Client #	54857	**Date**	February 29, 2015
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Project Name	Seward Airport Improvements	**Reviewed by**	KR/AS/KK
Subject	Location Study/Alternatives Memo		

Topic	Discussion
Introduction	The Alaska Department of Transportation and Public Facilities (DOT&PF) is proposing to improve the airport at Seward, Alaska. The State of Alaska owns and operates the Seward Airport, which includes a paved main runway (13-31), a paved crosswind runway (16-34), multiple taxiways, and two aprons. Seward is located on the Kenai Peninsula at the north end of Resurrection Bay, approximately 75 air miles or 125 highway miles southwest of Anchorage. The Seward Airport primarily serves the City of Seward and residents of the area between Seward and Moose Pass. Local residents use the airport for travel to Anchorage and Prince William Sound. Tour operators also use the airport as a base for sightseeing tours of Kenai Fjords National Park via airplane and helicopter. The number of operations at the airport is much higher in the summer than in the winter.
Background	Most of the Seward Airport is located within the floodplain of the Resurrection River Delta. The frequency with which Runway 13-31 has been overtopped by the Resurrection River has increased significantly in recent years. During the 13 years from 1995 to 2008, the runway was overtopped at least four times. During the four years from 2009 to September 2013, the runway was overtopped 15 times. These instances were limited initially to the fall, but they are now occurring in the summer as well (June to November). Recent changes in channel morphology have rendered the existing riprap along the eastern side of the runway inadequate. Without additional protection, erosion and overtopping of the runway will continue and DOT&PF will keep pouring maintenance funds into the river. Recent testing of the main runway embankment shows an insufficient bearing capacity to support large aircraft. Frequent flooding is thought to have contributed to a weakened embankment under the pavement. As a result, landings by larger aircraft have been restricted. The Seward Airport Improvements project has two primary purposes. The first is to develop engineering solutions that will protect the airport facilities from further damage caused by recurrent flooding, and the second is to correct deficiencies that may exist based on the airport's forecast function and Federal Aviation Administration (FAA) design standards. The first task of the project was to review the recommendations of the 2008 Airport Master Plan (AMP) and revisit the project's purpose and need. In the light of recent flood and erosion events, as well as potential changes in airport activity and funding constraints,

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	refinements of the 2008 recommendations were anticipated. A draft technical memorandum titled *Aviation Activity & Facility Requirements* was prepared in September 2014. That memorandum presents the past aviation activity and forecast future activity, as well as the mix of aircraft type. It is the future demand that drives recommendations for the facility requirements. The memo was reviewed by DOT&PF and then by the Seward Working Group (SWG), group established to maintain regular communication between the project team and key stakeholders impacted by the project, namely, the City of Seward, local pilots, and adjacent landowners. The memo was reviewed by DOT&PF and then the SWG in November 2014, and after revisions, again in July 2015. The memo's recommendations included a long-term plan for a 4,000-foot runway meeting Design Group II dimensional standards, with a near-term recommendation for a 3,300-foot runway. At the November 2014 SWG meeting, members strongly voiced the importance of a 4,000-foot runway, noting that the longer runway was justified given projected increases in population and economic development. In general, SWG members wanted to see alternatives with a length similar to the existing main runway (4,249 feet) and asked that reconstruction of the existing runway to withstand the erosive forces be considered. The project team further studied the economic data and other resources provided by the SWG, and revised the document. Recommendations from that revised document were presented to the SWG in July 2015. Consensus was reached that a 3,300-foot runway length was acceptable for the near term. Allowances would be made for a future runway length of 4,000 feet. An increase in economic activity or initiation of commuter air service would support the longer runway length. ***This technical memorandum documents the alternative development and evaluation process. It will be combined with other technical memoranda and special reports (such as the Hydrology & Hydraulic Analysis report) to produce the Scoping Report.***
Design Standards	The draft *Aviation Activity & Facility Requirements* technical memorandum documents the facility requirements, which drive the layout of the alternatives. For development and evaluation of initial alternatives, only the primary elements of the airport facilities—the runway and taxiway—were considered. Key dimensional standards are summarized below.

Runway	**Runway Dimensional Standards for Various Scenarios**

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Feature	Current Based Aircraft Group	Current Demand & Medevac (Beech 200) Recommended for Near-Term Development	Growth Scenario & Emergency Preparedness (Beech 1900) Long Term Plan	Existing RW 13-31
Approach Category*	A	**B**	B	B
Aircraft Design Group**	I	**II**	II	II
Runway Length	3,300' (Note 1)	**3,300' (Note 1)**	4,000'/4,700' (Note 2)	4,249'
Runway Width	60'	**75'**	75'	100'
Visibility Minimums	1 mile	**1 mile**	1 mile	1 mile
Crosswind Component	10.5 knots	**13 knots**	13 knots	13 knots
Runway Safety Area	120' x 3,780'	**150' x 3,900'**	150' x 4,600’	150’ x 4,749'
Object Free Area	400' x 3,780'	**500' x 3,900'**	500' x 4,600’	500' x 4,749'
Runway Protection Zone	1,000' x 500' x 700'	**1,000' x 500' x 700'**	1,000' x 500' x 700’	1,000' x 500' x 700'
Part 77 Primary Surface	500' x 3,700'	**500' x 3,700'**	500' x 4,400'	500' x 4,649'
Part 77 Approach Slope	20:1 (Visual)	**20:1 (Visual) (Note 3)**	20:1 (Visual) (Note 3)	20:1 (Visual)

* Approach Category: a letter code, A-E, that classifies aircraft based on the speed at which the aircraft approaches a runway for landing. Category A aircraft approach at a slower speed than Category E aircraft; the higher the approach speed, the longer the runway needed.
**Aircraft Design Group: a numerical code, I-VI, that groups aircraft by wingspan range. Group I has the smallest wingspan range; Group VI aircraft has the widest wingspan range. The wider the wingspan range, the wider the runway.

1. Minimum runway length for community class airports per Alaska Aviation Preconstruction Manual exceeds FAA Advisory Circular (AC) 150/5325-4B (2,750 feet for 95% of fleet or 3,250 feet for 100% of fleet) and Beech 200 published takeoff and landing distances.
2. The 4,700-foot length is based on FAA AC 150/5325-4B for aircraft over 12,500 lbs. but less than 60,000 lbs. (75% of fleet at 60% useful load). FAA is circulating a Draft AC 150/5325-4C, which recommends using the manufacturer’s airport planning manuals for all airplanes over 12,500 lbs. The Beech 1900D specification and performance sheet lists a takeoff length of 3,737 feet. Discussions with the primary air carrier in Alaska using this aircraft indicated a need for a 4,000-foot runway to accommodate it. A 4,000-foot runway option is being considered, which would accommodate the Beech 1900 and other large aircraft such as the Dash 8 and Sherpa.
3. By definition, a non-precision instrument (NPI) approach runway means a straight-in approach is planned or has been approved (Part 77.2). Seward Airport’s approach is currently a circling approach (RNAV [GPS]-A). Review of the FAA flight standards and local topography indicates a straight-in approach is not viable at Seward due to the mountainous terrain on all sides.

Taxiway

Taxiway and Taxilane Design Dimensions Based on Aircraft Design Group (per AC 150/5300-13A, Table 4-1)

Feature	Near Term & Ultimate – B-II (Beech 200 & Beech 1900)	Existing
Runway to Taxilane Separation	240'	184' (Note 1)
Taxiway Safety Area	79'	79'
Taxiway Object-Free Area (OFA)	131'	131'
Taxilane OFA	115'	131'
Taxilane Centerline to Fixed or Movable Object	57.5'	
Taxilane Wing Tip Clearance	18'	

1. Separation distance shown on 2008 ALP between Runway 16-34 centerline and general aviation (GA) apron taxilane (A-I Small requires 150 feet).

To meet the dimensional standards above and preserve the existing building restriction line

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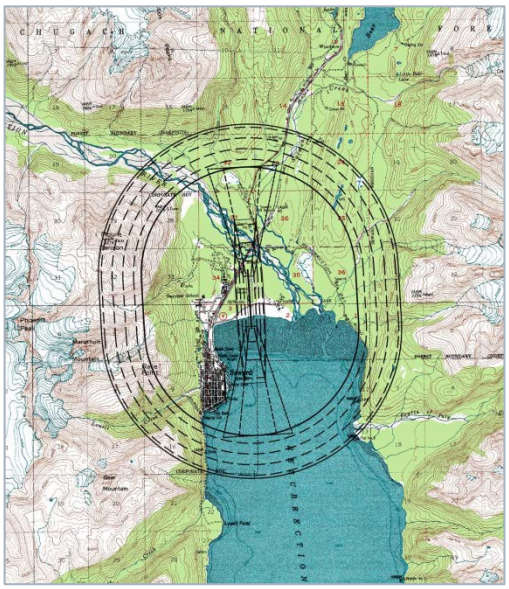
	(BRL) and general aviation (GA) apron size, a runway parallel to the apron (Runway 16-34) would need to have a runway-to-BRL separation of 394.5 feet; the existing Runway 16-34 is separated from the BRL by only 300 feet. Additional separation may be needed to correct the layout deficiency of taxiways that provide direct access from the runway to aircraft parking areas.
Initial Alternative Development	Development of design alternatives requires an understanding of existing conditions and considerations that could impact the reasonableness of any alternatives. Information gained from site visits, data collection, public involvement, and coordination with airport stakeholders, combined with the facility requirements listed above, influenced the identification and development of alternatives for the Seward airport.
Considerations and Constraints in Developing Alternatives	 • Surrounding topography that limited the practicality of airport relocation (see map, right) • The need to consider different runway lengths to provide various potential levels of service to the community • The Federal Emergency Management Agency (FEMA) defined floodway, floodplain, and coastal flood zone (VE) designations, which affect layout and build elevations for the facilities • Adjacent built features (such as the railroad, roads, etc., at the northern end of the airport) that could cause substantial cost or be impractical to relocate • Adjacent privately owned property • Wind coverage (determining whether a single runway could provide 95% coverage) • Proximity of the port facilities of the Alaska Railroad Corporation (ARRC) and ARRC's future plans • DOT&PF's decision not to dredge or reroute the channel due to the maintenance cost of continued dredging, the unpredictability of the long-term changes this could cause, and the potential for unforeseen impacts to owners of adjacent property (such as properties across the channel) Other considerations such as cost, function, and environmental impacts of the various alternatives were used as evaluation criteria for comparing the alternatives against each other and the no-build alternative (as discussed below).
Initial Alternatives	Development of the alternatives began with five concepts initially developed for preliminary discussion at the November SWG meeting. These alternatives evolved as additional information was discovered, analysis completed, or direction provided. For instance, initial concepts for the alternatives that expanded Runway 16-34 kept the railroad and the roadway on the north end outside of the Runway Protection Zone (RPZ). Subsequently, consultation between DOT&PF and FAA determined that this was not a constraint.

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Once the layouts were defined, the next step was to determine the appropriate hydrological parameters, such as flood frequency and freeboard (a measure of the relative height of the flood line), to use to set the surface elevations of the runways. To establish these parameters, hydrologists from Hydraulic Mapping and Modeling (HMM) and DOT&PF drafted a series of technical memoranda and other coordination documents (copies are attached) that were then discussed among the consultant team and DOT&PF. These actions culminated in the decision to use the 100-year (Q100) flood frequency and a freeboard of 2 feet. This decision agrees with draft Federal guidance.

Another consideration that was identified during discussion of the hydrological parameters was the closure of Runway 13-31. If Runway 13-31 were closed, the embankment could be either (a) armored to serve as a dike to prevent lateral migration of the main channel and therefore protect an improved and expanded Runway 16-34, or (b) it could be left as is, allowing future flood waters to breach it. In either case, Runway 16/34 would need to be armored, because the closed runway would not be raised to prevent flooding. Armoring of the closed runway was considered in Alternatives 2.1a and 2.2a. These options were dropped because of the higher cost to armor both runways and these options provided no additional benefit to the airport facilities when compared with options that armored Runway 16/34 only.

The process of refining the original five concepts resulted in the eight alternatives presented in the table below. In coordination with DOT&PF, it was determined that evaluating only the three highlighted alternatives would be sufficient to provide viable options for selecting the airport layout(s) to carry forward into design. If the initial analysis should indicate that other alternatives seem prudent, the details of the first three could be refined to match elements of the others.

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Alternative	Main Runway Disposition	Crosswind (CW) Runway Disposition	Hydraulic Analysis
1.1	Raise the existing main runway (maintain existing length and width) - protect from overtopping and protect from erosion	No improvements anticipated; CW runway not impacted	Use Q100 with 2-foot freeboard on main runway. This option is within the Regulatory Floodway; consider impacts to properties due to potential for large WSEL increase.
1.2	Allow overtopping of main runway, but protect from erosion and allow reuse shortly after flood event ends	Depending upon the hydraulic analysis, improvements may be needed	Use Q100 with 2-foot freeboard on CW runway. Depending upon the design storm, CW runway may need a grade raise and/or erosion protection.
2.1	Allow to be breached	Offset CW runway from apron to allow Design Group II; **shift threshold south to avoid road and rail**; widen to 75' (150' Runway Safety Area (RSA) and lengthen to **3,300' (3,900' RSA)**	Use Q100 with 2-foot freeboard on CW runway. Raise CW runway elevation; provide erosion protection; provide protection for the portion in the VE zone.
2.1a	Protect from being breached but do not raise the embankment height	Same as above; maybe less erosion protection	Use Q100 with 2-foot freeboard on CW runway. Less erosion protection needed since main RW will provide some protection.
2.2	Allow to be breached	Offset CW runway from apron to allow Design Group II; **shift threshold north to avoid VE impacts;** widen to 75' (150' RSA) and lengthen to **3300' (3900' RSA);**	Use Q100 with 2-foot freeboard on CW runway. Raise CW runway elevation; provide erosion protection.
2.2a	Armor to protect from being breached but do not raise the embankment height	Same as above; maybe less erosion protection	Use Q100 with 2-foot freeboard on CW runway. Less erosion protection needed since main RW will provide some protection.
3	Allow to be breached	Offset CW runway from apron to allow Design Group II; shift alignment to avoid ARRC on south end, shift north to reduce impact in ZE zone; widen to 75' (150' RSA) and lengthen to **4,000' (4,600' RSA)**	Use Q100 with 2-foot freeboard on CW runway. Raise CW runway elevation; provide erosion protection; provide protection for the portion in the VE zone.
4	Allow to be breached	Same alignment and north threshold point as Alt 3; lengthen to **4,700' (5,300' RSA)**	Use Q100 with 2-foot freeboard on CW runway. Raise CW runway elevation; provide erosion protection; provide protection for the portion in the VE zone.

Dropping of Alternative 1.2 from Further Evaluation

Alternative 1.2 would reconstruct Runway 13-31 without raising the runway elevation. As compared to Alternative 1.1, this solution would reduce potential impacts to the mapped floodway, but at the cost of allowing the runway to be flooded on a frequent basis. This option was not carried forward for more detailed review because it was considered impractical:

- The runway would be unreliable due to the frequent flooding.
- Construction costs would be as much as 50% higher than for Alternative 1.1 due to the thicker embankment, the use of crushed rock wrapped in geotextile, and the installation of floodwater erosion protection on the west side of the runway.
- Maintenance and operation (M&O) costs would be substantially higher to cover frequent clearing of the debris after each overtopping event plus likely additional costs to repair pavement and airport lighting.

An initial analysis indicates overtopping would occur for at least 12 to 21 days each year. However, this likely underestimates the overtopping duration because of the shortness and age of the discharge record period (1964–1968) and the fact that the years in that record were low-average years.

Topic	Discussion
Alternative Refinement and Consultant Team Evaluation Process	The more detailed development of the alternatives was also an iterative process. • HMM provided preliminary design flood (Q100) elevations. • PDC modeled the alternatives; based on the Q100 elevation and 2-foot freeboard, the alignment of Runway 16-34 shifted (Alternatives 2.2a and 3) so that Taxiway grades would meet FAA standards. • HMM modeled the alternatives with HEC-RAS (a computer program that predicts the hydraulics of water flow), determined initial impacts to the flood elevations (including coastal flooding effects from the 1%-annual-chance tide event, which govern up to Cross-Section E), and identified potential scour velocities and depths. This resulted in further refinement of the alternatives. • The scour depths and velocities resulted in preliminary recommendations for riprap size, thickness, and volumes (to accommodate scour). • PDC estimated earthwork quantities, including the excavations necessary to install the riprap. The key elements of the finalized concept alternatives are presented below. All alternatives meet the dimensional and grading standards for Design Group II. Figures depicting each of the alternatives, including the extents of erosion protection and the riprap size and thickness, are attached for reference.
Refined Alternatives	**Alternative 1.1** Reconstruct and Raise Runway 13-31 (4,249 feet long) • Raise Runway 13-31 above the 100-year flood level (Q100) with 2 feet of freeboard • Install armor to protect Runway 13-31 • Adjust Runway 16-34 profile on the north end to match into raised profile of Runway 13-31 • Reconstruct Taxiways B and C to match into Runway 13-31 raised profile • Eliminate entrance Taxiways A, D, and E in accordance with new FAA guidance that disallows taxiways entering the runway in the middle one/third of the runway. **Alternative 2.2** Close Runway 13-31 and Reconstruct Runway 16-34 (3,300 feet long) • Shift Runway 16-34 to the east and raise it above 100-year flood level with 2 feet of freeboard (shifting the runway minimizes changes to the apron and adjoining lease area/buildings) • Install armor to protect Runway 16-34; since Runway 13-31 will be overtopped and subsequently breached, flood water will reach this embankment • Relocate Taxiway B and reconstruct Taxiway F to match into Runway 16-34 location and grade changes • Eliminate entrance Taxiways A, C, D, and E in accordance with new FAA guidance **Alternative 3.0** Close Runway 13-31 and Reconstruct Runway 16-34 (4,000 feet long) • Close Runway 13-31; flood water will overtop the embankment and eventually breach it • Shift Runway 16-34 to the east and raise it above 100-year flood level with 2 feet of freeboard (shifting the runway minimizes changes to the apron and adjoining lease

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	area/buildings) • Install armor to protect Runway 16-34 in anticipation of Runway 13-31 being breached • Relocate Taxiways B and F to match into Runway 16-34 location and grade changes • Eliminate entrance Taxiways A, C, D, and E in accordance with new FAA guidance
Evaluation	Evaluation criteria were developed by the consultant team in conjunction with DOT&PF. The criteria were selected to aid in evaluating the important differences between each of the alternatives. The criteria can be broadly grouped into four primary categories: • Cost • Ability to serve the community's needs • Engineering and user considerations or function • Environmental considerations The attached matrix provides a narrative of the advantages and disadvantages of each alternative. The construction cost comparison only considers the key differences between the alternatives under evaluation and does not include all costs that could be associated with reconstruction. For instance, mobilization and demobilization would be similar for each of the projects and thus were not considered a differentiating item, whereas embankment items such as borrow, riprap, and pavement are substantially different between the alternatives. Right of Way costs are approximate planning-level estimates based on the additional area of flooding and the assessed value of the flooded property. No jurisdictional agency scoping has been completed at this point. Anticipated environmental impacts were based largely upon evaluations presented in the 2008 Environmental Assessment and the experience of the consultant team. We feel this level of analysis suffices for this conceptual stage of the evaluation. The consultant team and the DOT&PF held two work sessions to compare the alternatives, reviewing each criterion and comparing each alternative against the no-build and against each other to ascertain the relative magnitude of difference. Alternative 2.2 appears to provide the best solution when comparing the advantages and disadvantages of this alternative against the others. SWG and public input should be considered before determining which alternative to progress as the preferred engineering alternative to carry forward into the Environmental Assessment where it will be compared to the no-build option.

Attachments

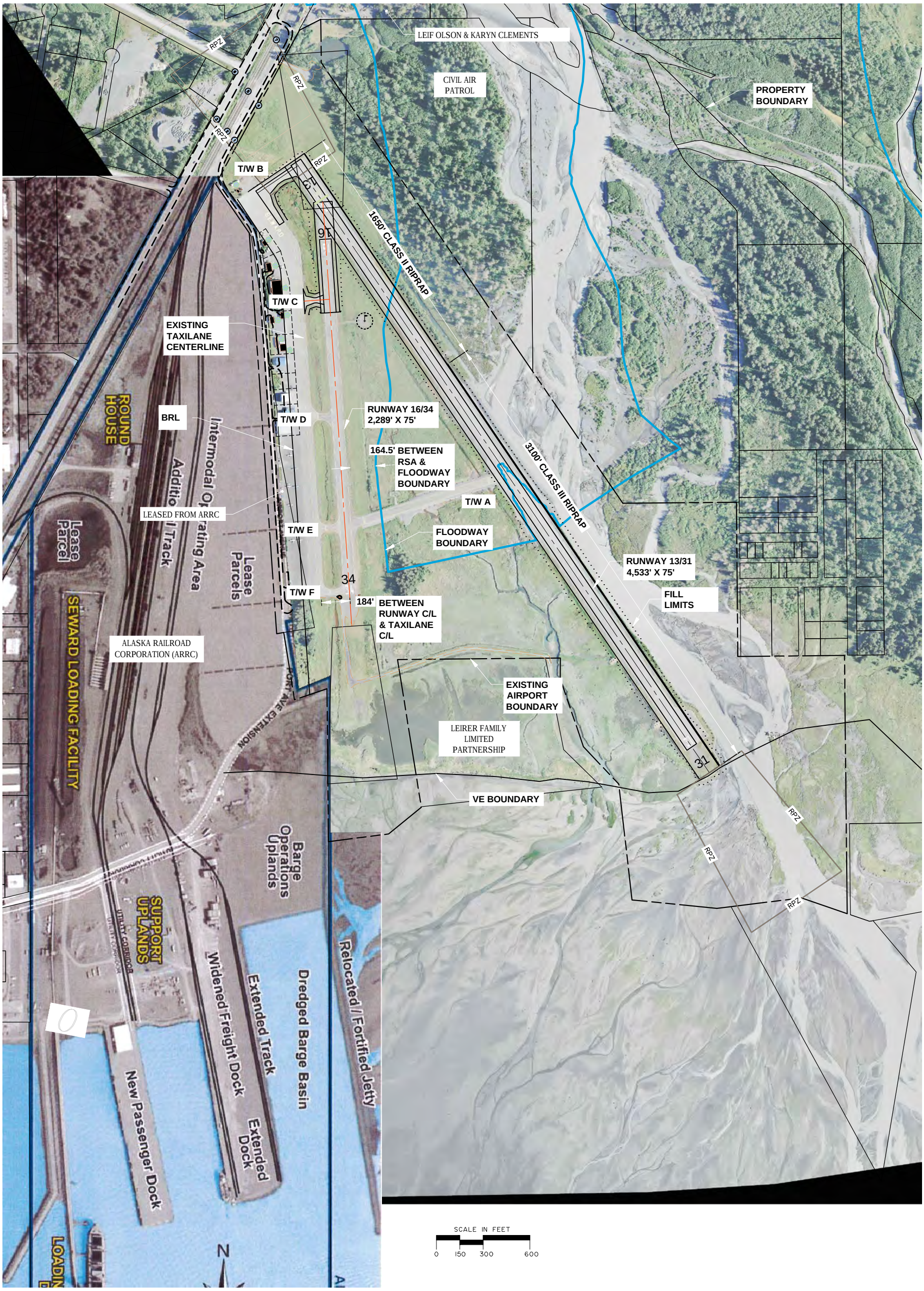
Evaluation Matrix	Alternatives for Consideration_Eval Criteria.xlsx

Topic	Discussion
Figures	1. Alternative 1.1 – Plan 2. Alternative 2.2 – Plan 3. Alternative 3.0 – Plan 4. Alternative 1.1 – Profile 5. Alternatives 2.2. & 3.0 – Profile 6. Alternative 1.1 - Typical Section 7. Alternative 2.2 & 3.0 – Typical Section 8. Part 77 Airspace
Reference Materials	1. Final Hydrologic and Hydraulic Report, Seward Airport Improvements Project 2. Draft Design Discharges Return Interval (1/23/2015, by Paul Janke, DOT&PF) 3. Geotechnical Input on Conceptual Designs (2/20/15 and 3/18/15, by Shannon & Wilson, Inc.) 4. Selected Correspondence

Seward Airport ***Alternative Evaluation***

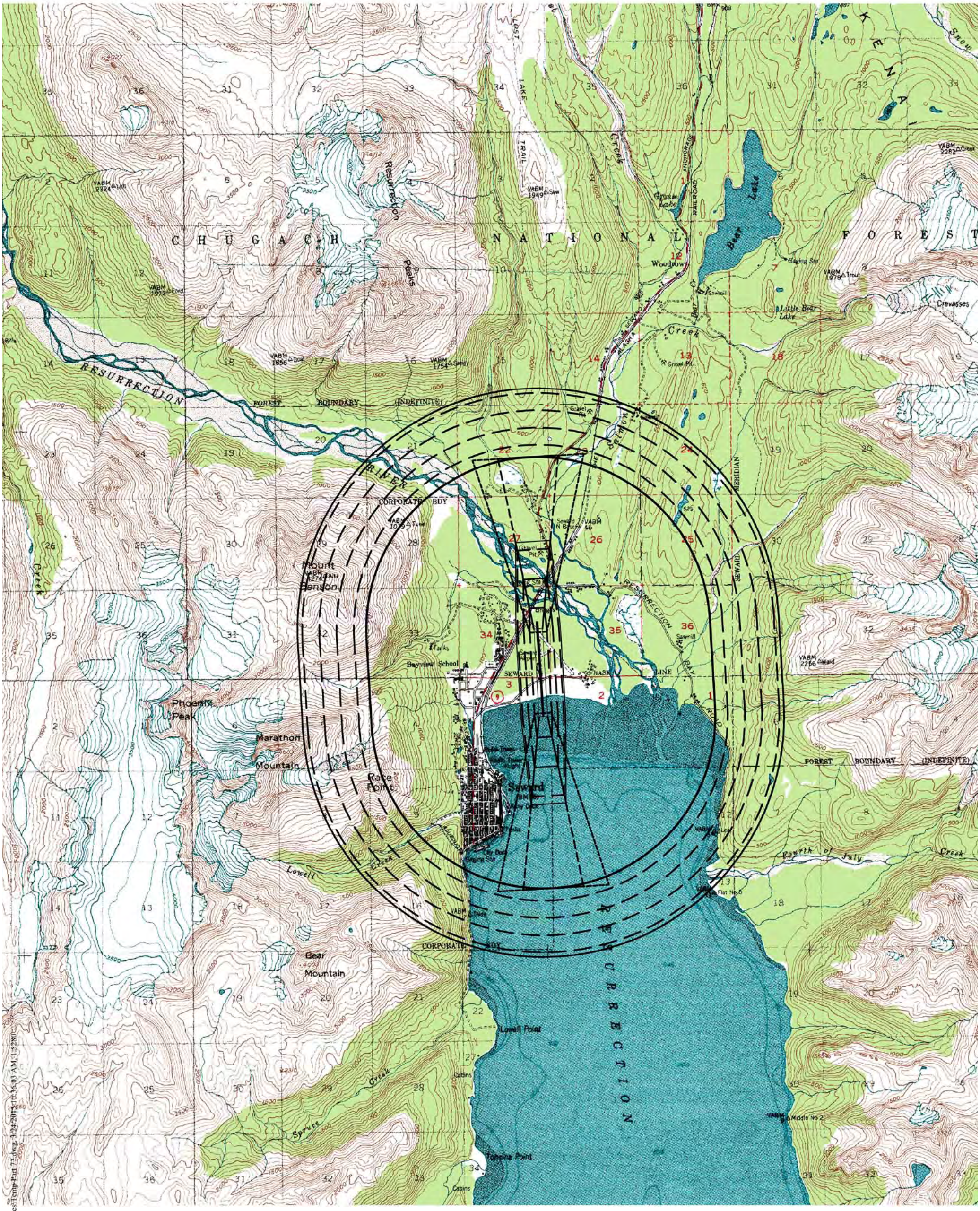
Alternative Descriptions		***Alternative 1.1***		***Alternative 2.2***		***Alternative 3***	
	Main Runway Disposition	Raise the main runway (maintain existing length and embankment width) - protect from overtopping and protect from erosion		Allow main runway to be overtopped by floodwaters		Allow main runway to be overtopped by floodwaters	
	Crosswind Runway (CW) Disposition	Raise crosswind runway on north to match raised main runway.		Offset CW runway from apron to allow Design Group II aircraft; shift threshold north to avoid VE impacts; widen to 75' (150' safety area) and lengthen to 3300' (3900' safety area)		Offset CW runway from apron to allow Design Group II aircraft; shift alignment to avoid ARRC on south end, shift north to reduce impact in VE zone; widen to 75' (150' safety area) and lengthen to 4000' (4600' safety area)	
	Hydraulic Analysis	Use Q100 with 2-foot freeboard on main runway. This option is within the floodway; consider impacts to properties due to change in the floodway.		Use Q100 with 2-foot freeboard on CW; raise CW elevation; provide erosion protection		Use Q100 with 2-foot freeboard on crosswind; raise CW elevation; provide erosion protection; provide protection for the portion in the VE zone	
Evaluation Criteria		*Advantage*	*Disadvantage*	*Advantage*	*Disadvantage*	*Advantage*	*Disadvantage*
Cost							
	Construction/Earthwork Cost - for comparison only -Not total project costs		$13 million		$11 million		$16 million
	Maintenance & Operations (M&O)	Acts as a levee to protect the apron from 100-year flood	More snow removal and pavement surface to maintain than others - assumes the erosion protection is stable/permanent and no additional costs for M&O within the design life. More lighting and pavement markings to maintain.	M&O costs will be less; pavement and lighting for only one runway;new runway embankment acts as a levee to protect the apron from flooding	Maintain closed runway markings; assumes the stabilization is permanent and no additional costs for M&O within the design life	M&O costs less than existing. Only one runway with pavement and lighting to maintain . Embankment acts as a levee to protect the apron from flooding	Similar to Alt 2.2; although slightly more because the longer runway requires additional maintenance due to extra pavement, markings, lights, etc.
	Right of Way --preliminary costs only		$1,300,000		$950,000		$950,000
	FAA Funding Eligibility	Generally easier to get approval of work on existing facility	Two runways may be seen as unwarranted; Environmental Impacts could trigger scrutiny of funding	Should be eligible	None	Should be eligible for FAA funding up to 3300' length.	4000' length would require other funding sources to supplement the FAA funding.
Ability to Serve the Community's Needs							
	Medevac	Longest runway - best for jets; also see wind coverage. Allows C-130 access in case of a mass casualty event (very infrequent need).		Serves the King Air 200, provides for basic medevac service	Too short for jets	Longer than Alt 2.2, 4000' length preferable for King Air pilots	Too short for long-range jets with destinations outside of Alaska
	Meets General Aviation	Improves Runway. Exceeds the forecasted aviation needs.		Improves Runway most often used and adds length. Wider/longer runway accomodates operational tolerance during occasional strong winds.		Improves Runway most often used and adds length. Wider/longer runway accomodates operational tolerance during occasional strong winds.	
	Search and Rescue	Improves Runway		Better Apron Access	Eliminates Longer Runway	Better Apron Access	Shorter than Alternative 1.1
	Economic Development	Longest runway - supports occasional use by Lear jets, tourism opportunities, larger cargo and passenger planes; improves reliability (runway open under a greater range of conditions) and potential for aviation-related business development at the airport including Lear jets and commuter operations	No change to apron area, which limits use of large aircraft on the apron, thus limits business development.	Runway offset provides for larger aircraft (DG II) on the apron taxilane; provides more areas for use by larger aircraft and thus could provide FBO's with greater operational area	Runway too short for Beech 1900 commuter service	Runway offset provides for larger aircraft (DG II) on the apron taxilane; longer runway facilitates use by FBO's including commuter aircraft and some short range jets	
Safety, Engineering & User Considerations (Items not covered by Costs)							
	Wind	Two runways provide slightly better wind coverage for small aircraft. Combined coverage DG II =99.93, DG I = 99.64	Longer runway (13/31) orientation is not as good as the "crosswind" runway. RW 13/31 coverage DG I = 91.1%, DG II = 96.0%	Provides longer/wider runway for best wind coverage orientation; DG I = 98.6% ; DG II = 99.53%. A number of pilots seem to favor improving the cross-wind versus the main runway.	Slightly reduced coverage due to single runway but meets FAA guidelines for a single runway.	Provides longest runway for best wind coverage orientation; DG I = 98.6% ; DG II = 99.53%. A number of pilots seem to favor improving the cross-wind versus the main runway.	Slightly reduced coverage due to single runway but meets FAA guidelines for a single runway.
	Airspace/Runway Protection Zone (RPZ)/Approach Obstructions	**Airspace**: Higher runway, slightly less penetration of airspace	**RPZ**: Main runway has undesirable uses in the RPZ, (Public Road, Railroad) **Approach:** Existing obstructions in the RW 13 approach (road, railroad) would remain. ARRC is planning barge loading/unloading facilities under the approach of RW 34	**Approach:** Horizontal shift of runway moves the RW 34 approach away from the proposed ARRC development; Closing the main runway significantly reduces RW 13 RPZ obstructions.	RPZ: ARRC development for barge operations (jetty, access road) may occur in RPZ.	**Approach**: Horizontal shift of runway moves the RW 34 approach away from the proposed Alaska Railroad development. Significantly reduces RW 13 RPZ obstructions.	RPZ: ARRC development for barge operations (jetty, access road) may occur in RPZ. RPZ and approach extend into the planned ARRC barge basin.

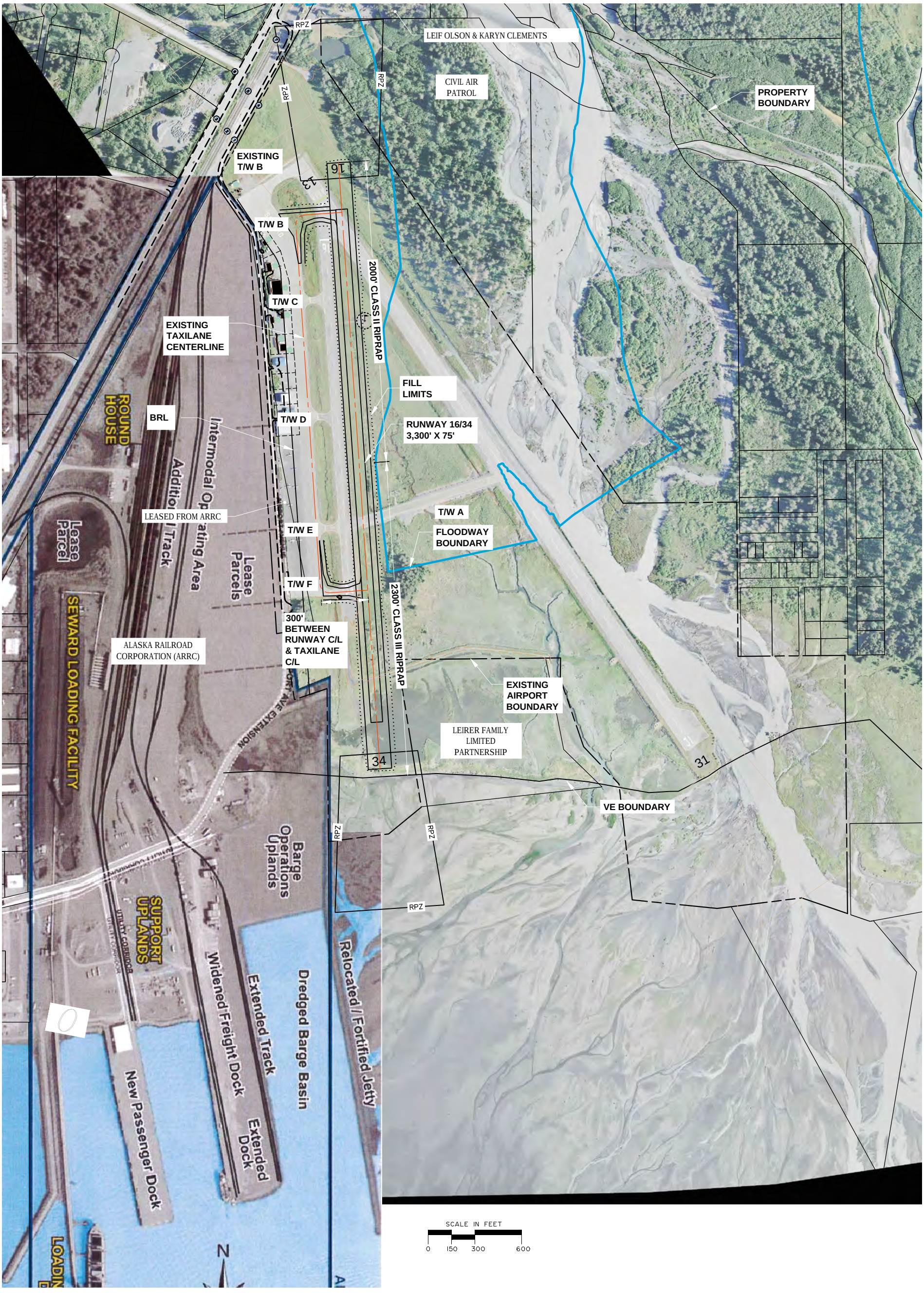
Alternative Descriptions		***Alternative 1.1***		***Alternative 2.2***		***Alternative 3***	
	Main Runway Disposition	Raise the main runway (maintain existing length and embankment width) - protect from overtopping and protect from erosion		Allow main runway to be overtopped by floodwaters		Allow main runway to be overtopped by floodwaters	
	Crosswind Runway (CW) Disposition	Raise crosswind runway on north to match raised main runway.		Offset CW runway from apron to allow Design Group II aircraft; shift threshold north to avoid VE impacts; widen to 75' (150' safety area) and lengthen to 3300' (3900' safety area)		Offset CW runway from apron to allow Design Group II aircraft; shift alignment to avoid ARRC on south end, shift north to reduce impact in VE zone; widen to 75' (150' safety area) and lengthen to 4000' (4600' safety area)	
	Hydraulic Analysis	Use Q100 with 2-foot freeboard on main runway. This option is within the floodway; consider impacts to properties due to change in the floodway.		Use Q100 with 2-foot freeboard on CW; raise CW elevation; provide erosion protection		Use Q100 with 2-foot freeboard on crosswind; raise CW elevation; provide erosion protection; provide protection for the portion in the VE zone	
Evaluation Criteria		*Advantage*	*Disadvantage*	*Advantage*	*Disadvantage*	*Advantage*	*Disadvantage*
	User Function/Runway Reliability/ Level of Service (LOS)	Uses existing VASI approach aids; Higher (above the flood) runway will improve the reliability of the airport; LOS is slightly higher because capacity is increased	Long taxi path; requires displaced threshold to meet RSA requirement.	Lengthens the runway along the orientation for prevailing winds; meets the needs of the based aircraft; improves apron expansion opportunities; reduces congestion; provides full safety area; Higher (above the flood) runway will improve the reliability of the airport. Shorter taxi path.	Large infrequent aircraft, such as Coast Guard C-130 will be unable to use as well as some larger commuter aircraft.	Lengthens the runway along the orientation for prevailing winds; improves apron expansion opportunities; reduces congestion; provides full safety area. Higher (above the flood) runway will improve the reliability of the airport. Shorter taxi path.	Still limits use by infrequent large aircraft, but functions well for based aircraft, medevac, and future commuter aircraft; Single runway provides lower LOS than two runways
	Long-Term Stability/Risks	On existing embankments, which are stable except for erosion.	Greater risk of flood damage since the river is next to the runway and the "model" has variables; climate change could affect river flow; additional sediment deposition unpredictable. Requires reconstruction of runway to meet bearing capacity requirement	R/W provides flood protecton for apron. Runway is sited further from the river, less potential for flood impacts.	Potential risk to downstream (ARRC) facilities if the river moves	Provides flood protecton for apron. Runway is sited further from the river, less potential for flood impacts.	Potential risk to downstream (ARRC) facilities if river moves; is within VE zone and susceptible to tidal influence (greater potential effects from sea level rise).
	Construction Considerations		Riprap installation below water, in river channel, more difficult. Construction likely delayed (as much as 2 years) by a CLOMAR/ LOMAR process with public hearings.	No riprap placement into river channel. Results in easier installation.	Construction phasing will be most challenging. If excavation from abandoned runway is used for fill, both runways will be under construction concurrently.	Same as Alt 2.2.	Runway extends out into tidally influenced region. Requires extension of Riprap into the tidal zone. CLOMAR/ LOMAR may be required and could delay construction, but expected to be easier and quicker to obtain than Alt. 1.1. Longer runway is more flexible for construction phasing.
Environmental Considerations							
	Floodplain/Floodway Impacts	Provides flood protection for apron since runway acts a levee. Raises Main RW 2 feet above 100-year flood level.	In the floodway - increases the flood elevation by up to 4', impacts additional private properties. Permitting will face more obstacles due to public process and floodway impacts = expensive and time delays. Impacts the floodway - requires revision to the FIRM map. Process includes public involvement.	Provides flood protection for apron since runway acts a levee. Does not impact the floodway - no change to the FIRM map needed. Eventual breach of main runway would partially remove an obstruction in the floodplain/ floodway.	Greater chance for channel movement into the floodplain when flood waters breach the main runway. In floodplain - increases the flood elevation by <1 foot (with coastal flooding considered); (however based on previous discussions by DOT with FEMA and City 1' rise is okay)	Provides flood protection for apron since runway acts a levee. Eventual breach of main runway would partially remove an obstruction in the floodplain/ floodway. Construction penetrates the VE zone, but is still more likely permittable than Alt 1.1.	Greater chance for channel movement into the floodplain when flood waters breach the main runway. In floodplain - increases the flood elevation by <1 foot (with coastal flooding considered); (however based on previous discussions by DOT with FEMA and City 1' rise is okay). Does not impact floodway but a revision to the FIRM map needed to change the limits of the VE zone.
	Fish Habitat Impacts	Least impact to intertidal (coastal) EFH area for salmon and marine fish species	Requires in water work to place erosion protection; most impacts to Resurrection River mainstream, which is EFH for salmon species	Fewer impacts to intertidal EFH than Alt 3. No impacts to Resurrection River than Alt 1.1.	More impacts to intertidal EFH than Alt 1.1.	In instream impacts to the Resurrection River	Greatest impacts to intertidal EFH; but is not within marine habit.
	Wetlands Impacts	No wetlands fill associated with RW 16-34.	Most impacts to wetlands from fill in River to raise RW 13-31. May be difficult to permit because Clean Water Actequires selection of practicable alternative with least impacts.	Most permittable. Fewer acres of impacts than Alt 1.1.	Similar wetland impacts to Alt 3,but less due to shorter RW).	Fewer acres of impacts than Alt 1.1.	Similar wetland impacts to Alt 2.2 but more due to longer runway. Fill for longer RW would be harder to justify.
	Endangered Species Act (ESA)/Bald Eagle	Farthest from Resurrection Bay where sea lions, otters and harbor seals are known to be located. Most acceptable under ESA and MMPA	Possible bald eagle nest impacts (based on 2004 nest sites), more so than with other alternatives	Similar distance from Resurrection Bay as Alt 3. Less fill near or in the bay than Alt 3.	Fill in/near Resurrection Bay and possible bald eagle nest impacts	Similar distance from Resurrection Bay as Alt 2.2.	Least acceptable under ESA and MMPA. More fill than Alt 2.2 in/near Resurrection Bay.
	Human (Socioeconomic) Impacts (ROW Impacts, Compatiable Land Use)	Greater reliability of main RW and keeping both runways provides Increased capacity, higher LOS. This option would provide additional protection for the ARRC facilities	Flood plain impacts would impact more private properties adjacent to River and the affect their property values; portions of the impacted property are undeveloped and the properties lack access.	Flooding affects reduced therefore less property impacts during Q100. Longer RW 16-34, but not as long as in Alt 3.;	Loss of main RW and short length of RW 16-34 less favorable to the City from Economic development potential standpoint. Restricts access to floatplane takeout area.	Longer RW 16-34 than Alt 2.2; provides oppuntity for larger aircraft	Loss of main RW; Restricts access to floatplane takeout area.



Alt 1.1 RECONSTRUCT EXISTING RUNWAY 13/31 (4,533ft x 75ft)

- Raise Runway 13/31 above 100yr flood level
- Install armor to protect runway 13/31
- Adjust Runway 16/34 profile to match into raised Runway 13/31
- Reconstruct Taxiway B & C to match into runway modifications
- Eliminate Taxiways A, D & E





Alt 2.2 RECONSTRUCT EXISTING RUNWAY 16/34 (3,300ft x 75ft)

- -Abandon Runway 13/31 and allow flood water over topping of the existing runway
- -Raise Runway 16/34 above 100 year flood level
- -Relocate Taxiway B to match into runway modifications
- -Reconstruct Taxiway F to match into runway modifications
- -Eliminate Taxiways A, C, D & E

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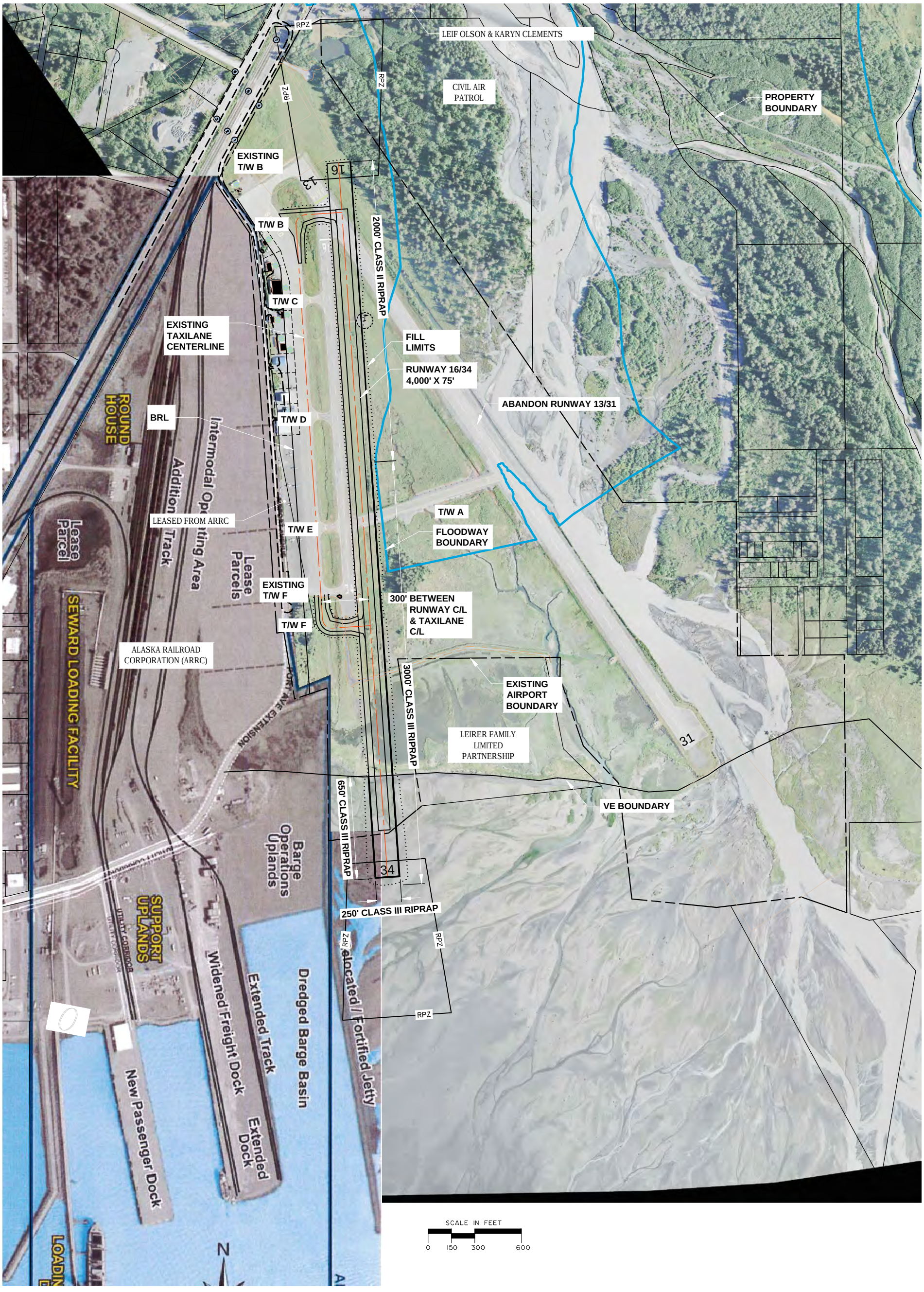

Alt 3.0 RECONSTRUCT EXISTING RUNWAY 16/34 (4,000ft x 75')

- -Abandon Runway 13/31 and allow flood water overtopping of the existing runway and eventual breaching
- -Raise Runway 16/34 above 100 year flood level
- -Relocate Taxiway B & F to match into runway modifications
- -Install armor to protect Runway 16/34
- -Eliminate Taxiways A, C, D & E

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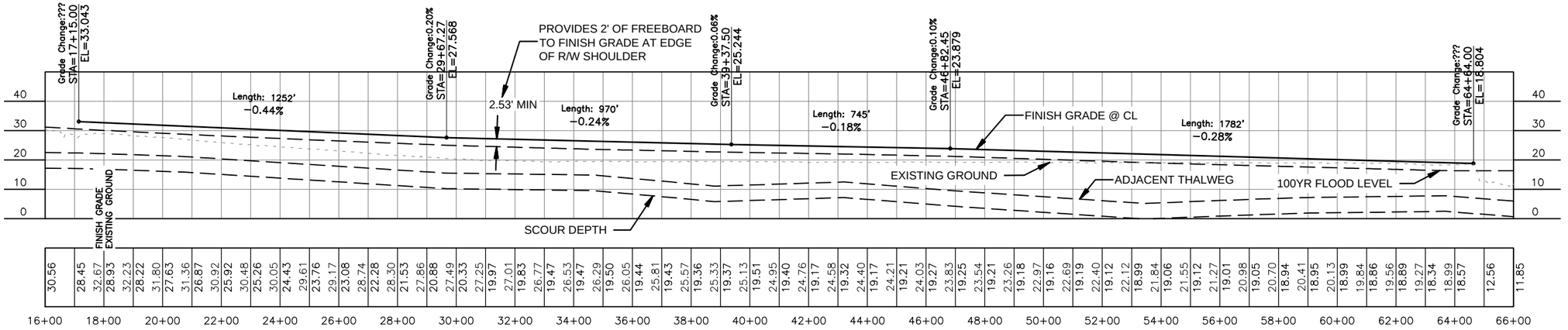
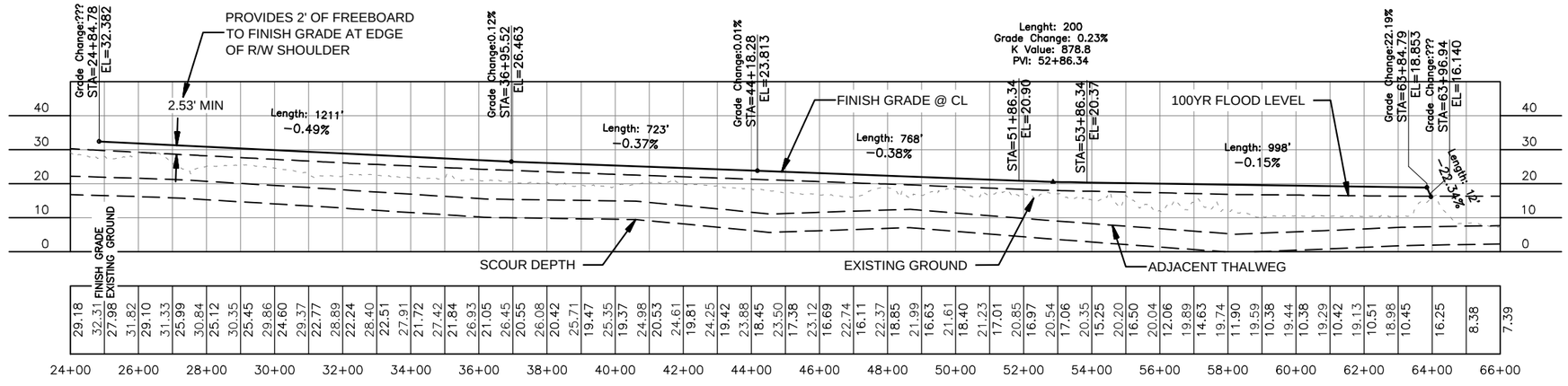
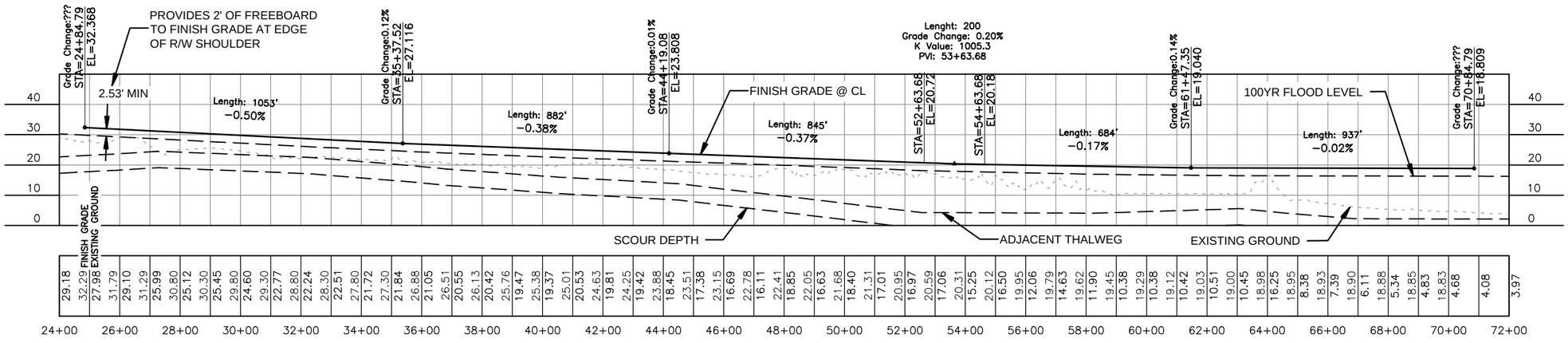


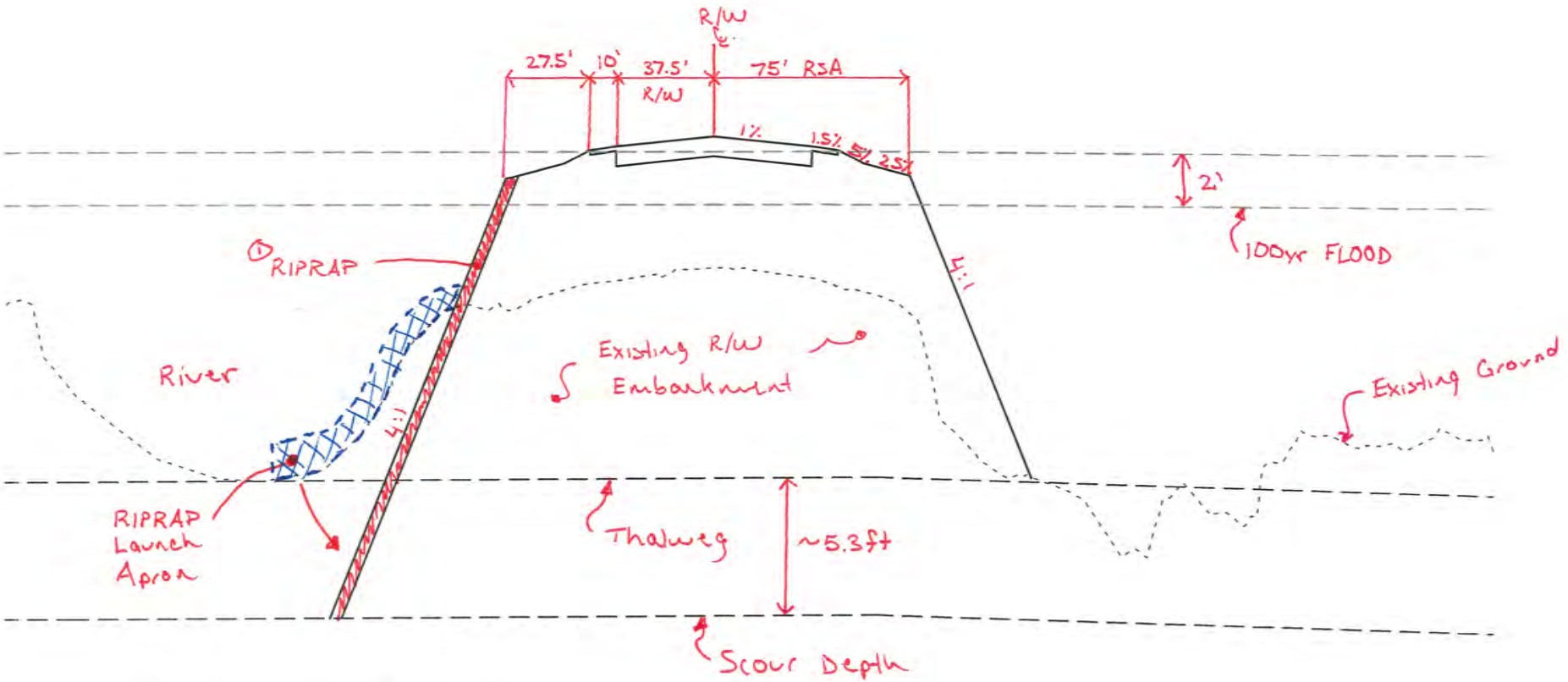
Alt 1.1 RUNWAY 13/31 (4,533ft x 75ft)



Alt 2.2 RUNWAY 16/34 (3,300ft x 75ft)

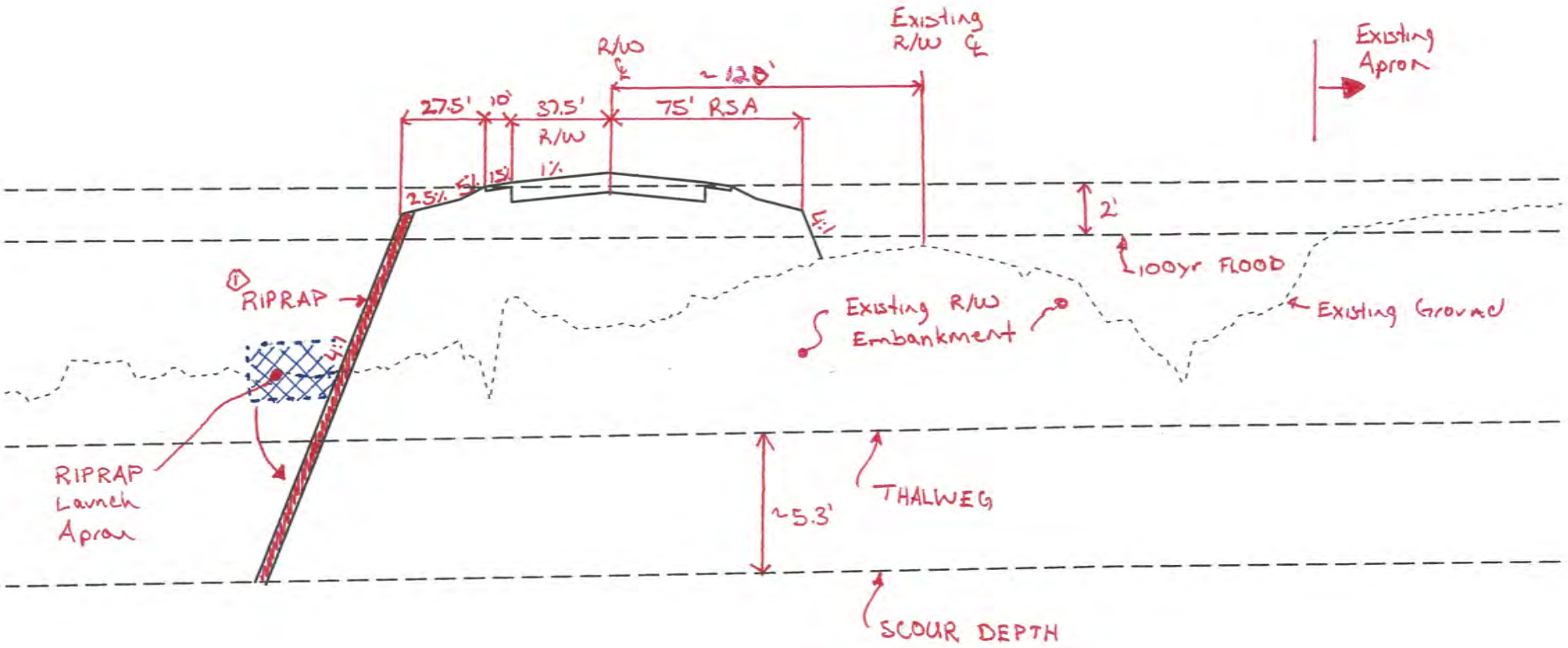


Alt 3.0 RUNWAY 16/34 (4,000ft x 75ft)



Alt 1.1: RUNWAY 13/31

① Type varies, see plan. 5' thick for Class III
3' thick for Class II



ALT. 2.2 and 3.0

① Type varies. See plan for type. 5' thick for Class III.
3' Thick for Class II.