Heartland Corridor, Walton Virginia to Columbus Ohio

Preliminary Engineering Phase Report

Hatfield Main #2 Tunnel – MP N462.09 Sprigg, WV

October 14, 2005, Rev. 2

Hatch Mott MacDonald

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Norfolk Southern Railway
Heartland Corridor, Walton VA to Columbus OH

Hatfield Main #2 Tunnel – MP N462.09

Statistics: Pocahontas Division
Single-width Tunnel Main #2
Length = 997'
Unlined
Degree of Curvature = 2.8 LT (per Track Chart)
Superelevation = 1.5" (per Track Chart)

1. EXISTING CONDITIONS

1.1 Background

Valuation maps V-13-WV/85 (16343), dated June 30, 1916, and V-15-KY/1 (12030), for the Hatfield Main #2 Tunnel show the parcels for the tunnel were acquired in 1894 and 1895. This tunnel was probably constructed shortly thereafter. 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 29 and June 15, 2005.

1.2 General Area

The tunnel is located in Pike County Kentucky. The area near the tunnel is residential. Bridges over the Tug River are located outside of both portals. Access to the east portal is via a local road northeast of the Main #2 track; there is no access to the west portal other than through the tunnel or over the bridge. There is a small area outside of the east portal of Main #2 which could be used to store some equipment or materials. A larger staging area is located across the river east of the tunnel. Access from this area would have to be across the bridge or via local roads.

1.3 Structural Conditions

This unlined single-track tunnel is 997' long with a nominal width of 17'. There are fallen pieces of rock evident along the track and it is understood that the railroad occasionally brings equipment into the tunnel to scale any loose rock. There is water leaking approximately 36' and 100' in from the west portal and 10' in from the east portal. Rock fall sensors are mounted on the ties both outside of and in between the rails.

1.4 Track

The track is of conventional design with wooden crossties and a stone ballast section. The ballast is even with the ties and in good condition. The continuous welded rail is 132 RE with a tie spacing of 20". The track is curved 2.8 degrees to the left throughout the tunnel. The water in the tunnel was tested and its pH reading was 7.21. This is a fairly neutral reading and indicates that the water is not unusually corrosive.

1.5 Geotechnical

The tunnels in the west-central part of the Pocahontas Division (Williamson, Hatfield, Big Sandy 1, 2, 3, 4 and 7) are located in the Appalachian Plateaus Physiographic Province, a region characterized by deeply incised plateaus underlain by flat-lying sedimentary rock. The tunnels in this region are lined, with the exception of Hatfield Main #2 Tunnel. 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 tunnels are excavated through the Kanawha Formation, a medium- to thick-bedded fine- to medium-grained sandstone, with interbeds of shale, siltstone, and coal. Bedding in the Kanawah Formation is subhorizontal and gently rolls back and forth towards the northwest and southeast. Joints in the rock cuts in both formations 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 17. 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 obtained from the tunnel portal on June 15, 2005. Lab testing of the sample indicates that the rock is shale and has a compressive strength of 10,930 psi.

Due to the inability of the probing equipment to access the tunnel, top of rock locations were only taken outside of the tunnel portals. The geoprobes indicate that the top of rock is located between 2.8' to 5.0' below the top of ballast at 5' to 120' east of the east portal and between 0.5' to 5.0' below the top of ballast at 55' to 120' west of the west portal for Hatfield 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 except for a minor encroachment on the right at station 5+02. There is inadequate vertical clearance for both the "Double Stack Load" and the "High-Wide Load" portions of the composite clearance envelope. For the "Double Stack" portion of the envelope, encroachment on both sides of the tunnel crown averages about 12", and varies up to 20". For the "High-Wide Load", encroachment on the left side of the crown averages about 4", the right side averages 8", and varies from 0" to 18" at points lower than the Double Stack template throughout the tunnel. At the center of the tunnel crown itself, there are no encroachments except from station 7+01 to station 7+50 and from station 9+01 to the west portal (station 9+50) where the "Double Stack Load" portion of the composite clearance envelope encroaches from approximately 3" to 6". Cross sections of the tunnel clearance encroachments are shown in the drawings at the end of this report. The maximum encroachments are summarized in the table below:

Distance (ft) from East Portal	Crown Encroachment (radial inches)	
	Left Side	Right Side
0	16	2
102	12	5
201	8	0
301	16	15
401	13	15
502	12	23
601	20	23
701	12	17
802	14	13
901	18	21
950	14	15

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; rock excavation, liner installation, and 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 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 reduce the amount of rock excavation needed. However, the amount that steel ties would reduce the quantity of rock excavation would not provide a significant enough advantage that to warrant their expense. Also, lateral shifting of the track is a concern when using steel ties. Therefore, they will no longer be considered as a viable alternative.

2.2 Rock Excavation

Since the tunnel is unlined, the existing rock crown of the tunnel could be removed to the desired clearances. Previous scaling efforts have removed portions of the encroaching rock, leaving only limited encroaching rock areas to be removed. Periodic inspection and scaling will be needed as an ongoing maintenance operation.

2.3 Liner Installation

To obtain the desired clearance the native rock must be excavated to the clearance limits plus the new liner thickness and a new concrete liner installed. This option will eliminate the long term maintenance scaling of the tunnel.

3. PREFERRED ALTERNATIVE

Given the history of rock fall from the crown of the tunnel, simply removing the crown would provide clearances, but would leave the existing conditions relatively unchanged. We therefore recommend that the roof be lined with rock dowels and shotcrete at the proper clearances. The installation of the roof lining would allow removal of the rock fall detectors, thereby lowering maintenance costs and improving the reliability of the line.

3.1 Preliminary Design

The preliminary design uses rock excavation of the tunnel crown, installation of rock dowels, and installation of a concrete liner to achieve the necessary clearance and provide for a lower-maintenance tunnel. Signal cable located within the tunnel will be temporarily relocated during construction.

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 invert improvements consisting of ballast replacement by means of undercutting, track surfacing and lining and the installation of a new drainage system. Due to the proximity of the excavation required for the drainage trench to the tunnel footing, it is assumed that underpinning will be required to stabilize the wall during construction. The extent of underpinning will be further evaluated during final design.

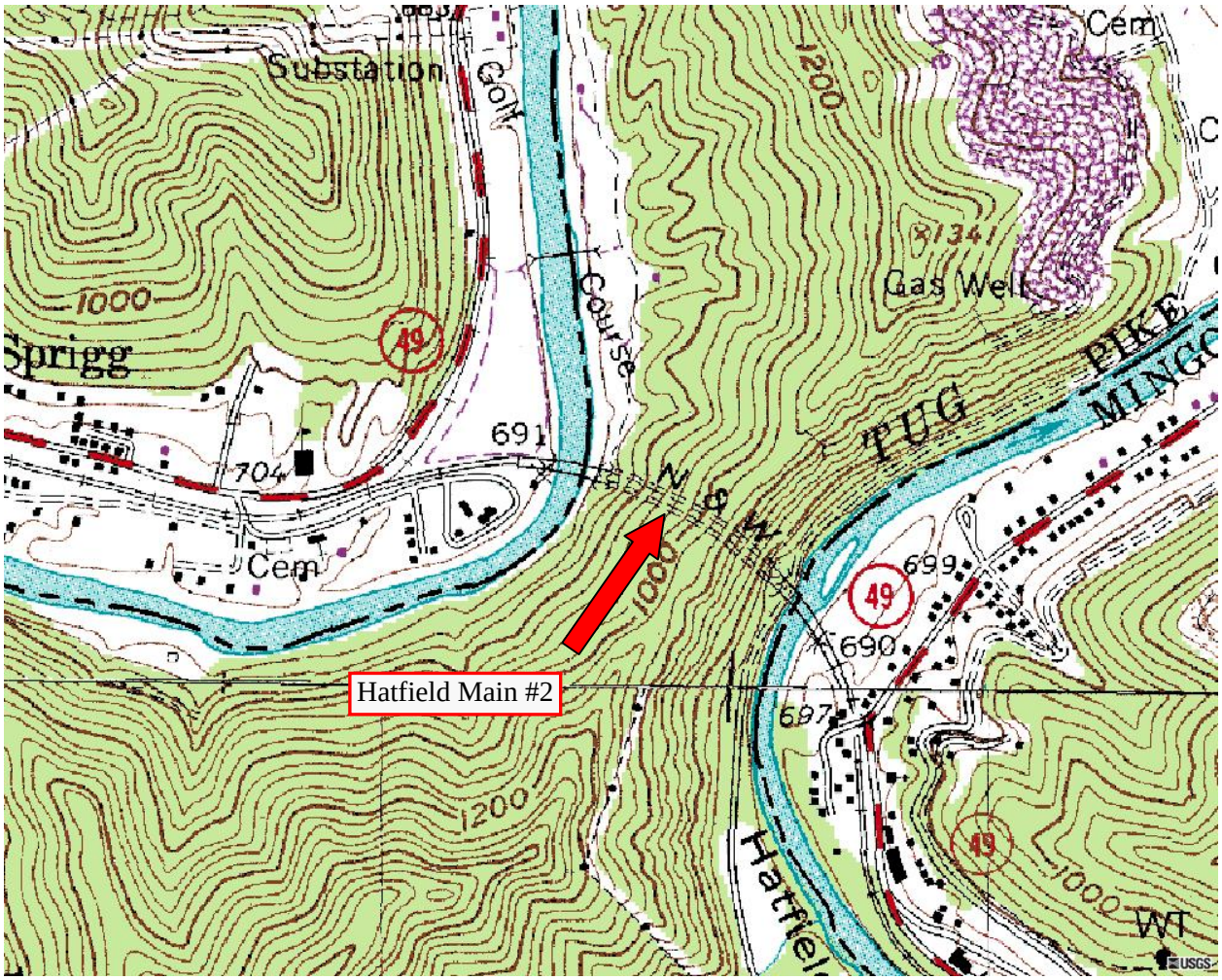
3.2 Schedule

The estimated schedule for completing improvements on this tunnel is twenty-two (22) weeks including mobilization and demobilization. The schedule assumes the track will be closed for ten hours each day, five days a week. The schedule assumes a rock excavation production rate of 20' of tunnel per day. After the rock excavation, installation of rock dowels and tunnel lining will occur at an assumed rate of 20' of tunnel per day. Drainage improvement operations would be undertaken at the same time as the crown and wall installation, but at different locations in the tunnel. Trackwork, including undercutting, surfacing and lining, and ballast installation will occur following the tunnel work.

3.3 Estimate

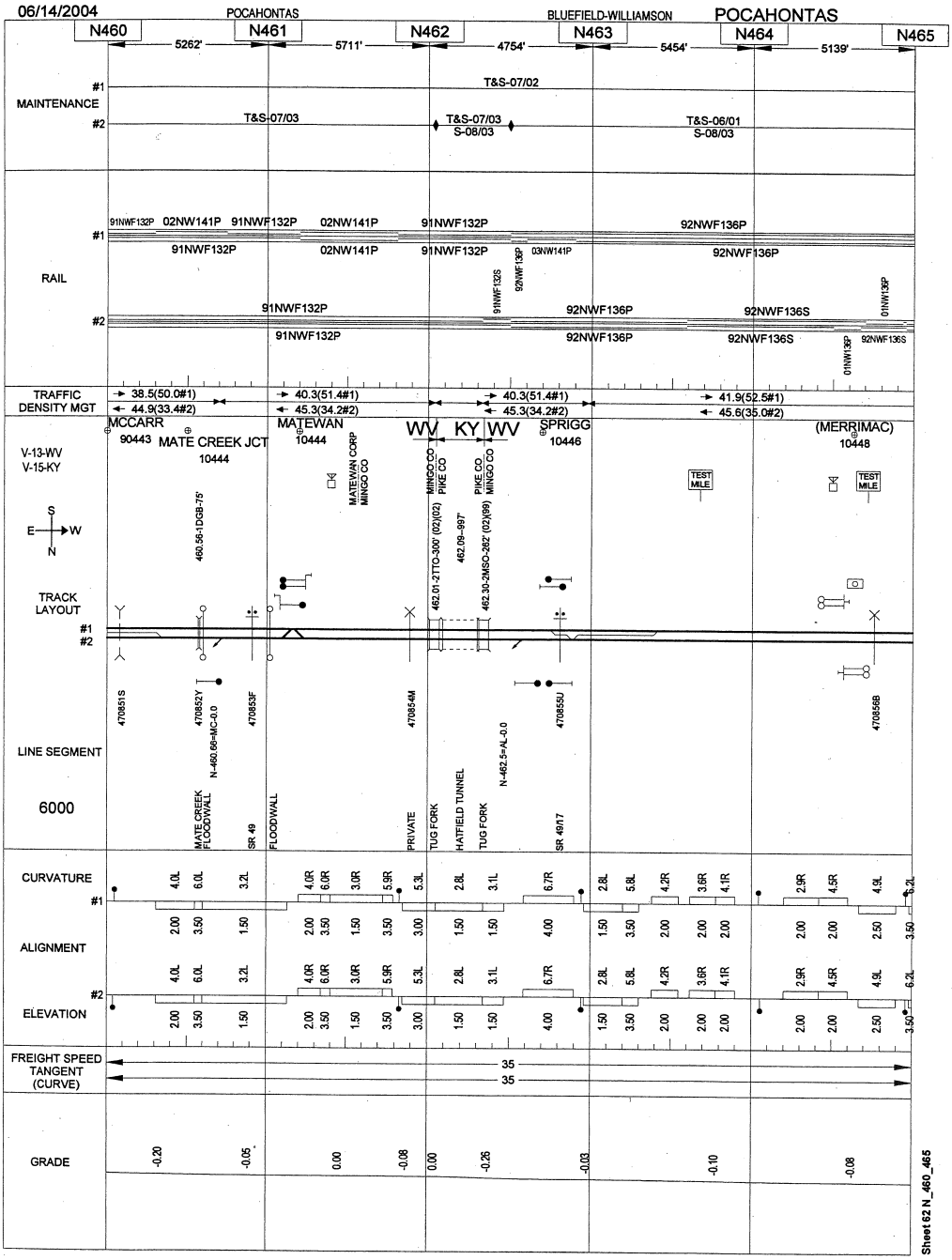
The total estimated cost for achieving clearance at this location is $5.40 million (2005 rates) or $5,417 per foot of tunnel. The total cost is made up of tunnel, track, signal, and site work items at $3.35 million, plus a 30% construction contingency, a 10% engineering allowance, and a 14% construction management allowance.

4. USGS TOPOGRAPHIC MAP



5. AERIAL PHOTO

6. TRACK CHART



7. PHOTOS

Photo 1. East Portal

Photo 2. View from East Portal

Photo 3. West Portal

Photo 4. View from West Portal

Photo 5. Crown and Walls

Photo 6. Crown

8. ESTIMATE

Hatfield (Main No. 2)

Tunnel Length	997	ft
Tunnel Width	17	ft
# of Tracks	1	

	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%		$146,229.33
Surveying	DY	5	$1,300.00	$6,500.00
Rock Dowels 14' with Chain Link Mesh - Crown	EA	1662	$275.81	$458,306.67
Rock Dowels 14' with Chain Link Mesh - Wall	EA	665	$485.53	$322,714.67
Rock Removal - Crown	CY	986	$216.45	$213,427.20
Rock Removal - Wall	CY	1477	$144.50	$213,427.20
Crown Installation	SF	26623	$17.96	$478,275.33
Wall Installation	SF	32901	$16.59	$545,701.11
Under Pinning	LF	997	$487.99	$486,523.33
Rock Cut Drainage Trench	LF	1397	$114.44	$159,873.60
Tunnel Drainage	LF	1397	$16.77	$23,421.44
Demobilization	DY	5	$3,283.20	$16,416.00
Total Tunnel Work Items	**LF**	**997**	**$3,080.06**	**$3,070,815.88**

Trackwork Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Surveying	DY			
Track Preparation/Restoration	DY			
Undercutting	PF	997	$26.11	$26,029.72
Install Steel Ties	EA			
Surfacing & Lining	PF	2991	$1.72	$5,152.03
Ballasting Track	TN	997	$40.75	$40,626.32
Equalizing rail	DY			
Elastomeric Flangeway Crossing	EA			
Demobilization	DY			
Total Trackwork Items				**$71,808.07**

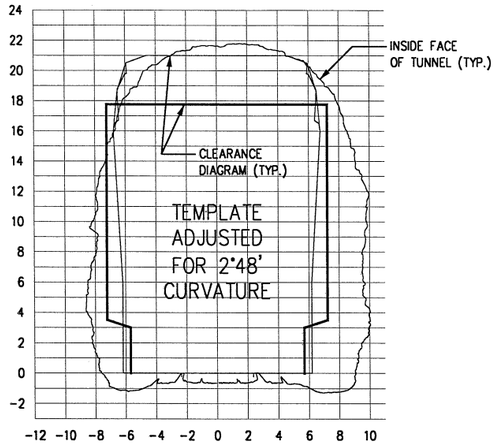
Signal Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Relocate Cables / Track Leads	LF	997	$10.66	$10,630.18
Cut-in	EA			
New CP	EA			
Modify CP	EA			
Grade Crossing - Single to Double Track	EA			
Signal Location Modification	EA			
New Cut Section	EA			
Demobilization	DY			
Total Signal Items				**$10,630.18**

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
Site Grading	CY			
Rock Excavation	CY			
Sub-Ballast	CY			
Drainage	LF			
Demobilization	DY			
Total Site Items				**$14,442.40**

Special Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Flagging	DY	109	$821.50	$89,543.50
Flood Track with Ballast for Protection	TN	1994	$38.49	$76,753.03
Remove Flooded Ballast	TN	1994	$8.18	$16,316.30
Temporary Bridges	EA			
New Railroad Bridges	EA			
New Highway Bridges	EA			
Invert/Crown Void Grouting	DY			
Demobilization	DY			
Total Specialty Items				**$182,612.83**

Subtotal All Items		**$3,350,309.36**
Construction Contingency	**30%**	**$1,005,092.81**
Engineering Allowance	**10%**	**$435,540.22**
Construction Management Allowance	**14%**	**$609,756.30**
Total		**$5,400,698.69**

9. DRAWINGS



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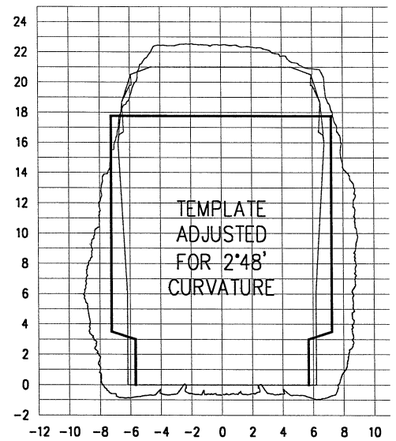

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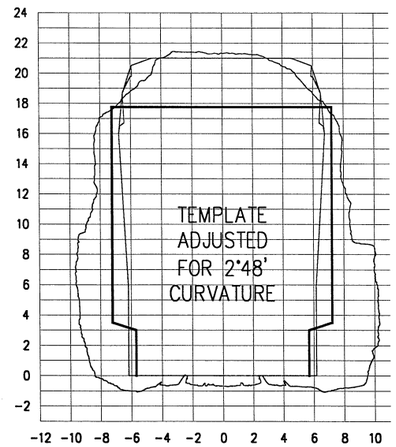

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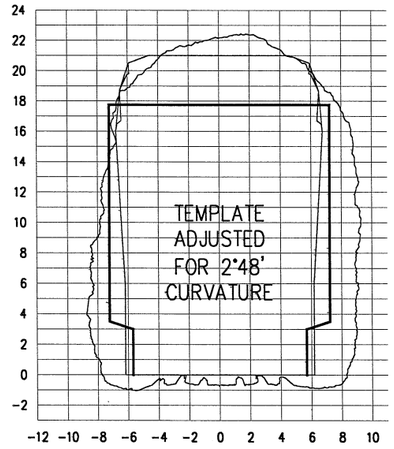

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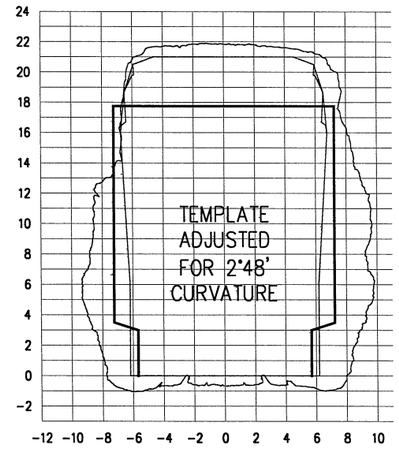

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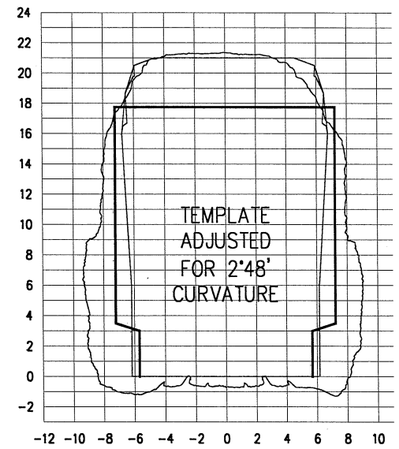

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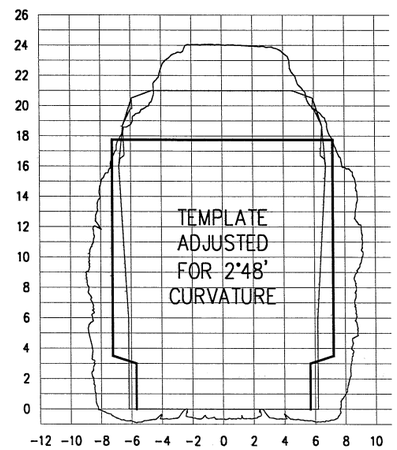

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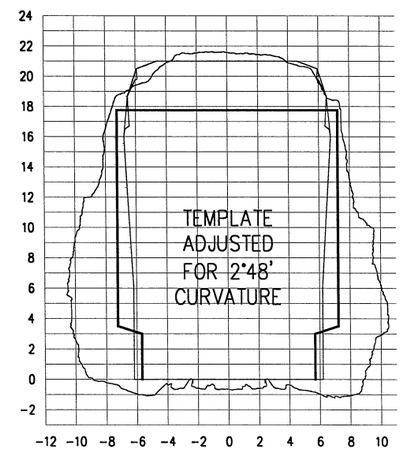

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NOTES:

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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.

PT DJL 8/5/05	PRELIMINARY ENGINEERING PHASE REPORT		
REV BY DATE	DESCRIPTION		
LOCATION	HATFIELD MAIN #2 TUNNEL, SPRIGG, WV.		
TITLE	TUNNEL CLEARANCE CROSS SECTIONS – 1 OF 3		
DGN	PID No.	VRN 12030 & 16343	MILE POST N-462.09
DWN	FILE No.	DRAWING NUMBER	
CHK	DATE APRIL 22, 2005		

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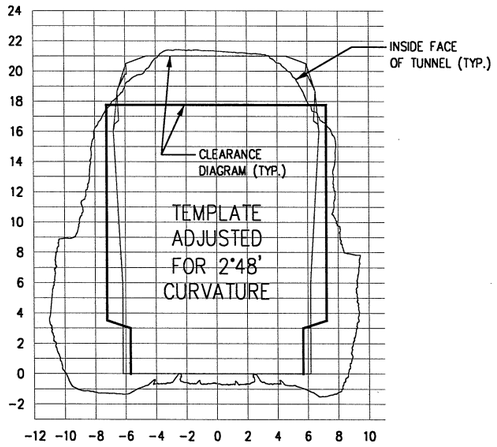

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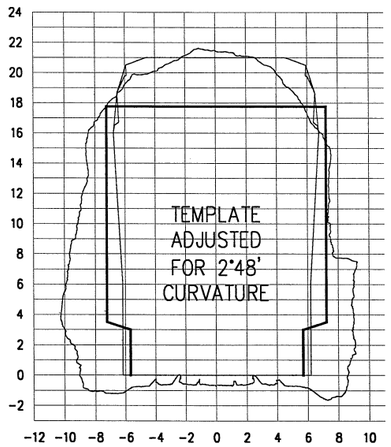

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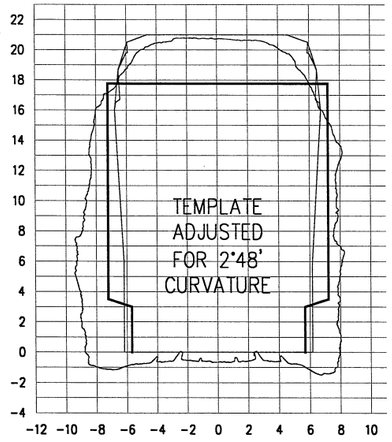

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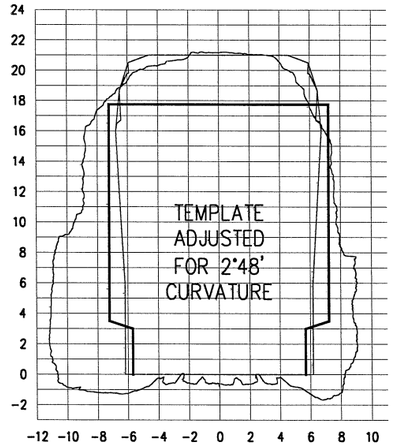

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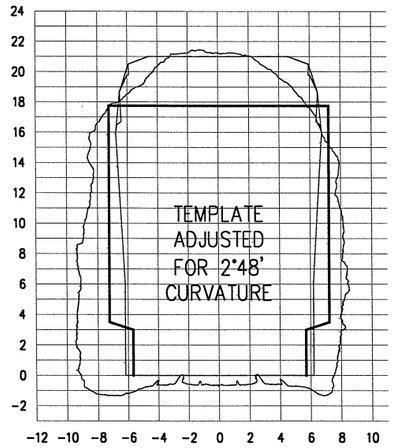

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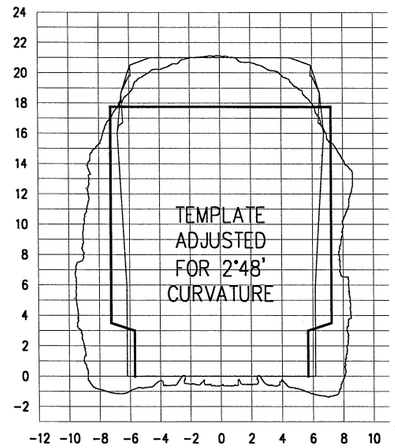

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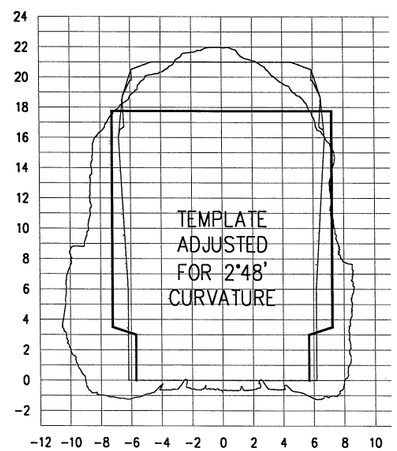

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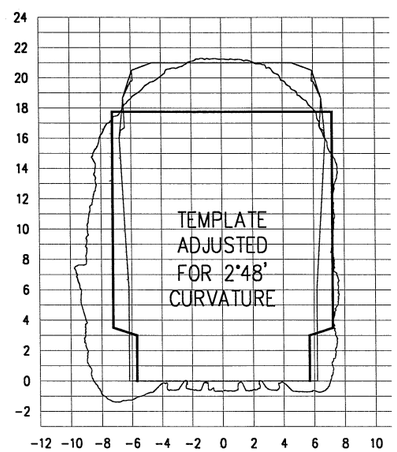

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NOTES:

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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

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REV. BY	DATE	DESCRIPTION
PT	DJL 8/5/05	PRELIMINARY ENGINEERING PHASE REPORT

LOCATION: HATFIELD MAIN #2 TUNNEL, SPRIGG, WV.

TITLE: TUNNEL CLEARANCE CROSS SECTIONS – 2 OF 3

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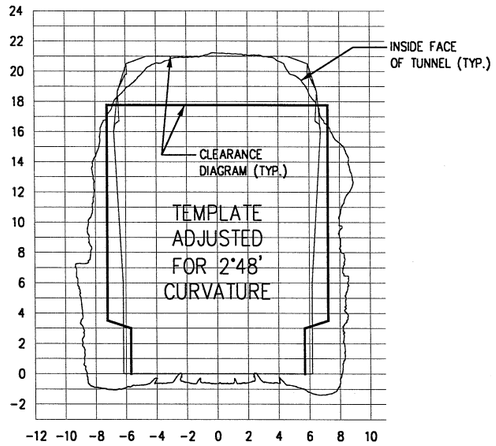

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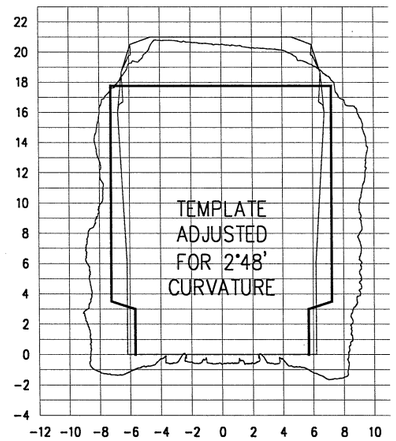

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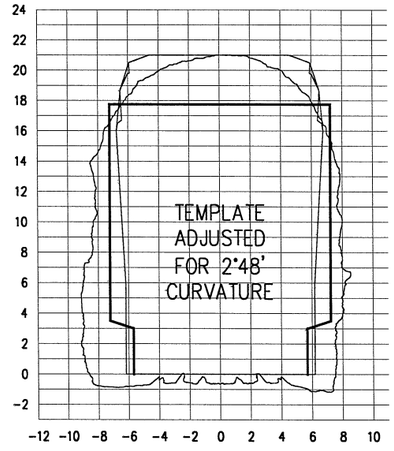

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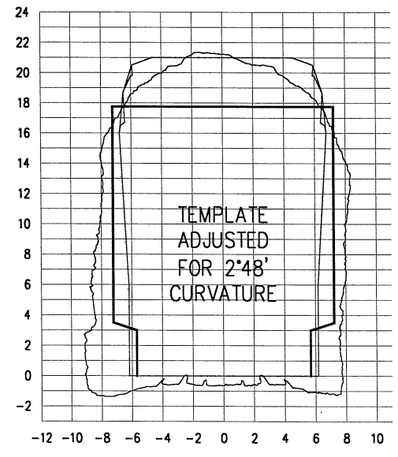

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NOT FOR CONSTRUCTION

SCALE: 1"=100'

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REV	BY	DATE	DESCRIPTION
P1	DJL	8/5/05	PRELIMINARY ENGINEERING PHASE REPORT

LOCATION: HATFIELD MAIN #2 TUNNEL, SPRIGG, WV.

TITLE: TUNNEL CLEARANCE CROSS SECTIONS – 3 OF 3

DGN	P.I.D. No.	VRN 12030 & 16343	MILE POST N-462.09
DWN	FILE No.	DRAWING NUMBER	
CHK	DATE APRIL 22, 2005		

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OPERATING DIVISION
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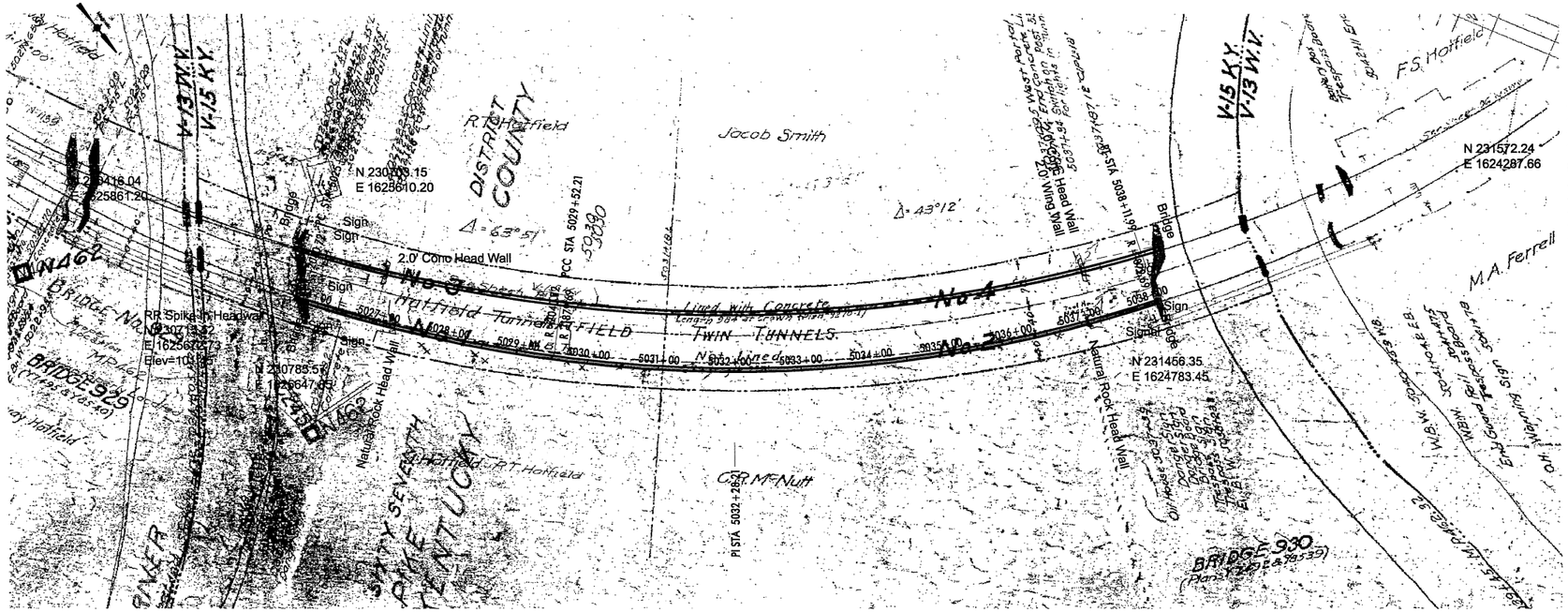


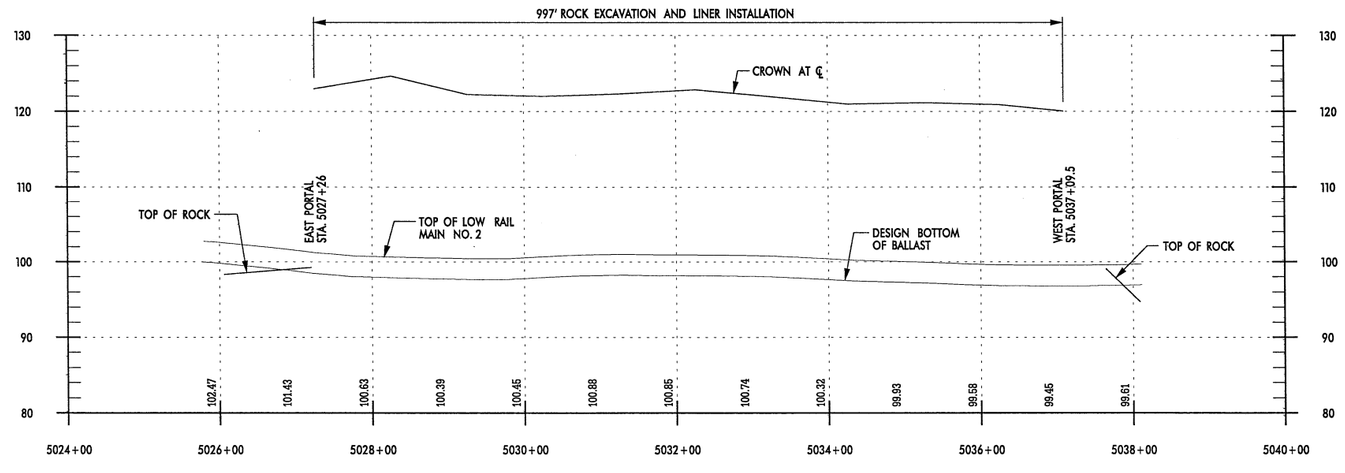
HATFIELD MAIN #2 PLAN

SCALE: 1"=100'

HATFIELD EAST CURVE DATA

Description:
Style:
Input Factor: 1.0000

	STATION	NORTHING	EASTING
Element: Circular			
PC (1)	5025+79.57	230711.39	1625687.13
PI ( )	5027+66.43	230866.48	1625582.90
CC (2)		229573.01	1623993.44
PCC (3)	5029+52.21	231000.05	1625452.23
Radius:	2040.72		
Delta:	10°27'48" Left		
Degree of Curvature(Chord):	2°48'28"		
Length:	372.68		
Length(Chorded):	372.64		
Tangent:	186.86		
Chord:	372.16		
Middle Ordinate:	8.50		
External:	8.54		
Tangent Direction:	326°05'38"		
Radial Direction:	56°05'38"		
Chord Direction:	320°51'43"		
Radial Direction:	45°37'49"		
Tangent Direction:	315°37'49"		
Element: Circular			
PCC (3)	5029+52.21	231000.05	1625452.23
PI ( )	5033+89.81	231312.87	1625146.22
CC (4)		229685.61	1624108.54
PT (5)	5038+11.99	231458.36	1624733.52
Radius:	1879.69		
Delta:	26°12'38" Left		
Degree of Curvature(Chord):	3°02'55"		
Length:	859.88		
Length(Chorded):	859.78		
Tangent:	437.60		
Chord:	852.40		
Middle Ordinate:	48.96		
External:	50.27		
Tangent Direction:	315°37'49"		
Radial Direction:	45°37'49"		
Chord Direction:	302°31'31"		
Radial Direction:	19°25'12"		
Tangent Direction:	289°25'12"		



HATFIELD MAIN #2 PROFILE

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

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
P2	DJL 10/14/05	PRELIMINARY ENGINEERING PHASE REPORT
P1	DJL 8/19/05	PRELIMINARY ENGINEERING PHASE REPORT

LOCATION: HATFIELD MAIN #2 TUNNEL, SPRIGG, WV

TITLE: PLAN AND PROFILE

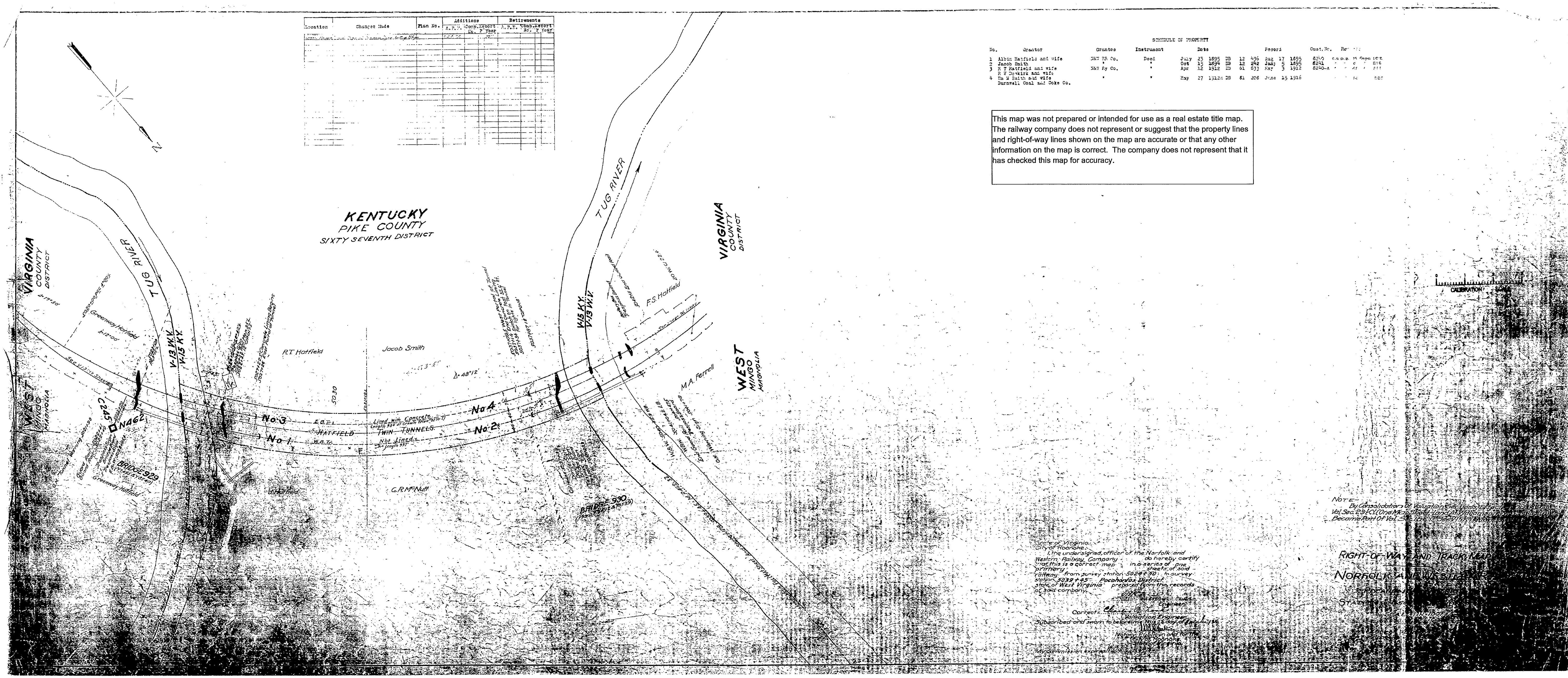
DGN	PID No.	VRN	16343 & 12030	MILE POST N-462.09
DWN	FILE No.			DRAWING NUMBER
CHK	DATE APRIL 22, 2005			

FILE NAME = P:\NSRV\29399\CAD\survey info\462.09 Hatfield\462.09 Hatfield Main #2.dgn
DATE/TIME = 10/6/2005 03:23:36 PM

SCHEDULE OF PROPERTY

No.	Grantor	Grantee	Instrument	Date						Record			Cust. No.	Re[illegible]
1	Albin Hatfield and wife	N&W RR Co.	Deed	July	23	1895	DB	12	436	Aug 17		1895	6240	C.S.D.B. 15 Page 102
2	Jacob Smith	"	"	Oct	15	1894	DB	12	242	Jan 5		1895	6241	" " 6 " 216
3	R T Hatfield and wife R W Dunkirk and wife	N&W Ry Co.	"	Apr	12	1912	DB	61	633	May 3		1912	6240-A	" " 45 " 311
4	Wm M Smith and wife Burnwell Coal and Coke Co.	"	"	May	27	1912	DB	61	206	June 15		1916		" " 56 " 227

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.



Location	Changes Made	Plat No.	Additions A.F.E.	Additions Comp. Report No.	Additions Comp. Report P	Additions Comp. Report Year	Retirements A.F.E.	Retirements Comp. Report No.	Retirements Comp. Report P	Retirements Comp. Report Year
Changed to Normal Track	Revised Typical Transmission Line & Signal Changes		84.6826.7"			1927				

SCHEDULE OF PROPERTY

No.	Grantor	Grantee	Instrument	Date	Record			Cust.No.	Remarks
1	Elias Hatfield and wife	W Va & I RR Co.	Deed	June 23,1890	DB	3-P	67	Aug 26,1890	6232	
2	O W Hatfield and wife	NAW Ry Co.		Apr 9,1912	DB	27	112	June 10,1912	6232	
	Elias Hatfield and wife	W Va & I RR Co.	Agreement	July 15,1892					6232-A	C.C.&S.F.R.R. Co. 45 10

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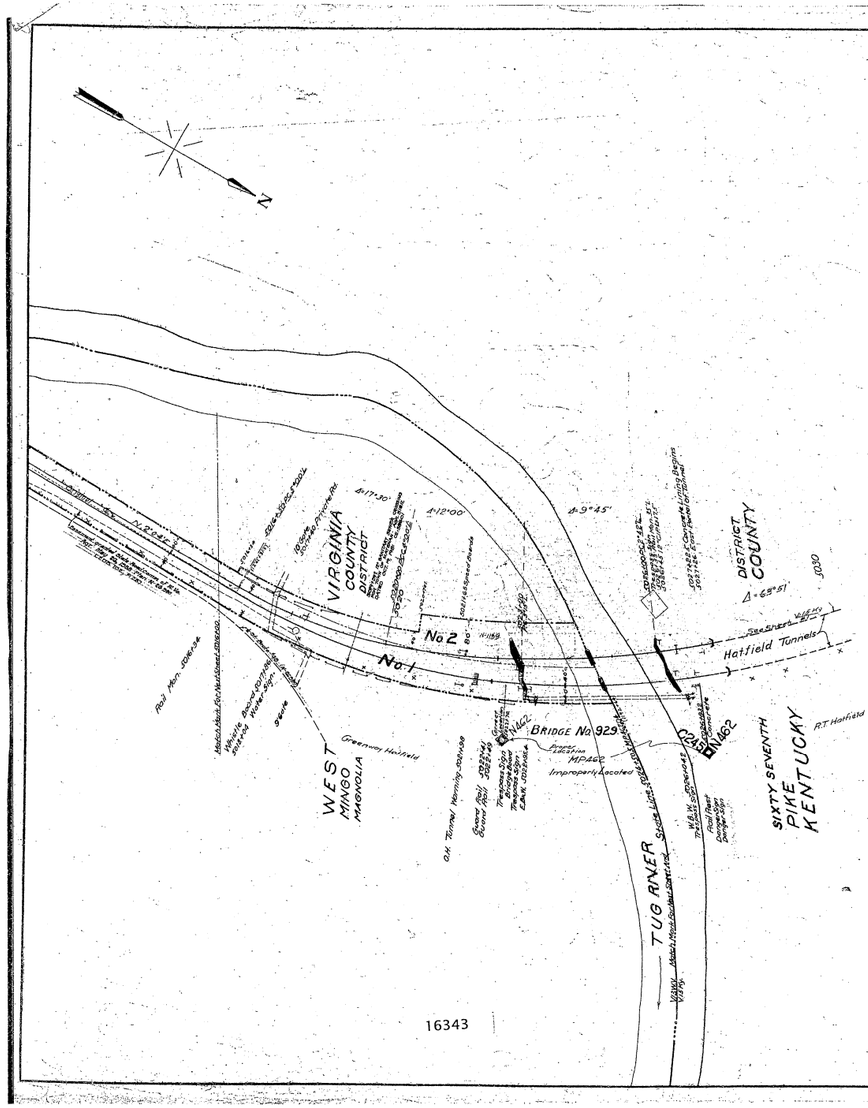

Sheet No. 85 of 204 sheets of Poca. District
from survey station 5016+00 to survey station 5024+50.5
Chief of Valuation Engineer.

RIGHT-OF-WAY AND TRACK MAP.
NORFOLK AND WESTERN RY.
POCAHONTAS DISTRICT.
STATION 5016+00 TO STATION 5024+50.5
SCALE: 1 IN. = 100 FT.
Office of Valuation Engineer.
Roanoke Va. June 30, 1916.

VALUATION ENGINEER
V-18 WV
85