Heartland Corridor, Walton Virginia to Columbus Ohio

Preliminary Engineer Phase Report

TWIN BRANCH NO. 2
TUNNEL –
MP N408.11
TWIN BRANCH, WV

October 14, 2005, Rev. 2

Hatch Mott MacDonald

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Preliminary Engineering Phase Report

October 14, 2005

Norfolk Southern Railway
Heartland Corridor, Walton VA to Columbus OH

Twin Branch No. 2 Tunnel – MP N408.11

Statistics: Pocahontas Division
Double-width Tunnel for Main #1 and Main #2
Length = 883'
Concrete lined
Degree of Curvature = 2.4 LT (per Track Chart)
Superelevation = 1.5" (per Track Chart)

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1. EXISTING CONDITIONS

1.1 Background

Valuation Map V-13WV/34 (16290) for the Twin Branch No. 2 Tunnel is dated June 30, 1916. Parcels for the tunnel were acquired in 1903. Therefore it is suspected that the tunnel was constructed in 1903 or shortly afterwards. Drawing No. Y-1617-D (4 sheets) is dated November 25, 1985 and documents repairs made to the portals and the liner. A Norfolk Southern tunnel inspection sheet references "12574-A – Plan – Tunnel Undercutting Program 1981." Additional information on this tunnel was obtained from various sources such as topographic maps, aerial photos, inspection reports, track charts, and field investigations that were performed on March 23, June 14, and July 8-9, 2005.

1.2 General Area

The tunnel is located in a lightly populated area of the Town of Twin Branch, McDowell County, West Virginia. Nearby land use includes a residential area near the west portal. There is a staging area close to the west portal. The tunnel can be accessed by Route 7 at the east portal. Equipment will need to cross a rail bridge to get to the east portal. The rail bridge crosses Route 7 and the Tug Fork River. A rail greaser is located between the two Twin Branch Tunnels.

1.3 Structural Conditions

The tunnel is 883' long with a concrete lining and a width of approximately 30'. It is a double-width tunnel for two tracks. The track circuit is mounted on the north wall of the tunnel lining. The tunnel lining is in good condition and dry, with only the joints at the portals being wet. For the majority of the tunnel's south side, the base of the footing, which has a thickness of 12", is exposed and erosion of the rock below is occurring (see Photo 6.) The vertical distance from the top of rail to the base of the footing was measured at 20".

Liner cores were taken on July 8 and 9, 2005. Cores were drilled into the liner at locations 250' and 750' into the tunnel from the east portal. The cores were taken at the 10 and 12 o'clock positions at each location. A borescope was inserted into the holes to view inside the liner. The video from the borescope was recorded onto a DVD. The liner probe investigation is summarized in the table below:

Summary of Twin Branch No. 2 Tunnel Liner Core Investigation			
Distance from East Portal	**Position**	**Liner Thickness**	**Notes**
250'	10 o'clock	46"	Broken rock behind concrete liner. No void.

Summary of Twin Branch No. 2 Tunnel Liner Core Investigation			
Distance from East Portal	**Position**	**Liner Thickness**	**Notes**
250’	12 o’clock	33”	No void behind liner.
750’	10 o’clock	41”	No void behind liner.
750’	12 o’clock	39”	No void behind liner.

The bridge outside of the east portal of the tunnel was investigated on June 14, 2005. It is a 4-span timber deck girder bridge. The girders are built-up steel plate girders with the south pair of girders carrying Main #1 and the north pair carrying Main #2. The girders bear directly on the abutments. The bridge spans over the Tug Fork River and two roads. There is only 9’-1” of clearance from the road to the bottom of the girder. The structure type and site geometry, coupled with the proximity of rock below the rail make track lowering a difficult and expensive option.

Excavation was done to expose a small portion of the tunnel liner footing. The footing thickness was found to be 12”. The vertical distance from the top of rail to the base of the footing was measured at 26”.

1.4 Track

The track is continuous welded rail of conventional design with wooden crossties at approximately 19” on center and a stone ballast section. The rail is typically 132RE on 18” tie plates and fastened with rail spikes and anchors at every tie. The track curves left 2.4 degrees with a superelevation of 1.5”on both tracks. The ballast is approximately 2’ below top of tie and is in generally poor condition. Most of the foundation is exposed on the south side of the tunnel where the pumping exists. There are drainage ditches along each wall and in between the tracks. Drainage appears to be a problem, as standing water is present in the south ditch (inside of the curve) causing pumping on Main #1. The water in the tunnel was tested and its pH reading was 8.57. This is a fairly neutral reading and indicates that the water is not unusually corrosive. The ballast from this tunnel was not tested, however ballast in the adjacent Twin Branch No. 1 Tunnel was tested and classified as being “Very Strong”, requiring many blows of a geological hammer to break intact rock specimens.

1.5 Geotechnical

The tunnels in the east-central part of the Pocahontas Division (including Twin Branch No. 2) are located in the Appalachian Plateaus Physiographic Province, a region characterized by deeply incised plateaus underlain by flat-lying sedimentary rock. The tunnel itself is lined and no rock was exposed. The description of the site geology at each tunnel is based on our observations of the rockmass at the portals and adjacent cuts and the 1968 West Virginia Geologic Map prepared by the West Virginia Geologic and Economic Survey.

The tunnel was excavated through the medium- to thick-bedded fine-to medium grained sandstone of the New River Formation. The sandstone is locally interbedded with thin-bedded sandstone, siltstone, shale, and coal. Bedding is subhorizontal and gently rolls back and forth towards the northwest and southeast. Beds of thin-bedded sandstone and shale up to five feet thick were infrequently noted within the sandstone. Joints in the rock cuts are typically steeply dipping and widely spaced. Most joints are less than 15 feet in length and are not through-going across the exposure face.

The rock quality designation, Q, at the portals was determined to be 18. A Q rating between 10 and 40 is considered "Good" with 10 bordering on "Fair" and 40 bordering on "Very Good." A sample of rock was taken from the portal and tested. Lab testing of the sample indicates that the rock has a compressive strength of 21,500 psi.

The geoprobes indicate that the top of rock is located between 1.75' to 4.5' (averaging about 3.2') below the top of ballast throughout the tunnel for Main #1 and between 2.0' to 4.0' (averaging about 2.9') below the top of ballast throughout the tunnel for Main #2. Top of ballast is typically about 0.8' below top of low rail.

1.6 Clearances

The laser car measurements indicate that the existing tunnel has adequate horizontal clearance for both the "High-Wide Load" and the "Double-Stack Load" portions of the composite clearance envelope throughout the tunnel. For vertical clearance, the "Double Stack" portion of the envelope encroaches on the sides of the tunnel crown by an average of about 14" on the left wall and 19" on the right wall, and varies up to a maximum of 25" on the right wall. The "High-Wide" portion of the envelope encroaches on the sides of the tunnel crown (at points lower than the "Double Stack" portion) by an average of about 4" on the left wall and 12" on the right wall, and varies up to a maximum of 15" on the right wall. Cross sections of the tunnel clearance encroachments are shown in the drawings at the end of this report. The maximum vertical encroachments are summarized in the table below:

	Crown Encroachment (radial inches)	
Distance (ft) from East Portal	**Left Side**	**Right Side**
0	12	21
102	14	21
203	13	20
303	12	19
403	11	17
503	12	18
602	12	20
703	16	20
803	22	20
852	24	20

2. CLEARANCE IMPROVEMENT ALTERNATIVES

Given the magnitude of the vertical clearance deficiency, there are several general alternatives that can be used to obtain the clearance; replacing the lining, notching the lining, or using steel ties to lower the track. Combinations of the general methods may be required to obtain a design that is cost effective and that can be constructed within reasonable track outages. Track lowering by excavating or undercutting does not appear feasible due to the proximity of the top of rock to the surface.

2.1 Liner Replacement

To obtain the desired clearance, the concrete roof must be demolished, the native rock excavated to the clearance limits plus the new liner thickness, and a new concrete liner installed. This alternative appears necessary for most the tunnel, though notching with steel ties may work at portions of the tunnel if the encroachment can be reduced to approximately 16”.

2.2 Notching the Crown

Notching in the upper quadrants of the tunnel crown may not cut entirely through the liner and could be an alternative to complete liner replacement. However, the encroachment is large enough that a minimum liner thickness of at least 10” might not be maintained. The four cores taken in July 2005 varied in thickness from 33” to 46”, which is more than the minimum thickness of 26" at crown and 34" minimum in the sidewalls that was indicated on drawings for adjacent tunnels. However, additional investigations would be required before the apparent additional thickness of concrete can be relied on in the reconstruction. Therefore, deep notching of the tunnel crown will no longer be considered as a viable alternative for achieving the necessary vertical clearance, unless additional investigations in the Final Design Phase conclude that an adequate thickness can be maintained.

2.3 Steel Ties

Substitution of steel ties for the standard wood ties would permit the rails to be lowered about 6 inches. Transition sections would be constructed at the tunnel approaches for the vertical curves and for a gradual transition in track stiffness. A proper drainage system is required to minimize corrosion of the ties.

Steel ties would not be sufficient to fix the entire clearance deficiencies, but in some cases could be used in conjunction with notching to provide a more economical solution. However, in this case, even with steel ties the amount of encroachment of the tunnel crown would still be significant enough to eliminate deep notching as a practical alternative. Due to the close proximity of the rail bridge outside the east portal, steel ties would require expensive and impractical bridge modifications in order to lower the bridge. Also, lateral shifting of the track is a concern when using steel ties. Steel ties do not provide any significant advantages that would warrant their expense. Therefore, they will no longer be considered as a viable alternative.

3. PREFERRED ALTERNATIVE

Given the magnitude of the vertical encroachment, liner replacement of the tunnel crown is necessary to achieve the required clearance in the tunnel. Additional investigations in the final design phase may determine that notching is possible for some of the tunnel. Drainage improvements are also recommended.

3.1 Preliminary Design

The preliminary design uses replacement of the liner crown. The existing track structure is planned to be flooded with ballast to the top of the rail to provide access into the tunnel for the contractor to work and to protect the track during the construction. The preliminary design also proposes to install a new drainage system and undercut the track to replace the fouled ballast.

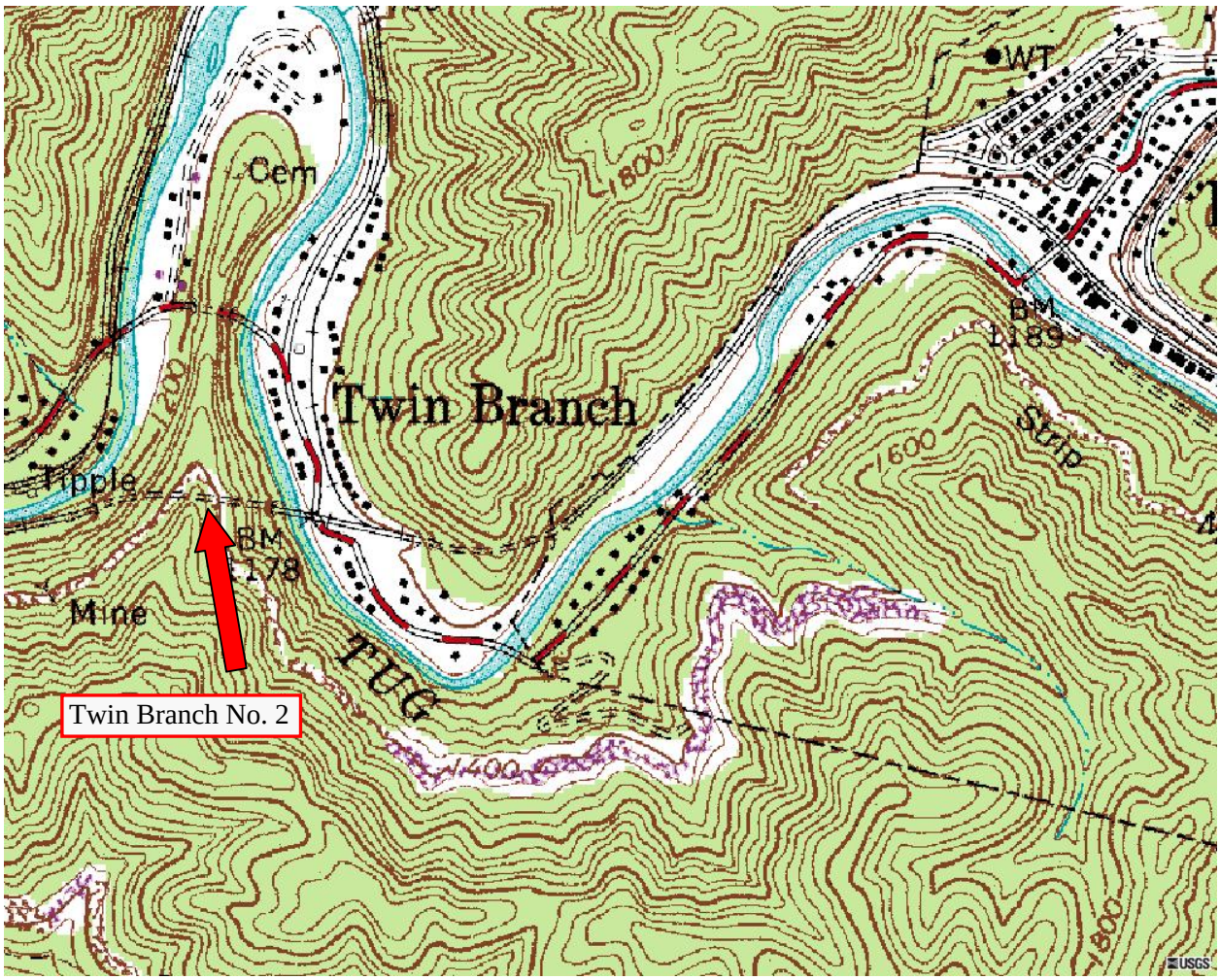
3.2 Schedule

The estimated schedule for completing improvements on this tunnel is thirty-three (33) weeks from mobilization to demobilization. The schedule assumes one track being closed at a time, for eight hours, five days a week. The schedule assumes 12' of crown removal each day, with concrete removal, rock removal, installation of rock dowels and installation of shotcrete all occurring on the same day for each 12' segment. Drainage improvement operations would be undertaken at the same time as the crown removal, but at different locations in the tunnel.

3.3 Estimate

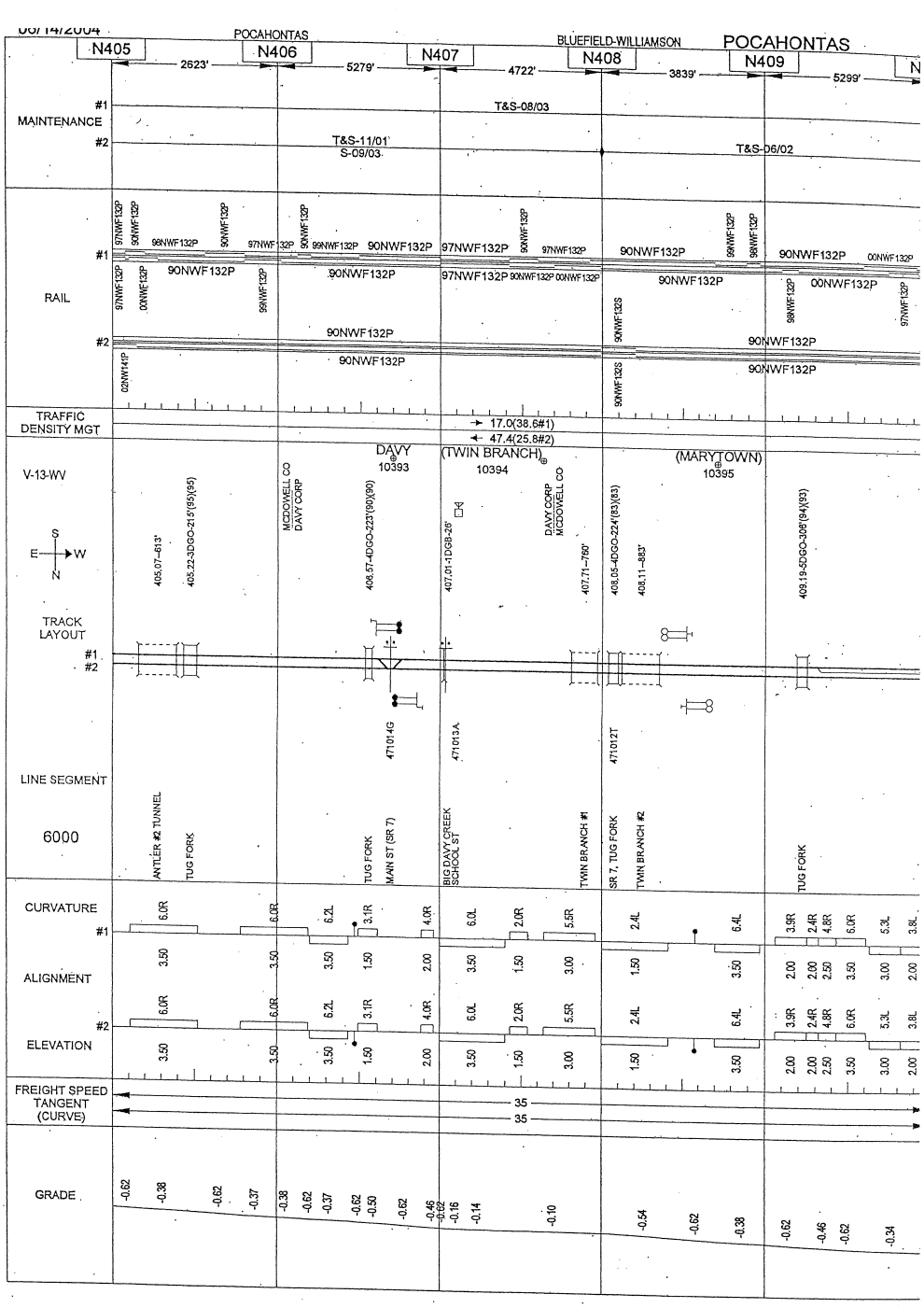
The total estimated cost for achieving clearance at this location is $6.5 million (2005 rates) or $7,336 per foot of tunnel. The work items include mobilization, surveying, liner removal, rock removal, rock dowels, crown installation, rock cut for drainage trench, tunnel drainage system, ballast cleaning, and demobilization. The total cost is made up of tunnel, track, signal, and site work items at $4.0 million, plus a 30% construction contingency, a 10% engineering allowance, and a 14% construction management allowance.

4. USGS TOPOGRAPHIC MAP



5. AERIAL PHOTO

6. TRACK CHART



7. PHOTOS

Photo No. 1 – East Portal

Photo No. 2 – Highway Underpass Beyond East Portal

Photo No. 3. – West Portal

Photo No. 4. – Looking from West Portal

Photo No. 5. – Footer Exposed With Standing Water

Photo No. 6. – Mud Pumping Through Ballast

8. ESTIMATE

Twin Branch No. 2

Tunnel Length	883	ft
Tunnel Width	29.75	ft
# of Tracks	2	

	Contractor		Railroad	
Work Window	10	hrs	10	hrs
Setup & Demobilization Allowance	2	hrs	2	hrs
Production Time	8	hrs	8	hrs

Tunnel Work Items	UOM	Quantity	Unit Rate	Total
Mobilization	%	5%		$169,492.16
Surveying	DY	5	$1,300.00	$6,500.00
Rock Dowels 14' with Chain Link Mesh - Crown	EA	1472	$603.27	$887,813.87
Crown Removal	SF	41610	$16.17	$672,867.20
Rock Removal - Crown	CY	1541	$427.00	$658,067.20
Crown Installation	SF	41610	$24.42	$1,016,193.66
Rock Cut Drainage Trench	LF	1283	$85.26	$109,387.20
Tunnel Drainage	LF	1283	$17.61	$22,598.11
Demobilization	DY	5	$3,283.20	$16,416.00
Total Tunnel Work Items	**LF**	**883**	**$4,030.96**	**$3,559,335.40**

Trackwork Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Undercutting	PF	1766	$29.48	$52,059.44
Surfacing & Lining	PF	5298	$1.94	$10,304.06
Ballasting Track	TN	1766	$38.25	$67,541.32
Demobilization	DY			
Total Trackwork Items				**$129,904.82**

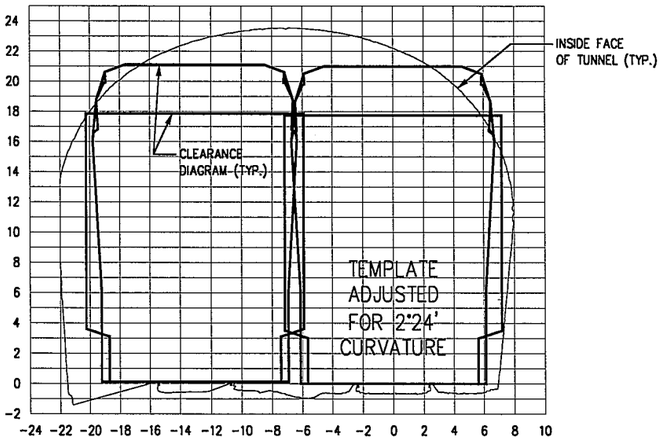
Signal Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Relocate Cables / Track Leads	LF	883	$11.39	$10,060.18
Demobilization	DY			
Total Signal Items				**$10,060.18**

Site Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY	1	$2,483.60	$2,483.60
Erosion & Sedimentation Control	EA	1	$11,958.80	$11,958.80
Demobilization	DY			
Total Site Items				**$14,442.40**

Special Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Flagging	DY	164	$821.50	$134,726.00
Flood Track with Ballast for Protection	TN	3532	$38.94	$137,546.06
Remove Flooded Ballast	TN	3532	$9.24	$32,632.61
Demobilization	DY			
Total Specialty Items				**$304,904.66**

Subtotal All Items		**$4,018,647.47**
Construction Contingency	**30%**	**$1,205,594.24**
Engineering Allowance	**10%**	**$522,424.17**
Construction Management Allowance	**14%**	**$731,393.84**
Total		**$6,478,059.73**

9. DRAWINGS



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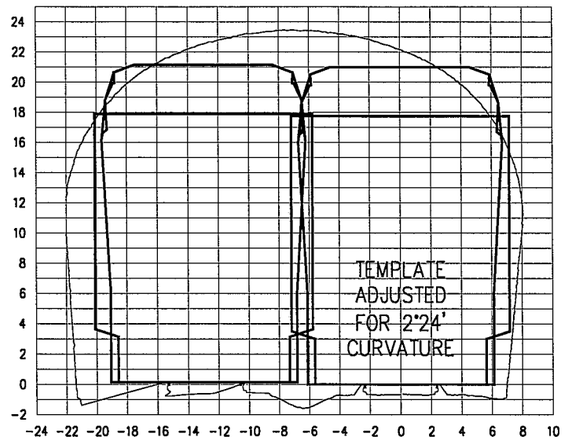

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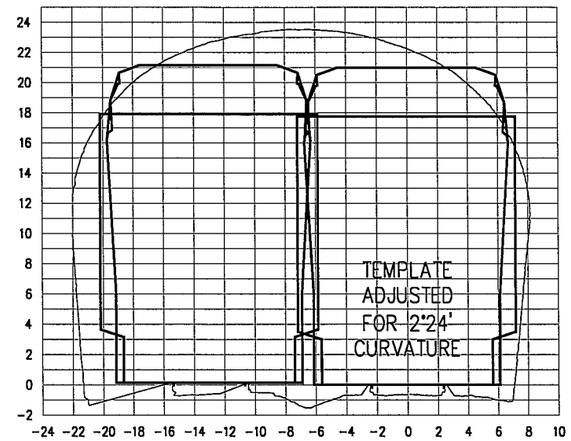

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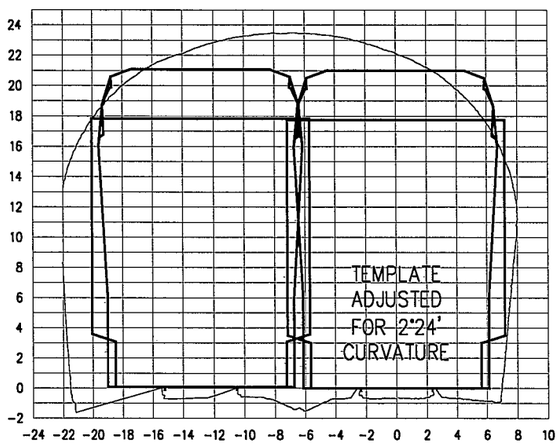

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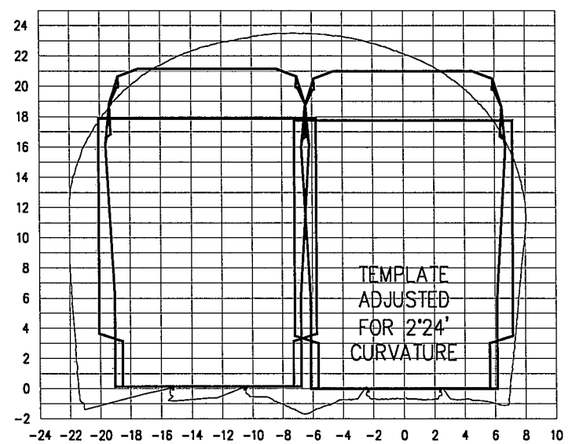

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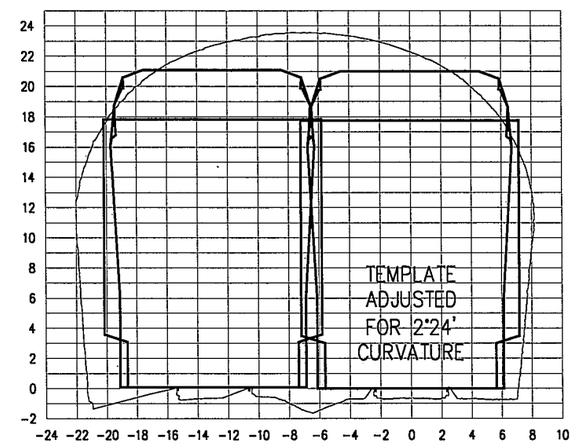

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NOTES:

1. HORIZONTAL DATUM IS PARALLEL TO TRACK. WHERE TRACK IS SUPERELEVATED, DATUM IS NOT PARALLEL WITH GROUND.
2. CROSS SECTION GIVEN FOR STA. 0+00 IS A COMPOSITE FOR THE TUNNEL FROM STA. 0+00 THROUGH 0+50. ALL OF THE SECTIONS FOLLOW THIS CONVENTION.

NOT FOR CONSTRUCTION

SCALE: 1" = 100'

50 0 100 200 300

Hatch Mott MacDonald

NORFOLK SOUTHERN

OWNING COMPANY
POCAHONTAS
OPERATING DIVISION
OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.

REV	BY	DATE	DESCRIPTION
P1	DJL	7/29/05	PRELIMINARY ENGINEERING PHASE REPORT

LOCATION: TWIN BRANCH NO. 2, TWIN BRANCH, WV

TITLE: TUNNEL CLEARANCE CROSS SECTIONS – 1 OF 3

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CHK | DATE APRIL 15, 2005

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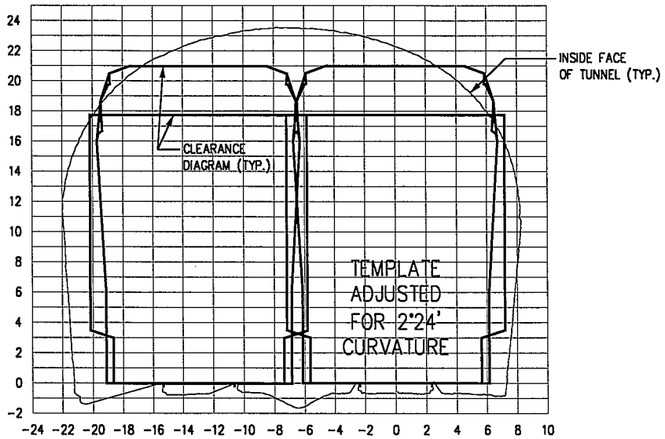

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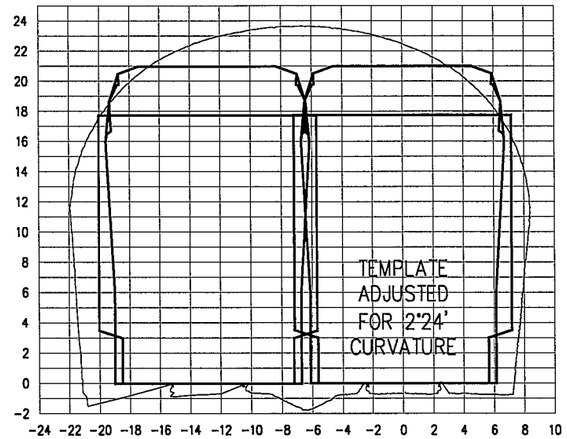

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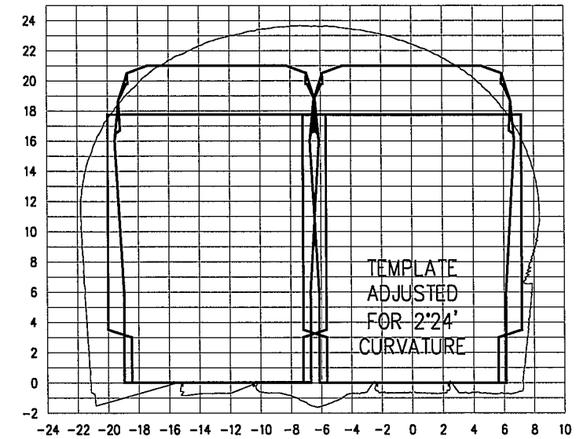

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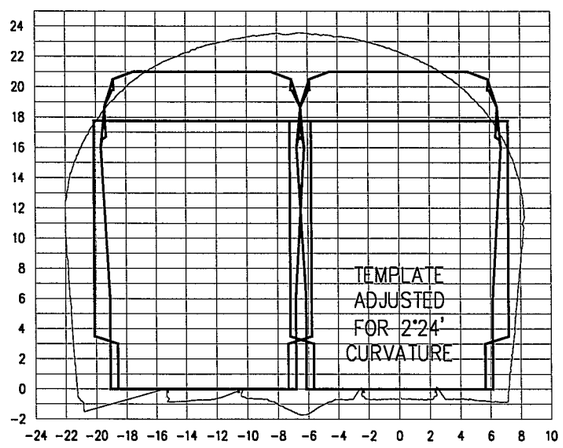

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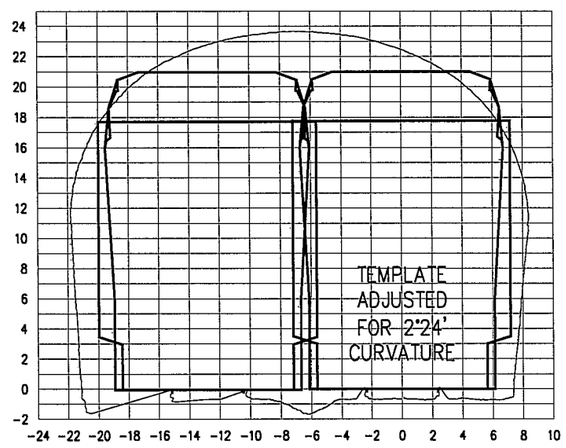

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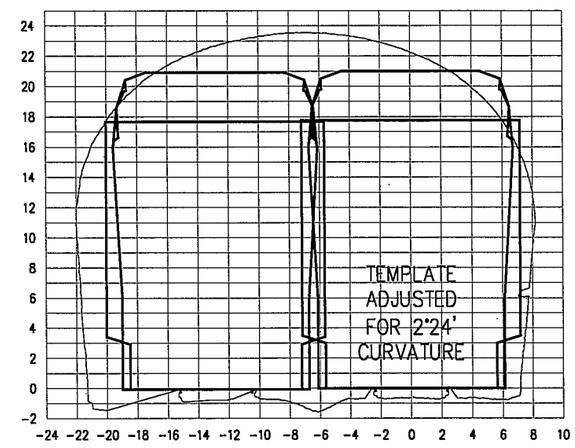

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P1	DJL	7/29/05	PRELIMINARY ENGINEERING PHASE REPORT

LOCATION: TWIN BRANCH NO. 2, TWIN BRANCH, WV

TITLE: TUNNEL CLEARANCE CROSS SECTIONS - 2 OF 3

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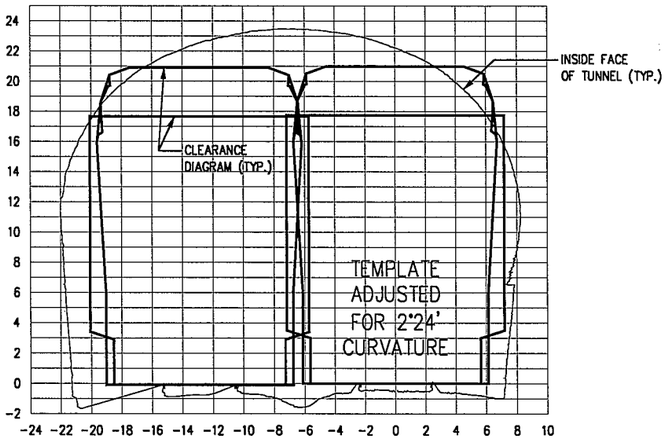

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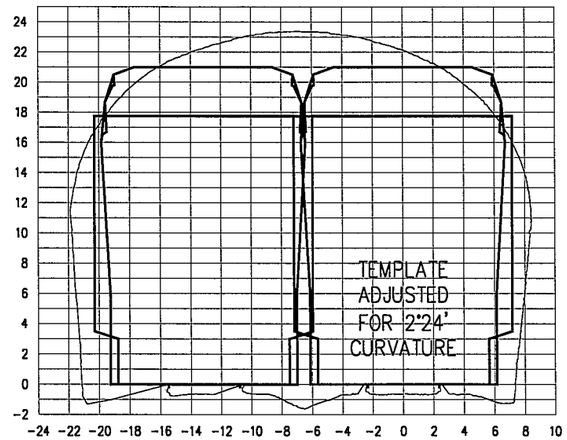

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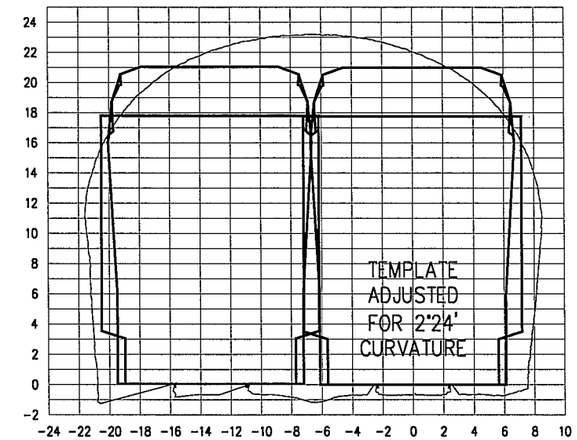

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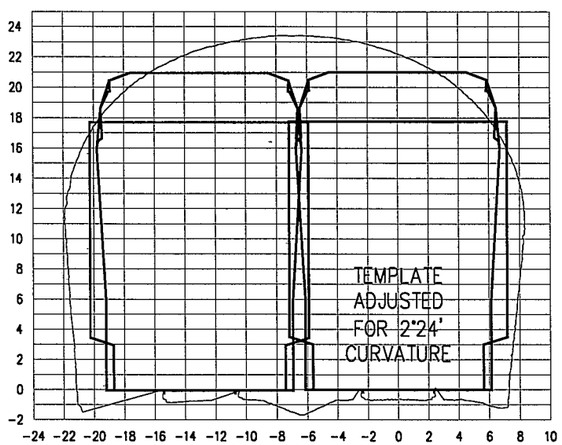

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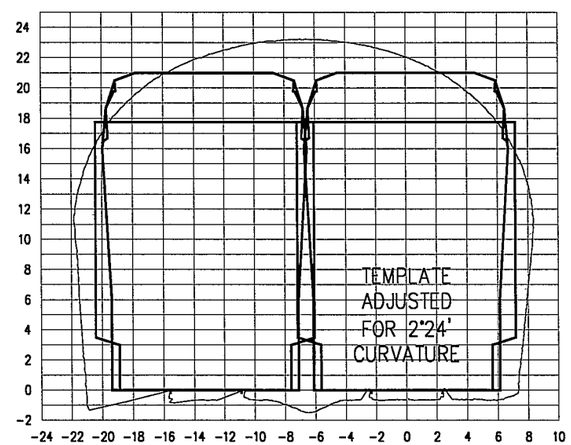

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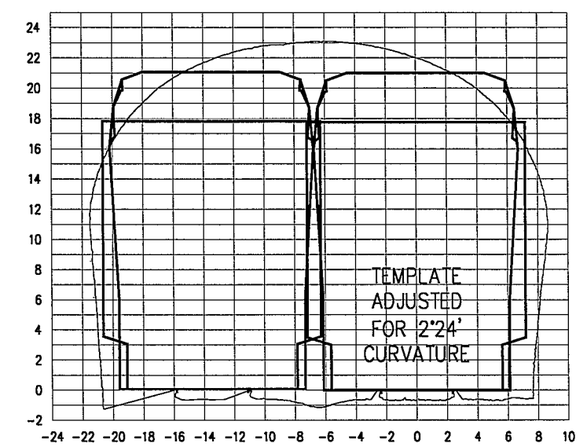

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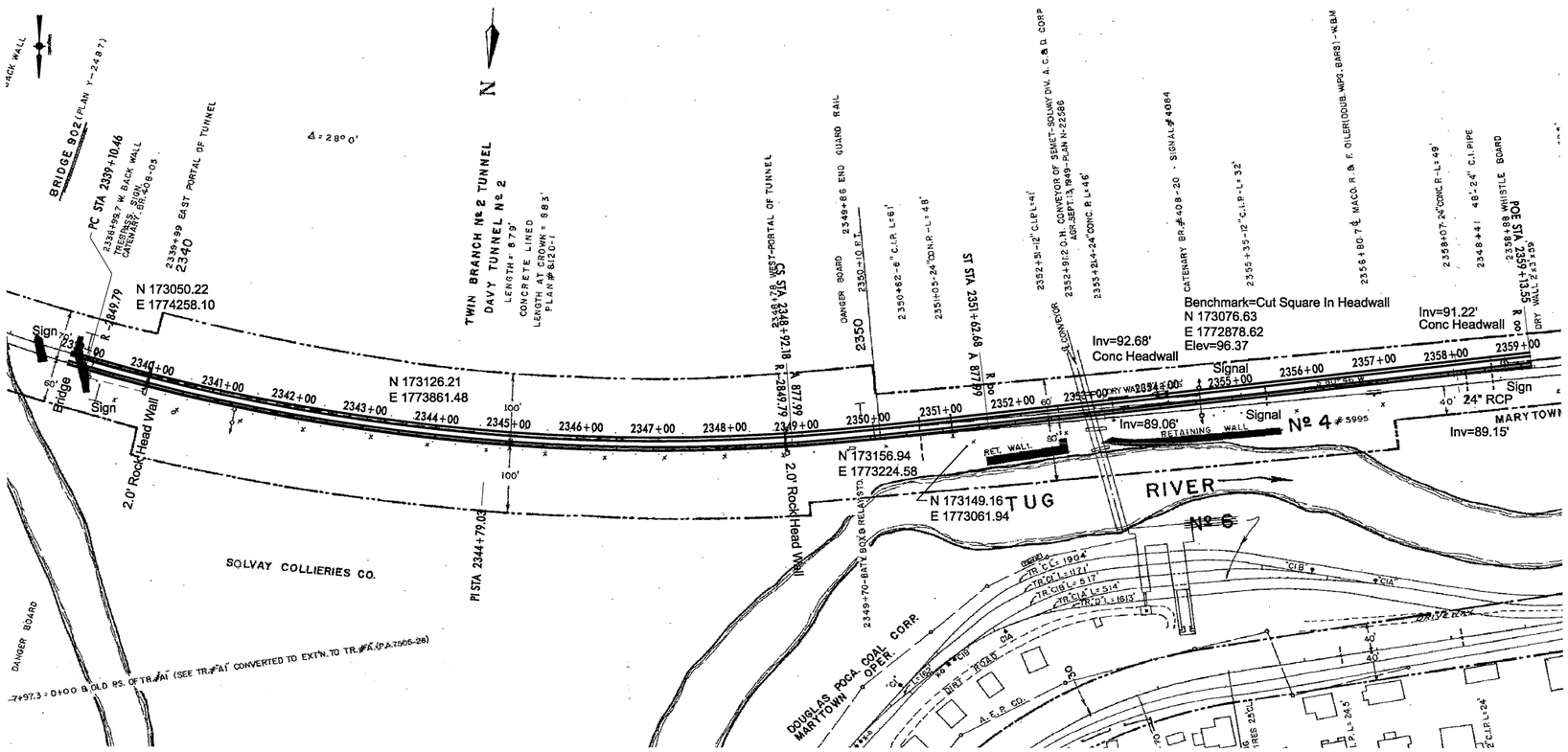

TWIN BRANCH NO. 2 PLAN

SCALE: 1"=100'

TWIN BRANCH NO. 2 CURVE DATA

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Style:
Input Factor: 1.0000

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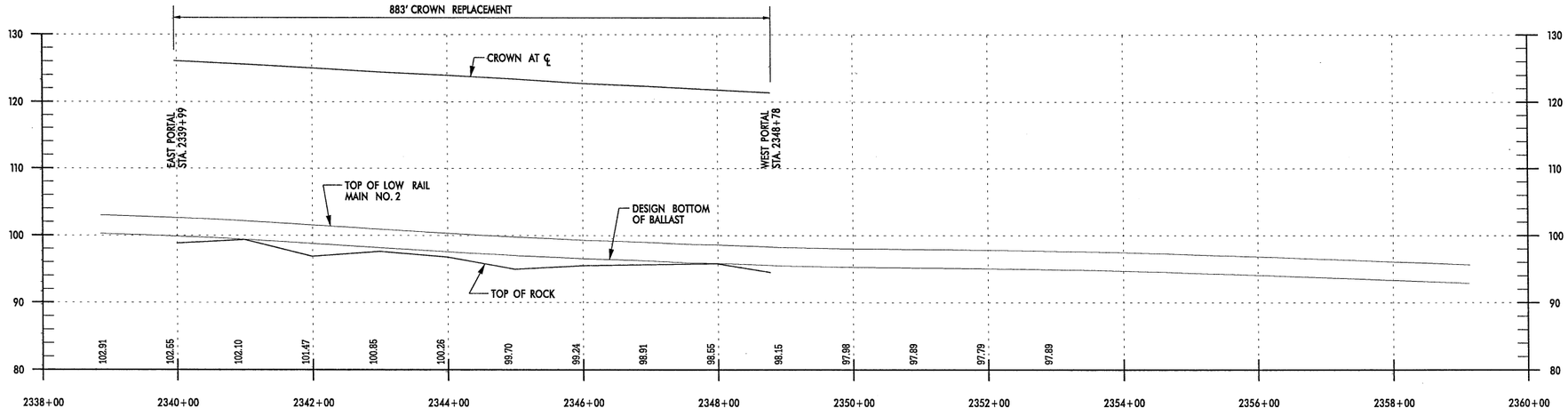
PI	( )	2344+06.26	173189.46	1773795.35
CC	(4)		170309.46	1773525.74
CS	(5)	2348+92.18	173150.38	1773301.09
Radius:		2849.79		
Delta:		19°44' 19" Left		
Degree of Curvature(Chord):		2°00' 38"		
Length:		981.77		
Length(Chorded):		981.72		
Tangent:		495.80		
Chord:		976.92		
Middle Ordinate:		42.17		
External:		42.81		
Tangent Direction:		285°13' 03"		
Radial Direction:		15°13' 03"		
Chord Direction:		275°20' 53"		
Radial Direction:		355°28' 44"		
Tangent Direction:		265°28' 44"		
Element: Clothoid				
CS	(5)	2348+92.18	173150.38	1773301.09
SPI	(6)	2349+82.36	173143.27	1773211.19
ST	(7)	2351+62.68	173120.54	1773032.27
Entrance Radius:		2849.79		
Exit Radius:		0.00		
Length:		270.50		
Angle:		2°43' 09" Left		
Constant:		877.99		
Long Tangent:		180.35		
Short Tangent:		90.19		
Long Chord:		270.47		
Xs:		270.44		
Ys:		4.28		
P:		1.07		
K:		135.24		
Tangent Direction:		265°28' 44"		
Radial Direction:		355°28' 44"		
Chord Direction:		263°39' 58"		
Radial Direction:		352°45' 35"		
Tangent Direction:		262°45' 35"		
Element: Linear				
ST	(7)	2351+62.68	173120.54	1773032.27
POE	(3)	2359+13.55	173025.90	1772287.39
Tangent Direction:		262°45' 35"		
Tangent Length:		750.88		



TWIN BRANCH NO. 2 PROFILE

SCALE: 1"=100' HORIZ.
1"=10' VERT.

NOT FOR CONSTRUCTION

SCALE: 1"=100'

50 0 100 200 300

REV	BY	DATE	DESCRIPTION
P2	DJL	10/14/05	PRELIMINARY ENGINEERING PHASE REPORT
P1	DJL	7/29/05	PRELIMINARY ENGINEERING PHASE REPORT

LOCATION: TWIN BRANCH NO. 2 TUNNEL, TWIN BRANCH, WV

TITLE: PLAN AND PROFILE

NORFOLK SOUTHERN

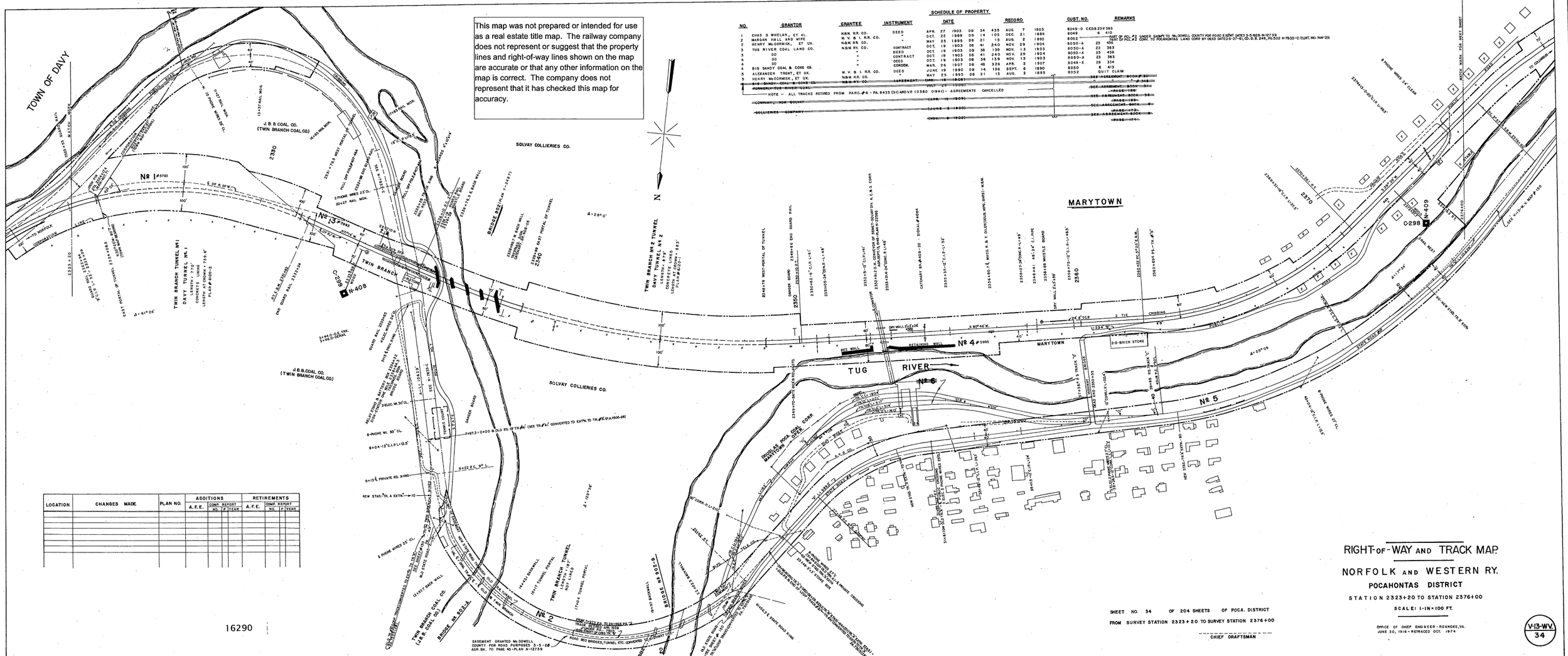
OWNING COMPANY
POCAHONTAS
OPERATING DIVISION
OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.

Hatch Mott MacDonald

DGN	PID No.	VRN 16290	MILE POST N-408.11
DWN	FILE No.		DRAWING NUMBER
CHK	DATE APRIL 15, 2005		

FILE NAME = P:\NSR\219393\CAD\survey info\408.1Twin Branch No 2\408.1Twin Branch No 2.dgn
DATE/TIME = 10/12/2005 02:57:26 PM

This map was not prepared or intended for use as a real estate title map. The railway company does not represent or suggest that the property lines and right-of-way lines shown on the map are accurate or that any other information on the map is correct. The company does not represent that it has checked this map for accuracy.



SCHEDULE OF PROPERTY

NO.	GRANTOR	GRANTEE	INSTRUMENT	DATE	RECORD	CUST. NO.	REMARKS
1	CHAS S WHELAN, ET AL.	N&W R.R. CO.	DEED	APR. 27 1903	DB 34 435	AUG. 7 1903	8049-D CED.B.23 P.385
2	MARGAN HALL AND WIFE	W. V. & I. R.R. CO.	"	OCT. 22 1889	DB 14 105	DEC. 21 1889	8049 6 410
2	HENRY McCORMICK, ET UX.	N&W R.R. CO.	"	MAY 25 1895	DB 21 15	AUG. 2 1895	8052 "
3	TUG RIVER COAL LAND CO.	N&W RY. CO.	CONTRACT	OCT. 19 1903	DB 41 240	NOV. 29 1904	8050-A 23 436
3	DO	"	DEED	OCT. 19 1903	DB 38 139	NOV. 13 1903	8050-A 23 363
4	DO	"	CONTRACT	OCT. 19 1903	DB 41 240	NOV. 29 1904	8050-A 23 436
4	DO	"	DEED	OCT. 19 1903	DB 38 139	NOV. 13 1903	8050-A 23 363
4	BIG SANDY COAL & COKE CO.	"	CONDEM.	MAR. 26 1907	DB 48 326	APR. 2 1907	8049-E 29 334
5	ALEXANDER TRENT, ET UX.	W. V. & I. R.R. CO.	DEED	JUNE 19 1890	DB 14 136	SEPT. 6 1890	8050 8 413
5	HENRY McCORMICK, ET UX.	N&W R.R. CO.	"	MAY 25 1895	DB 21 15	AUG. 2 1895	8052 QUIT CLAIM
6	BIG SANDY COAL & COKE CO.	N&W RY. CO.	AGREEMENT	JULY 19 1909			SEE AGREEMENT BOOK # 30
6	FORMERLY TUG RIVER COAL			JULY 29 1909			SEE AGREEMENT BOOK 34
	NOTE - ALL TRACKS RETIRED FROM P.A.R.C. #6 - PA. 8435 (31) AND V.R. 10380 (1941) - AGREEMENTS CANCELLED						PAGE 189
	COMPANY, NOW SOLVAY			(APR. 19 1909)			SEE AGREEMENT BOOK 32
	COLLIERIES COMPANY			(JUNE 8 1900)			PAGE 183
				(NOV. 9 1900)			SEE AGREEMENT BOOK 8
							PAGE 173
							SEE AGREEMENT BOOK 9
							PAGE 174

LOCATION	CHANGES MADE	PLAN NO.	ADDITIONS A.F.E.	ADDITIONS COMP. REPORT NO.	P	YEAR	RETIREMENTS A.F.E.	RETIREMENTS COMP. REPORT NO.	P	YEAR

16290

6290

RIGHT-OF-WAY AND TRACK MAP

NORFOLK AND WESTERN RY.

POCAHONTAS DISTRICT

STATION 2323+20 TO STATION 2376+00

SCALE: 1-IN=100 FT.

OFFICE OF CHIEF ENGINEER - ROANOKE, VA.
JUNE 30, 1916 - RETRACED OCT. 1974

SHEET NO. 34 OF 204 SHEETS OF POCA. DISTRICT
FROM SURVEY STATION 2323+20 TO SURVEY STATION 2376+00

CHIEF DRAFTSMAN

V-13-WV.
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