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N. P. RY. CO.

OFFICE OF CHIEF ENGINEER

FILE NO. 1532.

SUBJECT:

LIND CUT-OFF.

1532

1532

St.Paul, Minn., January 29th., 1906.

WLD-W.

Mr. C. M. Levey,

Third Vice President, Tacoma, Wash.,

Dear Sir:-

In reply to yours of the 24th.inst., relative to the advisability of construction of branch about on the line of the Ellensburg cut-off.

Under date of July 19th., 1905 Mr. Crosby was asked to have examination made, but to date we have received no reply from Mr. Crosby.

Chief Clerk Gemmell notes that Mr. Pearson's attention was called to the fact that no reply had been made, but that no further action was taken.

Yours truly,

W. L. DARLING

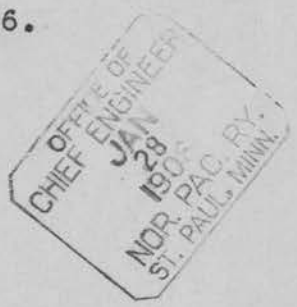
Chief Engineer.

Form 290 TW

Northern Pacific Railway Company

Non accede

Tacoma, January 24, 1906.



Mr. W. L. Darling,

Chief Engineer, St. Paul, Minn.

Dear Sir:

On July 19th Mr. Pearson wrote Mr. B. L. Crosby, Principal Assistant Engineer, Tacoma, requesting that an investigation be made of the country west of Lind, to enable an opinion to be formed of the advisability of construction of a branch about on the line of the Lind - Ellensburg cutoff.

Will you please advise whether or not this investigation was made and, if it was, be kind enough to send me a copy of the report, as I cannot find that I have such report in my files.

Yours truly,

C W Leavey
GT

A E G - Was any Lind report ever made?
W S 1/28

Mr Darling - No - no comments
attention was called to fact no reply made
but he took no further action - see letter to Mr Crosby
attached -
W S 1/25

COPY.

1532

EJP-M On Washington Central Railway, July 19, 1905.

Mr. B. L. Crosby,

Principal Assistant Engineer,
Tacoma, Wash.

Dear Sir:

As early as it can be conveniently arranged, an investigation should be made of the country west of Lind, say for a distance of approximately 15 miles each way from the located line of the Lind-Ellensburg cut-off. This examination need be carried west only 30 to 40 miles to some natural point to which construction of a branch would terminate for awhile. The question is that of sufficiency of the country and its development and traffic probabilities to justify and support a branch built on what would eventually be part of the cut-off line.

Please send copies of report to Mr. Levey and to myself.

Yours truly,

Copy to Mr. Levey. Chief Engineer.

No reply.

Mr. Gemmell:-

I would like to have a file containing copies of all the various reports, estimates, etc. relating to the Lind Cut-off.

E.J.P. 9/12/04.

File
1

Tacoma, Jan. 15th, 1902.

Mr. W. L. Darling,

Chief Engineer.

Dear sir-

Below Please find report of reconnoisance on the Lind-Ellensburg cut-off to reduce the grade from the summit west to Junction with main line.

In looking over the ground, I decided to run the grade line down from a point 2½ miles from the summit or from Mile 90½ to 102, as there were several saddles that it was difficult to tell whether or not the grade line would pass over. I send you herewith one map marked "A", which shows on a scale of 2" per mile, the lines as actually run, and all proposed lines, which is also a general contour map of the country through which the proposed lines run. Also two profiles, one marked "B", which a profile as actually run of the 1% grade line from Mile 90½ to Mile 102, also one marked "C", which is a condensed profile of all the lines in question.

I ran the levels clear through on the 1% grade line and took the contours with the barometer and they should be fairly accurate.

LINE A. B. C. D. E. is the 1% grade line that I ran through connecting with main line at Mile 111. Line A. B. C. F. G. is an alternate 1% maximimum grade line connecting with main line at Mile 111, which makes them equal in length, but would be somewhat cheaper and a more pleasing line if a 1% max grade is used.

Line A. F. G. is the proposed 0.8% grade line which I think is the proper line to use, as it only is about 3/4 mile longer than the 1% line, and if the large fill at B. C. is eliminated the length of the lines would be equal. The 0.8% grade line seems to fit the country better and will cost but little more than the 1% grade line. Therefore, I will make the approximate estimate for this line. Any grade less than this will get into a heavy country on the lower end of the line and would parallel the present line for a considerable distance.

The distance from the common point "A" (which is Mile 89) to the junction at Ellensburg is 17.4 miles, Via the original survey A. H. The distance from A. to G. = 31 miles, which makes a total distance from A. to H. via A. H. G. 19.5 miles, and via the 0.8% grade line A. F. G. 23 miles, or 3½ miles longer than via the original survey. This makes the distance to build via the original survey 16.4 miles and the 0.8% line 23 miles. There will be some heavy work from m[illegible] 95 on the 0.8% grade line and from there to the junction of Main Line [illegible]ium work only. The estimated cost of the original survey is as below

Miles 89 to 99 = 10 miles @ $45000 per miles,	$450,000.00
Miles 99 to 105.4 = 6.4 miles @ $17000.00 per mile,	$108,800.00
Mile 89 to 105.4 = 16.4 miles, @ per mile,	$558,800.00

Estimated cost of 0.8 % grade line:

Mile 89 to 95 = 6 miles @ $65000 per mile,	$390,000.00
Mile 95 to 112 = 17 miles @ $23000 per mile,	391,000.00
Mile 89 to 112 = 23 miles,	$781,000.00

which makes a difference in favor of the original survey of $222,200.00. But it would save the 1.5% grade on the original survey 10 miles long, but would add 3½ miles distance and probably quite an amount of curvature.

The economical cost of 3½ miles = 18480 ft according to the Welling McHenry Theory is as follows:

18480 ft. @ 50¢ per daily train = $9240.00 per daily train and the extra cost of operating the 10 mile pusher grade will be 10 x 2 x 75¢ per miles = $15.00 per day x 365 days = $5475.00 per year, capitalized at 0.6% it will be economical to spend $\frac{5475}{.06}$ = $91250.00 per daily train to eliminate the 10 mile pusher service, then the total saving per daily train will be $91250.00 - $9240.00 = $82010.00, per daily train.

Then to save the extra cost of the 0.8% line over the original line which is $222,200.00, it will require $\frac{222,200}{82010}$ = less than 3 trains per day to insure the required economy.

I am yours truly,

(Signed) G. A. Kyle,

Asst. Engr.

WLC-C

November 21st, 1903.

C. S. Mellen, Esq.,

President.

Dear Sir;-

In reference to the new line that is proposed between Lind and Ellensburg. Just before Mr. McHenry left I called his attention to a line different from what had been run, leaving our present main line at Ritzville instead of Lind, and following the third coulee to its intersection with the present located line about 46 miles west of Lind. It seemed feasible to obtain a 0.5% grade by this line instead of the 0.7% obtained by the one located, and Mr. McHenry assigned Assistant Engineer Kyle to make an examination, and I attach copy of his report hereto.

It seems that a 0.5% grade is feasible, except that the line will be made 1½ miles longer between Ritzville and Ellensburg, and contain more curvature between miles 40 and 60. In order to obtain this 0.5% grade on the Ritzville line, it will be necessary to construct about 18½ miles more of line than by the Lind line, at a cost of $541,000.00. As the grades now between Ritzville and Sprague are practically 0.5%, the construction of this line will make the new line a practical 0.5% line east-bound from the tunnel west of the Columbia River to Sprague, and also west-bound, except the 2.0% grade going west up out of the Columbia River. It is possible also, to reduce the present 1.0% line between Sprague and Spokane to a 0.5% grade, in at least an easterly direction. A more thorough investigation of the country west of tunnel shows a possible 1.0% line

instead of the 1.5% now located. The length of line will be increased about one mile, and have some more curvature. This latter line, however, has never been thoroughly investigated, and I would recommend therefore, if you consider the matter worthy of further investigation, that a survey be made from Ritzville west for 56 miles to determine the actual cost and condition of a 0.5% line, also a survey west from the tunnel to a connection with the main line three or four miles west of Ellensburg. In order to give you an intelligent idea of the cost and value of this line, the following distance and values have been calculated:

The cost of obtaining a 0.5% line instead of a 0.7% line both ways between the Columbia River and Ritzville is $541,000.00 in excess of the present located line between the Columbia River and Lind, at an expense of 1½ miles more distance and considerably more curvature between miles 45 and 60. The value of this 0.5% line as compared with a 0.7% line between the Columbia River and Ritzville is $2,275,000.00. The cost of a 1.0% line in place of a 1.5% from the tunnel west to a connection with the main line will cost about $250,000.00 more than the present 1.5% line, and add, perhaps, one mile of distance. The value of this line based on the same amount of business as for portion between the Columbia River and Ritzville is $1,440,000.00. This portion of the main line has become so crowded with business that at certain seasons of the year nearly the full capacity of the single track is required to take care of the business. This is not due so much to the amount of tonnage passing over it as to the manner in which it is handled, the grades being so heavy at present that the tonnage is double headed or run by pushers with the consequent necessity of having to get light engines back to the originating terminal. A light engine being practically the same as a train on the road, it adds considerably to the meeting points that

dispatchers have to make, and a consequent delay to traffic. As a matter of fact, the experience on the Northern Pacific has shown that long trains are gotten over the road more expeditiously than the lighter trains, due to the fact of having fewer meeting points. In order therefore, to increase the capacity of this single track, it is necessary to increase the length of trains, either by heavier power or by flatter grades. The power now in use on this division is the heaviest, and consequently the only thing that remains is to flatten grades. The capacity of the single track on this district is limited to a great extent by the fact that the climb in one direction is very severe, and trains are consequently a long time going between meeting points, and if meeting points are frequent, the delay to traffic is enormous.

In connection with the matter of getting trains over the road, the following figures may be of interest: By reducing the 1.5% grade to a 1.0%, the number of trains between Ellensburg and Columbia River east-bound, can be reduced about 30% and require but ⅔ the meeting points. By reducing the 0.7% grades to 0.5%, 20% of the trains can be saved, and but 60% of the meeting points needed.

Yours truly,

Chief Engineer

COLUMBIA RIVER BRIDGE-

Chicago, August 21,1901.

E. H. McHenry, Esq.,

Ch. Engr., Northern Pacific Ry.,

St. Paul, Minn.

Dear sir:

I send you under separate enclosure three (3) copies of revised plan, showing proposed designes No. 2 and 3 for the Columbia River Bridge. The plan sent you last would be called design No. 1. I also enclose estimates on the three designs Design No. 1 differs from design No. 2 in the east approach only; while design No.1 contemplates extending the viaduct piers some 10 ft below the surface of the ground, design No. 2 contemplates extending them only 2 or 3 ft below the surface of the ground, or enough to get a good foothold, and protecting them with a low embankment, the top of which will be a foot or two above the surface of ordinary high water. This embankment can either be made of earth or gravel, protected with riprap, or else can be made entirely of rock fill, which I presume will be available from the adjoining cut. I believe this design is an improvement on design No. 1, and the estimates show a slight difference in its favor. Design No. 3 differs from the two preceding ones in that the steel viaduct approaches are substituted by an embankment. In order to keep the embankment away from the channel it will be necessary to build two approach girders, say 60 ft in length, resting on two abutments. These abutments will not need to extend down to bed rock, which would make them quite expensive, but if gravel or rock is used in the fill it will be quite safe to put the foundations into the made ground. It may be that the character of the fill will be such as not to permit the building of this abutment until the fill has stopped settling. This would require supporting the approach girders on a temporary sill for some time after the completion of the main approach.

The enclose estimates show a slight saving in Design No. 2, over designs Nos. 1 and 3. In figuring the cost of the embankment, I have assumed a unit price of 25¢ per cubic yard, which you gave me some time ago. Not being familiar with the character of the surrounding country, I am not able to say whether this price could be applied at this particular crossing. It would seem to me however that this unit is rather low considering that the embankment would have to be pro-

tected. You probably posses in your office sufficient data to correct my figures.

In designs No. 1 and 2, I have assumed a price of $5.00 per foot for the timber floor on the bridge. I am led to believe that this price is a great deal t o high, and that $3.00 would cover it. This would make a further saving of $5764.

Unlessit is found upon revising the unit price for embankment that design No. 3 is more expensive than d sign No. 2, I would favor design No. 3, principally on account of the reduction in cost of maintenance; otherwise, I would recommend d esign No 2.

very t ruly yours,

(Signed) Ralph Modjeski,

RALPH MODJESKI,
CIVIL ENGINEER,
Monadnock Bldg.
CHICAGO.

743

COLUMBIA RIVER BRIDGE.

August 14th, 1901.

PRELIMINARY ESTIMATES of COST

of

BRIDGE and APPROACHES,

between stations 3731 + 90 and 3767 + 10 on projected line L5.

Design No. 1.

Consisting of one (1) span of 300', 11 spans of 200' each, and steel viaduct approaches 510' long at each end.

5,620,000 lbs. of steel erected in place in bridge proper @ 4¢ per lb.	224,800.00
1,250,000 lbs. of steel erected in place in viaduct approaches @ 3.75¢ per lb.	46,875.00
6,088 cu. yds. of concrete in river piers @ 8.00 per cu. yd.	48,704.00
1,779 cu. yds. of concrete in foundations of river piers @ 25.00 per cu. yd.	44,475.00
1,115 cu. yds. of concrete in approach piers and abutments at 7.00 per cu. yd. including excavation,	7,805.00
3,520 lin. ft. of timber floor @ 5.00 per ft.	17,600.00
	390,259.00
Engineering & Contingencies, 10%	39,025.90
	429,284.90

Design No. 2.

Consisting of one span of 300', 11 spans of 200' each, steel viaduct approaches 510' long at each end and a protection embankment for viaduct piers at east end of bridge.

5,620,000 lbs. of steel erected in place in bridge proper at 4¢ per lb.	224,800.00
1,250,000 lbs. of steel erected in place in viaduct approaches @ 3.75¢ per lb.	46,875.00
6,088 cu. yds. of concrete in river piers at 8.00 per cu. yd.	48,704.00
1,779 cu. yds. of concrete in foundations of river piers @ 25.00 per cu. yd.	44,475.00
710 cu. yds. of concrete in approach piers and abutments @ 7.00 per cu. yd., including excavation,	4,970.00
3,520 lin. ft. of timber floor @ 5.00 per foot,	17,600.00
	387,424.00
Engineering & Contingencies, 10%	38,742.40
	426,166.40

Design No. 3.

Consisting of one span of 300', 11 spans of 200' each, two approach spans of 60 ft. each and embankment approaches.

5,620,000 lbs. of steel erected in place in bridge proper @ 4¢ per lb.	224,800.00
94,000 lbs. of steel erected in 60' approach spans @ 3.75¢ per lb.	3,525.00
6,088 cu. yds. of concrete in river piers @ 8.00	48,704.00
1,779 " " " " " foundations of river piers @ 25.00 per cu. yd.	44,475.00
350 " " " " " abutments @ 7.00, including excavation	2,450.00
215,000 cu. yds. of fill in embankment @ 25¢ per c.yd.	53,750.00
2,620 lin. ft. of timber floor @ 5.00	13,100.00
900 " " " temporary wooden trestle @ 15.00 per lin foot	13,500.00
900 " " " ties and roadbed @ 2.00 per ft.	1,800.00
	406,104.00
Engineering & Contingencies 10%	40,610.00
	446,714.40

NOTE: The above estimate for design No. 3 includes temporary trestle approaches, to be filled in eventually. If it can be arranged to dispense with them the cost will be reduced by $14,850.00, making total cost $431,864.40

EHH-C

August 14th, 1901

C. S. Mellen, Esq.,

President.

Dear Sir:-

I desire to supplement my letter of the 13th inst. containing the last report on the Lind-Ellensburg Cut Off by additional information which could not readily be given in that report. Since my previous report to you of February 13th, the location of the Lind-Ellensburg line has been completed, and exact distances are now known. I have also found it possible to considerably reduce the distances given from Coulee City to the Coast by fixing the junction point of the branch line from Coulee City at a more westerly point on the Lind-Ellensburg line. Also a small discrepancy appeared in the former report in the mileage from Coulee City to Tacoma and Spokane via Cheney Junction, all of which is corrected in the present tables.

The tabular distance from Spokane to Portland over the O.R.& N. is given via Colfax as that is the scheduled route of the passenger trains, but I think it necessary to add that the distance could be reduced by 10 miles via the more direct route between Seltice and Winona, which would be used except for the commercial importance of the city of Colfax. The previous figures have also been altered by the completion of the Snake River line between Riparia and Wallula. With these corrections the statement of the comparative distances from Spokane to various points is as follows:

TO SEATTLE

Via Pasco,	400.6 miles
Via Crab Creek,	315.7 "
Via Great Northern,	348 "

TO TACOMA

Via Pasco,	399.4 "
Via Crab Creek,	314.9 "

TO PORTLAND

Via Pasco,	543.7 "
Via Crab Creek and Tacoma,	459.2 "
Via Colfax and O.R.& N.	433 "
Via Wallula (joint line)	374.9 "

TO ASTORIA

Via Pasco	564.7 "
Via Crab Creek,	460.2 "
Via O.R.& N.Co.	532.8 "

The above comparisons show that the present advantage of 52 miles in favor of the Great Northern to Seattle will be reversed to 32 miles in favor of the Northern Pacific, and the difference of 90 miles between St.Paul and Seattle in favor of the Great Northern will be reduced to 5.5 miles. If the Northern Pacific through route is calculated via Butte, the net difference will be but 2 miles. Various line revisions now under construction or in contemplation will still further reduce the present distance and make the Northern Pacific the shortest line. The Great Northern has a number of line revisions in progress which, I believe, will have the general effect of increasing their distance, as I understand the relocation over the divide between Kalispell and the Kootenai River, although lower in rate of grade, will be longer than their present line.

The present difference in favor of the O.R.& N. to Portland of 111 miles will be reduced to 26 miles, using the distance via Colfax. The Northern Pacific will have in its favor 53 miles less distance than the O.R.& N. between Spokane and Astoria. The joint Northern Pacific and O.R.& N. line to Portland

via Wallula will still be shorter by 58 miles than the present O.R.& N. route, and 84 miles shorter than the Northern Pacific route via Crab Creek.

A western outlet for the Washington Central branch is all important, and may be obtained by extending southerly from Coulee City to a junction with the Lind-Ellensburg line, a distance of 65 miles. Should the location between Lind and Ellensburg be changed to the more northerly route with the junction at Ritzville, the junction with the Coulee City branch would be placed 18 miles further north, reducing its length to 47 miles instead of 65 miles.

The distance from Coulee City to Tacoma or Seattle via Cheney Junction is now 491 miles, which would be reduced to 406 miles via Cheney and Lind Junctions, and may be still further reduced to 252 miles by the construction of a southerly connection from Coulee City, saving 239 miles over the Pasco route, and 154 miles over the Crab Creek route. The proposed extension from Coulee City would cross the Great Northern line at a point about two miles east of Adrian, and this intersection may be considered a common point. The distance from the intersection near Adrian to Seattle via the Northern Pacific and Great Northern routes is almost identical, being 234.4 miles and 235 miles respectively. Accordingly the Northern Pacific Railway Company need be at no disadvantage with the Great Northern Company for business originating in the Big Bend, Waterville and Okanogan districts. The Washington Central branch should be immediately extended to Bridgeport, more particularly on account of the great strategic importance of such extension, which would then command the main Columbia River valley and the valleys of its tributaries, the Chelan, Methow, Okanogan and Sans Poil Rivers.

With schedule speeds now in effect between Lind and Ellensburg, the

construction of the new line would shorten the time of trains as follows:

WEST-BOUND	EAST-BOUND
Train No. 1 - 2 hours, 56 minutes	Train No. 2 - 2 hours, 36 minutes
" No. 3 - 2 hours, 53 minutes	" No. 4 - 2 hours, 47 minutes
" No.53 - 6 hours, 18 minutes	" No.54 - 5 hours, 54 minutes

The real saving should be greater as the new line would have less curvature and would permit faster time. On our present schedule the time between Spokane and Seattle via the Great Northern would be about 1 hour and 30 minutes shorter, which by the construction of the new line would be reversed to 1 hour in favor of the Northern Pacific. So great a difference in time must have a high commercial value and greatly affect gross receipts.

Yours truly,

Chief Engineer

August 13th, 1901

EHH-C

C. S. Mellen, Esq.,
President.

Dear Sir:

Supplementing my previous report regarding the proposed construction of the "cut-off" line between Lind and Ellensburg, I find opportunity to add some information which could not properly find place in the previous report.

In making the original reconnoissance my Assistant Engineer Mr. C. C. Van Aredol reported that the detour via the forks formed by the junction of Providence Coulee and Crab Creek would increase the distance fifteen miles. This was referred to you at the time and you decided it preferable to accept the more direct route via the Dry Creek summit, but I find that the Dry Creek section, approximately 30 miles in length, will cost nearly $200,000.00 more than the cost of a section of similar length on the bottom of Providence and Crab Creeks. The earlier maps were quite imperfect, and Mr. Bihler has since reported that the additional distance along the water grade would not exceed eleven miles. No survey has been made around this way however, and I think that the chances for still further reducing the distance to 6 or 7 miles are not unpromising, and as all possibilities should be exhausted before construction is authorized, I have asked Mr. Bihler to run a preliminary line following the drainage between common points, for the purpose of obtaining exact distances, grades and elevations, and the results will be submitted with a comparative estimate for your consideration.

During my recent western trip, I discussed this matter fully with Mr.

Darling, who makes the very interesting suggestion that the eastern junction of the line be fixed at Ritzville. A more recent map, of which I send you a copy, shows a coulee which heads very close to Ritzville, marked on the map as "Third Coulee". The fall of Providence Coulee from Ritzville to Lind, demands for a bottom location, a 0.7 maximum grade, and it is altogether probable that the fall of "Third Coulee" is the same, with a chance however, of securing a lighter and better grade. The distance via the alternate routes is apparently the same, but there is a fair chance of securing a still shorter route if the local topography is favorable.

The suggested route has very much in its favor to commend it, particularly if a lower rate of grade can be obtained, for it is quite possible to reduce the grades between Ritzville and Sprague to a corresponding degree at no great cost, and as the Dry Creek summit would be wholly avoided, all of the rise could be concentrated into a single incline, thus avoiding the section of light grade between Lind and the Dry Creek summit on the route as now located, and correspondingly extending the low grade section between the Columbia River and the 45th mile. I have thought so favorably of this idea that I have directed a reconnoissance made in order that the results may be placed before you without delay.

The additional length of new line will apparently be between 18 and 20 miles, but we will have to apply against this, the approximate sum of $200,000. saved by avoiding the Dry Creek summit, and we will also save not less than 12 miles additional branch line construction should the projected connection be made with the Central Washington Branch at Coulee City. Considered in combination, it is altogether probable that the cost of this route would not be in excess of the one now located, and even if it is not practicable to reduce the grades below 0.7%, we can certainly secure a considerable improvement in align-

ment as compared with the present section between Ritzville and Lind, and will incidentally develope more local territory in the valuable wheat producing district around Ritzville, and move the division line between the territory tributary to the Northern Pacific and Great Northern further north.

This route should have the fullest consideration before the line of final location is adopted.

Yours truly,

Chief Engineer

Enc

EHM-C

August 8th, 1901

C. S. Mellen, Esq.,

President.

Dear Sir:-

I send you herewith maps, profiles and estimates of the located line between Lind and Ellensburg.

The estimated cost is $3,[illegible]4,878.00, equivalent to $37,[illegible].00 per mile, including the Columbia River bridge. The cost considerably exceeds the preliminary estimate, the increase being due to the heavy character of the location, based upon an operation of 20 daily trains, (each way) the heavy work across the Dry Creek summit incurred in the effort to avoid excessive grades and to secure the best possible alignment, and in addition, large contingency allowances inserted by Mr. Ribler under appropriate heads, but it is believed that the final cost of the line will be less rather than over the amount of the estimate.

The new line follows the valley of Providence Coulee westerly a distance of 12 miles from the junction with the main line at Lind, and from that point is supported along the side hill slopes with easy alignment to the Dry Creek summit at the 23rd mile. The adverse grades east-bound to the Dry Creek summit have been reduced to 0.25%. From the Dry Creek summit to the foot of the grade at Dry Creek, a 0.7% incline has been located, 19 miles in length, along the course of Dry Creek. Construction work on this section is very heavy on account of the difficulty in securing supporting ground without unduly sacrificing alignment. From the foot of this incline at the junction of Dry Creek with Crab Creek, to the Columbia River, the line follows the valley of Crab Creek with long tangents, low

grades and light work. Along this part of its course Crab Creek is flanked by precipitous cliffs on the north, and by the slopes of Saddle Mountain on the south.

The Columbia River is crossed by a high bridge, 2500 feet in length, consisting of 11 deck truss spans each 200 feet long, and one through truss cantilever span 300 feet in length. Preliminary correspondence with the government engineer at Portland indicates that the bridge as projected, will be approved by the Secretary of War upon receipt of formal petition. Much care and study have been given to this crossing, and you will find a special map showing the alternate lines, together with corresponding profiles and estimates. The latter have been computed not only for the bridge proper, but for the approaches and line on either side of the crossing between common points. Special estimates have been obtained from Mr. Ralph Modjeski for two or three of the most promising crossings, and I believe the estimates may be considered entirely reliable. The bridge will be erected without false work, each span being anchored back to the preceeding span as the work advances, forming a cantilever, the anchor span being removed after each span has reached the next pier. Considering all factors in combination, the crossing marked "L-5" affords the best results, and I believe you will approve this recommendation. The soundings indicate that the piers will be founded on bed rock throughout the entire length of crossing.

It was necessary to continue the descending grade from the Pechastin Summit across the bridge, on account of insufficient distance to complete the descent on the west side of the river without forced development, and also to avoid the construction of about two miles of line on a loose rock slope, 1600 feet in height. The cliff at the top of this slope is still disintegrating,

and the falling rocks would make operation dangerous.

The located section between the Columbia River crossing and the Pechastin Summit is heavier than any line heretofore located on the Northern Pacific system, economy in construction having been sacrificed to alignment, as required by the adopted basis of 20 daily trains. A very much cheaper line could be located by sacrificing grades and alignment, but it is understood that this was not desired. The quantities have been so balanced in excavation and embankment that the material from the former will fill all openings, and no bridges will be necessary. The summit tunnel will be 3350 feet in length, and has been located to save expenditures on the flanking inclines to an equivalent amount. The incline from the Columbia River to the summit is 18 miles in length, and is located as a continuous 2.2% grade. The incline from the summit to the foot of the grade on the west is 11 miles in length and 1.5% in rate. From the foot of the incline to Ellensburg, 6½ miles, the line is located over cultivated fields with very light work, and with maximum grades not exceeding 0.6%.

The new line is 105.5 miles in length, as compared with the present route of 190 miles, effecting a saving in distance of 84.5 miles. It is possible to construct this line within one year from date of letting contract if labor is abundant and the work is pushed, but a better and more reasonable estimate of time required is 18 months.

In the operation of the new line it is believed that the best results will be secured in the mutual adaptation of engines and grades by the operation of class "S" engines through in both directions between Spokane and Ellensburg, with assistant engine service east-bound from the foot of the grade at the 99th mile to the Pechastin summit, and two assistant engines west-bound from the Columbia River to the same summit, as this arrangement permits a train rating

east and west-bound of 1600 tons, to be extended to a point 61 miles east of Ellensburg, which is the foot of the 0.7% incline to the Dry Creek summit. The present train rating of 1200 tons between Lind and Spokane may be extended to the same point.

The proposed rating of 1600 tons on the western section, is 200 tons in excess of the present rating between Pasco and Ellensburg. The distance between Spokane and Ellensburg is 188 miles, which is somewhat too long for an engine stage, and it has been recommended for this reason that an intermediate district terminal be established at the foot of the Dry Creek grade, 26 miles east of the Columbia River, but the length of the second district would be but 64 miles, which is undesirably short for the best results, and I would recommend that the proposed district terminal be omitted for the present, pending a practical determination of the necessity for such a terminal, as it may be added at any time. If necessary the crews can be changed at this point without changing the engines.

As the east-bound train tonnage changes at this point from 1600 to 1400, 200 tons will have to be dropped from each train until a sufficient number of loads are accumulated to fill out an additional "turn-around" train.

Summing up the operating advantages and disadvantages of the proposed new route, as compared with the existing route via Pasco, it can be shown that the construction of the new line will save the cost of operating 85 miles of distance, 6000° of curvature, assistant engine service over the Providence and Badger hills, and the train mileage represented by an increase of 200 tons over the present train rating over a district 61 miles in length, but the new line must be charged with the maintenance of additional track mileage, the cost of operating the mountain summit and the fixed charges on construction cost.

The operation of one passenger train each way of the present double trans-continental service via Pasco must be continued, also sufficient freight train service to accomodate the local business and business received from the W.& C.R. and O.R.& N. companies at Pasco, and I find that the traffic diverted to the new line will be equivalent to 4.6 daily trains of the second district and 4.1 trains of the third district of the Idaho Division. With this number of trains the effect upon the cost of operation will be as follows:

SAVING

DISTANCE - 261,892 train miles @ 80¢,	$209,505.60	
CURVATURE - 4.1 daily trains X 6000° X 43¢	10,578.00	
TRAIN TONNAGE - 365 trains X 64 miles X 60°	14,784.00	
ASSISTANT ENGINE SERVICE - 2432 trains @ $10.00,	24,320.00	
		259,187.60

PER CONTRA

ADDITIONAL COST OF MOUNTAIN OPERATION -		
1670 trains X $15.30, $25,551.00		
940 trains X 25.50, 23,970.00	49,521.00	
ADDITIONAL TRACK MAINTENANCE - 105 miles @ $200.	21,000.00	
		70,521.00
Net saving -		$ 188,666.60

I have not thought it necessary to recapitulate the details of the calculations entering into the above statement, as these have already been given you in a previous report. So large a saving in distance and curvature should materially affect traffic receipts, but omitting this very important factor from consideration the estimated reduction in operating expenses on the present volume of traffic is equivalent to nearly 5% on the investment. When the expected future increase in traffic requires ten daily trains, the investment will yield 9%, and with twenty daily trains 18%. The new line will also secure additional

local traffic of value and will otherwise indirectly reduce general operating expenses and increase receipts.

The construction cost has been estimated on a very liberal basis, while the estimated saving in operating expenses is very conservative, and in view of the constantly increasing volume of traffic and importance of the western portion of the Northern Pacific Company's system, a recommendation for this construction necessarily follows.

Yours truly,

Chief Engineer

MHM-C February 13th, 1901

C. S. Mellen, Esq.,

President.

Dear Sir:-

I have now secured sufficient information and data to permit a report on the comparative operating value of the proposed new line between Lind and Ellensburg and the existing line.

I have given the matter a great deal of thought and study, and have secured much practical data derived from actual present operation, in correspondence with the superintendent of the Idaho Division, and the superintendents operating mountain districts elsewhere, and I believe the estimates will conform very closely to the actual results should the line be constructed and operated.

The length of the new line between the junction points at Lind and Ellensburg will be 105 miles, as compared with 190 miles on the present route, saving 85 miles in distance. Our present through business between Lind and Ellensburg requires annually 1300 trains each way between Lind and Pasco, and 1132 trains each way between Pasco and Ellensburg. The train tonnage rating on the second district is higher on account of lighter grades, with a consequent reduction of train mileage for equivalent business. This is equivalent to 3.6 daily trains each way on the second district, and 3.1 daily trains each way on the first district, to which must be added the passenger trains.

We now have double trans-continental service over this district during the summer months, which is reduced to single service during the winter months, but the increasing trans-continental business and the importance of the local business between Spokane and the coast, even now demand a continuous double ser-

vice, and with the construction of the new line, there should be a daily train over both lines, as the local business between Lind and Ellensburg, including the connections with the W.& C.R.Ry. and the O.R.& N.Co. cannot be neglected. Accordingly I have assumed in my calculations that the new line will have 4.6 trains east of the intermediate district terminal, and 4.1 trains west of the terminal.

The distribution of controlling grades on the new line will be as follows:

Lind to Crab Creek, 41 miles,	0.7% descending
Crab Creek to Columbia River, 29 miles,	0.3% descending
Columbia River to Pechastin Summit, 13½ miles,	2.2% ascending
Pechastin Summit to Ellensburg, 17½ miles,	1.5% descending

The controlling grade between Lind and Spokane, eastbound, is 0.7%. There are sections of higher maximum rate between Lind and Spokane, but as these are operated by assistant engines, the controlling maximum does not exceed 0.7%. The grades on the eastern section of the new line have been laid out to correspond with the controlling rate on the main line east of Lind, and should obviously be included in the same district. The length of this district, Crab Creek to Spokane, will be 124 miles. It would superficially appear that the district terminal should be located at the foot of the mountain grade, but in this case, the section between Crab Creek and the Columbia River, 29 miles in length, with grades of 0.3%, would have to be operated as a part of the district with 0.7% grades, with a corresponding sacrifice of efficiency.

The possibility of saving the district terminal entirely by operating through between Spokane and Ellensburg, is quite attractive, but the distance, 188 miles, is unduly long, and the suggestion does not have the superintendents' approval, particularly as there are special reasons of considerable weight, for moving the present terminal from Ellensburg to Cleelum. This latter move has been recommended at various times, to avoid the operation of a section of low

grade between Ellensburg and the foot of the Cascade Range, which is too short for economical operation, and also on account of the great coal tonnage originating at Clealum.

The district between Crab Creek and Ellensburg would be 64 miles; between Crab Creek and Clealum, 89 miles; in both cases undesirably short for the best results, but the topographical conditions are such that it does not appear practicable to secure a better or more economical adjustment. I find that the best results are assured in mutual adaptation of engine power and grades, by operating our class "S" engines "through" in both directions, providing for assistant engine service east-bound between Ellensburg and the Peshastin Summit, and two assistant engines west-bound from the Columbia River to the same summit. This arrangement permits a train rating of 1600 tons both east and west-bound between Crab Creek and Ellensburg or Clealum, which is 200 tons in excess of the present rating between Ellensburg and Pasco. The present train rating of 1200 tons between Lind and Spokane, will be extended to the new district between Crab Creek and Spokane. In practice, I think it not improbable that all trains, both passenger and freight, may be operated through between Spokane and Ellensburg with change of crews at Crab Creek. I attach a condensed profile which will illustrate the proposed operation more clearly.

The new line will effect the extraordinary saving of 6000° of curvature, which is principally accounted for by the avoidance of the Yakima Canyon, with its severe and continuous curvature. The direct reduction in operating expense due to this item, may be estimated, but its real value is doubtless much greater, as there is every reason to believe that the reduction of so large an amount of curvature must indirectly affect traffic receipts, in common with all factors which affect the comfort of the passengers.

The new line will make it possible to save the assistant engine service

at present necessary on the Providence hill, between Connell and Providence, and on the Badger and Relief hills, west of Kennewick. Both of these minor summits have adverse grades in both directions, but the assistant engine service is principally required on the higher and steeper inclines toward the Columbia River.

On the other hand the new line will have the disadvantage of the new summit introduced by crossing the Peshastin Range between the Columbia River and Ellensburg, requiring mountain operation, and the necessity for maintaining two lines for the same amount of traffic now concentrated on a single line must also be counted against it. I am puzzled in assigning a value to the latter.

The cost of maintenance of way per track mile on the present line is $800.00. Should the new line be built, there will be but one daily passenger and one daily freight train which would continue to use the old line. It is quite certain that the cost of maintaining track and roadbed will be very greatly reduced, as it is in very good condition, and as much as $350.00 or $400.00 per mile may be saved. With the present cost, the two remaining trains would permit a proportionate expenditure of $267.00 per mile only. On the other hand, the new line will doubtless be built in a strictly first class manner, with 16 foot embankments, good ballast, heavy steel and permanent bridges, and the cost of maintenance of way and roadbed under such conditions should be low, and the number of trains operating the new line will be diminished by the diversion of two daily trains (each way) to the old line, with a corresponding reduction in the cost of maintaining the new line, and while it seems that the two lines must cost more to maintain than one, I find it very difficult to prove this. The division of operation between the two lines has the effect of saving about ten meeting points per day, the credit value of which is quite high, and as my estimates do not take into account the value of any additional local business to be secured by the construction of the new line, the assumption that track maintenance would not be

increased, is possibly justified.

While the prospects for local traffic appear quite unpromising, our experience of late years leads us to believe that it will in fact constitute an item of no inconsiderable value.

Summing up the foregoing, it appears that the construction of the new line will save the operation of 85 miles in distance, 6000° of curvature, the assistant engine service over the Badger and Relief hills, and the train mileage represented by an increase of 200 tons over the present train rating over a section 64 miles in length, at the expense of the additional cost of operating the mountain summit, and the additional fixed charges on construction cost. Values are assigned to these different items as follows:

DISTANCE

The cost of main line service on the second district, Idaho Division, per train mile is $1.04½, divided in percentages as follows:

Maintenance of roadbed and structures,	30 %
Maintenance of equipment,	17.5%
Conducting transportation,	27 %
Station expenses,	10 %
Contingencies, etc.	9 %
General expenses,	6.5%
Total =	100 %

The cost of maintenance of way and structures, maintenance of equipment, conducting transportation and station expenses, varies almost directly with the train mileage, but there are certain general expenses, such as round house labor and cost of minor organization, which would not be affected by a reduction or increase in train mileage, which I estimate at 10%. The charges to contingencies and general expenses will probably not be at all affected. If this is admitted, 80 cents only of the total cost of $1.04½ per train mile may be saved by a considerable reduction in train mileage, and this factor will be used.

Between Lind and Pasco there are now annually operated in through service,

2600 freight trains and 1460 passenger trains, and between Lind and Ellensburg 2264 freight and 1460 passenger trains. One half of these passenger trains only would operate over the new line, and the saving would be as follows:

3330 trains X 22 miles X 80 cents = $58,608.00
2994 trains X 63 miles X 80 cents = 150,897.60
} $ 209,505.60

CURVATURE

The greatest saving in curvature is on the third district, and the value of this may be computed on the basis of the number of trains on such district without appreciable error. The best authority on this subject is A. M. Wellington, who estimates the annual cost of operating 1° of curvature per daily train (round trip) at 43 cents, which certainly is not excessive, but in the present instance, the large reduction in curvature results as follows:

4.1 daily trains X 6000° X 43 cents = $10,578.00

TRAIN TONNAGE

An increase in train rating of 200 tons per train, is equivalent to a reduction on 385 trains per annum, the value of which is as follows:

385 trains X 64 miles X 60 cents = $14,784.00

An increase of train tonnage rating saves train mileage, but does not save car mileage, hence the smaller rate of value assigned in this case, as compared with the value of train mileage, when both train and car mileage are saved, as given above under the head of "distance".

ASSISTANT ENGINE SERVICE

I have a statement of the actual cost of operating the Providence and Badger summits, furnished by Superintendent Gilbert, from which I find that the cost of assistant engine service for each assisted train is almost exactly $10.00. Freight trains are assisted in one direction only, and passenger trains are usually not assisted. The value of the service saved will be accordingly =

Providence summit; 1300 trains X $10.00 =	$13,000.00	
Badger summit; 1132 trains X $10.00 =	11,320.00	$ 24,320.00
Total reduction in cost of operation, - - - - - - - - - -		$259,187.60

From the above, the additional cost introduced by the operation of the high summit between the Columbia River and Ellensburg, must be deducted. I have secured from Superintendents Russell and Horn, valuable statements of the actual cost of operation of the Rocky Mountain and Bozeman summits, which do not differ materially from the conditions under which the new summit will be operated, and I will use this data for the calculation.

Mr. Russell finds that the average cost of mountain engine service, including wages of wipers and repairs, is 36 cents per engine mile, as compared with 23 cents per engine mile for operation over the lower grades, and he properly assumes that the difference of 13 cents represents the greater cost of wages, fuel and repairs due to mountain service. The track maintenance on mountains is greatly increased by the greater weight and number of engines, and the use of brakes and sand on steep grades, which has the effect Of increasing the cost of rail renewals 50%, tie renewals 30% and labor 20%, as compared with a low grade district, increasing maintenance per track mile $439.00 per annum, equivalent to about 20 cents per train mile. In the estimate the life of rails is taken at five years; the statement of the increased cost per train mile is accordingly as follows:

Increased cost of operating road engines,	13 cents
Assistant engines at 36¢ per engine mile X 2, =	72 "
Track maintenance per track mile,	20 "
	$1.05
For an additional helper, add 72 cents,	.72
	$1.77 per train mile

You will note that the engine mileage in helper service is necessarily double the train mileage, as the engine must run light from the summit to the foot of the hill on either side. I find this statement of the cost per train mile

unsatisfactory, as the actual total cost is not appreciably increased or diminished by small differences in length of incline, but if the length of incline is used as a divisor, it gives different results in comparisons where the actual cost may not vary at all, and I find it better to divide the cost as given by the total number of trains assisted, which puts it in more practical form, and I find that Mr. Russell's operation is equivalent to a cost of $15.30 per train with a road engine and one helper, and $25.50 for a train with a road engine and two helpers. In the operation of the Peshastin summit, all passenger and freight trains east-bound will require one helper in addition to the road engine. West-bound passenger trains will require one helper, and freight trains two. Under these conditions the cost will be as follows:

East-bound trains; freight and passenger. 1305 trains X $15.30, =		$ 19,966.50
West-bound trains;		
365 passengar trains X $15.30, =	$5,584.50	
940 freight trains X $25.50, =	23,970.00	29,554.50
Total additional cost incident to mountain operation =		$ 49,521.00

In the above I have not given a separate estimate of the value of 600 feet additional rise and fall on the new line, as this is included in the estimates of extra cost for such service.

After deducting the cost of special service as above, the net saving due to the construction of the new line, based upon the present number of trains, averaging for both districts 4.3 daily trains will be:

	$ 259,187.60
Less-	49,521.00
	$ 209,666.60

which capitalized at 4%, permits an expenditure of $5,241,665.00.

If the additional maintenance of the two lines is estimated at $200.00 a mile for 190 miles, between Lind and Ellensburg, the saving would be diminished by $38,000.00, and the justifiable expenditure reduced by nearly one million dollars.

C.S.M. #9

The location of the mountain section is not yet completed, as it has been located with great care and has required many revisions, and as yet a preliminary line only has been run between Lind and the Columbia River. I have made a preliminary estimate from such data as I now have in my possession, and it appears that the line if located for five daily trains (each way), may be constructed for the sum of $3,150,000.00. The engineer however, was instructed to locate this line to provide for expected future growth in volume of traffic, on the basis of 20 daily trains, which entails very heavy work on the mountain section in reducing curvature and improving alignment, and if such location is adopted, the cost will probably be increased by $250,000.00, making the capital expenditure $3,400,000.00. I cannot guarantee this estimate until the completion of the survey and of estimates based upon more exact knowledge, but it is not probable that the final estimate will differ materially. In any case, I would recommend the expenditure of the additional sum, for it is not at all improbable that the traffic may, in fact, require twenty daily trains at no far distant date. We have had as many as forty daily trains at times on the Minnesota Division between Staples and Wadena, and I believe that our Washington lines will develope to a corresponding degree, and we have every reason to expect a proportionate increase in the number of trains. Should the traffic attain a volume requiring ten daily trains, the economy in operation secured by the new line, capitalized at 4%, would justify an expenditure of $12,190,000.00, and with twenty daily trains, $24,380,000.00, and under the circumstances we should be willing to expend three or four hundred thousand dollars, if necessary, in anticipation of future needs.

The largest single item of cost of construction on this line, occurs at the Columbia River, where a high bridge of considerable magnitude and length will be required. I have obtained a preliminary estimate for such bridge from Mr. Modjeski, amounting to $500,000.00, which includes the bridge foundations,

sub-structure, super-structure and approaches.

Assuming that the location for twenty daily trains is approved, the results as above, indicate a return of 6% on the capital investment with the present volume of traffic, and an ultimate return of 29% at such time as the future increase of traffic may require the operation of twenty daily trains. This is the direct return from the reduction in operating expenses only, and it would doubtless be a minor proportion only of the full value of the new line if values could be calculated and added for the effect on traffic receipts, of so large a reduction in distance and curvature, and for the strategic value of position in affording a western outlet for our Central Washington Branch, and access to the great region included in the north central part of the state. The gross receipts from traffic between coast points and Spokane and other interior points could hardly fail to show a most gratifying increase, but no data is available for an estimate of this kind.

The distance between Spokane and Seattle has been reduced from 421 miles to 400 miles by the construction of the Palmer Cut-off, and would be further reduced to 315 miles by the construction of the Lind Cut-off, as compared with the distance via the Great Northern line as 348 miles. At the same rate of speed, the present time via the Great Northern would be about one hour and thirty minutes shorter than by way of the Northern Pacific line. By referring to the train schedules, and using the schedule speeds now in effect between Lind and Ellensburg, I find that the construction of the new line would shorten the time of trains as follows:

WEST-BOUND		EAST-BOUND	
Train No. 11 -	2 hours, 30 minutes	Train No. 12 -	2 hours, 30 minutes
" " 3 -	3 "	" " 4 -	2 " 50 "
" " 53 -	6 " 20 "	" " 54 -	5 "

The passenger train time over the proposed new route would accordingly be about one hour less than via the Great Northern line, at the same rate of speed, and the reduction in time of passenger trains, and in lesser measure of freight trains, must have a high commercial value.

The reduction in distance would affect both receipts and cost of operation on all business to or from Seattle, Tacoma, Portland, Astoria and minor local points. The effect at Portland and Astoria, in competition with the O.R.& N. Co. is particularly impressive, and for your information I give you a statement of the comparative distances from Spokane to various points, as follows:

TO SEATTLE

Via Pasco,	400 miles
Via Crab Creek,	315 "
Via Great Northern,	348 "

TO TACOMA

Via Pasco,	399 miles
Via Crab Creek,	314 "

TO PORTLAND

Via Pasco,	543 miles
Via Crab Creek,	458 "
Via O.R.& N.Co.	450 "
Via Wallula(joint line)	375 "

TO ASTORIA

Via Pasco,	565 miles
Via Crab Creek,	480 "
Via O.R.& N.Co.	550 "

The above comparisons show that the present advantage of 52 miles in favor of the Great Northern to Seattle, will be reversed to 33 miles in favor of the Northern Pacific, and the difference of 90 miles between St.Paul and Seattle in favor of the Great Northern, will be reduced to 5 miles, also that the present difference in favor of the O.R.& N.Co. to Portland of 93 miles, will be reduced to

8 miles only. Should any considerable proportion of the present business of Portland be transferred to Astoria, the difference will be 70 miles in favor of the Northern Pacific Company. Under these circumstances the value of a Columbia River route to the Northern Pacific is greatly reduced, but there will still remain a difference of 83 miles in favor of a joint Northern Pacific and O.R.& N. route via Wallula, which should be of great value to both companies, and the construction of the Lind Cut-off, by placing both companies on an equality, may incidentally facilitate a joint arrangement of this kind in the future.

The construction of a western outlet for the Washington Central appears imperative, as both the present and potential value of this line to the Northern Pacific is quite high, and under present conditions it is almost wholly at the mercy of the Great Northern Railway, by reason of the necessity for reversing the direction of operation in making the long detour via Cheney.

The distance from Coulee City to Tacoma or Seattle via Cheney is 508 miles, which would be reduced to 267 miles by constructing a connection 55 miles in length, between Coulee City and a connection with the Crab Creek line at a point about 21 miles west of Lind, thus saving 241 miles of unnecessary operation. This line would intersect the Great Northern Railway at Adrian, and the distance from this common point to Seattle would be 256 miles via the Northern Pacific Railway, and 235 miles via the Great Northern Railway. The Northern Pacific Railway would accordingly be subjected to a slight disadvantage only, in competition in any part of the region now served by the Washington Central Branch. Under present conditions, the development of the northern part of the state cannot be undertaken by extensions from this branch, on account of the distance handicap, but with a western outlet, this whole region of great present and future value may be added to Northern Pacific territory, embracing the Waterville district, the Columbia River valley and the valleys of its tributary streams, the Chelan,

C.S.M. #13

Methow, Okanogan and Sans Poil rivers. The Washington Central should be immediately extended to Bridgeport, and as policy and the growing development of the country may require, should be subsequently extended up the valley of the Okanogan River to the Waterville district, and perhaps also down the river to the Methow and Lake Chelan valleys. The Columbia River valley, both above and below Bridgeport, and its tributary valleys, could be readily served at a small present cost by instituting a steamboat service.

It would seem therefore that the line should be built, not only to effect a reduction of present and future operating expenses, but to save the present investment in the Washington Central Branch, and to retain for the Northern Pacific the present and future traffic of the northern portion of the state. Under such conditions, a recommendation in favor of the new line seems superfluous.

Yours truly,

Chief Engineer

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