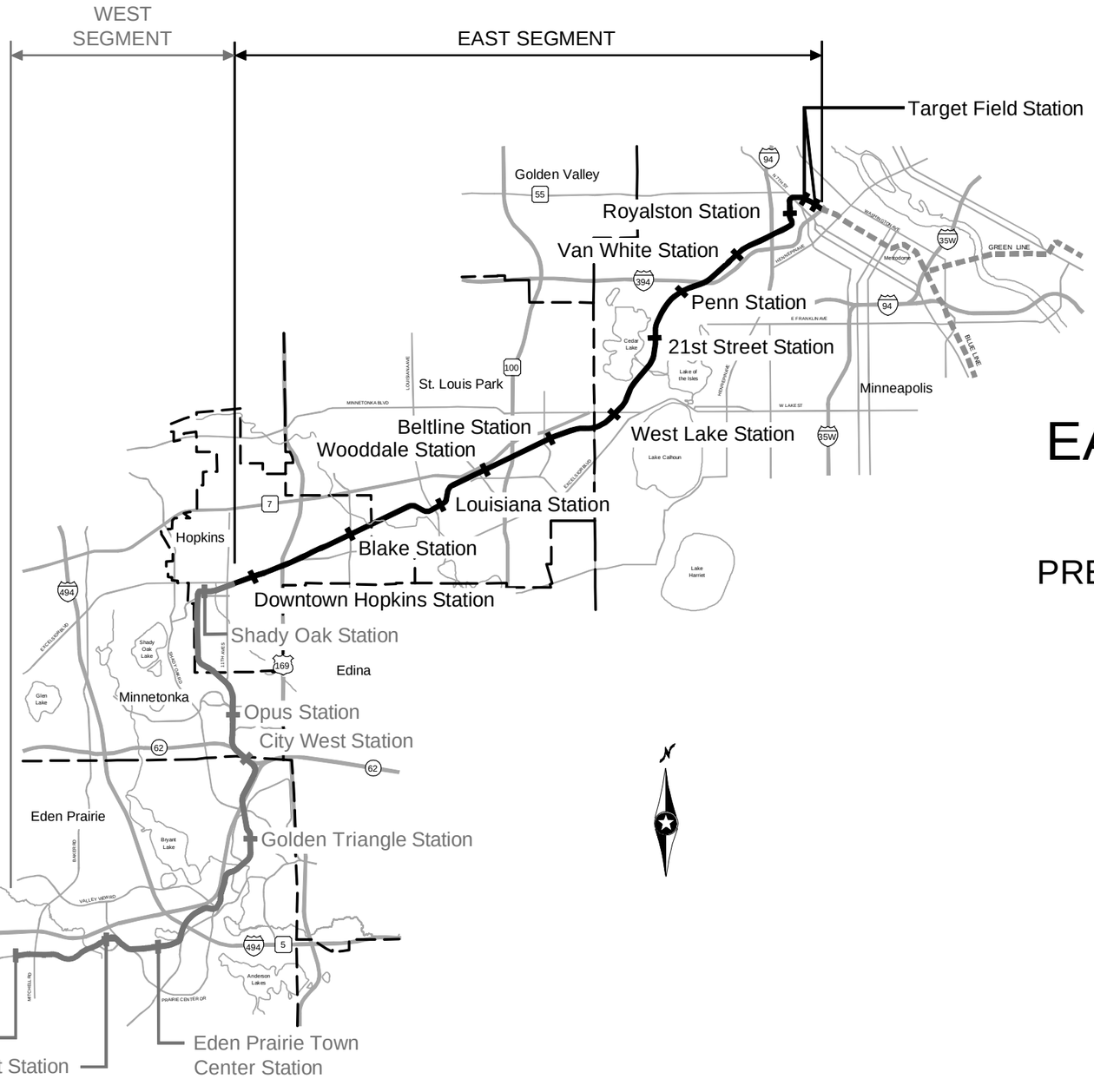

SOUTHWEST
Green Line LRT Extension

METROPOLITAN COUNCIL

EAST - VOLUME 1b (FREIGHT)
WAYZATA SUBDIVISION

PRELIMINARY ENGINEERING (SEPTEMBER 2014)

INDEX

FREIGHT (BNSF)

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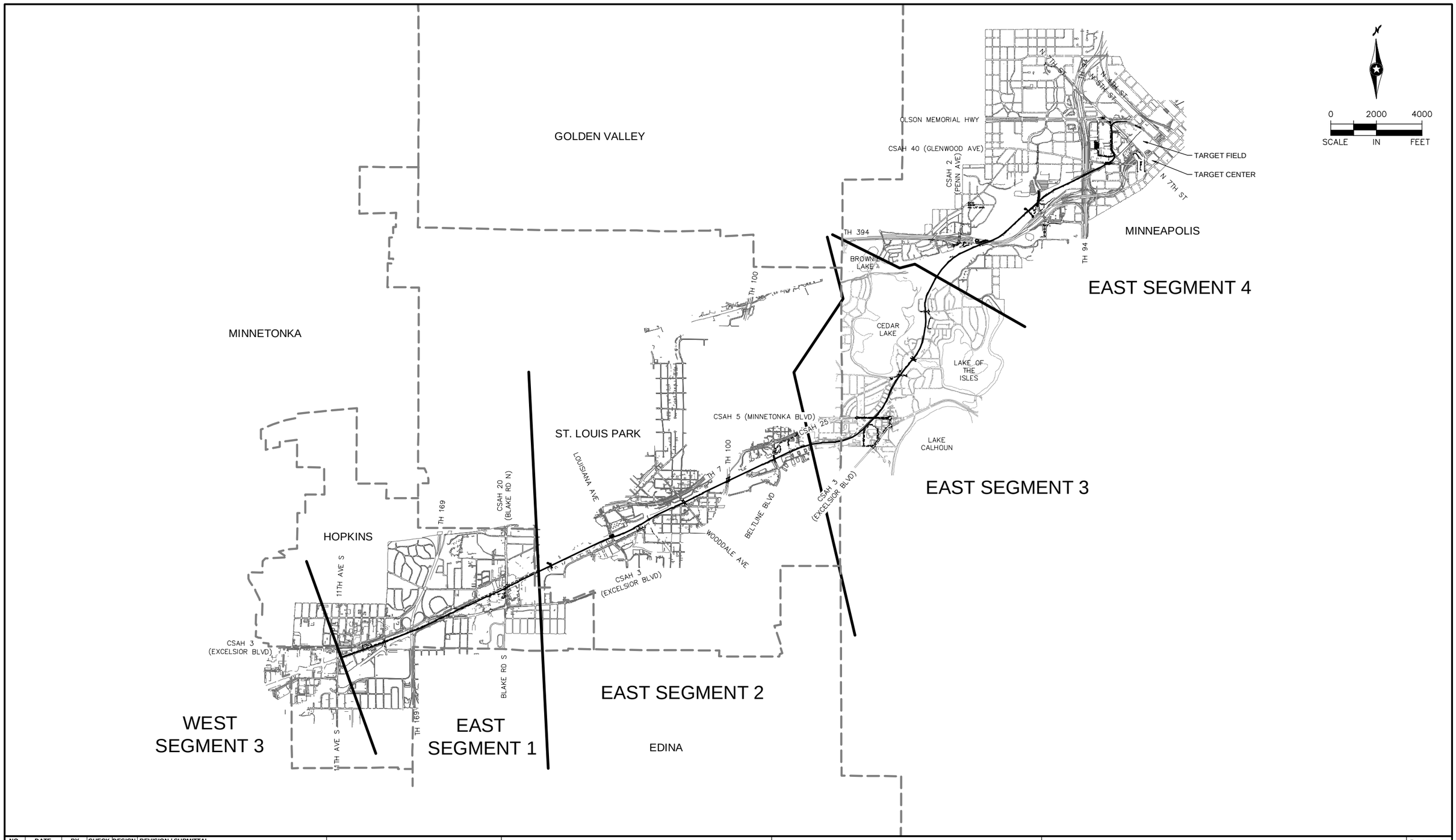
Kimley»Horn Gannett Fleming

PRELIMINARY - NOT FOR CONSTRUCTION

Aug, 29 2014 10:31 am V:\3300_PEC-E\CAD\OVERALL\PLAN SHEETS\FREIGHT\E0-FRR-CVRb.dwg By: chris.bunders



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PRELIMINARY ENGINEERING

METROPOLITAN COUNCIL

SOUTHWEST Green Line LRT Extension

EAST - VOLUME 1b (FREIGHT)
WAYZATA SUBDIVISION
SEGMENT KEY MAP

SHEET 2 OF 13

DISCIPLINE: VOLUME1b

SHEET NAME: E0-FRR-KEYb - 001

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TRACK LINETYPES

- TRACK ℄
- RETAINING WALL
- TUNNEL WALL
- ROADWAY ℄
- FENCE
- BALLAST CURB

TRACK SYMBOLS

- SIGNALIZED INTERSECTION
- EXISTING SIGNALIZED INTERSECTION
- PROPOSED DIRECTIONAL LANE USE
- EXISTING DIRECTIONAL LANE USE
- AUTOMATIC GATE
- RAIL TURNOUT
- POINT OF SWITCH (PS)
- 200 — RAILROAD CURVE NUMBER
- 12 — MILE POST

CIVIL LINETYPES

- ROADWAY ℄
- TRACK ℄
- CONCRETE CURB AND GUTTER
- TRAIL
- SIDEWALK
- DRIVEWAY
- BRIDGE
- RETAINING WALL
- TUNNEL WALL
- CROSSWALK
- STOP BAR
- MEDIAN NOSE
- SAWCUT
- FENCE
- LIMITS OF DISTURBANCE
- CONCRETE SIDEWALK JOINTING

CIVIL SYMBOLS

- ACCESSIBLE PEDESTRIAN CURB RAMP
- PROPOSED SIGNALIZED INTERSECTION
- EXISTING SIGNALIZED INTERSECTION
- PROPOSED DIRECTIONAL LANE USE
- EXISTING DIRECTIONAL LANE USE
- AUTOMATIC GATE
- HANDICAP PARKING STALL
- TACTILE WARNING STRIP
- TPSS BUILDING
- SIGNAL OR INTERMEDIATE OR PLATFORM OR XING OR TUNNEL HOUSE OR ANY COMBINATION OF THESE

ABBREVIATIONS

AD	ALGEBRAIC DIFFERENCE	NO	NUMBER
AVE	AVENUE	OCS	OVERHEAD CONTACT SYSTEM
BGN	BEGIN	OH	OVERHEAD
BVCE	BEGINNING VERTICAL CURVE ELEVATION	PC	POINT OF CURVE
BVCS	BEGINNING VERTICAL CURVE STATION	PITO	POINT OF INTERSECTION OF TURNOUT
BLVD	BOULEVARD	PKWY	PARKWAY
BNSF	BURLINGTON NORTHERN SANTA FE RAILWAY	POT	POINT ON TANGENT
C&G	CURB AND GUTTER	PROP	PROPOSED
℄	CENTERLINE	PS	POINT OF SWITCH
CP	CANADIAN PACIFIC	PT	POINT OF TANGENT
CPRAIL	CANADIAN PACIFIC RAILWAY	PVI	POINT OF VERTICAL INTERSECTION
CS	CURVE TO SPIRAL	R	RADIUS (FEET)
CSAH	COUNTY STATE AID HIGHWAY	r	RATE OF CHANGE VERTICAL CURVE
DF	DIRECT FIXATION	RH	RIGHT HAND
DR	DRIVE	ROW	RIGHT OF WAY
Ea	ACTUAL SUPERELEVATION (INCHES)	S	SOUTH
EB	EAST BOUND	SB	SOUTH BOUND
ELEV	ELEVATION	SC	SPIRAL TO CURVE
Eu	UNBALANCED SUPERELEVATION (INCHES)	SIG–COMM	SIGNAL COMMUNICATION
EVCE	ENDING VERTICAL CURVE ELEVATION	ST	STREET
EVCS	ENDING VERTICAL CURVE STATION	ST	SPIRAL TO TANGENT
EX	EXISTING	STA	STATION
HCRRA	HENNEPIN COUNTY REGIONAL RAILROAD AUTHORITY	TOR	TOP OF RAIL
LH	LEFT HAND	TPSS	TRACTION POWER SUBSTATION
Ls	SPIRAL LENGTH (FEET)	TRK	TRACK
MPLS	CITY OF MINNEAPOLIS	TS	TANGENT TO SPIRAL
MPRB	MINNEAPOLIS PARK AND RECREATION BOARD	UG	UNDERGROUND
N	NORTH	V	DESIGN VELOCITY (MPH)
NB	NORTH BOUND	WB	WEST BOUND

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METROPOLITAN COUNCIL

SOUTHWEST Green Line LRT Extension

EAST - VOLUME 1b (FREIGHT)
WAYZATA SUBDIVISION
LEGEND AND ABBREVIATIONS

DISCIPLINE: FREIGHT

SHEET NAME: E0-FRR-NTSb - 001

SHEET 3 OF 13

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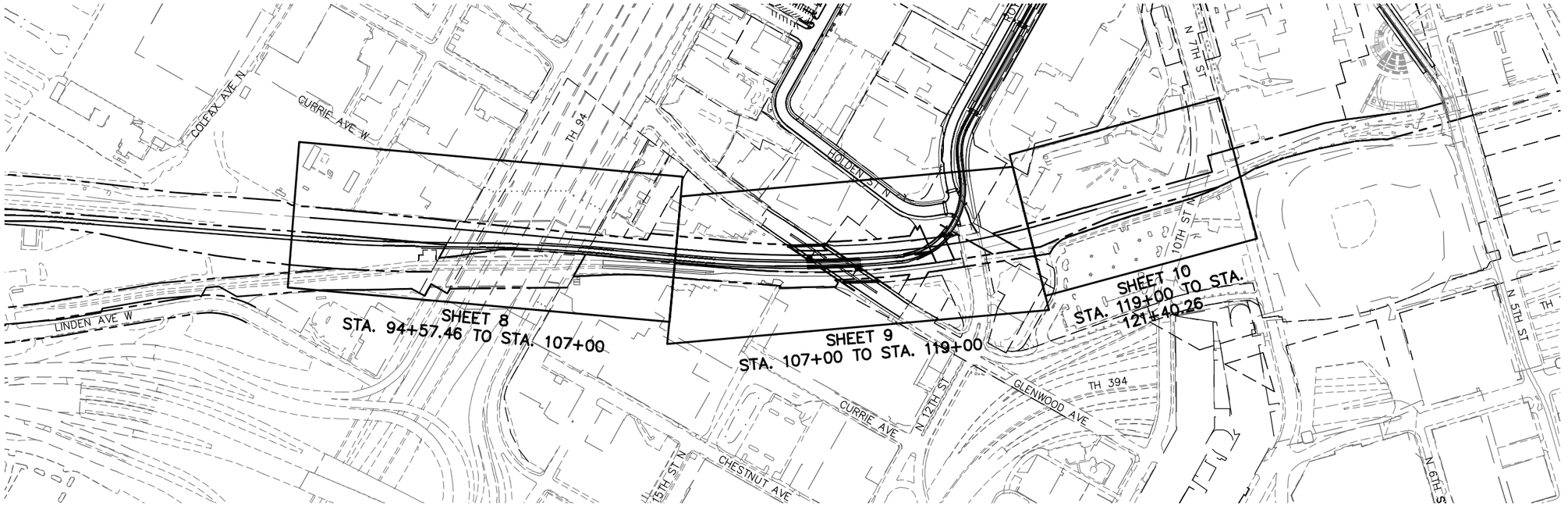

0 100 200 400

SCALE IN FEET

NO.	DATE	BY	CHECK	DESIGN	REVISION / SUBMITTAL

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PRELIMINARY ENGINEERING

METROPOLITAN COUNCIL

SOUTHWEST Green Line LRT Extension

EAST - VOLUME 1b (FREIGHT)
WAYZATA SUBDIVISION
SHEET INDEX

DISCIPLINE: FREIGHT

SHEET NAME: E4-FRR-IDX - 001

SHEET 4 OF 13

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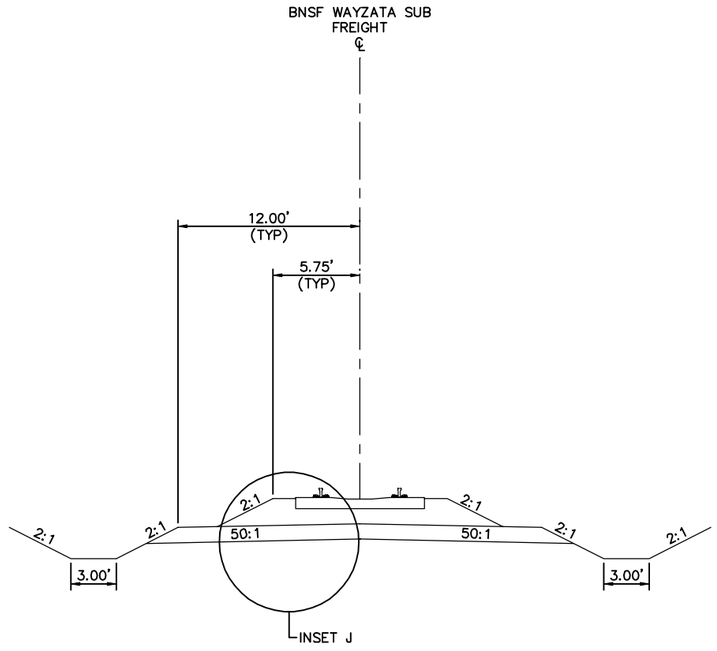

TYPICAL SECTION

STA. 94+57 TO STA. 99+68
STA. 116+01 TO STA. 116+66
STA. 117+36 TO STA. 121+40

NOTE:
FOR INSETS, SEE EAST – VOLUME 1
(CIVIL) – SEGMENT 4 SHEET 57.

SEE EAST – VOLUME 1 (CIVIL) – SEGMENT 4
FOR ADDITIONAL TYPICAL SECTIONS.

NO.	DATE	BY	CHECK	DESIGN	REVISION / SUBMITTAL

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PRELIMINARY ENGINEERING

METROPOLITAN COUNCIL

SOUTHWEST Green Line LRT Extension

EAST - VOLUME 1b (FREIGHT)
WAYZATA SUBDIVISION
TYPICAL SECTIONS

DISCIPLINE: FREIGHT

SHEET NAME: E0-FRR-TYPb - 001

SHEET 5 OF 13

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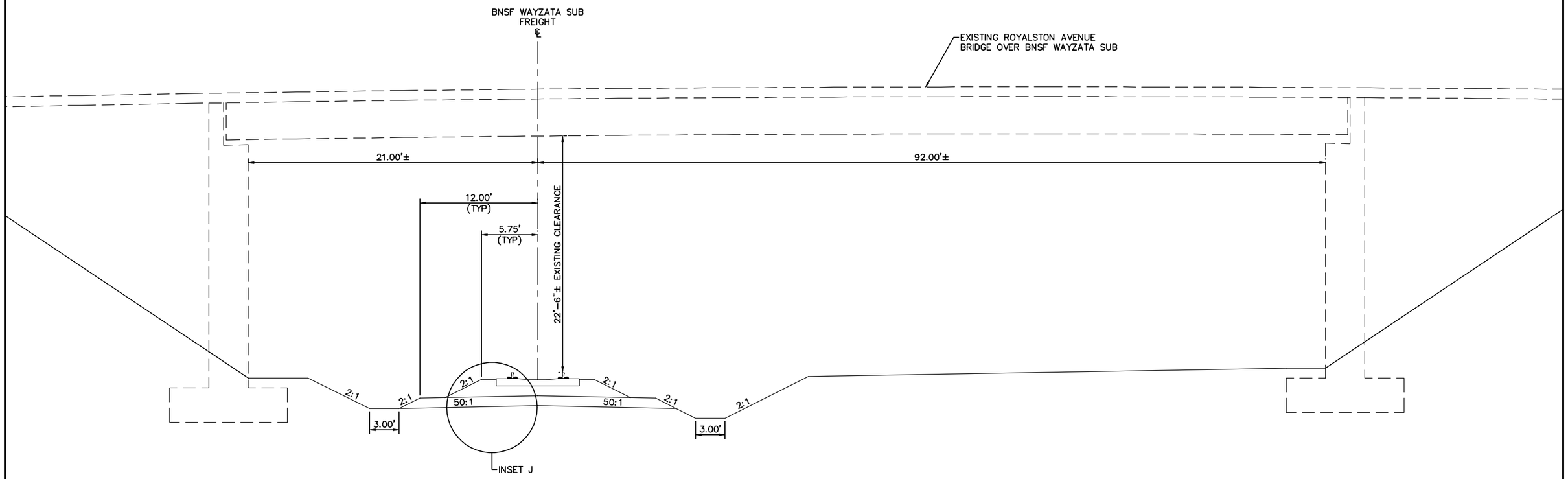

TYPICAL SECTION
STA. 116+66 TO STA. 117+36

NOTE:
FOR INSETS, SEE EAST – VOLUME 1
(CIVIL) – SEGMENT 4 SHEET 57.

SEE EAST – VOLUME 1 (CIVIL) – SEGMENT 4
FOR ADDITIONAL TYPICAL SECTIONS.

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PRELIMINARY ENGINEERING

METROPOLITAN COUNCIL

SOUTHWEST
Green Line LRT Extension

EAST - VOLUME 1b (FREIGHT)
WAYZATA SUBDIVISION
TYPICAL SECTONS

DISCIPLINE: FREIGHT

SHEET NAME: E0-FRR-TYPb - 002

SHEET 6 OF 13

Aug, 29 2014 10:32 am V:\3300_PEC-E\CAD\OVERALL\PLAN SHEETS\FREIGHT\E0-FRR-TYPb.dwg By: chris.bunders

12

5820'

5277'

DESIGN SPEED

25 MPH

CURVES

0°15'

401

402

1°30'

403

2°0'

GRADE DATA

900 890 880 870 860 850 840 830 820 810 800

-0.36%

820.40

0.08%

821.42

0.20%

823.09

0.36%

90+00 95+00 100+00 105+00 110+00 115+00 120+00 125+00

GENERAL INFORMATION

STA. 101+80.65
℄ I-94 (OH)
.05

STA. 111+89.58
℄ CSAH 40 (GLENWOOD AVE) (OH)
.86

STA. 115+87.67
℄ LRT XING (OH)
.78

STA. 117+01.12
℄ ROYALSTON AVE N (OH)
.76

BNSF WAYZATA SUB

LRT

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METROPOLITAN COUNCIL

SOUTHWEST Green Line LRT Extension

EAST - VOLUME 1b (FREIGHT)
TRACK CHARTS
STA. 90+00 TO STA. 125+00

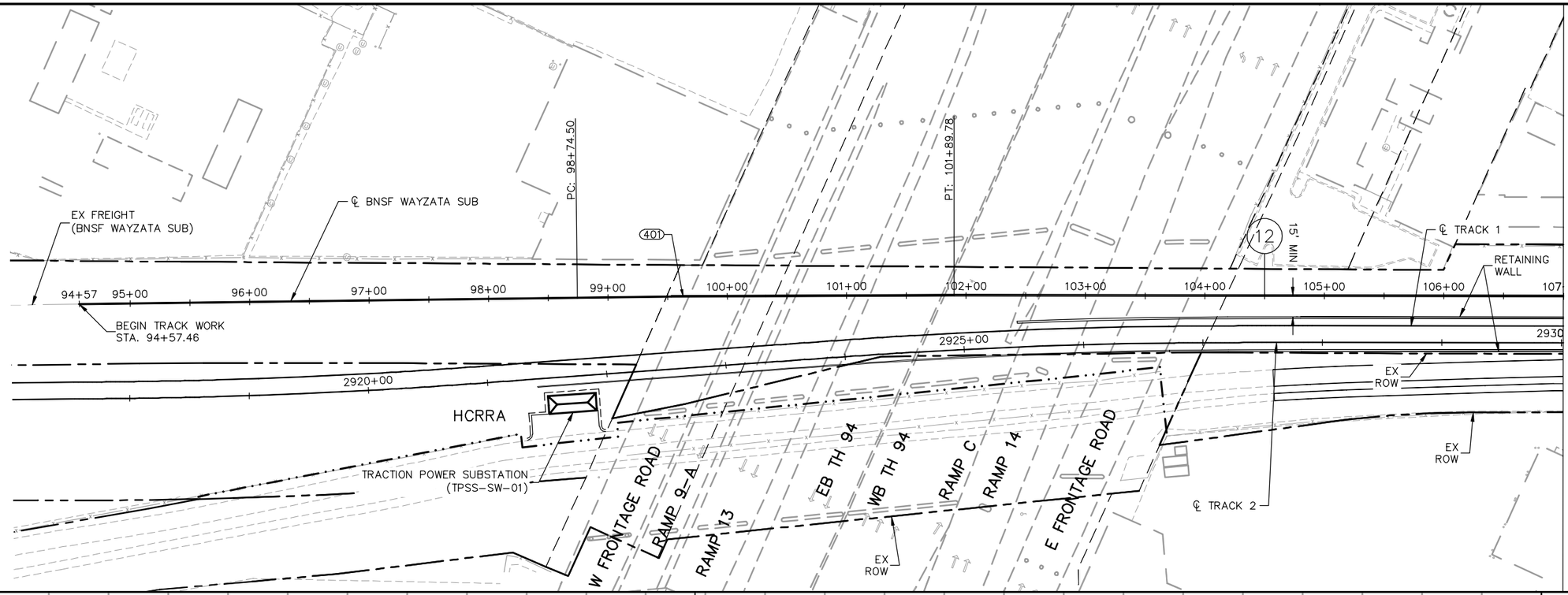
SHEET 7 OF 13

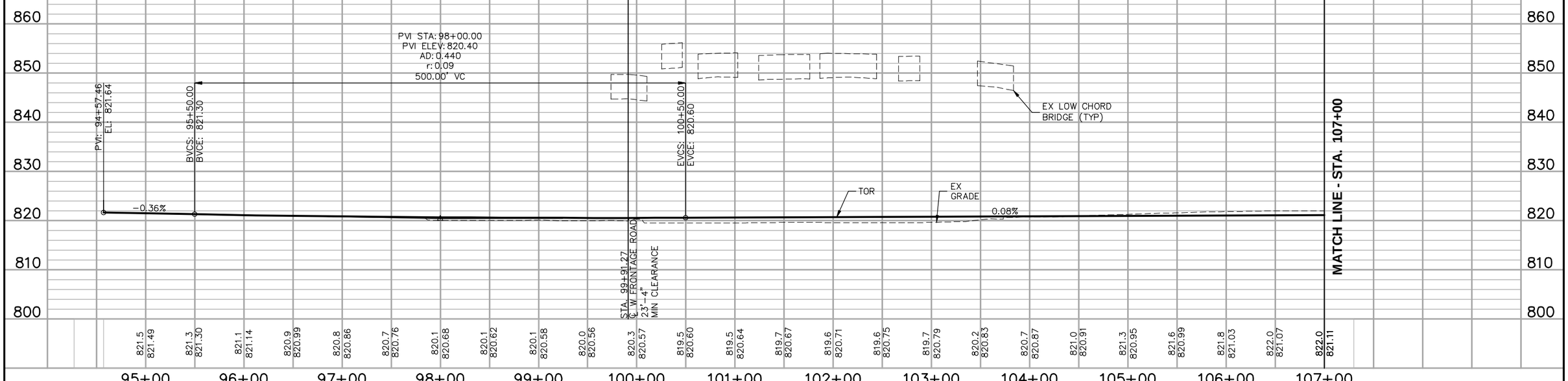
DISCIPLINE: FREIGHT

SHEET NAME: E4-FRR-CHART - 001

Aug, 29 2014 10:32 am V:\3300_PEC-E\CAD\OVERALL\PLAN SHEETS\FREIGHT\E4-FRR-CHART.dwg By: chris.bunders

CURVE NO. 401
Dc = 0° 15' 0.00" RH
R = 22,918.60'
Lc = 315.28'
Ea = 0.00"
Eu = 0.11"
V = 25 MPH





0 5 10 20
VERTICAL
0 25 50 100
HORIZONTAL
SCALE IN FEET

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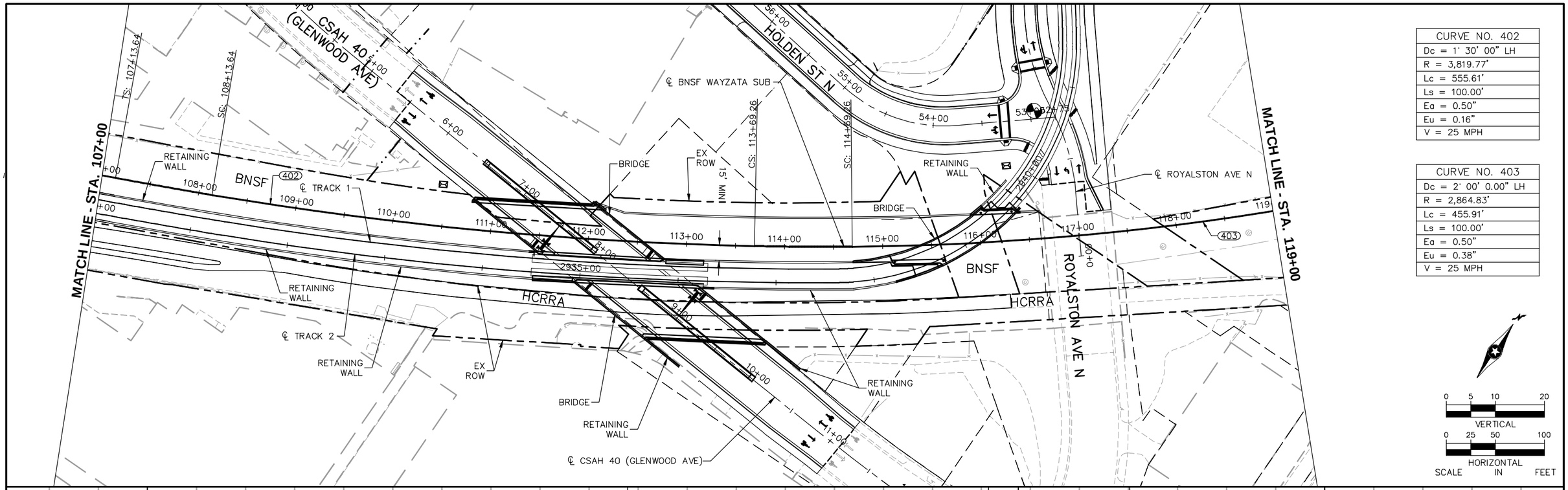
METROPOLITAN COUNCIL
SOUTHWEST Green Line LRT Extension

EAST - VOLUME 1b (FREIGHT)
WAYZATA SUBDIVISION
PLAN AND PROFILE
STA. 94+57.46 TO STA. 107+00

SHEET 8 OF 13

DISCIPLINE: FREIGHT
SHEET NAME: E4-FRR-PPFL - 001

Aug, 29 2014 10:33 am V:\3300_PEC-E\CAD\OVERALL\PLAN SHEETS\FREIGHT\E4-FRR-PPFL.dwg By: chris.bunders



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PRELIMINARY ENGINEERING

METROPOLITAN COUNCIL

SOUTHWEST Green Line LRT Extension

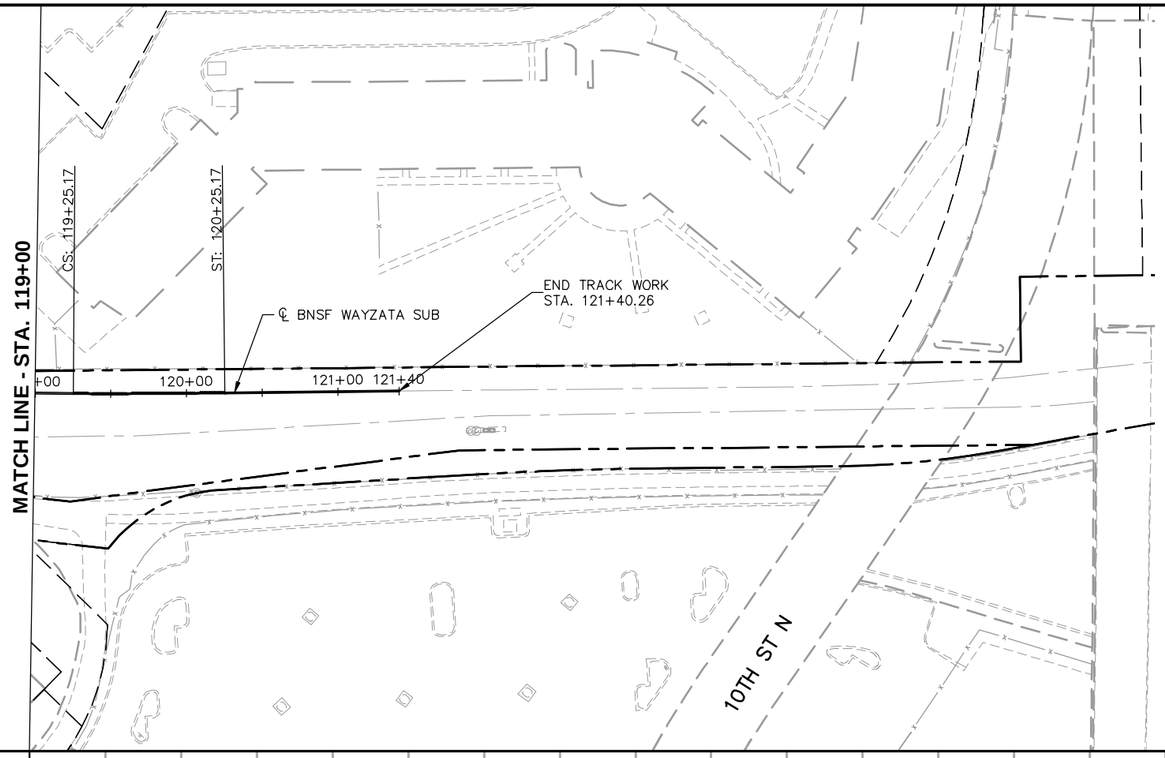
EAST - VOLUME 1b (FREIGHT)
WAYZATA SUBDIVISION
PLAN AND PROFILE
STA. 107+00 TO STA. 119+00

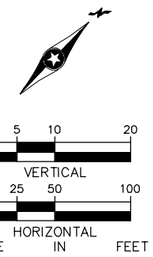
DISCIPLINE: FREIGHT

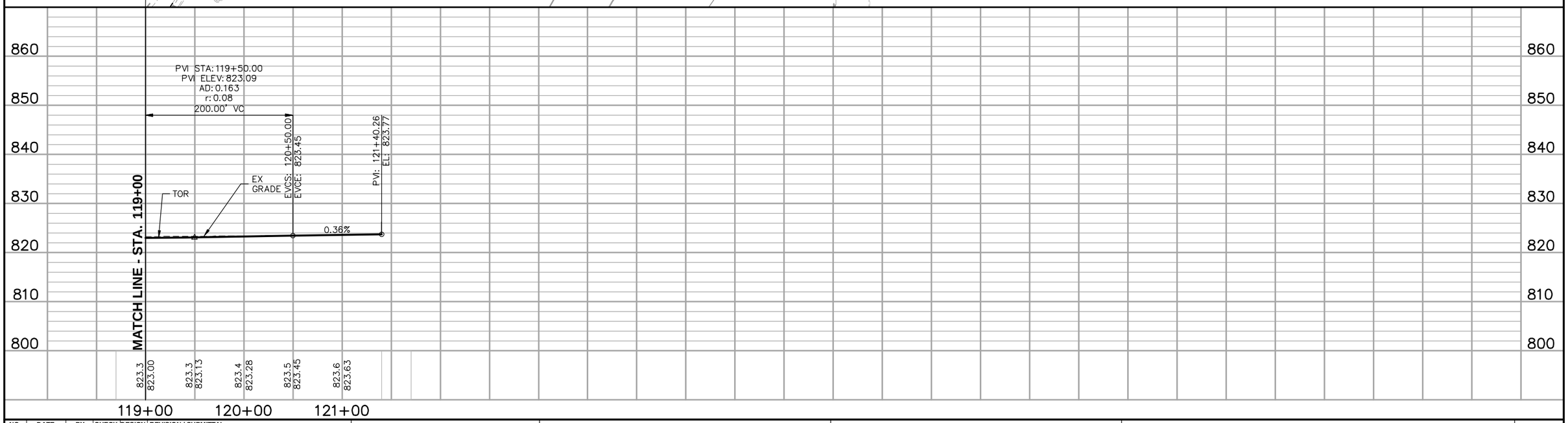
SHEET NAME: E4-FRR-PPFL - 002

SHEET 9 OF 13

Aug, 29 2014 10:33 am V:\3300_PEC-E\CAD\OVERALL\PLAN SHEETS\FREIGHT\E4-FRR-PPFL.dwg By: chris.bunders







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METROPOLITAN COUNCIL

SOUTHWEST Green Line LRT Extension

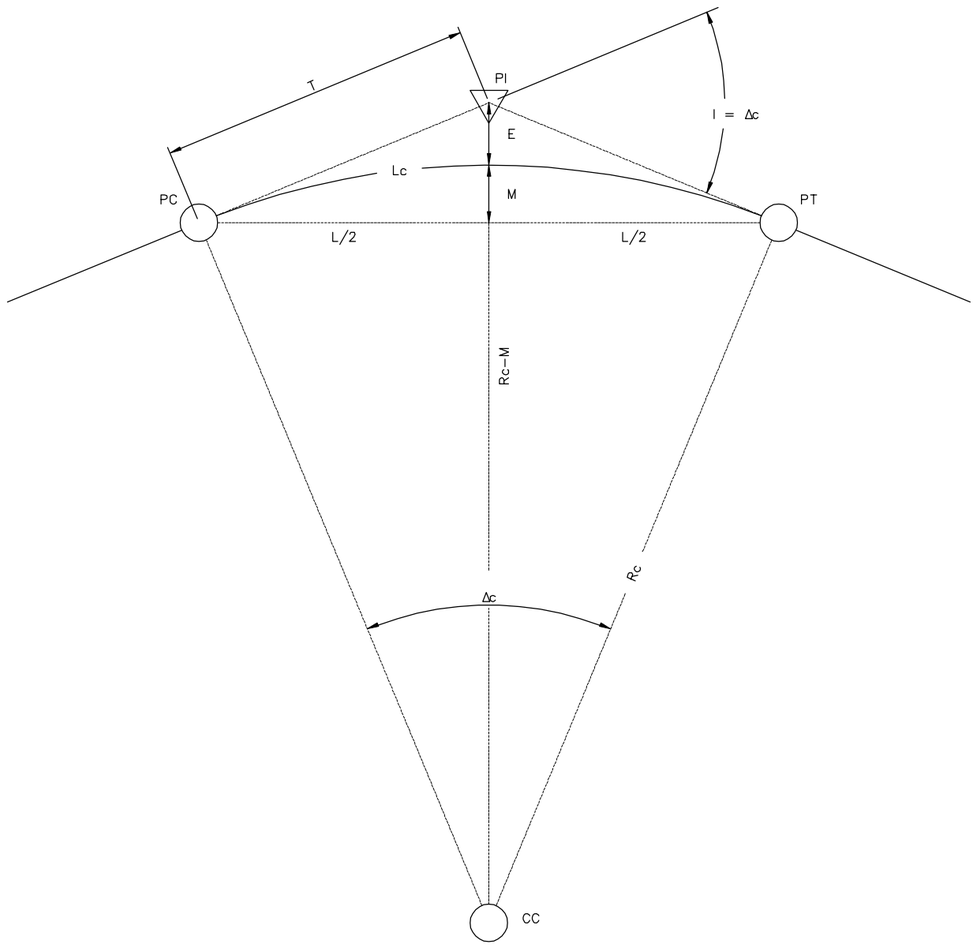
EAST - VOLUME 1b (FREIGHT)
WAYZATA SUBDIVISION
PLAN AND PROFILE
STA. 119+00 TO STA. 121+40.26

DISCIPLINE: FREIGHT

SHEET NAME: E4-FRR-PPFL - 003

SHEET 10 OF 13

Aug, 29 2014 10:33 am V:\3300_PEC-E\CAD\OVERALL\PLAN SHEETS\FREIGHT\E4-FRR-PPFL.dwg By: chris.bunders



SIMPLE CURVE DIAGRAM

DEFINITIONS

Dc = DEGREE OF CURVE IN CHORD DEFINITION (DECIMAL DEGREES)
Rc = RADIUS OF CURVE (FEET)
Lc = LENGTH OF CURVE IN 100' CHORDS (FEET)
Δc = CENTRAL ANGLE OF CURVE (DECIMAL DEGREES)
E = EXTERNAL DISTANCE (FEET)
T = TANGENT DISTANCE (FEET)
M = MIDDLE ORDINATE (FEET)
L = CHORD LENGTH (FEET)
I = DEFLECTION ANGLE (DECIMAL DEGREES)
PC = POINT OF CURVE
PT = POINT OF TANGENT
PI = POINT OF INTERSECTION
CC = CENTER OF CURVE

SIMPLE CURVE FORMULAS

$\frac{\text{SIN } Dc}{2} = \frac{50}{Rc}$

$Dc = \frac{5729.65'}{Rc}$

$Lc = \frac{\Delta c}{Dc}$

$T = Rc \text{ TAN } \frac{I}{2}$

$E = Rc \text{ SEC}\frac{I}{2} - Rc$

$M = Rc - Rc \text{ COS}\frac{I}{2}$

$L = 2 \text{ Rc SIN}\frac{I}{2}$

NO.	DATE	BY	CHECK	DESIGN	REVISION / SUBMITTAL

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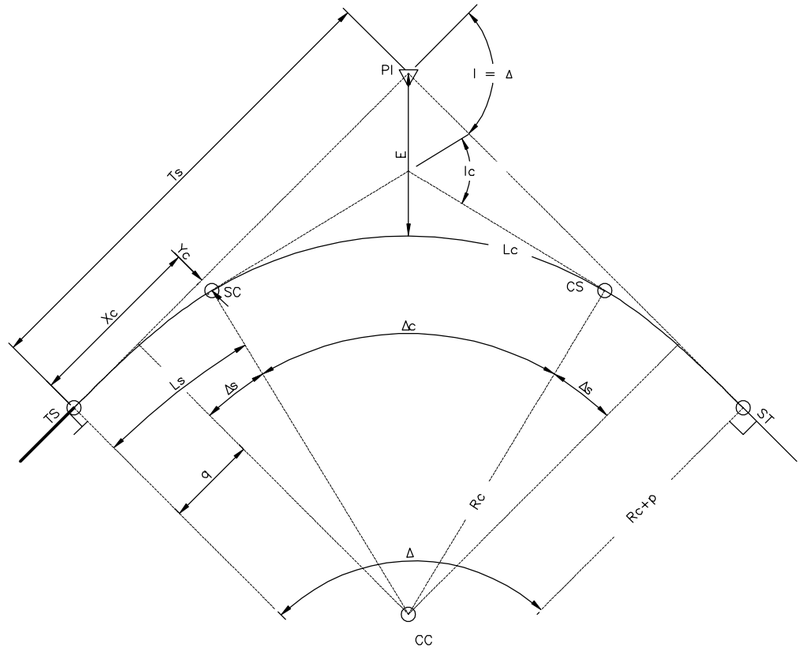
METROPOLITAN COUNCIL
SOUTHWEST Green Line LRT Extension

EAST - VOLUME 1b (FREIGHT)
WAYZATA SUBDIVISION
DETAILS

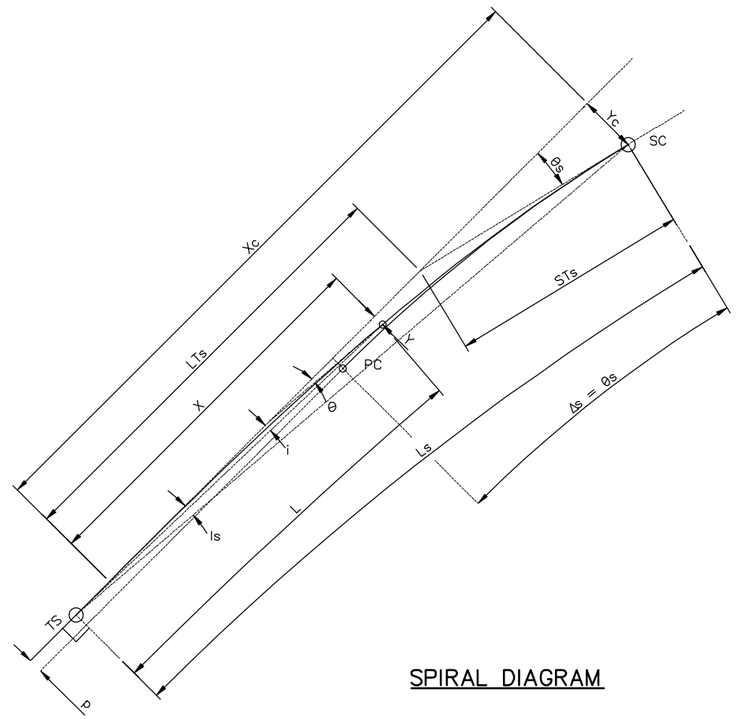
DISCIPLINE: FREIGHT
SHEET NAME: E0-FRR-DTLb - 001

SHEET 11 OF 13

Aug. 29 2014 10:33 am V:\3300_PEC-E\CAD\OVERALL\PLAN SHEETS\FREIGHT\E0-FRR-DTLb.dwg By: chris.bunders



SPIRAL CURVE DIAGRAM



SPIRAL DIAGRAM

DEFINITIONS

Dc =	DEGREE OF SIMPLE CURVE IN CHORD DEFINITION (DEGREES)
d =	DEGREE OF CURVATURE OF THE SPIRAL AT ANY POINT
Rc =	RADIUS OF CURVE (FEET)
Δ =	TOTAL CENTRAL ANGLE OF CURVE (DEGREES)
Δc =	CENTRAL ANGLE OF SIMPLE CURVE (DEGREES)
Δs =	CENTRAL ANGLE OF SPIRAL (DEGREES)
E =	EXTERNAL DISTANCE OF THE SIMPLE CURVE (FEET)
Ts =	TOTAL TANGENT DISTANCE (FEET)
Ls =	LENGTH OF SPIRAL (FEET)
Lc =	LENGTH OF THE SIMPLE CURVE IN CHORD DEFINITION (FEET)
L =	LENGTH FROM TS TO ANY POINT ALONG THE SPIRAL (FEET)
I =	TOTAL DEFLECTION ANGLE (DEGREES)
Ic =	DEFLECTION ANGLE OF THE SIMPLE CURVE (DEGREES)
Is =	DEFLECTION ANGLE OF THE SPIRAL (DEGREES)
i =	DEFLECTION ANGLE FROM TS TO ANY POINT ON THE SPIRAL
p =	LENGTH OF THROW, OFFSET DISTANCE FROM TANGENT TO PC/PT
q =	DISTANCE FROM TS/ST TO THE OFFSET TC/CT
Xc =	DISTANCE ALONG TANGENT FROM TS/ST TO THE SC/CS (FEET)
Yc =	OFFSET DISTANCE FROM TANGENT TO SC/CS (FEET)
X =	DISTANCE ALONG TANGENT FROM TS/ST TO ANY POINT ON THE SPIRAL
Y =	OFFSET DISTANCE FROM TANGENT TO ANY POINT ON THE SPIRAL
θs =	SPIRAL ANGLE FROM TANGENT TO SC
θ =	SPIRAL ANGLE FROM TANGENT TO ANY POINT ON THE SPIRAL
LTs =	LONG TANGENT OF SPIRAL (FEET)
STs =	SHORT TANGENT OF SPIRAL (FEET)
TS =	POINT OF TANGENT TO SPIRAL CURVE
SC =	POINT OF SPIRAL CURVE TO SIMPLE CURVE
CS =	POINT OF SIMPLE CURVE TO SPIRAL CURVE
ST =	POINT OF SPIRAL CURVE TO TANGENT
PC =	POINT OF CURVE
PT =	POINT OF TANGENT
PI =	POINT OF INTERSECTION
CC =	CENTER OF CURVE

FORMULAS

$\Delta = \Delta c + 2\Delta s$

$\Delta s = \frac{Ls}{2Rc}$

$i = \frac{\theta}{3}$

$X = L - \frac{L^5}{40Rc^2Ls^2}$

$Xc = Ls - \frac{Ls^3}{40Rc^2}$

$Y = \frac{L^3}{6RcLs}$

$Yc = \frac{Ls^2}{6Rc}$

$q = Xc - Rc\ SIN\Delta s$

$p = \frac{1}{4}Yc = \frac{Ls^2}{24Rc}$

$Ts = (Rc + p)\ TAN\frac{I}{2} + q$

$E = \frac{Rc + p}{COS\ \frac{I}{2}} - Rc$

$LTs = Xc - \frac{Yc}{TAN\Delta s}$

$STs = \frac{Yc}{SIN\Delta s}$

$\frac{SIN\ Dc}{2} = \frac{50}{Rc}$

$Dc = \frac{5729.65'}{Rc}$

$Lc = \frac{\Delta c}{Dc}$

NO.	DATE	BY	CHECK	DESIGN	REVISION / SUBMITTAL

Kimley»Horn

Gannett Fleming

PRELIMINARY ENGINEERING

METROPOLITAN COUNCIL

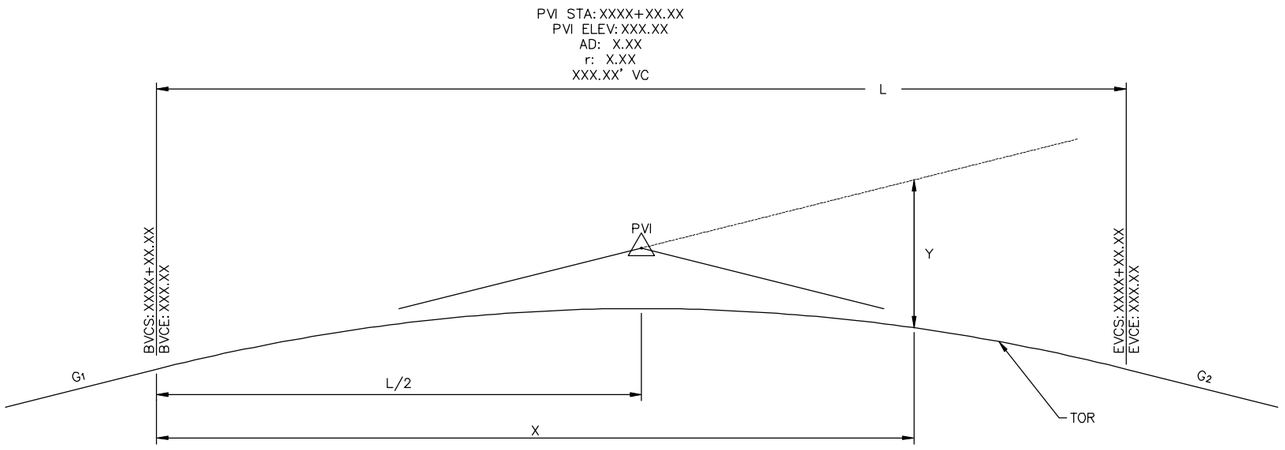
SOUTHWEST Green Line LRT Extension

EAST - VOLUME 1b (FREIGHT)
WAYZATA SUBDIVISION
DETAILS

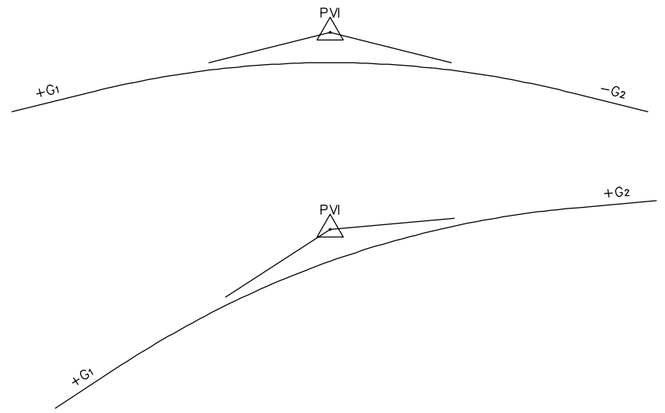
DISCIPLINE: FREIGHT

SHEET NAME: E0-FRR-DTLb - 002

SHEET 12 OF 13



STANDARD VERTICAL CURVE



CREST TYPE VERTICAL CURVES

DEFINITIONS

G_1	=	ENTRY GRADE %
G_2	=	DEPARTING GRADE %
PVI	=	POINT OF VERTICAL INTERSECTION
AD	=	ALGEBRAIC DIFFERENCE
r	=	RATE OF CHANGE OF GRADE
L	=	LENGTH OF VERTICAL CURVE
Vd	=	DESIGN VELOCITY (MPH)
BVCS	=	BEGIN VERTICAL CURVE STATION
BVCE	=	BEGIN VERTICAL CURVE ELEVATION
EVCS	=	END VERTICAL CURVE STATION
EVCE	=	END VERTICAL CURVE ELEVATION
X	=	HORIZONTAL DISTANCE FROM BVC
Y	=	ELEVATION OF PARABOLA BELOW G_1
Rv	=	EQUIVALENT RADIUS OF VERTICAL CURVE

FORMULAS

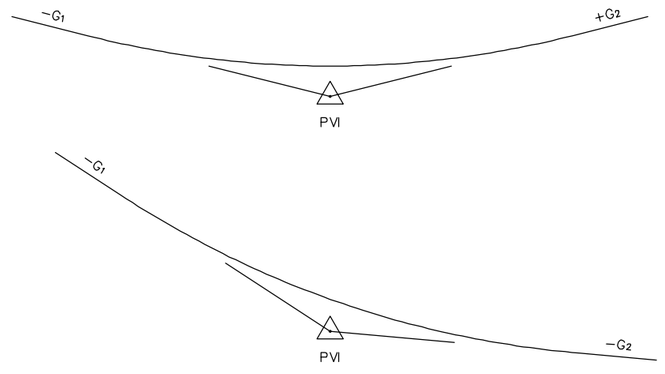
$$a = \frac{G_2 - G_1}{2L}$$

$$Y = BVCE + G_1X + aX^2$$

$$AD = G_2 - G_1$$

$$r = \frac{100\ AD}{L}$$

$$Rv = \frac{L}{0.01\ AD}$$



SAG TYPE VERTICAL CURVES

NO.	DATE	BY	CHECK	DESIGN	REVISION / SUBMITTAL

Kimley»Horn

Gannett Fleming

PRELIMINARY ENGINEERING

METROPOLITAN COUNCIL

SOUTHWEST Green Line LRT Extension

EAST - VOLUME 1b (FREIGHT)
WAYZATA SUBDIVISION
DETAILS

DISCIPLINE: FREIGHT

SHEET NAME: E0-FRR-DTLb - 003

SHEET 13 OF 13