APPENDIX C

Lackawanna Cut-Off Restoration – Passenger Rail Study

RAILROAD GEOMETRY REVIEW

GPI

Gannett Fleming Transit & Rail Systems **Dec. 3, 2019**

Water Gap Station – Track Review

Maximum Track Speed Analysis

A desktop study was performed to determine the maximum speeds that may be feasible for the track between the proposed Water Gap Station and the Delaware River. The existing track geometry for the line was taken from existing real estate valuation maps and from old Conrail track charts. This includes the area from Slateford Junction to the Delaware River where the track has been removed. This study is conceptual and was performed without benefit of detailed field survey or an examination of the site.

The curves in the line were numbered 1 through 11, starting at the Delaware River and following increasing mileposts towards Scranton. The curves were analyzed for both passenger and freight trains, both using zero super elevation and maximum super elevation. Maximum underbalance (Eu) of 3" was used for passenger trains and 1.5" was used for freight trains. Maximum super elevation allowed on NJ Transit is 6". The curves were analyzed for both FRA Class 2 and Class 4 speeds. FRA Class 2 speed is maximum 30 mph for passenger equipment and 25 mph for freight equipment. FRA Class 4 speed is maximum 80 mph for passenger and 60 mph for freight. NJ Transit current design practice requires track design speed to be a minimum of 3 mph faster than the required speeds, so each of the FRA required speeds were increased by 3 mph for the study.

The results of the analysis show the following:

- Using zero super elevation, Class 2 passenger speed was not feasible in curves 6, 8 and 10.
- Using up to the maximum super elevation, Class 2 passenger speed was feasible in all curves.
- Using zero super elevation, Class 4 passenger speed was not feasible in any curve
- Using up to the maximum super elevation, Class 4 passenger speed is not feasible for any curves.
- Using zero super elevation, Class 2 freight speed was not feasible in curves 1, 4, 5, 6, 7, 8 10 and 11.
- Using up to the maximum super elevation, Class 2 freight speed was feasible in all curves.
- Using zero super elevation, Class 4 freight speed was not feasible in any curve
- Using up to the maximum super elevation, Class 4 freight speed is not feasible in 8 of the 11 curves and was only feasible in curve 2, 3 and curve 9.

As the line is currently configured, it can be assumed that FRA Class 2 speeds can be achieved on the line, but FRA Class 4 speeds cannot be achieved. To achieve higher speeds, it would be necessary to flatten the curves by relocating them inwards. This may not be feasible because most of the curves are constrained by the Delaware River on the east and Highway 611 on the west. This is especially true of curves 4 through 8 which are within the Water Gap. The tracks could be physically improved with new ties and rail to meet Class 4 standards, but the tracks through this area would still be under slow order speeds due to the curvature. A table showing the results of the study is attached.

It must be noted that adding super elevation to the curves would require the addition of spirals which would alter the length and the alignment of the curves. The new spiraled alignments may or may not be

mathematically feasible. This alignment re-design has not been done and is beyond the scope of this study.

Track Alignment

At Slateford Junction, a new no. 15 turnout would be installed to connect with the existing freight line continuing along the west side of the Delaware River. The actual Slateford Junction is a 200 to 300-foot tangent spot between 2 reverse curves. In its original configuration, this was a dividing point between the Lackawanna Cut-Off going to Hoboken and the Old Road (the original DL&W main line) following the river. The existing track follows the alignment of the Old Road, currently used in freight service. At the junction there is currently a turnout to a small two-track yard used by the freight carriers. The yard is approximately 400 feet in length.

The proposed passenger line would follow the alignment of the Lackawanna Cut-Off. South of Slateford Junction, this alignment makes a 2-degree curve to the west, and then enters a tangent section approximately 3,000 feet long before making a 3-degree 20-minute curve to the east to the Delaware River Bridge. This section of the Lackawanna Cut-Off was a 2-track railroad at one time. The long tangent area is located between Route 611 and a row of homes located on Slateford Road. A proposed plan view is attached. This plan was prepared without the benefit of a detailed survey and is conceptual.

The new passenger line would have to travel under a rebuilt overhead bridge carrying Slateford Road near the north end where it intersects with PA 611. There was a bridge located here when the rail line was active, but it was converted into a fill section after the Lackawanna Cut-Off was abandoned and removed.

Conceptual Cost Estimate

A conceptual cost estimate has been prepared in two parts. The first part is an estimate to restore the passenger line to FRA Class 2 condition, from the Delaware River Bridge to the proposed Water Gap Station on Tinkertown Road. This estimate assumes that the existing track from Slateford Junction to Tinkertown Road would be rehabilitated with 30% new ties and lined and surfaced with additional ballast. The section from Slateford Junction to the Delaware River Bridge would be completely rebuilt with new welded rail, wood ties and ballast. NJ Transit Engineering currently does not support the use of concrete ties.

The second part of the estimate is to restore the passenger line to FRA Class 4 conditions. This estimate assumes the complete re-construction of the track from the Delaware River Bridge to Tinkertown Road with new welded rail, wood ties and ballast. Even though the track structure could be constructed to Class 4 standards, this part of the passenger line could not maintain Class 4 track speeds due to the excessive curvature of the line and would have to be slow ordered.

Both estimates include a no. 15 turnout connecting to the freight line at Slateford Junction, complete reconstruction of the grade crossing at Tinkertrown Road, and ditching and drainage improvements.

These estimates are not based on actual design and have been prepared without benefit of a detailed survey and are conceptual.

Gannett Fleming Transit & Rail Systems 6/3/19
Delaware Water Gap
Maximum Track Speed Analysis

Required speed may be feasible

Required speed is not feasible

Location	MP From	MP To	Old M.P.	Direction (R/L)	Degree Curve	**Passenger** Max V (mph) Max Eu=3" Max Ea=0"	**Passenger** Class 2 30 mph (design 33)	**Passenger** Class 4 80 mph (design 83)	**Passenger** Max V (mph) Max Eu=3" Max Ea=6"	**Passenger** Class 2 30 mph (design 33)	**Passenger** Class 4 80 mph (design 83)	**Freight** Max V (mph) Max Eu=1.5" Max Ea=0"	**Freight** Class 2 25 mph (design 28)	**Freight** Class 4 60 mph (design 63)	**Freight** Max V (mph) Max Eu=1.5" Max Ea=6"	**Freight** Class 2 25 mph (design 28)	**Freight** Class 4 60 mph (design 63)
Delaware River Bridge	1.30		72.98														
Curve 1	1.57	1.72		R	3.33	35	Y	N	62	Y	N	25	N	N	56	Y	N
Curve 2	2.59	2.61		L	2.00	46	Y	N	80	Y	N	32	Y	N	73	Y	Y
Slateford Junction	2.62		74.30														
Curve 3	2.63	2.95		R	1.06	63	Y	N	110	Y	Y	44	Y	N	100	Y	Y
					1.70	50	Y	N	86	Y	Y	35	Y	N	79	Y	Y
					1.98	46	Y	N	80	Y	N	32	Y	N	73	Y	Y
Curve 4	3.05	3.10		L	3.00	37	Y	N	65	Y	N	26	N	N	59	Y	N
Curve 5	3.30	3.40		R	3.06	37	Y	N	64	Y	N	26	N	N	59	Y	N
Curve 6	3.50	3.80		L	4.63	30	N	N	52	Y	N	21	N	N	48	Y	N
					7.00	24	N	N	42	Y	N	17	N	N	39	Y	N
					6.22	26	N	N	45	Y	N	18	N	N	41	Y	N
Curve 7	3.90	4.00		L	2.75	39	Y	N	68	Y	N	27	N	N	62	Y	N
Curve 8	4.05	4.40		R	4.72	30	N	N	52	Y	N	21	N	N	47	Y	N
					3.75	33	Y	N	58	Y	N	23	N	N	53	Y	N
Curve 9	4.50	4.70		R	2.60	40	Y	N	70	Y	N	28	Y	N	64	Y	Y
					0.75	75	Y	N	130	Y	Y	53	Y	N	119	Y	Y
Curve 10	4.80	5.00		R	2.67	40	Y	N	69	Y	N	28	Y	N	63	Y	Y
				R	1.70	50	Y	N	86	Y	Y	35	Y	N	79	Y	Y
				R	4.12	32	N	N	55	Y	N	22	N	N	51	Y	N
Curve 11	5.40	5.60		L	3.42	35	Y	N	61	Y	N	25	N	N	55	Y	N
Water Gap Station	6.20		77.88														

CONNECTION TO EXISITNG FREIGHT TRACKS

BRIDGE FOR LACKAWANNA CUT-OFF

TO HOBOKEN

DELAWARE RIVER

SLATEFORD ROAD

TO SCRANTON

ROUTE 611

RECONSTRUCTED SINGLE MAIN TRACK

SLATEFORD JUNCTION
NO. 15 LH TURNOUT

GANNETT FLEMIING TRANSIT & RAIL SYSTEMS
DECEMBER 3, 2019

SCALE
0 200 400 FEET

SHEET 4