (4,501 - 5,500 nm)		Total operations		
Group	INM type	Aircraft type	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Total
Military jet	C140	Lockheed JetStar	0.11	--	0.11	--	--	--	--	--	--	--	--	--	--	--	--	--	0.23	--	0.23
Military jet	C17	Globemaster III	0.34	--	0.34	--	--	--	--	--	--	--	--	--	--	--	--	--	0.68	--	0.68
Military jet	EA6B	Northrop Grumman EA-6B Prowler	0.36	--	0.36	--	--	--	--	--	--	--	--	--	--	--	--	--	0.72	--	0.72
Military jet	F15E20	F-15 Eagle	1.44	--	1.44	--	--	--	--	--	--	--	--	--	--	--	--	--	2.88	--	2.88
Military jet	F16PW9	F-16 Fighting Falcon	1.08	--	1.08	--	--	--	--	--	--	--	--	--	--	--	--	--	2.16	--	2.16
Military jet	F-18	McDonnell Douglas Hornet	1.44	--	1.44	--	--	--	--	--	--	--	--	--	--	--	--	--	2.88	--	2.88
Military prop	C-130E	Lockheed Hercules	0.45	--	0.45	--	--	--	--	--	--	--	--	--	--	--	--	--	0.91	--	0.91
Military prop	T34	T-34 Mentor (Single Prop Military Trainer)	0.36	--	0.36	--	--	--	--	--	--	--	--	--	--	--	--	--	0.72	--	0.72
Prop	BEC58P	Baron 58P	4.02	2.34	4.55	1.81	--	--	--	--	--	--	--	--	--	--	--	--	8.58	4.15	12.72
Prop	GASEPV	Grumman Tr2 (piston-single)	25.13	9.39	28.79	5.76	--	--	--	--	--	--	--	--	--	--	--	--	53.91	15.15	69.06
Small	CNA172	Cessna 120 (tail-wheel)	1.05	0.08	1.05	0.08	--	--	--	--	--	--	--	--	--	--	--	--	2.09	0.15	2.25
Small	CNA206	Cessna P210 (turbine) (single-turboprop)	1.55	0.17	1.55	0.17	--	--	--	--	--	--	--	--	--	--	--	--	3.09	0.34	3.43
Small	PA31	PA-31-350	15.97	5.11	15.95	5.12	--	--	--	--	--	--	--	--	--	--	--	--	31.91	10.22	42.13
Turboprop	1900D	Beech 1900D	1.25	0.54	0.30	--	1.25	--	--	--	--	--	--	--	--	--	--	--	2.80	0.54	3.33
Turboprop	CNA441	Rockwell Turbo Commander 680	7.21	0.56	7.66	0.12	--	--	--	--	--	--	--	--	--	--	--	--	14.87	0.68	15.55
Turboprop	DHC6	Piper Aerostar (twin-piston)	20.03	4.55	19.55	5.05	--	--	--	--	--	--	--	--	--	--	--	--	39.58	9.60	49.18
Turboprop	DHC8	Aerotécnica AC-14	1.79	--	1.79	--	--	--	--	--	--	--	--	--	--	--	--	--	3.57	--	3.57
Turboprop	DHC830	De Havilland Canada Dash 8-300	113.31	7.99	115.00	6.39	--	--	--	--	--	--	--	--	--	--	--	--	228.30	14.37	242.68
Turboprop	EMB120	Embraer 120 Brasilia	12.77	1.60	14.37	--	--	--	--	--	--	--	--	--	--	--	--	--	27.14	1.60	28.74
		Total	668.56	107.93	440.70	48.81	111.24	17.65	29.36	10.53	72.79	31.52	1.00	--	9.11	--	2.60	0.93	1,335.37	217.37	1,552.74

nm = nautical miles

Note: Columns and rows may not add to totals shown because of rounding.

Source: Jacobs Consultancy, INM input files, October 2009 based on the Airport's aviation demand forecasts approved by the FAA in 2008.

Table C-5

RUNWAY USE BY AIRCRAFT GROUP – SCENARIO 2
Noise Exposure Analysis
Portland International Airport

Aircraft group	Runway end 03	10L	10R	21	28L	28R	Total
Heavy jet	--%	26.8	25.6	--	24.7	23.0	100.0%
Jet	--%	27.4	24.4	--	24.6	23.6	100.0%
Military jet	--%	--	51.1	--	44.8	4.1	100.0%
Military prop	--%	51.2	--	--	--	48.8	100.0%
Prop	5.8%	18.8	27.6	1.9	4.7	41.2	100.0%
Small	5.8%	11.6	34.8	3.3	13.8	30.7	100.0%
Turboprop	0.5%	25.2	25.8	1.2	24.2	23.1	100.0%
Total	0.6%	25.8	25.4	0.5	23.2	24.5	100.0%
Helicopter	16.9%	18.3	13.6	2.8	21.3	27.2	100.0%

Note: Rows may not add to totals shown because of rounding.

Source: Jacobs Consultancy, INM input files, October 2009, based on the analysis of data from the Port's Airport Noise and Operations Management System and discussion with Airport Control Tower staff.

Table C-6

RUNWAY USE BY AIRCRAFT GROUP – SCENARIO 3
Noise Exposure Analysis
Portland International Airport

Aircraft group	Runway end 03	10L	10R	21	28L	28R	Total
Heavy jet	--%	26.5	25.9	--	24.3	23.3	100.0%
Jet	--%	26.0	25.8	--	24.3	24.0	100.0%
Military jet	--%	--	51.1	--	44.8	4.1	100.0%
Military prop	--%	51.2	--	--	--	48.8	100.0%
Prop	5.8%	18.8	27.6	1.9	4.7	41.2	100.0%
Small	5.8%	11.6	34.8	3.3	13.8	30.7	100.0%
Turboprop	0.5%	24.7	26.3	1.2	23.7	23.6	100.0%
Total	0.6%	24.8	26.4	0.5	22.9	24.9	100.0%
Helicopter	16.9%	18.3	13.6	2.8	21.3	27.2	100.0%

Note: Rows may not add to totals shown because of rounding.

Source: Jacobs Consultancy, INM input files, October 2009, based on the analysis of data from the Port's Airport Noise and Operations Management System and discussion with Airport Control Tower staff.

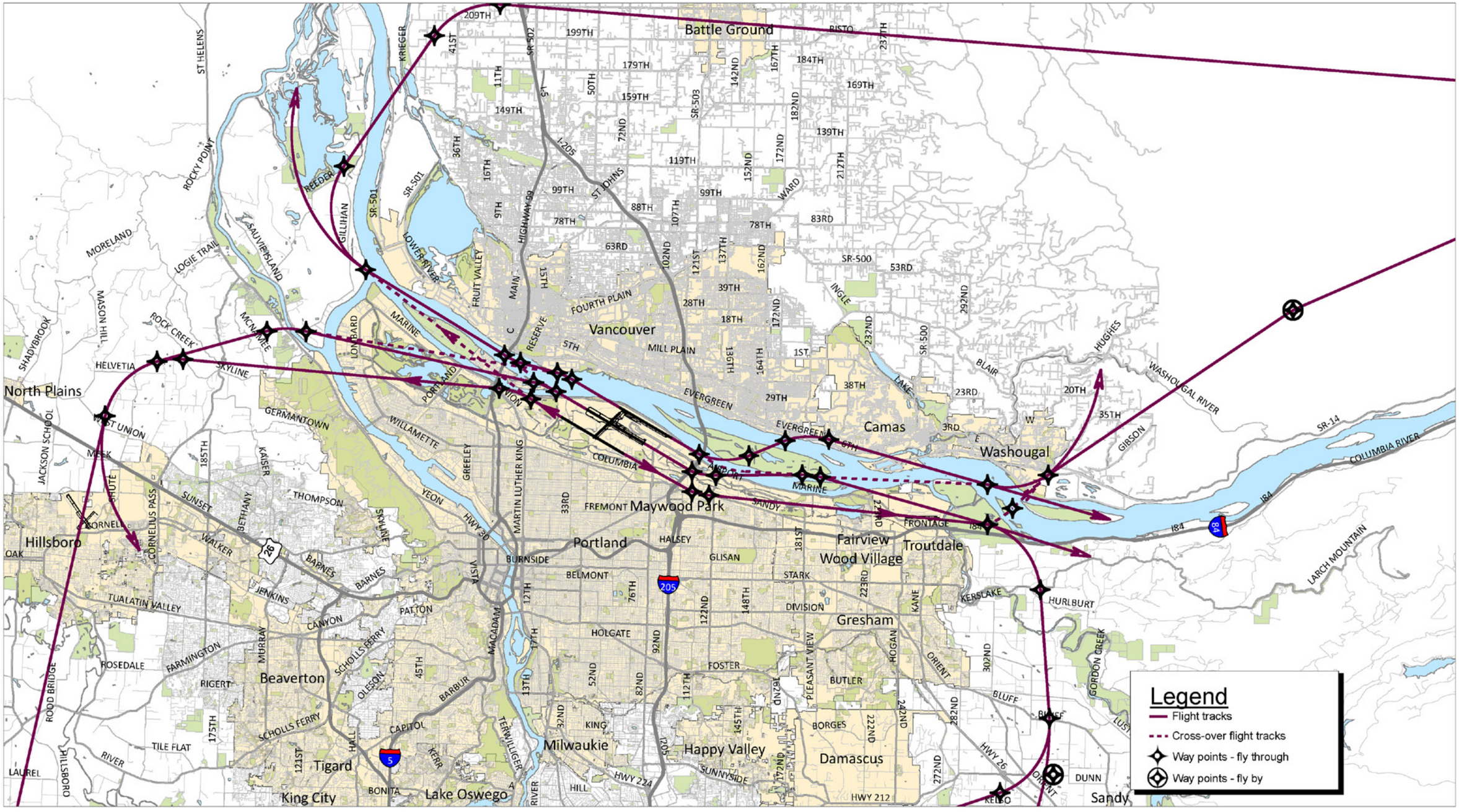
Table C-7

RUNWAY USE BY AIRCRAFT GROUP – SCENARIO 4
Noise Exposure Analysis
Portland International Airport

Aircraft group	Runway end 10L	10R	11	28L	28R	29	Total
Heavy jet	19.1%	19.5	11.6	19.3	19.6	10.9	100.0%
Jet	18.2%	19.8	12.9	18.8	18.1	12.1	100.0%
Military jet	--%	47.1	5.0	35.3	7.6	5.0	100.0%
Military prop	51.2%	--	--	--	43.8	5.0	100.0%
Prop	16.7%	30.1	3.9	5.2	40.2	3.9	100.0%
Small	13.0%	32.9	4.0	14.5	31.6	4.0	100.0%
Turboprop	19.7%	19.5	11.2	21.0	18.8	9.8	100.0%
Total	18.3%	20.8	11.7	18.6	19.9	10.8	100.0%
Helicopter	18.3%	13.6	16.9	21.3	27.2	2.8	100.0%

Note: Rows may not add to totals shown because of rounding.

Source: Jacobs Consultancy, INM input files, October 2009, based on the analysis of data from the Port's Airport Noise and Operations Management System and discussion with Airport Control Tower staff.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0 3 miles
Scale: 1" = 3 miles

Figure C-2

Future Triple-Stream Departure Flight Tracks

Master Plan Update
Portland International Airport

Sources: Jacobs Consultancy - Generalized Future INM Flight Tracks, June 2009; Port of Portland - Basemap, June 2009.

December 2009

AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0 3 miles
Scale: 1" = 3 miles

Figure C-1

Future Dual-Stream Departure Flight Tracks

Master Plan Update
Portland International Airport

Sources: Jacobs Consultancy - Generalized Future INM Flight Tracks, June 2009; Port of Portland - Basemap, June 2009.

December 2009

C.3 RESULTS

An overview of the output produced by the INM for each scenario modeled is provided in this section.

C.3.1 Day-Night Average Sound Level Contours

DNL 55, 60, and 65 noise exposure contours are presented for each scenario respectively on Figures C-3 through C-6. DNL contours vary in size and shape because of differences in the INM inputs. For example, a higher number of annual operations would produce larger contours. The fleet mix operating at the Airport also influences the size of the noise exposure contours—one large jet aircraft is louder than one small piston aircraft.

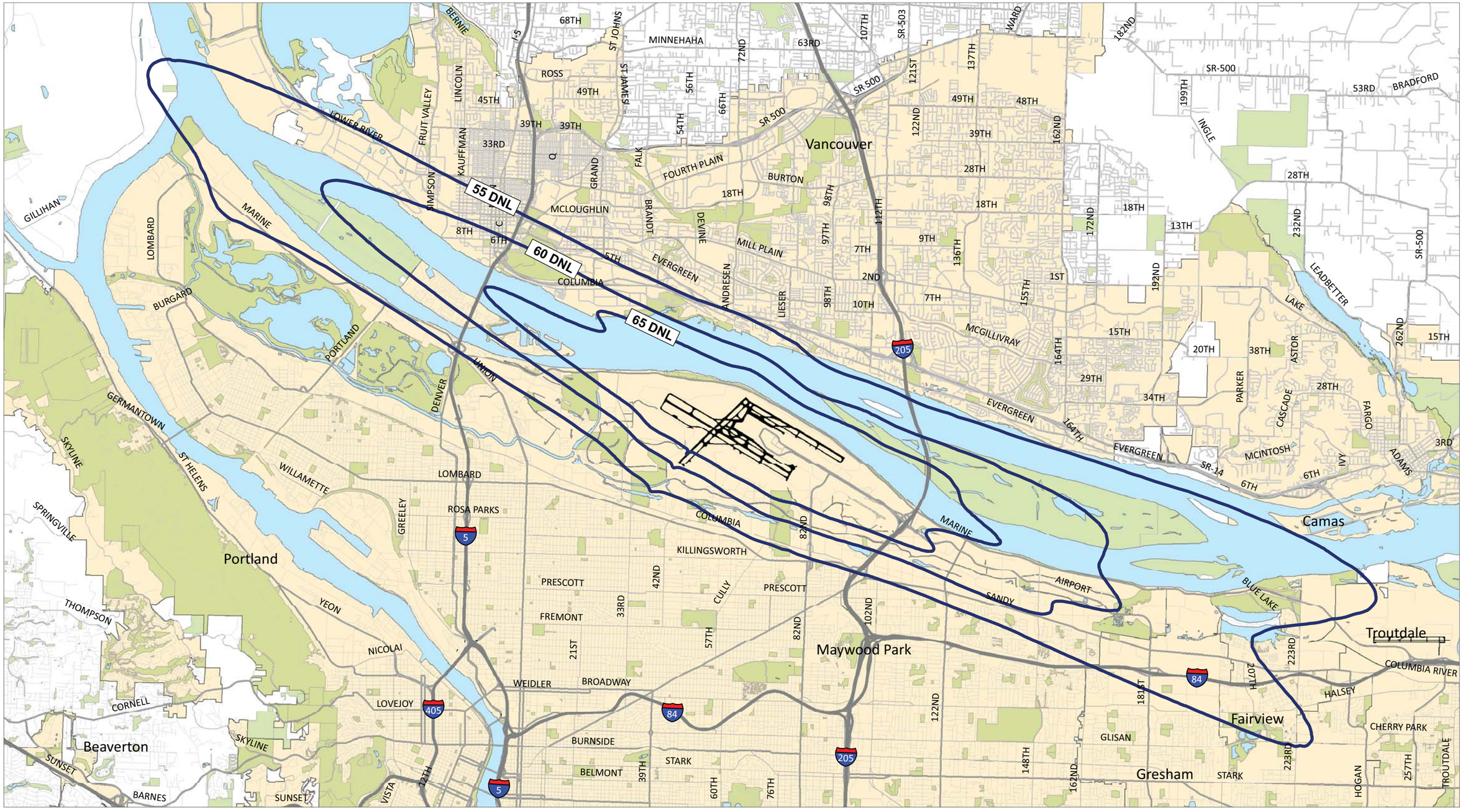
The shape of the DNL contour is influenced by the location of the noise. Two scenarios with similar fleet mixes and numbers of annual aircraft operations would result in similarly sized noise exposure contours. However, if those aircraft were assigned different runways and flight tracks, the shape of the contours would be different.

The contours produced for Scenario 2 are noticeably larger than the contours produced for Scenario 1. The aircraft fleet mix for both scenarios is constant, but Scenario 2 is based on about 200,000 more annual aircraft operations. The general shape of the contours remains the same inasmuch as the airfield geometry, flight tracks, and runway use percentages remain constant in both scenarios.*

While Scenarios 2, 3, and 4 are based on identical fleet mixes, numbers of annual aircraft operations, and day/night split, they are based on different flight tracks, runway use percentages, and—in the case of Scenario 4—a different runway configuration. As depicted on Figure C-1, the flight tracks for departing jet aircraft were modified under Scenario 3. The modification involves removal of existing departure restrictions that require departing jet aircraft to converge into a “single stream” over the river. The modified flight tracks represent a “dual-stream” departure scenario, changing the shape of the contours west and east of the Airport.

Scenario 4 differs from all other scenarios in that the airfield configuration includes a third parallel runway south of the existing parallel runways, and the removal of the crosswind runway. This scenario also results in a change in contour shape similar to that shown for Scenario 3 (resulting from modified departure procedures) as well as a change in contour shape south of the Airport caused by operations assigned to the additional runway and flight tracks.

*Small variances in the runway use percentages for Scenarios 1 and 2 are the result of annualization, the difference in forecast schedules, and a slight change in the distribution of operations on the two parallel runways.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

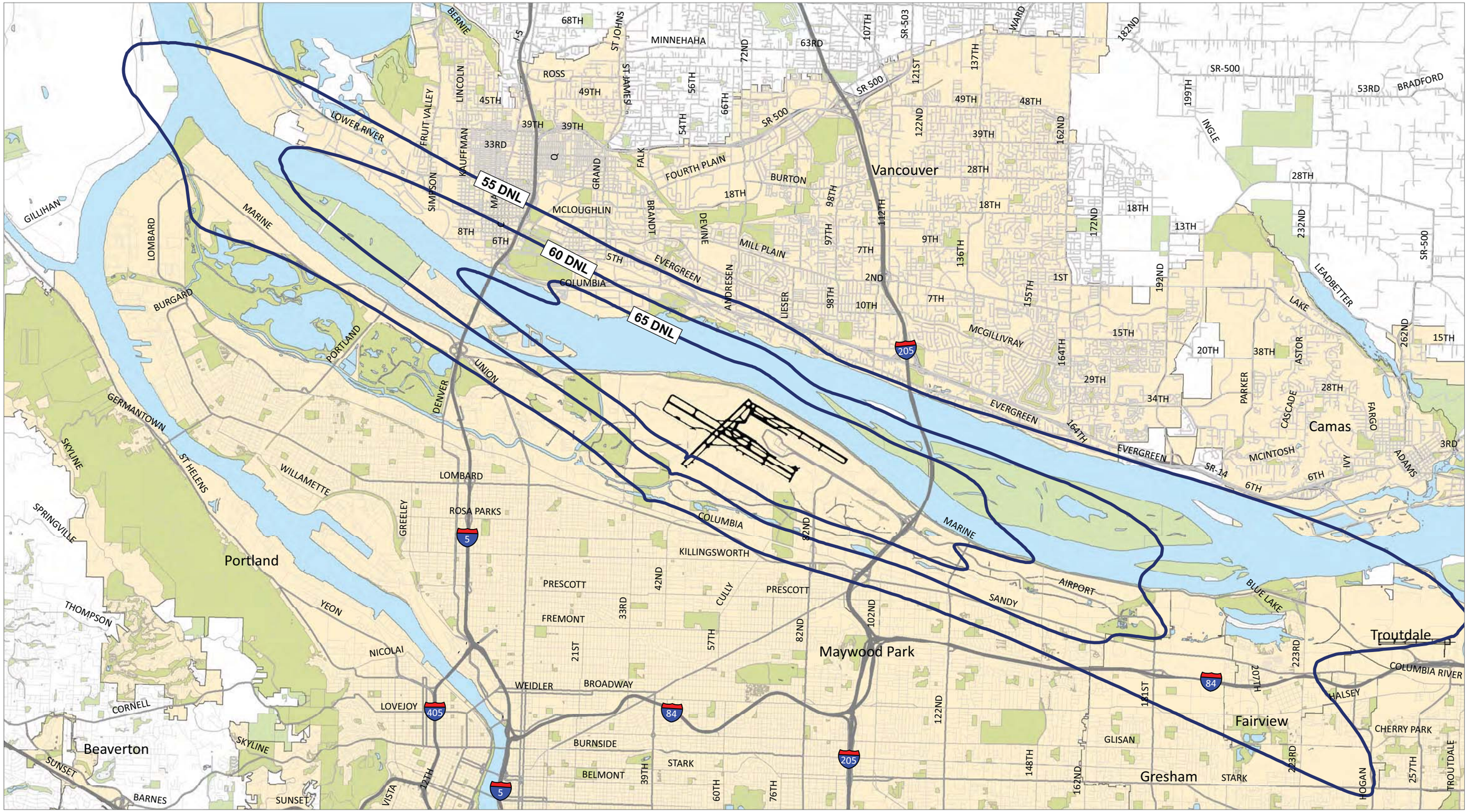
Figure C-3

Noise Exposure Contours - Scenario 1

Master Plan Update
Portland International Airport

Sources: Jacobs Consultancy - Noise Exposure Contours, June 2009; Port of Portland - Basemap, June 2009.

December 2009



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 7000'
Scale: 1" = 7000'

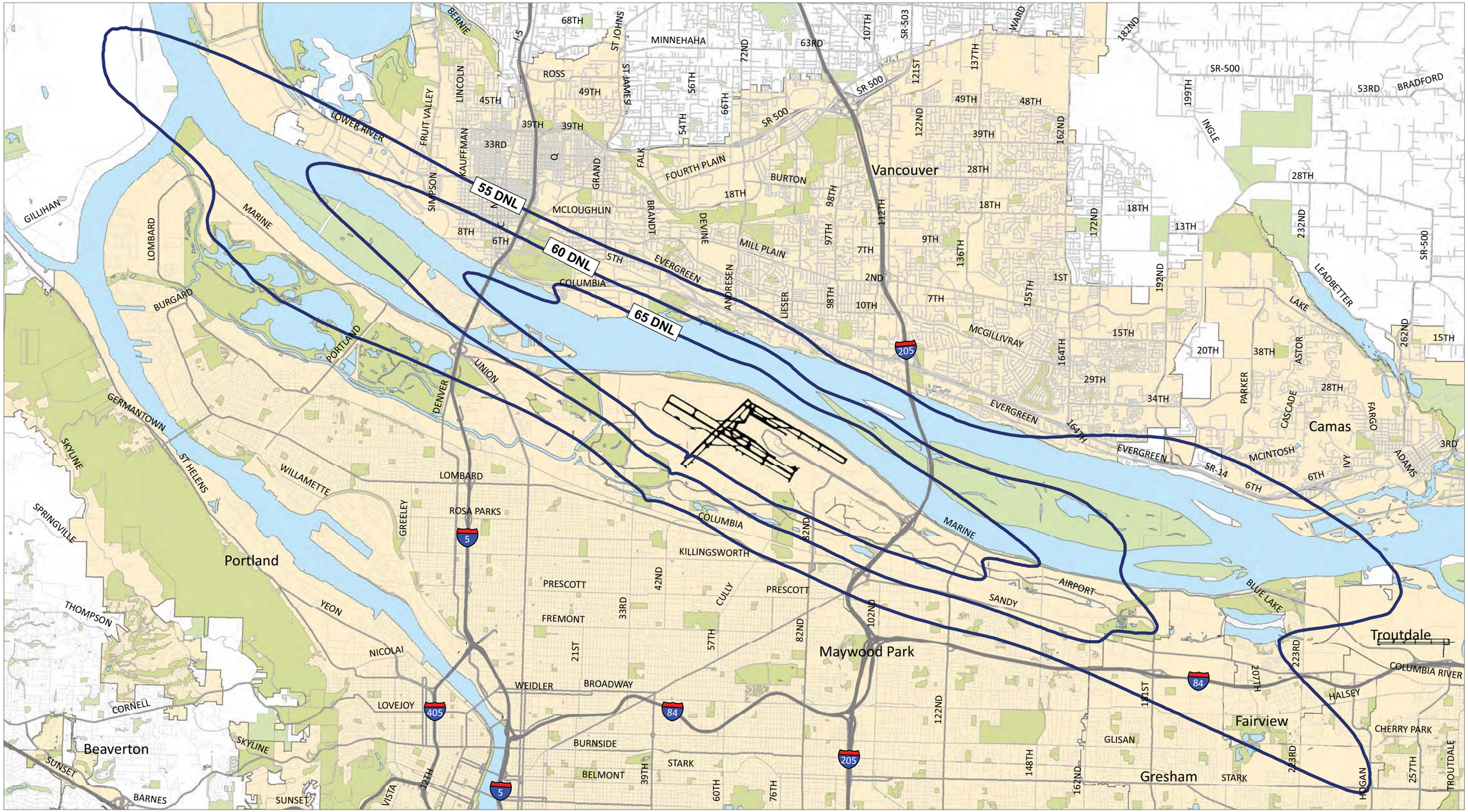
Figure C-4

Noise Exposure Contours - Scenario 2

Master Plan Update
Portland International Airport

Sources: Jacobs Consultancy - Noise Exposure Contours, June 2009; Port of Portland - Basemap, June 2009.

December 2009



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

Figure C-5

Noise Exposure Contours - Scenario 3

Master Plan Update
Portland International Airport

Sources: Jacobs Consultancy - Noise Exposure Contours, June 2009; Port of Portland - Basemap, June 2009.

December 2009

55 DNL

60 DNL

65 DNL

Vancouver

Portland

Camas

Maywood Park

Troutdale

Fairview

Gresham

Beaverton

AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 7000'
Scale: 1" = 7000'

Figure C-6

Noise Exposure Contours - Scenario 4

Master Plan Update
Portland International Airport

Sources: Jacobs Consultancy - Noise Exposure Contours, June 2009; Port of Portland - Basemap, June 2009.

December 2009

C.3.2 Supplemental Metrics

In addition to DNL noise exposure contours, contours for two supplemental metrics were produced. TA contours, presenting the duration of noise above 65 dBA, and NA contours, presenting the frequency of events producing noise above 65 dBA, are depicted for each scenario on Figures C-9 through C-15.

The variation in the size and shape of the TA and NA contours generally corresponds with the variation in the size and shape of the DNL contours. Changes in flight tracks and airfield geometry resulted in changes in the TA and NA contours similar to those observed in the DNL contours.

C.4 SUMMARY AND CONCLUSIONS

The key findings from the noise exposure analysis for the Airport are:

- Increasing numbers of annual aircraft operations would result in larger DNL noise exposure contours.
- Removing jet aircraft departure restrictions would change the location of noise exposure, and thus the shape of the DNL contours.
- Adding a third parallel runway would change the location of noise exposure, and thus the shape of the DNL contours.
- Scenario 3 and Scenario 4 would result in DNL noise exposure contours that encompass the largest land area.
- The X-Overlay encompasses the majority of the DNL 65 contours for Scenarios 3 and 4.

Figures C-7 and C-8, respectively, present comparisons of Scenarios 3 and 4 with the X-Overlay. The DNL 65 contour for Scenario 3 encompasses about 6,300 acres. Approximately 1,000 acres within the DNL 65 contour for Scenario 3 are not encompassed by the X-Overlay. The majority of this area, approximately 900 acres, consists of the Columbia River. The remaining area is located southeast of Airport property.

The DNL 65 contour for Scenario 4 encompasses about 7,000 acres. Approximately 1,200 acres within the DNL 65 contour for Scenario 4 are not encompassed by the X-Overlay. About half of this area, approximately 600 acres, consists of the Columbia River. The remaining 600 acres are located south of Airport property.

City of Portland X-Overlay 65 dBA

Noise Exposure Contour above 65 dBA

Vancouver

Portland

Beaverton

Gresham

Troutdale

Fairview

Maywood Park

Camas

AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 7000'
Scale: 1" = 7000'

Figure C-7

Comparison of Noise Exposure Contours: Scenario 3 and X-Overlay

Master Plan Update
Portland International Airport

December 2009

Sources: Jacobs Consultancy - Noise Exposure Contours, June 2009; City of Portland - X-Overlay, June 2009; Port of Portland - Basemap, June 2009.

City of Portland X-Overlay 65 dBA

Noise Exposure Contour above 65 dBA

AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 7000'
Scale: 1" = 7000'

Figure C-8

Comparison of Noise Exposure Contours: Scenario 4 and X-Overlay

Master Plan Update
Portland International Airport

Sources: Jacobs Consultancy - Noise Exposure Contours, June 2009; City of Portland - X-Overlay, June 2009; Port of Portland - Basemap, June 2009.

December 2009

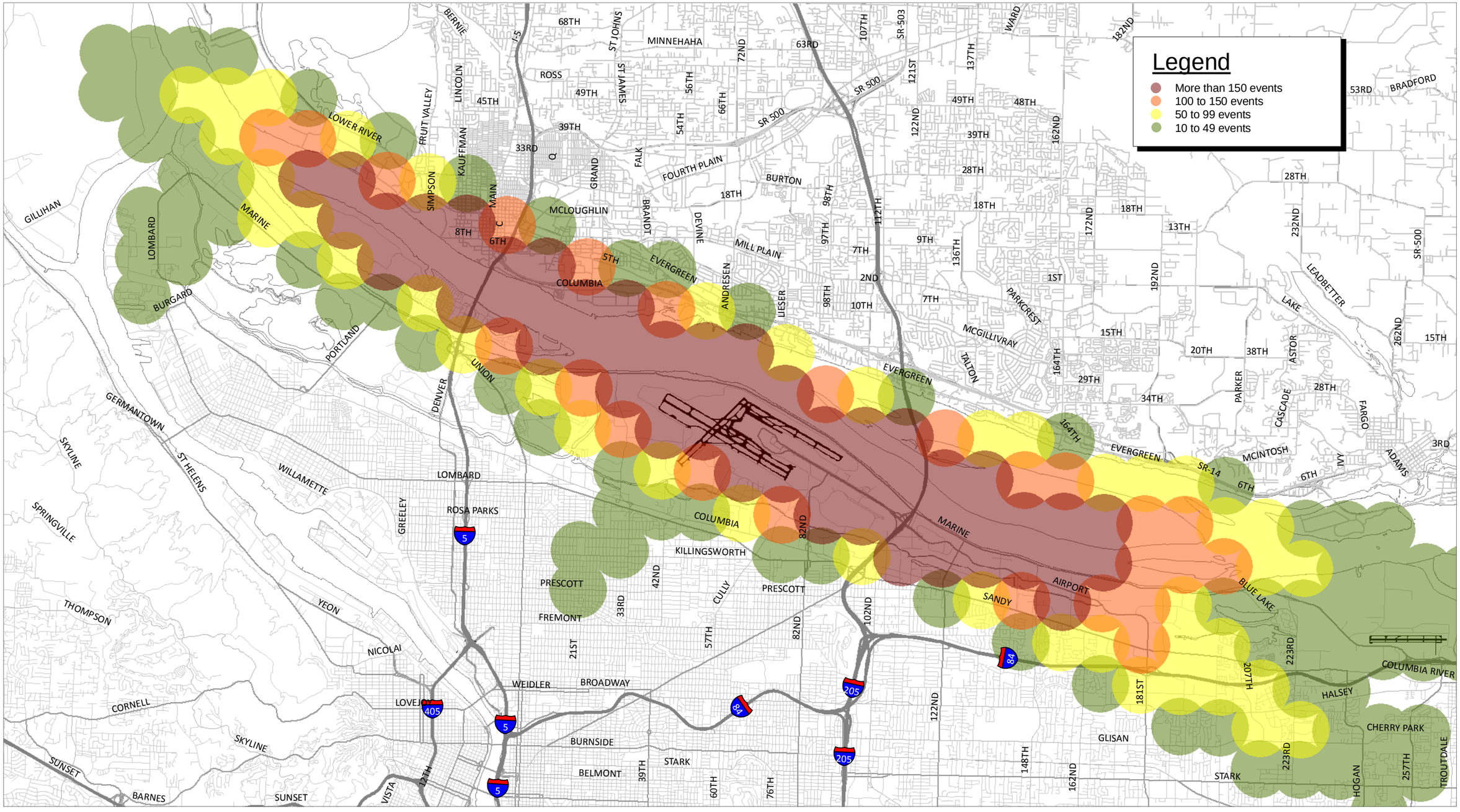


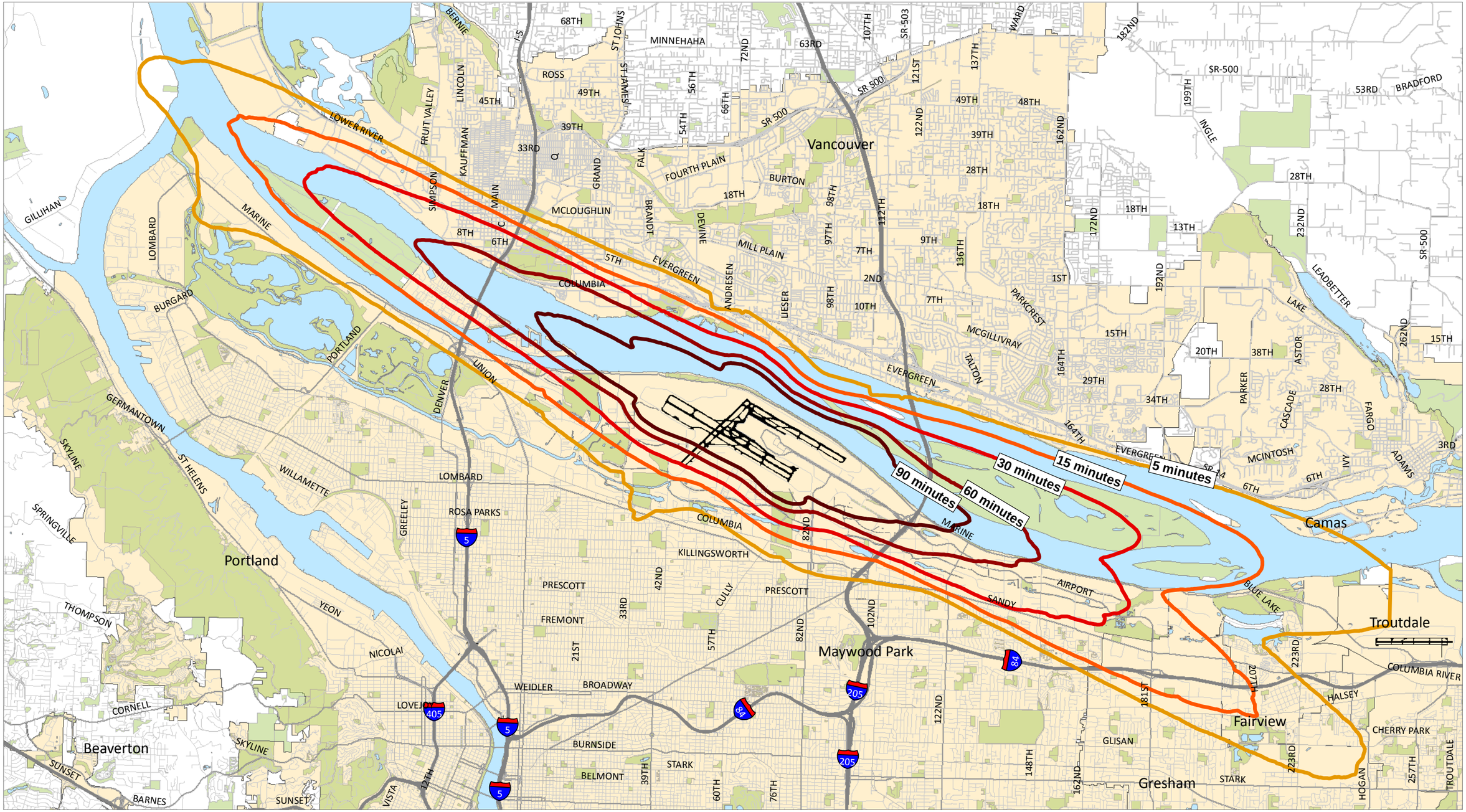
Figure C-9

Number of Events above 65 dBA - Scenario 1

Master Plan Update
Portland International Airport

Sources: Jacobs Consultancy - Number of Events above 65 dBA per day, August 2009; Port of Portland - Basemap, June 2009.

December 2009



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

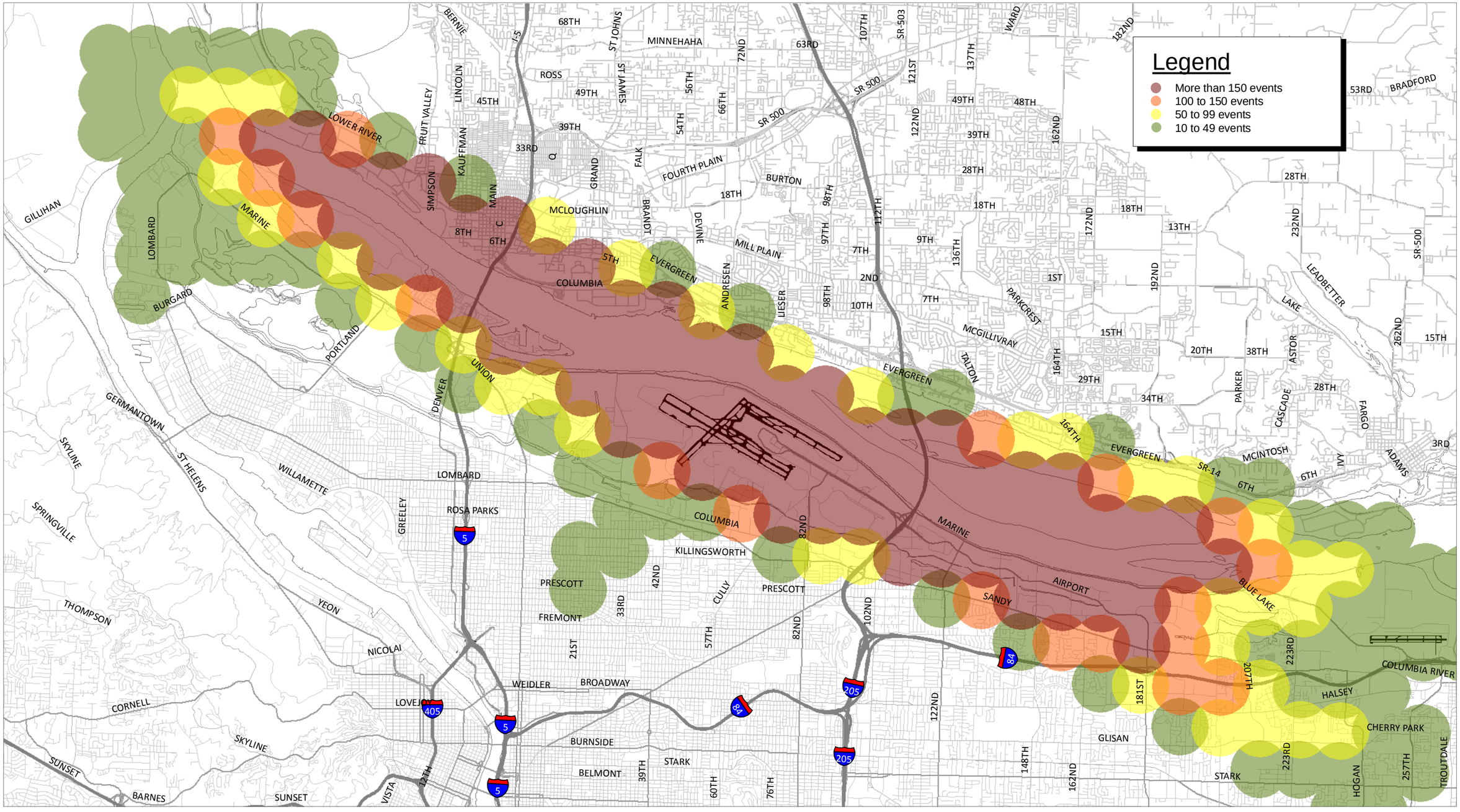
Figure C-10

Time above 65 dBA Noise Exposure Contours - Scenario 1

Master Plan Update
Portland International Airport

Sources: Jacobs Consultancy - Time above 65 dBA Noise Exposure Contours, August 2009; Port of Portland - Basemap, June 2009.

December 2009



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

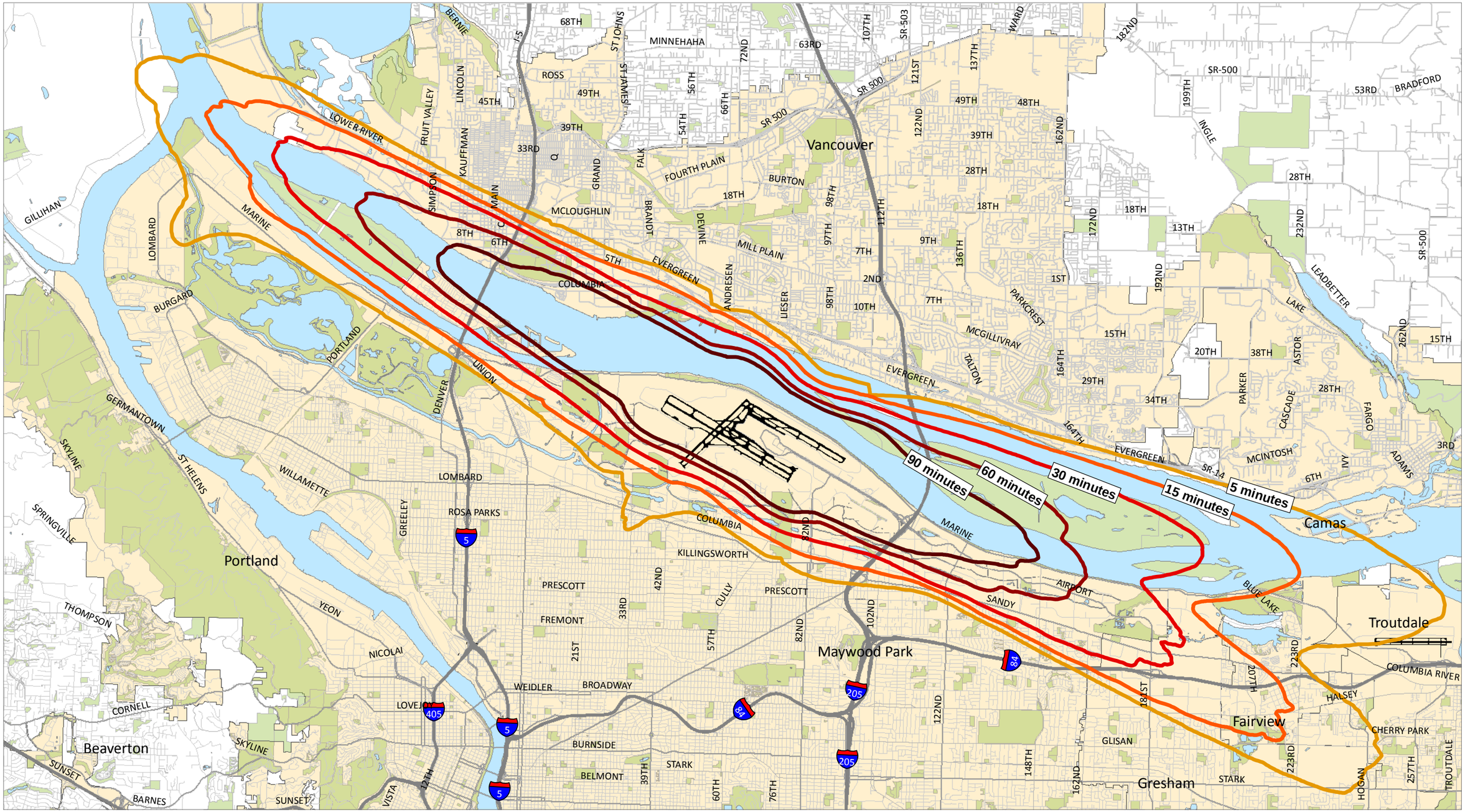
Figure C-11

Number of Events above 65 dBA -Scenario 2

Master Plan Update
Portland International Airport

December 2009

Sources: Jacobs Consultancy - Number of Events above 65 dBA per day, August 2009; Port of Portland - Basemap, June 2009.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 7000'
Scale: 1" = 7000'

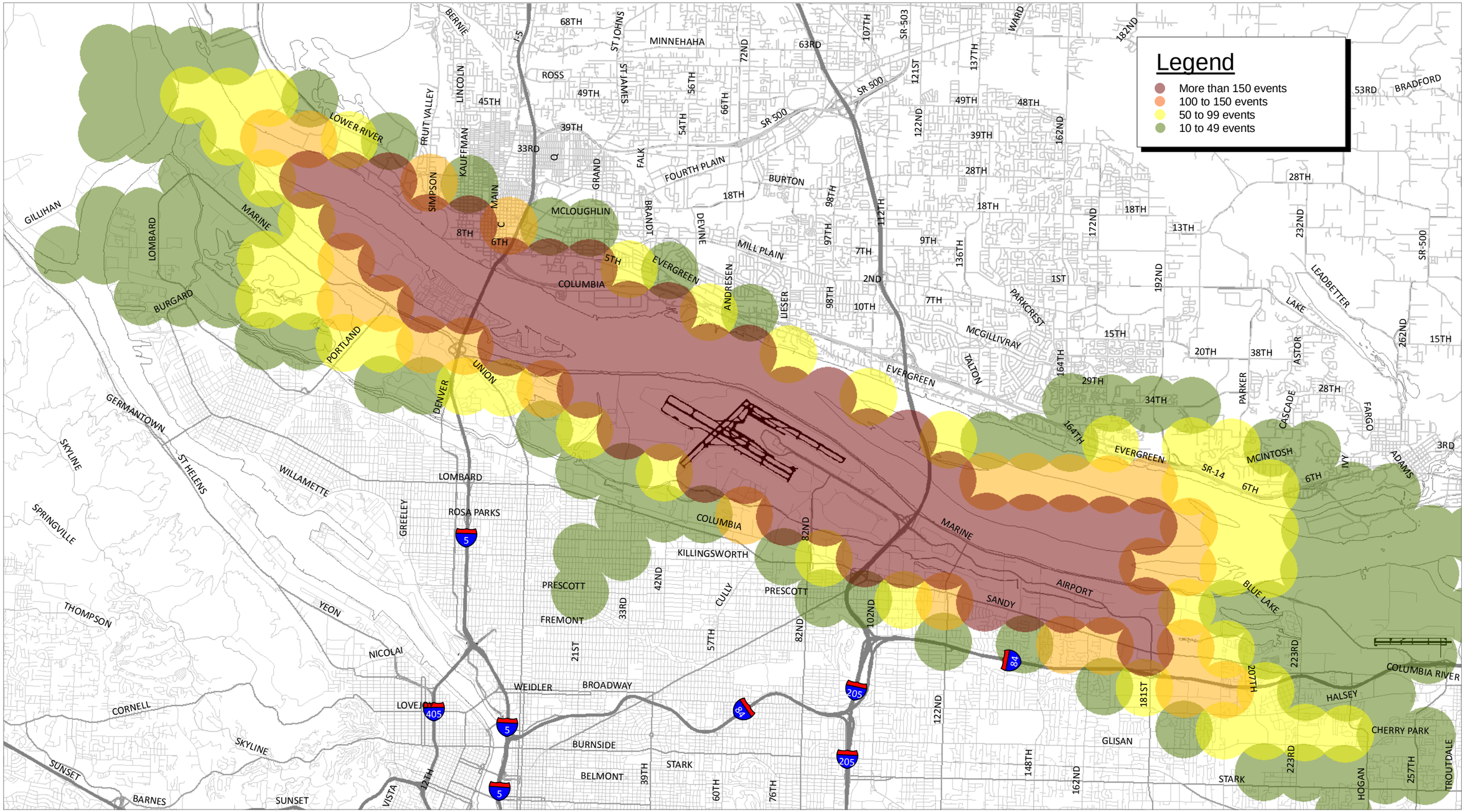
Figure C-12

Time above 65 dBA Noise Exposure Contours - Scenario 2

Master Plan Update
Portland International Airport

Sources: Jacobs Consultancy - Time above 65 dBA Noise Exposure Contours, August 2009; Port of Portland - Basemap, June 2009.

December 2009



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 7000'
Scale: 1" = 7000'

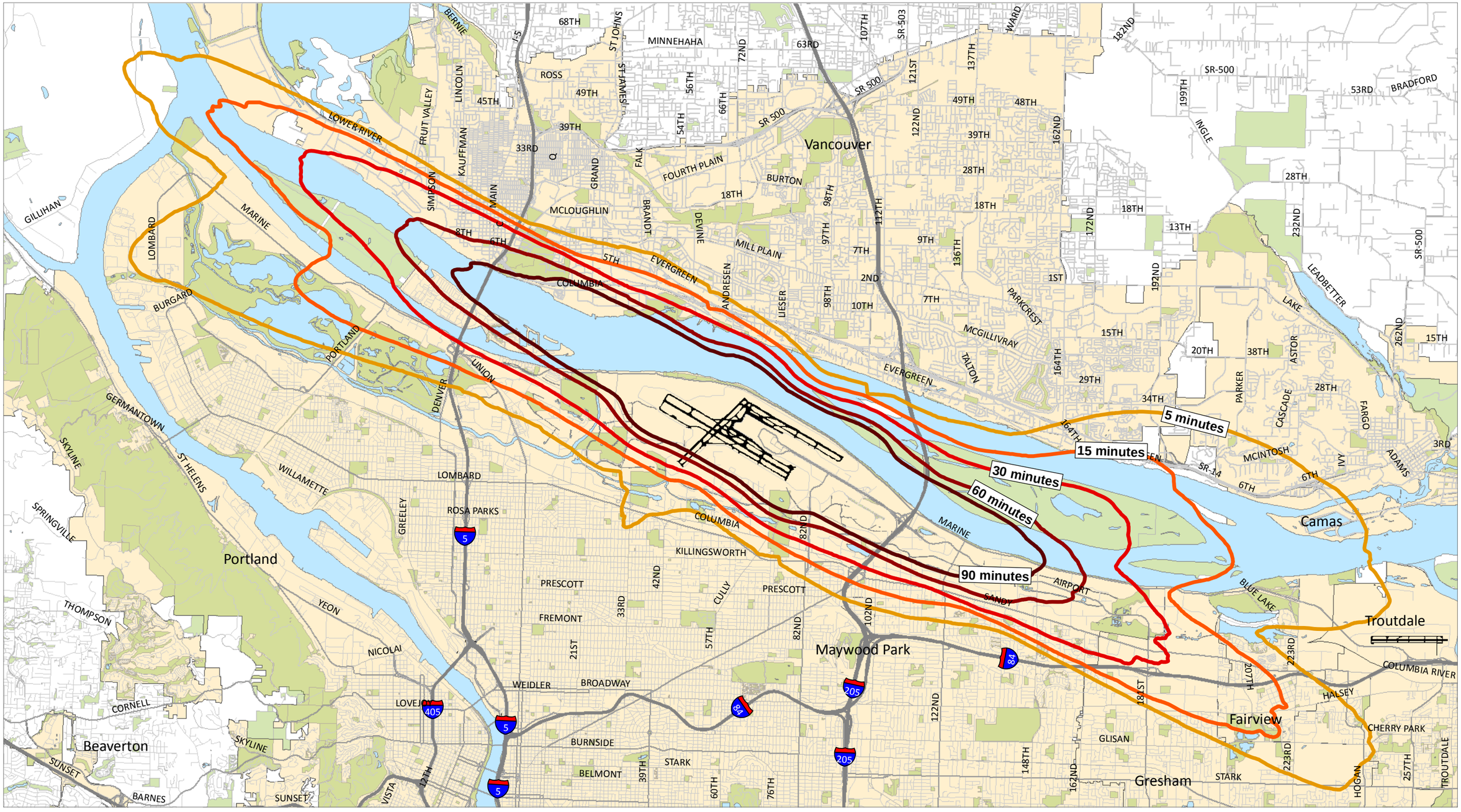
Figure C-13

Number of Events above 65 dBA - Scenario 3

Master Plan Update
Portland International Airport

Sources: Jacobs Consultancy - Number of Events above 65 dBA per day, August 2009; Port of Portland - Basemap, June 2009.

December 2009



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

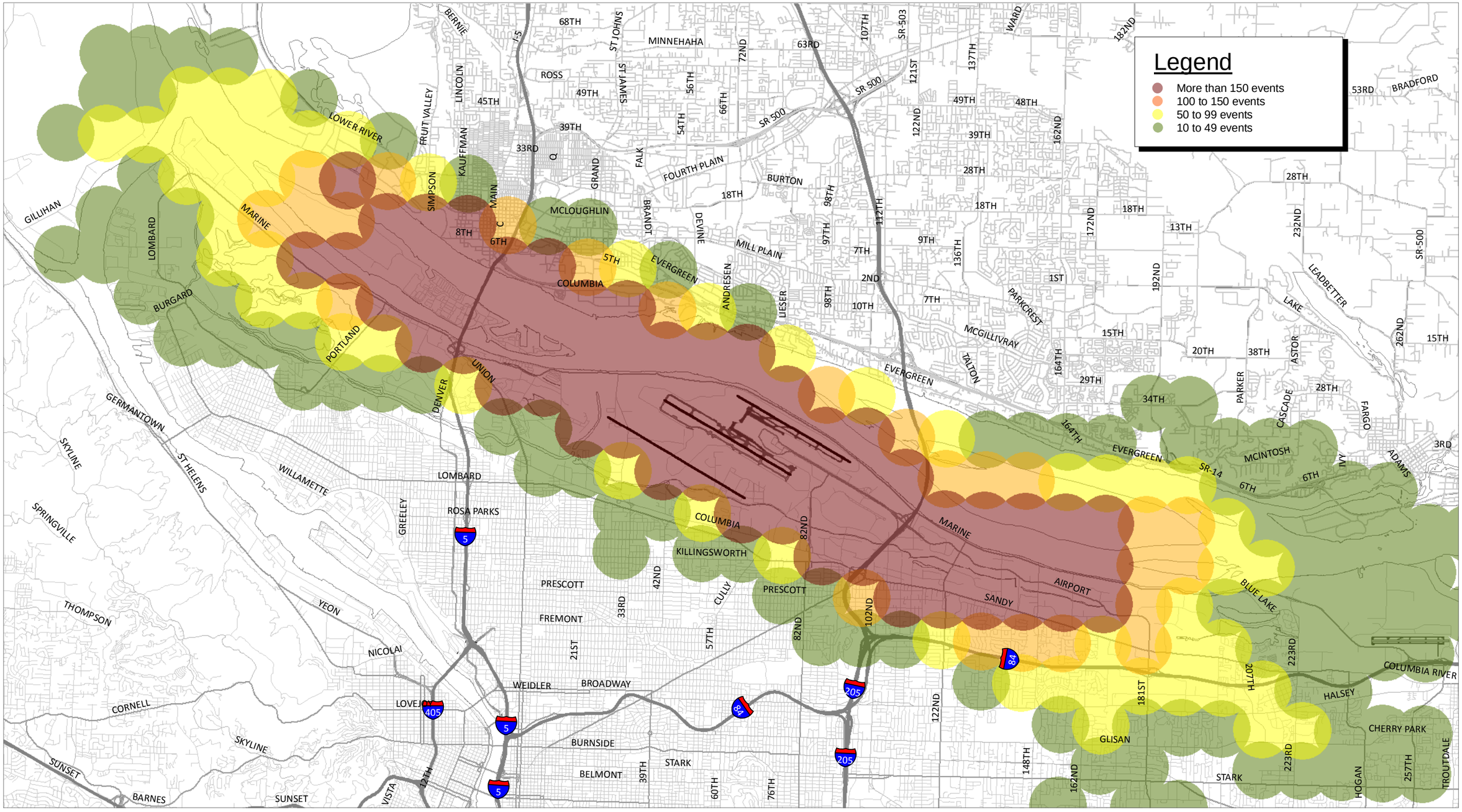
Figure C-14

Time above 65 dBA Noise Exposure Contours - Scenario 3

Master Plan Update
Portland International Airport

December 2009

Sources: Jacobs Consultancy - Time above 65 dBA Noise Exposure Contours, August 2009; Port of Portland - Basemap, June 2009.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 7000'
Scale: 1" = 7000'

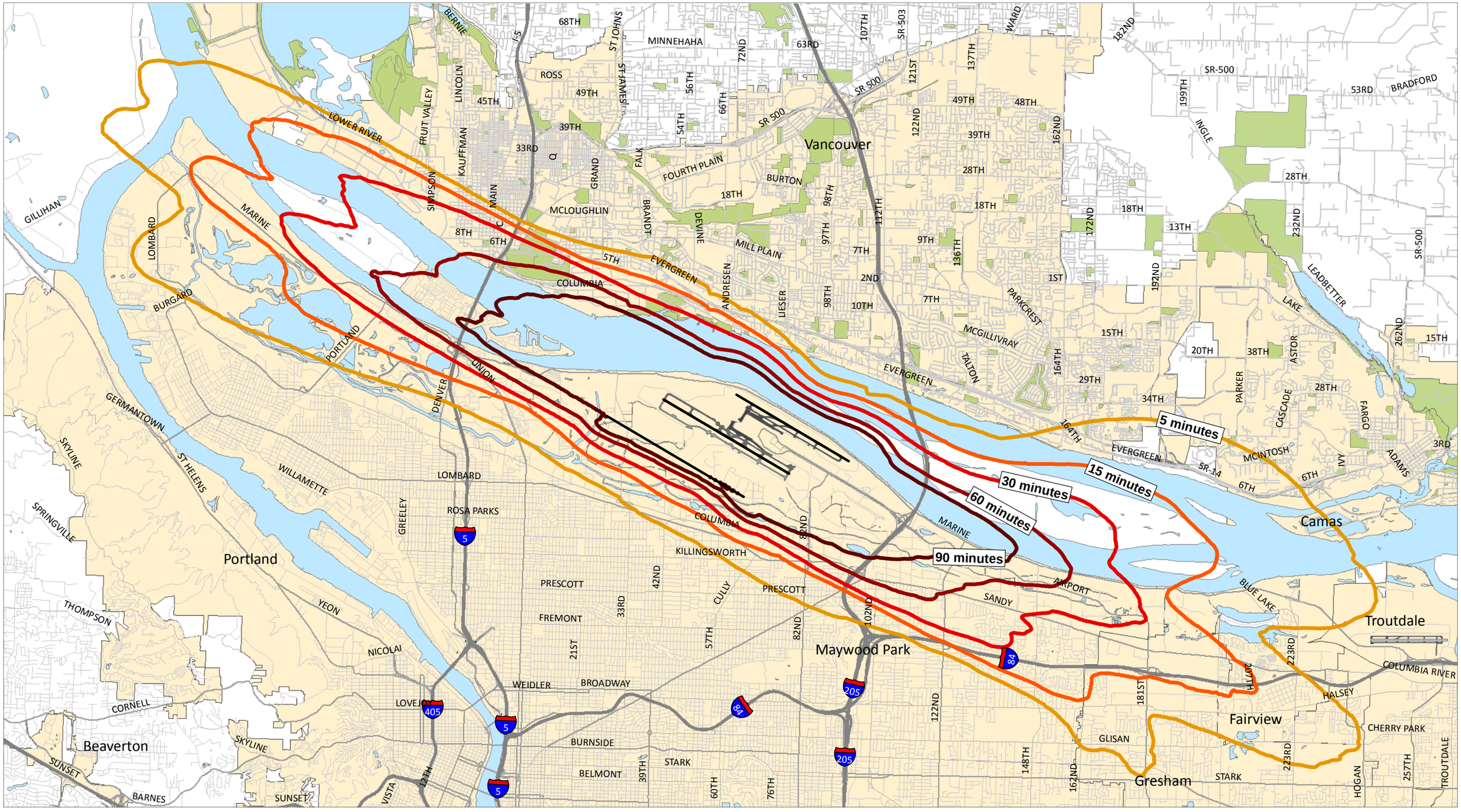
Figure C-15

Number of Events above 65 dBA - Scenario 4

Master Plan Update
Portland International Airport

December 2009

Sources: Jacobs Consultancy - Number of Events above 65 dBA per day, August 2009; Port of Portland - Basemap, June 2009.



AIRPORT FUTURES
CHARTING A COURSE FOR PDX

0' 7000'
Scale: 1" = 7000'

Figure C-16

Time above 65 dBA Noise Exposure Contours - Scenario 4

Master Plan Update
Portland International Airport

December 2009

Sources: Jacobs Consultancy - Time above 65 dBA Noise Exposure Contours, August 2009; Port of Portland - Basemap, June 2009.

Appendix D

COST ESTIMATES

CEPHAS
Construction Cost Consultants
119 Pine Street, Suite 301
Seattle, WA 98101
Telephone 206-624-8539
Fax 206-624-8955

MASTER PLAN

PORTLAND INTERNATIONAL AIRPORT

October 21, 2009

PORTLAND, OREGON

CONCEPT ESTIMATE

Prepared for:
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555 Airport Boulevard, Suite 300
Burlingham, California, 94010
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MASTER PLAN
PORTLAND INTERNATIONAL AIRPORT ***Date:*** **October 21, 2009**
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ESTIMATE REPORT PAGE INDEX

MASTER PLAN **Date: October 21, 2009**
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INTRODUCTION
BASIS OF ESTIMATE

GENERAL

This report summarizes estimated construction costs and project costs corresponding to the emerging development concepts described in Section 1 of this Technical Memorandum. Concepts costs are defined as construction costs plus allowances for contingency, project development and support, and project development contingency.

Emerging development concepts are those projects believed by the planning team to reasonably represent how future development may occur at the Airport. These concepts are described throughout this Technical Memorandum and their locations are illustrated in Section 1, Figures 1-1 through 1-5.

The basis for the cost estimates is summarized in Table C-1 and described in more detail later in this appendix. The format of the Table C-1 is the same as the format in which the requirements are summarized (refer to Table 1-2 in this Technical Memorandum); cell entries are provided only where incremental requirements were indicated in Table 1-2.

The project cost estimates are summarized in three levels of detail. The Main Summary of Project Cost (pages 5 and 6) is a high-level summary showing total project cost by functional element for each planning activity level and in total for all planning activity levels. Project costs are presented in both current (i.e., October 2009 dollars) and "year of expenditure" dollars (i.e., 2012, 2017, 2022, 2027, and 2035, corresponding to planning activity levels 1 through 5, respectively).

The Summary (pages 7 through 16) disaggregates the total project cost for each functional element into construction cost (this also includes the estimating contingency), project development and support, and project development contingency by planning activity level. Costs are presented in both current and year of expenditure dollars.

The Back-up Detail Estimate (pages 17 through 77) provides the details of the estimates for each functional element (note these estimates includes estimate design contingency). The Back-up Detail Estimate is organized by planning activity level.

COMPONENTS OF THE ESTIMATE

Construction:

The estimate construction cost includes all construction cost, together with temporary work, contractors site administration and general contractor's direct project cost, including overheads and profit.

A 15% estimating and design contingency has additionally been added to the overall construction cost numbers, that have been transferred to the individual summary sheets. .

Project Development & Support:

These costs covers addition cost other than construction cost. Included under this section is Project Administration, Design Fees, Construction & Project Management, Permit Fes and Close Out Costs. The percentage used in the estimate is 50% of construction cost and is based on Port Input numbers.

Project Development Contingency

This is an overall project contingency and includes the construction contingency.
A 20% overall construction and development contingency has been added separately to the combined construction and project development costs on each individual summary sheet to give the overall project cost for each future work item.

ESCLATION

All cost used in the back-up estimate sheets are in current October 2009 cost. Escalation has been added for the appropriate year on the main summary sheets.

INTRODUCTION
BASIS FOR PROJECT COST ESTIMATES
Table C-1

Functional Element	Planning Activity Level (PAL)				
	PAL 1 (2012)	PAL 2 (2017)	PAL 3 (2022)	PAL 4 (2027)	PAL 5 (2035)
	2012	2017	2022	2027	2035
PASSENGER TERMINAL COMPLEX					
Aircraft Gates and Parking					
Remote / RON parking	Phase 1 of RON pad is north of hotels (pad is ~580' x 400' to accommodate 4 aircraft)	Phase 2 is immediately east of phase 1 (pad is ~285' x 400' to accommodate 2 aircraft)	Phase 3 is immediately east of phase 2 (north of Delta Air Cargo; pad ~580' x 400' to accommodate 4 aircraft)	Phase 4 RON parking is west of crosswind runway pad ~465' wide x 525' deep; +8 aircraft in two facing rows separated by a taxilane; assume a new taxiway connecting pad to apron; assume VOR is relocated	Phase 5 is to lengthen PAL 4 pad by ~400 feet to accommodate a total of about 12 aircraft (+4)
Passenger Security Screening	Assumes (1) costs driven by need to change layout of areas accommodating screening lanes and/or queuing areas, (2) existing space will be reused and cost allowances are for electrical and floor repairs, and (3) basis for estimates is total floor area involved in north and south security screening areas	Assumes (1) costs driven by need to change layout of areas accommodating screening lanes and/or queuing areas, (2) existing space will be reused and cost allowances are for electrical and floor repairs, and (3) basis for estimates is total floor area involved in north and south security screening areas	Assumes (1) costs driven by need to change layout of areas accommodating screening lanes and/or queuing areas, (2) existing space will be reused and cost allowances are for electrical and floor repairs, and (3) basis for estimates is total floor area involved in north and south security screening areas	Assumes (1) costs driven by need to change layout of areas accommodating screening lanes and/or queuing areas, (2) existing space will be reused and cost allowances are for electrical and floor repairs, and (3) basis for estimates is total floor area involved in north and south security screening areas	Assumes (1) costs driven by need to change layout of areas accommodating screening lanes and/or queuing areas, (2) existing space will be reused and cost allowances are for electrical and floor repairs, and (3) basis for estimates is total floor area involved in north and south security screening areas
GROUND TRANSPORTATION AND PARKING					
Public Parking (spaces)		Phase 1 of garage is at P3 site	Phase 2 of garage is at P3 site	Phase 3 of garage is at P3 site	Phase 4 of garage is at P3 site
Employee Parking (spaces)				Expand existing at-grade lot	Expand existing at-grade lot
Curbside Loading & Unloading (linear feet)					
Enplaning curbside			Requirements will be met by means other than construction	Requirements will be met by means other than construction	Requirements will be met by means other than construction
Deplaning curbside		Do nothing	Reconfigure commercial vehicle area to increase deplaning curbside & provide additional roadway lane	Relocate rental car service center to CONRAC; move taxicabs into garage; restripe commercial vehicle areas inside & outside P1 garage	Do nothing
Curbside Roadway (lanes)					
Enplaning curbside				Meet requirement by reducing outer roadway areas reserved for non-curbside functions and use of outer roadway	Meet requirement by reducing outer roadway areas reserved for non-curbside functions and use of outer roadway

MASTER PLAN **Date: October 21, 2009**
PORTLAND INTERNATIONAL AIRPORT
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INTRODUCTION
BASIS FOR PROJECT COST ESTIMATES
Table C-1

Functional Element	Planning Activity Level (PAL)				
	PAL 1 (2012)	PAL 2 (2017)	PAL 3 (2022)	PAL 4 (2027)	PAL 5 (2035)
	2012	2017	2022	2027	2035
Deplaning curbside			Reconfigure commercial vehicle area to increase deplaning curbside & provide additional roadway lane		
Rental Car Facilities					
Ready / return parking (spaces)				Parking garage constructed to house new consolidated facility	
Service facilities (area in square feet)	New at-grade service facilities added to east of existing road. Bridge added to connect east and west service areas.	Service facilities expanded on east side of existing road	Service facilities expanded on east side of existing roadway	At-grade service facilities constructed adjacent facilities in new garage	
Roadways					
NE Airport Way, westbound (link ID A--Fig 4-4)			New lane		
NE Airport Way, eastbound (link ID B--Fig 4-4)				New lane	
Parking entrance (link ID C--Fig 4-4)				New lane	
Enplaning level approach (link ID D--Fig 4-4)			Follow-up study required		
Deplaning level approach (link ID E--Fig 4-4)					
Enplaning level departure (link ID F--Fig 4-4)	Follow-up study required			Follow-up study required	
Deplaning level departure (link ID G--Fig 4-4)				New lane	
Parking exit (link ID H--Fig 4-4)				New lane	
Terminal exit (link ID I--Fig 4-4)	New lane			New lane	
Return-to-terminal road (link ID J--				New lane	
Terminal area exit (link ID K--Fig 4-4)		New lane		New lane	
Key Intersections					
NE 82nd Ave/NE Airport Way		Basis is ODOT estimate; assumed some buildings demolished (see estimate detail)			
NE Airport Way/I-205 interchange I-205 Northbound	Not on Port property; no cost				
NE 82nd Avenue/NE Alderwood Road					Basis is existing Port estimate
NE Alderwood Road/NE Cornfoot Road			Basis is existing Port estimate		
NE Airframes Way/NE Cornfoot Road	Basis is existing Port estimate				
AIR CARGO					
All Cargo	Cost estimate is for site preparation, access, utilities and 5,000 square feet aircraft ramp.	Assumes demolition of maintenance hangar and reuse of aircraft ramp as is	Phase 1 of SW Quadrant development includes site prep, utilities, aircraft ramp, and upgrades to NE Elrod Road	Phase 2 of development in SW Quadrant includes expansion of aircraft ramp	Phase 3 of development in SW Quadrant includes expansion of aircraft ramp

BASIS FOR PROJECT COST ESTIMATES
Table C-1

Functional Element	Planning Activity Level (PAL)				
	PAL 1 (2012)	PAL 2 (2017)	PAL 3 (2022)	PAL 4 (2027)	PAL 5 (2035)
	2012	2017	2022	2027	2035
GENERAL AVIATION	Includes site preparation, access, utilities and 5,000 square feet aircraft ramp. Site prep includes costs equivalent to those to demolish the North Cargo Center, Unites Airlines Maintenance, and a flight kitchen. Assumed 2nd FBO begins operation in PAL 1				

MASTER PLAN
PORTLAND INTERNATIONAL AIRPORT
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PROJECTED COSTS FOR PAL 1 TO PAL 5 YEAR 2012-2035
MAIN SUMMARY OF PROJECT COST

Date: October 21, 2009
By: DN

FUNCTION ELEMENT	Unit	Total Quantity PAL 1-5	In Current Sept 2009 Cost: **Total Project Cost in 2009 Dollars**	PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035	Year of Expenditure 2012 -2035Cost: **Total Year of Expenditure Project Cost Dollars**	PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035
PASSENGER TERMINAL COMPEX														
Aircraft Gates & Parking														
Remote /RON Parking														
Narrow Body Aircraft	Aircraft	23	40,548,000	9,108,000	4,500,000	9,132,000	9,564,000	8,244,000	66,432,000	10,044,000	5,856,000	13,968,000	17,244,000	19,320,000
Taxiway Connection RON Parking Area	SY	5,556	2,268,000				2,268,000		4,092,000				4,092,000	
Passenger Security Screening														
Queue Area														
Document Check	SF	4,142	312,000		168,000	24,000	24,000	96,000	504,000		216,000	36,000	36,000	216,000
Primary Check	SF	4,156	480,000	108,000	72,000	108,000	60,000	132,000	780,000	132,000	96,000	168,000	96,000	288,000
GROUND TRANSPORTATION & PARKING														
Public Parking														
Garage	Space	11,532	639,348,000		106,008,000	176,856,000	179,628,000	176,856,000	1,146,888,000		137,760,000	270,744,000	323,916,000	414,468,000
Employee Parking														
At Grade Parking Lot	Space	556	4,296,000				2,004,000	2,292,000	8,964,000				3,600,000	5,364,000
Curbside Passenger Loading & Unloading														
Enplaning Curbside	LF	271												
Deplaning Curbside	LF	230	2,400,000			1,944,000	456,000	0	3,792,000			2,976,000	816,000	0
Curbside Roadway														
Enplaning Curbside	Lane	2	0				0		0				0	
Deplaning Curbside	Lane	1	216,000			216,000			324,000			324,000		
Rental Car Facility														
Ready Return Parking	Spaces	2,700	186,912,000				186,912,000		337,068,000				337,068,000	
Rental Car Service Facility														
Car Wash	Position	24	15,252,000	1,980,000	648,000	1,284,000	11,340,000		25,452,000	2,184,000	852,000	1,968,000	20,448,000	
Fuel Positions	Position	83	12,396,000	132,000	648,000	648,000	10,968,000		21,756,000	144,000	852,000	996,000	19,764,000	
Stacking Spaces	Spaces	720	4,092,000	528,000	180,000	360,000	3,024,000		6,840,000	576,000	240,000	564,000	5,460,000	
Circulation	SF	47,400	1,344,000	144,000	60,000	108,000	1,032,000		2,268,000	168,000	72,000	168,000	1,860,000	
Connecting Bridge	LF	136	1,620,000	1,404,000			216,000		1,944,000	1,548,000			396,000	
Roadways														
NE Airport Way Westbound [link ID A-Fig 4-4]	LS	1	708,000			708,000			1,080,000			1,080,000		
NE Airport Way Eastbound [link ID B-Fig 4-4]	LS	1	708,000				708,000		1,260,000				1,260,000	
Parking Entrance Link [link ID C -Fig 4-4]	LS	1	432,000				432,000		780,000				780,000	
Enplaning Level Approach [link ID D-Fig 4-4]	LS	1												
Deplaning Level Approach [link ID E-Fig 4-4]	LS	0												
Enplaning Level Departure [link ID F-Fig 4-4]	LS	2	Follow - up study required											
Deplaning Level Departure [link ID G-Fig 4-4]	LS	1	756,000				756,000		1,368,000				1,368,000	
Parking Exit [link ID H-Fig 4-4]	LS	1	324,000				324,000		576,000				576,000	
Terminal Exit [link ID I-Fig 4-4]	LS	2	2,760,000	1,356,000			1,404,000		4,044,000	1,500,000			2,544,000	
Return to Terminal Road [link ID J-Fig 4-4]	LS	1	528,000				528,000		936,000				936,000	
Terminal Area Exit [link ID K-Fig 4-4]	LS	2	1,704,000		852,000		852,000		2,640,000		1,104,000		1,536,000	
Key Intersections														
NE 82nd Avenue/NE Airport Way														
Moving TriMet Light Rail Line [Double Track]	LS	1	15,360,000		15,360,000				19,968,000		19,968,000			
Intersection Road Work and Overpass	LS	1	101,232,000		101,232,000				131,568,000		131,568,000			
Demolition of Embassy Suite	LS	1	2,544,000		2,544,000				3,300,000		3,300,000			
Demolition and Alternation to Sheraton Hotel	LS	1	2,844,000		2,844,000				3,696,000		3,696,000			
Mt Hood Interchange Area [3 sections]	LS	0												

MASTER PLAN
PORTLAND INTERNATIONAL AIRPORT
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PROJECTED COSTS FOR PAL 1 TO PAL 5 YEAR 2012-2035
MAIN SUMMARY OF PROJECT COST

Date: October 21, 2009
By: DN

			In Current Sept 2009 Cost						Year of Expenditure 2012 -2035Cost					
FUNCTION ELEMENT	Unit	Total Quantity PAL 1-5	**Total Project Cost in 2009 Dollars**	PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035	**Total Year of Expenditure Project Cost Dollars**	PAL 1 2012	PAL 2 2017	PAL 3 2022	PAL 4 2027	PAL 5 2035
NE Airport Way/I-205 interchange														
1-205 Southbound	LS	0												
1-205 Northbound	LS	0												
NE 82nd Avenue/NE Alderwood Road	LS	1	900,000					900,000	2,112,000					2,112,000
NE Alderwood Road/NE Cornfoot Road	LS	1	900,000			900,000			1,392,000			1,392,000		
NE Airtrans Way/NE Cornfoot Road	LS	1	360,000	360,000					396,000	396,000				
NE Columbia Boulevard/NE 82nd Avenue	LS	0												
NE Killingsworth Street/I-205 interchange area	LS	0												
AIR CARGO														
All Cargo														
Warehouse Space [Site Preparation only]	SF	613,000	13,380,000	240,000	11,772,000	540,000	360,000	468,000	18,132,000	252,000	15,300,000	828,000	648,000	1,104,000
Ramp	SY	369,000	96,036,000	17,100,000	96,000	20,232,000	24,696,000	33,912,000	173,964,000	18,864,000	108,000	30,984,000	44,532,000	79,476,000
Landside Area [Site Preparation only]	SF	613,000	1,908,000	204,000	420,000	360,000	396,000	528,000	3,264,000	216,000	540,000	564,000	720,000	1,224,000
Upgrade of Elrod Road [To New Cargo Area]	LS	1	2,508,000			2,508,000			3,840,000			3,840,000		
GENERAL AVIATION														
General														
Site Preparation	Acre	13	2,076,000	2,076,000					2,292,000	2,292,000				
			1,159,452,000	34,740,000	247,404,000	215,928,000	437,952,000	223,428,000	2,003,712,000	38,316,000	321,528,000	330,600,000	789,696,000	523,572,000
		Check	1,159,452,000						2,003,712,000					

MASTER PLAN
PORTLAND INTERNATIONAL AIRPORT **PROJECTED COSTS FOR PLANNING ACTIVITY LEVEL 1 YEAR 2012** Date: October 21, 2009
PORTLAND, OREGON **SUMMARY** By: DN

FUNCTION ELEMENT	Unit	Quantity	Current Sept 2009 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Year of Expenditure 2012 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Comments
PASSENGER TERMINAL COMPEX													
Aircraft Gates & Parking													
Remote /RON Parking													
Narrow Body Aircraft	Aircraft	4	2,277,000	5,060,000	2,530,000	1,518,000	9,108,000	2,511,000	5,580,000	2,790,000	1,674,000	10,044,000	580' x 400' ramp area
Taxiway Connection RON Parking Area	SY												
Passenger Security Screening													
Queue Area													
Document Check													
Primary Check	SF	1,036	104	60,000	30,000	18,000	108,000	127	70,000	40,000	22,000	132,000	
GROUND TRANSPORTATION & PARKING													
Public Parking													
Garage	Space												
Employee Parking													
At Grade Parking Lot	Space												
Curbside Passenger Loading & Unloading													
Enplaning Curbside	LF												
Deplaning Curbside	LF												
Curbside Roadway													
Enplaning Curbside	Lane												
Deplaning Curbside	Lane												
Rental Car Facility													
Ready Return Parking	Spaces												
Rental Car Service Facility													
Car Wash	Position	3	660,000	1,100,000	550,000	330,000	1,980,000	728,000	1,210,000	610,000	364,000	2,184,000	
Fuel Positions	Position	1	132,000	70,000	40,000	22,000	132,000	144,000	80,000	40,000	24,000	144,000	
Stacking Spaces	Space	90	5,867	290,000	150,000	88,000	528,000	6,400	320,000	160,000	96,000	576,000	
Circulation	SF	4,800	30	80,000	40,000	24,000	144,000	35	90,000	50,000	28,000	168,000	
Connecting Bridge	LF	135	10,400	780,000	390,000	234,000	1,404,000	11,467	860,000	430,000	258,000	1,548,000	
Roadways													
NE Airport Way Westbound [link ID A-Fig 4-4]	LS												
NE Airport Way Eastbound [link ID B-Fig 4-4]	LS												
Parking Entrance Link [link ID C -Fig 4-4]	LS												
Enplaning Level Approach [link ID D-Fig 4-4]	LS												
Deplaning Level Approach [link ID E-Fig 4-4]	LS												
Enplaning Level Departure [link ID F-Fig 4-4]	LS	1											Meets requirement other than Construction
Deplaning Level Departure [link ID G-Fig 4-4]	LS												
Parking Exit [link ID H-Fig 4-4]	LS												
Terminal Exit [link ID I-Fig 4-4]	LF	1	1,356,000	750,000	380,000	226,000	1,356,000	1,500,000	830,000	420,000	250,000	1,500,000	Two lanes add plus sidewalk
Return to Terminal Road [link ID J-Fig 4-4]	LS												
Terminal Area Exit [link ID K-Fig 4-4]	LS												
Key Intersections													
NE 82nd Avenue/NE Airport Way													
Moving TriMet Light Rail Line [Double Track]	LS												
Intersection Road Work and Overpass	LS												
Demolition of Embassy Suite	LS												
Demolition and Alternation to Sheraton Hotel	LS												
Mt Hood Interchange Area [3 sections]	LS												
NE Airport Way/I-205 interchange													
1-205 Southbound	LS												
1-205 Northbound	LS												
NE 82nd Avenue/NE Alderwood Road	LS												

MASTER PLAN
PORTLAND INTERNATIONAL AIRPORT **PROJECTED COSTS FOR PLANNING ACTIVITY LEVEL 1 YEAR 2012** Date: October 21, 2009
PORTLAND, OREGON **SUMMARY** By: DN

FUNCTION ELEMENT	Unit	Quantity	Current Sept 2009 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Year of Expenditure 2012 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Comments
													3.33% per annum used [yearly escalation average over 20 years for Portland]. A 20% project development contingency
NE Alderwood Road/NE Cornfoot Road	LS												
NE Airtrans Way/NE Cornfoot Road	LS	1	360,000	200,000	100,000	60,000	360,000	396,000	220,000	110,000	66,000	396,000	$300,000 construction cost from Port
NE Columbia Boulevard/NE 82nd Avenue	LS												2 intersections
NE Killingsworth Street/I-205 interchange area	LS												2 intersections
AIR CARGO													
All Cargo													
Warehouse Space [Site Preparation only]	SF	40,000	6	130,000	70,000	40,000	240,000	6	140,000	70,000	42,000	252,000	
Ramp	SY	51,000	335	9,500,000	4,750,000	2,850,000	17,100,000	370	10,480,000	5,240,000	3,144,000	18,864,000	
Landside Area [Site Preparation only]	SF	40,000	5	110,000	60,000	34,000	204,000	5	120,000	60,000	36,000	216,000	
GENERAL AVIATION													
General													
Site Preparation	Acre	13	159,692	1,150,000	580,000	346,000	2,076,000	176,308	1,270,000	640,000	382,000	2,292,000	No decision regarding made regarding supplementary aviation availability The cost is intended to provide a worst case cost The cost is related to Concept 1 in TM No 4 Alternates. Demolishing North Cargo Center, United Maintenance Center & flight kitchen
TOTALS FOR PAL 1				19,280,000	9,670,000	5,790,000	34,740,000		21,270,000	10,660,000	6,386,000	38,316,000	
Check							34,740,000					38,316,000	

MASTER PLAN
PORTLAND INTERNATIONAL AIRPORT — **PROJECTED COSTS FOR PLANNING ACTIVITY LEVEL 2 YEAR 2017** — Date: October 21, 2009
PORTLAND, OREGON — **SUMMARY** — By: DN

FUNCTION ELEMENT	Unit	Quantity	Current Sept 2009 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Year of Expenditure 2017 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Comments
													3.33% per annum used [yearly escalation average over 20 years for Portland]. A 20% project development contingency used
PASSENGER TERMINAL COMPEX													
Aircraft Gates & Parking													
Remote /RON Parking													
Narrow Body Aircraft	Aircraft	2	2,250,000	2,500,000	1,250,000	750,000	4,500,000	2,928,000	3,250,000	1,630,000	976,000	5,856,000	285' x 400' ramp area
Taxiway Connection RON Parking Area	SY												
Passenger Security Screening													
Queue Area													
Document Check	SF	2,595	65	90,000	50,000	28,000	168,000	83	120,000	60,000	36,000	216,000	
Primary Check	SF	572	126	40,000	20,000	12,000	72,000	168	50,000	30,000	16,000	96,000	
GROUND TRANSPORTATION & PARKING													
Public Parking													
Garage	Space	1,912	55,444	58,890,000	29,450,000	17,668,000	106,008,000	72,050	76,530,000	38,270,000	22,960,000	137,760,000	
Employee Parking													
At Grade Parking Lot	Space												
Curbside Passenger Loading & Unloading													
Enplaning Curbside	LF												
Deplaning Curbside	LF	20		No Cost									
Curbside Roadway													
Enplaning Curbside	Lane												
Deplaning Curbside	Lane												
Rental Car Facility													
Ready Return Parking	Spaces												
Rental Car Service Facility													
Car Wash	Position	1	648,000	360,000	180,000	108,000	648,000	852,000	470,000	240,000	142,000	852,000	
Fuel Positions	Position	6	108,000	360,000	180,000	108,000	648,000	142,000	470,000	240,000	142,000	852,000	
Stacking Spaces	Space	30	6,000	100,000	50,000	30,000	180,000	8,000	130,000	70,000	40,000	240,000	
Circulation	SF	2,280	26	30,000	20,000	10,000	60,000	32	40,000	20,000	12,000	72,000	
Connecting Bridge	LF												
Roadways													
NE Airport Way Westbound [link ID A-Fig 4-4]	LS												
NE Airport Way Eastbound [link ID B-Fig 4-4]	LS												
Parking Entrance Link [link ID C -Fig 4-4]	LS												
Enplaning Level Approach [link ID D-Fig 4-4]	LS												
Deplaning Level Approach [link ID E-Fig 4-4]	LS												
Enplaning Level Departure [link ID F-Fig 4-4]	LS												
Deplaning Level Departure [link ID G-Fig 4-4]	LS												
Parking Exit [link ID H-Fig 4-4]	LS												
Terminal Exit [link ID I-Fig 4-4]	LF												
Return to Terminal Road [link ID J-Fig 4-4]	LS												
Terminal Area Exit [link ID K-Fig 4-4]	LS	1	852,000	470,000	240,000	142,000	852,000	1,104,000	610,000	310,000	184,000	1,104,000	One lane added
Key Intersections													
NE 82nd Avenue/NE Airport Way													Based on HHPR. Drawing
Moving TriMet Light Rail Line [Double Track]	LS	1	15,360,000	8,530,000	4,270,000	2,560,000	15,360,000	19,968,000	11,090,000	5,550,000	3,328,000	19,968,000	Cost broken down
Intersection Road Work and Overpass	LS	1	101,232,000	56,240,000	28,120,000	16,872,000	101,232,000	131,568,000	73,090,000	36,550,000	21,928,000	131,568,000	
Demolition of Embassy Suite	LS	1	2,544,000	1,410,000	710,000	424,000	2,544,000	3,300,000	1,830,000	920,000	550,000	3,300,000	
Demolition and Alternation to Sheraton Hotel	LS	1	2,844,000	1,580,000	790,000	474,000	2,844,000	3,696,000	2,050,000	1,030,000	616,000	3,696,000	
Mt Hood Interchange Area [3 sections]	LS												
NE Airport Way/I-205 interchange													
1-205 Southbound	LS												
1-205 Northbound	LS												

MASTER PLAN
PORTLAND INTERNATIONAL AIRPORT **PROJECTED COSTS FOR PLANNING ACTIVITY LEVEL 2 YEAR 2017** Date: October 21, 2009
PORTLAND, OREGON **SUMMARY** By: DN

FUNCTION ELEMENT	Unit	Quantity	Current Sept 2009 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Year of Expenditure 2017 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Comments
													3.33% per annum used [yearly escalation average over 20 years for Portland]. A 20% project development contingency used
NE 82nd Avenue/NE Alderwood Road	LS												
NE Alderwood Road/NE Cornfoot Road	LS												
NE Airtrans Way/NE Cornfoot Road	LS												
NE Columbia Boulevard/NE 82nd Avenue	LS												
NE Killingsworth Street/I-205 interchange area	LS												
AIR CARGO													
All Cargo													
Warehouse Space [Site Preparation only]	SF	129,000	91	6,540,000	3,270,000	1,962,000	11,772,000	119	8,500,000	4,250,000	2,550,000	15,300,000	
Ramp	SY	72,000	1	50,000	30,000	16,000	96,000	2	60,000	30,000	18,000	108,000	Using existing ramp to hangar
Landside Area [Site Preparation only]	SF	129,000	3	230,000	120,000	70,000	420,000	4	300,000	150,000	90,000	540,000	
GENERAL AVIATION													
General													
Site Preparation	Acre												
TOTALS FOR PAL 2				137,420,000	68,750,000	41,234,000	247,404,000		178,590,000	89,350,000	53,588,000	321,528,000	
Check							247,404,000					321,528,000	

MASTER PLAN
PORTLAND INTERNATIONAL AIRPORT — **PROJECTED COSTS FOR PLANNING ACTIVITY LEVEL 3 YEAR 2022** — Date: October 21, 2009
PORTLAND, OREGON — **SUMMARY** — By: DN

FUNCTION ELEMENT	Unit	Quantity	Current Sept 2009 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Year of Expenditure 2022 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Comments: 3.33% per annum used [yearly escalation average over 20 years for Portland]. A 20% project development contingency used
PASSENGER TERMINAL COMPEX													
Aircraft Gates & Parking													
Remote /RON Parking													
Narrow Body Aircraft	Aircraft	4	2,283,000	5,070,000	2,540,000	1,522,000	9,132,000	3,492,000	7,760,000	3,880,000	2,328,000	13,968,000	680' x 400' ramp area
Taxiway Connection RON Parking Area	SY												
Passenger Security Screening													
Queue Area													
Document Check	SF	234	103	10,000	10,000	4,000	24,000	154	20,000	10,000	6,000	36,000	
Primary Check	SF	910	119	60,000	30,000	18,000	108,000	185	90,000	50,000	28,000	168,000	
GROUND TRANSPORTATION & PARKING													
Public Parking													
Garage	Space	3,190	55,441	98,250,000	49,130,000	29,476,000	176,856,000	84,873	150,410,000	75,210,000	45,124,000	270,744,000	$28,000 per space allowed
Employee Parking													
At Grade Parking Lot	Space												
Curbside Passenger Loading & Unloading													
Enplaning Curbside	LF	31		no cost									Meets requirement other than Construction
Deplaning Curbside	LF	80	24,300	1,080,000	540,000	324,000	1,944,000	37,200	1,650,000	830,000	496,000	2,976,000	Commercial vehicle reconfiguration
Curbside Roadway													
Enplaning Curbside	Lane												
Deplaning Curbside	Lane	1	216,000	120,000	60,000	36,000	216,000	324,000	180,000	90,000	54,000	324,000	Road island added
Rental Car Facility													
Ready Return Parking	Spaces												
Rental Car Service Facility													
Car Wash	Position	2	642,000	710,000	360,000	214,000	1,284,000	984,000	1,090,000	550,000	328,000	1,968,000	
Fuel Positions	Position	6	108,000	360,000	180,000	108,000	648,000	166,000	550,000	280,000	166,000	996,000	
Stacking Spaces	Space	60	6,000	200,000	100,000	60,000	360,000	9,400	310,000	160,000	94,000	564,000	
Circulation	SF	3,840	28	60,000	30,000	18,000	108,000	44	90,000	50,000	28,000	168,000	
Connecting Bridge	LF												
Roadways													
NE Airport Way Westbound [link ID A-Fig 4-4]	LS	1	708,000	390,000	200,000	118,000	708,000	1,080,000	600,000	300,000	180,000	1,080,000	One lane added
NE Airport Way Eastbound [link ID B-Fig 4-4]	LS												
Parking Entrance Link [link ID C -Fig 4-4]	LS												
Enplaning Level Approach [link ID D-Fig 4-4]	LS	1		no cost									Meets requirement other than Construction
Deplaning Level Approach [link ID E-Fig 4-4]	LS												
Enplaning Level Departure [link ID F-Fig 4-4]	LS												
Deplaning Level Departure [link ID G-Fig 4-4]	LS												
Parking Exit [link ID H-Fig 4-4]	LS												
Terminal Exit [link ID I-Fig 4-4]	LF												
Return to Terminal Road [link ID J-Fig 4-4]	LS												
Terminal Area Exit [link ID K-Fig 4-4]	LS												
Key Intersections													
NE 82nd Avenue/NE Airport Way													
Moving TriMet Light Rail Line [Double Track]	LS												
Intersection Road Work and Overpass	LS												
Demolition of Embassy Suite	LS												
Demolition and Alternation to Sheraton Hotel	LS												
Mt Hood Interchange Area [3 sections]	LS												
NE Airport Way/I-205 interchange													
1-205 Southbound	LS												
1-205 Northbound	LS												
NE 82nd Avenue/NE Alderwood Road	LS												

MASTER PLAN
PORTLAND INTERNATIONAL AIRPORT **PROJECTED COSTS FOR PLANNING ACTIVITY LEVEL 3 YEAR 2022** Date: October 21, 2009
PORTLAND, OREGON **SUMMARY** By: DN

			Current Sept 2009 Cost					Year of Expenditure 2022 Cost					Comments
FUNCTION ELEMENT	Unit	Quantity	Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	3.33% per annum used [yearly escalation average over 20 years for Portland]. A 20% project development contingency used
NE Alderwood Road/NE Cornfoot Road	LS	1	900,000	500,000	250,000	150,000	900,000	1,392,000	770,000	390,000	232,000	1,392,000	$750,000 construction cost from Port
NE Airtrans Way/NE Cornfoot Road	LS												
NE Columbia Boulevard/NE 82nd Avenue	LS												
NE Killingsworth Street/I-205 interchange area	LS												
AIR CARGO													New Facility
All Cargo													
Warehouse Space [Site Preparation only]	SF	114,000	5	300,000	150,000	90,000	540,000	7	460,000	230,000	138,000	828,000	
Ramp	SY	63,000	321	11,240,000	5,620,000	3,372,000	20,232,000	492	17,210,000	8,610,000	5,164,000	30,984,000	
Landside Area [Site Preparation only]	SF	114,000	3	200,000	100,000	60,000	360,000	5	310,000	160,000	94,000	564,000	
Upgrade of Elrod Road [To New Cargo Area]	LS	1	2,508,000	1,390,000	700,000	418,000	2,508,000	3,840,000	2,130,000	1,070,000	640,000	3,840,000	
GENERAL AVIATION													
General													
Site Preparation	Acre												
TOTALS FOR PAL 3				119,940,000	60,000,000	35,988,000	215,928,000		183,630,000	91,870,000	55,100,000	330,600,000	
Check							215,928,000					330,600,000	

MASTER PLAN
PORTLAND INTERNATIONAL AIRPORT **PROJECTED COSTS FOR PLANNING ACTIVITY LEVEL 4 YEAR 2027** Date: October 21, 2009
PORTLAND, OREGON **SUMMARY** By: DN

			Current Sept 2009 Cost					Year of Expenditure 2027 Cost					Comments
FUNCTION ELEMENT	Unit	Quantity	Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	3.33% per annum used [yearly escalation average over 20 years for Portland]. A 20% project development contingency used
PASSENGER TERMINAL COMPEX													
Aircraft Gates & Parking													
Remote /RON Parking													
Narrow Body Aircraft	Aircraft	7	1,366,286	5,310,000	2,660,000	1,594,000	9,564,000	2,463,429	9,580,000	4,790,000	2,874,000	17,244,000	580' x 400' ramp area
Taxiway Connection RON Parking Area	SY	5,556	408	1,260,000	630,000	378,000	2,268,000	737	2,270,000	1,140,000	682,000	4,092,000	500' x 100' paving allowed
Passenger Security Screening													
Queue Area													
Document Check	SF	169	142	10,000	10,000	4,000	24,000	213	20,000	10,000	6,000	36,000	
Primary Check	SF	468	128	30,000	20,000	10,000	60,000	205	50,000	30,000	16,000	96,000	
GROUND TRANSPORTATION & PARKING													
Public Parking													
Garage	Space	3,240	55,441	99,790,000	49,900,000	29,938,000	179,628,000	99,974	179,950,000	89,980,000	53,986,000	323,916,000	$28,000 per space allowed
Employee Parking													
At Grade Parking Lot	Space	256	7,828	1,110,000	560,000	334,000	2,004,000	14,063	2,000,000	1,000,000	600,000	3,600,000	325 sf space allowed per car
Curbside Passenger Loading & Unloading													
Enplaning Curbside	LF	120		no cost									Meets requirement other than Construction
Deplaning Curbside	LF	50	9,120	250,000	130,000	76,000	456,000	16,320	450,000	230,000	136,000	816,000	Commercial vehicle reconfiguration
Curbside Roadway													
Enplaning Curbside	Lane	1											Meet requirements by adjusting operation
Deplaning Curbside	Lane												
Rental Car Facility													New Facility
Ready Return Parking	Spaces	2,700	69,227	103,840,000	51,920,000	31,152,000	186,912,000	124,840	187,260,000	93,630,000	56,178,000	337,068,000	Multi-story parking structure
Rental Car Service Facility													New Facility
Car Wash	Position	18	630,000	6,300,000	3,150,000	1,890,000	11,340,000	1,136,000	11,360,000	5,680,000	3,408,000	20,448,000	
Fuel Positions	Position	70	156,686	6,090,000	3,050,000	1,828,000	10,968,000	282,343	10,980,000	5,490,000	3,294,000	19,764,000	
Stacking Spaces	Space	540	5,600	1,680,000	840,000	504,000	3,024,000	10,111	3,030,000	1,520,000	910,000	5,460,000	
Circulation	SF	36,480	28	570,000	290,000	172,000	1,032,000	51	1,030,000	520,000	310,000	1,860,000	
Connecting Bridge [Removal]	LS	1	216,000	120,000	60,000	36,000	216,000	396,000	220,000	110,000	66,000	396,000	
Roadways													
NE Airport Way Westbound [link ID A-Fig 4-4]	LS												
NE Airport Way Eastbound [link ID B-Fig 4-4]	LS	1	708,000	390,000	200,000	118,000	708,000	1,260,000	700,000	350,000	210,000	1,260,000	one lane added
Parking Entrance Link [link ID C -Fig 4-4]	LS	1	432,000	240,000	120,000	72,000	432,000	780,000	430,000	220,000	130,000	780,000	one lane added
Enplaning Level Approach [link ID D-Fig 4-4]	LS												
Deplaning Level Approach [link ID E-Fig 4-4]	LS												
Enplaning Level Departure [link ID F-Fig 4-4]	LS	1											Follow - up study required
Deplaning Level Departure [link ID G-Fig 4-4]	LS	1	756,000	420,000	210,000	126,000	756,000	1,368,000	760,000	380,000	228,000	1,368,000	one lane added
Parking Exit [link ID H-Fig 4-4]	LS	1	324,000	180,000	90,000	54,000	324,000	576,000	320,000	160,000	96,000	576,000	one lane added
Terminal Exit [link ID I-Fig 4-4]	LF	1	1,404,000	780,000	390,000	234,000	1,404,000	2,544,000	1,410,000	710,000	424,000	2,544,000	one lane added
Return to Terminal Road [link ID J-Fig 4-4]	LS	1	528,000	290,000	150,000	88,000	528,000	936,000	520,000	260,000	156,000	936,000	one lane added
Terminal Area Exit [link ID K-Fig 4-4]	LS	1	852,000	470,000	240,000	142,000	852,000	1,536,000	850,000	430,000	256,000	1,536,000	one lane added
Key Intersections													
NE 82nd Avenue/NE Airport Way													
Moving TriMet Light Rail Line [Double Track]	LS												
Intersection Road Work and Overpass	LS												
Demolition of Embassy Suite	LS												
Demolition and Alternation to Sheraton Hotel	LS												
Mt Hood Interchange Area [3 sections]	LS												
NE Airport Way/I-205 interchange													
1-205 Southbound	LS												

MASTER PLAN
PORTLAND INTERNATIONAL AIRPORT **PROJECTED COSTS FOR PLANNING ACTIVITY LEVEL 4 YEAR 2027** Date: October 21, 2009
PORTLAND, OREGON **SUMMARY** By: DN

			Current Sept 2009 Cost					Year of Expenditure 2027 Cost					Comments
FUNCTION ELEMENT	Unit	Quantity	Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	3.33% per annum used [yearly escalation average over 20 years for Portland]. A 20% project development contingency used
1-205 Northbound	LS												
NE 82nd Avenue/NE Alderwood Road	LS												
NE Alderwood Road/NE Cornfoot Road	LS												
NE Airtrans Way/NE Cornfoot Road	LS												
NE Columbia Boulevard/NE 82nd Avenue	LS												
NE Killingsworth Street/I-205 interchange area	LS												
AIR CARGO													
All Cargo													
Warehouse Space [Site Preparation only]	SF	138,000	3	200,000	100,000	60,000	360,000	5	360,000	180,000	108,000	648,000	
Ramp	SY	77,000	321	13,720,000	6,860,000	4,116,000	24,696,000	578	24,740,000	12,370,000	7,422,000	44,532,000	
Landside Area [Site Preparation only]	SF	138,000	3	220,000	110,000	66,000	396,000	5	400,000	200,000	120,000	720,000	
GENERAL AVIATION													
General													
Site Preparation	Acre												
TOTALS FOR PAL 4				243,270,000	121,690,000	72,992,000	437,952,000		438,690,000	219,390,000	131,616,000	789,696,000	
Check							437,952,000					789,696,000	

MASTER PLAN
PORTLAND INTERNATIONAL AIRPORT — **PROJECTED COSTS FOR PLANNING ACTIVITY LEVEL 5 YEAR 2035** — Date: October 21, 2009
PORTLAND, OREGON — **SUMMARY** — By: DN

FUNCTION ELEMENT	Unit	Quantity	Current Sept 2009 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Year of Expenditure 2035 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Comments
													3.33% per annum used [yearly escalation average over 20 years for Portland]. A 20% project development contingency used
PASSENGER TERMINAL COMPEX													
Aircraft Gates & Parking													
Remote /RON Parking													
Narrow Body Aircraft	Aircraft	6	1,374,000	4,580,000	2,290,000	1,374,000	8,244,000	3,220,000	10,730,000	5,370,000	3,220,000	19,320,000	580' x 400' ramp area
Taxiway Connection RON Parking Area	SY												
Passenger Security Screening													
Queue Area													
Document Check	SF	1,144	84	50,000	30,000	16,000	96,000	189	120,000	60,000	36,000	216,000	
Primary Check	SF	1,170	113	70,000	40,000	22,000	132,000	246	160,000	80,000	48,000	288,000	
GROUND TRANSPORTATION & PARKING													
Public Parking													
Garage	Space	3,190	55,441	98,250,000	49,130,000	29,476,000	176,856,000	129,927	230,260,000	115,130,000	69,078,000	414,468,000	$28,000 per space allowed
Employee Parking													
At Grade Parking Lot	Space	300	7,640	1,270,000	640,000	382,000	2,292,000	17,880	2,980,000	1,490,000	894,000	5,364,000	325 sf space allowed per car
Curbside Passenger Loading & Unloading													
Enplaning Curbside	LF	120		no cost									Meets requirement other than Construction
Deplaning Curbside	LF	80		no cost									Requirement meet in PAL-4
Curbside Roadway													
Enplaning Curbside	Lane	1		no cost									Road island added in Pal-4
Deplaning Curbside	Lane												
Rental Car Facility													
Ready Return Parking	Spaces												
Rental Car Service Facility													
Car Wash	Position												
Fuel Positions	Position												
Stacking Spaces	Space												
Circulation	SF												
Connecting Bridge	LF												
Roadways													
NE Airport Way Westbound [link ID A-Fig 4-4]	LS												
NE Airport Way Eastbound [link ID B-Fig 4-4]	LS												
Parking Entrance Link [link ID C -Fig 4-4]	LS												
Enplaning Level Approach [link ID D-Fig 4-4]	LS												
Deplaning Level Approach [link ID E-Fig 4-4]	LS												
Enplaning Level Departure [link ID F-Fig 4-4]	LS												
Deplaning Level Departure [link ID G-Fig 4-4]	LS												
Parking Exit [link ID H-Fig 4-4]	LS												
Terminal Exit [link ID I-Fig 4-4]	LF												
Return to Terminal Road [link ID J-Fig 4-4]	LS												
Terminal Area Exit [link ID K-Fig 4-4]	LS												
Key Intersections													
NE 82nd Avenue/NE Airport Way													
Moving TriMet Light Rail Line [Double Track]	LS												
Intersection Road Work and Overpass	LS												
Demolition of Embassy Suite	LS												
Demolition and Alternation to Sheraton Hotel	LS												
Mt Hood Interchange Area [3 sections]	LS												
NE Airport Way/I-205 interchange													
1-205 Southbound	LS												
1-205 Northbound	LS												
NE 82nd Avenue/NE Alderwood Road	LS	1	900,000	500,000	250,000	150,000	900,000	2,112,000	1,170,000	590,000	352,000	2,112,000	

MASTER PLAN
PORTLAND INTERNATIONAL AIRPORT **PROJECTED COSTS FOR PLANNING ACTIVITY LEVEL 5 YEAR 2035** Date: October 21, 2009
PORTLAND, OREGON **SUMMARY** By: DN

FUNCTION ELEMENT	Unit	Quantity	Current Sept 2009 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Year of Expenditure 2035 Cost: Unit Project Cost	Construction Cost	Project Development & Support	Project Development Contingency	Total Project Cost	Comments
													3.33% per annum used [yearly escalation average over 20 years for Portland]. A 20% project development contingency used
NE Alderwood Road/NE Cornfoot Road	LS												
NE Airtrans Way/NE Cornfoot Road	LS												
NE Columbia Boulevard/NE 82nd Avenue	LS												
NE Killingsworth Street/I-205 interchange area	LS												
AIR CARGO													
All Cargo													
Warehouse Space [Site Preparation only]	SF	192,000	2	260,000	130,000	78,000	468,000	6	610,000	310,000	184,000	1,104,000	
Ramp	SY	106,000	320	18,840,000	9,420,000	5,652,000	33,912,000	750	44,150,000	22,080,000	13,246,000	79,476,000	
Landside Area [Site Preparation only]	SF	192,000	3	290,000	150,000	88,000	528,000	6	680,000	340,000	204,000	1,224,000	
GENERAL AVIATION													
General													
Site Preparation	Acre												
TOTALS FOR PAL 5				124,110,000	62,080,000	37,238,000	223,428,000		290,860,000	145,450,000	87,262,000	523,572,000	
Check							223,428,000					523,572,000	

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PAL-1 2012
BACK-UP DETAIL ESTIMATE

Item Description	Quantity	Unit	Unit Cost Incl.	Totals
PASSENGER TERMINAL COMPEX				
Aircraft Gates & Parking [No 4]				
Remote /RON Parking				
Temporary Work				
Temporary construction and work	1	LS	50,000.00	50,000
Escorts	1	LS	100,000	100,000
Traffic control	1	LS	20,000.00	20,000
Demolition & Site Preparation				
Removal of concrete or asphalt paving [1/3 area allowed]	8,507	SY	10.50	89,324
Miscellaneous demolition work including drainage and electrical work	25,778	SY	1.25	32,223
Miscellaneous general demolition work	1	LS	10,000.00	10,000
New				
Mass excavation	25,969	CY	8.00	207,752
Extra for rock excavation	260	CY	45.00	11,686
Remove excavated material and stockpile on site	25,969	CY	4.00	103,876
Rough grading and compaction	27,067	SY	0.50	13,534
Erosion & sedimentary control	27,067	SY	0.65	17,594
Imported select compact Sub-base	9,022	CY	18.00	162,396
Geotech fabric	25,778	SY	1.50	38,667
Crushed aggregate base	6,045	CY	34.00	205,530
Concrete paving 16 1/2" thick	25,778	SY	80.00	2,062,240
Asphalt paving	239	TON	115.00	27,485
Sealer coat concrete	25,778	SY	0.25	6,445
Primer and tack coat	1,895	SY	1.50	2,842
Extra for joining new paving to existing	1,160	LF	15.00	17,400
Pavement marking	25,778	SY	0.50	12,889
Allowance for general repair	25,778	SY	0.50	12,889
Utilities				
Drainage to apron area	25,778	SY	15.00	386,670
Electrical including lighting and power	25,778	SY	3.00	77,334
Guidance and general signage	4	EA	3500.00	14,000
Landscaping				
Hydro-seeding and landscaping	1	LS	10000.00	10,000
	Sub-Total			3,692,774
General Contractors General Conditions		12.50%		461,597
	Sub-Total			4,154,370
General Contractors Fee		6.00%		249,262
	Sub-Total			4,403,633
Design & Estimating Contingency		15.00%		660,545
	Total for Remote RON Parking			**5,064,177**
Passenger Security Screening				
Queue Area Primary Check				
Temporary Work				

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Temporary screening and protection to construction area	1,036	SF	1.00	1,036
Demolition				
Interior demolition work	1,036	SF	1.50	1,554
New				
Interior construction	1,036	SF	2.00	2,072
Floor wall and ceiling finishes [mainly using existing]	1,036	SF	1.00	1,036
New queue barrier	1,036	SF	3.00	3,108
Specialties and signage	1,036	SF	2.00	2,072
	1,036	SF	5.00	5,180
HVAC [alteration and additional hvac at examination area]				
Electrical [power supply to examination machines]	1,036	SF	6.00	6,216
Electrical lighting changes	1,036	SF	1.50	1,554
Casework and furniture	1,036	SF	5.00	5,180
Miscellaneous work	1	LS	1,000.00	1,000
	Sub-Total			30,008
Extra for shift and out of normal hours working		30.00%		9,002
	Sub-Total			39,010
General Contractors General Conditions		30.00%		9,002
	Sub-Total			48,013
General Contractors Fee		10.00%		4,801
	Sub-Total			52,814
Design & Estimating Contingency		15.00%		7,922
Total for Queue Area Primary Check				**60,736**

GROUND TRANSPORTATION & PARKING
Rental Car Facility
Service Facility
Rental Car Wash [3 No]

Temporary Work				
Allowance for temporary work and fencing etc	600	SY	1.50	900
Site Preparation & Demolition				
Demolition and preparation	6,750	SF	2.50	16,875
Erosion & sedimentary control	6,750	SF	0.20	1,350
Foundations & Slab				
Foundations	5,400	SF	3.00	16,200
Concrete slab on grade	5,400	SF	6.50	35,100
Superstructure				
Pre-engineered building	5,400	SF	30.00	162,000
Interior Construction				
Partition interior doors	5,400	SF	1.50	8,100
Specialties bollards	12	EA	450.00	5,400
Signs and pavement marking	3	EA	600.00	1,800
Interior Finishes				

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Wall floor and ceiling finishes	5,400	SF	2.00	10,800
Plumbing				
Sump pit	3	EA	1,250.00	3,750
Drainage	3	EA	5,000.00	15,000
HVAC				
Ventilation and radiant heating	5,400	SF	1.50	8,100
Electrical				
Electrical supply and distribution	3	EA	8,500.00	25,500
Lighting and power	5,400	SF	3.00	16,200
Low voltage and communication, fire alarm	5,400	SF	1.65	8,910
Equipment				
Vehicle washing equipment	3	EA	110,000	330,000
Height barrier	3	EA	2,500.00	7,500
Water reclamation system	1	LS	60,000.00	60,000
Steel guard rails	3	EA	4,000.00	12,000
Allow for testing	3	EA	1,250.00	3,750
Site Improvement				
Asphalt paving associated with new washing facility	150	SY	35.00	5,250
Site Mechanical Utilities				
Connecting drain pipe to existing	1	LS	10,000.00	10,000
New water supply	1	LS	10,000.00	10,000
Site Electrical Utilities				
Electrical supply to facility	1	LS	20,000.00	20,000
	Sub-Total			794,485
General Contractors General Conditions		13.00%		103,283
	Sub-Total			897,768
General Contractors Fee		6.50%		58,355
	Sub-Total			956,123
Design & Estimating Contingency		15.00%		143,418
	Total for Car Wash [3 No]			**1,099,541**
Fuel Positions [1]				
Fuel position add to existing				
Temporary Work				
Allowance for temporary work and fencing etc	600	SF	1.00	600
Site Preparation & Demolition				
Allowance for pavement and other demolition work	750	SF	2.50	1,875
Allowance for miscellaneous demolition work	1	LS	500.00	500
Erosion & sedimentary control	750	SF	1.00	750
Site Work				
3" asphalt on 4" crushed rock base including excavation	67	SY	46.88	3,141
Allow for joining paving to existing	1	LS	300.00	300
Reinforced concrete island	150	SF	10.00	1,500
Pavement marking and signage	67	SY	2.50	168
Bollards	4	EA	465.00	1,860

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Canopy	798	SF	30.00	23,940
Miscellaneous painting	1	LS	200.00	200
Utilities				
Storm drainage including connecting to existing	1	LS	1,000.00	1,000
Electrical supply to dispenser	1	LS	1,200.00	1,200
Low voltage control to dispenser	1	LS	1,000.00	1,000
Connecting to existing control	1	LS	500.00	500
Lighting to canopy	798	SF	2.50	1,995
Fuel				
Fuel dispenser to match existing	1	EA	3,350.00	3,350
Supply piping and vent including excavation	1	LS	2,500.00	2,500
New dispenser sump to match existing	1	EA	800.00	800
Extra for connection to existing tank	1	LS	1,000.00	1,000
Miscellaneous work associate with fuel supply and control	1	LS	500.00	500
Sub-Total				48,678
General Contractors General Conditions		14.00%		6,815
Sub-Total				55,493
General Contractors Fee		6.50%		3,607
Sub-Total				59,100
Design & Estimating Contingency		15.00%		8,865
Total for New Fuel Position				**67,965**
Rental Car Stack Spaces [For 90 cars]				
Temporary Work				
Allowance for temporary work and fencing etc	2,000	SY	3.00	6,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work	1,320	SY	10.00	13,200
Allowance for miscellaneous demolition work	1	LS	5,000.00	5,000
Erosion & sedimentary control	2,000	SY	2.25	4,500
Site Work				
3" asphalt on 4" crushed rock base including excavation	2,000	SY	37.50	75,000
Pavement marking and signage	2,000	SY	2.50	5,000
Concrete curb and gutter	660	LF	24.00	15,840
Storm drainage	2,000	SY	8.50	17,000
Oil/water separator	1	LS	10,000.00	10,000
Lighting poles	4	EA	3,500.00	14,000
Allowance for landscaping	1	LS	10,000.00	10,000
Miscellaneous parking equipment including barriers	1	LS	6,000.00	6,000
Electrical supply	1	LS	7,000.00	7,000
Fire hydrant and water main	1	LS	6,500.00	6,500
Fencing	1	LS	6,000.00	6,000
Miscellaneous site work	1	LS	10,000.00	10,000
Sub-Total				211,040

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
General Contractors General Conditions		13.50%		28,490
	Sub-Total			239,530
General Contractors Fee		6.50%		15,569
	Sub-Total			255,100
Design & Estimating Contingency		15.00%		38,265
	Total for Rental Stack Parking			**293,365**
Rental Car Circulation Area				
Temporary Work				
Allowance for temporary work and fencing etc	533	SY	5.00	2,665
Demolition				
Allowance for pavement and other demolition work	533	SY	10.00	5,330
Allowance for miscellaneous demolition work	1	LS	2,500.00	2,500
Site Work				
Erosion & sedimentary control	533	SY	2.25	1,199
3" asphalt on 4" crushed rock base including excavation	533	SY	37.50	19,988
Pavement marking and signage	533	SY	3.00	1,599
Concrete curb and gutter	107	LF	24.00	2,558
Storm drainage	533	SY	8.50	4,531
Lighting poles	1	EA	3,500.00	3,500
Allowance for landscaping	1	LS	2,000.00	2,000
Miscellaneous parking equipment including barriers	1	LS	1,500.00	1,500
Electrical supply	1	LS	1,200.00	1,200
Fire hydrant and water main	1	LS	4,000.00	4,000
Fencing	1	LS	1,500.00	1,500
Miscellaneous site work	1	LS	1,000.00	1,000
	Sub-Total			55,070
General Contractors General Conditions		13.50%		7,434
	Sub-Total			62,504
General Contractors Fee		6.50%		4,063
	Sub-Total			66,567
Design & Estimating Contingency		15.00%		9,985
	Total for Rental Car Parking Circulation			**76,552**
Connecting Bridge				
Temporary Work				
Allowance for temporary work and fencing etc	405	SY	5.00	2,025
Traffic co-ordination and control	1	LS	10,000	10,000
Protection to parking ramp	1	LS	20,000	20,000
Demolition & Site Preparation				

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Allowance for pavement and other demolition work	297	SY	10.00	2,970
Miscellaneous demolition	1	LS	10,000.00	10,000
Clear and prepare site	0.25	ACRE	3,500.00	875
Site Work				
Erosion & sedimentary control	405	SY	3.50	1,418
Excavation	15	CY	10.00	150
Removal of excavated material	15	CY	15.00	225
Compact fill for ramps	675	CY	22.00	14,850
Rough grade	270	SY	1.50	405
Concrete retaining wall foundation	90	LF	250.00	22,500
Concrete retaining wall	810	SF	65.00	52,650
Concrete bridge including support	1,215	SF	265.00	321,975
Bridge spandrel wall	90	LF	140.00	12,600
4" asphalt on 6" crushed rock base	270	SY	40.00	10,800
Extra for joining new road to existing	54	LF	20.00	1,080
Pavement marking and signage	405	SY	2.50	1,013
Crash barrier to bridge columns road	1	LS	5,000.00	5,000
Crash barrier	80	LF	65.00	5,200
Steel guardrails	270	LF	85.00	22,950
Storm drainage	405	SY	6.50	2,633
Lighting poles	4	EA	3,200.00	12,800
Electrical supply	1	LS	10,000	10,000
Allowance for landscaping	1	LS	5,000	5,000
Utility diversion and relocation	1	LS	10,000	10,000
Miscellaneous site work	1	LS	10,000	10,000
	Sub-Total			569,118
General Contractors General Conditions		12.50%		71,140
	Sub-Total			640,257
General Contractors Fee		6.50%		41,617
	Sub-Total			681,874
Design & Estimating Contingency		15.00%		102,281
	Total for Connecting Bridge			**784,155**

Roadway

Terminal Exit [Link ID I-Fig 4-4] [One Lane Added]

Temporary Work				
Allowance for temporary work and fencing etc	2,412	SY	5.00	12,060
Traffic co-ordination and control	1	LS	35,000.00	35,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work	2,412	SY	10.00	24,120
Remove existing fencing etc	1,500	LF	6.00	9,000
Miscellaneous demolition	1	LS	12,000.00	12,000
Site Work				
Erosion & sedimentary control	2,412	SY	3.00	7,236
4" asphalt on 6" crushed rock base including excavation	2,412	SY	45.00	108,540

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Allowance for extra fill	402	CY	22.00	8,844
Extra for joining new road to existing	1	LS	20,000.00	20,000
Pavement marking and signage	2,412	SY	2.50	6,030
Concrete curb and gutter	1,500	LF	30.00	45,000
Storm drainage	2,412	SY	6.50	15,678
Lighting poles	15	EA	3,850.00	57,750
Allowance for landscaping	1	LS	30,000.00	30,000
Electrical supply	1	LS	10,000.00	10,000
Fire hydrant and water main	1	LS	10,000.00	10,000
Fencing	1,500	LF	35.00	52,500
Concrete sidewalk including excavation	9,000	SF	6.00	54,000
Miscellaneous site work	1	LS	25,000.00	25,000
	Sub-Total			542,758
General Contractors General Conditions		13.00%		70,559
	Sub-Total			613,317
General Contractors Fee		6.50%		39,866
	Sub-Total			653,182
Design & Estimating Contingency		15.00%		97,977
Total for Terminal Exit [Link ID I-Fig 4-4]				**751,159**

Key Intersections

NE Airtrans Way/NE Cornfoot Road

Signalizing existing intersection				
Project cost for allowance from Port $300,000				
Adjusted for construction cost				200,000
Total for NE Airtrans Way/NE Cornfoot Road				**200,000**

AIR CARGO

All Cargo

Warehouse Space

New warehouse area 40,000 SF				
Site preparation and utilities to warehouse only				
Temporary Work				
Temporary construction and work	1	LS	10,000.00	10,000
Traffic control	1	LS	5,000.00	5,000
Demolition & Site Preparation				
Miscellaneous general demolition work	1	LS	5,000.00	5,000
Miscellaneous demolition work including drainage and site utilities	4,444	SY	0.25	1,111
Clear and prepare site for building pad	4,444	SY	0.50	2,222
Erosion & sedimentary control	4,444	SY	1.00	4,444
Grade for new building pad	4,444	SY	1.80	7,999
New				

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
All warehouse construction work to be performed at Tenant's cost				
Site Utilities				
Domestic water	1	LS	10,000.00	10,000
Fire water main	1	LS	10,000.00	10,000
Fire hydrants	1	EA	4,000.00	4,000
Sanitary	1	LS	10,000.00	10,000
Storm water	1	LS	10,000.00	10,000
Gas	1	LS	5,000.00	5,000
Electrical supply	1	LS	10,000.00	10,000
	Sub-Total			94,776
General Contractors General Conditions		12.50%		11,847
	Sub-Total			106,623
General Contractors Fee		6.00%		6,397
	Sub-Total			113,021
Design & Estimating Contingency		15.00%		16,953
	Total for Warehouse Space Area			**129,974**
Cargo Warehouse Ramp Area				
New ramp area 51,000 SY				
Temporary Work				
Temporary construction and work	1	LS	50,000.00	50,000
Escorts	1	LS	100,000	100,000
Traffic control	1	LS	30,000.00	30,000
Demolition & Site Preparation				
Removal of concrete or asphalt paving [assuming 1/4 of area]	12,750	SY	10.50	133,875
Miscellaneous demolition work including drainage and electrical work	51,000	SY	0.50	25,500
Clear and prepare site preparation	38,250	SY	0.20	7,650
Miscellaneous general demolition work	1	LS	20,000.00	20,000
New				
Mass excavation	51,378	CY	8.00	411,024
Extra for rock excavation	514	CY	45.00	23,120
Remove excavated material and stockpile on site	51,378	CY	4.00	205,512
Rough grading and compaction	53,550	SY	0.65	34,808
Erosion & sedimentary control	51,000	SY	0.60	30,600
Imported select compact Sub-base	17,850	CY	18.00	321,300
Geotech fabric	51,000	SY	1.50	76,500
Crushed aggregate base	11,960	CY	34.00	406,640
Concrete paving 16 1/2" thick	51,000	SY	80.00	4,080,000
Sealer coat concrete	51,000	SY	0.25	12,750
Extra for joining new paving to existing	700	LF	15.00	10,500
Pavement marking	51,000	SY	0.20	10,200
Allowance for general repair	51,000	SY	0.20	10,200

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Utilities				
Drainage to ramp area	51,000	SY	15.00	765,000
Electrical including lighting and power	51,000	SY	2.50	127,500
Guidance and general signage	1	LS	20,000.00	20,000
Landscaping				
Hydro-seeding and landscaping	1	LS	12000.00	12,000
	Sub-Total			6,924,679
General Contractors General Conditions		12.50%		865,585
	Sub-Total			7,790,263
General Contractors Fee		6.00%		467,416
	Sub-Total			8,257,679
Design & Estimating Contingency		15.00%		1,238,652
	Total for Warehouse Ramp Area			**9,496,331**
Cargo Landside Area				
New landside area 40,000 SF				
Temporary Work				
Allowance for temporary work and fencing etc	4,444	SY	2.00	8,888
Traffic co-ordination and control	1	LS	5,000.00	5,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work [1/3 area allowed]	1,481	SY	10.00	14,813
Remove existing fencing etc	200	LF	6.00	1,200
Miscellaneous demolition	1	LS	5,000.00	5,000
Clear and prepare site for building pad	4,444	SY	0.50	2,222
Erosion & sedimentary control	4,444	SY	1.00	4,444
Grade for new building pad	4,444	SY	1.80	7,999
New				
All cargo landside construction work to be performed at Tenant's cost				
Site Utilities				
Fire water main	1	LS	10,000.00	10,000
Sanitary	1	LS	5,000.00	5,000
Storm water	1	LS	10,000.00	10,000
Electrical supply	1	LS	5,000.00	5,000
	Sub-Total			79,567
General Contractors General Conditions		13.00%		10,344
	Sub-Total			89,910
General Contractors Fee		6.50%		5,844
	Sub-Total			95,754

Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Design & Estimating Contingency		15.00%		14,363
	Total for Cargo Landside Area			**110,117**
GENERAL AVIATION				
General Area [13 Acres]				
Temporary Work				
Allowance for temporary work and fencing etc	62,920	SY	1.00	62,920
Traffic co-ordination and control	1	LS	30,000.00	30,000
Demolition				
Demolish existing maintenance and flight kitchen	819,000	CF	0.26	212,940
Allowance for hazardous waste removal	1	LS	75,000.00	75,000
Break up and remove building concrete slab and foundation	45,500	SF	2.20	100,100
Allowance for asphalt pavement and other demolition work [1/2 area allowed]	28,932	SY	8.00	231,456
Allowance for removing or plugging unused services	28,932	SY	0.80	23,146
Site Preparation				
Clear site [1/2 area allowed]	6.5	ACRES	2,500.00	16,250
Site preparation	62,920	SY	1.25	78,650
	Sub-Total			830,462
General Contractors General Conditions		13.00%		107,960
	Sub-Total			938,422
General Contractors Fee		6.50%		60,997
	Sub-Total			999,419
Design & Estimating Contingency		15.00%		149,913
	Total for Cargo Landside Area			**1,149,332**

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PASSENGER TERMINAL COMPEX				
Aircraft Gates & Parking				
Remote /RON Parking [2 No]				
Temporary Work				
Temporary construction and work	1	LS	25,000.00	25,000
Escorts	1	LS	50,000	50,000
Traffic control	1	LS	10,000.00	10,000
Demolition & Site Preparation				
Removal of concrete or asphalt paving [1/3 area allowed]	4,180	SY	10.50	43,890
Miscellaneous demolition work including drainage and electrical work	12,667	SY	1.25	15,834
Miscellaneous general demolition work	1	LS	6,000.00	6,000
New				
Mass excavation	12,761	CY	8.00	102,088
Extra for rock excavation	128	CY	45.00	5,742
Remove excavated material and stockpile on site	12,761	CY	4.00	51,044
Rough grading and compaction	13,300	SY	0.50	6,650
Erosion & sedimentary control	13,300	SY	0.65	8,645
Imported select compact Sub-base	4,433	CY	18.00	79,794
Geotech fabric	12,667	SY	1.50	19,001
Crushed aggregate base	2,970	CY	34.00	100,980
Concrete paving 16 1/2" thick	12,667	SY	80.00	1,013,360
Asphalt paving	118	TON	115.00	13,570
Sealer coat concrete	12,667	SY	0.25	3,167
Primer and tack coat	931	SY	1.50	1,397
Extra for joining new paving to existing	685	LF	15.00	10,275
Pavement marking	12,667	SY	0.50	6,334
Allowance for general repair	12,667	SY	0.50	6,334
Utilities				
Drainage to apron area	12,667	SY	15.00	190,005
Electrical including lighting and power	12,667	SY	3.00	38,001
Guidance and general signage	2	EA	3500.00	7,000
Landscaping				
Hydro-seeding and landscaping	1	LS	10000.00	10,000
	Sub-Total			1,824,109
General Contractors General Conditions		12.50%		228,014
	Sub-Total			2,052,123
General Contractors Fee		6.00%		123,127
	Sub-Total			2,175,250
Design & Estimating Contingency		15.00%		326,287
	Total for Remote RON Parking			**2,501,537**
Passenger Security Screening				
Screening Lanes				
Unclear how screen walls will be added	No cost estimated			

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Item Description	Quantity	Unit	Unit Cost Incl. Subcont.	Totals	
Queue Area Document Check					
Temporary Work					
Temporary screening and protection to construction area	2,595	SF	1.00	2,595	
Demolition					
Interior demolition work	2,595	SF	1.50	3,893	
New					
Interior construction	2,595	SF	2.00	5,190	
Floor wall and ceiling finishes [mainly using existing]	2,595	SF	1.00	2,595	
New queue barrier	2,595	SF	3.00	7,785	
Specialties and signage	2,595	SF	2.00	5,190	
HVAC [minor alteration]	2,595	SF	1.50	3,893	
Electrical lighting changes	2,595	SF	1.00	2,595	
Casework and furniture	2,595	SF	4.00	10,380	
Miscellaneous work	1	LS	2,500.00	2,500	
	Sub-Total			46,615	
Extra for shift and out of normal hours working		30.00%		13,985	
	Sub-Total			60,600	
General Contractors General Conditions		25.00%		11,654	
	Sub-Total			72,253	
General Contractors Fee		10.00%		7,225	
	Sub-Total			79,479	
Design & Estimating Contingency		15.00%		11,922	
Total for Queue Area Document Check				**91,400**	
Queue Area Primary Check					
Temporary Work					
Temporary screening and protection to construction area	572	SF	1.00	572	
Demolition					
Interior demolition work	572	SF	1.50	858	
New					
Interior construction	572	SF	2.00	1,144	
Floor wall and ceiling finishes [mainly using existing]	572	SF	1.00	572	
New queue barrier	572	SF	3.00	1,716	
Specialties and signage	572	SF	2.00	1,144	
	572	SF	5.00	2,860	
HVAC [alteration and additional hvac at examination area]					
Electrical [power supply to examination machines]	572	SF	5.00	2,860	
Electrical lighting changes	572	SF	1.50	858	
Casework and furniture	572	SF	5.00	2,860	
Miscellaneous work	1	LS	2,500.00	2,500	

Item Description	Quantity	Unit	Unit Cost Incl. Subcont.	Totals	
	Sub-Total			17,944	
Extra for shift and out of normal hours working		30.00%		5,383	
	Sub-Total			23,327	
General Contractors General Conditions		30.00%		5,383	
	Sub-Total			28,710	
General Contractors Fee		10.00%		2,871	
	Sub-Total			31,581	
Design & Estimating Contingency		15.00%		4,737	
Total for Queue Area Primary Check				**36,319**	
GROUND TRANSPORTATION & PARKING					
Public Parking					
Close in Parking					
New Close-in Parking Structure					
Garage located P3 site. Cost of $28,000 per space obtained from Port					
Multi-story parking structure including all construction cost [average cost for parking structure $22,500 per space]	1,912	Space	28,000.00	53,536,000	
	Sub-Total			53,536,000	
General Contractors General Conditions		incl in above			
	Sub-Total			53,536,000	
General Contractors Fee		incl in above			
	Sub-Total			53,536,000	
Design & Estimating Contingency		10.00%		5,353,600	
Total for New Close in Parking Structure				**58,889,600**	
Curbside Loading & Unloading					
Deplaning curbside					
No cost involved					
Rental Car Facility					
Service Facility					
Rental Car Wash [1 No]					
Temporary Work					
Allowance for temporary work and fencing etc	200	SY	1.50	300	

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Item Description	Quantity	Unit	Unit Cost Incl. Subcont.	Totals
Site Preparation & Demolition				
Demolition and preparation	2,250	SF	2.50	5,625
Erosion & sedimentary control	2,250	SF	0.20	450
Foundations & Slab				
Foundations	1,800	SF	3.00	5,400
Concrete slab on grade	1,800	SF	6.50	11,700
Superstructure				
Pre-engineered building	1,800	SF	30.00	54,000
Interior Construction				
Partition interior doors	1,800	SF	1.50	2,700
Specialties bollards	4	EA	450.00	1,800
Signs and pavement marking	1	EA	600.00	600
Interior Finishes				
Wall floor and ceiling finishes	1,800	SF	2.00	3,600
Plumbing				
Sump pit	1	EA	1,250.00	1,250
Drainage	1	EA	5,000.00	5,000
HVAC				
Ventilation and radiant heating	1,800	SF	1.50	2,700
Electrical				
Electrical supply and distribution	1	EA	8,500.00	8,500
Lighting and power	1,800	SF	3.00	5,400
Low voltage and communication, fire alarm	1,800	SF	1.65	2,970
Equipment				
Vehicle washing equipment	1	EA	110,000	110,000
Height barrier	1	EA	2,500.00	2,500
Water reclamation system	1	LS	20,000.00	20,000
Steel guard rails	1	EA	4,000.00	4,000
Allow for testing	1	EA	1,250.00	1,250
Site Improvement				
Asphalt paving associated with new washing facility	50	SY	35.00	1,750
Site Mechanical Utilities				
Connecting drain pipe to existing	1	LS	2,000.00	2,000
New water supply	1	LS	2,000.00	2,000
Site Electrical Utilities				
Electrical supply to facility	1	LS	6,666.00	6,666
	Sub-Total			262,161
General Contractors General Conditions		13.00%		34,081
	Sub-Total			296,242
General Contractors Fee		6.50%		19,256
	Sub-Total			315,498
Design & Estimating Contingency		15.00%		47,325
	Total for Car Wash [1 No]			**362,822**

Fuel Positions [6]

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Item Description	Quantity	Unit	Unit Cost Incl. Subcont.	Totals
Fuel position add to existing				
Temporary Work				
Allowance for temporary work and fencing etc	3,600	SF	1.00	3,600
Site Preparation & Demolition				
Allowance for pavement and other demolition work	4,500	SF	2.50	11,250
Allowance for miscellaneous demolition work	1	LS	5,000.00	5,000
Erosion & sedimentary control	4,500	SF	1.00	4,500
Site Work				
3" asphalt on 4" crushed rock base including excavation	420	SY	41.25	17,325
Allow for joining paving to existing	1	LS	1,000.00	1,000
Reinforced concrete island	720	SF	10.00	7,200
Pavement marking and signage	400	SY	2.50	1,000
Bollards	24	EA	465.00	11,160
Canopy	4,788	SF	30.00	143,640
Miscellaneous painting	1	LS	800.00	800
Utilities				
Storm drainage including connecting to existing	1	LS	2,000.00	2,000
Electrical supply to dispenser	1	LS	3,000.00	3,000
Low voltage control to dispenser	1	LS	2,000.00	2,000
Connecting to existing control	1	LS	500.00	500
Lighting to canopy	4,788	SF	2.50	11,970
Fuel				
Fuel dispenser to match existing	6	EA	3,350.00	20,100
Supply piping and vent including excavation	1	LS	7,500.00	7,500
New dispenser sump to match existing	6	EA	800.00	4,800
Extra for connection to existing tank	1	LS	2,000.00	2,000
Miscellaneous work associate with fuel supply and control	1	LS	1,000.00	1,000
Sub-Total				261,345
General Contractors General Conditions		13.00%		33,975
Sub-Total				295,320
General Contractors Fee		6.50%		19,196
Sub-Total				314,516
Design & Estimating Contingency		15.00%		47,177
Total for New Fuel Position				**361,693**
Rental Car Stack Spaces [For 30 cars]				
Temporary Work				
Allowance for temporary work and fencing etc	667	SY	5.00	3,335
Demolition & Site Preparation				
Allowance for pavement and other demolition work	447	SY	10.00	4,469
Allowance for miscellaneous demolition work	1	LS	2,500.00	2,500
Erosion & sedimentary control	667	SY	2.25	1,501
Site Work				
3" asphalt on 4" crushed rock base including excavation	667	SY	37.50	25,013
Pavement marking and signage	667	SY	2.50	1,668

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Item Description	Quantity	Unit	Unit Cost Incl. Subcont.	Totals
Concrete curb and gutter	220	LF	24.00	5,283
Storm drainage	667	SY	8.50	5,670
Connect to Oil/water separator	1	LS	1,000.00	1,000
Lighting poles	2	EA	3,500.00	7,000
Allowance for landscaping	1	LS	3,500.00	3,500
Miscellaneous parking equipment including barriers	1	LS	1,000.00	1,000
Electrical supply	1	LS	2,500.00	2,500
Fire hydrant and water main	1	LS	3,000.00	3,000
Fencing	1	LS	2,000.00	2,000
Miscellaneous site work	1	LS	3,000.00	3,000
Sub-Total				72,437
General Contractors General Conditions		15.00%		10,866
Sub-Total				83,302
General Contractors Fee		6.50%		5,415
Sub-Total				88,717
Design & Estimating Contingency		15.00%		13,308
Total for Rental Stack Parking				**102,025**
Rental Car Circulation Area				
Temporary Work				
Allowance for temporary work and fencing etc	253	SY	5.00	1,265
Demolition				
Allowance for pavement and other demolition work	253	SY	10.00	2,530
Allowance for miscellaneous demolition work	1	LS	2,500.00	2,500
Site Work				
Erosion & sedimentary control	253	SY	2.25	569
3" asphalt on 4" crushed rock base including excavation	253	SY	37.50	9,488
Pavement marking and signage	253	SY	3.00	759
Concrete curb and gutter	51	LF	24.00	1,214
Storm drainage	253	SY	8.50	2,151
Lighting poles	None			
Allowance for landscaping	1	LS	1,000.00	1,000
Miscellaneous parking equipment including barriers	1	LS	500.00	500
Electrical supply	1	LS	500.00	500
Fire hydrant and water main	None			
Fencing	1	LS	500.00	500
Miscellaneous site work	1	LS	500.00	500
Sub-Total				23,476
General Contractors General Conditions		15.00%		3,521
Sub-Total				26,997
General Contractors Fee		6.50%		1,755

Item Description	Quantity	Unit	Unit Cost Incl. Subcont.	Totals
	Sub-Total			28,752
Design & Estimating Contingency		15.00%		4,313
Total for Rental Car Parking Circulation				**33,065**
Roadway				
Terminal Area Exit [Link ID K-Fig 4-4] [One lane added]				
Temporary Work				
Allowance for temporary work and fencing etc	1,374	SY	5.00	6,870
Traffic co-ordination and control	1	LS	25,000.00	25,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work	1,374	SY	10.00	13,740
Remove existing fencing etc	989	LF	6.00	5,937
Miscellaneous demolition	1	LS	7,500.00	7,500
Site Work				
Erosion & sedimentary control	1,374	SY	3.00	4,122
4" asphalt on 6" crushed rock base including excavation	1,374	SY	45.00	61,830
Allowance for extra fill	229	CY	22.00	5,038
Extra for joining new road to existing	1	LS	10,000.00	10,000
Pavement marking and signage	1,374	SY	2.50	3,435
Concrete curb and gutter	989	LF	30.00	29,684
Storm drainage	1,374	SY	6.50	8,931
Lighting poles	10	EA	3,850.00	38,500
Allowance for landscaping	1	LS	20,000.00	20,000
Electrical supply	1	LS	5,000.00	5,000
Fire hydrant and water main	1	LS	10,000.00	10,000
Fencing	989	LF	35.00	34,632
Concrete sidewalk including excavation	5,937	SF	6.00	35,621
Miscellaneous site work	1	LS	12,000.00	12,000
	Sub-Total			337,840
General Contractors General Conditions		13.00%		43,919
	Sub-Total			381,759
General Contractors Fee		6.50%		24,814
	Sub-Total			406,573
Design & Estimating Contingency		15.00%		60,986
Total for Terminal Exit [Link ID K-Fig 4-4]				**467,559**
Key Intersections				
NE 82nd Ave/NE Airport Way				
Moving TriMet Light Rail Line [Double Track]				
Remove existing track	6,300	TF	25.00	157,500
Remove existing OCS	6,300	TF	15.00	94,500
Remove existing fencing	6,400	LF	6.00	38,400

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Item Description	Quantity	Unit	Unit Cost Incl. Subcont.	Totals
Site clearing and preparation	3	ACRES	3,500.00	10,500
Demolition work associated with new rail route	1	LS	25,000.00	25,000
Excavation and preparation for new double track	3,150	TF	160.00	504,000
Double ballasted track	3,150	TF	660.00	2,079,000
Crossover connection to existing	2	EA	160,000.00	320,000
General drainage and utility relocation	3,150	TF	100.00	315,000
Environment mitigation	1	LS	60,000.00	60,000
Structural walls etc	3,150	TF	100.00	315,000
Traffic control	1	LS	50,000.00	50,000
Signage	1	LS	20,000.00	20,000
Crossings	2	EA	60,000.00	120,000
Signals	1	LS	100,000.00	100,000
Power supply	1	LS	100,000.00	100,000
OCS for double rail	3,150	TF	320.00	1,008,000
Ductbank	3,150	TF	70.00	220,500
Electrical shield at bridge	1	EA	20,000.00	20,000
New fencing	6,400	LF	38.00	243,200
Extra for connection to existing	2	EA	50,000.00	100,000
Communication	3,150	TF	55.00	173,250
Allow for preparing existing track route of other use	14,000	SY	3.00	42,000
Landscape	1	LS	50,000.00	50,000
	Sub-Total			6,165,850
General Contractors General Conditions		13.00%		801,561
	Sub-Total			6,967,411
General Contractors Fee		6.50%		452,882
	Sub-Total			7,420,292
Design & Estimating Contingency		15.00%		1,113,044
Total for NE 82nd Ave/NE Airport Way for Moving Light Rail				**8,533,336**
Intersection Road Work and Overpass				
Temporary Work				
Allowance for temporary work and fencing etc	29,309	SY	5.00	146,545
Allowance for temporary road and diversion during construction including dismantling	1,733	SY	32.00	55,456
Traffic co-ordination and control	1	LS	200,000	200,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work	1,647	SY	10.00	16,470
Remove existing fencing etc	3,400	LF	6.00	20,400
Demolish existing Delta cargo buildings	2,012,500	CF	0.18	362,250
Break-out and remove concrete slab and foundations to hangar	100,625	SF	2.00	201,250
Miscellaneous demolition	1	LS	30,000.00	30,000
Demolition of Sheridan & Embassy Suite hotels taken separately				
Clear and prepare site	7	ACRE	3,500.00	24,500

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Site Work				
Erosion & sedimentary control	36,636	SY	3.50	128,226
Excavation	1,125	CY	7.00	7,875
Removal of excavated material	1,125	CY	15.00	16,875
Compact fill for ramps	47,897	CY	22.00	1,053,730
Rough grade	36,636	SY	1.50	54,954
Concrete retaining wall foundation	16,160	LF	314.81	5,087,407
Concrete retaining wall	335,160	SF	65.00	21,785,400
Concrete bridge including support	16,549	SF	320.00	5,295,680
Bridge spandrel wall	514	LF	160.00	82,240
4" asphalt on 6" crushed rock base	28,136	SY	40.00	1,125,440
Extra for joining new road to existing	1,700	LF	20.00	34,000
Pavement marking and signage	29,645	SY	2.50	74,113
Concrete curb and gutter	2,100	LF	30.00	63,000
Concrete sidewalk including excavation	12,600	SF	5.50	69,300
Crash barrier to bridge columns road	1	LS	30,000.00	30,000
Crash barrier to bridge columns rail	1	LS	20,000.00	20,000
Crash barrier at off and on ramps	1,800	LF	65.00	117,000
Extra for pedestrian down ramp on north side	1,000	SF	30.00	30,000
Steel guardrails	16,387	LF	85.00	1,392,895
Pedestrian crossing with lights	2	EA	20,000.00	40,000
Storm drainage	31,148	SY	6.50	202,462
Lighting poles	41	EA	5,500.00	225,500
Electrical supply	1	LS	120,000	120,000
Traffic signals	4	EA	285,000	1,140,000
Allowance for landscaping	1	LS	250,000	250,000
Fire hydrant and water main	1	LS	60,000.00	60,000
Fencing	4,000	LF	38.00	152,000
Utility diversion and relocation	1	LS	1,000,000	1,000,000
Miscellaneous site work	1	LS	100,000	100,000
	Sub-Total			40,814,968
General Contractors General Conditions		12.50%		5,101,871
	Sub-Total			45,916,838
General Contractors Fee		6.50%		2,984,594
	Sub-Total			48,901,433
Design & Estimating Contingency		15.00%		7,335,215
Total for NE 82nd Ave/NE Airport Way for Intersection & Overpass				**56,236,648**
Demolition of Embassy Suite				
Temporary Work				
Allowance for temporary work and fencing etc	10,226	SY	4.00	40,904
Traffic co-ordination and control	1	LS	10,000	10,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work	500	SY	10.00	5,000
Remove existing fencing etc	300	LF	6.00	1,800

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Item Description	Quantity	Unit	Unit Cost Incl. Subcont.	Totals
Demolish existing Hotel	2,709,200	CF	0.27	731,484
Break-out and remove concrete slab and foundations to hangar	69,200	SF	2.25	155,700
Demolish entry canopy	5,000	SF	3.00	15,000
Allowance for removing or plugging unused services	10,226	SY	2.50	25,565
Miscellaneous demolition work	1	LS	10,000.00	10,000
Site Preparation				
Clear site [1/2 area allowed]	3	ACRES	3,500.00	10,500
Site preparation	10,226	SY	1.50	15,339
	Sub-Total			1,021,292
General Contractors General Conditions		13.00%		132,768
	Sub-Total			1,154,060
General Contractors Fee		6.50%		75,014
	Sub-Total			1,229,074
Design & Estimating Contingency		15.00%		184,361
Total for NE 82nd Ave/NE Airport Way for Demolition of Embassy Suite				**1,413,435**
Demolition and Alternation to Sheridan Hotel				
Temporary Work				
Allowance for temporary work and fencing etc	2,135	SY	10.00	21,350
Traffic co-ordination and control	1	LS	10,000.00	10,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work	1,000	SY	10.00	10,000
Remove existing fencing etc	600	LF	6.00	3,600
Demolish existing Hotel	497,700	CF	0.28	139,356
Break-out and remove concrete slab and foundations to hangar	14,450	SF	2.25	32,513
Allowance for removing or plugging unused services	2,135	SY	2.00	4,270
Miscellaneous demolition work	1	LS	5,000.00	5,000
Site Preparation				
Clear site [1/2 area allowed]	2	ACRES	3,500.00	7,000
Site preparation	2,135	SY	1.50	3,203
Building				
Allow for closing existing building were section has been removed	4,390	SF	70.00	307,300
Extra for alteration work required due to removal of part of hotel	1	LS	600,000	600,000
	Sub-Total			1,143,591
General Contractors General Conditions		13.00%		148,667
	Sub-Total			1,292,258
General Contractors Fee		6.50%		83,997

Item Description	Quantity	Unit	Unit Cost Incl. Subcont.	Totals
	Sub-Total			1,376,255
Design & Estimating Contingency		15.00%		206,438
Total for NE 82nd Ave/NE Airport Way for Demolition & Alteration of The Sheridan				**1,582,693**
AIR CARGO				
All Cargo				
Assuming all new slab. Significant saving could be made if existing is re-used for ramp and landside				
Warehouse Space				
New warehouse area 129,000 SF				
Site preparation and utilities to warehouse only				
Temporary Work				
Temporary construction and work	1	LS	10,000.00	10,000
Traffic control	1	LS	20,000.00	20,000
Demolition & Site Preparation				
Demolish existing two bay large aircraft hangar	27,720,000	CF	0.13	3,603,600
Break-out and remove concrete slab and foundations to hangar	252,000	SF	4.00	1,008,000
Miscellaneous general demolition work	1	LS	25,000.00	25,000
Miscellaneous demolition work including drainage and site utilities	1	LS	10,000.00	10,000
Clear and prepare site for building pad	14,333	SY	0.50	7,167
Erosion & sedimentary control	14,333	SY	1.00	14,333
Grade for new building pad	14,333	SY	1.80	25,799
New				
All warehouse construction work to be performed at Tenant's cost				
Site Utilities				
Assuming existing utilities to hangar can be used for new warehouse				
Domestic water	1	LS	5,000.00	5,000
Fire water main	1	LS	5,000.00	5,000
Fire hydrants	1	EA	4,500.00	4,500
Sanitary	1	LS	8,000.00	8,000
Storm water	1	LS	10,000.00	10,000
Gas	1	LS	2,000.00	2,000
Electrical supply	1	LS	10,000.00	10,000
	Sub-Total			4,768,399
General Contractors General Conditions		12.50%		596,050
	Sub-Total			5,364,449
General Contractors Fee		6.00%		321,867
	Sub-Total			5,686,316
Design & Estimating Contingency		15.00%		852,947
Total for Warehouse Space Area				**6,539,263**

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Item Description	Quantity	Unit	Unit Cost Incl. Subcont.	Totals	
Cargo Warehouse Ramp Area					
New cargo ramp area 72,000 SY					
Using existing ramp to Aircraft Hangar					
Allowing for only minor alteration and repair work					
Demolition					
Remove signage and miscellaneous demolition work	1	LS	8.00	8	
New					
Minor pavement repair and alteration work	72,000	SY	0.50	36,000	
	Sub-Total			36,000	
General Contractors General Conditions		12.50%		4,500	
	Sub-Total			40,500	
General Contractors Fee		6.00%		2,430	
	Sub-Total			42,930	
Design & Estimating Contingency		15.00%		6,440	
	Total for Warehouse Ramp Area			**49,370**	
Cargo Landside Area					
New landside area 129,000 SF					
Temporary Work					
Allowance for temporary work and fencing etc	14,333	SY	2.00	28,666	
Traffic co-ordination and control	1	LS	10,000.00	10,000	
Demolition					
Allowance for pavement and other demolition work [1/4 area allowed]	3,583	SY	10.00	35,833	
Remove existing fencing etc	500	LF	6.00	3,000	
Miscellaneous demolition	1	LS	10,000.00	10,000	
Clear and prepare site for building pad	14,333	SY	0.50	7,167	
Erosion & sedimentary control	14,333	SY	1.00	14,333	
Grade for new building pad	14,333	SY	1.80	25,799	
New					
All cargo landside construction work to be performed at Tenant's cost					
Site Utilities					
Fire water main	1	LS	10,000.00	10,000	
Sanitary	1	LS	5,000.00	5,000	
Storm water	1	LS	10,000.00	10,000	
Electrical supply	1	LS	5,000.00	5,000	
	Sub-Total			164,797	
General Contractors General Conditions		13.00%		21,424	
	Sub-Total			186,221	

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Item Description	Quantity	Unit	Unit Cost Incl. Subcont.	Totals	
General Contractors Fee		6.50%		12,104	
	Sub-Total			198,325	
Design & Estimating Contingency		15.00%		29,749	
	Total for Cargo Landside Area			**228,074**	

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
PASSENGER TERMINAL COMPEX				
Aircraft Gates & Parking				
Remote /RON Parking [No 4]				
Temporary Work				
Temporary construction and work	1	LS	50,000.00	50,000
Escorts	1	LS	100,000	100,000
Traffic control	1	LS	20,000.00	20,000
Demolition & Site Preparation				
Removal of concrete or asphalt paving [1/3 area allowed]	8,507	SY	10.50	89,324
Miscellaneous demolition work including drainage and electrical work	25,778	SY	1.25	32,223
Miscellaneous general demolition work	1	LS	10,000.00	10,000
New				
Mass excavation	25,969	CY	8.00	207,752
Extra for rock excavation	260	CY	45.00	11,686
Remove excavated material and stockpile on site	25,969	CY	4.00	103,876
Rough grading and compaction	27,067	SY	0.50	13,534
Erosion & sedimentary control	27,067	SY	0.65	17,594
Imported select compact Sub-base	9,022	CY	18.00	162,396
Geotech fabric	25,778	SY	1.50	38,667
Crushed aggregate base	6,045	CY	34.00	205,530
Concrete paving 16 1/2" thick	25,778	SY	80.00	2,062,240
Asphalt paving	239	TON	115.00	27,485
Sealer coat concrete	25,778	SY	0.25	6,445
Primer and tack coat	1,895	SY	1.50	2,842
Extra for joining new paving to existing	1,160	LF	15.00	17,400
Pavement marking	25,778	SY	0.50	12,889
Allowance for general repair	25,778	SY	0.50	12,889
Utilities				
Drainage to apron area	25,778	SY	15.00	386,670
Electrical including lighting and power	25,778	SY	3.00	77,334
Guidance and general signage	4	EA	3500.00	14,000
Landscaping				
Hydro-seeding and landscaping	1	LS	12500.00	12,500
	Sub-Total			3,695,274
General Contractors General Conditions		12.50%		461,909
	Sub-Total			4,157,183
General Contractors Fee		6.00%		249,431
	Sub-Total			4,406,614
Design & Estimating Contingency		15.00%		660,992
	Total for Remote RON Parking			**5,067,606**
Passenger Security Screening				
Queue Area Document Check				
Temporary Work				

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Temporary screening and protection to construction area	234	SF	1.00	234
Demolition				
Interior demolition work	234	SF	1.50	351
New				
Interior construction	234	SF	2.00	468
Floor wall and ceiling finishes [mainly using existing]	234	SF	1.00	234
New queue barrier	234	SF	3.00	702
Specialties and signage	234	SF	2.00	468
HVAC [minor alteration]	234	SF	2.00	468
Electrical lighting changes	234	SF	1.50	351
Casework and furniture	234	SF	4.00	936
Miscellaneous work	1	LS	1,000.00	1,000
	Sub-Total			5,212
Extra for shift and out of normal hours working		30.00%		1,564
	Sub-Total			6,776
General Contractors General Conditions		30.00%		1,564
	Sub-Total			8,339
General Contractors Fee		10.00%		834
	Sub-Total			9,173
Design & Estimating Contingency		15.00%		1,376
Total for Queue Area Document Check				**10,549**
Queue Area Primary Check				
Temporary Work				
Temporary screening and protection to construction area	910	SF	1.00	910
Demolition				
Interior demolition work	910	SF	1.50	1,365
New				
Interior construction	910	SF	2.00	1,820
Floor wall and ceiling finishes [mainly using existing]	910	SF	1.00	910
New queue barrier	910	SF	3.00	2,730
Specialties and signage	910	SF	2.00	1,820
	910	SF	5.00	4,550
HVAC [alteration and additional hvac at examination area]				
Electrical [power supply to examination machines]	910	SF	5.00	4,550
Electrical lighting changes	910	SF	1.50	1,365
Casework and furniture	910	SF	5.00	4,550
Miscellaneous work	1	LS	3,000.00	3,000
	Sub-Total			27,570
Extra for shift and out of normal hours working		30.00%		8,271

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
	Sub-Total			35,841
General Contractors General Conditions		30.00%		8,271
	Sub-Total			44,112
General Contractors Fee		10.00%		4,411
	Sub-Total			48,523
Design & Estimating Contingency		15.00%		7,278
Total for Queue Area Primary Check				**55,802**
GROUND TRANSPORTATION & PARKING				
Public Parking				
Close in Parking				
New Close-in Parking Structure				
Garage located P3 site. Cost of $28,000 per space obtained from Port				
Multi-story parking structure including all construction cost [average cost for parking structure $22,500 per space]	3,190	Space	28,000.00	89,320,000
	Sub-Total			89,320,000
General Contractors General Conditions		incl in above		
	Sub-Total			89,320,000
General Contractors Fee		incl in above		
	Sub-Total			89,320,000
Design & Estimating Contingency		10.00%		8,932,000
Total for New Close in Parking Structure				**98,252,000**
Curbside Loading & Unloading				
Deplaning curbside [alteration to accommodate buses, vans etc]				
Temporary Work				
Allowance for temporary work and fencing signage etc	3,547	SY	5.00	17,735
Traffic control	1	LS	20,000.00	20,000
Protection to pedestrians	1	LS	10,000.00	10,000
Demolition & Site Preparation				
Remove and hand to owner existing sidewalk screens, canopies seating and planters etc	1	LS	10,000.00	10,000
Break out and remove existing concrete sidewalk	10,112	SF	2.00	20,224
Allowance for saw cutting	1	LS	1,000.00	1,000
Remove existing concrete road curb and gutter	1,124	LF	5.00	5,620
Allowance for demolition work associated with drainage and electrical power and lighting	3,547	SY	1.50	5,321

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Allowance for moving signage and direction markers	1	LS	1,000.00	1,000
Allowance for miscellaneous demolition work	1	LS	3,000.00	3,000
Erosion & sedimentary control	10,112	SY	1.25	12,640
Site Work				
3" asphalt on 4" crushed rock base including excavation	3,547	SY	41.25	146,314
Extra for connecting to existing	140	LF	10.00	1,400
Concrete curb and gutter	610	LF	30.00	18,300
Concrete repair to existing sidewalk	560	LF	30.00	16,800
Extra for forming traffic island	2	EA	1,500.00	3,000
New stripping and traffic direction pavement marking	3,547	SY	2.50	8,868
Extra for pedestrian walkways crossing	3,248	SF	7.00	22,736
New signage	3,547	SY	10.00	35,470
Bollards	20	EA	450.00	9,000
Pedestrian barrier	400	LF	180.00	72,000
Allowance for canopies and pedestrian waiting facilities	1	LS	50,000.00	50,000
Storm drainage	3,547	SY	5.50	19,509
Lighting	31,920	SF	1.60	51,072
Allowance for landscaping	1	LS	20,000.00	20,000
Miscellaneous parking equipment	1	LS	2,500.00	2,500
Miscellaneous site work	1	LS	25,000.00	25,000
	Sub-Total			608,507
Extra for shift and out of normal hours working		30.00%		182,552
	Sub-Total			791,059
General Contractors General Conditions		15.00%		91,276
	Sub-Total			882,336
General Contractors Fee		6.50%		57,352
	Sub-Total			939,687
Design & Estimating Contingency		15.00%		140,953
	Total for Deplaning Curbside			**1,080,640**

Curbside Roadway lanes

Deplaning roadway curbside

Temporary Work				
Allowance for temporary work and fencing etc	167	SY	10.00	1,670
Traffic control	1	LS	5,000.00	5,000
Demolition & Site Preparation				
Remove existing road surface	167	SY	10.50	1,754
Allowance for saw cutting	1	LS	300.00	300
Remove existing concrete road curb and gutter	250	LF	5.00	1,250
Allowance for demolition work associated with drainage and electrical power and lighting	167	SY	5.00	835
Miscellaneous demolition work	1	LS	1,000.00	1,000
Site Work				

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Repair to existing road at new curb line	250	LF	20.00	5,000
Concrete curb and gutter	250	LF	30.00	7,500
Extra for joining new curb to existing	2	EA	100.00	200
Concrete repair to existing sidewalk	250	LF	35.00	8,750
Forming landscape island between road and sidewalk	3,600	SF	4.00	14,400
New stripping and traffic direction pavement marking	1	LS	1,000.00	1,000
New signage	1	LS	2,500.00	2,500
Bollards	4	EA	450.00	1,800
New catchbasin in new position including connecting to existing pipe runs	2	EA	2,000.00	4,000
Lighting	1	LS	2,500.00	2,500
Miscellaneous site work	1	LS	5,000.00	5,000
	Sub-Total			64,459
Extra for shift and out of normal hours working		30.00%		19,338
	Sub-Total			83,796
General Contractors General Conditions		25.00%		16,115
	Sub-Total			99,911
General Contractors Fee		8.00%		7,993
	Sub-Total			107,904
Design & Estimating Contingency		15.00%		16,186
Total for Deplaning Roadway Curbside				**124,089**

Rental Car Facility

Service Facility

Rental Car Wash [2 No]

Temporary Work				
Allowance for temporary work and fencing etc	400	SY	1.50	600
Site Preparation & Demolition				
Demolition and preparation	4,500	SF	2.50	11,250
Erosion & sedimentary control	4,500	SF	0.20	900
Foundations & Slab				
Foundations	3,600	SF	3.00	10,800
Concrete slab on grade	3,600	SF	6.50	23,400
Superstructure				
Pre-engineered building	3,600	SF	30.00	108,000
Interior Construction				
Partition interior doors	3,600	SF	1.50	5,400
Specialties bollards	8	EA	450.00	3,600
Signs and pavement marking	2	EA	600.00	1,200
Interior Finishes				
Wall floor and ceiling finishes	3,600	SF	2.00	7,200
Plumbing				
Sump pit	2	EA	1,250.00	2,500

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Drainage	2	EA	5,000.00	10,000
HVAC				
Ventilation and radiant heating	3,600	SF	1.50	5,400
Electrical				
Electrical supply and distribution	2	EA	7,500.00	15,000
Lighting and power	3,600	SF	3.00	10,800
Low voltage and communication, fire alarm	3,600	SF	1.65	5,940
Equipment				
Vehicle washing equipment	2	EA	110,000	220,000
Height barrier	2	EA	2,500.00	5,000
Water reclamation system	1	LS	35,000.00	35,000
Steel guard rails	2	EA	4,000.00	8,000
Allow for testing	2	EA	1,250.00	2,500
Site Improvement				
Asphalt paving associated with new washing facility	100	SY	35.00	3,500
Site Mechanical Utilities				
Connecting drain pipe to existing	1	LS	2,000.00	2,000
New water supply	1	LS	2,500.00	2,500
Site Electrical Utilities				
Electrical supply to facility	1	LS	12,000.00	12,000
	Sub-Total			512,490
General Contractors General Conditions		13.00%		66,624
	Sub-Total			579,114
General Contractors Fee		6.50%		37,642
	Sub-Total			616,756
Design & Estimating Contingency		15.00%		92,513
	Total for Car Wash [2 No]			**709,270**
Fuel Positions [6]				
Fuel position add to existing				
Temporary Work				
Allowance for temporary work and fencing etc	3,600	SF	1.00	3,600
Site Preparation & Demolition				
Allowance for pavement and other demolition work	4,500	SF	2.50	11,250
Allowance for miscellaneous demolition work	1	LS	5,000.00	5,000
Erosion & sedimentary control	4,500	SF	1.00	4,500
Site Work				
3" asphalt on 4" crushed rock base including excavation	420	SY	41.25	17,325
Allow for joining paving to existing	1	LS	1,000.00	1,000
Reinforced concrete island	720	SF	10.00	7,200
Pavement marking and signage	400	SY	2.50	1,000
Bollards	24	EA	465.00	11,160
Canopy	4,788	SF	30.00	143,640
Miscellaneous painting	1	LS	800.00	800
Utilities				

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Storm drainage including connecting to existing	1	LS	2,000.00	2,000
Electrical supply to dispenser	1	LS	3,000.00	3,000
Low voltage control to dispenser	1	LS	2,000.00	2,000
Connecting to existing control	1	LS	500.00	500
Lighting to canopy	4,788	SF	2.50	11,970
Fuel				
Fuel dispenser to match existing	6	EA	3,350.00	20,100
Supply piping and vent including excavation	1	LS	7,500.00	7,500
New dispenser sump to match existing	6	EA	800.00	4,800
Extra for connection to existing tank	1	LS	2,000.00	2,000
Miscellaneous work associate with fuel supply and control	1	LS	1,000.00	1,000
	Sub-Total			261,345
General Contractors General Conditions		13.00%		33,975
	Sub-Total			295,320
General Contractors Fee		6.50%		19,196
	Sub-Total			314,516
Design & Estimating Contingency		15.00%		47,177
	Total for New Fuel Position			**361,693**
Rental Car Stack Spaces [For 60 cars]				
Temporary Work				
Allowance for temporary work and fencing etc	1,333	SY	3.00	3,999
Demolition & Site Preparation				
Allowance for pavement and other demolition work	893	SY	10.00	8,931
Allowance for miscellaneous demolition work	1	LS	5,000.00	5,000
Erosion & sedimentary control	1,333	SY	2.25	2,999
Site Work				
3" asphalt on 4" crushed rock base including excavation	1,333	SY	37.50	49,988
Pavement marking and signage	1,333	SY	2.50	3,333
Concrete curb and gutter	440	LF	24.00	10,557
Storm drainage	1,333	SY	8.50	11,331
Connect to Oil/water separator	1	LS	1,000.00	1,000
Lighting poles	4	EA	3,500.00	14,000
Allowance for landscaping	1	LS	7,000.00	7,000
Miscellaneous parking equipment including barriers	1	LS	2,500.00	2,500
Electrical supply	1	LS	5,000.00	5,000
Fire hydrant and water main	1	LS	6,000.00	6,000
Fencing	1	LS	5,000.00	5,000
Miscellaneous site work	1	LS	5,000.00	5,000
	Sub-Total			141,637
General Contractors General Conditions		15.00%		21,246
	Sub-Total			162,883

Item Description	Quantity	Unit	Unit Cost Incl.	Totals
General Contractors Fee		6.50%		10,587
	Sub-Total			173,470
Design & Estimating Contingency		15.00%		26,021
	Total for Rental Stack Parking			**199,491**
Rental Car Circulation Area				
Temporary Work				
Allowance for temporary work and fencing etc	427	SY	5.00	2,135
Demolition				
Allowance for pavement and other demolition work	427	SY	10.00	4,270
Allowance for miscellaneous demolition work	1	LS	2,500.00	2,500
Site Work				
Erosion & sedimentary control	427	SY	2.25	961
3" asphalt on 4" crushed rock base including excavation	427	SY	37.50	16,013
Pavement marking and signage	427	SY	3.00	1,281
Concrete curb and gutter	85	LF	24.00	2,050
Storm drainage	427	SY	8.50	3,630
Lighting poles	1	EA	3,500.00	3,500
Allowance for landscaping	1	LS	1,000.00	1,000
Miscellaneous parking equipment including barriers	1	LS	500.00	500
Electrical supply	1	LS	500.00	500
Fire hydrant and water main	None			
Fencing	1	LS	1,000.00	1,000
Miscellaneous site work	1	LS	500.00	500
	Sub-Total			39,838
General Contractors General Conditions		15.00%		5,976
	Sub-Total			45,814
General Contractors Fee		6.50%		2,978
	Sub-Total			48,792
Design & Estimating Contingency		15.00%		7,319
	Total for Rental Car Parking Circulation			**56,111**
Roadway				
NE Airport Way Westbound [Link ID A-Fig 4-4] [One lane added]				
Temporary Work				
Allowance for temporary work and fencing etc	1,111	SY	5.00	5,555
Traffic co-ordination and control	1	LS	25,000.00	25,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work	1,111	SY	10.00	11,110
Remove existing fencing etc	800	LF	6.00	4,800
Miscellaneous demolition	1	LS	6,000.00	6,000

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Site Work				
Erosion & sedimentary control	1,111	SY	3.00	3,333
4" asphalt on 6" crushed rock base including excavation	1,111	SY	45.00	49,995
Allowance for extra fill	185	CY	22.00	4,070
Extra for joining new road to existing	1	LS	10,000.00	10,000
Pavement marking and signage	1,111	SY	2.50	2,778
Concrete curb and gutter	800	LF	30.00	24,000
Storm drainage	1,111	SY	6.50	7,222
Lighting poles	8	EA	3,850.00	30,800
Allowance for landscaping	1	LS	20,000.00	20,000
Electrical supply	1	LS	5,000.00	5,000
Fire hydrant and water main	1	LS	6,000.00	6,000
Fencing	800	LF	35.00	28,000
Concrete sidewalk including excavation	4,800	SF	6.00	28,800
Miscellaneous site work	1	LS	10,000.00	10,000
Sub-Total				282,462
General Contractors General Conditions		13.00%		36,720
Sub-Total				319,182
General Contractors Fee		6.50%		20,747
Sub-Total				339,929
Design & Estimating Contingency		15.00%		50,989
Total for NE Airport Way Westbound [Link ID A-Fig 4-4]				**390,918**

Key Intersections

NE Alderwood Road/NE Cornfoot Road

Signalizing existing intersection				
Project cost for allowance from Port $750,000				
Adjusted for construction cost				500,000
Total for NE Alderwood Road/NE Cornfort Road				**500,000**

AIR CARGO

All Cargo [New Facility]

Warehouse Space

New warehouse area 114,000 SF				
Site preparation and utilities to Warehouse only				
Temporary Work				
Temporary construction and work	1	LS	10,000.00	10,000
Traffic control	1	LS	5,000.00	5,000
Demolition & Site Preparation				
Miscellaneous general demolition work	1	LS	12,500.00	12,500
Miscellaneous demolition work including drainage and site utilities	1	LS	5,000.00	5,000
Clear and prepare site for building pad	12,667	SY	0.50	6,334
Erosion & sedimentary control	12,667	SY	1.00	12,667

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Grade for new building pad	12,667	SY	1.80	22,801
New				
All warehouse construction work to be performed at Tenant's cost				
Site Utilities				
Assuming new utilities needed [existing not available]				
Domestic water	1	LS	15,000.00	15,000
Fire water main	1	LS	20,000.00	20,000
Fire hydrants	2	EA	4,000.00	8,000
Sanitary	1	LS	25,000.00	25,000
Storm water	1	LS	30,000.00	30,000
Gas	1	LS	10,000.00	10,000
Electrical supply	1	LS	40,000.00	40,000
	Sub-Total			222,301
General Contractors General Conditions		12.50%		27,788
	Sub-Total			250,089
General Contractors Fee		6.00%		15,005
	Sub-Total			265,094
Design & Estimating Contingency		15.00%		39,764
	Total for Warehouse Space Area			**304,858**
Cargo Warehouse Ramp Area				
New ramp area 63,000 SY				
Temporary Work				
Temporary construction and work	1	LS	50,000.00	50,000
Escorts [assuming not required as new area]				
Traffic control	1	LS	20,000.00	20,000
Demolition & Site Preparation [assuming non paved area]				
Miscellaneous demolition work including drainage and electrical work	63,000	SY	0.30	18,900
Clear and prepare site preparation	66,150	SY	0.25	16,538
Miscellaneous general demolition work	1	LS	20,000.00	20,000
New				
Mass excavation	63,467	CY	8.00	507,736
Extra for rock excavation	635	CY	45.00	28,560
Remove excavated material and stockpile on site	63,467	CY	4.00	253,868
Rough grading and compaction	66,150	SY	0.70	46,305
Erosion & sedimentary control	63,000	SY	0.60	37,800
Imported select compact Sub-base	22,050	CY	18.00	396,900
Geotech fabric	63,000	SY	1.50	94,500
Crushed aggregate base	14,774	CY	34.00	502,316
Concrete paving 16 1/2" thick	63,000	SY	80.00	5,040,000
Sealer coat concrete	63,000	SY	0.25	15,750
Pavement marking	63,000	SY	0.20	12,600
Utilities				

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Drainage to ramp area	63,000	SY	15.00	945,000
Electrical including lighting and power	63,000	SY	2.50	157,500
Guidance and general signage	1	LS	20,000.00	20,000
Landscaping				
Hydro-seeding and landscaping	1	LS	15,000.00	15,000
	Sub-Total			8,199,273
General Contractors General Conditions		12.50%		1,024,909
	Sub-Total			9,224,182
General Contractors Fee		6.00%		553,451
	Sub-Total			9,777,633
Design & Estimating Contingency		15.00%		1,466,645
	Total for Warehouse Ramp Area			**11,244,278**
Cargo Landside Area				
New landside area 114,000 SF				
Temporary Work				
Allowance for temporary work and fencing etc	12,667	SY	2.00	25,334
Traffic co-ordination and control	1	LS	10,000.00	10,000
Demolition & Site Preparation [assuming non paved area]				
Remove existing fencing etc	400	LF	6.00	2,400
Miscellaneous demolition	1	LS	10,000.00	10,000
Clear and prepare site for building pad	12,667	SY	0.50	6,334
Erosion & sedimentary control	12,667	SY	1.00	12,667
Grade for new building pad	12,667	SY	1.80	22,801
New				
All cargo landside construction work to be performed at Tenant's cost				
Site Utilities				
Fire water main	1	LS	20,000.00	20,000
Sanitary	1	LS	5,000.00	5,000
Storm water	1	LS	20,000.00	20,000
Electrical supply	1	LS	10,000.00	10,000
	Sub-Total			144,535
General Contractors General Conditions		13.00%		18,790
	Sub-Total			163,325
General Contractors Fee		6.50%		10,616
	Sub-Total			173,941
Design & Estimating Contingency		15.00%		26,091

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Total for Cargo Landside Area				**200,032**
Upgrade of NE Elrod Road [For new Cargo Area] [New Surfacing to Existing & One lane added]				
Temporary Work				
Allowance for temporary work and fencing etc	5,833	SY	5.00	29,165
Traffic co-ordination and control	1	LS	25,000.00	25,000
Demolition & Site Preparation				
Allowance for site clearing and preparation	1.5	ACRES	3,500.00	5,250
Allowance for removal of existing road curb	4,200	LF	4.00	16,800
Allowance for demolition work	5,833	SY	1.00	5,833
Remove existing fencing etc	5,000	LF	3.00	15,000
Allowance for demolition work at road intersection	1	LS	2,000.00	2,000
Site Work				
Erosion & sedimentary control	5,833	SY	3.00	17,499
4" asphalt on 6" crushed rock base including excavation	5,833	SY	45.00	262,485
Allowance for extra fill	972	CY	22.00	21,384
Extra for joining new road to existing	4,200	LF	2.50	10,500
Prepare existing road surface for new topping coat	11,667	SY	2.50	29,168
1 1/2" asphalt topping to existing road surface	11,667	SY	7.50	87,503
New work at road intersection	1	LS	5,000.00	5,000
Pavement marking and signage	17,500	SY	1.00	17,500
Concrete curb and gutter	4,200	LF	30.00	126,000
Storm drainage	5,833	SY	6.50	37,915
Lighting poles	21	EA	3,850.00	80,850
Allowance for landscaping	1	LS	25,000.00	25,000
Electrical supply	1	LS	20,000.00	20,000
Fire hydrant and water main	1	LS	10,000.00	10,000
Fencing	4,200	LF	35.00	147,000
Miscellaneous site work	1	LS	10,000.00	10,000
	Sub-Total			1,006,851
General Contractors General Conditions		13.00%		130,891
	Sub-Total			1,137,741
General Contractors Fee		6.50%		73,953
	Sub-Total			1,211,694
Design & Estimating Contingency		15.00%		181,754
Total for Upgrading NE Elrod Road				**1,393,448**

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
PASSENGER TERMINAL COMPEX				
Aircraft Gates & Parking				
Remote /RON Parking [7 No]				
Temporary Work				
Temporary construction and work	1	LS	75,000.00	75,000
Escorts	1	LS	120,000	120,000
Traffic control	1	LS	30,000.00	30,000
Demolition & Site Preparation				
Removal of concrete or asphalt paving [Taxiway]	4,069	SY	10.50	42,725
Miscellaneous demolition work including drainage and electrical work	27,125	SY	1.25	33,906
Miscellaneous general demolition work	1	LS	15,000.00	15,000
New				
Mass excavation	27,326	CY	8.00	218,608
Extra for rock excavation	273	CY	45.00	12,297
Remove excavated material and stockpile on site	27,326	CY	4.00	109,304
Rough grading and compaction	28,481	SY	0.50	14,241
Erosion & sedimentary control	28,481	SY	0.65	18,513
Imported select compact Sub-base	9,494	CY	18.00	170,892
Geotech fabric	27,125	SY	1.50	40,688
Crushed aggregate base	6,361	CY	34.00	216,274
Concrete paving 16 1/2" thick	27,125	SY	80.00	2,170,000
Asphalt paving	252	TON	115.00	28,980
Sealer coat concrete	27,125	SY	0.25	6,781
Primer and tack coat	1,994	SY	1.50	2,991
Pavement marking	27,125	SY	0.50	13,563
Allowance for general repair to existing	27,125	SY	0.20	5,425
Utilities				
Drainage to apron area	27,125	SY	15.00	406,875
Electrical including lighting and power	27,125	SY	3.00	81,375
Guidance and general signage	7	LS	3500.00	24,500
Landscaping				
Hydro-seeding and landscaping	1	LS	15000.00	15,000
	Sub-Total			3,872,935
General Contractors General Conditions		12.50%		484,117
	Sub-Total			4,357,052
General Contractors Fee		6.00%		261,423
	Sub-Total			4,618,475
Design & Estimating Contingency		15.00%		692,771
	Total for Remote RON Parking			**5,311,247**
Taxiway Connection From RON to Taxiway M				
Allowing taxiway of 500 long by 100'				
Temporary Work				
Temporary construction and work	1	LS	50,000.00	50,000

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Escorts	1	LS	50,000	50,000
Traffic control	1	LS	20,000.00	20,000
Demolition & Site Preparation				
Removal of concrete or asphalt paving [Taxiway]	556	SY	10.50	5,834
Clear and prepare for new Taxiway	5,000	SY	0.70	3,500
Miscellaneous demolition work including drainage and electrical work	5,556	SY	1.25	6,945
Miscellaneous general demolition work	1	LS	10,000.00	10,000
New				
Mass excavation	5,597	CY	8.00	44,776
Extra for rock excavation	56	CY	45.00	2,519
Remove excavated material and stockpile on site	5,597	CY	4.00	22,388
Rough grading and compaction	5,833	SY	0.50	2,917
Erosion & sedimentary control	5,833	SY	0.65	3,791
Imported select compact Sub-base	1,944	CY	18.00	34,992
Geotech fabric	5,556	SY	1.50	8,334
Crushed aggregate base	1,303	CY	34.00	44,302
Concrete paving 16 1/2" thick	5,556	SY	80.00	444,480
Sealer coat concrete	5,556	SY	0.25	1,389
Pavement marking	5,556	SY	0.50	2,778
Allowance for general repair to existing and connecting	1	LS	10,000.00	10,000
Utilities				
Drainage to taxi area	5,556	SY	15.00	83,340
Electrical including lighting and power	5,556	SY	7.00	38,892
Guidance and general signage	1	LS	20000.00	20,000
Landscaping				
Hydro-seeding and landscaping	1	LS	10000.00	10,000
	Sub-Total			921,177
General Contractors General Conditions		12.50%		115,147
	Sub-Total			1,036,324
General Contractors Fee		6.00%		62,179
	Sub-Total			1,098,503
Design & Estimating Contingency		15.00%		164,775
Total for Taxiway Connection From RON				**1,263,279**

Passenger Security Screening

Screening Lanes

Unclear how screen walls will be added	No cost estimated			

Queue Area Document Check

Temporary Work				
Temporary screening and protection to construction area	169	SF	1.00	169
Demolition				
Interior demolition work	169	SF	2.00	338
New				

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Interior construction	169	SF	2.00	338
Floor wall and ceiling finishes [mainly using existing]	169	SF	1.00	169
New queue barrier	169	SF	3.00	507
Specialties and signage	169	SF	2.00	338
HVAC [minor alteration]	169	SF	2.00	338
Electrical lighting changes	169	SF	1.50	254
Casework and furniture	169	SF	4.00	676
Miscellaneous work	1	LS	1,000.00	1,000
	Sub-Total			4,127
Extra for shift and out of normal hours working		30.00%		1,238
	Sub-Total			5,364
General Contractors General Conditions		30.00%		1,238
	Sub-Total			6,602
General Contractors Fee		10.00%		660
	Sub-Total			7,263
Design & Estimating Contingency		15.00%		1,089
Total for Queue Area Document Check				**8,352**
Queue Area Primary Check				
Temporary Work				
Temporary screening and protection to construction area	468	SF	1.00	468
Demolition				
Interior demolition work	468	SF	1.50	702
New				
Interior construction	468	SF	2.00	936
Floor wall and ceiling finishes [mainly using existing]	468	SF	1.00	468
New queue barrier	468	SF	3.00	1,404
Specialties and signage	468	SF	2.00	936
	468	SF	5.00	2,340
HVAC [alteration and additional hvac at examination area]				
Electrical [power supply to examination machines]	468	SF	5.00	2,340
Electrical lighting changes	468	SF	1.50	702
Casework and furniture	468	SF	5.00	2,340
Miscellaneous work	1	LS	2,000.00	2,000
	Sub-Total			14,636
Extra for shift and out of normal hours working		30.00%		4,391
	Sub-Total			19,027
General Contractors General Conditions		30.00%		4,391

Item Description	Quantity	Unit	Unit Cost Incl.	Totals
	Sub-Total			23,418
General Contractors Fee		10.00%		2,342
	Sub-Total			25,759
Design & Estimating Contingency		15.00%		3,864
Total for Queue Area Primary Check				**29,623**
GROUND TRANSPORTATION & PARKING				
Public Parking				
Close in Parking				
New Close-in Parking Structure				
Garage located P3 site. Cost of $28,000 per space obtained from Port				
Multi-story parking structure including all construction cost [average cost for parking structure $22,500 per space]	3,240	Space	28,000.00	90,720,000
	Sub-Total			90,720,000
General Contractors General Conditions		incl in above		
	Sub-Total			90,720,000
General Contractors Fee		incl in above		
	Sub-Total			90,720,000
Design & Estimating Contingency		10.00%		9,072,000
Total for New Close in Parking Structure				**99,792,000**
Employee Parking				
Employee Lot Parking [256 Spaces]				
Temporary Work				
Allowance for temporary work and fencing etc	9,244	SY	2.00	18,488
Demolition work associated with removal of existing facility on new site				
Demolition				
Demolition of existing buildings	1	LS	20,000.00	20,000
Remove slab on grade and foundation to buildings	1	LS	10,000.00	10,000
Site Preparation				
Allowance for pavement and other demolition work	6,101	SY	10.00	61,010
Allowance for miscellaneous demolition work	1	LS	5,000.00	5,000
Erosion & sedimentary control	9,244	SY	2.25	20,799
Site Work				
3" asphalt on 4" crushed rock base including excavation	9,244	SY	37.50	346,650
Pavement marking and signage	9,244	SY	2.50	23,110
Concrete curb and gutter	1,109	LF	24.00	26,623
Storm drainage	9,244	SY	8.50	78,574
Oil/water separator	1	LS	10,000.00	10,000

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Lighting poles	14	EA	3,500.00	49,000
Allowance for landscaping	1	LS	20,000.00	20,000
Miscellaneous parking equipment including barriers	1	LS	12,500.00	12,500
Electrical supply	1	LS	20,000.00	20,000
Fire hydrant and water main	1	LS	20,000.00	20,000
Fencing	1,166	LF	33.00	38,465
Vehicle entry gates electronically controlled	1	EA	8,500.00	8,500
Miscellaneous site work	1	LS	20,000.00	20,000
	Sub-Total			808,719
General Contractors General Conditions		12.00%		97,046
	Sub-Total			905,765
General Contractors Fee		6.50%		58,875
	Sub-Total			964,640
Design & Estimating Contingency		15.00%		144,696
	Total for Employee Lot Parking			**1,109,336**
Curbside Loading & Unloading				
Deplaning curbside [Moving Taxis into Garage]				
Temporary Work				
Allowance for temporary work and fencing signage etc	1,396	SY	5.00	6,980
Traffic control	1	LS	20,000.00	20,000
Protection to pedestrians	1	LS	10,000.00	10,000
Demolition & Site Preparation				
Remove existing garage signage and parking striping	1,396	SY	1.50	2,094
Demolition work associated with new entry and exist	1	LS	10,000.00	10,000
Allowance for miscellaneous demolition work	1	LS	3,000.00	3,000
New Work				
Alteration work to existing parking area to accommodate new road and parking use	1,396	SY	10.00	13,960
New entry and exist	2	EA	10,000.00	20,000
New stripping and traffic direction pavement marking	1,396	SY	2.50	3,490
Extra for pedestrian walkways crossing	2	EA	1,000.00	2,000
New signage	1,396	SY	5.00	6,980
Bollards	8	EA	450.00	3,600
Lighting	12,560	SF	1.50	18,840
Allowance for landscaping	1	LS	10,000.00	10,000
Miscellaneous parking equipment	1	LS	2,500.00	2,500
Miscellaneous site work	1	LS	10,000.00	10,000
	Sub-Total			143,444
Overtime night working and working restrictions		30.00%		43,033
	Sub-Total			186,477

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
General Contractors General Conditions		15.00%		21,517
	Sub-Total			207,994
General Contractors Fee		6.50%		13,520
	Sub-Total			221,513
Design & Estimating Contingency		15.00%		33,227
	Total for Deplaning Curbside			**254,740**
Curbside Roadway Lanes				
Enplaning roadway curbside				
Meet requirements by adjusting operations	No Cost			
Rental Car Facility				
Ready/Return Parking [New Facility 2,700 spaces]				
Allowing 325 SF per space all in Multi-story Parking Structure Garage located P3 site. Cost of $28,000 per space obtained from Port				
Multi-story parking structure including all construction cost [average cost for parking structure $22,500 per space]	2,700	Space	28,000.00	75,600,000
Rental Car Concession Building				
Allow for utilities to rental concession buildings	1	LS	100,000.00	100,000
	Sub-Total			75,700,000
General Contractors General Conditions		12.00%		9,084,000
	Sub-Total			84,784,000
General Contractors Fee		6.50%		5,510,960
	Sub-Total			90,294,960
Design & Estimating Contingency		15.00%		13,544,244
	Total for Ready/Return Parking			**103,839,204**
Service Facility				
Rental Car Wash [18 No] [New Facility]				
Temporary Work				
Allowance for temporary work and fencing etc	3,600	SY	1.00	3,600
Site Preparation & Demolition				
Demolition and preparation	35,640	SF	2.50	89,100
Erosion & sedimentary control	35,640	SF	0.20	7,128
Foundations & Slab				
Foundations	32,400	SF	3.00	97,200
Concrete slab on grade	32,400	SF	6.50	210,600
Superstructure				

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Pre-engineered building	32,400	SF	30.00	972,000
Interior Construction				
Partition interior doors	32,400	SF	1.50	48,600
Specialties bollards	72	EA	450.00	32,400
Signs and pavement marking	18	EA	600.00	10,800
Interior Finishes				
Wall floor and ceiling finishes	32,400	SF	2.00	64,800
Plumbing				
Sump pit	18	EA	1,250.00	22,500
Drainage	18	EA	4,500.00	81,000
HVAC				
Ventilation and radiant heating	32,400	SF	1.50	48,600
Electrical				
Electrical supply and distribution	18	EA	6,000.00	108,000
Lighting and power	32,400	SF	3.00	97,200
Low voltage and communication, fire alarm	32,400	SF	1.65	53,460
Equipment				
Vehicle washing equipment	18	EA	110,000	1,980,000
Height barrier	18	EA	2,500.00	45,000
Water reclamation system	1	LS	200,000	200,000
Steel guard rails	18	EA	4,000.00	72,000
Allow for testing	18	EA	1,250.00	22,500
Site Improvement				
Asphalt paving associated with new washing facility	360	SY	35.00	12,600
Site Mechanical Utilities				
New sewer system	1	LS	26,730.00	26,730
New stormwater system	1	LS	20,000.00	20,000
Oil/water separator	1	EA	10,500.00	10,500
New water supply	1	LS	25,000.00	25,000
New fire hydrants	2	EA	4,000.00	8,000
Site Electrical Utilities				
Electrical supply to facility	1	LS	120,000	120,000
Demolition of Existing Car Wash Facility				
Demolition				
Removal of existing car washing facilities	11	EA	4,500	49,500
Allowance for removing utilizes to facility	1	LS	5,000	5,000
Allow for clean-up	11	EA	500	5,500
	Sub-Total			4,549,318
General Contractors General Conditions		13.00%		591,411
	Sub-Total			5,140,729
General Contractors Fee		6.50%		334,147
	Sub-Total			5,474,877
Design & Estimating Contingency		15.00%		821,232
	Total for Car Wash [18 No]			**6,296,108**

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals	
Fuel Positions [70] [New fuel station facility]					
Allowing 40 gasoline fueling position and 30 charging stations					
Temporary Work					
Allowance for temporary work and fencing etc	42,000	SF	0.80	33,600	
Site Preparation & Demolition					
Allowance for pavement and other demolition work	4,900	SY	8.00	39,200	
Allowance for miscellaneous demolition work	1	LS	10,000.00	10,000	
Erosion & sedimentary control	4,900	SY	3.00	14,700	
Site Work					
3" asphalt on 4" crushed rock base including excavation	3,967	SY	37.50	148,763	
Allow for curb and gutter	820	LF	28.00	22,960	
Reinforced concrete island	8,400	SF	10.00	84,000	
Pavement marking and signage	4,667	SY	2.50	11,668	
Bollards	140	EA	465.00	65,100	
Canopy	55,860	SF	30.00	1,675,800	
Miscellaneous painting	1	LS	10,000.00	10,000	
Fencing	1,000	LF	38.00	38,000	
Vehicle entry gate	2	LS	10,000.00	20,000	
Security Booth	1	EA	20,000.00	20,000	
Lighting to canopy	55,860	SF	2.50	139,650	
Security system	1	LS	20,000.00	20,000	
Building					
Control Building and office	3,000	SF	230.00	690,000	
General signage	1	LS	20,000.00	20,000	
Utilities					
Storm drainage including connecting to existing	4,667	SY	20.00	93,340	
Sanitary drainage	1	LS	20,000.00	20,000	
Oil/water separator	3	EA	10,000.00	30,000	
Water and fire	1	LS	25,000.00	25,000	
Fire hydrants	4	EA	4,000.00	16,000	
Electrical supply	1	LS	100,000.00	100,000	
Fuel & Charging Stations					
Excavation for new storage tanks	3,267	CY	18.00	58,806	
Remove excavated material from site	782	CY	15.00	11,730	
Backfill excavated material	2,485	CY	16.00	39,760	
Concrete base for storage tanks	116	CY	385.00	44,660	
12,000 gallon capacity fiberglass underground double wall fuel storage tank	10	EA	35,000.00	350,000	
Fuel loading cover	10	EA	800.00	8,000	
Ventilation system to tanks	10	EA	3,000.00	30,000	
Fuel dispenser	40	EA	3,350.00	134,000	
Supply piping and vent including excavation	40	EA	1,100.00	44,000	
New dispenser sump to match existing	40	EA	800.00	32,000	
Extra for connection to tanks	1	LS	10,000.00	10,000	
Electrical switchgear and control	1	LS	40,000.00	40,000	
Electrical supply to dispenser	40	EA	650.00	26,000	
Low voltage control to dispenser	40	EA	400.00	16,000	
Electrical charging station	30	EA	3,000.00	90,000	
Electrical supply to charging station	30	EA	1,100.00	33,000	
Control equipment	1	LS	20,000.00	20,000	
Miscellaneous work associate with new fuel facility	1	LS	25,000.00	25,000	
Demolition work associated with removal of existing Fueling Facility					

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Demolition				
Remove existing fuel dispensers and associated piping and electrical controls	43	EA	300.00	12,900
Removal all connecting piping	1	LS	2,000.00	2,000
Removal of electrical equipment cables and supply	1	LS	1,000.00	1,000
Cleaning tanks of sludge and remaining products before removal	5	EA	500.00	2,500
Remove of existing 12,000 gallon underground storage tanks	5	EA	2,000.00	10,000
Remove tanks fro site to disposal tip	5	EA	1,500.00	7,500
Allow for clean-up after tanks have been removed	1	LS	25,000.00	25,000
	Sub-Total			4,421,636
General Contractors General Conditions		12.50%		552,705
	Sub-Total			4,974,341
General Contractors Fee		6.50%		323,332
	Sub-Total			5,297,673
Design & Estimating Contingency		15.00%		794,651
	Total for New Fuel Position			**6,092,324**
Rental Car Stack Spaces [For 540 cars]				
Temporary Work				
Allowance for temporary work and fencing etc	12,000	SY	2.00	24,000
Demolition work associated with removal of existing facility on new site				
Demolition				
Demolition of existing USPS building	662,400	CF	0.25	165,600
Remove slab on grade and foundation to building	41,400	SF	2.00	82,800
Site Preparation				
Allowance for pavement and other demolition work	4,884	SY	10.00	48,840
Allowance for miscellaneous demolition work	1	LS	5,000.00	5,000
Erosion & sedimentary control	12,000	SY	2.25	27,000
Site Work				
3" asphalt on 4" crushed rock base including excavation	12,000	SY	37.50	450,000
Pavement marking and signage	12,000	SY	2.50	30,000
Concrete curb and gutter	1,440	LF	24.00	34,560
Storm drainage	12,000	SY	8.50	102,000
Oil/water separator	1	LS	20,000.00	20,000
Lighting poles	22	EA	3,500.00	77,000
Allowance for landscaping	1	LS	25,000.00	25,000
Miscellaneous parking equipment including barriers	1	LS	10,000.00	10,000
Electrical supply	1	LS	25,000.00	25,000
Fire hydrant and water main	1	LS	25,000.00	25,000
Fencing	1,500	LF	33.00	49,500
Miscellaneous site work	1	LS	25,000.00	25,000
	Sub-Total			1,226,300

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
General Contractors General Conditions		12.00%		147,156
	Sub-Total			1,373,456
General Contractors Fee		6.50%		89,275
	Sub-Total			1,462,731
Design & Estimating Contingency		15.00%		219,410
	Total for Rental Stack Parking			**1,682,140**
Rental Car Circulation Area				
Temporary Work				
Allowance for temporary work and fencing etc	4,053	SY	3.00	12,159
Demolition				
Allowance for pavement and other demolition work	2,716	SY	10.00	27,155
Allowance for miscellaneous demolition work	1	LS	3,000.00	3,000
Site Work				
Erosion & sedimentary control	4,053	SY	2.25	9,119
3" asphalt on 4" crushed rock base including excavation	4,053	SY	37.50	151,988
Pavement marking and signage	4,053	SY	2.65	10,740
Concrete curb and gutter	608	LF	24.00	14,591
Storm drainage	4,053	SY	8.50	34,451
Lighting poles	9	EA	3,500.00	31,500
Allowance for landscaping	1	LS	20,000.00	20,000
Miscellaneous parking equipment including barriers	1	LS	20,000.00	20,000
Control booth	1	LS	15,000.00	15,000
Electrical supply	1	LS	10,000.00	10,000
Fire hydrant and water main	2	EA	4,500.00	9,000
Fencing	500	LF	33.00	16,500
Vehicle entry gates electronically controlled	2	EA	8,500.00	17,000
Main area signage	1	LS	5,000.00	5,000
Miscellaneous site work	1	LS	10,000.00	10,000
	Sub-Total			417,203
General Contractors General Conditions		12.50%		52,150
	Sub-Total			469,353
General Contractors Fee		6.50%		30,508
	Sub-Total			499,861
Design & Estimating Contingency		15.00%		74,979
	Total for Rental Car Parking Circulation			**574,840**
Connecting Bridge [Removal]				
Temporary Work				

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Allowance for temporary work and fencing etc	405	SY	3.00	1,215
Traffic co-ordination and control	1	LS	2,500	2,500
Protection to parking ramp	1	LS	10,000	10,000
Demolition & Site Preparation				
Demolition of crash barrier to bridge columns road	1	LS	500.00	500
Demolition of crash barrier	80	LF	6.00	480
Remove steel guardrails	270	LF	7.00	1,890
Storm drainage and utility demolition work	405	SY	5.00	2,025
Rermove lighting poles	4	EA	400.00	1,600
Removal of concrete bridge including support	1,215	SF	20.00	24,300
Remove asphalt concrete paving	270	SY	7.50	2,025
Remove retaining walls	810	SF	10.00	8,100
Remove retaining wall foundation	90	LF	60.00	5,400
Remove compact fill to ramp	675	CY	8.00	5,400
Miscellaneous demolition	1	LS	5,000.00	5,000
Site Work				
Erosion & sedimentary control	270	SY	5.00	1,350
Rough grade	270	SY	1.50	405
4" asphalt on 6" crushed rock base	270	SY	40.00	10,800
Extra for joining new road to existing	288	LF	20.00	5,760
Pavement marking and signage	270	SY	2.50	675
	Sub-Total			89,425
General Contractors General Conditions		12.50%		11,178
	Sub-Total			100,603
General Contractors Fee		6.50%		6,539
	Sub-Total			107,142
Design & Estimating Contingency		15.00%		16,071
	Total for Connecting Bridge			**123,214**

Roadway

NE Airport Way Eastbound [Link ID B-Fig 4-4] [One lane added]

Temporary Work				
Allowance for temporary work and fencing etc	1,111	SY	5.00	5,555
Traffic co-ordination and control	1	LS	25,000.00	25,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work	1,111	SY	10.00	11,110
Remove existing fencing etc	800	LF	6.00	4,800
Miscellaneous demolition	1	LS	6,000.00	6,000
Site Work				
Erosion & sedimentary control	1,111	SY	3.00	3,333
4" asphalt on 6" crushed rock base including excavation	1,111	SY	45.00	49,995
Allowance for extra fill	185	CY	22.00	4,070
Extra for joining new road to existing	1	LS	10,000.00	10,000
Pavement marking and signage	1,111	SY	2.50	2,778
Concrete curb and gutter	800	LF	30.00	24,000

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Storm drainage	1,111	SY	6.50	7,222
Lighting poles	8	EA	3,850.00	30,800
Allowance for landscaping	1	LS	20,000.00	20,000
Electrical supply	1	LS	5,000.00	5,000
Fire hydrant and water main	1	LS	6,000.00	6,000
Fencing	800	LF	35.00	28,000
Concrete sidewalk including excavation	4,800	SF	6.00	28,800
Miscellaneous site work	1	LS	10,000.00	10,000
	Sub-Total			282,462
General Contractors General Conditions		13.00%		36,720
	Sub-Total			319,182
General Contractors Fee		6.50%		20,747
	Sub-Total			339,929
Design & Estimating Contingency		15.00%		50,989
Total for NE Airport Way Eastbound [Link ID B-Fig 4-4]				**390,918**
Park Entry [Link ID C-Fig 4-4] [One lane added]				
Temporary Work				
Allowance for temporary work and fencing etc	731	SY	5.00	3,655
Traffic co-ordination and control	1	LS	20,000.00	20,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work	731	SY	10.00	7,310
Remove existing fencing etc	526	LF	6.00	3,158
Miscellaneous demolition	1	LS	5,000.00	5,000
Site Work				
Erosion & sedimentary control	731	SY	3.00	2,193
4" asphalt on 6" crushed rock base including excavation	731	SY	45.00	32,895
Allowance for extra fill	122	CY	22.00	2,684
Extra for joining new road to existing	1	LS	5,000.00	5,000
Pavement marking and signage	731	SY	2.50	1,828
Concrete curb and gutter	526	LF	30.00	15,789
Storm drainage	731	SY	6.50	4,752
Lighting poles	5	EA	3,850.00	20,263
Allowance for landscaping	1	LS	10,000.00	10,000
Electrical supply	1	LS	4,000.00	4,000
Fire hydrant and water main	1	LS	5,000.00	5,000
Fencing	526	LF	35.00	18,421
Concrete sidewalk including excavation	No sidewalk allowed			
Miscellaneous site work	1	LS	10,000.00	10,000
	Sub-Total			171,948
General Contractors General Conditions		14.00%		24,073
	Sub-Total			196,020

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
General Contractors Fee		6.50%		12,741
	Sub-Total			208,762
Design & Estimating Contingency		15.00%		31,314
Total for Parking Entry [Link ID C-Fig 4-4]				**240,076**
Deplaning Level Departure [Link ID G-Fig 4-4] [One lane added]				
Temporary Work				
Allowance for temporary work and fencing etc	1,170	SY	5.00	5,850
Traffic co-ordination and control	1	LS	30,000.00	30,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work	1,170	SY	10.00	11,700
Remove existing fencing etc	700	LF	6.00	4,200
Miscellaneous demolition	1	LS	12,000.00	12,000
Site Work				
Erosion & sedimentary control	1,170	SY	3.00	3,510
4" asphalt on 6" crushed rock base including excavation	1,170	SY	45.00	52,650
Allowance for extra fill	195	CY	22.00	4,290
Extra for joining new road to existing	1	LS	10,000.00	10,000
Pavement marking and signage	1,170	SY	2.50	2,925
Concrete curb and gutter	842	LF	30.00	25,263
Storm drainage	1,170	SY	6.50	7,605
Lighting poles	8	EA	3,850.00	32,421
Allowance for landscaping	1	LS	20,000.00	20,000
Electrical supply	1	LS	5,000.00	5,000
Fire hydrant and water main	1	LS	6,000.00	6,000
Fencing	700	LF	35.00	24,500
Concrete sidewalk including excavation	4,200	SF	6.00	25,200
Miscellaneous site work	1	LS	20,000.00	20,000
	Sub-Total			303,114
General Contractors General Conditions		13.00%		39,405
	Sub-Total			342,519
General Contractors Fee		6.50%		22,264
	Sub-Total			364,783
Design & Estimating Contingency		15.00%		54,717
Total for Deplaning Level Departure [Link ID G-Fig 4-4]				**419,500**
Park Exit [Link ID H-Fig 4-4] [One lane added]				
Temporary Work				
Allowance for temporary work and fencing etc	439	SY	5.00	2,195
Traffic co-ordination and control	1	LS	15,000.00	15,000
Demolition & Site Preparation				

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Allowance for pavement and other demolition work	439	SY	10.00	4,390
Remove existing fencing etc	315	LF	6.00	1,890
Miscellaneous demolition	1	LS	5,000.00	5,000
Site Work				
Erosion & sedimentary control	439	SY	3.00	1,317
4" asphalt on 6" crushed rock base including excavation	439	SY	45.00	19,755
Allowance for extra fill	73	CY	22.00	1,606
Extra for joining new road to existing	1	LS	5,000.00	5,000
Pavement marking and signage	439	SY	2.50	1,098
Concrete curb and gutter	315	LF	30.00	9,450
Storm drainage	439	SY	6.50	2,854
Lighting poles	3	EA	3,850.00	10,106
Allowance for landscaping	1	LS	10,000.00	10,000
Electrical supply	1	LS	2,500.00	2,500
Fire hydrant and water main	1	LS	5,000.00	5,000
Fencing	315	LF	35.00	11,025
Concrete sidewalk including excavation	1,890	SF	6.00	11,340
Miscellaneous site work	1	LS	10,000.00	10,000
	Sub-Total			129,525
General Contractors General Conditions		14.00%		18,134
	Sub-Total			147,659
General Contractors Fee		6.50%		9,598
	Sub-Total			157,257
Design & Estimating Contingency		15.00%		23,588
Total for Parking Exit [Link ID H-Fig 4-4]				**180,845**
Terminal Exit [Link ID I-Fig 4-4] [One Lane Added]				
Temporary Work				
Allowance for temporary work and fencing etc	2,412	SY	5.00	12,060
Traffic co-ordination and control	1	LS	35,000.00	35,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work	2,412	SY	10.00	24,120
Remove existing fencing etc	1,660	LF	6.00	9,960
Miscellaneous demolition	1	LS	12,000.00	12,000
Site Work				
Erosion & sedimentary control	2,412	SY	3.00	7,236
4" asphalt on 6" crushed rock base including excavation	2,412	SY	45.00	108,540
Allowance for extra fill	402	CY	22.00	8,844
Extra for joining new road to existing	1	LS	20,000.00	20,000
Pavement marking and signage	2,412	SY	2.50	6,030
Concrete curb and gutter	1,660	LF	30.00	49,800
Storm drainage	2,412	SY	6.50	15,678
Lighting poles	17	EA	3,850.00	63,910
Allowance for landscaping	1	LS	30,000.00	30,000
Electrical supply	1	LS	10,000.00	10,000

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Fire hydrant and water main	1	LS	10,000.00	10,000
Fencing	1,660	LF	35.00	58,100
Concrete sidewalk including excavation	9,960	SF	6.00	59,760
Miscellaneous site work	1	LS	25,000.00	25,000
	Sub-Total			566,038
General Contractors General Conditions		13.00%		73,585
	Sub-Total			639,623
General Contractors Fee		6.50%		41,575
	Sub-Total			681,198
Design & Estimating Contingency		15.00%		102,180
Total for Terminal Exit [Link ID I-Fig 4-4]				**783,378**
Return To Terminal Road [Link ID J-Fig 4-4] [One Lane Added]				
Temporary Work				
Allowance for temporary work and fencing etc	658	SY	5.00	3,290
Traffic co-ordination and control	1	LS	20,000.00	20,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work	658	SY	10.00	6,580
Remove existing fencing etc	474	LF	6.00	2,842
Miscellaneous demolition	1	LS	12,000.00	12,000
Site Work				
Erosion & sedimentary control	658	SY	3.00	1,974
4" asphalt on 6" crushed rock base including excavation	658	SY	45.00	29,610
Allowance for extra fill	110	CY	22.00	2,420
Extra for joining new road to existing	1	LS	10,000.00	10,000
Pavement marking and signage	658	SY	2.50	1,645
Concrete curb and gutter	450	LF	30.00	13,500
Storm drainage	658	SY	6.50	4,277
Lighting poles	5	EA	3,850.00	17,325
Allowance for landscaping	1	LS	20,000.00	20,000
Electrical supply	1	LS	5,000.00	5,000
Fire hydrant and water main	1	LS	6,000.00	6,000
Fencing	450	LF	35.00	15,750
Concrete sidewalk including excavation	2,700	SF	6.00	16,200
Miscellaneous site work	1	LS	20,000.00	20,000
	Sub-Total			208,413
General Contractors General Conditions		13.50%		28,136
	Sub-Total			236,549
General Contractors Fee		6.50%		15,376
	Sub-Total			251,925

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Design & Estimating Contingency		15.00%		37,789
Total for Return To Terminal Road [Link ID J-Fig 4-4]				**289,713**
Terminal Area Exit [Link ID K-Fig 4-4] [One lane added]				
Temporary Work				
Allowance for temporary work and fencing etc	1,374	SY	5.00	6,870
Traffic co-ordination and control	1	LS	25,000.00	25,000
Demolition & Site Preparation				
Allowance for pavement and other demolition work	1,374	SY	10.00	13,740
Remove existing fencing etc	989	LF	6.00	5,937
Miscellaneous demolition	1	LS	7,500.00	7,500
Site Work				
Erosion & sedimentary control	1,374	SY	3.00	4,122
4" asphalt on 6" crushed rock base including excavation	1,374	SY	45.00	61,830
Allowance for extra fill	229	CY	22.00	5,038
Extra for joining new road to existing	1	LS	10,000.00	10,000
Pavement marking and signage	1,374	SY	2.50	3,435
Concrete curb and gutter	989	LF	30.00	29,684
Storm drainage	1,374	SY	6.50	8,931
Lighting poles	10	EA	3,850.00	38,500
Allowance for landscaping	1	LS	20,000.00	20,000
Electrical supply	1	LS	5,000.00	5,000
Fire hydrant and water main	1	LS	10,000.00	10,000
Fencing	989	LF	35.00	34,632
Concrete sidewalk including excavation	5,937	SF	6.00	35,621
Miscellaneous site work	1	LS	12,000.00	12,000
	Sub-Total			337,840
General Contractors General Conditions		13.00%		43,919
	Sub-Total			381,759
General Contractors Fee		6.50%		24,814
	Sub-Total			406,573
Design & Estimating Contingency		15.00%		60,986
Total for Terminal Exit [Link ID K-Fig 4-4]				**467,559**

Key Intersections

None

AIR CARGO

All Cargo

Warehouse Space

New warehouse area 138,000 SF

Site preparation and utilities to warehouse only

Temporary Work

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Temporary construction and work	1	LS	10,000.00	10,000
Traffic control	1	LS	7,000.00	7,000
Demolition & Site Preparation				
Miscellaneous general demolition work	1	LS	14,000.00	14,000
Miscellaneous demolition work including drainage and site utilities	1	LS	6,000.00	6,000
Clear and prepare site for building pad	15,333	SY	0.50	7,667
Erosion & sedimentary control	15,333	SY	1.00	15,333
Grade for new building pad	15,333	SY	1.80	27,599
New				
All warehouse construction work to be performed at Tenant's cost				
Site Utilities				
Assuming connecting to existing utilities				
Domestic water	1	LS	5,000.00	5,000
Fire water main	1	LS	5,000.00	5,000
Fire hydrants	2	EA	4,000.00	8,000
Sanitary	1	LS	10,000.00	10,000
Storm water	1	LS	10,000.00	10,000
Gas	1	LS	5,000.00	5,000
Electrical supply	1	LS	12,500.00	12,500
	Sub-Total			143,099
General Contractors General Conditions		13.00%		18,603
	Sub-Total			161,702
General Contractors Fee		6.00%		9,702
	Sub-Total			171,404
Design & Estimating Contingency		15.00%		25,711
	Total for Warehouse Space Area			**197,114**
Cargo Warehouse Ramp Area				
New ramp area 77,000 SY				
Temporary Work				
Temporary construction and work	1	LS	50,000.00	50,000
Escorts [assuming not required as new area]				
Traffic control	1	LS	20,000.00	20,000
Demolition & Site Preparation [assuming non paved area]				
Miscellaneous demolition work including drainage and electrical work	77,000	SY	0.30	23,100
Clear and prepare site preparation	80,850	SY	0.25	20,213
Miscellaneous general demolition work	1	LS	20,000.00	20,000
New				
Mass excavation	77,571	CY	8.00	620,568
Extra for rock excavation	776	CY	45.00	34,907
Remove excavated material and stockpile on site	77,571	CY	4.00	310,284
Rough grading and compaction	80,850	SY	0.70	56,595

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Erosion & sedimentary control	77,000	SY	0.60	46,200
Imported select compact Sub-base	26,950	CY	18.00	485,100
Geotech fabric	77,000	SY	1.50	115,500
Crushed aggregate base	18,057	CY	34.00	613,938
Concrete paving 16 1/2" thick	77,000	SY	80.00	6,160,000
Sealer coat concrete	77,000	SY	0.25	19,250
Pavement marking	77,000	SY	0.20	15,400
Utilities				
Drainage to ramp area	77,000	SY	15.00	1,155,000
Electrical including lighting and power	77,000	SY	2.50	192,500
Guidance and general signage	1	LS	20,000.00	20,000
Landscaping				
Hydro-seeding and landscaping	1	LS	25,000.00	25,000
	Sub-Total			10,003,554
General Contractors General Conditions		12.50%		1,250,444
	Sub-Total			11,253,999
General Contractors Fee		6.00%		675,240
	Sub-Total			11,929,239
Design & Estimating Contingency		15.00%		1,789,386
	Total for Warehouse Ramp Area			**13,718,624**
Cargo Landside Area				
New landside area 138,000 SF				
Temporary Work				
Allowance for temporary work and fencing etc	15,333	SY	2.00	30,666
Traffic co-ordination and control	1	LS	10,000.00	10,000
Demolition & Site Preparation [assuming non paved area]				
Remove existing fencing etc	460	LF	6.00	2,760
Miscellaneous demolition	1	LS	10,000.00	10,000
Clear and prepare site for building pad	15,333	SY	0.50	7,667
Erosion & sedimentary control	15,333	SY	1.00	15,333
Grade for new building pad	15,333	SY	1.80	27,599
New				
All cargo landside construction work to be performed at Tenant's cost				
Site Utilities				
Fire water main	1	LS	20,000.00	20,000
Sanitary	1	LS	5,000.00	5,000
Storm water	1	LS	20,000.00	20,000
Electrical supply	1	LS	10,000.00	10,000
	Sub-Total			159,025
General Contractors General Conditions		13.00%		20,673

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals	
	Sub-Total			179,698	
General Contractors Fee		6.50%		11,680	
	Sub-Total			191,379	
Design & Estimating Contingency		15.00%		28,707	
	Total for Cargo Landside Area			**220,085**	

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
PASSENGER TERMINAL COMPEX				
Aircraft Gates & Parking				
Remote /RON Parking [6 No]				
Temporary Work				
Temporary construction and work	1	LS	60,000.00	60,000
Escorts	1	LS	105,000	105,000
Traffic control	1	LS	25,000.00	25,000
Demolition & Site Preparation				
Removal of concrete or asphalt paving [Taxiway]	3,500	SY	10.50	36,750
Miscellaneous demolition work including drainage and electrical work	23,333	SY	1.25	29,166
Miscellaneous general demolition work	1	LS	12,000.00	12,000
New				
Mass excavation	23,506	CY	8.00	188,048
Extra for rock excavation	235	CY	45.00	10,578
Remove excavated material and stockpile on site	23,506	CY	4.00	94,024
Rough grading and compaction	24,500	SY	0.50	12,250
Erosion & sedimentary control	24,500	SY	0.65	15,925
Imported select compact Sub-base	8,167	CY	18.00	147,006
Geotech fabric	23,333	SY	1.50	35,000
Crushed aggregate base	5,472	CY	34.00	186,048
Concrete paving 16 1/2" thick	23,333	SY	80.00	1,866,640
Asphalt paving	217	TON	115.00	24,955
Sealer coat concrete	23,333	SY	0.25	5,833
Primer and tack coat	1,895	SY	1.50	2,842
Extra for joining new paving to existing	525	LF	15.00	7,875
Pavement marking	23,333	SY	0.50	11,667
Allowance for general repair	23,333	SY	0.50	11,667
Utilities				
Drainage to apron area	23,333	SY	15.00	349,995
Electrical including lighting and power	23,333	SY	3.00	69,999
Guidance and general signage	6	EA	3500.00	21,000
Landscaping				
Hydro-seeding and landscaping	1	LS	12500.00	12,500
	Sub-Total			3,341,767
General Contractors General Conditions		12.50%		417,721
	Sub-Total			3,759,488
General Contractors Fee		6.00%		225,569
	Sub-Total			3,985,057
Design & Estimating Contingency		15.00%		597,759
	Total for Remote RON Parking			**4,582,815**
Passenger Security Screening				
Screening Lanes				
Unclear how screen walls will be added	No cost estimated			

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Queue Area Document Check				
Temporary Work				
Temporary screening and protection to construction area	1,144	SF	1.00	1,144
Demolition				
Interior demolition work	1,144	SF	1.50	1,716
New				
Interior construction	1,144	SF	2.00	2,288
Floor wall and ceiling finishes [mainly using existing]	1,144	SF	1.00	1,144
New queue barrier	1,144	SF	3.00	3,432
Specialties and signage	1,144	SF	2.00	2,288
HVAC [minor alteration]	1,144	SF	2.00	2,288
Electrical lighting changes	1,144	SF	1.50	1,716
Casework and furniture	1,144	SF	4.00	4,576
Miscellaneous work	1	LS	3,000.00	3,000
Sub-Total				23,592
Extra for shift and out of normal hours working		30.00%		7,078
Sub-Total				30,670
General Contractors General Conditions		25.00%		5,898
Sub-Total				36,568
General Contractors Fee		10.00%		3,657
Sub-Total				40,224
Design & Estimating Contingency		15.00%		6,034
Total for Queue Area Document Check				**46,258**
Queue Area Primary Check				
Temporary Work				
Temporary screening and protection to construction area	1,170	SF	1.00	1,170
Demolition				
Interior demolition work	1,170	SF	1.50	1,755
New				
Interior construction	1,170	SF	2.00	2,340
Floor wall and ceiling finishes [mainly using existing]	1,170	SF	1.00	1,170
New queue barrier	1,170	SF	3.00	3,510
Specialties and signage	1,170	SF	2.00	2,340
	1,170	SF	5.00	5,850
HVAC [alteration and additional hvac at examination area]				
Electrical [power supply to examination machines]	1,170	SF	5.00	5,850
Electrical lighting changes	1,170	SF	1.50	1,755
Casework and furniture	1,170	SF	5.00	5,850
Miscellaneous work	1	LS	4,000.00	4,000

Item Description	Quantity	Unit	Unit Cost Incl.	Totals
	Sub-Total			35,590
Extra for shift and out of normal hours working		30.00%		10,677
	Sub-Total			46,267
General Contractors General Conditions		30.00%		10,677
	Sub-Total			56,944
General Contractors Fee		10.00%		5,694
	Sub-Total			62,638
Design & Estimating Contingency		15.00%		9,396
Total for Queue Area Primary Check				**72,034**
GROUND TRANSPORTATION & PARKING				
Public Parking				
Close in Parking				
New Close-in Parking Structure				
Garage located P3 site. Cost of $28,000 per space obtained from Port				
Multi-story parking structure including all construction cost [average cost for parking structure $22,500 per space]	3,190	Space	28,000.00	89,320,000
	Sub-Total			89,320,000
General Contractors General Conditions		incl in above		
	Sub-Total			89,320,000
General Contractors Fee		incl in above		
	Sub-Total			89,320,000
Design & Estimating Contingency		10.00%		8,932,000
Total for New Close in Parking Structure				**98,252,000**
Employee Parking				
Employee Lot Parking [300 Spaces]				
Temporary Work				
Allowance for temporary work and fencing etc	10,833	SY	2.00	21,666
Demolition work associated with removal of existing facility on new site				
Demolition				
Demolition of existing buildings	1	LS	20,000.00	20,000
Remove slab on grade and foundation to buildings	1	LS	10,000.00	10,000
Site Preparation				
Allowance for pavement and other demolition work	7,150	SY	10.00	71,498
Allowance for miscellaneous demolition work	1	LS	5,000.00	5,000

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Erosion & sedimentary control	10,833	SY	2.25	24,374
Site Work				
3" asphalt on 4" crushed rock base including excavation	10,833	SY	37.50	406,238
Pavement marking and signage	10,833	SY	2.50	27,083
Concrete curb and gutter	1,300	LF	24.00	31,199
Storm drainage	10,833	SY	8.50	92,081
Oil/water separator	1	LS	10,000.00	10,000
Lighting poles	16	EA	3,500.00	56,000
Allowance for landscaping	1	LS	22,000.00	22,000
Miscellaneous parking equipment including barriers	1	LS	12,500.00	12,500
Electrical supply	1	LS	20,000.00	20,000
Fire hydrant and water main	1	LS	20,000.00	20,000
Fencing	1,280	LF	33.00	42,240
Vehicle entry gates electronically controlled	1	EA	8,500.00	8,500
Miscellaneous site work	1	LS	24,000.00	24,000
	Sub-Total			924,378
General Contractors General Conditions		12.00%		110,925
	Sub-Total			1,035,303
General Contractors Fee		6.50%		67,295
	Sub-Total			1,102,598
Design & Estimating Contingency		15.00%		165,390
	Total for Employee Lot Parking			**1,267,987**

Curbside Loading & Unloading

Deplaning curbside [alteration to accommodate buses, vans etc]

All cost involved have been taken care of in PAL-4

Curbside Roadway lanes

Enplaning roadway curbside

Roadway alteration roadwork adding traffic island has been included in PAL 4
Further work to increase enplaning will encounter major design work
No estimated cost included in PAL-5

Rental Car Facility

No increase in this facility has been planned under PAL-5

Roadway

No roadwork changes or additions have been planned under PAL-5

Key Intersections

NE 82nd Avenue/NE Alderwood Road

Signalizing existing intersection
Project cost for allowance from Port $750,000
Adjusted for construction cost 500,000

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals	
Total for NE Alderwood Road/NE Cornfort Road				**500,000**	
AIR CARGO					
All Cargo [New Facility]					
Warehouse Space					
New warehouse area 192,000 SF					
Site preparation and utilities to Warehouse only					
Temporary Work					
Temporary construction and work	1	LS	10,000.00	10,000	
Traffic control	1	LS	8,500.00	8,500	
Demolition & Site Preparation					
Miscellaneous general demolition work	1	LS	20,000.00	20,000	
Miscellaneous demolition work including drainage and site utilities	1	LS	8,000.00	8,000	
Clear and prepare site for building pad	21,333	SY	0.50	10,667	
Erosion & sedimentary control	21,333	SY	1.00	21,333	
Grade for new building pad	21,333	SY	1.80	38,399	
New					
All warehouse construction work to be performed at Tenant's cost					
Site Utilities					
Assuming connecting to existing utilities					
Domestic water	1	LS	6,000.00	6,000	
Fire water main	1	LS	6,000.00	6,000	
Fire hydrants	3	EA	4,500.00	13,500	
Sanitary	1	LS	13,500.00	13,500	
Storm water	1	LS	13,000.00	13,000	
Gas	1	LS	6,500.00	6,500	
Electrical supply	1	LS	15,000.00	15,000	
Sub-Total				190,399	
General Contractors General Conditions		12.50%		23,800	
Sub-Total				214,199	
General Contractors Fee		6.00%		12,852	
Sub-Total				227,051	
Design & Estimating Contingency		15.00%		34,058	
Total for Warehouse Space Area				**261,108**	
Cargo Warehouse Ramp Area					
New ramp area 106,000 SY					
Temporary Work					
Temporary construction and work	1	LS	50,000.00	50,000	
Escorts [assuming not required as new area]					
Traffic control	1	LS	20,000.00	20,000	
Demolition & Site Preparation [assuming non paved area]					

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Miscellaneous demolition work including drainage and electrical work	106,000	SY	0.30	31,800
Clear and prepare site preparation	111,300	SY	0.25	27,825
Miscellaneous general demolition work	1	LS	30,000.00	30,000
New				
Mass excavation	106,786	CY	8.00	854,288
Extra for rock excavation	1,068	CY	45.00	48,054
Remove excavated material and stockpile on site	106,786	CY	4.00	427,144
Rough grading and compaction	111,300	SY	0.70	77,910
Erosion & sedimentary control	106,000	SY	0.60	63,600
Imported select compact Sub-base	37,100	CY	18.00	667,800
Geotech fabric	106,000	SY	1.50	159,000
Crushed aggregate base	24,857	CY	34.00	845,138
Concrete paving 16 1/2" thick	106,000	SY	80.00	8,480,000
Sealer coat concrete	106,000	SY	0.25	26,500
Pavement marking	106,000	SY	0.20	21,200
Utilities				
Drainage to ramp area	106,000	SY	15.00	1,590,000
Electrical including lighting and power	106,000	SY	2.50	265,000
Guidance and general signage	1	LS	25,000.00	25,000
Landscaping				
Hydro-seeding and landscaping	1	LS	25,000.00	25,000
	Sub-Total			13,735,259
General Contractors General Conditions		12.50%		1,716,907
	Sub-Total			15,452,166
General Contractors Fee		6.00%		927,130
	Sub-Total			16,379,296
Design & Estimating Contingency		15.00%		2,456,894
	Total for Warehouse Ramp Area			**18,836,190**
Cargo Landside Area				
New landside area 192,000 SF				
Temporary Work				
Allowance for temporary work and fencing etc	21,333	SY	2.00	42,666
Traffic co-ordination and control	1	LS	10,000.00	10,000
Demolition & Site Preparation [assuming non paved area]				
Remove existing fencing etc	640	LF	6.00	3,840
Miscellaneous demolition	1	LS	12,500.00	12,500
Clear and prepare site for building pad	21,333	SY	0.50	10,667
Erosion & sedimentary control	21,333	SY	1.00	21,333
Grade for new building pad	21,333	SY	1.80	38,399
New				
All cargo landside construction work to be performed at Tenant's cost				
Site Utilities				

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Item Description	Quantity	Unit	Unit Cost Incl.	Totals
Fire water main	1	LS	20,000.00	20,000
Sanitary	1	LS	10,000.00	10,000
Storm water	1	LS	25,000.00	25,000
Electrical supply	1	LS	15,000.00	15,000
	Sub-Total			209,405
General Contractors General Conditions		13.00%		27,223
	Sub-Total			236,628
General Contractors Fee		6.50%		15,381
	Sub-Total			252,008
Design & Estimating Contingency		15.00%		37,801
	Total for Cargo Landside Area			**289,810**

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Project Development & Support

Information from Port of Portland	
Project Admin	4.00%
Design Fees	26.00%
Construction Management	18.00%
Permit	1.00%
Close-out	1.00%
	50.0%

Poject Development Contingency

20%

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	Escalation Cost		escalation amount				
	Current start	May-08 December-89 over 20 years	3.3%				
	Using Escalation	Sep-09	**3.33%** annual inflation over 20 years		months	Year	
	Sep-09					1.0000	
		103.3%	0.033	1.000	0.0333	0.0333	
	Sep-10					1.0333	3.33%
		103.3%	0.0333	1.000	0.0333	0.0344	
	Sep-11					1.0677	6.77%
		103.3%	0.0333	1.000	0.0333	0.0356	
PAL-1	Sep-12					1.1033	10.33%
		103.3%	0.0333	1.000	0.0333	0.0367	
	Sep-13					1.1400	14.00%
		103.3%	0.0333	1.000	0.0333	0.0380	
	Sep-14					1.1780	17.80%
		103.3%	0.0333	1.000	0.0333	0.0392	
	Sep-15					1.2172	21.72%
		103.3%	0.0333	1.000	0.0333	0.0405	
	Sep-16					1.2577	25.77%
		103.3%	0.0333	1.000	0.0333	0.0419	
PAL-2	Sep-17					1.2996	29.96%
		103.3%	0.0333	1.000	0.0333	0.0433	
	Sep-18					1.3429	34.29%
		103.3%	0.0333	1.000	0.0333	0.0447	
	Sep-19					1.3876	38.76%
		103.3%	0.0333	1.000	0.0333	0.0462	
	Sep-20					1.4338	43.38%
		103.3%	0.0333	1.000	0.0333	0.0477	
	Sep-21					1.4816	48.16%
		103.3%	0.0333	1.000	0.0333	0.0493	
PAL-3	Sep-22					1.5309	53.09%
		103.3%	0.0333	1.000	0.0333	0.0510	
	Sep-23					1.5819	58.19%
		103.3%	0.0333	1.000	0.0333	0.0527	
	Sep-24					1.6345	63.45%
		103.3%	0.0333	1.000	0.0333	0.0544	
	Sep-25					1.6890	68.90%
		103.3%	0.0333	1.000	0.0333	0.0562	
	Sep-26					1.7452	74.52%
		103.3%	0.0333	1.000	0.0333	0.0581	
PAL-4	Sep-27					1.8033	80.33%
		103.3%	0.0333	1.000	0.0333	0.0601	
	Sep-28					1.8634	86.34%
		103.3%	0.0333	1.000	0.0333	0.0621	
	Sep-29					1.9254	92.54%
		103.3%	0.0333	1.000	0.0333	0.0641	
	Sep-30					1.9896	98.96%
		103.3%	0.0333	1.000	0.0333	0.0663	
	Sep-31					2.0558	105.58%
		103.3%	0.0333	1.000	0.0333	0.0685	
	Aug-32					2.1243	112.43%
		103.3%	0.0333	1.000	0.0333	0.0707	
	Sep-33					2.1950	119.50%
		103.3%	0.0333	1.000	0.0333	0.0731	
	Sep-34					2.2681	126.81%
		103.3%	0.0333	1.000	0.0333	0.0755	
PAL-5	Sep-35					2.3436	134.36%
		103.3%	0.0333	1.000	0.0333	0.0780	

8.14.3 Scope

The enplaning roadway study should consider the potential impact of construction of the additional lanes on the entire terminal area, especially the lower level roadway.

8.14.4 Timing

The enplaning roadway study should be completed within two years of the Master Plan Update to accommodate PAL 1 requirements.