HCR

10

Introduced: 1/21/83
Referred: State Affairs, Transportation & Finance

IN THE HOUSE

BY FRITZ, SZYMANSKI AND BARNES

HOUSE CONCURRENT RESOLUTION NO. 10

IN THE LEGISLATURE OF THE STATE OF ALASKA

THIRTEENTH LEGISLATURE - FIRST SESSION

Relating to access to Whittier, Alaska.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

WHEREAS there are a number of places along the railbed of the Alaska Railroad that are paved for temporary use by automobiles when snowslides cover the Seward Highway, making it impassable; and

WHEREAS a significant number of people seek access to Whittier, Alaska, and access is limited to service on the Alaska Railroad; and

WHEREAS the railroad service to and from Whittier is inadequate or inconvenient and a significant number of people would prefer to drive to and from Whittier;

BE IT RESOLVED by the Alaska State Legislature that the Governor is respectfully requested to direct the Department of Transportation and Public Facilities to study the paving of the Whittier railroad tunnel for vehicular traffic and to enter into negotiations with the Alaska Railroad for the acquisition of right-of-way privileges to permit use of the right-of-way for vehicular access to Whittier, Alaska.

Doris

50 R/T $280 to town
65 per night x 2
50 food

A very important
consideration is
the ventilation +
lighting of the one
mile-long tunnel –
DOT will
speak to it.
please bring that
point up. Thanks

STATE OF ALASKA
PRELIMINARY STATEMENT OF FISCAL IMPACT

Bill No: HCR 10 Date on Bill: 1/21/83
Title: Relating to access to Whittier, Alaska
Sponsor: Fritz, Szymanski & Barnes
Requestor: House State Affairs

1. Estimated fiscal impacts on:

a. Expenditures:

(Thousands of Dollars)

			FY 83	FY 84	FY 85	FY 86		
Capital			0	* 250.0	0	0		
Operating								
Total			0	250.0	0	0		

b. Revenues:

Revenue			0	0	0	0		

2. Source of funds to offset fiscal impact of bill:

1400 boats
332 slips
343 waiting list

April 87

Barrett

3. Assumptions:

Cost of Preparing the existing tunnel for:

One Way Joint Use: $77,220,000 assuming 42 months design period and construction beginning in the summer of 1987.

Two Way Joint Use: $135,300,000 assuming 42 months design period and construction beginning in the summer of 1987.

*A new feasibility study to examine one way joint use, two way joint use, and (cont'd)

4. Disclaimer:
This statement has not been reviewed by the OMB in the Office of the Governor. It therefore does not represent the final estimate of fiscal impact.

Prepared By: Phone:
Division: Date:

Approved by Commissioner: J Bates Date: 3/4/83
Department: DOT+PF

5. Distribution:
Original to Legislative Finance
Copy to OMB
Copy to Sponsor
Copy to Requestor

2/15/83

Assumptions (cont'd)

a new automobile tunnel would cost approximately $250,000. Due to the lead time needed for design of this project, and the progress in transferring the Alaska Railroad to the State, it would be more appropriate to begin negotiations at a later stage of the design process.

HCR 10

MEMORANDUM

State of Alaska

RECEIVED
MAR 9 1983

TO:	Reed Gibby Planning & Programming Central Region	DATE:	March 2, 1983
		FILE NO:	2420-25
		TELEPHONE NO:	266-1502
FROM:	Donald Morfield DM Design Engineer Central Region	SUBJECT:	Project A82711 Legislative Request for Whittier Access by Tunnel

We have reviewed your request to provide a cost estimate for a feasibility study of upgrading the Whittier Railroad Tunnel(s) to accept car traffic.

This study would consider:

1. One way, joint use tunnel
2. Two way, joint use tunnel
3. New tunnel

It is expected this work would include enough geotechnical study to arrive at design parameters for whatever option was finally picked. This type of work is usually very expensive.

With the above in mind I would expect a cost range of $200,000 - $300,000. Since we have no experience in tunnel consultant, I feel a cost of $250,000 is reasonable.

DM/cp

RECEIVED
DOT/PF
PLANNING & PROGRAMMING
MAR 03 1983
ANCHORAGE, ALASKA

02-001A (Rev. 10/79)

each portal, grouting and lining to eliminate water leakage and ice buildup in winter months, and track reconstruction.

This alternative would have adequate theoretical capacity to accommodate the maximum potential demand. However, delays during peak demand periods could be excessive due to long queues waiting for opposing traffic to clear the tunnel. In addition, disabled vehicles in the tunnel could cause further delays since the tunnel width is inadequate to allow for automobiles to pass. The possibility of a vehicle fire presents safety problems, again due to the inability to clear the tunnel. There are also unresolved institutional issues in this option, particularly acceptance of risk or liability by the State or railroad.

Capital cost for this alternative, estimated at $36.7 million, is higher than the various rail options but lower than other direct access options. The ventilation requirement is a major item in cost for this alternative. Since the existing tunnel does not have adequate height to allow installation of the required ventilation plenum, the tunnel would have to be enlarged, resulting in extensive rock excavation. Maintenance and operating costs have been estimated at $390,000 per year. Direct access would eliminate the rail shuttle fares but the possibility of tunnel use tolls could offset these user savings.

<u>Alternative No. 4 - Two-way Joint Use of Widened Existing Tunnel</u>

This alternative would provide direct access to Whittier by widening the existing railroad tunnel to permit adequate highway width for two auto traffic lanes with the rail line confined to one lane. Other improvements to the tunnel would include the same features as in Alternative No. 3.

Operationally, this alternative is much simpler than the single lane tunnel but signals would still be required at each end to control traffic when a train is approaching or in the tunnel. Safety issues are also reduced but potential conflicts still exist as do the liability issues. This alternative has adequate capacity to meet the maximum demand but some potential for delays exist when train movement would close the tunnel to auto use.

Maintenance of rail facilities during the extensive tunnel expansion work would also be difficult. Capital costs for this alternative have been estimated at $64.3 million with annual operating and maintenance costs of $440,000.

Alternative No. 5 - New Two-way Highway Tunnel

In this alternative, a new two-lane highway tunnel would be constructed just south of the existing rail tunnel. The new tunnel would be approximately two and one-half miles long, provide lighting, ventilation and emergency phones. As with all highway options, the roadway into Bear Valley would be required but the rail terminal facilities would not be constructed.

Operationally, this alternative presents no rail/auto conflicts and would function simply as a highway. This alternative would provide the highest level of service and reliability of all options considered, would meet maximum demand, and also eliminate the institutional problems associated with joint tunnel use. It would also be the most expensive with capital cost estimated at $68.3 million and $440,000 annual operating and maintenance cost.

Alternative No. 6 - Portage Pass Highway

This alternative would provide a two-lane highway from the existing Portage Glacier Visitor's Center into Bear Valley and along the face of Maynard Mountain passing the end of Portage Glacier and over Portage Pass. Several locations in the section on Maynard Mountain may require either snow sheds or a short tunnel to reduce probable avalanche problems in areas of major snow chutes.

From an operational standpoint, this option would function much as other mountain highways and would have adequate capacity to meet maximum demand volumes. However, heavy winter snows, icing conditions and avalanche dangers would present severe road hazards in the winter months and high winds through Portage Pass would be a year round problem, particularly for campers and trailers. There are also steep grades (up to 9%) required between Portage Pass and Whittier which make the roadway more hazardous, particularly in winter months.

The Portage Pass Highway, Alternative No. 6, has all of the impacts associated with the other direct access options plus a much greater environmental consequence because of the cut along Maynard Mountain and the road through the Pass. While this route would offer excellent vistas of the glacier, it would also be visible from the visitor's center and would detract from that visually aesthetic experience.

Table S-4 presents a comparison matrix summarizing the various features of each alternative.

Cost Effectiveness

In addition to the evaluation factors summarized in Table S-4, an assessment of the relative cost effectiveness of each alternative was accomplished. This analysis was based on the assumption that the maximum demand levels would be reached at some point in time. Capital costs were annualized at various discount rates and then added to annual operating cost. Total annual costs were then divided by annual person trips to determine a cost per trip. Annual person trips were determined on the basis of maximum demand for the direct access alternatives and at system capacity for the rail systems. Tabel S-5 shows the result of this analysis.

It should be noted that this analysis tends to favor the direct access alternatives since they reflect accommodation of the number of trips under the maximum demand projections while the rail options reflect only the system capacity described in the report. However, as noted in the report, it would be possible to meet person trip demand by adding more passenger cars to the rail options even though auto access would still be limited and therefore user convenience would be lower. If maximum demand were met by the rail systems, direct cost per trip would be substantially lower than for the auto access options. Similarly, the rail options are lower in direct cost at any comparable demand level. This is particularly important since volumes lower than the maximum would undoubtedly prevail for at least a number of years.

Revenue estimates were also made for the rail systems to provide a comparison of potential net public costs since that could bear

TABLE S-4
COMPARISON MATRIX

	ALTERNATIVE							
	NULL	1	1-A	2	3	4	5	6
	No Change	Improved Auto/ Passenger Shuttle	Improved Portage Whittier Shuttle	Improved Rail Passenger Service	One-way Joint Use of Existing Tunnel	Widened Existing Tunnel, Two-way Joint Use	New Vehicle Tunnel	Portage Pass Highway
se Existing Tunnel	X	X	X	X	X			
nlarge Existing Tunnel						X		
ew Highway Tunnel							X	
ew Surface Highway								X
ear Valley Road		X		X	X	X	X	X
ear Valley Parking & Facilities		X		X	X			
ourism/Recreation	None	Low	Low	Low to Medium	Medium	Medium to high	High	High
mployment opportunities	None	Low	Low	Medium	Low	Medium	High	High
hittier Area Development	None	Low	Low	Medium	Low	Medium	High	High
nvironmental Impact	None	Low	Very Low	Low	Low	Medium	Medium	High
ervice Level/Capacity	Low	Medium	Medium	Medium	Medium	High	Very High	Very High
ummer Reliability	High	High	High	High	Medium	High	Very High	Very High
inter Reliability	Medium	High	High	High	Low	High	High	Very Low
ummer Availability	Medium	High	High	High	Medium	High	High	High
inter Availability	Very Low	Medium	Medium	Medium	Medium	High	High	Very Low
onvenience/Comfort	Very Low	Medium	Medium	Medium	Medium	High	Very High	Very High
afety	High	High	High	High	Medium	Medium	High	Medium
robability of Funding	N/A	Medium	Medium	Medium	Medium	Low	Low	Low
onstruction/Implementation Time	N/A	Short	Very Short	Short	Medium	Long	Long	Long
nnual Maintenance & Operating Costs (thousands)	N/A	$559 Initial $1041 Exp.	$504 Initial $546 Exp.	$793 Init. $1500 Exp.	$390	$440	$440	$270
onstruction/Capital Cost (millions)	N/A	$20.0 Init. $24.2 Exp.	$8.8	$21.9 Init. $26.0 Exp.	$36.7	$64.3	$68.3	$47.8

TABLE S-5

ESTIMATED COST EFFECTIVENESS

Assumed Discount Rates		Alt. 1 10%	Alt. 1 15%	Alt. 1-A 10%	Alt. 1-A 15%	Alt. 2 10%	Alt. 2 15%	Alt. 3 10%	Alt. 3 15%	Alt. 4 10%	Alt. 4 15%	Alt. 5 10%	Alt. 5 15%	Alt. 6 10%	Alt. 6 15%
Annual Cap. Cost	($1000)	2,055	3,030	909	1,203	2,273	3,326	3,706	5,509	6,496	9,862	6,894	10,254	4,875	7,197
Annual O/M Cost	($1000)	559	559	504	504	793	793	390	390	440	440	440	440	270	270
TOTAL	($1000)	2,614	3,589	1,413	1,707	3,066	4,119	4,096	5,899	6,936	10,302	7,334	10,794	5,145	7,467
Cap or Demand	(1000)	756	756	432	432	576	576	2,727	2,727	2,727	2,727	2,727	2,727	2,727	2,727
Cost Per Trip		$3.46	$4.75	$3.27	$3.95	$5.32	$7.15	$1.50	$2.16	$.54	$3.78	$2.69	$3.96	$1.89	$2.74
Revenue/Trip[1]		$3.96	$3.96	$3.96	$3.96	$3.96	$3.96								
Net Cost/Trip		$+0.50	$0.79	$+.69	$+.01	$1.36	$3.19	$1.50	$2.16	$2.54	$3.78	$2.69	$3.96	$1.89	$2.74

[1] Revenue per trip based on passenger only revenue as generated in 1979.

on financing feasibility. Revenue per person trip was estimated based on average per passenger (excluding vehicle revenue) during 1979. As shown in the table, when potential revenue is applied, the public cost would be completely covered for both Alternatives 1 and 1-A while being reduced significantly for Alternative No. 2. It would be possible to impose tolls in the direct access options as well and thereby reduce the public costs. However, that would eliminate one of the most significant benefits of those systems.

Summary of Funding Opportunities

The last step in evaluating the various options was to look at potential funding sources. While funding sources and mechanisms are obviously a policy issue, it was considered appropriate to look at possible existing sources, both Federal and State.

At the Federal level, the most likely sources were considered to be the Urban Mass Transit Administration (UMTA), Federal Highways (FHWA) and Federal Railway Administration (FRA). Of these, the UMTA funds were considered highly unlikely since most are applicable to communities over 50,000 population. That would mean funding would have to come through the Municipality of Anchorage where other transit programs are also under consideration. The UMTA Section 18 funds for rural area transit are relatively small and would be inadequate to cover this program.

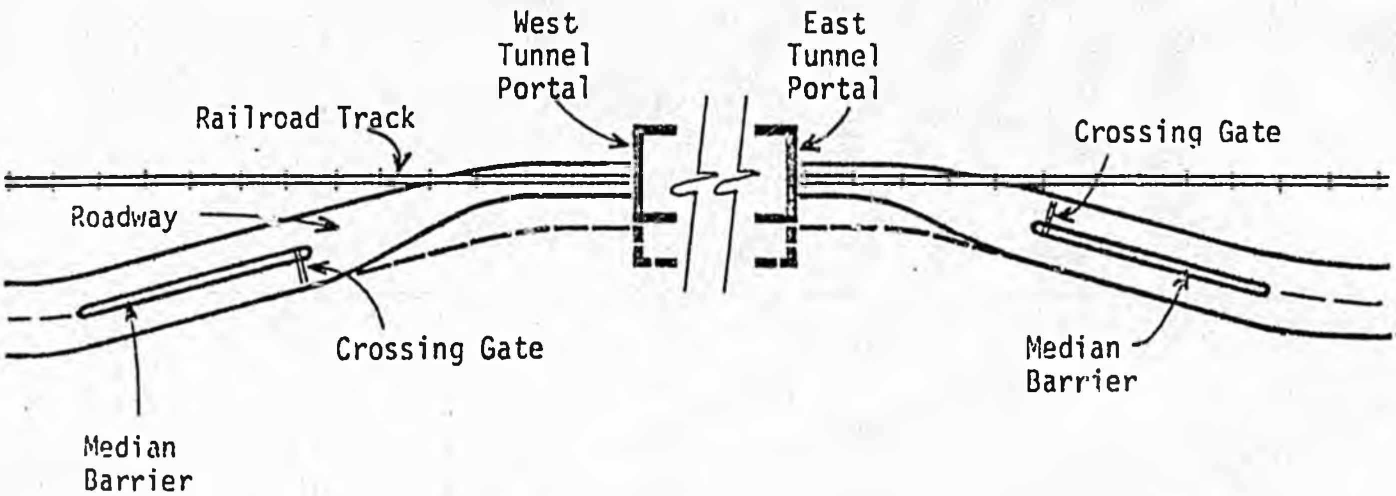
FHWA funds are allocated to the State in a formula basis. Funds for the direct access options, particularly the new tunnel and Portage Pass Highway would undoubtedly come from the Federal-Aid Primary (FAP) monies. While the allocation of those funds is a policy issue, it did not appear proper to count on such funds for a project of this magnitude given the other highway programs with possible higher immediate demand levels.

At the state level, a current support program is operational on the Whittier shuttle as part of the Marine Highway System. In addition, HR 11737 permits the State to divert up to 5% of its annual FAP funding for capital improvement and operating train. At the Whittier end, the container could be used as a secured storage locker or placed on chassis to transport the shipped material to the final destination. The method of handling would depend upon the size and weight of the container or containers and the distance to be moved.

Alternative No. 3 - One-way Joint Use of Existing Tunnel

Operationally, this alternative is relatively simple from the user's standpoint. However, actual operation becomes quite complex because of the absolute measures which must be incorporated to prevent opposing traffic from entering the tunnel and to ensure priority for freight train operation. This control may range from manual operation of crossing gates to traffic actuated detectors to detect directional demands and a clear tunnel. In either event, the actual control could be similar and one method is shown in Exhibit M. In this approach, a crossing gate would be installed on the right hand roadway to stop traffic prior to entering the one-way segment leading to the tunnel portal. These gates would be lowered at alternating ends and remain lowered until the opposing traffic had cleared the tunnel.

Traffic would be channelized for some distance ahead of the gate by a median barrier to insure against by-passing the gate prior to a clear tunnel signal. During periods of high traffic volume, the system could operate with fixed cycle lengths allowing traffic in alternating directions for set periods



TRAFFIC CONTROL SYSTEM
JOINT TUNNEL USE ALTERNATIVES No. 3 & No. 4

EXHIBIT M

depending on the balance of directional volume. In low traffic periods, the system could be operated on demand and rest on the closed or stop position.

Because of the length of the tunnel, two full time "gate keepers" would be required together with a method of monitoring the tunnel. Closed circuit television monitoring could be used to insure a clear tunnel prior to opening the gate to opposing traffic and to spot any disabled vehicle in the tunnel. An alternative to closed circuit television could be directional loop detectors at each end of the tunnel with an accumulator in the signal controller which would "count" entering traffic and prevent opening the opposing gate until the same number had been counted out.

Emergency phones would have to be installed at intervals of about 1/4 to 1/2 mile in the tunnel to be used in the event of breakdowns in the tunnel. The signal system would also have to be interconnected with the rail system so that presence of a train in either direction would over-ride the signals and close both gates. Any failure of the control gates or detection of a vehicle in the tunnel would cause a red track signal, stopping the train until it could be determined that the track was clear.

Tow vehicles would be stationed at each end of the tunnel in the event of a breakdown and would be operated by the "gate keepers". Access from either end is necessary to insure that the tow vehicle can reach any disabled vehicle. In addition, special fire protection equipment would be required at each end in the event of a vehicle fire in the tunnel. Fire fighting in this alternative presents a very difficult and potentially hazardous condition because of the restricted access for emergency equipment and the probability of toxic fumes from burning plastics and other materials.

The possibility of fires presents a serious problem in any tunnel, but in this single lane alternative, it would be particularly serious because any following vehicles would be trapped in the tunnel. The high probability of trailered vehicles would even preclude reversing the traffic in this confined space.

Fire is also a major consideration in the design of the ventilation system in addition to removal of carbon monoxide and other air pollutants. In this case, the overall height of the existing tunnel is inadequate to install the necessary plenum for ventilation and still provide adequate clearance for rail traffic. Therefore, considerable rock removal at the top of the tunnel would be necessary to create an adequate plenum space. Without adequate ventilation, the possibility would exist that carbon monoxide levels could build up to the point where the tunnel would require closure to all traffic, including rail, until the pollutants had dissipated.

Alternative No. 4 - Widened Existing Tunnel, Two-way Joint Use

In this alternative, the existing tunnel would be widened to permit two traffic lanes. The rail line would be placed in one traffic lane for joint use of the tunnel. Operationally, this alternative is much simpler than the one-way tunnel since the only traffic control requirements would be to stop motor vehicle traffic to permit passage of rail traffic.

In concept, the traffic control layout would be similar to that for the one-way alternative in that rail crossing gates would be required on each roadway ahead of the portal. Train detection would also be necessary to lower the crossing gates in advance so that adequate time is available to clear the tunnel before the train arrives. A tunnel monitoring system would also be necessary to insure a clear tunnel prior to train entry.

Monitoring could be by closed circuit television or a series of loop detectors in the roadways to detect the presence of any vehicle. Television monitoring will require surveillance, at least when a train is scheduled, so that a red track signal could be initiated in the event of a vehicle in the tunnel; loop detectors could be tied directly to the train signal system.

In this alternative, emergency vehicles such as fire trucks and tow equipment would not have to be continuously stationed at the tunnel portals since a stalled vehicle will not completely block the tunnel. However, emergency vehicles would be necessary in Whittier or Bear Valley to respond to any emergency situation in the tunnel.

Alternative No. 5 - Vehicle Tunnel and Alternative No. 6 - Portage Pass Highway

In these alternatives, standard highway operations are all that is required since there are no physical conflicts between train and auto traffic. Emergency procedures in the tunnel would be similar to Alternative No. 4 in that emergency phones would be necessary together with the availability of emergency equipment, probably in Whittier.

With respect to the Portage Pass Highway, standard traffic advisories dealing with climatic conditions such as high winds, snow or avalanche danger would be necessary. Wind advisories could be extremely important since campers, boat trailers, etc. are likely to make up a significant percentage of the daily traffic. During winter months, snow removeal would be a major operational problem.

B. Capacity

In Phase II, a potential peak day demand volume was estimated based on potential holding capacity in the Whittier area. It was also stated that demand was unconstrained by access limitations and that no market analysis had been done to confirm or

Thus, this system can readily approach the total potential demand volume in terms of total person trips if and when the potential development in Whittier is reached. However, as in Alternative 1, vehicle capacity in the shuttle is limited and would require that Whittier residents and ferry demands be given priority treatment.

Capacity

Alternate No. 3. - One-Way Joint Use Existing Tunnel

This alternative relies solely on highway access. Shuttle operations would be discontinued. In that circumstance, the only capacity limit is the ability of the single lane tunnel to pass traffic in alternating directions plus any reductions due to rail freight operations. Under present conditions, rail freight volume is so light that it could be essentially disregarded. However, it is possible that rail traffic could increase at some point in the future to an extent that would adversely impact vehicle capacity. That possibility, given the present demand projections defined in Phase II, presents a degree of uncertainty and any attempt to quantify it would be conjecture at best. Therefore, for this analysis it will be disregarded.

In defining the capacity of the single lane tunnel some assumptions are necessary. Firstly, daily volume will be assumed 50% in each direction over the course of a day. In this case, it will be assumed that the direction merely reverses from morning to evening periods and capacity will be defined on a daily basis.

Secondly, even with a 50% split, considerable delay time will be experienced waiting for the last vehicle through one set of gates to clear the 2.5 mile tunnel. For estimating purposes, a uniform speed of 25 mph will be assumed for determining the clearance time.

Lastly, it will be assumed that the dispersion of traffic in Whittier will be such as to not cause a backup in the eastbound direction. Given the confined space in the Whittier area and the probable congestion levels if and when full development occurs, and the only access is via highway, this assumption may be optimistic.

In order to estimate a capacity for the tunnel operation, it is first necessary to determine the average daily volume at some level of service for a two-lane roadway. The peak hour volume of a two-lane highway at level service D (volume approaching unstable flow or capacity) is 1,800 vehicles per hour. Similarly, at the 30th highest hour, which is a normal design value for the rural highways, peak hour traffic represents about 15% of ADT. Therefore, translating these values to an average daily capacity at level service D produces capacity of about 12,000 vehicles per day, or 6,000 per lane. This assumes that each lane is available 100% of the time.

In terms of the one-way tunnel, this condition is not available since time must be shared by direction plus clearance.

clearance time, assuming a 25 mph average speed over the 2.5 mile length would require 6 minutes for each change of direction. Assuming two cycles per hour to allow equal time to each direction will result in 24 minutes total clearance time, or 40% of each hour, leaving 60% for travel or 30% in each direction. With one cycle per hour, clearance time is reduced to 12 minutes, or 20%, leaving 40% available in each direction. Thus with two cycles per hour, the practical capacity of the tunnel would be about 30% of 6,000 or about 1,800 cars per day each way. This would produce a wait time for the first vehicle in the queue of 15 minutes, assuming that vehicle was stopped by the change in direction.

With one cycle per hour, practical daily capacity would reach 2,400 vehicles but the waiting time for the first vehicle in line would be 30 minutes.

Thus, this alternative could meet the potential vehicular demand at full development if the operation averaged one cycle per hour. However, at these levels, there is likely to be a constant queue at each end of the tunnel even assuming random arrivals. Delays during peak demand periods are likely to be in excess of the one cycle (30 minutes) wait. Even at much lower daily volumes, queues are likely to develop during peak demand periods.

In addition, if a vehicle failure occurs, traffic backup in both directions even at low volumes is almost certain; and resulting delays could be excessive before normal operations are resumed.

Alternative No. 4 - Widened Existing Tunnel and Alternative No. 5 - New Highway - Tunnel

These alternatives can be expected to operate essentially as two-lane highways with average daily traffic capacities in the 12,000 vehicle range. Under these conditions, either could easily meet the potential demand for vehicle access. Even though occasional delays could occur due to train/vehicle conflicts in Alternative No. 5, adequate capacity should still exist unless freight volume grows tremendously.

Alternative No. 6 - Portage Pass Highway

During peak demand summer months, this alternative would have adequate capacity to easily meet the potential vehicular demand. Some delays should be expected due to high winds through the pass; and under extreme conditions, some periods of total closure could occur.

During winter months, however, closure due to snowfall, drifting snow and avalanches should be expected quite frequently. However, during this time, demand will be substantially lower;

and with the exception of emergencies, travel could be postponed for some days. Under certain conditions, such as a major avalanche, the possibility exists that long road closures would result. Assuming that local support services such as shopping, routine medical needs and the like would develop along with general community development, even long closures might be tolerable.

Table VI provides a comparison of the projected system capacities for each alternative with the current (1979) and potential future demands. As indicated, any of the alternatives provide substantial growth capacity compared to current observed demand.

C. Service and Convenience

In general, the highest level of convenient transportation in modern America is represented by the private automobile. The auto represents freedom of movement without being tied to a schedule, can carry passengers and incidental baggage, and can go essentially door to door. Under those conditions, it would seem clear that any alternative offering unrestricted use of private transportation should rank high. However, factors such as congestion, traffic delays, parking problems, and lately, gasoline shortages tend to reduce the convenience of the private auto.

TABLE VI

SYSTEM CAPACITY VS. CURRENT AND POTENTIAL DEMAND
(TWO-WAY PERSON TRIPS)

	ALTERNATIVE	CURRENT VOLUME[1]	POTENTIAL DEMAND[2]	SYSTEM CAPACITY INITIAL	SYSTEM CAPACITY EXPANDED
1.	WHIT./B.V. Shuttle	Summer[3] 673 Winter[4] 64	17,140	3360[5]	6240[5]
1-A.	WHIT./PORT. Shuttle			1920[5]	2880[5]
2.	Improved Rail			2560[5]	4800[5]
3.	Single Lane Joint Use			9600[6] Potential Demand	9600[6] Potential Demand
4.	Enlarged Tunnel Joint Use			Exceeds[7] Potential Demand	Exceeds[7] Potential Demand
5.	Highway Tunnel			Exceeds Potential Demand	Exceeds Potential Demand

1 Based on calendar 1979 demand - includes vehicle driver.
2 Reflects unconstrained average peak day demand at full development of Whittier and south side of passage canal (see Table II).
3 Average daily in peak month.
4 Seven month daily average (excludes May through Sept.).
5 Capacity based on 80% load factor at summer schedule and train consist described and shown in diagrams - passenger trip capacity on Alternatives 1 & 2 can be expanded to meet potential demand by adding passenger coaches to trains - vehicle capacity is limited by schedule (see text).
6 Assumes average of 2 persons/vehicle - see text for capacity discussion.
7 Two-lane highway capacity is about 12,000 veh./day - potential.

All of these factors are more or less present in the Whittier situation and also vary according to residence location and trip purpose. For a Whittier resident going into Anchorage to shop, visit friends, conduct business, etc. an auto becomes quite important.

However, for a non-resident visiting Whittier to use his boat or condominium, go fishing or hiking, or just to sightsee, an auto is much less important because the area is genereally of walking scale, providing that a convenient means is available to transport baggage and equipment. In addition, unrestricted auto access to Whittier, if much development actually occurs, would produce extreme traffic congestion and parking problems which by themselves would reduce the convenience and also the desirability of the area as a recreation area.

All of these factors and conditions should be kept in mind when considering service and convenience of the various alternatives. There is no doubt that the exsting system is inconvenient and does not provide a high level of service, particularly for Whittier residents who cannot leave and return the same day. All alternatives solve that problem and improve service frequencies. Other factors will be described for each alternative.

would occur prior to arrival of the shuttle train for the return trip.

Improved methods to transport gear and baggage could possibly be provided though use of wheeled lockers (much like a hand cart) which could be loaded onto the train and then wheeled to dock or condominium. Such improvements would make non-auto use by non-residents much more convenient than at present.

Also for Whittier residents, both permanent and seasonal, these alternatives will tend to reduce the number of vehicles in Whittier and therefore minimize traffic and parking problems in the confined area available.

Alternative No. 3 - One-way Joint Use Existing Tunnel

This alternative, while appearing to offer the advantages inherent in the use of private vehicles, actually has a high level of inconvenience built into it. As described in the preceding operations and capacity discussions, long delays would occur under all but the lightest volume conditions.

At the present level of use, particularly in winter months, these delays would undoubtedly be tolerable. However, as development and growth in Whittier occurs, this delay at either end would rapidly increase. In summer months even at present levels of use where some 600 persons and over 100 vehicles use the shuttle on an average day in the peak months, delays could be expected during peak demand periods. At future development levels, a continuous queue of cars, campers, and buses should be expected and delays would be long.

In addition, this alternative produces the lowest safety potential of all alternatives. As described in the operations discussion, an accident or vehicle fire in the tunnel could be disasterous given the severe access limitations for emergency vehicles.

<u>Alternatives No. 4 and No. 5 - Widened Existing Tunnel - Two-way Joint Use, and New Two-way Highway Tunnel</u>

These alternatives are approximately equal in terms of convenience and service in that they both offer essentially unrestricted access for private vehicles. There are small differences in 4 and 5 because of the possibilty of delays associated with the rail freight operations. However, at present levels of rail freight service, this should not be a serious consideration. In the event of a major increase in rail traffic, such as might occur if Whittier were to become a major depot for bulk cargo such as coal, the joint tunnel would be seriously impacted. If that should occur, the single lane (Alternative No. 3) would become unworkable.

These highway alternatives, while offering essentially unrestricted access, can be expected to produce the greatest development pressures in Whittier. Therefore, they will also produce the highest level of traffic congestion and parking problems in Whittier because there would be no real alternative to use of the private vehicle to travel into and out of Whittier for residents and visitors alike.

Alternative No. 6 - Portage Pass Highway

This alternative, while offering vehicle access, has some significant delay problems, particularly during winter months. In addition, this alternative presents some dangerous conditions due to the potential for high winds and the steep grades (up to 9%) necessary to drop into Whittier from the pass. These grades, coupled with sharp curves required by the topography would produce dangerous driving conditions, particularly during winter months.

In addition, this alternative shares the problems inherent in unlimited vehicle access to Whittier that would produce traffic and parking problems.

Overall, from a convenience and service standpoint and discounting the internal traffic and parking problems, Alternative No. 5 provides the highest levels of improvement, closely followed by No. 4. Alternatives 1 and 2 would rank next at about equal levels and Alternatives 3 and 6 would rank last due to excessive delays and potential winter closure.

D. Operating Costs

Comparison of these alternatives on the basis of operating cost poses some inconsistencies. In the rail shuttle and passenger alternatives, operating and maintenance costs are borne by an agency that must recover those costs in some manner, usually through fares and subsidy. In the highway alternatives, the major operation costs, i.e. vehicle operation, are borne by the private individual while facility maintenance is paid by the State. Thus the perception of operation and maintenance costs is different for the different modes.

Even though full operating and maintenance costs for an automobile are now in excess of 30 cents per mile, the average motorist perceives only his "out-of-pocket" costs for gas, oil, and parking. Public systems such as rail and bus systems, on the other hand, identify all costs. Therefore to be directly comparable, total vehicle miles by all modes under each alternative should be identified and costed out.

However, vehicle miles traveled by private vehicles are difficult to determine without full synthesis of the total system alternatives which was well beyond the scope of this study. Therefore, for the purposes of this comparison, all costs are identified for the rail systems since they will require funding from some source. For the highway systems, only the operating and maintenance costs associated with the facility itself, the public costs, are identified. However, this "incomparability" of the operating and maintenance costs should be kept in mind when considering the alternatives.

Alternate No. 1. - Improved Auto/Passenger Shuttle

Two conditions are developed for this alternative: an initial cost and a cost for the future high level or expanded service day. All unit costs for labor, fuel, etc. are based on current conditions for the Alaska Railroad operations. Crew costs for the rail operations are based on current wage rates and operating agreements which set a standard day. For those operations based in Whittier, a premium of 20% has been applied. In addition, a four person crew has been assumed rather than the current five even though this will require changes in current work rules. It also assumes that the rail operation would continue under the Federal ownership and therefore be exempt from State minimum crew laws. Where one crew operates more than a standard day either in miles or hours worked, overtime (or mileage) rates were used. In estimating these operating costs, only direct operating and maintenance costs (including an allowance for track maintenance) are included. No depreciation or capital recovery factor has been applied. All costs are 1980 dollars.

Table VII shows the estimated operating and maintenance costs by component for the service schedules shown in Exhibit G and H in Section A of this Chapter.

Alternatives No. 3, 4, 5, & 6 (Highway Alternatives)

Table X summarizes maintenance costs for the highway (direct access) alternatives. As can be noted the first three Alternatives, 3, 4, & 5, have higher costs than Alternative No. 6, with the major difference being attributable to tunnel maintenance. The short tunnel included in the Alternative No. 6 scheme is not programmed to have lighting. ventilation, or attendants; and therefore, does not require the typically high tunnel maintenance cost of the other three. However, snow removal costs in Alternative No. 6 are expected to be a major item and, therefore, costs for this alternative have been based on experience on Thompson Pass where snow conditions are similar.

E. Capital Costs

The approach used in the development and preparation of the capital cost estimates was based on current state of the art methods and procedures, directed toward establishing realistic costs for the various alternatives. Initially, estimates were prepared using data from similar projects in remote mountain locations. These data were then adjusted to accommodate the uniqueness of the project area based on input from key estimators/engineers from both Alaska DOT/PF and the Alaska Railroad.

TABLE X

ESTIMATED MAINTENANCE COSTS
ALTERNATIVES 3, 4, 5, & 6

ITEM	ANNUAL COST ALT. #3	ALT. #4	ALT #5	ALT #6
Tunnel Maint.				
Gen'l. Maint. & Power	$200,000	$250,000	$250,000	----
Attendants Salaries	150,000	150,000	150,000	----
Highway				
Portage Glacier Road	25,000	25,000	25,000	$25,000
Bear Valley Road	10,000	10,000	10,000	----
West Camp-Whittier Road	5,000	5,000	5,000	5,000
Portage Pass Road	----	----	----	240,000
Total	$390,000	$440,000	$440,000	$270,000

even though considerable effort was put forth in developing the capital costs, it should be emphasized here that given the tight time constraints of this project coupled with the lack of detailed mapping and other data, the estimates should be considered as order-of-magnitude in nature.

Alternative Nos. 1, 1-A & 2

Capital costs for these two alternatives are comprised of two major components, construction costs and equipment costs. The various elements making up the construction costs are the rail/shuttle facilities ie., rail sidings, loading ramps, parking lot, vehicle staging area, depot (sheltered platform), etc. Also included are the Bear Valley Access road in Alternatives 1 &2, and improvements to the tunnel which entails grouting to eliminate water problems, rock excavation to remove tight spots, rock bolts plus shotcrete lining at strategic locations to arrest the rock spalling problem and replacement of the road bed with new rail, ties and ballast. Alternative 1-A has less extensive rail modifications and does not include the Bear Valley Road. Both alternatives 1 & 2 require all of the above listed facilities and therefore have the same construction costs.

Equipment requirements vary, however, as to the resulting costs. The equipment cost component is broken down into four elements based on equipment needs for both initial and expanded levels of service for each alternative. These elements and the equipment required are: 1) Alternative No. 1 Initial Operation; two new passenger coaches. 2) Alternative No. 1 Expanded Operations; to the initial operation equipment, add two new train sets, each comprised of two passenger coaches and fourteen flat cars. 3) Alternative No. 2 Initial Operation; two new SPV 2000 passenger vehicles plus an allowance for spare parts. 4) Alternative No. 2 Expanded Operation; add two new train sets to the initial equipment. These are the same as the train sets listed above for Alternative No. 1 Expanded Operations. Alternative No. 1-A assumes only replacement of the existing passenger coaches with more modern and comfortable equipment. With respect to capital cost, the initial and expanded service levels in this alternative are equal. Table XI following with a summary of the capital costs for Alternative Nos. 1, 1-A and 2 for both the initial and expanded operations.

Alternative Nos. 3, 4, 5, & 6

Capital costs for these four alternatives are made up of the following six major cost elements: Earthwork, Road construction, Bridge construction, Tunnel construction, Camp operations and Mobilization. Also included are Engineering/Administration and Contingency costs.

The first three cost elements, earthwork, road, and bridge construction, are the same for Alternative Nos. 3, 4, and 5 since these elements relate only to the access road for these three alternatives. The other major cost element, tunnel construction, varies considerably between the three with the greatest difference being between Alternative No. 3 and either Alternative Nos. 4 or 5 which have the highest tunnel costs. Alternative No. 6 on the other hand, has the lowest tunnel costs and the highest costs for earthwork, road and bridge construction. Capital costs are summarized in Table No. XII.

F. Fares and Revenues

Estimating system revenue again requires a number of assumptions. First of all, there is no real solid basis for estimating real demand on the rail alternatives since the growth in Whittier; and general travel is based only on a holding capacity basis. It is reasonable to assume, however, that the significant increases in service levels will attract increased patronage.

Based on the telephone interviews conducted in Phase II, a significant number of Anchorage residents will increase the frequency of visits to Whittier. Also, Whittier residents indicated a large potential increase in travel with improved access. In addition, the marina is being expanded by some 200 slips which will in itself contribute added travel demand in the initial periods.

TABLE XII

ESTIMATED CAPITAL COST SUMMARY
ALTERNATIVES No. 3, 4, 5 & 6

COST ELEMENT	ALT. No. 3	ALT. No. 4	ALT. No. 5	ALT. No. 6
Earthwork	$ 2,351,000	$ 2,351,000	$2,351,000	$21,770,000
Road Construction	833,000	833,000	833,000	2,750,000
Bridge Construction	2,057,000	2,057,000	2,057,000	3,287,000
Tunnel Construction	20,000,000	39,496,000	42,199,000	4,713,000
Camp Oper/Maint	1,643,000	1,916,000	2,190,000	2,190,000
Mobilization	850,000	2,000,000	2,000,000	1,500,000
Sub-total	$27,734,000	$48,653,000	$51,630,000	$36,210,000
Engr/Admin + 15%	4,160,000	7,298,000	7,745,000	5,431,000
Sub-total	$31,894,000	$55,951,000	$59,375,000	41,641,000
Contingency + 15%	4,784,000	8,393,000	8,906,000	6,246,000
TOTAL	$36,678,000	$64,344,000	$68,281,000	$47,887,000

However, unless some joint fare policy were implemented such that the bus-shuttle transfer could be made on the basis of the Anchorage-Bear Valley bus ticket or vice-versa, the net cost for the complete trip would not be significantly different.

Ideally, such a joint fare should be initiated to encourage use of the public system for the entire trip. If that were done, a round trip bus/shuttle fare in the range of $7.50 to $8.00 might be appropriate. A round trip fare in Alternative No. 1 in that range would reduce total revenue for that system by about $100,000 per year. Even with that reduction, however, it would appear that a break-even condition could be realized with the other assumptions made.

G. Cost Effectiveness

One of the most effective measures used to compare alternatives is cost effectiveness which defines the cost per unit of usage. For example, total cost per person trip. This requires determining total annual cost for both operating and capital cost. While operating costs have been calculated on an annual basis, the capital cost has been presented as a total cost in-place for all facilities. To convert these costs to an annual equivalent cost, an amortization or capital recovery factor has been applied over the expected economic life of each item. Since recent interest rates have been fluctuating rapidly, the conversion has been done on the basis of two rates, 10% and 15%, to illustrate a potential range of annual equivalent costs depending on future interest or discount rates.

One further simplification has been used. The total capital cost for construction items includes provision for mobilization, camp operations, engineering/administration, and contingencies. Rather than recalculate each item, the total cost has been apportioned to each item to be amortized on the basis of the percentage of total cost it represents, excluding the variable items. Also, no salvage or residual value has been assumed at the end of the life cycle.

Since the costs represent an annual equivalent, a useful life must be established for each item. For the purposes of this analysis, the following useful life periods have been used:

Highways	40 years
Bridges and Tunnels	50 years
Rail Improvements	50 years
Buildings and Appurtenances	30 years
Rolling stock	20 years

Applying these factors to the capital costs shown in Tables XI and XII produces the annual equivalent cost for each alternative shown in Table XVII. The annualized capital costs from Table XVII must be combined with annual O/M costs from Tables VII, VIII, IX and X to produce total annual cost; and then compared to the capacities of the various alternatives shown in Table VI, or maximum person trip demand to obtain a measurable unit.

Some additional discussion is pertinent here to put thes values in context. First, the initial service level costs and capacities are used since the length of time before the expanded service levels would be implemented is unknown. As indicated by the capacity available compared to current usage, it could be some time before the demand increased enough to justify the added expense.

The unit of measure usually used to define cost effectiveness is the total person trips, vehicles, vehicle miles or some similar unit projected to be actually carried by the alternative systems. In this case, however, no actual projection of usage for the highway oriented alternatives has been made since that value is so closely tied to development levels in Whittier. At the same time, use of the total available capacity as a measure could produce biased comparisons because the total capacity of alternatives 4, 5 and 6 is well beyond the

TABLE XVII
ANNUAL EQUIVALENT CAPITAL COSTS

ITEM	LIFE	TOTAL COST	ANNUAL COST AT 10%	ANNUAL COST AT 15%
ALT. #1				
Roads, Pkg, etc.	40	5,476,650	560,000	824,600
Bridge & Tunnel	50	10,764,450	1,085,700	1,616,200
Rail	50	2,266,200	228,600	340,200
Buildings, etc.	30	377,700	40,000	57,500
Equipment	20	1,200,000	141,000	191,700
ANNUAL COST			$2,055,300	$3,030,200
ALT. #1-A				
Roads, Pkg. etc.	40	151,980	15,500	22,900
Rail	50	151,980	15,300	22,800
Tunnel	50	6,991,080	705,100	919,100
Buildings, etc.	30	303,960	32,200	46,300
Equipment	20	1,200,000	141,000	191,700
ANNUAL COST			$909,100	$1,202,800
ALT. #2				
Roads, Pkg, etc.	40	5,476,650	560,000	824,600
Bridge & Tunnel	50	10,764,450	1,085,700	1,616,200
Rail	50	2,266,200	228,600	340,200
Buildings, etc.	20	3,050,000	358,300	487,300
ANNUAL COST			$2,278,600	$3,325,800
ALT. #3				
Roads, etc.	40	4,768,100	487,600	717,900
Bridge & Tunnel	50	31,909,900	3,218,400	4,790,900
ANNUAL COST			$3,706,000	$5,508,800
ALT. #4				
Roads, etc.	40	4,504,100	460,600	687,100
Bridge & Tunnel	50	59,839,900	6,035,400	8,984,300
ANNUAL COST			$6,496,000	$9,862,400
ALT. #5				
Roads, etc.	40	4,779,700	488,800	719,600
Bridge & Tunnel	50	63,501,300	6,404,700	9,534,000
ANNUAL COST			$6,893,500	$10,253,600
ALT. #6				
Roads, etc.	40	35,915,300	3,672,700	5,407,500
Bridge & Tunnel	50	11,917,700	1,202,000	1,789,300
ANNUAL COST			$4,874,700	$7,196,800

maximum projected demand at full Whittier development. Similarly, the initial rail alternatives do not have an adequate capacity to accommodate that demand level, should it actually occur.

Therefore, for the purposes of this analysis, the available capacity has been used for those alternatives which are capacity constrained, and maximum projected demand has been used for those with excess capacity. Thus, the comparison is made on the basis of the maximum number of person trips that could or are likely to be made on each alternative.

In that context, Alternative No. 3 is the only marginal Alternative. As shown in the discussion on capacity, this Alternative could accommodate up to about 4800 vehicles per day. Therefore, at about 3.6 persons per vehicle on the average, that Alternative could accommodate the projected maximum demand. While that value represents a high average, the projected maximum demand also represents the average peak day, and therefore, on most days of the year, this Alternative could accommodate the demand.

Estimating the annual demand based on the projected peak day is the last step in determining the cost effectiveness. To accomplish that estimate, the relationship between observed peak days and average annual traffic on the Seward Highway has been used. Since Whittier demand is highly related to Anchorage, the count station at Potter Creek has been used to determine the appropriate relationship.

During 1978, the average of the ten highest traffic days was 229.4% of the annual average daily traffic. Assuming a uniform vehicle occupancy over the year, and applying that traffic relationship to the projected peak demand for person trips (17,140) produces an annual average daily person trip demand of 7,472 person trips or about 2,727,000 person trips per year. For the capacity limited systems, the comparable value is represented by the daily system capacity times the number of days operated. Since operating costs used are based on the three day winter schedule, a total of 225 days per year has been used to determine system capacity.

The estimated cost effectiveness of the various Alternatives expressed as cost per trip is shown in Table XVIII. As shown in that table, under the assumptions used, Alternative No. 3 with a per trip cost of from $1.50 to $2.16 is the least costly, while Alternative No. 2 at from $5.32 to $7.15 per trip is the highest.

That relationship is, however, somewhat misleading in that capacity of the rail based alternatives can be readily doubled by the simple addition of two more coaches per train. In addition, revenue generated by fares would offset much of the cost. For example, if the rail Alternatives operated at capacity and generated the average per trip revenue for passengers only of $3.96 experienced in 1979, the per trip costs in Alternative 1-A would be completely offset even at the highest interest rate and Alternative 1 would produce a net cost of less than eighty (80¢) cents per trip at the high interest rate with all costs offset at the lower rate. There are no corresponding revenues to offset costs in the highway Alternatives.

in Whittier instead of Anchorage. This would add slightly to Whittier's economy directly, since crews would be based in the community.

Environmental

Alternative No. 3 - One-way Joint Use of Existing Tunnel

Alternatives 3 through 6 permit direct access by automobile to Whittier. Secondary impacts due to auto congestion in Whittier, including parking and safety problems, will be significant, particularly during peak summer weekend travel periods. The community will have to bolster its public safety force and city planning capabilities in order to successfully mitigate auto-related secondary impacts.

A major primary impact of Alternatives 3 through 5 concern air quality and safety problems within the tunnel itself. Alternatives 3 through 5 will require adequate ventilation systems, emergency telephones, and fail-safe mechanisms to ensure trains and autos are never in the tunnel simultaneously. A one-way tunnel presents serious fire dangers; particularly if traffic is stalled, and cannot pass or reserve direction in the event of fire. Long waiting times at each portal could cause air quality degradation.

Alternative No. 4 - Widened Tunnel - Two-way Joint Use

This option has most of the direct and secondary implications associated with Alternative No. 3. While construction costs are the highest for any alternative except for an entirely new tunnel, this option avoids the need for waiting on either end for on-coming traffic.

Alternative No. 5 - New Highway Tunnel - Two-way

Alternatives 4 through 6 are major construction projects requiring two or more construction seasons to complete. Each of these alternatives will require a major environmental impact statement to be prepared and evaluated as part of the decision-making process. Environmental impacts incude the requirement for construction camps and staging areas, air and water quality problems due to siltation, dust, etc., and the need to dispose of massive quantities of rock and borrow material.

Alternative No. 6 - Portage Pass Highway

As stated previously, a decision to construct a Portage Pass highway can only be made following a lengthy environmental impact statement planning process. This option would be extremely controversial because: 1) it would involve constructing a road through a currently roadless area in the National Forest; 2) it is highly unlikely the road could be used regularly in winter; 3) it would alter the present landscape as seen from the Portage Glacier visitors center; and 4) several other alternatives are available which avoid these problems.

- The access period could be extended up to "round-the-clock" when demand justified.
- Because of shorter shuttle distances, fares may be reduced.
- The system will create a small number of permanent jobs
- It opens Bear Valley to recreational use and to more spectacular views of Portage Glacier.
- Its selection would not eliminate the future choice of another alternative.

The Disadvantages of alternative No. 2 are:

- It allows no direct automobile access
- It still requires auto shuttle, with their related facilities
- The operating costs are highest of all alternatives
- The excess operating costs must be subsidized
- User must adhere to schedule

Advantages & Disadvantages

Alternative No. 3 - One-way Joint Use of Existing Tunnel

This alternative would provide direct auto access through the existing tunnel between Whittier and Bear Valley. A ceiling would be constructed along with other surface improvements and a roadway would be paved that would allow both rail traffic and rubber wheeled traffic in one direction at a time, controlled by gates and signals. Because this alternative could cause disruption of rail service it would be less favorable than other alternatives. The alternative, while allowing direct vehicle access, and eliminating the need for a vehicle shuttle, would save the user vehicle shuttle fees. The collection of tolls, however, could partially reduce this advantage for the user.

Access, however, would be governed by a fixed or variable schedule and wait time could be much greater during rush periods than with the improved shuttle alternatives.

The Advantages of Alternative No. 3 are:

- It allows direct auto access to and from Whittier
- It allows scheduled and conditional 24 hour, 7 day access
- It eliminates dependency on rail shuttle
- It is the least costly of the direct auto access alternatives
- It opens Bear Valley to recreational use and Portage glacier to close up vantage points
- Its selection would not eliminate the choice of another alternative at a future date
- It is compatible with a passenger shuttle service

The Disadvantages of Alternate No. 3 are:

- The construction of the necessary improvements must be coordinated with railroad schedules and clearances which will add time and cost over uninterrupted construction
- The capital cost relative to improvement of access is high
- Revenues for vehicle access would be reduced or eliminated if tolls are not collected
- Joint use in the existing narrow tunnel presents a greater number of safety concerns than other alternatives
- Access is limited by rail schedules and by one way traffic coordination
- Waiting times at tunnel entrances will be prolonged during rush periods
- Waiting times will be prolonged for unscheduled rail traffic
- Daytime access could reach the point of saturation with the increase of rail freight

<u>Alternative No. 4 - Two-way Joint Use of Widened Existing Tunnel</u>

This alternative would provide direct two-way vehicle access with interruption of access for both passenger and freight rail service. This alternative as with No. 3 could disrupt existing rail service thus would be less favorable to the Alaska Railroad than other alternatives. The cost relative to the access improvement would be extremely high. The factors justifying this alternative are that the tunnel access minimizes susceptibility to adverse weather conditions, and that the tunnel conditions are known.

The Advantages of Alternative No. 4 are:

- o Allows direct two way auto access to and from Whittier
- o It allows conditional 24 hour, 7 day access
- o It eliminates dependency on rail shuttle
- o It is not as costly as the new tunnel alternatives
- o It opens Bear Valley to recreational use and Portage Glacier to close up vantage points
- o It is compatible with a passenger shuttle service
- o It would open the greater Whittier area to development as a major recreational area
- o It would open access to the Whittier port for industry and freight to a greater extent than all previous alternatives

The Disadvantages of Alternative No. 4 are:

- o The construction must be coordinated with railroad schedules and clearances which will add time and cost over uninterrupted construction
- o The capital cost relative to improvement of access is very high

- o Revenues for vehicle access would be reduced or eliminated if tolls are not collected
- o Joint use presents a number of safety concerns
- o Access would be interrupted by rail traffic
- o Daytime access could be seriously disrupted with future increase of rail freight

Alternative No. 5 - New Two-Way Highway Tunnel

This alternative presents the most convenient solution for direct auto access to Whittier. It also presents the highest capital cost, and would require a long construction period. It may be difficult to justify the large capital cost in light of other State transportation needs.

If cost and time were not a consideration, construction of a new tunnel would be advisable, however, the actual travel demand in terms of projected residents and tourists, does not justify this alternative. It should be recognized, however, that this alternative ranks first, from the standpoint of convenience, as a way to open up Whittier, a year round ice-free port, and Prince William Sound, a major recreation area, to half of the population of the State. It is possible that current demand figures may be artifically low due to the nature of current access. With unlimited year round access the possibility exists that uncontrolled development could result in land congestion and overburdening of existing public ways and

APPENDIX 2

TUNNEL DESIGN CONSIDERATIONS

APPENDIX 2

THE THREE TUNNEL ALTERNATES

General

This report recognized three viable 2 1/2 mile tunnel alternatives coupled with a surface road from Portage Lake through Maynard Mountain to the western edge of Whittier in lieu of a 5.85 mile surface route over Portage Pass. For ease of identification the three tunnel alternates are labeled as CASE I, II, and III and are applicable to Alternative Nos. 3, 4, and 5 respectively. In addition, Case I provides the basis for suggested tunnel improvements in Alternatives 1, 1-A and 2.

Description of Case I - Tunnel Alternate

Case I (Alternative 3) provides for the joint use of vehicular traffic and rail traffic through the existing 2 1/2 mile railroad tunnel by "decking" the rails so that the railroad can operate normally and rubber tired vehicles can also use the platform on a one-direction at a time basis. Turnouts would be constructed to assure some degree of continuous one-way vehicular traffic. Appropriate signals and barricades at both portals of the tunnel would be the means of preventing the simultaneous use of the tunnel. The implementation and on-going operation of the foregoing plan would require the complete understanding and concurrence of all conditions to assure that a cooperative agreement between the railroad and the highway department could be achieved.

Description of Case II - Tunnel Alternate

Case II (Alternative 4) also comtemplates joint vehicular traffic use of the existing 2 1/2 mile railroad tunnel by the enlargement of the existing tunnel width through excavation to accommodate a new but separate automobile lane parallel to the rails. As with Case I, vehicular traffic through the tunnel would be excluded from the tunnel when a train was operating in the tunnel and this restriction would be controlled by appropriate signalling and barriers at both portals.

The expanded tunnel width would, however, permit two-way vehicular traffic through the tunnel when the trains were not in operation. One traffic lane would be much the same as Case I, i.e., the rails would be "decked" to permit the normal operation of train traffic as well as operation of rubber tired vehicles. The traffic lane created by extending the tunnel width would be similar to a normal highway traffic lane.

The implementation of this plan would require an even greater degree of understanding and cooperation between the ARR and AHD because of the greater interferences during the construction period.

Description of Case III - Tunnel Alternate

Case III (Alternative 5) contemplates the construction of an entirely new tunnel for two-way traffic for the exclusive use of vehicles. This new tunnel would approximately parallel the railroad tunnel for alignment and grade and the length would be approximately the same as the railroad tunnel. The horizontal separation would be sufficient to assure complete safety to the railroad tunnel during the period of construction for the new tunnel.

The control of traffic through the tunnel will be far less restrictive than Case I or II since the railroad imposes no restrictions and since the vehicular traffic is two-way. Controls and signalling are, however, contemplated to ensure safety to the travelling public.

Design and Construction Considerations of the Three Tunnel Alternates

Tunnel construction has a history of presenting surprises that might materially alter the original design and anticipated quantities which in turn all too often increase the originally anticipated cost of the tunnel. In this present era tunnel designers generally have the benefit of extensive geological investigations, the benefit of increasingly more "past experiences" and more meaningful geotechnical tools. Even so, a tunnel is a construction effort demanding very costly units of work that must be projected into less than totally explored areas.

The original construction of the Whittier Railroad Tunnel has to a large extent performed this exploration into the unforeseen, and the existing structure reveals that the best imaginable insight into the conditions that could be encountered in the enlargement of the existing tunnel as in Case II. Since the proposed new tunnel in Case III is parallel and adjacent to the existing tunnel, the unknowns inherent in most underground construction have been greatly minimized.

The following description of requirements for construction of Cases I, II and III and the accompanying cost estimates are based entirely on what can be observed in the existing 2 1/2 mile railroad tunnel and published geologic information relating to the tunnel and adjacent areas. Final design for any one of the alternate plans would of course be supplemented by more detailed geologic and field measurements that are not possible at the level of this investigation. Further geotechnical investigations and measurements would principally refine the quantities of the work to be performed.

At this level of investigation any one of the three proposed alternates are judged to be reasonable and feasible from the standpoint of common construction methods.

Excavation

The rock excavation entailed in Case I Alternate is primarily the removal of minor thicknesses of rock (tights) on the walls of the tunnel and at the springline of the arch to achieve the minimum requirements for railroad clearances designed by the AREA. Coupled with this operation would be the barring down and scaling of all obviously loose material that has developed over the years by exposure to weathering and especially freeze and thaw cycles. The amount of this class of excavation may exceed more than nominal thicknesses in those areas that are presently supported by timber and lagging. The foregoing procedures would also be applied to the wall and arch of the existing tunnel on the side that is not enlarged under the program called for under Case II Alternate.

The rock excavation of Case II and Case III would be accomplished by conventional drill and blast methods and the barring down and scaling of newly exposed faces of rock would be a part of the final effort of the major excavation procedures.

Temporary and permanent supports, excepting reaches immediately adjacent to the portal areas, would be accomplished by rock bolts or shotcrete and more likely a combination of both. Considerably more detailed investigation would be required to identify areas that would require steel sets or a formed concrete lining.

Tunnel excavation required by Case I and II will demand a premium unit price because of the conflict with the railroad operations.

Grout Curtain

A present-day examination, March 1980, of the existing 2 1/2 mile railroad tunnel shows relatively little water originating from the ribs and the back of the tunnel, none of which could be considered to be under pressure. Areas showing free water are quite limited and only one area that would be classed as a significant amount of water. There are areas in the tunnel that appear moist that quite likely in other seasons of the year might show free water. It is reported that the extent of drainage varies from season to season with the greatest amount being noted in the fall season of the year.

The problems of the formation of ice, because of the presence of water in the tunnel and the circulation of cold air through the tunnel, is a difficult and expensive problem to cope with, without question. The railroad controls, to the extent possible, the icing by use of the draft doors at either end of the tunnel and by rail mounted electric heaters that are plugged into a power cable at selected locations within the tunnel, and the heat from the heating units are directed to a particular problem area of ice formation. It is understood that even with the present corrective measures the formation of ice is still a problem and is an expensive operational problem.

From observation in the existing tunnel and from study of geologic report information, it seems certain that the entrance of water to the existing tunnel, an expanded tunnel or a new tunnel could virtually be eliminated by pressure grouting. The wet areas would be drilled and stage grouted in a pattern to form a curtain of grout around the periphery of the rock opening. The grout curtain would form a barrier and in effect force the water outside of the tunnel opening and effectively "dry-up" the opening. It is assumed that ordinary Portland Cement grout would be effective. However, if the joint pattern is more demanding than can be sealed with cement, there are available numerous chemical grouts that could be substituted for Portland Cement.

The pressure grouting to control water would be employed in all areas of the tunnel that could be identified as potential water producers. The pressure grouting would be done prior to any placement of concrete lining, structural shotcrete or protective coatings of shotcrete. Concrete lining and pneumatically applied mortar could be an effective barrier to water; however, the extreme cold could cause freezing behind the applied concrete and after repeated cycles of freeze and thaw cause spalling and the eventual ice formation due to the escape of free water.

Pneumatically Applied Mortar

The conceptual design for the alternate tunnels, Case I, II and III contemplates the extensive use of shotcrete and gunnite to accomplish specific objectives.

Shotcrete, pneumatically applied cement-mortar containing a coarse aggregate, would be placed in those areas of the tunnel that require structural support in thicknesses consistent with the support necessary. Rock bolts and structural shapes used as bridges would also be used in conjunction with shotcrete, if appropriate, to gain structural support. The isolated zones of rock weakness, now supported by timber in the existing tunnel, would be expected to persist as a formation characteristic in the expanded tunnel or a new tunnel as proposed in Case II or Case III. It is proposed that those zones that require support such as can be seen in the existing tunnel, would be supported by shotcrete built up to the necessary support strength required.

Since the extensive use of steel sets is not apparent at this level of design, it is considered desirable o avoid steel sets if possible through the use of shotcrete. Steel sets are possible to use; however, their use introduces a break in the construction routine of essentially a nonsupported tunnel section. It is possible that a material supply problem could also be introduced by relying on steel sets.

The use of pneumatically applied mortar over welded wire mesh reinforcement for a surface treatment would be either a shotcrete mixture, with coarse aggregate, or a gunnite mixture with no coarse aggregate, depending on the characteristics of the rock surfaces and the results that are obtained in the field for the different gradations of the applied mortar. The surface treatment mortar would be applied to all exposed rock surfaces in Cases I, II and III to minimize the continual ravelling and spalling of small rocks due to normal weathering and to prevent the loss of "keying" rock particles that support more significant block size rocks. Surface treatment would not be intended to be a ground support method and the purpose of the welded wire mesh would be to maintain only the integreity of the mortar. Surface treatment mortar also would minimize the lighting requirements for the tunnel and greatly improve the co-efficient of friction for the movement of ventilation air. Surface treatment further enhances visual appearance of the tunnel and very importantly provides a greater feeling of security and a "good feeling" about being in a tunnel to the travelling public.

Rock Bolts

The use of rock bolts to provide temporary ground support during construction and in conjunction with shotcrete and channel hardware as permanent supports is contemplated throughout the tunnel. The locations within the tunnel where rock bolts would be used is not identified at this level of conceptual design. The bolts would be of varying length and would be specified as the epoxy anchored and goruted type as opposed to the mechanical anchored type with cement grout at a later date for corrosion protection.

Concrete Lining

A concrete lining of the tunnel will be necessary at each portal of the tunnel to insure structural integrity of the tunnel as it enters and passes through the weathered zone of rock at the portals. A small portion of concrete lining would be exterior to the tunnel for the purpose of creating a transition from the tunnel section to the portal structures.

The greatest amount of surface water and ground water occurs in this weathered zone and the concrete lining becomes a necessity to waterproof the most vulnerable area to freezing. Low pressure backfill grout would be introduced behind the concrete and between the rock to minimize water drainage and assure contact between the concrete lining and the excavated rock surface. The exposed section of concrete portal would be backfilled for insulation and aesthetic reasons.

Detailed geology and the actual field conditions encountered would delineate the length of the concrete lining at each portal of the three cases being considered.

Portal Structures

Reinforced concrete portal structures will be required at each end of the three tunnel alternates. The portal-structure would physically connect to the concrete lining of the tunnel and the structures would have common facilities such as draft doors to control ventilation and weather extremes, the housing of emergency equipment for rescue of stalled vehicles, communication and control equipment for vehicular traffic, tunnel ventilation controls and personnel quarters.

Each portal structure for the three Cases, I, II and III would vary considerably in physical details because of the three tunnel sizes and the necessity to provide for combined use of railroad and vehicular traffic for Case I and II and the single use of the new tunnel for vehicular traffic, Case III.

Roadway Platform

Each of the three tunnel alternates being considered have a different roadway platform and each platform presents a different quality of roadway for vehicular traffic.

Case I Platform must be designed for the use of vehicular traffic as well as for continued railroad operation. This platform has the distinct disadvantage of the "rail slot" that will tend to detract from the surface for rubber tired vehicles.

Case II Platform will have the same disadvantage in that the "rail slot" will tend to make the vehicular tires follow the "slot".

The driving experience for Case III Platform will be similar to a two-lane bridge.

The roadway platform for all three cases is constructed essentially the same way, to the extent that the sub-grade and base course would be free draining material with parallel lateral pipe drains to collect any free water. The roadway surface would be hot mix asphalt with concrete curbs to minimize contact with the walls of the tunnel and catch basins to collect and direct "imported" water from the vehicles to the sub-drains and on out of the tunnel.

The road tracks that remain as part of the permanent features in Case I and II will be reconstructed with precast concrete ties and cushioned with a sufficient depth of ballast and sub-base to minimize the ongoing maintenance of the rails. It is anticipated that the grade of the railroad would remain the same; however, it is to be expected that there will be a minor amount of additional rock excavation to permit the construction of a uniform thickness of sub-base and ballast. The construction of the roadway platform in Case I and II will require considerable cooperation with the railroad and will be a time-consuming operation since it must be done in short segments such that the rail line is never out of operation for a longer period of time than would be permitted by their normal operating schedule.

Tunnel Lighting

Lighting is considered necessary for all three cases under consideration in the interest of public safety and for routine maintenance and inspection of the tunnel. The level of illumination at the portals would be in the order of 100-foot candles and gradually decreased in intensity to approximately 10-foot candles for the remaining 80% of the tunnel length. The variation of light intensity form the portal area to the tunnel proper permits a driver to become accustomed to the darkness of the tunnel from the bright conditions exterior from the tunnel.

The level of illumination will also be increased in the vicinity of the turnouts that are provided in Case I.

The surfacing of the tunnel back and walls with shotcrete, coupled with lighting also greatly disspells the uneasy feeling for some when underground.

Signalling and Monitoring Systems

The monitoring and control of traffic for Cases I and II would involve restrictions imposed by the joint use of railroad and vehicular traffic. The monitoring and control of tunnel traffic for dual use is more complicated that that involving only vehicular traffic as with Case III. The monitoring of the status of the flow of traffic through the tunnel and the demand for the use of the tunnel at the portal would result in the controls that would optimize the safe use of the tunnel. Such conditions as an automobile fire, stalled vehicle and resulting pollution buildup all would result in control of traffic.

All of the above considerations would be incorporated into a supervisory control system that would indicate the conditions within the tunnel and exterior and react to those conditions to the extent possible. The tools of the system would be TV monitors, lighted signs, automatic barricades and air quality analyzers and temperature sensors.

The supervisory control system would be flexible so that the system could be changed from summer to winter mode, from present day to future traffic volumes and to some extent would be adjusted to accommodate different weather conditions.

Miscellaneous Items

Included, but not limited to, is the removal and reinstalling of the existing 7.5 KVA power cable and the existing railroad communication duct that is presently at the invert of the tunnel. These items of work are required only for Cases I and II.

Other minor items common to all three cases are the furnishing and installing fire extinguishers and emergency pull-box stations and telephone stations.