



*Heartland Corridor, Walton Virginia to
Columbus Ohio*

Preliminary Engineering Phase Report



HUGER
TUNNEL –
MAIN #1
MP N395.56
HUGER, WV

October 14, 2005, Rev. 2



Preliminary Engineering Phase Report

PR219399 - Huger Main #1
Page 1

October 14, 2005

Norfolk Southern Railway Heartland Corridor, Walton VA to Columbus OH

Huger Main #1 Tunnel – MP N395.56

Huger, WV

Statistics: Pocahontas Division
Single-width Tunnel for Main #1
Length = 362'
Concrete lined
Degree of curvature = 3.1 Right (per Track Chart)
Superelevation = 1.5” (per Track Chart)

1.	EXISTING CONDITIONS	2
2.	CLEARANCE IMPROVEMENT ALTERNATIVES	4
3.	PREFERRED ALTERNATIVE.....	6
4.	USGS TOPOGRAPHIC MAP	8
5.	AERIAL PHOTO.....	9
6.	TRACK CHART.....	10
7.	PHOTOS.....	11
8.	ESTIMATE	14
9.	DRAWINGS	16
	Existing Tunnel Clearance Cross Sections	
	Proposed Tunnel Clearance Cross Sections	
	Plan and Profile	
	Valuation Map	

1. EXISTING CONDITIONS

1.1 Background

Valuation Map V-13WV/23 (16279) is dated June 30, 1916. The Changes/Additions/Retirements table on this map is empty. According to the Schedule of Property, parcels for the tunnel were acquired in 1907. A Norfolk Southern tunnel inspection sheet reports that the tunnel was built in 1912. 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 16, June 9, and June 13, 2005.

1.2 General Area

The tunnel is located in a sparsely populated area with good access to the east portal from US Rt. 52. A railroad access road off of the highway is adequate for bringing equipment to a small staging area near the east portal. Access from the west side is not as practical as from the east, with a railroad bridge over Elkhorn Creek only 140' west of the west portal. This bridge is approximately 116' long. US Rt. 52 crosses over the tunnel. Equipment can readily get onto the tracks from areas close to the tunnel.

1.3 Structural Conditions

Huger Main #1 Tunnel is one of a pair of twin tunnels along with Huger Main #2 Tunnel. Each tunnel is a concrete-lined single-width tunnel for one track. The tunnel is 362' long with a nominal width of 17'. There is a signals and communications cable mounted on the south wall. There is one area at the peak of the crown about 70' from the west portal where there is spalling, efflorescence, and leaking.

The bridge outside of the west portal of the tunnel was investigated on June 13, 2005. It is a 2-span, 2-girder, timber deck bridge. Each span is simply supported. The two girders are built-up steel plate girders. The girders rest on bearings at the abutments and center pier. The four bearing heights vary from 16.5" to 24". The bridge spans over a paved road, Elkhorn Creek, and a gravel road.

Ballast covers the top of the footing on both sides for most of the tunnel. The last 50' of the top of the right wall footing is exposed. A small portion of the tunnel invert material was excavated to fully expose the base of the tunnel liner footing. The footing thickness was found to be 33". The vertical distance from the top of rail to the base of the footing was measured at 64".

1.4 Track

The track is of conventional design with approximately 8'-6" long wooden crossties at 19" spacing and a stone ballast section. The ballast is not even with the tops of ties but is generally dry and clean. The rails are 141RE continuously welded rail. The water in the tunnel was tested

and its pH reading was 7.79. This is a fairly neutral reading and indicates that the water is not unusually corrosive.

1.5 Geotechnical

The tunnel is 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 the 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 Huger Tunnels were excavated through medium- to thick-bedded sandstone of the Pocahontas Formation. Minor interbeds of shale, siltstone, and coal may also be present in this formation, but were not observed in the exposures. Bedding is sub-horizontal.

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 taken from the portal and tested.

The geoprobes taken within the tunnel indicate that the top of rock is located 3.2’ to 4.4’ (averaging about 3.8’) below the top of ballast throughout the tunnel. Top of ballast is typically about 0.8’ below top of low rail. Geoprobes were also taken at 100’ increments for 1000’ outside of the east portal. Each probe reached a depth of 5.0’ below the top of ballast without reaching refusal.

1.6 Clearances

The laser car measurements indicate that the existing tunnel has inadequate horizontal and vertical clearances for the composite design template. The horizontal encroachments occur in the eastern part of the tunnel and average about 3” for a clearance template that has been modified for a 3.1 degree of curvature that exists throughout the length of the tunnel. This curvature is based on the Track Chart and agrees closely with the results of the survey. The crown encroachments vary from 0” to 18” and average about 9” on the right side of the tunnel crown only. The template encroaches at the 1 o’clock position and along the right wall only. See the Tunnel Clearance Cross Sections section of this report for an illustration of the clearance encroachments. The maximum vertical encroachments are summarized in the table below:

Distance (ft) from East Portal	Crown Encroachment (radial inches)		Wall Encroachment (inches)	
	Left Side	Right Side	Left Side	Right Side
0	0	11	0	0
101	0	18	0	4
202	0	10	0	0
301	0	1	0	0
350	0	0	0	0

2. CLEARANCE IMPROVEMENT ALTERNATIVES

Given the magnitude of the clearance deficiency, there are several general alternatives that can be used to obtain the clearance; replacing the lining, notching the lining, realigning the track, steel ties or lowering the track. Combinations of the general methods with other improvements may be required to obtain a design that is cost effective and that can be constructed within reasonable track outages.

2.1 Liner Replacement

To obtain the desired clearance, the existing concrete liner would be demolished, the native rock excavated to the clearance limits plus the new liner thickness, and a new concrete liner installed.

2.2 Notching the Crown

The modifications in the upper quadrants of the tunnel may not cut entirely through the liner. Depending on the depth of the notch, minor or deep notching would be utilized through the tunnel on one or both sides. If track realignment were used in conjunction with notching, approximately 50% of the tunnel would require minor notching only.

2.3 Realigning the Track

The Tunnel Clearance Cross Sections indicate that the centerline of track is closer to the right wall than to the left wall for the first 250' of the tunnel, which is the primary area of encroachment on the right wall and at the 1 o'clock position. Minor realignment could alleviate the clearance problems, especially the horizontal encroachment.

2.4 Steel Ties

Substitution of steel ties for the standard wood ties will 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.

The successful use of steel ties requires a proper drainage system to minimize wet invert conditions. Otherwise, corrosion of the ties could become a maintenance issue. A wet invert could also increase the frequency of signal faults as the electrical isolation of the rails to ties is compromised by wet conditions.

Steel ties would likely not be sufficient to fix the entire clearance deficiencies but could be used in conjunction with another method to provide a more economical solution. However, due to the close proximity of the rail bridge at the west portal, if steel ties are incorporated the bridge would need to be lowered as well. Also, lateral shifting of the track is a concern when using steel ties. For these reasons, steel ties will be eliminated as a viable alternative.

2.5 Track Lowering

The geoprobes indicate an elevation to refusal of 3.2' to 4.4' below the top of rail in the tunnel, and 5.0' outside the east portal. Such a depth could allow for some degree of track lowering while retaining a standard ballast depth.

Excavation would involve removing the track and using conventional earth moving equipment to remove the ballast and subgrade materials. The entire operation would require approximately a 4-day outage and continuous work to remove the track, excavate the subgrade, and restore the track. The production rate would be limited by having to back the dump trucks down the tunnel. New drainage installation and subgrade stabilization could be accomplished from the subgrade directly. The resulting track structure would be completely new except for the rail.

The proximity of the bridge 150' to the west of the tunnel could cause difficulty in transitioning the lowered rail to match the existing rail elevations over a fairly short distance. If such grading is not possible, the track lowering method could also require bridge modifications or liner removal near the portal. Based on the findings of the preliminary bridge investigation, lowering the bridge by replacing the existing bearings seems to be feasible.

2.6 Track Undercutting

The geoprobes indicate an elevation to refusal of 3.2' to 4.4' below the top of rail. Such a depth could allow for some degree of track undercutting while retaining a standard ballast depth.

A mainline track undercutter with a conveyor and air dump cars could accomplish undercutting over the course of 1-2 days of 8-hour work windows. An evaluation of typical undercutting equipment showed that the size of the equipment is compatible with undercutting in this tunnel. Using a work train engine to move the air-dump cars to the disposal site would allow the undercutter to remain setup with the bar under the track. The run-in and run-out of the undercut area would need to be surfaced daily to accommodate the trains.

One to two days of prep work will be required to plug and spike the exiting ties to keep them from falling off of the rail behind the undercutter bar. Plate-boys with modifications to the jacks could be used to lift the track to allow geotextile to be installed under the skeletonized track.

The proximity of the bridge 150' to the west of the tunnel could cause difficulty in transitioning the lowered rail to match the existing rail elevations over a fairly short distance. If such grading is not possible, the track undercutting method could also require bridge modifications or liner removal near the portal. Based on the findings of the preliminary bridge investigation, lowering the bridge by replacing the existing bearings seems to be feasible.

3. PREFERRED ALTERNATIVE

The clearance can be best accomplished using the Track Undercutting methodology. There are no significant impediments to the undercutting procedure. There are also some improvements to be achieved using track realignment.

3.1 Preliminary Design

The preliminary design combines undercutting and track shifting.

3.1.1 Horizontal Geometry

The track shift will require shifting 1,200' of the existing track southward up to 1'-6". The track shift places the centerline of the track approximately parallel with the centerline of the tunnel crown. The actual limiting clearance is at the 11 and 1 o'clock positions and is approximately 20'-6".

The new curvature in the tunnel is a 3° 06' 00" curve to the right. The track chart indicates a timetable speed in the tunnel of 35 mph and that the curve has 1.5" of superelevation. The new curve can achieve the 35 mph speed with 1.5" of super elevation at an under balance of 1.5".

The spirals are sized to provide a minimum elevation runoff of ½" per 31', or a minimum length of 93'. The spirals at the tunnel portals are symmetric. The spiral is 93' long and meets the minimum length.

The track shift ties to the existing tangent on the east end, and into the existing bridge west of the tunnel.

3.1.2 Vertical Alignment

Due to the proximity of the bridge on the west side of the tunnel, the proposed undercutting operation was designed to restore a uniform track profile through the tunnel. Unlike other tunnels the track profile does not parallel the crown of the tunnel. The proposed track profile also extends the vertical tangent beyond the portals of the tunnels. Since the existing grade is relatively steep (-1.02%), the vertical profile was compressed to reduce the depth of the undercutting. The grade in the tunnel is a -0.62% grade, the western vertical alignment merely extended the vertical tangent from the tunnel to a point where a single crest vertical curve is used to connect to the existing profile at the end of the existing bridge.

The vertical tangents are connected by vertical curves based on the new AREMA procedures. The new procedures do not use different rates of changes for crest and sag curves, resulting in vertical curves of similar lengths. All of the vertical curves exceed the minimum recommended lengths.

The undercutter is assumed to have air dump cars fitted with a conveyor system to remove the spoil from the tunnel. The material outside of the tunnel can be cast to the side, however proper grading is essential to prevent the material from being washed into the new tuck structure.

3.1.3 Other Construction

Proper drainage is vital to maintaining the track structure. A new trench drainage system proposed in the tunnel. This drain will carry any water in the tunnel out of the tunnel to surface drainage along the tracks.

Lowering the track will place it below the existing ground surface. To allow drainage from beneath the track structure, the ground surface adjacent to the track must be excavated to provide new longitudinal ditches along the track. Likewise, the existing material on the tunnel invert must be lowered to the bottom of the ballast section and sloped to the trench drain.

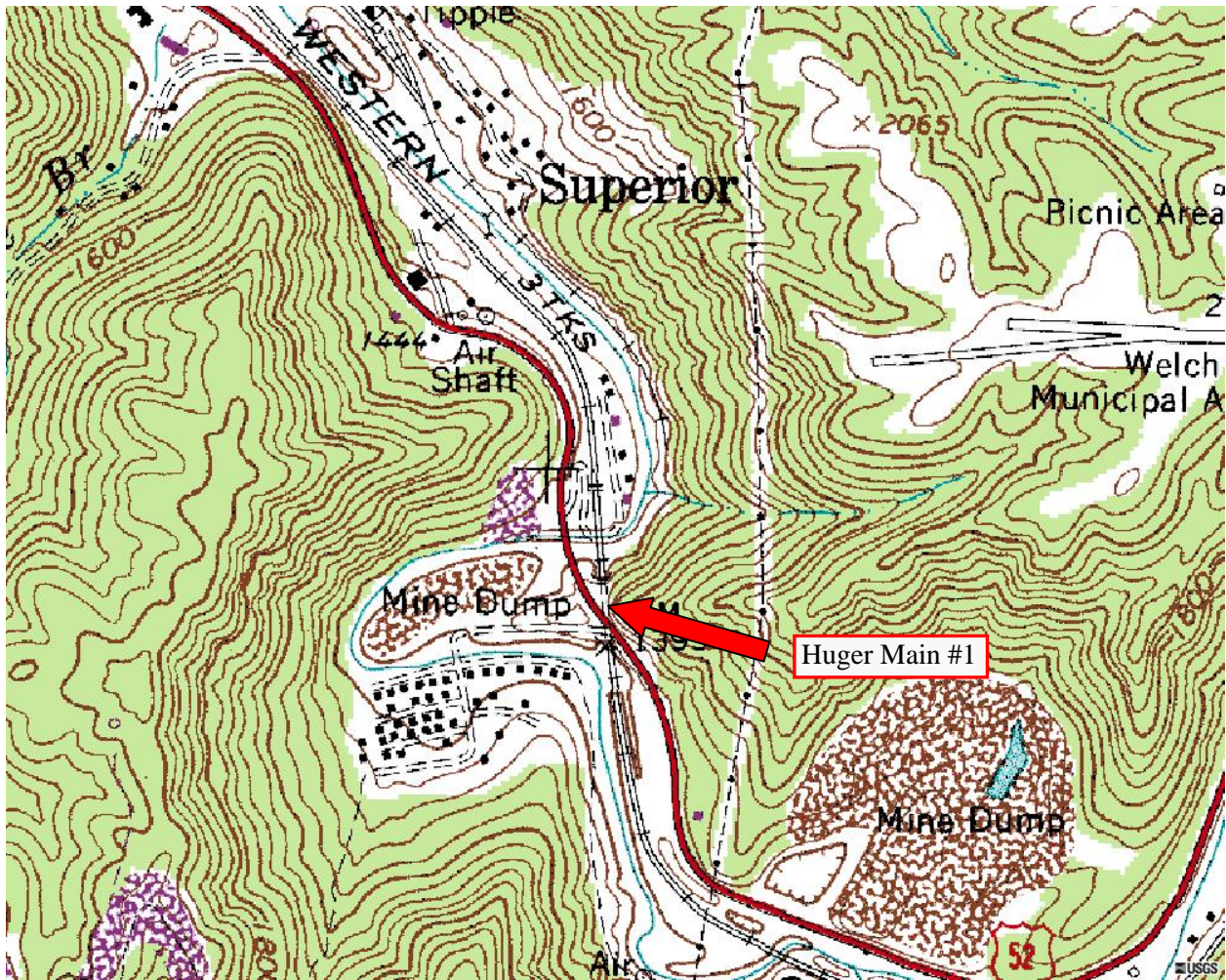
3.2 Schedule

The estimated schedule for completing improvements on this tunnel is seven (7) weeks from mobilization to demobilization.

3.3 Estimate

The total estimated cost for achieving clearance at this location is \$791,963 (2005 rates) or \$2,188 per foot of tunnel. The work items include mobilization, surveying, track shifting, minor notching, 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 \$532,233, plus a 20% construction contingency, a 10% engineering allowance, and a 14% construction management allowance.

4. USGS TOPOGRAPHIC MAP



5. AERIAL PHOTO



7. PHOTOS



Photo 1. Main #1 east portal (Main #2 on right)



Photo 2. Looking to the east on Main #1 from the east portal (Main #2 on left)

*Preliminary Engineering Phase Report
MP N-395.56 - Huger Main #1*



Photo 3. Main #1 west portal



Photo 4. Main #1 looking to the west from west of tunnel (Main #2 on right)

*Preliminary Engineering Phase Report
MP N-395.56 - Huger Main #1*



Photo 5. Main #1, looking west from inside east portal



Photo 6. Significant spalling, efflorescence, and leaking from crown, about 70' from west portal of Main #1.

**Preliminary Engineering Phase Report
MP N-395.56 - Huger Main #1**

8. ESTIMATE
Huger No. 1

Tunnel Length **362** ft
Tunnel Width **16** 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%		\$11,431.82
Under Pinning	LF	362	\$506.83	\$183,473.87
Rock Cut Drainage Trench	LF	400	\$84.14	\$33,657.60
Tunnel Drainage	LF	400	\$20.55	\$8,221.69
Demobilization	DY	1	\$3,283.20	\$3,283.20
Total Tunnel Work Items	LF	362	\$663.17	\$240,068.17

Trackwork Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY	1	\$3,110.32	\$3,110.32
Surveying	DY	4	\$1,300.00	\$5,200.00
Track Preparation/Restoration	DY	2	\$3,431.32	\$6,862.64
Undercutting	PF	3100	\$16.79	\$52,059.44
Track Shift < 8' & > 1'	TF	1200	\$7.49	\$8,993.56
Saw Cuts	EA	4	\$6,839.44	\$27,357.76
Field Welds	EA	4	\$2,523.78	\$10,095.12
Surfacing & Lining	PF	5100	\$2.02	\$10,304.06
Ballasting Track	TN	1700	\$38.37	\$65,231.32
Equalizing rail	DY	1	\$6,701.14	\$6,701.14
Demobilization	DY			
Total Trackwork Items				\$195,915.38

**Preliminary Engineering Phase Report
MP N-395.56 - Huger Main #1**

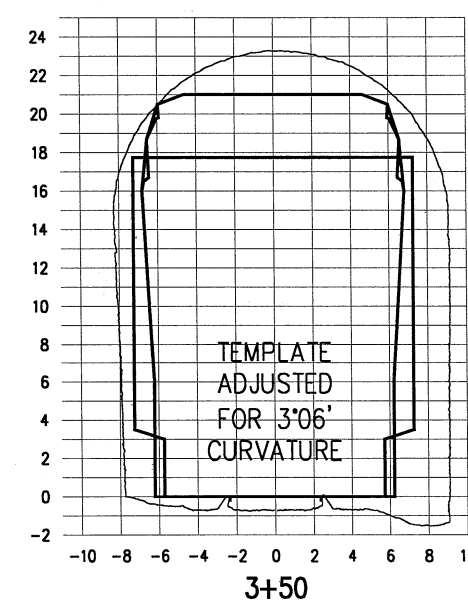
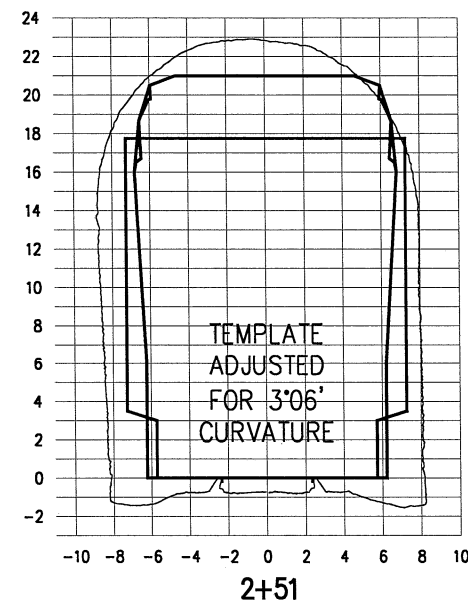
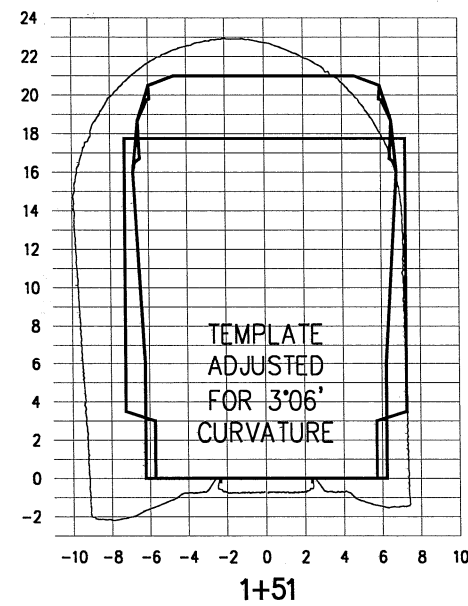
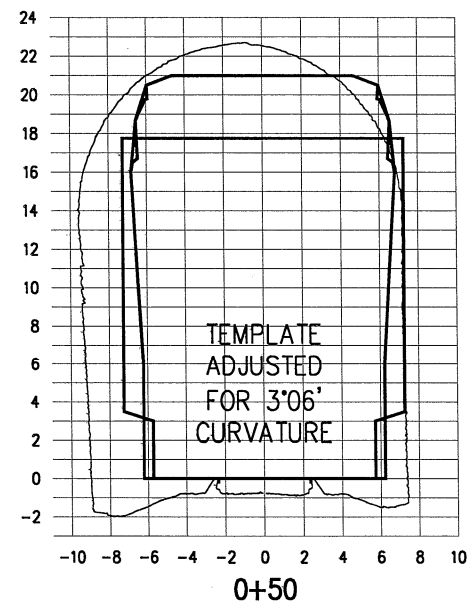
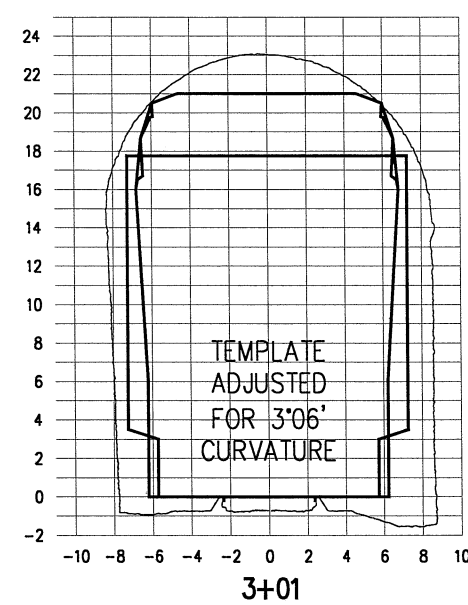
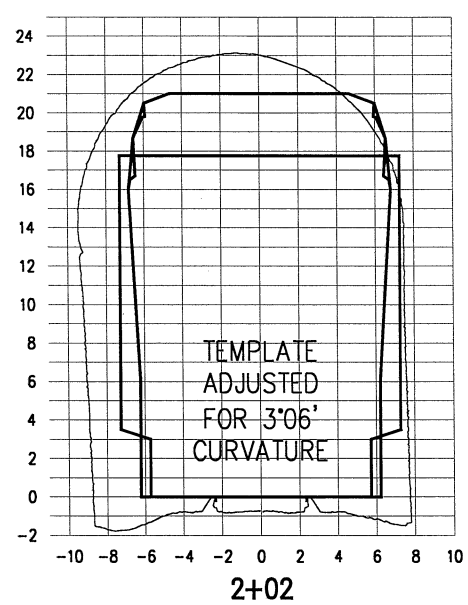
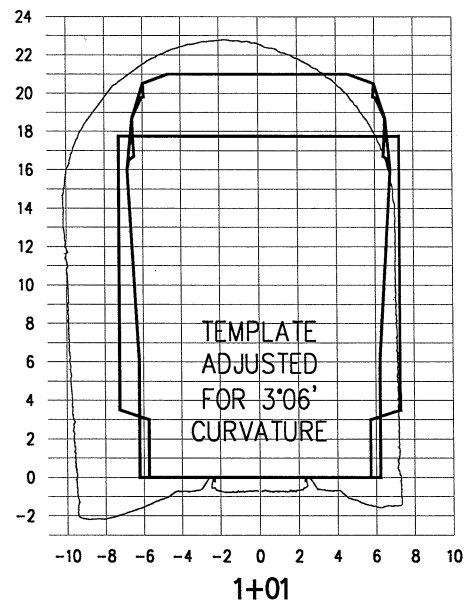
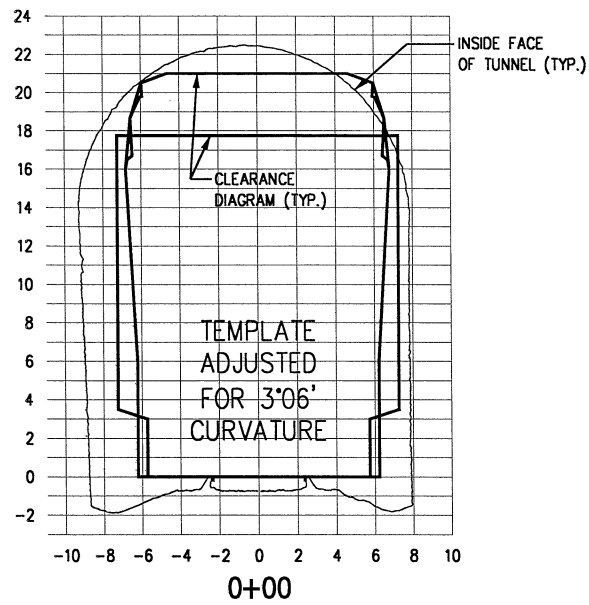
Signal Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Relocate Cables / Track Leads	LF	362	\$12.80	\$4,632.59
Demobilization	DY			
Total Signal Items				\$4,632.59

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	2400	\$20.52	\$49,243.34
Demobilization	DY			
Total Site Items				\$63,685.74

Special Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Flagging	DY	34	\$821.50	\$27,931.00
Demobilization	DY			
Total Specialty Items				\$27,931.00

Subtotal All Items		\$532,232.88
Construction Contingency	20%	\$106,446.58
Engineering Allowance	10%	\$63,867.95
Construction Management Allowance	14%	\$89,415.12
Total		\$791,962.53

9. DRAWINGS

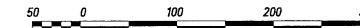


NOTES:

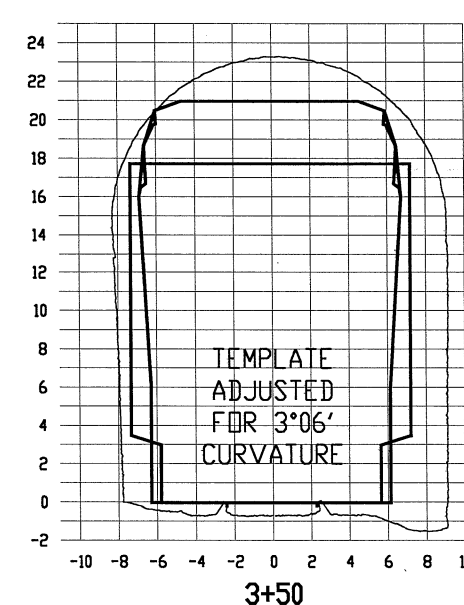
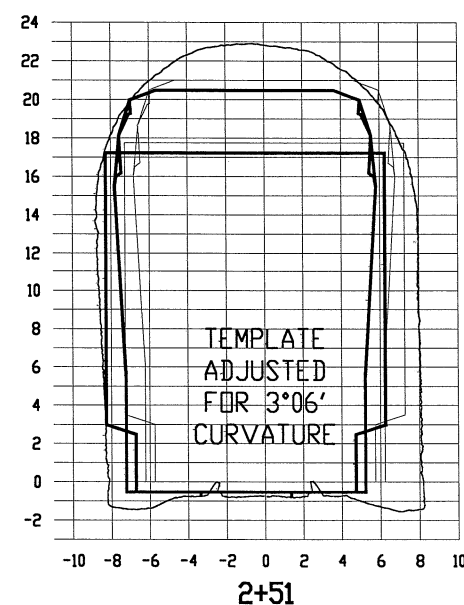
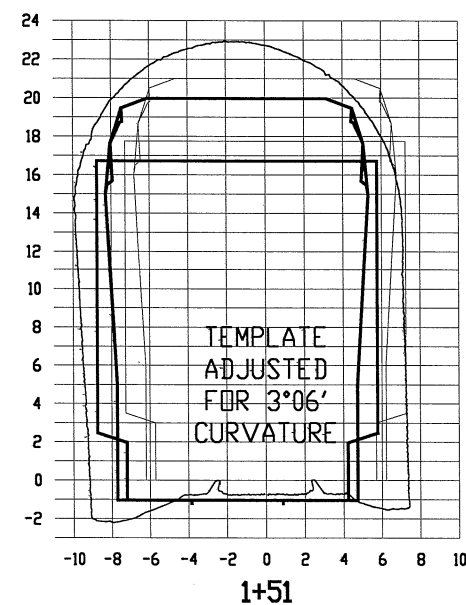
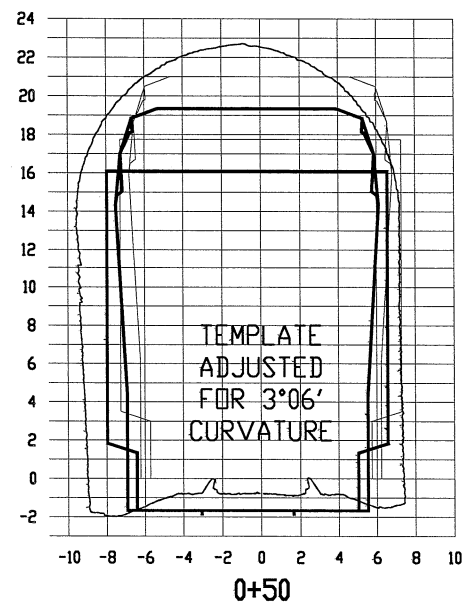
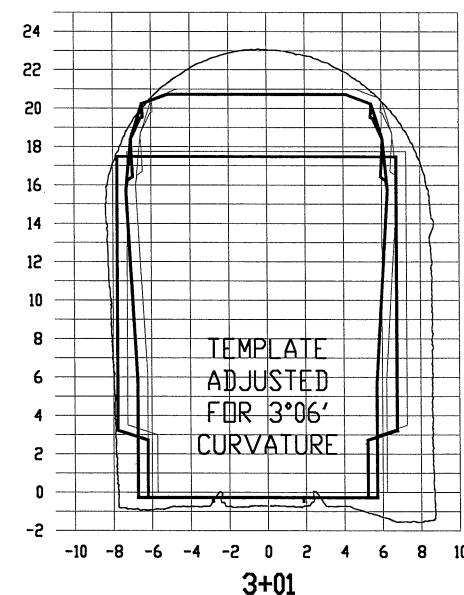
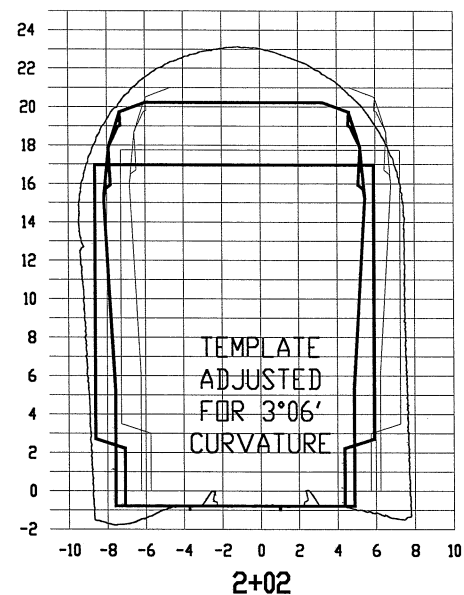
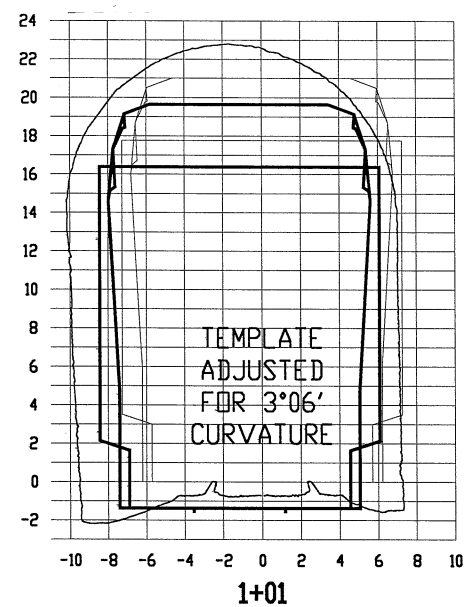
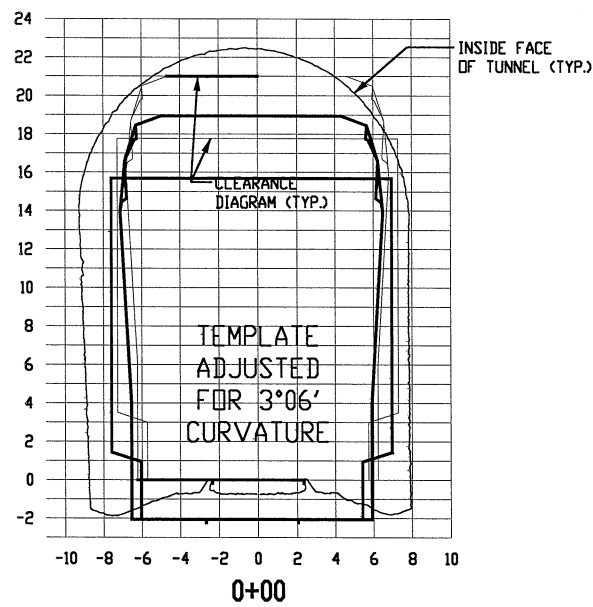
- HORIZONTAL DATUM IS PARALLEL TO TRACK. WHERE TRACK IS SUPERELEVATED, DATUM IS NOT PARALLEL WITH GROUND.
- CROSS SECTION GIVEN FOR STA. 0+00 IS A COMPOSITE FOR THE TUNNEL FROM STA. 0+00 THROUGH 0+50. ALL OF THE SECTIONS FOLLOW THIS CONVENTION.

NOT FOR CONSTRUCTION

SCALE: 1" = 100'

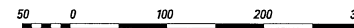


PI	DJL	8/5/05	PRELIMINARY ENGINEERING PHASE REPORT
REV	BY	DATE	DESCRIPTION
LOCATION HUGER TUNNEL MAIN #1, HUGER, WV			
TITLE TUNNEL CLEARANCE CROSS SECTIONS - 1 OF 1			
DESIGN	FILE NO.	16279	FILE POST N-395.56
OPERATING DIVISION	DATE	APRIL 8, 2005	DRAWING NUMBER
OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA			



FILE NAME = P:\NSR\29395\CAD\survey info\395.56 Huger.mxd I:\prop cross sect.dgn
DATE/TIME = 08/11/2005 10:13:32 AM

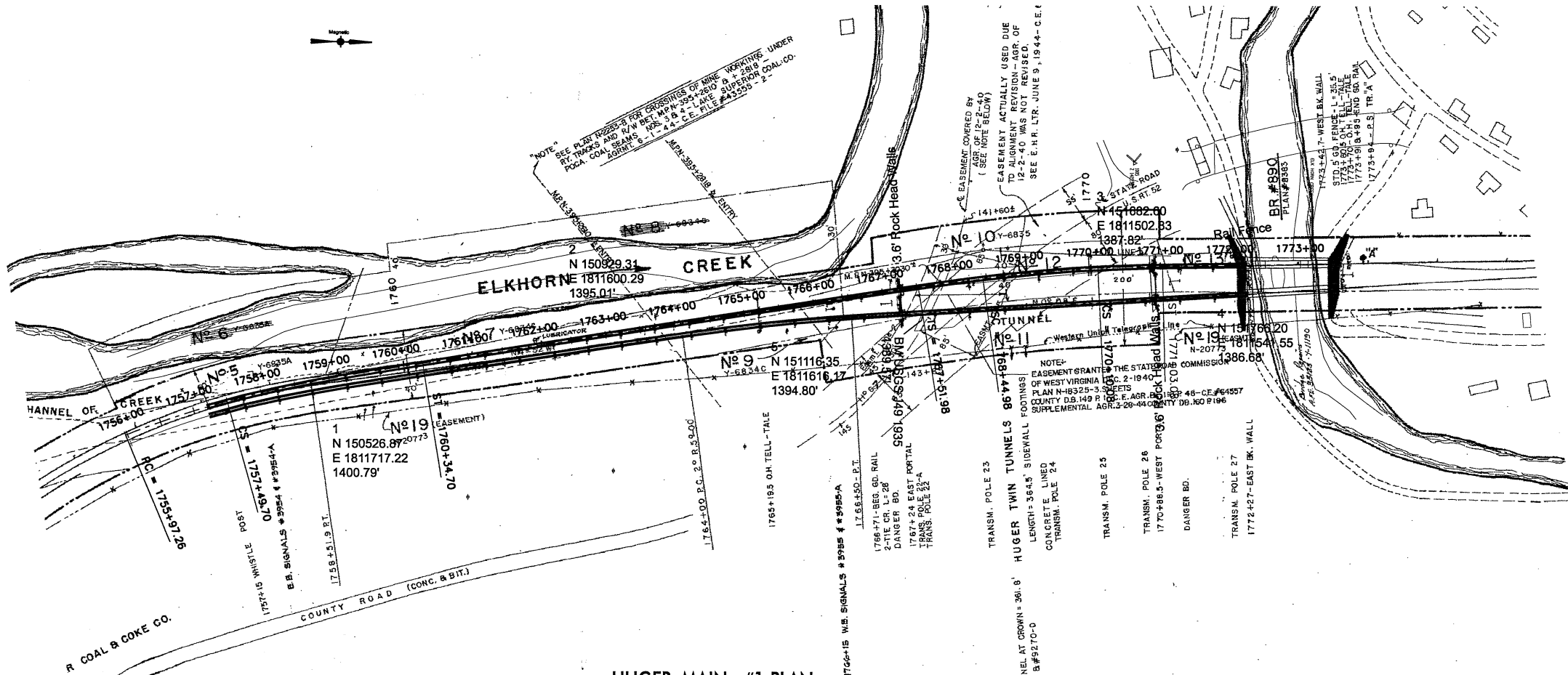
SCALE: 1" = 100'



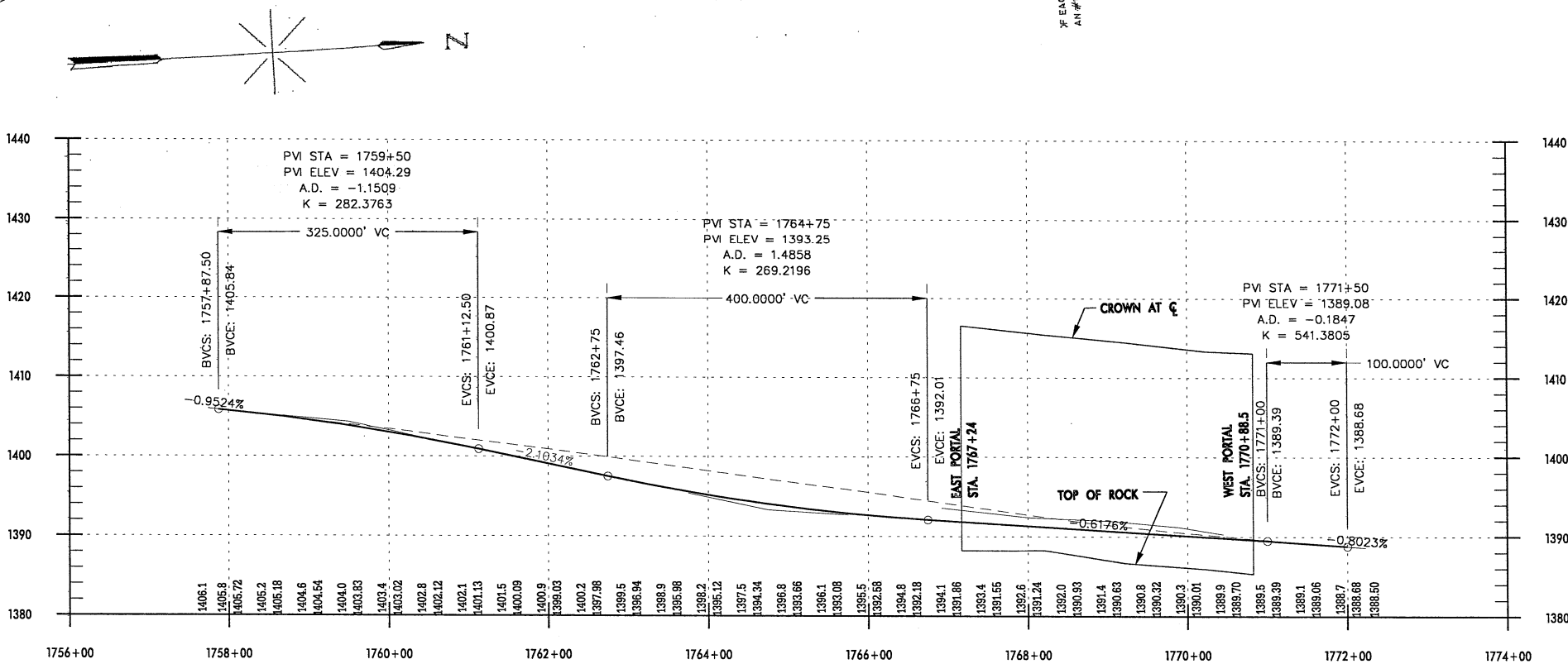
DRAWING COMPANY
POCAHONTAS
OPERATING DIVISION
OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA

NOT FOR CONSTRUCTION

PI D.J.L. 8/15/05	PRELIMINARY ENGINEERING PHASE REPORT
REV. BY DATE	DESCRIPTION
LOCATION	HUGER MAIN #1 TUNNEL, HUGER, WV
TITLE	PROPOSED TUNNEL CLEARANCE CROSS SECTIONS
OWN	P10 No. 14279
CHK	FILE No. N-395.56
DATE	DRAWING NUMBER
	APRIL 8, 2005



HUGER MAIN #1 PLAN
SCALE: 1"=100'



HUGER MAIN #1 PROFILE
SCALE: 1"=100' HORIZ.
1"=10' VERT.

Horizontal Alignment Station and Curve Report.				
Alignment: mt-1				
Desc: Main Track #1				
Desc.	Station	Spiral/Curve Data	Northing	Eastng
PI	1755+97.26		150174.7185	1811786.5646
	Length:	159.7025	Course: N 23-12-18 W	
PI	1757+56.96		150321.5014	1811723.6386
	Length:	1172.3623	Course: N 09-57-00 W	
	Delta:	13-15-18		
PC	1755+97.26	Circular Curve Data		
RP	1757+49.70		150174.7185	1811786.5646
SC	1757+49.70		150677.0549	1812958.3275
	Delta:	07	Type: RIGHT	
	Radius:	1274.9000	DOC: 04	
	Length:	152.4371	Tangent: 76.3095	
	Mid-Ord:	2.2776	External: 2.2817	
	Chord:	152.3463	Course: N 19-46-46 W	
	Es:	9.9638		
SC	1757+49.70	Spiral Curve Data: CLOTHOID		
SPI	1760+34.70		150318.0767	1811735.0104
PC	1760+34.70		150409.3416	1811708.2290
	Length:	285.0000	L Tan: 190.1245	
	Radius:	1274.9000	S Tan: 95.1132	
	Theta:	6-24-15	P: 2.6534	
	X:	284.6441	K: 142.4407	
	Y:	10.6090	A: 602.7823	
	Chord:	284.8418	Course: N 12-05-04 W	
	Ts:	279.3060		
PI	1769+27.75		151476.2301	1811521.0677
	Length:	383.2410	Course: N 01-57-00 W	
	Delta:	8-00-00		
	Tangent Data			
	1760+34.70		150596.6064	1811675.3777
	1767+51.98		151303.1034	1811551.4389
	Length:	717.2857	Course: N 09-57-00 W	
	Spiral Curve Data: CLOTHOID			
TS	1767+51.98		151303.1034	1811551.4389
SPI	1768+44.98		151364.1729	1811540.7256
SC	1768+44.98		151394.8335	1811536.1386
	Length:	93.0000	L Tan: 62.0021	
	Radius:	1848.4800	S Tan: 31.0019	
	Theta:	1-26-29	P: 0.1950	
	X:	92.9941	K: 46.4990	
	Y:	0.7798	A: 414.6187	
	Chord:	92.9974	Course: N 09-28-10 W	
	Ts:	175.7705		
SC	1768+44.98	Circular Curve Data		
RP	1770+10.08		151394.8335	1811536.1386
SC	1770+10.08		151668.3330	1813364.2733
	Delta:	05	Type: RIGHT	
	Radius:	1848.4800	DOC: 03	
	Length:	165.0956	Tangent: 82.6027	
	Mid-Ord:	1.8429	External: 1.8447	
	Chord:	165.0408	Course: N 05-57-00 W	
	Es:	4.7092		
SC	1770+10.08	Spiral Curve Data: CLOTHOID		
SPI	1771+03.08		151558.9852	1811519.0304
PC	1771+03.08		151589.9327	1811517.1965
	Length:	93.0000	L Tan: 62.0021	
	Radius:	1848.4800	S Tan: 31.0019	
	Theta:	1-26-29	P: 0.1950	
	X:	92.9941	K: 46.4990	
	Y:	0.7798	A: 414.6187	
	Chord:	92.9974	Course: N 02-25-50 W	
	Ts:	175.7705		
PI	1773+10.55		151859.2492	1811508.0269
	Tangent Data			
	1771+03.08		151651.8989	1811515.0867
	1773+10.55		151859.2492	1811508.0269
	Length:	207.4705	Course: N 01-57-00 W	

NOT FOR CONSTRUCTION

FILE NAME = P:\MSD\393558\5011\survey\info\395.56 huger\395.56 huger main.dgn
DATE/TIME = 10/27/2005 08:55:15 AM

SCALE: 1"=100'



NORFOLK SOUTHERN

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

DATE	DESCRIPTION	
P2 JUL 10 2005	PRELIMINARY ENGINEERING PHASE REPORT	
P1 JUL 8 2005	PRELIMINARY ENGINEERING PHASE REPORT	
REV	DATE	DESCRIPTION
1		
LOCATION		
HUGER MAIN #1 TUNNEL, HUGER, WV		
TITLE		
PLAN AND PROFILE		
DGN	PTD No.	V/PW
14279		
DWN	FILE No.	DRAWING NUMBER
CHK	DATE	APR 8 2005



