Prepared for

Hampton Roads Transportation Planning Organization

HAMPTON ROADS HIGH SPEED PASSENGER RAIL VISION PLAN

Appendices

November 2014

Prepared by

TEMS

Transportation Economics & Management Systems, Inc.

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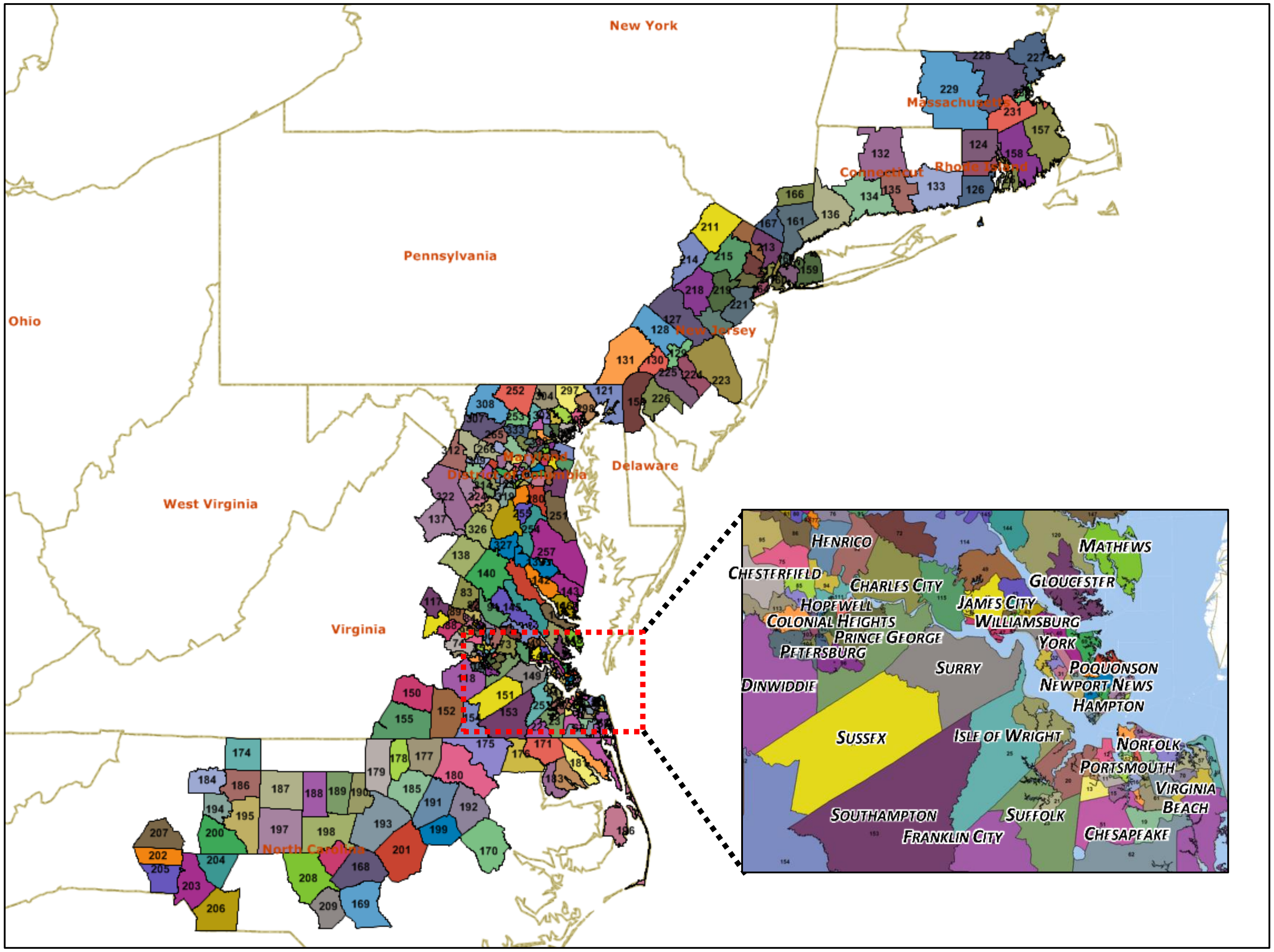
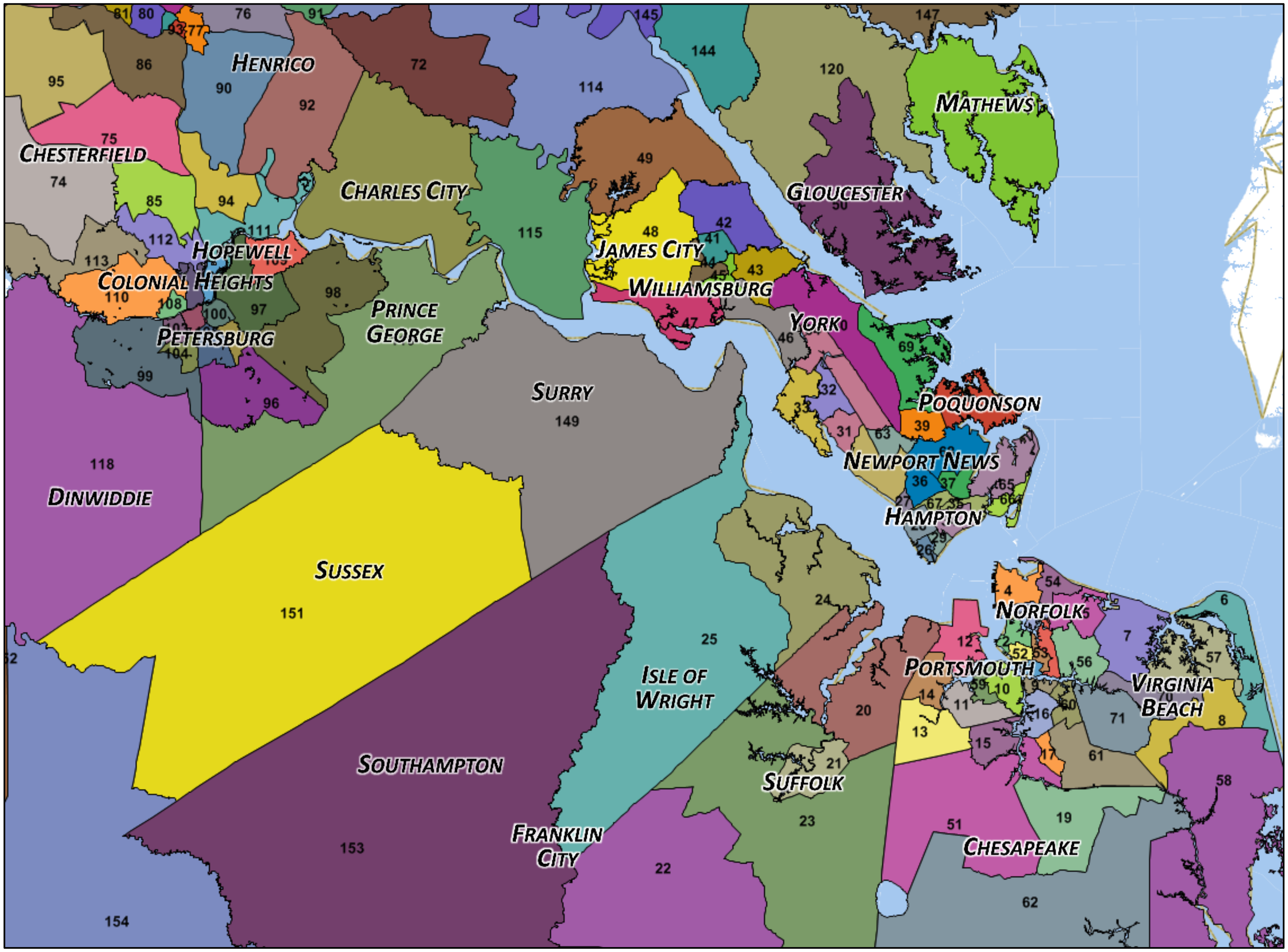
APPENDIX A

1. ZONE SYSTEM AND SOCIOECONOMIC DATA

THE STUDY AREA IS DIVIDED INTO 333 ZONES:



HAMPTON ROADS AREA ZONES:



1.1 Study Area Population Data and Forecasts

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
1	Norfolk (Downtown)	9,217	9,514	10,032	10,578	11,153	11,760	12,249	12,800	13,354
2	Lamberts Point - Colonial Place	21,382	21,436	21,526	21,617	21,708	21,799	21,889	21,980	22,071
3	Fairmount Park - Lafayette Annex	18,326	18,364	18,428	18,493	18,557	18,622	18,685	18,749	18,814
4	Glenwood Park	11,748	11,692	11,598	11,505	11,413	11,321	11,227	11,134	11,041
5	Norfolk International Airport	43,060	43,138	43,270	43,401	43,533	43,665	43,796	43,928	44,059
6	Virginia Beach	42,370	42,786	43,490	44,205	44,932	45,671	46,363	47,080	47,798
7	Chinese Corner	77,205	77,996	79,332	80,691	82,074	83,480	84,794	86,157	87,522
8	Oceana Naval Air Station	33,246	33,803	34,751	35,726	36,728	37,758	38,680	39,659	40,641
9	Berkley - Campostella	7,889	7,901	7,922	7,943	7,964	7,986	8,007	8,028	8,049
10	Portsmouth	23,638	23,774	24,002	24,233	24,466	24,701	24,927	25,158	25,389
11	Victory Park	33,924	34,188	34,633	35,083	35,540	36,002	36,441	36,893	37,345
12	Arostead Forest - Craney Island	25,991	26,080	26,230	26,381	26,532	26,685	26,834	26,984	27,135
13	Bowers Hill	18,319	19,439	21,459	23,689	26,151	28,869	30,673	32,948	35,248
14	Boone	22,559	23,341	24,706	26,150	27,679	29,297	30,582	32,040	33,508
15	Loxley Gardens – Geneva Park	13,605	13,842	14,246	14,662	15,090	15,531	15,924	16,341	16,761
16	South Norfolk	24,795	25,401	26,444	27,529	28,660	29,836	30,837	31,930	33,028
17	1200 Battlefield Blvd N	10,055	10,383	10,953	11,554	12,189	12,858	13,397	14,004	14,614
18	910 Great Bridge Blvd	11,752	12,325	13,343	14,444	15,637	16,928	17,860	18,978	20,106
19	Chesapeake	49,640	51,722	55,387	59,311	63,514	68,015	71,418	75,392	79,395
20	Bennett Corner	34,325	38,694	47,247	57,689	70,440	86,009	92,409	103,429	114,681
21	Suffolk	16,852	17,746	19,344	21,085	22,983	25,052	26,503	28,273	30,060
22	Holland	6,352	6,713	7,359	8,068	8,846	9,698	10,280	11,002	11,731
23	Kings Fork	27,651	30,808	36,889	44,170	52,888	63,328	68,070	75,695	83,466
24	Smithfield	22,030	23,819	27,128	30,898	35,191	40,081	42,901	46,782	50,716
25	Zuni	13,369	14,312	16,033	17,962	20,123	22,543	24,048	26,024	28,023

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
26	Newport News (Downtown South)	8,232	8,222	8,206	8,190	8,173	8,157	8,141	8,124	8,108
27	Newport News Amtrak Station	6,276	6,265	6,245	6,226	6,207	6,187	6,168	6,148	6,129
28	Newport News (Downtown Peninsula)	13,646	13,524	13,324	13,127	12,932	12,741	12,538	12,341	12,145
29	Newport News (Reed)	10,848	10,893	10,969	11,045	11,122	11,199	11,274	11,350	11,426
30	Glendale - Beaconsville	37,195	37,921	39,161	40,442	41,764	43,130	44,331	45,618	46,910
31	Charles	19,225	19,498	19,963	20,439	20,926	21,424	21,878	22,355	22,834
32	Sunsan Constant Dr	28,317	28,568	28,992	29,422	29,859	30,302	30,719	31,150	31,582
33	2 Shore Park Dr	5,720	5,687	5,631	5,576	5,522	5,468	5,412	5,357	5,302
34	Hampton (West)	17,005	16,871	16,650	16,432	16,216	16,003	15,779	15,561	15,344
35	Hampton (Downtown)	9,460	9,461	9,463	9,466	9,468	9,471	9,473	9,476	9,478
36	Fox Corner	21,827	22,261	23,003	23,770	24,563	25,382	26,100	26,871	27,645
37	Chapel Village	16,171	16,441	16,900	17,372	17,858	18,357	18,804	19,278	19,754
38	Poquoson	12,097	12,378	12,860	13,361	13,882	14,423	14,887	15,391	15,898
39	Yorktown (Rt. 134 & Rt. 600)	19,264	19,717	20,496	21,306	22,149	23,024	23,773	24,589	25,407
40	Yorktown (West)	13,370	14,201	15,703	17,363	19,199	21,229	22,567	24,261	25,974
41	Greensprings-Plantation Heights	629	717	893	1,112	1,384	1,723	1,849	2,082	2,320
42	Skimino	3,019	3,357	4,007	4,783	5,710	6,816	7,326	8,138	8,965
43	Charleston Heights - York Terrace	7,052	7,365	7,917	8,512	9,151	9,837	10,348	10,950	11,557
44	Williamsburg	7,786	7,992	8,348	8,720	9,108	9,513	9,853	10,227	10,603
45	Williamsburg (Southeast - Forest Hill Park)	7,381	7,814	8,594	9,451	10,394	11,431	12,130	13,004	13,887
46	James Terrace - Grove	9,857	9,970	10,161	10,355	10,553	10,755	10,943	11,138	11,333
47	Jamestown - Hollybrook	17,065	17,302	17,704	18,115	18,535	18,966	19,358	19,771	20,184
48	Canterbury Hills - Jamestown Farms	28,078	30,688	35,588	41,270	47,859	55,501	59,555	65,439	71,415
49	Toano	13,967	15,840	19,538	24,098	29,723	36,662	39,366	44,199	49,138

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
50	Gloucester	19,404	20,181	21,548	23,006	24,564	26,226	27,500	28,975	30,462
51	Grassfield - Chesapeake Regional Apt.	15,475	16,656	18,829	21,286	24,063	27,203	29,076	31,600	34,156
52	Gent-Park Place	30,087	30,381	30,877	31,382	31,895	32,416	32,905	33,411	33,918
53	Huntersville (Hunter's Village)	15,920	15,963	16,034	16,106	16,178	16,251	16,322	16,394	16,466
54	Ocean View - Willoughby Beach	34,914	34,890	34,850	34,809	34,769	34,729	34,688	34,648	34,608
55	Sussex - Wards Corner	16,360	16,400	16,467	16,534	16,601	16,669	16,735	16,802	16,869
56	Thomas Corner	36,879	36,813	36,703	36,593	36,484	36,375	36,265	36,156	36,046
57	London Bridge	67,655	67,673	67,702	67,731	67,760	67,790	67,819	67,848	67,877
58	Nimmo-Woodhouse Corner	66,081	67,008	68,581	70,191	71,839	73,525	75,063	76,678	78,298
59	Westhaven Park	12,917	12,764	12,512	12,266	12,024	11,787	11,531	11,285	11,040
60	Hawthorne Drive, Chesapeake	20,986	21,186	21,522	21,864	22,211	22,563	22,895	23,237	23,580
61	Shenandoah Pkwy	27,222	28,939	32,046	35,485	39,294	43,512	46,273	49,785	53,336
62	St. Brides	14,009	14,590	15,614	16,709	17,881	19,135	20,087	21,196	22,312
63	Deer Park - Harpersville	14,857	15,421	16,409	17,460	18,579	19,769	20,694	21,757	22,827
64	Newport News/Williamsburg International Airport	36,409	37,375	39,040	40,780	42,598	44,496	46,089	47,841	49,602
65	Hampton (East)	38,334	38,005	37,463	36,929	36,402	35,883	35,334	34,800	34,268
66	504 E Mercury Blvd	16,654	16,911	17,349	17,797	18,258	18,730	19,157	19,607	20,059
67	Greenwood Farms	6,599	6,549	6,467	6,385	6,305	6,225	6,142	6,060	5,979
68	Drummonds Corner	10,786	10,937	11,194	11,457	11,727	12,002	12,253	12,517	12,782
69	Yorktown - Grafton	22,813	23,347	24,265	25,219	26,210	27,240	28,123	29,082	30,046
70	Pecan Gardens	65,992	66,395	67,072	67,757	68,448	69,147	69,818	70,503	71,190
71	Acredale	94,472	95,285	96,656	98,047	99,458	100,889	102,241	103,635	105,031
72	Woodhaven Shores - New Kent Co. Airport	10,517	11,125	12,153	13,194	14,237	15,282	16,331	17,351	18,390
73	Charles City	4,995	5,027	5,088	5,154	5,221	5,287	5,356	5,413	5,478
74	Swift Creek Resevoir	64,047	70,645	81,720	92,879	104,065	115,261	126,497	137,519	148,676

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
75	Chesterfield County Airport	77,015	84,949	98,267	111,685	125,135	138,598	152,110	165,364	178,780
76	East Highland Park	51,525	53,742	57,503	61,324	65,159	68,996	72,853	76,579	80,393
77	Church Hill	24,229	24,092	23,896	23,725	23,558	23,390	23,227	23,017	22,841
78	Ginter Park - Hotchkiss Field	32,739	32,553	32,289	32,058	31,832	31,605	31,384	31,101	30,863
79	Richmond (Downtown-West)	6,266	6,230	6,179	6,135	6,092	6,049	6,006	5,952	5,907
80	Richmond (The Fan District)	38,718	38,498	38,186	37,913	37,646	37,377	37,116	36,781	36,500
81	Richmond (West End)	18,099	17,996	17,850	17,722	17,597	17,472	17,350	17,193	17,062
82	Ashland	14,889	15,963	17,773	19,600	21,433	23,267	25,109	26,907	28,734
83	Goodallr-Farrington	16,451	17,638	19,637	21,656	23,681	25,708	27,743	29,729	31,747
84	Tuckahoe	98,624	102,867	110,067	117,380	124,719	132,064	139,447	146,579	153,880
85	Chester	34,243	37,770	43,692	49,658	55,638	61,624	67,632	73,525	79,490
86	Richmond (Southside)	86,293	85,803	85,107	84,499	83,903	83,304	82,722	81,976	81,349
87	Laurel	117,792	122,859	131,458	140,193	148,959	157,731	166,549	175,067	183,786
88	Powhatan (Rt. 60 & Dorset Rd.)	11,455	12,164	13,359	14,568	15,780	16,993	18,212	19,399	20,607
89	Sabot	10,313	11,196	12,681	14,178	15,679	17,182	18,690	20,167	21,664
90	Richmond International Apt. (Sandston)	33,390	34,826	37,264	39,740	42,225	44,711	47,211	49,625	52,097
91	Mechanicsville (Henry Clay Heights)	69,328	74,331	82,756	91,266	99,800	108,341	116,917	125,289	133,794
92	Sandston (Rt. 156 & Rt. 33)	13,600	14,185	15,178	16,187	17,199	18,212	19,230	20,213	21,220
93	Richmond (Downtown-East)	3,966	3,943	3,911	3,883	3,856	3,829	3,802	3,768	3,739
94	Meadowville - Cameron Hills	5,642	6,223	7,199	8,181	9,167	10,153	11,143	12,114	13,097
95	Robious & Hylton Park	97,106	107,110	123,902	140,820	157,779	174,754	191,790	208,502	225,418
96	Ethridge Estates	5,442	5,499	5,601	5,709	5,818	5,926	6,037	6,135	6,242
97	Fort Lee	15,682	15,846	16,140	16,451	16,764	17,078	17,395	17,679	17,987
98	Rt. 106 & Rt. 156	4,271	4,315	4,395	4,480	4,565	4,651	4,737	4,814	4,898
99	Petersburg (Dinwiddie County Airport - PTB)	11,130	11,203	11,340	11,489	11,639	11,790	11,943	12,073	12,219
100	Petersburg (Blandford)	2,894	2,913	2,948	2,987	3,026	3,065	3,105	3,139	3,177

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
101	Berkley Manor	3,703	3,728	3,773	3,822	3,873	3,923	3,974	4,017	4,066
102	Petersburg (Downtown)	7,945	7,997	8,095	8,201	8,308	8,416	8,525	8,618	8,722
103	Petersburg (Kennelworth)	6,971	7,016	7,102	7,195	7,289	7,383	7,479	7,561	7,652
104	Camelot	4,204	4,232	4,283	4,340	4,396	4,453	4,511	4,560	4,616
105	Petersburg (South)	6,257	6,298	6,375	6,458	6,543	6,627	6,713	6,786	6,869
106	Colonial Heights	12,649	12,732	12,888	13,056	13,227	13,399	13,572	13,720	13,887
107	Colonial Heights (East)	4,830	4,861	4,921	4,985	5,051	5,116	5,182	5,239	5,302
108	Ettrick (Amtrak Petersburg)	9,798	10,807	12,501	14,208	15,919	17,632	19,351	21,037	22,744
109	Hopewell	22,348	22,581	23,000	23,443	23,890	24,337	24,789	25,194	25,633
110	Matoaca	2,059	2,272	2,628	2,987	3,346	3,706	4,068	4,422	4,781
111	Screamersville	10,057	11,093	12,832	14,584	16,340	18,098	19,862	21,593	23,345
112	Pickadat Corner	16,344	18,027	20,853	23,701	26,555	29,412	32,280	35,092	37,939
113	Lake Chesdin Pkwy & Ivey Mill Rd.	7,547	8,324	9,629	10,944	12,262	13,581	14,905	16,204	17,518
118	Dinwiddie	8,652	8,709	8,815	8,931	9,048	9,165	9,284	9,385	9,498
119	Templeton	2,162	2,185	2,225	2,268	2,311	2,354	2,398	2,437	2,480
114	New Kent	16,668	16,745	16,900	17,074	17,253	17,434	17,620	17,761	17,933
115	Sherwood Forest - Rustic	11,034	11,085	11,188	11,303	11,421	11,541	11,664	11,758	11,872
116	Powhatan (Rt. 522 & Three Bridges Rd.)	16,864	16,943	17,099	17,275	17,456	17,639	17,827	17,970	18,144
117	Goochland	11,546	11,600	11,707	11,828	11,952	12,077	12,205	12,304	12,423
120	Dutton	17,482	17,564	17,726	17,909	18,096	18,286	18,481	18,629	18,810
121	Elkton	101,696	106,805	115,447	124,199	132,973	141,746	150,555	159,135	167,870
122	Bristol	49,144	49,592	50,398	51,252	52,111	52,965	53,829	54,611	55,454
123	Warwick	164,843	170,249	179,487	188,920	198,405	207,905	217,472	226,584	236,001
124	Providence	621,939	626,908	635,973	645,625	655,331	664,976	674,727	683,493	692,995
125	Newport	82,036	82,092	82,286	82,553	82,821	83,076	83,340	83,501	83,745
126	Wakefield-Westerly	119,972	123,769	130,263	136,896	143,566	150,246	156,974	163,377	169,998

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
127	Levittown	627,053	644,506	674,400	704,953	735,623	766,280	797,119	826,641	857,081
128	Norristown	808,460	819,872	839,956	860,875	881,930	902,963	924,199	943,808	964,572
129	Philadelphia	1,543,057	1,528,002	1,505,032	1,483,602	1,462,388	1,441,111	1,420,121	1,396,260	1,374,505
130	Springfield-Media	565,648	569,330	576,221	583,690	591,249	598,792	606,463	613,024	620,382
131	Downingtown-Exton	506,575	526,935	561,500	596,607	631,817	667,021	702,387	736,650	771,672
132	Hartford-Glastonbury	897,259	906,080	921,961	938,749	955,672	972,555	989,641	1,005,015	1,021,620
133	Norwich-New London	271,696	274,159	278,622	283,357	288,132	292,893	297,716	302,026	306,705
134	New Haven	859,960	867,413	880,957	895,357	909,876	924,348	939,002	952,075	966,294
135	Middletown	165,602	169,698	176,749	183,983	191,258	198,539	205,874	212,813	220,023
136	Bridgeport	915,683	924,495	940,377	957,177	974,107	990,991	1,008,076	1,023,450	1,040,060
137	Culpeper	47,911	48,135	48,579	49,080	49,593	50,113	50,647	51,054	51,549
138	Fredericksburg	152,991	153,706	155,124	156,722	158,364	160,021	161,729	163,028	164,608
139	Hague	17,524	17,606	17,768	17,951	18,139	18,329	18,525	18,674	18,855
140	Bowling Green	28,972	29,107	29,376	29,679	29,989	30,303	30,627	30,873	31,172
141	Tappahannock	11,233	11,285	11,390	11,507	11,627	11,749	11,875	11,970	12,086
142	Warsaw	9,059	9,101	9,185	9,280	9,377	9,475	9,576	9,653	9,747
143	Heathsville	12,346	12,404	12,518	12,647	12,780	12,913	13,051	13,156	13,283
144	Mattaponi	7,046	7,079	7,144	7,218	7,293	7,370	7,448	7,508	7,581
145	King William	15,981	16,056	16,204	16,371	16,542	16,715	16,894	17,029	17,194
146	Irvington	11,236	11,288	11,393	11,510	11,631	11,752	11,878	11,973	12,089
147	Topping-Deltaville	10,822	10,873	10,973	11,086	11,202	11,319	11,440	11,532	11,644
148	Foster	8,884	8,925	9,008	9,101	9,196	9,292	9,391	9,467	9,559
149	Surry	6,844	6,876	6,939	7,011	7,084	7,158	7,235	7,293	7,364
150	Lunenburg	12,588	12,647	12,764	12,895	13,030	13,166	13,307	13,414	13,544
151	Waverly	11,972	12,028	12,139	12,264	12,392	12,522	12,656	12,757	12,881
152	Lawrenceville	17,010	17,089	17,247	17,425	17,607	17,792	17,981	18,126	18,302
153	Franklin	26,937	27,063	27,313	27,594	27,883	28,175	28,475	28,704	28,982

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
154	Emporia	17,591	17,673	17,836	18,020	18,209	18,399	18,596	18,745	18,927
155	South Mill	31,749	31,897	32,192	32,523	32,864	33,208	33,562	33,832	34,160
156	Wilmington	546,076	553,489	566,564	580,200	593,931	607,645	621,496	634,250	647,783
157	Plymouth-Kingston	474,183	491,653	521,434	551,795	582,321	612,906	643,700	673,099	703,422
158	Taunton	545,999	557,844	578,312	599,368	620,539	641,715	663,053	683,174	704,140
159	Hempstead	1,349,233	1,359,561	1,378,534	1,398,844	1,419,331	1,439,738	1,460,423	1,478,665	1,498,685
160	Brooklyn	2,563,258	2,608,789	2,688,057	2,770,016	2,852,454	2,934,858	3,017,957	3,095,670	3,177,169
161	Yonkers-New Rochelle	931,309	941,266	959,080	977,833	996,725	1,015,574	1,034,633	1,051,924	1,070,487
162	Bronx	1,408,473	1,431,650	1,472,135	1,514,087	1,556,292	1,598,471	1,641,019	1,680,661	1,722,354
163	New York City	1,619,090	1,625,895	1,639,341	1,654,358	1,669,556	1,684,634	1,700,009	1,712,613	1,727,263
164	Staten Island	470,728	490,261	523,451	557,202	591,103	625,048	659,191	692,026	725,731
165	Queens	2,272,771	2,297,336	2,341,253	2,387,463	2,434,011	2,480,457	2,527,417	2,570,057	2,615,804
166	Carmel	99,607	104,188	111,957	119,849	127,773	135,710	143,691	151,383	159,265
167	Spring Valley	317,757	324,611	336,455	348,639	360,890	373,142	385,488	397,132	409,263
168	Dunn	122,135	128,746	139,929	151,260	162,634	174,020	185,463	196,551	207,872
169	Fayetteville	324,049	331,974	345,571	359,475	373,412	387,322	401,307	414,746	428,578
170	Greenville	172,554	183,235	201,278	219,548	237,894	256,271	274,744	292,633	310,899
171	Gatesville	11,869	12,123	12,564	13,018	13,476	13,936	14,400	14,831	15,284
172	Camden	10,090	10,680	11,672	12,672	13,669	14,663	15,659	16,650	17,645
173	Currituck	24,077	25,547	28,017	30,500	32,980	35,450	37,923	40,391	42,866
174	King	46,783	48,337	50,989	53,694	56,412	59,131	61,868	64,488	67,187
175	Jackson	21,428	21,397	21,370	21,359	21,344	21,325	21,305	21,273	21,254
176	Ahoskie	24,438	24,324	24,180	24,075	23,986	23,907	23,843	23,667	23,564
177	Warrenton	20,576	21,006	21,748	22,509	23,270	24,030	24,794	25,526	26,282
178	Henderson	45,132	45,650	46,564	47,516	48,468	49,412	50,362	51,259	52,198
179	Oxford	60,436	62,409	65,772	69,197	72,632	76,067	79,517	82,846	86,260
180	Rosemary	54,006	54,377	55,055	55,775	56,494	57,202	57,915	58,576	59,280

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
181	Elizabeth City	40,591	41,801	43,869	45,981	48,102	50,223	52,357	54,400	56,506
182	Hertford	13,563	13,973	14,675	15,391	16,109	16,829	17,551	18,244	18,958
183	Edenton	14,772	14,908	15,158	15,429	15,707	15,988	16,276	16,512	16,782
184	Yadkinville	38,084	38,907	40,329	41,791	43,261	44,730	46,211	47,609	49,065
185	Franklinton	61,475	64,944	70,809	76,751	82,714	88,685	94,686	100,502	106,439
186	Winston-Salem	358,137	369,671	389,371	409,475	429,668	449,876	470,211	489,668	509,721
187	Greensboro	500,879	508,554	522,003	535,967	550,015	564,050	578,210	591,366	605,235
188	Burlington	153,920	158,178	165,478	172,948	180,452	187,960	195,520	202,719	210,165
189	Chapel Hill	137,941	147,239	162,930	178,807	194,746	210,712	226,754	242,321	258,194
190	Durham	279,641	294,937	320,807	347,020	373,330	399,672	426,143	451,794	477,984
191	Rocky Mount	95,708	98,625	103,604	108,679	113,769	118,855	123,967	128,894	133,950
192	Tarboro	55,954	56,247	56,796	57,388	57,978	58,557	59,139	59,671	60,247
193	Raleigh	952,151	1,019,686	1,133,599	1,248,823	1,364,502	1,480,387	1,596,834	1,709,855	1,825,071
194	Mocksville	41,433	43,189	46,172	49,203	52,248	55,296	58,361	61,313	64,340
195	Lexington	163,260	168,232	176,734	185,419	194,143	202,873	211,658	220,051	228,712
196	Manteo	34,573	35,602	37,361	39,157	40,961	42,765	44,580	46,318	48,109
197	Asheboro	142,466	145,107	149,697	154,436	159,201	163,964	168,766	173,270	177,983
198	Siler City	65,976	70,418	77,913	85,498	93,111	100,737	108,401	115,837	123,419
199	Wilson	81,867	83,161	85,410	87,731	90,054	92,366	94,691	96,908	99,207
200	Salisbury	138,180	142,107	148,806	155,629	162,460	169,273	176,115	182,757	189,546
201	Smithfield	174,938	187,273	208,082	229,130	250,262	271,431	292,702	313,347	334,394
202	Lincolnton	79,313	82,956	89,128	95,390	101,671	107,955	114,268	120,388	126,639
203	Charlotte	969,031	1,028,333	1,128,528	1,230,001	1,331,885	1,433,935	1,536,500	1,635,849	1,737,282
204	Concord	184,498	199,744	225,448	251,446	277,567	303,754	330,080	355,567	381,582
205	Gastonia	208,049	213,785	223,576	233,550	243,533	253,490	263,487	273,193	283,115
206	Monroe	208,520	224,524	251,519	278,832	306,268	333,771	361,417	388,184	415,507
207	Hickory	154,339	158,641	165,984	173,462	180,949	188,416	195,914	203,193	210,634

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
208	Southern Pines	90,302	94,082	100,497	107,013	113,552	120,092	126,666	133,022	139,525
209	Raeford-Silver City	50,536	53,308	57,995	62,745	67,512	72,285	77,081	81,729	86,475
210	Sanford	59,715	62,177	66,358	70,605	74,865	79,127	83,411	87,553	91,791
211	Sussex	147,442	153,385	163,490	173,770	184,095	194,433	204,834	214,828	225,092
212	Paterson	502,885	505,269	509,896	515,013	520,187	525,326	530,559	534,923	539,927
213	Paramus	918,888	922,012	928,411	935,698	943,083	950,397	957,875	963,801	970,877
214	Phillipsburg	107,653	110,912	116,489	122,186	127,911	133,640	139,408	144,910	150,593
215	Parsippany Troy Hills	497,999	507,517	524,039	541,088	558,234	575,376	592,658	608,873	625,835
216	Newark	787,744	786,083	784,331	783,313	782,358	781,320	780,396	778,265	777,053
217	Jersey City-Hoboken	647,578	651,560	659,038	667,151	675,345	683,496	691,774	698,908	706,879
218	Flemington	127,050	131,997	140,414	148,980	157,585	166,201	174,867	183,190	191,743
219	Bridgewater-Somerville	327,707	338,615	357,233	376,227	395,309	414,409	433,632	452,020	470,971
220	Elizabeth	543,976	546,177	550,552	555,454	560,417	565,338	570,360	574,452	579,231
221	New Brunswick	811,493	833,235	870,554	908,768	947,173	985,601	1,024,296	1,061,076	1,099,168
222	Trenton	368,303	375,407	387,734	400,451	413,240	426,026	438,916	451,016	463,669
223	Willingboro	449,199	459,083	476,141	493,667	511,274	528,870	546,589	563,382	580,825
224	Camden	515,676	520,447	529,085	538,251	547,502	556,737	566,095	574,430	583,496
225	Woodbury	289,586	301,020	320,439	340,167	359,953	379,735	399,611	418,857	438,536
226	Penns Grove-Carneys Point	65,774	66,741	68,439	70,205	71,981	73,757	75,549	77,208	78,962
227	Lawrence	725,139	740,500	767,062	794,401	821,890	849,382	877,087	903,192	930,410
228	Cambridge - Burlington	1,537,215	1,546,416	1,563,678	1,582,360	1,601,150	1,619,763	1,638,611	1,655,166	1,673,462
229	Worcester	806,163	824,054	854,946	886,709	918,645	950,592	982,783	1,013,157	1,044,790
230	Boston	743,661	747,958	756,050	764,828	773,657	782,399	791,253	799,005	807,596
231	Quincy	651,798	659,980	674,455	689,572	704,775	719,935	735,235	749,361	764,339
232	Alexandria (Old Town)	58,564	59,435	60,915	62,433	63,988	65,458	67,339	68,731	70,337
233	Metro-Ballston Station	176,033	179,159	185,194	187,293	189,311	189,401	189,421	193,225	193,637
234	Downtown	36,530	36,986	37,449	37,828	39,894	43,510	46,042	46,838	49,447
235	Johns Hopkins Hospital	281,854	285,367	288,943	291,869	292,044	291,676	292,580	294,857	295,129

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
236	Brooklyn Manor	14,252	14,429	14,610	14,758	14,579	14,511	14,472	14,533	14,446
237	South Baltimore - Locust Point	8,976	9,087	9,201	9,294	9,262	9,478	9,606	9,660	9,761
238	Druid Hill Park - Mondawmin Mall	279,731	283,217	286,766	289,670	291,123	292,347	294,431	297,019	298,570
239	The National Mall	12,212	13,546	14,472	16,586	17,894	19,490	20,263	22,037	23,502
240	Capitol Hill - Union Station	80,082	84,409	91,922	108,280	111,229	114,853	119,414	129,694	135,154
241	Washington Hospital Center	77,210	82,648	88,782	95,622	100,236	105,873	110,087	116,517	121,624
242	Wesley Heights	78,771	79,885	82,316	83,377	84,869	86,676	90,123	91,118	93,019
243	Brightwood	43,119	43,768	46,556	47,061	47,594	48,246	50,168	50,993	51,652
244	Congress Heights	85,572	86,898	94,515	97,607	100,408	103,758	107,890	112,062	114,900
245	Capital View	61,554	63,750	66,415	67,420	71,287	75,968	78,994	81,514	85,090
246	Chevy Chase	26,880	26,999	27,071	27,650	28,083	28,612	29,745	29,906	30,610
247	Downtown DC	36,792	37,322	40,303	42,151	42,707	43,381	45,094	46,692	47,533
248	Logan Circle	130,130	133,939	139,897	143,125	145,051	147,356	153,219	155,835	158,642
249	Pentagon	45,012	46,572	51,571	53,806	54,611	54,977	56,817	59,283	59,973
250	Landmark - Van Dorn	87,730	89,075	91,364	93,712	96,120	100,583	103,841	106,171	109,520
251	Prince Frederick	89,628	92,385	96,165	98,847	100,616	102,414	104,238	107,089	108,821
252	Westminster	108,838	112,303	118,051	122,753	127,675	132,172	136,758	141,908	146,466
253	Eldersburg	58,379	59,681	61,408	62,979	64,842	65,858	66,895	68,739	70,062
254	Charlotte Hall (Peninsula) - Hughesville	29,469	31,274	34,260	36,569	37,903	39,250	40,608	42,941	44,275
255	Waldorf	87,506	93,964	104,679	115,494	122,942	130,420	137,932	148,023	155,733
256	Marbury-Pomonkey	33,617	34,838	36,841	38,891	40,705	42,524	44,347	46,332	48,171
257	Lexington Park	108,987	116,748	128,501	139,413	149,634	160,662	172,516	183,133	193,993
258	Bethesda	112,391	119,948	122,699	124,956	124,974	125,325	125,386	127,390	127,631
259	Silver Spring	84,989	91,045	92,678	92,616	92,297	91,817	92,785	92,786	92,553
260	Wheaton	178,431	181,481	187,692	188,863	189,547	190,176	190,849	193,599	193,733
261	Rockville	114,714	121,284	138,660	150,311	158,150	165,132	170,893	184,268	190,912

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
262	Potomac	73,667	74,169	74,253	74,687	74,965	76,058	76,887	77,098	77,850
263	Gaithersburg - Germantown	208,580	213,223	224,180	241,222	258,740	268,592	273,984	292,112	304,585
264	Olney	137,219	137,353	139,544	139,927	140,267	139,404	138,933	140,020	139,536
265	Damascus-Clarksburg	42,886	49,458	57,695	62,385	63,788	64,688	64,310	70,051	70,665
266	Dawsonville	50,158	50,126	50,220	50,033	50,215	50,603	50,611	50,677	50,833
267	Hyattsville (Chillum)	71,025	70,991	70,693	71,261	71,984	72,589	72,950	73,366	74,044
268	College Park	82,834	85,364	88,659	91,792	95,180	97,522	98,793	102,598	105,062
269	Hyattsville (Edmonston)	31,410	31,418	32,517	33,845	34,080	34,228	34,188	35,301	35,536
270	Lanham (Landover Hills)	41,563	41,355	42,761	43,343	44,009	44,201	44,151	45,200	45,426
271	Fairmount Heights	25,019	24,897	25,144	25,482	25,707	25,854	25,834	26,190	26,346
272	Glenarden	25,881	26,198	26,400	26,503	26,957	27,283	27,311	27,642	27,912
273	District Heights	47,770	47,683	47,938	48,102	48,003	48,052	48,019	48,159	48,136
274	Marlow Heights	85,530	85,506	86,453	87,746	88,407	89,011	89,035	90,291	90,857
275	Upper Marlboro	55,761	58,654	64,352	69,912	75,097	78,961	81,799	87,936	92,087
276	Beltsville	92,591	94,170	96,207	97,019	97,604	99,002	100,475	101,462	102,432
277	NASA Goddard Space Flight Center	34,961	35,185	35,241	35,183	35,668	35,957	36,014	36,219	36,481
278	Bowie	63,263	63,819	64,136	64,243	65,247	66,142	66,548	67,089	67,825
279	Woodmore	52,432	52,780	54,120	55,543	56,237	56,919	57,093	58,514	59,134
280	Cheltenham	59,447	61,384	63,686	64,849	67,493	70,240	71,108	73,553	75,574
281	Fort Washington	113,326	119,565	125,785	130,028	134,275	137,986	140,763	146,084	149,562
282	Severn	41,995	42,457	43,286	44,070	44,568	45,052	45,052	45,958	46,343
283	Odenton	28,487	29,092	29,906	30,617	31,966	32,255	32,255	33,437	34,025
284	Crofton	43,909	45,748	46,290	46,440	46,800	47,310	47,310	47,773	48,040
285	Crownsville	20,992	21,230	21,621	21,951	21,984	22,187	22,187	22,512	22,611
286	Davidsonville	13,647	13,665	13,738	13,758	13,759	13,907	13,907	13,961	14,010
287	Galesville	63,466	63,714	64,324	64,908	65,430	66,145	66,145	66,924	67,388
288	Riviera Beach	70,030	71,307	72,895	74,677	75,802	76,625	76,625	78,546	79,354

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
290	Pasadena (Millersville)	67,459	68,022	69,163	69,917	70,196	70,961	70,961	71,907	72,280
291	Linthicum Heights	23,495	24,233	24,601	25,090	25,360	25,615	25,615	26,108	26,334
292	Glenmore	48,740	48,922	49,527	50,205	50,481	51,033	51,033	51,735	52,076
293	Baltimore Washington International Airport	18	18	18	19	19	19	19	19	19
294	Fort Meade-Patuxent Research Refuge	26,050	26,376	26,852	27,353	28,289	28,623	28,623	29,435	29,902
295	Hanover	13,676	14,834	16,842	18,111	19,794	20,103	20,103	22,079	22,752
296	Edgewood	85,793	89,129	92,615	93,877	94,475	95,386	102,361	102,148	104,213
297	Bel Air	104,027	107,469	110,631	110,953	110,407	110,013	117,461	115,912	117,116
298	Aberdeen	58,802	61,646	65,340	67,927	70,192	72,485	77,091	79,206	81,952
299	Catonsville - Halethorpe	112,718	113,462	115,037	116,519	117,318	117,737	120,124	120,921	122,008
300	Randallstown	124,361	125,921	127,631	129,099	129,844	130,323	135,301	135,258	136,965
301	Reisterstown	65,274	67,385	68,315	69,130	69,609	69,863	75,786	74,727	76,467
302	Brooklandville	58,488	58,928	59,677	60,338	60,638	60,870	63,581	63,386	64,266
303	Towson	160,230	161,999	164,547	166,315	167,157	167,732	171,755	172,502	174,002
304	Hereford	33,311	33,679	34,313	34,793	35,093	35,227	36,808	36,854	37,403
305	Perry Hall	62,016	63,062	64,152	64,976	65,496	65,745	69,578	69,290	70,514
306	Rosedale-Rossville	201,056	203,636	206,662	209,043	210,278	211,077	217,127	217,831	220,092
307	Frederick	170,776	180,674	196,977	213,972	237,983	264,266	293,028	309,915	335,504
308	Thurmont	68,806	71,906	76,893	81,312	85,330	89,729	94,542	98,856	103,167
309	Sterling	156,548	161,350	171,007	178,296	181,369	183,384	186,121	193,327	195,960
310	Ashburn South	65,444	77,485	106,791	127,026	133,657	137,494	139,891	161,467	165,969
311	Leesburg	80,504	84,449	97,195	107,273	115,530	120,649	122,327	134,705	140,063
312	Purcellville	34,402	36,664	43,505	51,161	55,473	59,375	61,732	69,045	73,047
313	Herndon - Reston	181,731	187,662	196,953	205,374	212,393	217,619	224,128	232,490	238,743
314	Centreville	166,837	172,379	185,568	198,180	208,731	216,409	223,508	236,668	245,427
315	Fairfax	147,772	149,352	151,354	152,628	153,799	155,276	159,883	160,274	162,320

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
316	Vienna	96,854	102,091	105,503	108,299	110,697	112,544	117,223	119,311	122,028
317	Seven Corners	115,458	117,566	121,048	124,294	127,182	129,360	133,540	136,268	139,217
318	Springfield	155,228	157,722	162,401	166,322	169,543	172,110	178,755	181,560	185,348
319	Huntington	206,289	213,315	223,607	232,807	240,590	246,513	254,843	263,693	270,922
320	McLean	69,921	73,087	77,326	81,039	84,205	86,574	90,754	94,089	97,197
321	Great Falls	15,202	15,304	15,492	15,678	15,833	15,946	17,181	16,996	17,401
322	Warrenton	66,542	72,435	83,452	96,156	110,805	127,685	147,136	158,364	175,037
323	Dale City	250,649	263,858	280,288	293,796	306,016	315,908	323,713	339,099	349,173
324	Manassas	134,018	138,917	149,154	157,262	164,373	170,732	176,368	185,378	191,691
325	Haymarket	102,025	109,547	120,418	130,941	138,924	145,756	151,346	162,121	169,241
326	Stafford	134,352	147,866	167,501	187,129	206,280	225,429	246,358	265,299	284,915
327	200-KGC01-King George	24,500	26,071	29,427	32,780	36,176	39,569	43,283	46,539	50,009
328	Columbia	103,346	103,371	102,497	101,628	102,025	102,025	102,025	101,487	101,563
329	Ellicott City	65,393	66,141	68,800	68,727	68,727	68,730	68,730	69,583	69,276
330	Elkridge	41,868	44,817	49,076	50,050	50,722	50,722	50,722	52,865	52,789
331	Peninsula Laurel-Savage	39,503	40,827	43,439	47,349	49,672	51,164	51,164	54,987	56,697
332	Clarksville	18,359	20,176	21,054	21,433	22,490	23,099	23,099	24,073	24,612
333	Cooksville	30,961	32,725	34,428	35,565	36,881	38,305	38,305	40,120	41,077

1.2 Study Area Employment Data and Forecasts

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
1	Norfolk (Downtown)	32,375	33,058	34,227	35,438	36,692	37,989	39,118	40,336	41,558
2	Lamberts Point - Colonial Place	7,841	7,860	7,891	7,922	7,953	7,985	8,015	8,047	8,078
3	Fairmount Park - Lafayette Annex	2,790	2,808	2,838	2,869	2,900	2,931	2,961	2,992	3,023
4	Glenwood Park	65,593	64,647	63,100	61,589	60,115	58,677	57,095	55,589	54,087
5	Norfolk International Airport	11,420	11,492	11,613	11,735	11,859	11,983	12,103	12,225	12,347
6	Virginia Beach	28,511	28,850	29,425	30,011	30,609	31,219	31,783	32,371	32,961
7	Chinese Corner	57,429	57,883	58,649	59,425	60,211	61,008	61,764	62,542	63,320
8	Oceana Naval Air Station	24,729	24,691	24,628	24,565	24,502	24,439	24,375	24,312	24,249
9	Berkley - Campostella	6,545	6,378	6,109	5,852	5,605	5,369	5,089	4,833	4,578
10	Portsmouth	33,173	33,061	32,876	32,691	32,508	32,326	32,139	31,955	31,771
11	Victory Park	9,673	9,521	9,273	9,032	8,797	8,568	8,314	8,074	7,834
12	Arostead Forest - Craney Island	6,053	6,207	6,474	6,752	7,042	7,345	7,600	7,880	8,162
13	Bowers Hill	6,845	7,129	7,629	8,165	8,738	9,351	9,816	10,358	10,904
14	Boone	13,095	13,558	14,366	15,222	16,130	17,091	17,851	18,716	19,587
15	Loxley Gardens - Geneva Park	6,671	6,724	6,813	6,903	6,995	7,087	7,175	7,266	7,356
16	South Norfolk	8,989	9,256	9,719	10,205	10,716	11,252	11,692	12,183	12,676
17	1200 Battlefield Blvd N	10,742	11,028	11,521	12,037	12,576	13,139	13,610	14,130	14,652
18	910 Great Bridge Blvd	5,735	5,908	6,207	6,521	6,851	7,198	7,482	7,799	8,118
19	Chesapeake	14,258	15,320	17,267	19,461	21,934	24,722	26,409	28,660	30,941
20	Bennett Corner	9,417	10,957	14,102	18,151	23,362	30,068	32,126	36,498	40,985
21	Suffolk	18,802	19,703	21,303	23,032	24,902	26,923	28,391	30,145	31,915
22	Holland	1,090	1,097	1,107	1,117	1,128	1,139	1,149	1,160	1,170
23	Kings Fork	6,774	7,945	10,363	13,517	17,631	22,997	24,514	27,942	31,465
24	Smithfield	11,288	12,014	13,329	14,789	16,408	18,204	19,370	20,861	22,369
25	Zuni	4,865	5,434	6,534	7,857	9,448	11,361	12,212	13,600	15,015

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
26	Newport News (Downtown South)	8,188	8,508	9,070	9,670	10,309	10,990	11,516	12,122	12,733
27	Newport News Amtrak Station	3,210	3,175	3,118	3,062	3,007	2,952	2,894	2,838	2,782
28	Newport News (Downtown Peninsula)	22,867	23,011	23,253	23,498	23,745	23,995	24,235	24,480	24,725
29	Newport News (Reed)	1,426	1,425	1,423	1,421	1,420	1,418	1,416	1,414	1,413
30	Glendale - Beaconsville	16,646	16,586	16,485	16,386	16,286	16,188	16,087	15,987	15,888
31	Charles	2,305	2,406	2,584	2,775	2,980	3,201	3,366	3,559	3,755
32	Sunsan Constant Dr	5,548	5,671	5,883	6,102	6,329	6,565	6,769	6,989	7,210
33	2 Shore Park Dr	11,205	10,860	10,309	9,786	9,290	8,819	8,242	7,722	7,205
34	Hampton (West)	12,322	12,392	12,511	12,631	12,751	12,873	12,991	13,110	13,230
35	Hampton (Downtown)	6,675	6,726	6,811	6,898	6,986	7,075	7,160	7,247	7,334
36	Fox Corner	5,015	5,049	5,106	5,163	5,221	5,280	5,336	5,394	5,452
37	Chapel Village	11,904	12,019	12,214	12,412	12,614	12,818	13,010	13,208	13,407
38	Poquoson	3,342	3,419	3,550	3,686	3,827	3,974	4,101	4,238	4,375
39	Yorktown (Rt. 134 & Rt. 600)	2,719	2,801	2,943	3,092	3,249	3,414	3,548	3,699	3,850
40	Yorktown (West)	9,020	9,315	9,828	10,369	10,940	11,542	12,027	12,574	13,123
41	Greensprings-Plantation Heights	4,034	4,119	4,264	4,414	4,570	4,732	4,872	5,023	5,175
42	Skimino	2,579	2,926	3,610	4,453	5,494	6,779	7,279	8,173	9,087
43	Charleston Heights - York Terrace	6,194	6,630	7,426	8,317	9,316	10,434	11,130	12,043	12,967
44	Williamsburg	19,215	19,233	19,263	19,293	19,322	19,352	19,382	19,411	19,441
45	Williamsburg (Southeast - Forest Hill Park)	6,031	6,449	7,210	8,062	9,015	10,080	10,748	11,620	12,503
46	James Terrace - Grove	12,906	13,653	14,996	16,471	18,091	19,871	21,078	22,581	24,099
47	Jamestown - Hollybrook	3,866	3,917	4,004	4,092	4,182	4,275	4,359	4,448	4,537
48	Canterbury Hills - Jamestown Farms	12,631	13,286	14,455	15,727	17,110	18,616	19,680	20,972	22,277
49	Toano	3,809	4,400	5,595	7,114	9,046	11,502	12,311	13,943	15,615
50	Gloucester	14,798	15,382	16,407	17,500	18,667	19,911	20,867	21,973	23,087

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
51	Grassfield - Chesapeake Regional Apt.	3,189	3,838	5,226	7,116	9,690	13,196	13,938	16,039	18,206
52	Gent-Park Place	21,559	21,682	21,888	22,096	22,307	22,519	22,723	22,932	23,141
53	Huntersville (Hunter's Village)	3,590	3,598	3,613	3,627	3,641	3,656	3,670	3,684	3,699
54	Ocean View - Willoughby Beach	2,675	2,670	2,662	2,654	2,646	2,638	2,630	2,622	2,614
55	Sussex - Wards Corner	6,868	6,873	6,883	6,892	6,902	6,911	6,921	6,930	6,940
56	Thomas Corner	48,781	49,002	49,371	49,744	50,119	50,497	50,864	51,237	51,610
57	London Bridge	40,844	41,765	43,346	44,987	46,690	48,458	49,980	51,631	53,289
58	Nimmo-Woodhouse Corner	16,622	17,088	17,894	18,738	19,622	20,547	21,316	22,166	23,021
59	Westhaven Park	8,317	8,136	7,844	7,563	7,291	7,029	6,727	6,447	6,167
60	Hawthorne Drive, Chesapeake	16,899	16,993	17,152	17,312	17,473	17,636	17,793	17,953	18,114
61	Shenandoah Pkwy	33,346	34,328	36,031	37,818	39,694	41,662	43,281	45,083	46,894
62	St. Brides	5,400	5,672	6,156	6,681	7,251	7,870	8,312	8,845	9,383
63	Deer Park - Harpersville	23,553	24,310	25,626	27,014	28,476	30,018	31,264	32,664	34,072
64	Newport News/Williamsburg International Airport	21,458	22,233	23,588	25,024	26,549	28,166	29,438	30,890	32,351
65	Hampton (East)	7,385	7,361	7,319	7,278	7,238	7,197	7,156	7,115	7,074
66	504 E Mercury Blvd	8,214	8,248	8,304	8,361	8,418	8,475	8,531	8,588	8,644
67	Greenwood Farms	1,734	1,730	1,722	1,714	1,706	1,698	1,690	1,682	1,674
68	Drummonds Corner	24,391	24,435	24,510	24,585	24,660	24,735	24,810	24,885	24,960
69	Yorktown - Grafton	9,309	9,525	9,896	10,281	10,681	11,097	11,454	11,841	12,230
70	Pecan Gardens	52,096	52,731	53,808	54,907	56,028	57,172	58,228	59,330	60,434
71	Acredale	21,691	21,729	21,791	21,854	21,917	21,980	22,042	22,105	22,168
72	Woodhaven Shores - New Kent Co. Airport	5,655	5,895	6,307	6,712	7,116	7,518	7,912	8,305	8,717
73	Charles City	2,555	2,717	3,011	3,334	3,689	4,076	4,505	4,741	5,091
74	Swift Creek Resevoir	14,597	15,934	18,406	21,211	24,385	27,964	31,992	33,818	36,932
75	Chesterfield County Airport	31,231	34,092	39,382	45,384	52,175	59,833	68,450	72,358	79,020

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
76	East Highland Park	13,618	14,536	16,174	17,954	19,882	21,965	24,213	25,578	27,485
77	Church Hill	2,611	2,624	2,648	2,678	2,719	2,774	2,844	2,843	2,886
78	Ginter Park - Hotchkiss Field	11,695	11,750	11,856	11,995	12,179	12,421	12,737	12,733	12,926
79	Richmond (Downtown-West)	31,458	31,605	31,892	32,265	32,759	33,412	34,261	34,249	34,770
80	Richmond (The Fan District)	36,987	37,160	37,498	37,936	38,517	39,285	40,283	40,269	40,881
81	Richmond (West End)	8,707	8,747	8,827	8,930	9,067	9,247	9,482	9,479	9,623
82	Ashland	7,606	7,926	8,461	8,995	9,525	10,048	10,561	11,092	11,625
83	Goodallr-Farrington	2,277	2,373	2,533	2,693	2,852	3,008	3,162	3,321	3,480
84	Tuckahoe	77,134	82,333	91,612	101,692	112,611	124,413	137,147	144,879	155,676
85	Chester	21,971	23,984	27,705	31,928	36,705	42,093	48,155	50,905	55,591
86	Richmond (Southside)	38,960	39,142	39,498	39,959	40,571	41,380	42,431	42,417	43,062
87	Laurel	97,087	103,632	115,310	127,998	141,742	156,598	172,625	182,358	195,947
88	Powhatan (Rt. 60 & Dorset Rd.)	10,252	10,629	11,237	11,816	12,365	12,872	13,335	13,961	14,530
89	Sabot	20,043	21,633	24,530	27,764	31,365	35,365	39,796	42,039	45,585
90	Richmond International Apt. (Sandston)	21,592	23,048	25,645	28,467	31,523	34,827	38,392	40,556	43,579
91	Mechanicsville (Henry Clay Heights)	50,112	52,222	55,747	59,269	62,761	66,206	69,588	73,083	76,599
92	Sandston (Rt. 156 & Rt. 33)	4,374	4,669	5,195	5,766	6,385	7,055	7,777	8,215	8,827
93	Richmond (Downtown-East)	36,568	36,739	37,073	37,506	38,080	38,840	39,826	39,813	40,418
94	Meadowville - Cameron Hills	21,549	23,523	27,173	31,315	36,000	41,284	47,230	49,927	54,523
95	Robious & Hylton Park	82,207	89,738	103,660	119,459	137,334	157,491	180,173	190,461	207,997
96	Ethridge Estates	3,163	3,224	3,336	3,460	3,599	3,755	3,929	4,012	4,150
97	Fort Lee	7,513	7,660	7,926	8,220	8,550	8,919	9,335	9,530	9,860
98	Rt. 106 & Rt. 156	3,048	3,108	3,215	3,335	3,469	3,619	3,787	3,867	4,000
99	Petersburg (Dinwiddie County Airport - PTB)	5,975	6,079	6,252	6,424	6,595	6,765	6,936	7,097	7,273
100	Petersburg (Blandford)	1,421	1,445	1,487	1,527	1,568	1,609	1,649	1,688	1,729
101	Berkley Manor	1,494	1,520	1,563	1,606	1,649	1,691	1,734	1,774	1,818

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
102	Petersburg (Downtown)	5,949	6,053	6,225	6,396	6,567	6,736	6,906	7,067	7,242
103	Petersburg (Kennelworth)	1,809	1,841	1,893	1,945	1,997	2,048	2,100	2,149	2,202
104	Camelot	238	242	249	256	263	270	276	283	290
105	Petersburg (South)	4,371	4,447	4,573	4,699	4,824	4,949	5,074	5,192	5,321
106	Colonial Heights	4,733	4,815	4,952	5,088	5,224	5,359	5,494	5,622	5,761
107	Colonial Heights (East)	5,112	5,201	5,349	5,496	5,643	5,788	5,934	6,073	6,223
108	Ettrick (Amtrak Petersburg)	32,546	35,527	41,039	47,294	54,371	62,351	71,331	75,404	82,346
109	Hopewell	17,520	17,861	18,482	19,169	19,938	20,799	21,768	22,224	22,992
110	Matoaca	14,385	15,703	18,139	20,904	24,032	27,559	31,528	33,328	36,397
111	Screamersville	84,769	92,534	106,891	123,182	141,613	162,399	185,788	196,397	214,479
112	Pickadat Corner	38,149	41,644	48,105	55,436	63,731	73,085	83,611	88,385	96,523
113	Lake Chesdin Pkwy & Ivey Mill Rd.	1,707	1,863	2,153	2,481	2,852	3,270	3,741	3,955	4,319
118	Dinwiddie	7,752	7,887	8,111	8,334	8,557	8,777	8,999	9,208	9,437
119	Templeton	3,026	3,085	3,193	3,311	3,444	3,593	3,760	3,839	3,972
114	New Kent	5,655	5,895	6,307	6,712	7,116	7,518	7,912	8,305	8,717
115	Sherwood Forest - Rustic	2,555	2,717	3,011	3,334	3,689	4,076	4,505	4,741	5,091
116	Powhatan (Rt. 522 & Three Bridges Rd.)	10,252	10,629	11,237	11,816	12,365	12,872	13,335	13,961	14,530
117	Goochland	20,043	21,633	24,530	27,764	31,365	35,365	39,796	42,039	45,585
120	Dutton	14,680	15,546	17,069	18,675	20,360	22,117	23,930	25,292	26,968
121	Elkton	40,425	41,970	44,709	47,683	50,926	54,480	58,390	60,633	63,870
122	Bristol	22,361	23,022	24,186	25,429	26,762	28,175	29,680	30,722	32,047
123	Warwick	96,370	99,577	105,149	111,022	117,219	123,759	130,671	135,766	141,963
124	Providence	343,955	350,560	362,386	375,279	389,293	404,483	420,902	430,720	444,723
125	Newport	53,833	55,135	57,391	59,752	62,233	64,850	67,613	69,575	72,089
126	Wakefield-Westerly	75,747	79,360	85,807	92,830	100,509	108,907	118,122	123,490	131,107
127	Levittown	365,735	376,089	394,136	413,070	432,800	453,228	474,265	491,574	510,990
128	Norristown	607,136	625,456	657,386	690,896	725,817	761,954	799,122	829,260	863,816

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
129	Philadelphia	780,468	828,888	917,099	1,015,357	1,124,445	1,245,170	1,378,358	1,446,499	1,554,775
130	Springfield-Media	289,389	295,372	305,646	316,259	327,149	338,269	349,573	359,422	370,351
131	Downingtown-Exton	337,476	348,918	368,978	390,219	412,578	435,988	460,396	478,719	500,882
132	Hartford-Glastonbury	629,593	649,136	682,598	717,116	752,601	788,966	826,129	856,529	892,330
133	Norwich-New London	168,852	176,702	190,653	205,728	221,945	239,323	257,856	269,243	285,511
134	New Haven	483,124	495,871	518,599	543,286	570,048	598,990	630,217	649,145	675,827
135	Middletown	93,993	98,572	106,742	115,617	125,210	135,535	146,621	153,444	162,931
136	Bridgeport	609,378	620,455	639,330	658,735	678,664	699,091	719,997	738,638	758,658
137	Culpeper	21,907	23,127	25,291	27,644	30,210	33,010	36,078	37,884	40,406
138	Fredericksburg	77,947	82,883	91,668	101,194	111,497	122,618	134,587	142,040	152,179
139	Hague	6,259	6,505	6,928	7,356	7,792	8,236	8,683	9,099	9,528
140	Bowling Green	10,546	10,970	11,678	12,379	13,072	13,744	14,393	15,095	15,796
141	Tappahannock	5,605	5,739	5,939	6,122	6,285	6,424	6,541	6,786	6,947
142	Warsaw	4,003	4,051	4,129	4,209	4,291	4,375	4,461	4,552	4,626
143	Heathsville	4,592	4,732	4,980	5,245	5,523	5,811	6,110	6,347	6,614
144	Mattaponi	2,513	2,571	2,667	2,760	2,851	2,936	3,018	3,113	3,206
145	King William	5,030	5,111	5,240	5,361	5,467	5,568	5,652	5,791	5,905
146	Irvington	7,295	7,492	7,811	8,118	8,403	8,666	8,909	9,262	9,547
147	Topping-Deltaville	5,182	5,369	5,678	5,982	6,277	6,559	6,828	7,148	7,444
148	Foster	4,863	5,091	5,477	5,872	6,267	6,670	7,067	7,438	7,837
149	Surry	3,200	3,305	3,478	3,649	3,818	3,989	4,151	4,322	4,495
150	Lunenburg	4,149	4,251	4,401	4,558	4,705	4,843	4,974	5,145	5,290
151	Waverly	4,400	4,455	4,550	4,640	4,721	4,803	4,875	4,961	5,054
152	Lawrenceville	6,178	6,360	6,674	7,001	7,328	7,664	8,003	8,292	8,625
153	Franklin	11,729	12,032	12,548	13,075	13,615	14,172	14,746	15,220	15,766
154	Emporia	9,973	10,203	10,562	10,877	11,151	11,387	11,584	12,005	12,287
155	South Mill	16,707	17,048	17,663	18,349	19,113	19,959	20,894	21,425	22,152
156	Wilmington	348,757	361,731	384,839	410,021	437,575	467,826	501,148	519,806	547,311

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
157	Plymouth-Kingston	261,292	270,321	286,040	302,611	320,086	338,500	357,894	372,480	389,836
158	Taunton	271,133	277,670	289,290	301,870	315,490	330,220	346,140	356,374	369,648
159	Hempstead	819,105	837,327	868,665	901,213	934,956	969,885	1,005,980	1,035,506	1,069,662
160	Brooklyn	799,939	834,622	896,632	964,369	1,038,435	1,119,487	1,208,262	1,259,561	1,332,699
161	Yonkers-New Rochelle	572,029	586,189	610,355	635,227	660,823	687,137	714,148	736,854	762,966
162	Bronx	360,718	372,582	393,388	415,581	439,264	464,548	491,551	509,763	533,366
163	New York City	2,799,075	2,893,376	3,056,119	3,226,031	3,403,350	3,588,296	3,781,070	3,931,516	4,109,691
164	Staten Island	145,713	150,621	159,153	168,147	177,629	187,628	198,172	206,047	215,494
165	Queens	765,494	788,470	828,673	871,445	917,026	965,657	1,017,598	1,054,307	1,099,107
166	Carmel	40,573	42,211	45,078	48,122	51,357	54,801	58,473	60,996	64,243
167	Spring Valley	153,710	156,495	161,306	166,326	171,567	177,045	182,760	187,232	192,552
168	Dunn	42,409	44,997	49,647	54,735	60,298	66,370	72,997	76,803	82,284
169	Fayetteville	207,089	214,966	228,696	243,226	258,632	274,969	292,313	303,900	319,444
170	Greenville	89,350	95,589	106,863	119,314	133,044	148,151	164,753	173,392	187,102
171	Gatesville	2,543	2,615	2,731	2,840	2,948	3,043	3,130	3,244	3,356
172	Camden	3,922	4,076	4,339	4,608	4,878	5,148	5,411	5,678	5,942
173	Currituck	9,158	9,668	10,548	11,464	12,416	13,399	14,414	15,223	16,170
174	King	12,706	13,115	13,830	14,589	15,397	16,257	17,171	17,771	18,588
175	Jackson	7,261	7,541	8,034	8,562	9,122	9,716	10,347	10,756	11,321
176	Ahoskie	11,528	11,849	12,409	13,002	13,640	14,327	15,076	15,511	16,166
177	Warrenton	4,989	5,087	5,262	5,442	5,628	5,823	6,032	6,163	6,362
178	Henderson	18,647	19,183	20,116	21,112	22,171	23,309	24,535	25,372	26,410
179	Oxford	25,163	26,016	27,513	29,121	30,854	32,729	34,768	36,002	37,733
180	Rosemary	22,406	23,107	24,306	25,553	26,842	28,182	29,572	30,596	31,922
181	Elizabeth City	22,416	23,212	24,538	25,843	27,100	28,305	29,442	30,791	32,071
182	Hertford	3,805	3,895	4,046	4,202	4,364	4,527	4,695	4,839	4,998
183	Edenton	7,048	7,218	7,507	7,810	8,127	8,466	8,827	9,059	9,390
184	Yadkinville	13,993	14,522	15,425	16,376	17,366	18,393	19,468	20,271	21,271

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
185	Franklinton	22,641	23,790	25,919	28,373	31,211	34,521	38,398	39,881	42,649
186	Winston-Salem	223,313	233,742	252,206	272,087	293,462	316,389	340,919	356,324	377,704
187	Greensboro	332,239	342,702	360,764	379,640	399,373	420,003	441,585	457,774	477,565
188	Burlington	78,290	81,088	86,098	91,593	97,650	104,358	111,821	115,832	121,815
189	Chapel Hill	80,290	85,419	94,565	104,471	115,164	126,657	138,962	146,314	157,071
190	Durham	235,940	252,979	283,796	317,897	355,595	397,205	443,085	467,262	504,514
191	Rocky Mount	51,459	53,549	57,167	60,966	64,969	69,192	73,665	76,884	80,864
192	Tarboro	24,590	25,083	25,916	26,780	27,671	28,605	29,586	30,317	31,228
193	Raleigh	579,948	615,708	679,878	750,250	827,432	912,087	1,004,949	1,057,366	1,133,244
194	Mocksville	15,669	16,434	17,801	19,301	20,946	22,745	24,716	25,817	27,447
195	Lexington	72,150	74,960	80,014	85,585	91,728	98,519	106,036	110,145	116,171
196	Manteo	28,385	30,007	32,788	35,676	38,653	41,701	44,808	47,459	50,398
197	Asheboro	60,538	61,292	62,683	64,260	66,015	67,955	70,083	71,239	72,924
198	Siler City	37,029	39,636	44,414	49,780	55,808	62,562	70,127	73,727	79,656
199	Wilson	46,155	47,201	48,928	50,636	52,331	54,025	55,722	57,500	59,172
200	Salisbury	54,548	55,942	58,269	60,606	62,959	65,347	67,783	70,078	72,416
201	Smithfield	71,293	75,804	83,854	92,602	102,085	112,351	123,429	130,270	139,573
202	Lincolnton	25,769	26,776	28,544	30,449	32,506	34,725	37,121	38,635	40,658
203	Charlotte	708,403	757,342	845,801	943,506	1,051,225	1,169,797	1,300,110	1,370,405	1,476,672
204	Concord	90,984	95,794	104,377	113,706	123,826	134,775	146,613	153,677	163,711
205	Gastonia	93,408	95,525	99,351	103,608	108,345	113,637	119,537	122,482	127,162
206	Monroe	76,166	81,020	89,776	99,454	110,180	122,089	135,351	142,220	152,794
207	Hickory	95,027	97,094	100,498	103,850	107,154	110,425	113,666	116,977	120,355
208	Southern Pines	44,736	47,405	52,212	57,525	63,389	69,869	77,032	80,894	86,649
209	Raeford-Silver City	13,754	14,404	15,579	16,894	18,360	20,006	21,860	22,753	24,200
210	Sanford	33,134	34,287	36,298	38,421	40,670	43,074	45,648	47,470	49,673
211	Sussex	62,276	63,664	66,042	68,525	71,121	73,856	76,749	78,918	81,561
212	Paterson	229,683	232,264	236,786	241,615	246,789	252,346	258,327	262,484	267,539

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
213	Paramus	605,489	618,843	641,926	666,090	691,398	717,906	745,650	767,945	793,004
214	Phillipsburg	47,808	48,780	50,484	52,315	54,272	56,381	58,644	60,198	62,112
215	Parsippany Troy Hills	380,490	388,674	402,939	418,011	433,925	450,696	468,341	481,819	497,595
216	Newark	455,427	457,911	462,621	468,000	473,998	480,559	487,633	491,791	497,842
217	Jersey City-Hoboken	307,431	315,056	329,177	345,163	363,160	383,367	406,026	416,743	434,468
218	Flemington	77,174	79,557	83,819	88,504	93,664	99,377	105,703	109,152	114,306
219	Bridgewater-Somerville	224,877	233,590	249,457	267,208	287,125	309,520	334,777	347,194	366,817
220	Elizabeth	294,284	299,552	309,028	319,423	330,777	343,147	356,593	365,124	376,228
221	New Brunswick	500,535	511,675	531,265	552,216	574,602	598,488	623,954	642,325	664,312
222	Trenton	265,561	272,421	284,357	296,965	310,296	324,398	339,332	349,606	363,288
223	Willingboro	267,115	276,908	294,210	312,747	332,577	353,727	376,249	391,357	411,059
224	Camden	257,780	261,978	269,056	276,233	283,480	290,796	298,181	304,957	312,409
225	Woodbury	126,573	129,707	135,161	140,862	146,786	152,900	159,175	164,303	170,218
226	Penns Grove-Carneys Point	28,572	28,659	28,869	29,160	29,520	29,953	30,446	30,559	30,900
227	Lawrence	413,911	425,546	445,904	467,546	490,551	514,992	540,952	559,929	582,605
228	Cambridge - Burlington	1,097,473	1,137,380	1,206,816	1,280,060	1,357,285	1,438,656	1,524,336	1,589,070	1,665,527
229	Worcester	423,017	436,885	461,089	486,750	513,975	542,872	573,556	595,781	622,803
230	Boston	690,699	704,991	729,935	756,392	784,494	814,393	846,272	867,658	896,161
231	Quincy	433,786	452,887	486,728	523,257	562,713	605,349	651,441	680,988	719,981
232	Alexandria (Old Town)	52,531	51,420	56,227	58,635	61,929	64,102	63,170	67,583	70,130
233	Metro-Ballston Station	146,936	153,812	169,978	175,879	178,975	178,922	178,922	191,477	194,555
234	Downtown	144,406	145,724	147,174	147,994	148,172	148,172	151,012	151,270	152,002
235	Johns Hopkins Hospital	127,354	130,874	136,483	142,067	145,916	145,924	153,990	157,873	161,856
236	Brooklyn Manor	9,025	9,045	9,105	9,176	9,247	9,247	9,297	9,364	9,413
237	South Baltimore - Locust Point	7,775	7,743	7,724	7,713	7,705	7,705	7,641	7,643	7,628
238	Druid Hill Park - Mondawmin Mall	101,601	102,308	103,397	104,277	104,586	104,586	106,038	106,610	107,186
239	The National Mall	96,514	98,841	107,260	111,330	114,446	115,592	119,046	124,828	128,163

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
240	Capitol Hill - Union Station	137,170	145,364	176,077	176,880	183,002	184,782	190,145	205,932	211,418
241	Washington Hospital Center	55,780	56,978	57,422	67,061	70,245	70,939	73,048	78,140	81,779
242	Wesley Heights	61,208	61,670	62,590	62,590	63,810	64,446	66,356	66,517	67,415
243	Brightwood	21,203	21,203	21,338	21,338	22,891	23,120	23,804	24,092	24,738
244	Congress Heights	28,285	29,313	31,309	52,572	55,335	55,889	57,551	68,613	74,898
245	Capital View	12,069	14,416	14,815	14,815	20,774	20,979	21,598	24,064	25,734
246	Chevy Chase	2,889	2,889	2,889	2,889	2,889	2,918	2,996	2,966	2,987
247	Downtown DC	374,093	375,414	379,559	379,559	380,812	384,617	396,130	394,143	397,803
248	Logan Circle	47,241	47,658	48,408	48,408	51,879	52,399	53,954	54,894	56,342
249	Pentagon	72,365	79,427	84,821	86,237	87,715	94,207	96,640	101,214	103,890
250	Landmark - Van Dorn	66,220	68,235	79,561	90,545	99,621	107,888	112,041	124,034	133,090
251	Prince Frederick	35,130	38,552	41,742	43,433	44,276	45,120	45,963	48,987	49,930
252	Westminster	59,867	60,923	61,975	62,689	63,374	64,083	64,782	65,806	66,470
253	Eldersburg	23,334	23,758	24,169	24,444	24,756	25,035	25,310	25,725	25,996
254	Charlotte Hall (Peninsula) - Hughesville	4,986	5,609	5,918	6,259	6,587	6,915	7,243	7,682	7,963
255	Waldorf	46,750	49,665	52,040	54,134	56,079	58,022	59,966	62,629	64,453
256	Marbury-Pomonkey	10,581	10,714	11,214	11,671	12,099	12,526	12,954	13,394	13,849
257	Lexington Park	65,243	68,425	71,836	74,845	76,853	78,910	81,027	84,583	86,772
258	Bethesda	144,679	150,173	157,474	159,976	162,866	164,867	165,789	172,190	174,415
259	Silver Spring	55,512	56,368	56,978	59,007	61,220	61,686	61,911	63,964	65,210
260	Wheaton	68,964	73,457	74,368	75,394	77,374	78,596	79,172	81,668	82,496
261	Rockville	162,041	167,513	180,337	194,317	205,792	215,728	221,478	236,583	247,522
262	Potomac	46,922	49,510	51,967	52,824	53,568	53,957	54,747	56,825	57,434
263	Gaithersburg - Germantown	142,923	150,836	176,622	203,771	230,453	250,545	266,146	294,788	318,691
264	Olney	31,238	32,561	33,812	34,562	35,296	35,750	35,964	37,366	37,888
265	Damascus-Clarksburg	10,295	11,524	15,267	19,715	25,767	29,455	30,883	36,359	40,635
266	Dawsonville	3,881	3,892	3,896	3,899	3,906	3,913	3,915	3,923	3,927
267	Hyattsville (Chillum)	24,619	24,957	25,551	26,285	27,214	28,337	30,320	30,535	31,646

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
268	College Park	46,396	47,878	51,179	53,417	56,446	60,039	63,194	65,861	68,945
269	Hyattsville (Edmonston)	17,290	17,494	17,953	18,562	19,457	20,349	20,512	21,296	21,991
270	Lanham (Landover Hills)	25,612	25,868	27,666	29,788	32,035	34,905	37,848	39,292	41,880
271	Fairmount Heights	12,460	12,393	12,582	12,893	13,360	14,060	15,340	15,201	15,848
272	Glenarden	11,207	11,338	11,584	11,959	12,519	13,375	14,767	14,724	15,458
273	District Heights	25,002	25,198	25,684	26,904	27,646	28,477	29,038	29,897	30,746
274	Marlow Heights	33,547	33,844	34,448	35,390	36,639	38,832	42,685	42,368	44,242
275	Upper Marlboro	23,441	24,950	29,137	33,551	39,497	44,032	48,866	53,206	58,278
276	Beltsville	76,810	79,161	85,834	95,794	108,972	122,416	132,656	141,263	153,239
277	NASA Goddard Space Flight Center	25,434	24,957	24,695	25,472	26,518	27,699	27,928	28,325	29,199
278	Bowie	21,306	22,174	23,518	25,620	27,624	29,679	29,908	32,303	34,008
279	Woodmore	19,880	20,563	21,335	22,275	23,147	24,900	29,133	28,699	30,383
280	Cheltenham	29,688	31,110	32,456	33,180	34,214	35,477	37,341	38,252	39,361
281	Fort Washington	38,787	40,728	42,004	44,024	45,410	47,635	51,710	52,566	54,659
282	Severn	9,412	9,781	10,247	10,702	11,317	11,996	11,996	12,725	13,198
283	Odenton	12,693	14,217	16,582	19,447	22,286	25,057	25,057	28,805	31,111
284	Crofton	8,329	8,384	8,437	8,482	8,590	8,693	8,693	8,790	8,859
285	Crownsville	29,399	30,154	30,690	31,076	31,687	32,255	32,255	33,080	33,469
286	Davidsonville	7,395	7,440	7,480	7,520	7,675	7,802	7,802	7,904	7,992
287	Galesville	14,924	15,204	15,551	15,950	16,330	16,728	16,728	17,271	17,586
288	Riviera Beach	15,875	16,155	17,633	19,141	19,747	20,669	20,669	22,302	23,194
289	Annapolis - Cape St. Clair	64,594	65,925	66,177	66,394	67,848	69,015	69,015	70,083	70,746
290	Pasadena (Millersville)	23,384	23,706	23,928	24,220	24,788	25,293	25,293	25,808	26,164
291	Linthicum Heights	27,621	28,506	29,250	32,334	33,416	35,277	35,277	37,653	39,164
292	Glenmore	32,102	32,656	33,276	34,112	35,294	36,439	36,439	37,656	38,503
293	Baltimore Washington International Airport	6,371	6,778	7,494	7,951	8,255	8,617	8,617	9,355	9,673
294	Fort Meade-Patuxent Research Refuge	69,237	78,462	94,269	102,663	111,707	115,104	115,104	131,289	137,313

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
295	Hanover	48,456	51,722	59,315	64,225	66,321	69,375	69,375	76,567	79,529
296	Edgewood	29,006	30,354	32,154	34,747	35,826	36,047	41,053	41,697	43,572
297	Bel Air	42,850	43,889	46,854	48,378	50,132	50,377	55,080	56,005	57,931
298	Aberdeen	48,115	52,623	55,821	57,941	59,816	60,688	68,200	69,333	71,722
299	Catonsville - Halethorpe	89,044	90,537	92,549	93,955	95,007	95,954	99,863	100,559	102,160
300	Randallstown	60,945	61,434	62,703	63,638	64,269	64,796	68,160	68,124	69,324
301	Reisterstown	50,981	53,265	58,281	59,246	59,822	60,307	67,902	68,250	70,333
302	Brooklandville	21,721	21,948	22,358	22,655	22,890	23,073	23,748	23,930	24,249
303	Towson	161,495	163,461	166,515	168,675	170,400	171,833	176,702	178,164	180,485
304	Hereford	13,992	14,125	14,421	14,649	14,795	14,907	15,500	15,578	15,821
305	Perry Hall	18,530	18,760	19,151	19,429	19,648	19,813	20,447	20,624	20,920
306	Rosedale-Rossville	98,908	103,370	105,800	107,404	108,590	109,498	116,785	117,207	119,175
307	Frederick	117,802	121,920	127,109	131,236	134,248	137,333	140,485	145,511	148,781
308	Thurmont	14,601	15,468	16,468	17,045	17,473	17,910	18,359	19,258	19,714
309	Sterling	107,831	118,139	134,371	146,859	155,723	163,412	170,189	186,046	195,236
310	Ashburn South	50,854	57,809	74,764	87,079	94,917	101,226	106,480	121,930	130,592
311	Leesburg	26,512	29,784	37,814	43,349	47,760	50,961	53,270	60,751	65,016
312	Purcellville	7,622	8,572	10,460	12,137	13,032	13,823	14,574	16,423	17,498
313	Herndon - Reston	177,747	185,838	197,769	209,009	218,697	229,644	232,122	247,071	256,170
314	Centreville	112,408	117,405	126,428	136,159	144,048	147,081	150,115	161,214	167,454
315	Fairfax	76,896	79,164	82,732	86,064	88,677	90,720	92,879	96,586	99,149
316	Vienna	113,627	117,175	121,382	125,744	128,805	132,078	135,231	139,807	143,164
317	Seven Corners	75,684	78,436	81,886	84,686	86,396	87,215	85,986	90,572	91,759
318	Springfield	69,656	77,000	79,426	81,417	82,650	84,644	86,596	90,174	91,286
319	Huntington	110,585	117,265	122,939	127,783	131,740	136,065	140,389	146,501	150,510
320	McLean	127,743	133,266	144,841	154,200	160,380	167,978	175,308	185,352	193,185
321	Great Falls	3,893	3,974	4,155	4,341	4,389	4,389	4,389	4,590	4,656
322	Warrenton	38,684	41,322	48,448	53,350	58,750	64,694	71,246	76,564	82,434

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
323	Dale City	88,232	93,216	102,298	111,580	120,660	127,397	137,178	145,863	154,530
324	Manassas	66,827	70,030	75,377	80,820	86,217	90,643	96,241	101,513	106,692
325	Haymarket	42,952	52,291	65,760	79,528	93,257	103,184	117,756	131,208	143,912
326	Stafford	49,636	53,616	60,114	66,603	71,655	76,703	82,111	88,555	94,038
327	200-KGC01-King George	17,614	20,229	23,327	26,425	29,062	31,693	34,567	37,792	40,504
328	Columbia	83,387	85,808	90,758	94,837	99,096	101,231	103,384	108,610	111,968
329	Ellicott City	32,176	32,405	34,382	36,287	37,336	37,336	37,336	39,465	40,383
330	Elkridge	23,474	26,337	30,436	34,003	37,393	39,196	41,015	45,598	48,302
331	Peninsula Laurel-Savage	32,993	36,361	39,509	43,474	46,091	46,173	46,257	51,137	52,789
332	Clarksville	15,633	17,070	17,548	18,184	18,400	18,400	18,400	19,347	19,443
333	Cooksville	9,774	10,502	11,680	13,238	14,212	14,359	14,508	16,182	16,928

1.3 Study Area Per Capita Income Data and Forecasts (2012 US$)

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
1	Norfolk (Downtown)	24,668	25,349	26,474	27,599	28,723	29,848	30,973	32,099	33,225
2	Lamberts Point - Colonial Place	25,265	25,963	27,115	28,267	29,419	30,571	31,723	32,877	34,030
3	Fairmount Park - Lafayette Annex	23,617	24,269	25,346	26,423	27,499	28,576	29,653	30,732	31,809
4	Glenwood Park	17,495	17,978	18,776	19,573	20,371	21,169	21,967	22,765	23,564
5	Norfolk International Airport	24,494	25,170	26,287	27,404	28,521	29,638	30,755	31,873	32,991
6	Virginia Beach	44,116	45,649	48,174	50,700	53,226	55,752	58,278	60,808	63,337
7	Chinese Corner	31,169	32,252	34,036	35,821	37,606	39,390	41,175	42,962	44,749
8	Oceana Naval Air Station	26,558	27,480	29,001	30,522	32,042	33,563	35,083	36,606	38,129
9	Berkley - Campostella	15,109	15,526	16,215	16,904	17,593	18,282	18,971	19,661	20,351
10	Portsmouth	22,131	22,839	24,006	25,174	26,341	27,508	28,676	29,844	31,013
11	Victory Park	21,794	22,490	23,640	24,790	25,939	27,089	28,238	29,389	30,540
12	Arostead Forest - Craney Island	26,835	27,693	29,109	30,524	31,940	33,355	34,771	36,188	37,605
13	Bowers Hill	29,032	30,107	31,876	33,645	35,414	37,183	38,952	40,723	42,494
14	Boone	32,223	33,415	35,378	37,341	39,305	41,268	43,232	45,198	47,164
15	Loxley Gardens - Geneva Park	24,172	25,067	26,540	28,012	29,485	30,958	32,431	33,906	35,381
16	South Norfolk	18,878	19,577	20,727	21,877	23,027	24,178	25,328	26,480	27,632
17	1200 Battlefield Blvd N	28,237	29,282	31,002	32,723	34,443	36,164	37,884	39,608	41,330
18	910 Great Bridge Blvd	31,244	32,400	34,304	36,208	38,112	40,015	41,919	43,826	45,732
19	Chesapeake	37,718	39,114	41,412	43,710	46,009	48,307	50,605	52,907	55,208

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
20	Bennett Corner	35,261	36,447	38,401	40,356	42,311	44,265	46,220	48,177	50,134
21	Suffolk	20,579	21,271	22,412	23,552	24,693	25,834	26,975	28,117	29,259
22	Holland	28,199	29,147	30,710	32,273	33,836	35,400	36,963	38,528	40,093
23	Kings Fork	29,792	30,794	32,445	34,097	35,748	37,400	39,051	40,705	42,359
24	Smithfield	34,341	35,624	37,737	39,851	41,964	44,077	46,190	48,307	50,423
25	Zuni	27,128	28,141	29,811	31,480	33,150	34,819	36,488	38,160	39,832
26	Newport News (Downtown South)	12,667	12,959	13,443	13,926	14,410	14,893	15,376	15,860	16,344
27	Newport News Amtrak Station	20,390	20,860	21,638	22,416	23,195	23,973	24,751	25,530	26,309
28	Newport News (Downtown Peninsula)	23,745	24,293	25,199	26,105	27,011	27,917	28,823	29,730	30,637
29	Newport News (Reed)	15,058	15,405	15,980	16,555	17,129	17,704	18,278	18,854	19,429
30	Glendale - Beaconsville	33,002	33,763	35,023	36,282	37,541	38,801	40,060	41,321	42,581
31	Charles	31,066	31,782	32,968	34,154	35,339	36,525	37,710	38,897	40,083
32	Sunsan Constant Dr	23,319	23,857	24,747	25,637	26,527	27,417	28,307	29,198	30,089
33	2 Shore Park Dr	16,437	16,817	17,444	18,071	18,698	19,326	19,953	20,581	21,209
34	Hampton (West)	20,712	21,413	22,570	23,726	24,883	26,039	27,196	28,354	29,512
35	Hampton (Downtown)	28,846	29,823	31,434	33,045	34,655	36,266	37,877	39,490	41,102
36	Fox Corner	28,535	29,501	31,095	32,688	34,281	35,874	37,468	39,063	40,658
37	Chapel Village	27,037	27,953	29,462	30,972	32,481	33,991	35,501	37,012	38,524
38	Poquoson	39,447	41,009	43,579	46,149	48,719	51,288	53,858	56,433	59,006
39	Yorktown (Rt. 134 & Rt. 600)	35,058	36,446	38,730	41,014	43,298	45,582	47,866	50,154	52,441

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
40	Yorktown (West)	33,113	34,424	36,581	38,739	40,896	43,053	45,210	47,371	49,531
41	Greensprings-Plantation Heights	41,375	43,014	45,709	48,405	51,100	53,796	56,491	59,192	61,891
42	Skimino	41,375	43,014	45,709	48,405	51,100	53,796	56,491	59,192	61,891
43	Charleston Heights - York Terrace	34,682	36,056	38,315	40,575	42,834	45,094	47,353	49,616	51,879
44	Williamsburg	15,518	16,247	17,443	18,639	19,835	21,031	22,227	23,425	24,623
45	Williamsburg (Southeast - Forest Hill Park)	30,745	32,188	34,558	36,927	39,297	41,666	44,036	46,410	48,783
46	James Terrace - Grove	52,099	54,544	58,560	62,575	66,590	70,605	74,620	78,643	82,665
47	Jamestown - Hollybrook	41,119	42,676	45,239	47,803	50,366	52,929	55,493	58,060	60,627
48	Canterbury Hills - Jamestown Farms	40,219	41,742	44,249	46,757	49,264	51,771	54,278	56,789	59,300
49	Toano	33,906	35,190	37,304	39,417	41,531	43,645	45,758	47,875	49,992
50	Gloucester	28,788	29,687	31,169	32,651	34,133	35,615	37,097	38,581	40,064
51	Grassfield - Chesapeake Regional Apt.	30,089	31,202	33,036	34,869	36,702	38,536	40,369	42,205	44,041
52	Gent-Park Place	39,675	40,771	42,580	44,389	46,198	48,007	49,817	51,628	53,439
53	Huntersville (Hunter's Village)	12,063	12,396	12,946	13,496	14,046	14,596	15,146	15,697	16,248
54	Ocean View - Willoughby Beach	25,619	26,326	27,494	28,662	29,830	30,999	32,167	33,336	34,506
55	Sussex - Wards Corner	37,206	38,233	39,930	41,627	43,323	45,020	46,716	48,415	50,113
56	Thomas Corner	22,345	22,962	23,981	25,000	26,019	27,038	28,057	29,077	30,097
57	London Bridge	38,212	39,539	41,727	43,915	46,103	48,291	50,479	52,670	54,861
58	Nimmo-Woodhouse Corner	33,801	34,976	36,911	38,846	40,782	42,717	44,653	46,591	48,529
59	Westhaven Park	25,275	26,083	27,417	28,750	30,083	31,416	32,749	34,084	35,419

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
60	Hawthorne Drive, Chesapeake	29,028	30,102	31,871	33,639	35,408	37,177	38,945	40,717	42,488
61	Shenandoah Pkwy	36,371	37,717	39,933	42,149	44,366	46,582	48,798	51,018	53,236
62	St. Brides	32,075	33,261	35,216	37,170	39,124	41,079	43,033	44,991	46,947
63	Deer Park - Harpersville	26,152	26,756	27,754	28,752	29,750	30,748	31,746	32,745	33,744
64	Newport News/Williamsburg International Airport	27,896	28,540	29,604	30,669	31,734	32,798	33,863	34,928	35,994
65	Hampton (East)	26,183	27,070	28,531	29,993	31,455	32,917	34,379	35,843	37,307
66	504 E Mercury Blvd	20,272	20,958	22,090	23,222	24,354	25,486	26,618	27,751	28,884
67	Greenwood Farms	23,326	24,117	25,419	26,721	28,024	29,326	30,629	31,933	33,237
68	Drummonds Corner	30,276	31,302	32,992	34,683	36,373	38,064	39,754	41,447	43,139
69	Yorktown - Grafton	43,601	45,327	48,167	51,008	53,848	56,689	59,529	62,375	65,219
70	Pecan Gardens	26,393	27,310	28,821	30,332	31,844	33,355	34,866	36,379	37,892
71	Acredale	30,411	31,468	33,209	34,951	36,692	38,433	40,174	41,918	43,662
72	Woodhaven Shores - New Kent Co. Airport	30,480	31,515	33,220	34,925	36,631	38,336	40,041	41,749	43,456
73	Charles City	25,913	27,055	28,933	30,810	32,688	34,565	36,443	38,324	40,204
74	Swift Creek Resevoir	36,854	38,001	39,893	41,784	43,676	45,568	47,460	49,355	51,248
75	Chesterfield County Airport	25,209	25,993	27,287	28,581	29,875	31,169	32,463	33,759	35,055
76	East Highland Park	23,345	24,179	25,553	26,927	28,301	29,675	31,049	32,425	33,801
77	Church Hill	15,893	16,409	17,260	18,111	18,962	19,813	20,664	21,516	22,367
78	Ginter Park - Hotchkiss Field	23,587	24,353	25,615	26,878	28,141	29,403	30,666	31,931	33,195
79	Richmond (Downtown-West)	21,010	21,692	22,817	23,942	25,067	26,191	27,316	28,442	29,568

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
80	Richmond (The Fan District)	30,058	31,034	32,643	34,252	35,861	37,470	39,080	40,691	42,302
81	Richmond (West End)	60,255	62,211	65,436	68,662	71,888	75,114	78,340	81,570	84,799
82	Ashland	32,015	33,226	35,221	37,215	39,209	41,204	43,198	45,195	47,192
83	Goodallr-Farrington	38,926	40,399	42,824	45,249	47,674	50,098	52,523	54,952	57,380
84	Tuckahoe	42,596	44,117	46,624	49,131	51,638	54,145	56,652	59,163	61,673
85	Chester	28,185	29,062	30,509	31,956	33,402	34,849	36,296	37,745	39,193
86	Richmond (Southside)	24,165	24,949	26,243	27,536	28,830	30,124	31,417	32,713	34,008
87	Laurel	35,420	36,686	38,770	40,855	42,940	45,024	47,109	49,197	51,284
88	Powhatan (Rt. 60 & Dorset Rd.)	37,589	39,271	42,034	44,797	47,560	50,324	53,087	55,855	58,622
89	Sabot	70,484	74,398	80,804	87,211	93,618	100,025	106,432	112,854	119,273
90	Richmond International Apt. (Sandston)	25,989	26,918	28,447	29,977	31,506	33,036	34,566	36,098	37,629
91	Mechanicsville (Henry Clay Heights)	35,851	37,208	39,441	41,674	43,908	46,141	48,374	50,611	52,847
92	Sandston (Rt. 156 & Rt. 33)	28,664	29,688	31,375	33,062	34,749	36,436	38,123	39,813	41,502
93	Richmond (Downtown-East)	45,425	46,899	49,331	51,763	54,195	56,627	59,058	61,494	63,928
94	Meadowville - Cameron Hills	45,918	47,347	49,704	52,061	54,419	56,776	59,133	61,493	63,853
95	Robious & Hylton Park	40,606	41,869	43,954	46,038	48,123	50,207	52,292	54,379	56,465
96	Ethridge Estates	25,901	26,881	28,496	30,111	31,725	33,340	34,955	36,572	38,188
97	Fort Lee	20,282	21,050	22,315	23,579	24,843	26,108	27,372	28,638	29,904
98	Rt. 106 & Rt. 156	39,364	40,855	43,309	45,763	48,216	50,670	53,124	55,582	58,039
99	Petersburg (Dinwiddie County Airport - PTB)	21,745	22,592	23,984	25,377	26,770	28,162	29,555	30,950	32,345

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
100	Petersburg (Blandford)	11,639	12,092	12,838	13,583	14,329	15,074	15,820	16,566	17,313
101	Berkley Manor	20,664	21,468	22,792	24,115	25,439	26,762	28,086	29,411	30,737
102	Petersburg (Downtown)	14,817	15,394	16,343	17,292	18,241	19,190	20,139	21,090	22,040
103	Petersburg (Kennelworth)	19,038	19,779	20,998	22,218	23,437	24,656	25,876	27,097	28,318
104	Camelot	26,957	28,006	29,732	31,459	33,185	34,912	36,638	38,368	40,096
105	Petersburg (South)	24,612	25,570	27,146	28,722	30,299	31,875	33,451	35,030	36,609
106	Colonial Heights	25,958	26,968	28,631	30,293	31,956	33,618	35,281	36,946	38,611
107	Colonial Heights (East)	34,610	35,957	38,173	40,390	42,607	44,823	47,040	49,260	51,480
108	Ettrick (Amtrak Petersburg)	19,766	20,381	21,396	22,411	23,425	24,440	25,455	26,471	27,487
109	Hopewell	19,777	20,525	21,758	22,991	24,224	25,457	26,690	27,924	29,159
110	Matoaca	28,192	29,070	30,517	31,964	33,411	34,859	36,306	37,755	39,204
111	Screamersville	31,969	32,963	34,604	36,245	37,887	39,528	41,169	42,812	44,455
112	Pickadat Corner	33,416	34,455	36,171	37,886	39,601	41,317	43,032	44,750	46,467
113	Lake Chesdin Pkwy & Ivey Mill Rd.	34,425	35,496	37,263	39,030	40,798	42,565	44,332	46,101	47,870
118	Dinwiddie	36,335	37,749	40,076	42,403	44,731	47,058	49,385	51,716	54,046
119	Templeton	26,640	27,648	29,309	30,970	32,630	34,291	35,952	37,615	39,278
114	New Kent	29,061	30,047	31,673	33,299	34,925	36,550	38,176	39,804	41,432
115	Sherwood Forest - Rustic	33,112	34,572	36,971	39,370	41,769	44,168	46,567	48,971	51,373
116	Powhatan (Rt. 522 & Three Bridges Rd.)	25,696	26,846	28,735	30,624	32,513	34,402	36,290	38,183	40,075
117	Goochland	31,917	33,689	36,591	39,492	42,393	45,294	48,196	51,104	54,010

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
120	Dutton	30,942	31,907	33,500	35,093	36,686	38,279	39,871	41,467	43,061
121	Elkton	30,033	31,148	32,984	34,821	36,657	38,493	40,329	42,168	44,007
122	Bristol	37,887	39,569	42,333	45,096	47,860	50,623	53,387	56,156	58,924
123	Warwick	33,489	34,767	36,870	38,974	41,077	43,180	45,283	47,390	49,496
124	Providence	26,663	27,499	28,878	30,257	31,636	33,015	34,393	35,774	37,154
125	Newport	39,406	41,160	44,041	46,923	49,804	52,686	55,567	58,454	61,340
126	Wakefield-Westerly	37,385	39,052	41,789	44,527	47,264	50,001	52,739	55,482	58,223
127	Levittown	37,906	39,483	42,075	44,668	47,260	49,853	52,445	55,043	57,639
128	Norristown	42,552	44,206	46,926	49,647	52,368	55,088	57,809	60,534	63,259
129	Philadelphia	22,464	23,029	23,962	24,895	25,828	26,761	27,694	28,628	29,562
130	Springfield-Media	33,827	35,097	37,189	39,280	41,372	43,464	45,555	47,650	49,745
131	Downingtown-Exton	43,527	45,460	48,636	51,812	54,989	58,165	61,341	64,523	67,704
132	Hartford-Glastonbury	35,143	36,417	38,517	40,616	42,715	44,814	46,913	49,016	51,118
133	Norwich-New London	34,528	35,903	38,165	40,427	42,689	44,951	47,213	49,478	51,743
134	New Haven	33,439	34,621	36,569	38,516	40,463	42,411	44,358	46,309	48,258
135	Middletown	40,760	42,380	45,044	47,709	50,374	53,039	55,703	58,373	61,041
136	Bridgeport	50,005	52,406	56,346	60,286	64,227	68,167	72,107	76,055	80,002
137	Culpeper	28,022	29,012	30,643	32,273	33,904	35,534	37,165	38,798	40,430
138	Fredericksburg	31,820	32,873	34,611	36,348	38,085	39,823	41,560	43,300	45,039
139	Hague	27,865	28,990	30,842	32,693	34,544	36,395	38,247	40,101	41,955

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
140	Bowling Green	26,903	27,917	29,585	31,254	32,922	34,591	36,260	37,931	39,602
141	Tappahannock	23,214	24,110	25,586	27,062	28,538	30,014	31,490	32,968	34,446
142	Warsaw	21,567	22,024	22,780	23,536	24,292	25,048	25,804	26,561	27,318
143	Heathsville	29,390	30,621	32,645	34,669	36,693	38,717	40,741	42,769	44,796
144	Mattaponi	25,769	26,738	28,334	29,929	31,525	33,120	34,716	36,314	37,911
145	King William	28,697	29,698	31,348	32,999	34,649	36,299	37,949	39,602	41,254
146	Irvington	30,907	32,420	34,902	37,384	39,865	42,347	44,829	47,317	49,802
147	Topping-Deltaville	31,763	33,088	35,266	37,445	39,623	41,801	43,980	46,162	48,343
148	Foster	30,534	32,078	34,609	37,141	39,672	42,204	44,735	47,272	49,808
149	Surry	24,821	25,867	27,586	29,305	31,024	32,743	34,462	36,184	37,905
150	Lunenburg	17,706	18,228	19,090	19,952	20,814	21,676	22,537	23,401	24,263
151	Waverly	17,739	18,315	19,263	20,212	21,160	22,108	23,057	24,007	24,956
152	Lawrenceville	17,754	18,258	19,089	19,921	20,752	21,583	22,415	23,247	24,079
153	Franklin	21,204	22,086	23,535	24,984	26,433	27,883	29,332	30,784	32,235
154	Emporia	17,575	18,001	18,704	19,407	20,110	20,813	21,516	22,220	22,923
155	South Mill	20,578	21,312	22,521	23,731	24,940	26,150	27,359	28,571	29,782
156	Wilmington	33,057	34,100	35,821	37,542	39,264	40,985	42,706	44,429	46,152
157	Plymouth-Kingston	34,979	36,543	39,112	41,681	44,251	46,820	49,389	51,963	54,536
158	Taunton	29,427	30,512	32,300	34,088	35,876	37,664	39,452	41,242	43,032
159	Hempstead	43,810	45,454	48,160	50,867	53,573	56,279	58,986	61,696	64,406

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
160	Brooklyn	24,970	25,622	26,699	27,777	28,854	29,931	31,009	32,088	33,166
161	Yonkers-New Rochelle	48,856	50,898	54,254	57,610	60,966	64,323	67,679	71,041	74,402
162	Bronx	18,375	18,724	19,302	19,880	20,458	21,036	21,614	22,192	22,770
163	New York City	64,802	68,054	73,388	78,721	84,054	89,387	94,720	100,065	105,407
164	Staten Island	32,230	33,315	35,103	36,891	38,678	40,466	42,254	44,044	45,834
165	Queens	26,861	27,267	27,941	28,614	29,288	29,962	30,635	31,309	31,983
166	Carmel	41,066	42,737	45,487	48,237	50,986	53,736	56,486	59,240	61,994
167	Spring Valley	35,983	37,377	39,672	41,967	44,262	46,557	48,852	51,151	53,449
168	Dunn	20,483	21,341	22,750	24,159	25,569	26,978	28,388	29,799	31,211
169	Fayetteville	23,712	24,663	26,228	27,792	29,357	30,921	32,485	34,052	35,619
170	Greenville	23,556	24,459	25,946	27,434	28,921	30,408	31,895	33,385	34,874
171	Gatesville	21,700	22,376	23,490	24,604	25,719	26,833	27,947	29,063	30,178
172	Camden	26,956	28,087	29,947	31,807	33,668	35,528	37,388	39,252	41,115
173	Currituck	27,078	28,206	30,060	31,914	33,768	35,622	37,477	39,334	41,191
174	King	21,732	22,473	23,694	24,916	26,137	27,358	28,579	29,802	31,025
175	Jackson	18,440	19,282	20,665	22,048	23,431	24,814	26,197	27,583	28,968
176	Ahoskie	17,914	18,529	19,542	20,555	21,569	22,582	23,595	24,610	25,624
177	Warrenton	19,663	20,383	21,569	22,756	23,942	25,128	26,315	27,503	28,691
178	Henderson	18,011	18,608	19,592	20,576	21,559	22,543	23,527	24,512	25,497
179	Oxford	22,506	23,341	24,717	26,092	27,468	28,844	30,219	31,597	32,974

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
180	Rosemary	18,634	19,346	20,518	21,689	22,861	24,032	25,204	26,377	27,550
181	Elizabeth City	24,237	24,986	26,221	27,456	28,692	29,927	31,162	32,399	33,636
182	Hertford	22,261	23,191	24,721	26,251	27,780	29,310	30,840	32,372	33,904
183	Edenton	20,585	21,475	22,938	24,400	25,863	27,326	28,788	30,254	31,718
184	Yadkinville	22,266	23,026	24,277	25,529	26,781	28,032	29,284	30,537	31,790
185	Franklinton	22,796	23,769	25,369	26,968	28,568	30,168	31,768	33,370	34,972
186	Winston-Salem	27,143	27,988	29,384	30,779	32,174	33,570	34,965	36,362	37,759
187	Greensboro	27,440	28,363	29,885	31,407	32,929	34,451	35,973	37,497	39,021
188	Burlington	24,175	24,920	26,148	27,377	28,606	29,835	31,063	32,294	33,524
189	Chapel Hill	35,340	36,953	39,602	42,252	44,901	47,551	50,200	52,855	55,508
190	Durham	28,678	29,736	31,478	33,219	34,961	36,702	38,444	40,188	41,932
191	Rocky Mount	24,452	25,332	26,782	28,232	29,682	31,132	32,581	34,034	35,485
192	Tarboro	18,579	19,211	20,253	21,295	22,336	23,378	24,420	25,463	26,506
193	Raleigh	34,227	35,575	37,793	40,011	42,228	44,446	46,664	48,885	51,106
194	Mocksville	27,397	28,503	30,322	32,140	33,959	35,778	37,597	39,418	41,240
195	Lexington	23,484	24,323	25,705	27,087	28,468	29,850	31,232	32,615	33,999
196	Manteo	32,550	34,010	36,408	38,805	41,203	43,601	45,999	48,401	50,802
197	Asheboro	22,039	22,676	23,726	24,777	25,828	26,879	27,929	28,982	30,033
198	Siler City	33,116	34,730	37,379	40,027	42,676	45,324	47,973	50,627	53,279
199	Wilson	21,580	22,344	23,603	24,862	26,121	27,380	28,639	29,900	31,160

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
200	Salisbury	22,434	23,155	24,344	25,533	26,722	27,912	29,101	30,292	31,482
201	Smithfield	23,561	24,517	26,089	27,660	29,232	30,803	32,375	33,949	35,523
202	Lincolnton	26,507	27,448	28,999	30,550	32,101	33,652	35,203	36,756	38,309
203	Charlotte	33,806	35,203	37,500	39,797	42,094	44,391	46,688	48,989	51,289
204	Concord	26,952	28,044	29,839	31,634	33,430	35,225	37,020	38,819	40,617
205	Gastonia	23,623	24,534	26,034	27,534	29,033	30,533	32,033	33,535	35,036
206	Monroe	29,811	30,965	32,865	34,765	36,664	38,564	40,464	42,367	44,269
207	Hickory	24,328	25,090	26,347	27,603	28,860	30,117	31,374	32,632	33,890
208	Southern Pines	28,073	29,348	31,441	33,533	35,626	37,719	39,812	41,909	44,005
209	Raeford-Silver City	19,927	20,729	22,047	23,366	24,684	26,003	27,321	28,642	29,962
210	Sanford	22,403	23,181	24,464	25,747	27,029	28,312	29,594	30,879	32,163
211	Sussex	38,302	39,881	42,477	45,073	47,670	50,266	52,862	55,463	58,063
212	Paterson	27,275	28,073	29,392	30,711	32,029	33,348	34,666	35,987	37,307
213	Paramus	44,520	46,377	49,431	52,484	55,537	58,591	61,644	64,703	67,761
214	Phillipsburg	34,742	35,968	37,988	40,008	42,028	44,047	46,067	48,090	50,112
215	Parsippany Troy Hills	49,914	52,322	56,273	60,225	64,176	68,127	72,078	76,037	79,995
216	Newark	33,247	34,534	36,652	38,770	40,888	43,006	45,124	47,245	49,366
217	Jersey City-Hoboken	33,678	34,884	36,872	38,859	40,846	42,834	44,821	46,811	48,801
218	Flemington	51,435	53,982	58,161	62,340	66,518	70,697	74,875	79,062	83,248
219	Bridgewater-Somerville	49,890	52,233	56,077	59,922	63,767	67,612	71,456	75,309	79,160

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
220	Elizabeth	35,904	37,080	39,018	40,957	42,895	44,834	46,772	48,714	50,654
221	New Brunswick	35,297	36,508	38,505	40,501	42,497	44,494	46,490	48,489	50,488
222	Trenton	37,956	39,441	41,885	44,329	46,773	49,217	51,661	54,109	56,556
223	Willingboro	37,389	38,880	41,333	43,785	46,238	48,691	51,144	53,601	56,057
224	Camden	31,154	32,200	33,925	35,650	37,375	39,100	40,825	42,552	44,279
225	Woodbury	33,190	34,303	36,138	37,973	39,808	41,643	43,478	45,316	47,153
226	Penns Grove-Carneys Point	28,858	29,716	31,132	32,548	33,963	35,379	36,795	38,213	39,630
227	Lawrence	35,361	36,828	39,240	41,652	44,064	46,477	48,889	51,305	53,721
228	Cambridge - Burlington	42,900	44,845	48,039	51,232	54,426	57,620	60,814	64,014	67,212
229	Worcester	32,489	33,714	35,730	37,746	39,763	41,779	43,795	45,815	47,833
230	Boston	33,059	34,473	36,796	39,119	41,443	43,766	46,089	48,417	50,744
231	Quincy	45,502	47,543	50,896	54,249	57,602	60,955	64,308	67,667	71,025
232	Alexandria (Old Town)	68,472	71,344	76,066	80,788	85,510	90,232	94,954	99,684	104,412
233	Metro-Ballston Station	63,412	65,844	69,849	73,853	77,857	81,862	85,866	89,877	93,887
234	Downtown	32,074	32,969	34,447	35,925	37,404	38,882	40,360	41,840	43,319
235	Johns Hopkins Hospital	26,497	27,236	28,457	29,678	30,900	32,121	33,342	34,564	35,787
236	Brooklyn Manor	16,502	16,962	17,722	18,483	19,243	20,004	20,764	21,526	22,287
237	South Baltimore - Locust Point	51,970	53,421	55,816	58,211	60,606	63,001	65,396	67,794	70,191
238	Druid Hill Park - Mondawmin Mall	21,660	22,265	23,263	24,261	25,260	26,258	27,256	28,256	29,255
239	The National Mall	51,403	53,653	57,352	61,051	64,749	68,448	72,146	75,852	79,556

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
240	Capitol Hill - Union Station	46,343	48,372	51,706	55,041	58,375	61,710	65,044	68,385	71,724
241	Washington Hospital Center	31,058	32,418	34,652	36,887	39,122	41,357	43,591	45,830	48,068
242	Wesley Heights	75,926	79,251	84,714	90,177	95,640	101,103	106,567	112,040	117,511
243	Brightwood	31,731	33,121	35,404	37,687	39,970	42,254	44,537	46,824	49,111
244	Congress Heights	19,210	20,051	21,433	22,815	24,197	25,579	26,962	28,346	29,731
245	Capital View	22,013	22,977	24,561	26,145	27,729	29,313	30,897	32,484	34,070
246	Chevy Chase	74,136	77,382	82,716	88,050	93,385	98,719	104,053	109,398	114,739
247	Downtown DC	69,413	72,452	77,446	82,441	87,435	92,430	97,424	102,428	107,430
248	Logan Circle	55,177	57,593	61,563	65,533	69,504	73,474	77,444	81,422	85,397
249	Pentagon	59,610	61,897	65,661	69,426	73,190	76,954	80,719	84,489	88,258
250	Landmark - Van Dorn	48,746	50,791	54,152	57,514	60,875	64,237	67,599	70,966	74,332
251	Prince Frederick	38,636	39,984	41,980	44,531	46,805	49,068	51,313	53,568	55,846
252	Westminster	33,772	34,982	37,006	39,209	41,229	42,629	44,442	46,665	48,588
253	Eldersburg	40,959	42,566	45,251	48,113	50,684	52,470	54,738	57,703	60,187
254	Charlotte Hall (Peninsula) - Hughesville	40,698	42,413	45,773	49,188	52,131	55,135	58,198	61,448	64,599
255	Waldorf	37,211	38,545	40,552	42,448	44,519	46,552	48,548	50,599	52,612
256	Marbury-Pomonkey	36,967	38,877	42,222	46,038	49,514	53,132	56,898	60,194	63,768
257	Lexington Park	36,082	37,457	39,879	42,093	44,535	46,911	49,242	51,572	53,927
258	Bethesda	84,705	88,165	95,010	101,631	109,504	118,580	126,974	132,726	140,293
259	Silver Spring	39,486	40,687	43,369	45,548	48,096	50,368	52,349	54,884	57,228

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
260	Wheaton	37,706	38,096	39,275	40,236	41,277	42,165	42,891	43,980	44,943
261	Rockville	47,158	48,644	51,950	54,969	58,299	61,916	64,805	67,869	71,082
262	Potomac	83,392	86,474	91,789	96,029	100,618	105,833	110,514	115,418	120,227
263	Gaithersburg - Germantown	37,380	38,631	40,606	42,378	44,396	46,397	47,821	50,011	51,900
264	Olney	45,000	46,615	49,018	51,077	53,123	55,585	57,378	59,926	62,129
265	Damascus-Clarksburg	47,483	49,793	53,934	58,022	62,620	67,426	71,995	75,871	80,265
266	Dawsonville	58,720	62,086	67,837	72,885	77,529	82,259	86,587	92,414	97,398
267	Hyattsville (Chillum)	27,825	28,389	29,201	30,083	31,206	32,088	33,028	33,927	34,860
268	College Park	21,450	21,892	22,937	24,000	25,249	26,358	27,376	28,376	29,463
269	Hyattsville (Edmonston)	23,495	23,980	24,642	25,312	26,226	27,007	27,849	28,537	29,309
270	Lanham (Landover Hills)	27,293	27,941	28,950	29,953	31,182	32,314	33,457	34,471	35,571
271	Fairmount Heights	27,474	27,982	28,725	29,482	30,466	31,243	32,134	32,908	33,738
272	Glenarden	24,838	25,335	26,054	26,794	27,734	28,516	29,364	30,120	30,927
273	District Heights	28,917	29,581	30,550	31,554	32,803	33,947	35,107	36,109	37,212
274	Marlow Heights	29,187	29,764	30,613	31,488	32,603	33,514	34,496	35,395	36,344
275	Upper Marlboro	43,373	44,475	46,129	47,814	49,586	51,514	53,117	54,885	56,629
276	Beltsville	35,180	35,992	37,152	38,329	39,764	40,990	42,040	43,390	44,627
277	NASA Goddard Space Flight Center	33,156	33,921	35,047	36,216	37,633	39,004	39,991	41,310	42,551
278	Bowie	40,252	41,204	42,565	43,964	45,331	47,000	48,182	49,706	51,128
279	Woodmore	46,228	47,639	49,695	51,881	53,926	56,524	58,349	60,638	62,815

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
280	Cheltenham	39,878	40,949	42,532	44,099	45,592	47,365	48,597	50,374	51,941
281	Fort Washington	38,513	39,545	41,093	42,736	44,302	46,296	47,729	49,410	51,065
282	Severn	37,756	39,657	42,985	46,433	49,368	51,978	55,432	58,625	61,764
283	Odenton	39,943	41,683	44,499	48,139	51,420	55,649	59,366	62,171	65,654
284	Crofton	46,359	47,869	51,604	54,171	56,599	58,749	61,756	64,654	67,380
285	Crownsville	58,364	60,534	63,894	67,397	69,352	71,359	74,372	77,765	80,561
286	Davidsonville	53,953	56,028	59,582	63,392	66,826	69,855	72,221	76,395	79,743
287	Galesville	46,336	48,132	51,166	55,053	58,270	60,707	64,627	67,663	70,919
288	Riviera Beach	38,267	39,973	42,961	45,980	49,154	52,099	55,104	58,084	61,109
289	Annapolis - Cape St. Clair	47,273	48,862	51,594	54,422	57,400	60,424	63,258	65,991	68,863
290	Pasadena (Millersville)	43,439	44,972	47,560	50,142	52,691	55,112	57,425	60,120	62,635
291	Linthicum Heights	29,045	30,622	33,288	36,065	39,026	41,818	44,639	47,322	50,121
292	Glenmore	29,810	30,825	32,515	34,144	35,782	37,383	38,779	40,569	42,184
293	Baltimore Washington International Airport	2,022	2,088	2,189	2,280	2,343	2,401	2,464	2,574	2,653
294	Fort Meade-Patuxent Research Refuge	32,513	35,511	38,986	42,762	47,042	51,929	54,759	59,301	63,310
295	Hanover	26,623	30,534	37,352	42,185	47,485	54,395	58,249	65,060	70,762
296	Edgewood	32,204	33,014	35,731	38,587	40,839	42,873	43,043	46,440	48,592
297	Bel Air	39,426	39,983	42,949	46,037	48,453	49,674	50,045	53,502	55,637
298	Aberdeen	34,298	35,461	39,173	43,169	46,366	49,883	49,801	54,652	57,749
299	Catonsville - Halethorpe	30,759	31,747	33,354	34,874	36,810	38,705	39,744	41,656	43,311

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
300	Randallstown	33,469	35,386	38,570	41,628	44,911	47,341	47,908	52,318	55,061
301	Reisterstown	35,371	36,906	39,233	41,375	43,042	44,623	45,363	48,307	50,137
302	Brooklandville	62,941	66,182	71,263	76,070	79,693	83,230	83,955	90,779	94,705
303	Towson	35,426	36,702	38,742	40,458	42,512	44,295	45,240	47,697	49,500
304	Hereford	50,844	53,339	57,205	60,874	63,668	66,357	66,921	72,139	75,141
305	Perry Hall	40,677	42,525	45,358	47,975	49,987	51,907	52,370	56,146	58,320
306	Rosedale-Rossville	27,110	28,129	29,775	31,361	33,381	35,412	36,502	38,468	40,199
307	Frederick	38,240	39,699	42,092	44,480	46,814	49,274	51,786	54,110	56,518
308	Thurmont	36,100	37,555	39,907	42,236	44,476	46,837	49,222	51,540	53,872
309	Sterling	47,014	47,924	49,437	51,146	52,716	54,226	55,658	57,306	58,867
310	Ashburn South	50,333	52,669	56,553	59,773	63,455	67,140	70,914	74,518	78,158
311	Leesburg	46,391	48,721	51,340	54,216	57,464	61,245	65,137	67,802	71,058
312	Purcellville	51,578	52,586	53,464	54,579	56,254	57,972	59,728	60,733	62,147
313	Herndon - Reston	56,781	59,713	64,468	69,431	74,600	79,918	84,278	89,407	94,375
314	Centreville	50,395	52,957	57,611	62,331	67,124	71,057	75,146	80,011	84,494
315	Fairfax	48,044	50,357	54,286	58,504	63,084	67,435	71,769	75,728	79,994
316	Vienna	58,980	61,955	66,330	71,040	76,064	81,428	86,254	90,859	95,730
317	Seven Corners	44,734	46,453	49,636	52,289	55,147	58,137	60,539	63,670	66,518
318	Springfield	43,401	44,838	47,506	50,035	52,689	54,873	57,433	60,011	62,527
319	Huntington	45,106	46,321	48,589	50,523	52,537	54,637	56,206	58,514	60,526

Zone ID	Zone Name	2012	2015	2020	2025	2030	2035	2040	2045	2050
320	McLean	82,636	88,614	96,334	104,938	111,595	119,316	125,921	135,035	142,722
321	Great Falls	88,901	93,537	99,642	107,771	112,992	118,450	123,003	131,069	137,231
322	Warrenton	41,943	43,787	46,761	49,737	52,738	55,738	58,739	61,732	64,728
323	Dale City	35,897	37,082	39,094	40,980	42,860	44,712	46,562	48,555	50,459
324	Manassas	34,729	35,789	37,377	39,019	40,732	42,381	44,050	45,711	47,371
325	Haymarket	43,407	45,299	48,722	52,196	55,866	59,484	63,214	66,458	70,007
326	Stafford	36,907	38,086	40,015	41,943	43,868	45,791	47,712	49,652	51,581
327	200-KGC01-King George	35,132	36,083	37,655	39,227	40,800	42,372	43,944	45,518	47,091
328	Columbia	46,827	48,206	50,909	53,510	55,836	58,015	60,370	62,978	65,413
329	Ellicott City	49,339	51,369	54,082	56,881	59,714	62,383	65,278	68,205	71,016
330	Elkridge	41,793	43,830	47,127	50,875	54,369	57,533	61,021	64,499	67,948
331	Peninsula Laurel-Savage	41,478	42,845	44,669	46,922	49,269	51,491	53,252	55,553	57,687
332	Clarksville	69,070	73,166	79,205	85,716	93,745	101,377	110,088	115,734	122,983
333	Cooksville	55,192	57,898	62,068	65,225	68,532	72,404	76,054	79,947	83,598

APPENDIX B: COMPASS™ MODEL

The COMPASS™ Model System is a flexible multimodal demand-forecasting tool that provides comparative evaluations of alternative socioeconomic and network scenarios. It also allows input variables to be modified to test the sensitivity of demand to various parameters such as elasticities, values of time, and values of frequency. This section describes in detail the model methodology and process used in the study.

1. DESCRIPTION OF THE COMPASS™ MODEL SYSTEM

The COMPASS™ model is structured on two principal models: Total Demand Model and Hierarchical Modal Split Model. For this study, these two models were calibrated separately for three trip purposes, which are Business, Commuter, and Social. For each market segment, the models were calibrated on base year origin-destination trip data, existing network characteristics and base year socioeconomic data.

Since the models were calibrated on the base year data, when applying the models for forecasting, an incremental approach known as the “pivot point” method is used. By applying model growth rates to the base data observations, the “pivot point” method is able to preserve the unique travel flows present in the base data that are not captured by the model variables. Details on how this method is implemented are described below.

2. TOTAL DEMAND MODEL

The Total Demand Model, shown in Equation 1, provides a mechanism for assessing overall growth in the travel market.

Equation 1:

$$T_{ijp} = e^{\beta_{0p}}(SE_{ijp})^{\beta_{1p}} e^{\beta_{2p} U_{ijp}}$$

Where,

T_{ijp} = Number of trips between zones *i* and *j* for trip purpose *p*

SE_{ijp} = Socioeconomic variables for zones *i* and *j* for trip purpose *p*

U_{ijp} = Total utility of the transportation system for zones *i* to *j* for trip purpose *p*

$\beta_{0p}, \beta_{1p}, \beta_{2p}$ = Coefficients for trip purpose *p*

As shown in Equation 1, the total number of trips between any two zones for all modes of travel, segmented by trip purpose, is a function of the socioeconomic characteristics of the zones and the total utility of the transportation system that exists between the two zones. For this study, trip purposes include Business, Commuter, and Social. The socioeconomic characteristics consist of population, employment and per capita income. The utility function provides a measure of the quality of the transportation system in terms of the times, costs, reliability and level of service provided by all modes for a given trip purpose. The Total Demand Model equation may be interpreted as meaning that travel between zones will increase as socioeconomic factors such as population and income rise or as the utility (or quality) of the transportation system is improved by providing new facilities and services that reduce travel times and/or costs. The Total Demand Model can therefore be used to evaluate the effect of changes in both socioeconomic and travel characteristics on the total demand for travel.

2.1 SOCIOECONOMIC VARIABLES

The socioeconomic variables in the Total Demand Model show the impact of economic growth on travel demand. The COMPASS™ Model System, in line with most intercity modeling systems, uses three variables (population, employment, and per household income) to represent the socioeconomic characteristics of a zone. Different combinations were tested in the calibration process and it was found, as is typically found elsewhere, that the most reasonable and statistically stable relationships consists of the following formulations:

Trip Purpose	***Socioeconomic Variable***
Business	$E_i E_j (I_i + I_j) / 2$
Commuter	$(P_iE_j+P_jE_i) / 2 (I_i+I_j) / 2$
Social	$P_i P_j (I_i + I_j) / 2$

The Business formulation consists of a product of employment in the origin zone, employment in the destination zone, and the average per capita income of the two zones. Since business trips are usually made between places of work, the presence of employment in the formulation is reasonable. While the income factor is correlated to the type of employment, higher income levels generate more Business trips. The Commuter formulation consists of all socioeconomic factors, this is because commuter trips are between homes and places of work, which are closely related to population and employment, and income factor is related to the wealth of the origin zone and the type of employment in the destination zone. The formulation for Social trip purposes such as leisure and tourist trip consists of a product of population in the origin zone, population in the destination zone and the average per capita income of the two zones. Other trip purposes encompass many types of trips, but the majority is home-based and thus, greater volumes of trips are expected from zones with higher population and income.

2.2 TRAVEL UTILITY

Estimates of travel utility for a transportation network are generated as a function of generalized cost (GC), as shown in Equation 2:

Equation 2:

$$U_{ijp} = f(GC_{ijp})$$

where,

GC_{ijp} = Generalized Cost of travel between zones *i* and *j* for trip purpose *p*

Because the generalized cost variable is used to estimate the impact of improvements in the transportation system on the overall level of trip making, it needs to incorporate all the key attributes that affect an individual's decision to make trips. For the public modes (i.e., rail and bus), the generalized cost of travel includes all aspects of travel time (access, egress, in-vehicle times), travel cost (fares), and schedule convenience (frequency of service, convenience of arrival/departure times). For auto travel, full average cost of operating a car is used for Business, while only the marginal cost is used for Commuter and Social trips. In addition, tolls and parking charges are used where appropriate.

The generalized cost of travel is typically defined in travel time (i.e., minutes) rather than dollars. Costs are converted to time by applying appropriate conversion factors, as shown in Equation 3. The generalized cost (GC) of travel between zones i and j for mode m and trip purpose p is calculated as follows:

Equation 3:

$$GC_{ijmp} = TT_{ijm} + \frac{TC_{ijmp}}{VOT_{mp}} + \frac{VOF_{mp} * OH * \ln(\alpha * F_{ijm})}{VOT_{mp} * \beta * F_{ijm}^2}$$

Where,

TT_{ijm}	=	Travel Time between zones *i* and *j* for mode *m* (in-vehicle time + station wait time + connection wait time + access/egress time + interchange penalty), with waiting, connect and access/egress time multiplied by a factor (greater than 1) to account for the additional disutility felt by travelers for these activities
TC_{ijmp}	=	Travel Cost between zones *i* and *j* for mode *m* and trip purpose *p* (fare + access/egress cost for public modes, operating costs for auto)
VOT_{mp}	=	Value of Time for mode *m* and trip purpose *p*
VOF_{mp}	=	Value of Frequency for mode *m* and trip purpose *p*
F_{ijm}	=	Frequency in departures per week between zones *i* and *j* for mode *m*
α, β	=	Frequency damping factors, α=0.191, β=0.074
OH	=	Operating hours per week

Station wait time is the time spent at the station before departure and after arrival. On trips with connections, there would be additional wait times incurred at the connecting station. Wait times are weighted higher than in-vehicle time in the generalized cost formula to reflect their higher disutility as found from previous studies. Wait times are weighted 70 percent higher than in-vehicle time.

Similarly, access/egress time has a higher disutility than in-vehicle time. Access time tends to be more stressful for the traveler than in-vehicle time because of the uncertainty created by trying to catch the flight or train. Based on previous work, access time is weighted 80 percent higher for rail and bus travel.

The third term in the generalized cost function converts the frequency attribute into time units. Operating hours divided by frequency is a measure of the headway or time between departures. Tradeoffs are made in the stated preference surveys resulting in the value of frequencies on this measure. Although there may appear to some double counting because the station wait time in the first term of the generalized cost function is included in this headway measure, it is not the headway time itself that is being added to the generalized cost. The third term represents the impact of perceived frequency valuations on generalized cost. TEMS has found it very effective to measure this impact as a function of the headway.

2.3 Calibration of the Total Demand Model

In order to calibrate the Total Demand Model, the coefficients are estimated using linear regression techniques. Equation 1, the equation for the Total Demand Model, is transformed by taking the natural logarithm of both sides, as shown in Equation 4:

Equation 4:

$$\log(T_{ijp}) = \beta_{0p} + \beta_{1p} \log(SE_{ijp}) + \beta_{2p}(U_{ijp})$$

Equation 4 provides the linear specification of the model necessary for regression analysis.

The segmentation of the database by trip purpose resulted in two sets of models. The results of the calibration for the Total Demand Models are displayed in Exhibit B-1.

Exhibit B-1: Total Demand Model Coefficients (1)

Business $\log(T_{ij}) = -4.5027 + 0.3455 \ln(SE_{ij}) + 0.0309\, U_{ij}$ $R^2=0.74$

(-132) (288) (39)

where $U_{ij} = \log[\exp(-6.9370+0.9971U_{Public}) + \exp(-0.0316\, GC_{Auto})]$

Commuter $\log(T_{ij}) = -2.8057 + 0.2992 \ln(SE_{ij}) + 0.0326\, U_{ij}$ $R^2=0.70$

(-82) (252) (34)

where $U_{ij} = \log[\exp(-4.7605+0.9992U_{Public}) + \exp(-0.0303\, GC_{Auto})]$

Social $\log(T_{ij}) = -1.9887 + 0.2938 \ln(SE_{ij}) + 0.0914\, U_{ij}$ $R^2=0.68$

(-56) (254) (53)

where $U_{ij} = \log[\exp(-0.2406+0.9857U_{Public}) + \exp(-0.0054\, GC_{Auto})]$

(1) *t-statistics are given in parentheses.*

In evaluating the validity of a statistical calibration, there are two key statistical measures: t-statistics and R2. The t-statistics are a measure of the significance of the model's coefficients; values of 1.95 and above are considered "good" and imply that the variable has significant explanatory power in estimating the level of trips. R2 is a statistical measure of the "goodness of fit" of the model to the data; any data point that deviates from the model will reduce this measure. It has a range from 0 to a perfect 1, with 0.3 and above considered "good" for large data sets. Based on these two measures, the total demand calibrations are good. The t-statistics are high, aided by the large size of the data set. The R2 values imply good fits of the equations to the data.

As shown in Exhibit B-1, the socioeconomic elasticity values for the Total Demand Model are 0.34 and 0.29 for business and non-business trips, meaning that each one percent growth in the socioeconomic term generates approximately a 0.34 and 0.29 percent growth in the total business and non-business travel market respectively.

The coefficient on the utility term is not strictly elasticity, but it can be considered an approximation. The utility term is related to the scale of the generalized costs, for example, utility elasticity can be high if the absolute value of transportation utility improvement is significant. This is not untypical when new transportation systems are built. In these cases, a 20 percent reduction in utility is not unusual and may impact more heavily on longer origin-destination pairs than shorter origin-destination pairs.

2.4 Incremental Form of the Total Demand Model

The calibrated Total Demand Models could be used to estimate the total travel market for any zone pair using the population, employment, per household income, and the total utility of all the modes. However, there would be significant differences between estimated and observed levels of trip making for many zone pairs despite the good fit of the models to the data. To preserve the unique travel patterns contained in the base data, the incremental approach or "pivot point" method is used for forecasting. In the incremental approach, the base travel data assembled in the database are used as pivot points, and forecasts are made by applying trends to the base data. The total demand equation as described in Equation 1 can be rewritten into the following incremental form that can be used for forecasting (Equation 5):

Equation 5:

$$\frac{T_{ijp}{}^{f}}{T_{ijp}{}^{b}} = \left(\frac{SE_{ijp}{}^{f}}{SE_{ijp}{}^{b}}\right)^{\beta_{1p}} \exp(\beta_{2p}\,(U_{ijp}{}^{f} - U_{ijp}{}^{b}))$$

Where,

T^f_{ijp} = Number of Trips between zones *i* and *j* for trip purpose *p* in forecast year *f*

T^f_{ijp} = Number of Trips between zones *i* and *j* for trip purpose *p* in base year *b*

SE^f_{ijp} = Socioeconomic variables for zones *i* and *j* for trip purpose *p* in forecast year *f*

SE^b_{ijp} = Socioeconomic variables for zones *i* and *j* for trip purpose *p* in base year *b*

U^f_{ijp} = Total utility of the transportation system for zones *i* to *j* for trip purpose *p* in forecast year *f*

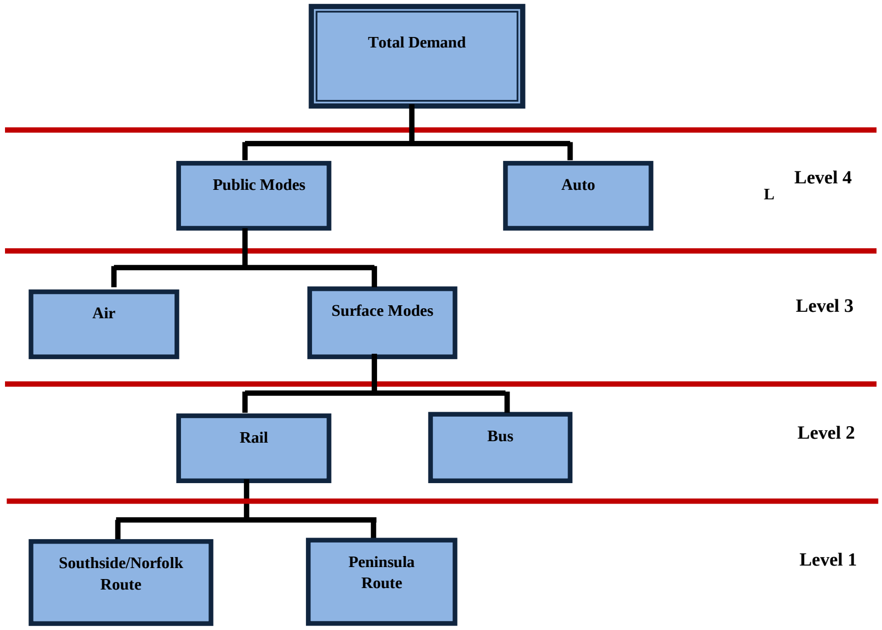
U^b_{ijp} = Total utility of the transportation system for zones *i* to *j* for trip purpose *p* in base year *b*

In the incremental form, the constant term disappears and only the elasticities are important.

3. HIERARCHICAL MODAL SPLIT MODEL

The role of the Hierarchical Modal Split Model is to estimate relative modal shares, given the Total Demand Model estimate of the total market that consists of different travel modes available to travelers. The relative modal shares are derived by comparing the relative levels of service offered by each of the travel modes. The COMPASS™ Hierarchical Modal Split Model uses a nested logit structure, which has been adapted to model the interurban modal choices available in the study area. The hierarchical modal split model is shown in Exhibit B-2.

Exhibit B-2: Hierarchical Structure of the Modal Split Model

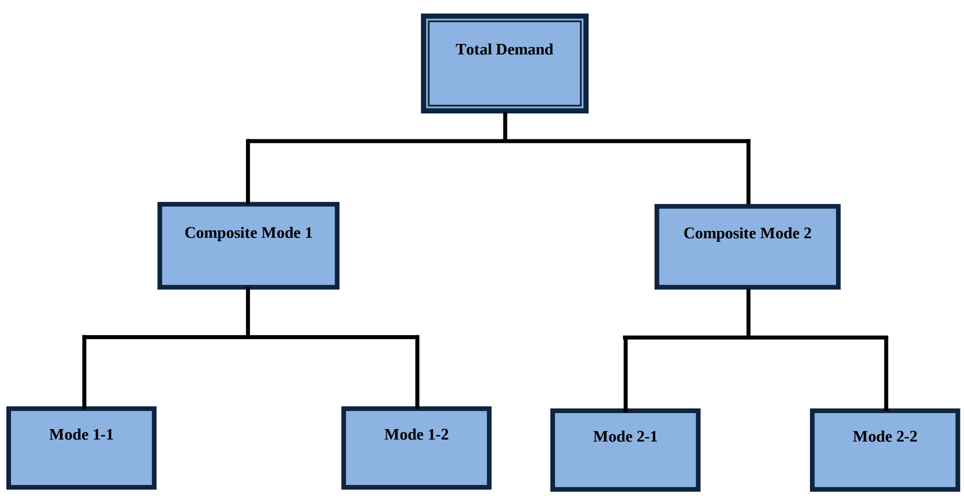


The main feature of the Hierarchical Modal Split Model structure is the increasing commonality of travel characteristics as the structure descends. The upper level of the hierarchy separates private auto travel – with its spontaneous frequency, low access/egress times, low costs and highly personalized characteristics – from the public modes. The lower separates Maglev – a faster and more comfortable public mode from Transit, which provides slower conventional rail and bus services within the corridor.

3.1 Background of the Hierarchical Modal Split Theory

The modal split models used by TEMS derived from the standard nested logit model. Exhibit B-3 shows a typical two-level standard nested model. In the nested model shown in Exhibit B-3, there are four travel modes that are grouped into two composite modes, namely, Composite Mode 1 and Composite Mode 2.

Exhibit B-3: A Typical Standard Nested Logit Model



Each travel mode in the above model has a utility function of Uj, j = 1, 2, 3, 4. To assess modal split behavior, the logsum utility function, which is derived from travel utility theory, has been adopted for the composite modes in the model. As the modal split hierarchy ascends, the logsum utility values are derived by combining the utility of lower-level modes. The composite utility is calculated by

$$U_{N_k} = \alpha_{N_k} + \beta_{N_k} \log \sum_{i \in N_k} \exp(\rho U_i) \qquad (1)$$

where

N_k is composite mode k in the modal split model,

i is the travel mode in each nest,

U_i is the utility of each travel mode in the nest,

ρ is the nesting coefficient.

The probability that composite mode k is chosen by a traveler is given by

$$P(N_k) = \frac{\exp(U_{N_k} / \rho)}{\sum_{N_i \in N} \exp(U_{N_i} / \rho)} \qquad (2)$$

The probability of mode i in composite mode k being chosen is

$$P_{N_k}(i) = \frac{\exp(\rho U_i)}{\sum_{j \in N_k} \exp(\rho U_j)} \qquad (3)$$

A key feature of these models is a use of utility. Typically in transportation modeling, the utility of travel between zones i and j by mode m for purpose p is a function of all the components of travel time, travel cost, terminal wait time and cost, parking cost, etc. This is measured by generalized cost developed for each origin-destination zone pair on a mode and purpose basis. In the model application, the utility for each mode is estimated by calibrating a utility function against the revealed base year mode choice and generalized cost.

Using logsum functions, the generalized cost is then transformed into a composite utility for the composite mode (e.g. Public modes in Exhibit B-2). This is then used at the next level of the hierarchy to compare the next most similar mode choice (e.g. in Exhibit B-2, Public mode is compared with Auto mode).

3.2 Calibration of the Hierarchical Modal Split Model

Working from the lower level of the hierarchy to the upper level, the first analysis is that of the Rail mode versus the Bus mode. As shown in Exhibit B-4, the model was effectively calibrated for three trip purposes, with reasonable parameters and R2 and t values. All the coefficients have the correct signs such that demand increases or decreases in the correct direction as travel times or costs are increased or decreased, and all the coefficients appear to be reasonable in terms of the size of their impact.

Exhibit B-4: Rail Southside/Norfolk Route versus Rail Peninsula Route Modal Split Model Coefficients [1]

Business $\log(P_{Rail\ South}/P_{Rail\ Peninsula}) = 0.2286 - 0.0086\ GC_{Rail\ South} + 0.0090\ GC_{Rail\ Peninsula}$ R^2=0.93

(61) (-686) (701)

Commuter $\log(P_{Rail\ South}/P_{Rail\ Peninsula}) = 0.1476 - 0.0059\ GC_{Rail\ South} + 0.0061\ GC_{Rail\ Peninsula}$ R^2=0.93

(59) (-674) (680)

Social $\log(P_{Rail\ South}/P_{Rail\ Peninsula}) = 0.1815 - 0.0056\ GC_{Rail\ South} + 0.0058\ GC_{Rail\ Peninsula}$ R^2=0.93

(65) (-679) (687)

(1) *t-statistics are given in parentheses.*

The coefficients for the upper levels of the hierarchy of Rail mode versus Bus mode, Surface mode versus Air mode, and Public versus Auto mode are given in Exhibits B-5, B-6, and B-7 respectively. The utility of the composite modes is obtained by deriving the logsum of the utilities of lower level modes from the model. The model calibrations for both trip purposes are statistically significant, with good R2 and t values, and reasonable coefficients.

Exhibit B-5: Rail versus Bus Modal Split Model Coefficients [1]

Business $\log(P_{Rail}/P_{Bus}) = 7.1339 + 0.8983\ U_{Rail} + 0.0037\ GC_{Bus}$ R^2=0.93

(904) (515) (267)

where $U_{Rail} = \log[\exp(0.2286-0.0086GC_{Rail\ South}) + \exp(-0.0090\ GC_{Rail\ Peninsula})]$

Commuter $\log(P_{Rail}/P_{Bus}) = 4.0241 - 0.8914\ GC_{Rail} + 0.0029\ GC_{Bus}$ R^2=0.81

(634) (385) (320)

where $U_{Rail} = \log[\exp(0.1476-0.0059GC_{Rail\ South}) + \exp(-0.0061\ GC_{Rail\ Peninsula})]$

Social $\log(P_{Rail}/P_{Bus}) = 4.0703 - 0.8988\ GC_{Rail} + 0.0020\ GC_{Bus}$ R^2=0.62

(431) (288) (158)

where $U_{Rail} = \log[\exp(0.1815-0.0056GC_{Rail\ South}) + \exp(-0.0058\ GC_{Rail\ Peninsula})]$

(1) *t-statistics are given in parentheses.*

Exhibit B-6: Surface versus Air Modal Split Model Coefficients (1)

Business $\log(P_{Surface}/P_{Air}) = -1.0862 + 0.9994\ U_{Surf} + 0.0077\ GC_{Air}$ $R^2=0.80$

(-31) (293) (206)

where $U_{Surf} = \log[\exp(7.1339 + 0.8983 U_{Rail}) + \exp(-0.0037\ GC_{Bus})]$

Commuter $\log(P_{Surface}/P_{Air}) = -2.4982 + 0.9976\ U_{Surf} + 0.0063\ GC_{Air}$ $R^2=0.72$

(-77) (229) (188)

where $U_{Surf} = \log[\exp(4.0241 + 0.8914 GC_{Rail}) + \exp(-0.0029\ GC_{Bus})]$

Social $\log(P_{Surface}/P_{Air}) = -1.9248 + 0.9963\ U_{Surf} + 0.0046\ GC_{Air}$ $R^2=0.73$

(-76) (246) (177)

where $U_{Surf} = \log[\exp(4.0703 + 0.8988 GC_{Rail}) + \exp(-0.0020\ GC_{Bus})]$

(1) *t-statistics are given in parentheses.*

Exhibit B-7: Public versus Auto Modal Split Model Coefficients (1)

Business $\log(P_{Public}/P_{Auto}) = -6.9370 + 0.9971\ U_{Public} + 0.0316\ GC_{Auto}$ $R^2=0.96$

(-358) (106) (595)

where $U_{Public} = \log[\exp(-1.0862 + 0.9994 U_{Surface}) + \exp(-0.0077\ GC_{Air})]$

Commuter $\log(P_{Public}/P_{Auto}) = -4.7605 + 0.9992\ U_{Public} + 0.0303\ GC_{Auto}$ $R^2=0.97$

(-153) (73) (625)

where $U_{Public} = \log[\exp(-2.4982 + 0.9976 U_{Surface}) + \exp(-0.0063\ GC_{Air})]$

Social $\log(P_{Public}/P_{Auto}) = -0.2406 + 0.9857\ U_{Public} + 0.0054\ GC_{Auto}$ $R^2=0.85$

(-27) (211) (418)

where $U_{Public} = \log[\exp(-1.9248 + 0.9963 U_{Surface}) + \exp(-0.0046\ GC_{Air})]$

(1) *t-statistics are given in parentheses.*

3.3 Incremental Form of the Modal Split Model

Using the same reasoning as previously described, the modal split models are applied incrementally to the base data rather than imposing the model estimated modal shares. Different regions of the corridor may have certain biases toward one form of travel over another and these differences cannot be captured with a single model for the entire system. Using the "pivot point" method, many of these differences can be retained. To apply the modal split models incrementally, the following reformulation of the hierarchical modal split models is used (Equation 6):

Equation 6:

$$\frac{\left(\frac{P_A^f}{P_B^f}\right)}{\left(\frac{P_A^b}{P_B^b}\right)} = e^{\beta(GC_A^f - GC_B^b) + \gamma(GC_B^f - GC_B^b)}$$

For hierarchical modal split models that involve composite utilities instead of generalized costs, the composite utilities would be used in the above formula in place of generalized costs. Once again, the constant term is not used and the drivers for modal shifts are changed in generalized cost from base conditions.

Another consequence of the pivot point method is that it prevents possible extreme modal changes from current trip-making levels as a result of the calibrated modal split model, thus that avoid over- or under-estimating future demand for each mode.

4. Induced Demand Model

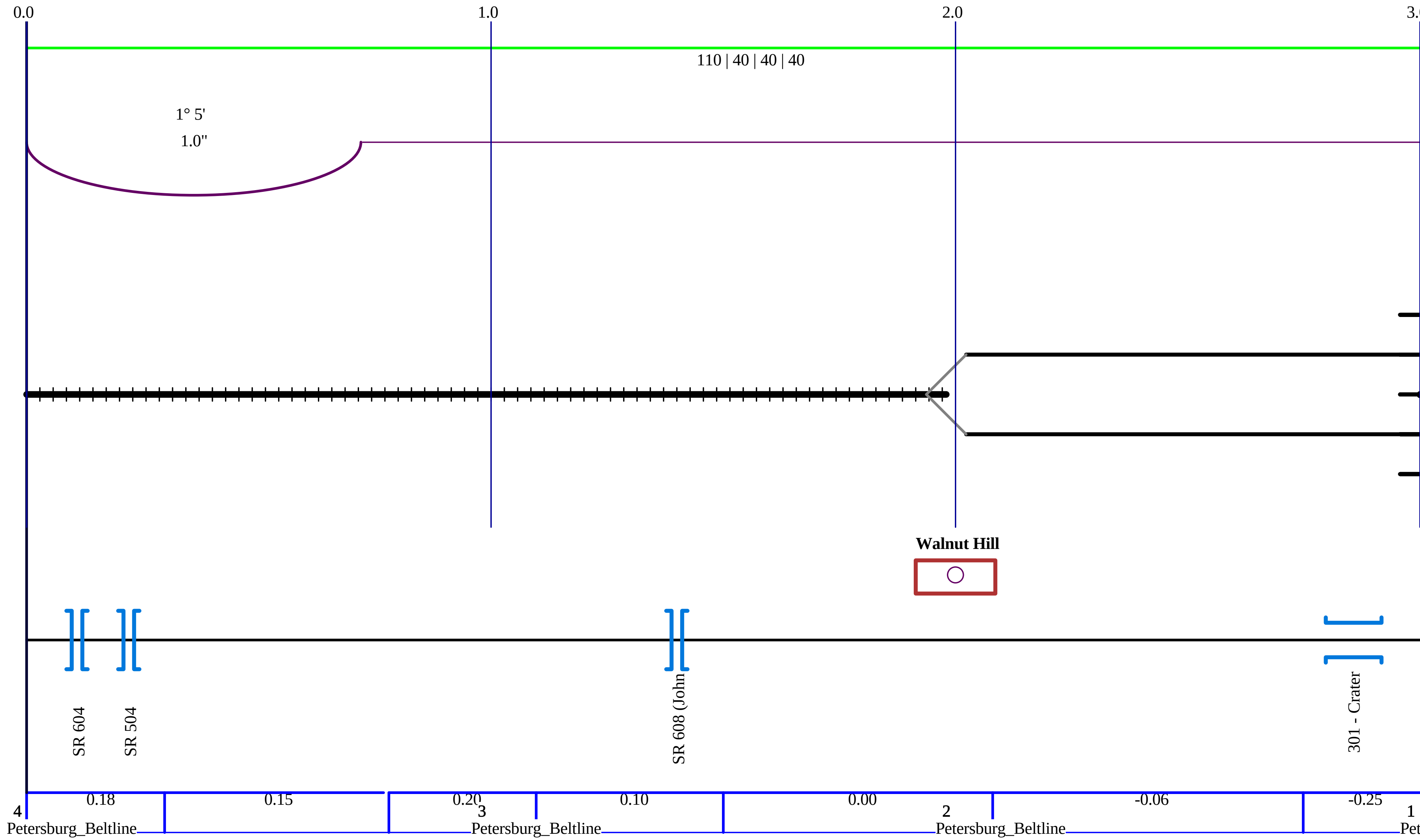
Induced demand refers to changes in travel demand related to improvements in a transportation system, as opposed to changes in socioeconomic factors that contribute to growth in demand. The quality or utility of the transportation system is measured in terms of total travel time, travel cost, and worth of travel by all modes for a given trip purpose. The induced demand model used the increased utility resulting from system changes to estimate the amount of new (latent) demand that will result from the implementation of the new system adjustments. The model works simultaneously with the mode split model coefficients to determine the magnitude of the modal induced demand based on the total utility changes in the system. It should be noted that the model will also forecast a reduction in trips if the quality of travel falls due to increased congestions, higher car operating costs, or increased tolls. The utility function is acting like a demand curve increasing or decreasing travel based on changes in price (utility) for travel. It assumes travel is a normal good and subject to the laws of supply and demand.

5. REFERENCES

- **[Ben-Akiva and Lerman, 1985],** M.E. Ben-Akiva and S.R. Lerman, *Discrete Choice Analysis: Theory and Application to Travel Demand,* MIT Press, 1985.
- **[Cascetta, 1996],** E. Cascetta, *Proceedings of the 13th International Symposium on the the Theory of Road Traffic Flow* (Lyon, France),1996.
- **[Daly, A, 1987],** A. Daly, *Estimating "tree" logit models*. Transportation Research B, 21(4):251-268, 1987.
- **[Daly, A., et.al., 2004],** A. Daly, J. Fox and J.G.Tuinenga, *Pivot-Point Procedures in Practical Travel Demand Forecasting*, RAND Europe, 2005
- **[Domenich and McFadden, 1975],** T.A. Domenich and D. McFadden, *Urban Travel Demand: A behavioral analysis,* Peninsula-Holland Publishing Company, 1975.
- **[Garling et.al., 1998],** T. Garling, T. Laitila, and K. Westin, *Theoretical Foundations of Travel Choice Modeling*, 1998.
- **[Hensher and Johnson, 1981],** D.A. Hensher and L.W. Johnson, *Applied discrete choice modelling.* Croom Helm, London, 1981
- **[Horowitz, et.al., 1986],** J.L. Horowitz, F.S. Koppelman, and S.R. Lerman, *A self-instructing course in disaggregate mode choice modeling,* Technology Sharing Program, USDOT, 1986.
- **[Koppelman, 1975],** F.S. Koppelman, *Travel Prediction with Models of Individual Choice Behavior*, PhD Submittal, Massachusetts Institute, 1975.
- **[Louviere, et.al., 2000],** *J.J.Louviere, D.A.Hensher, and J.D.Swait, Stated Choice Methods: Analysis and Application*, Cambridge, 2000
- **[Luce and Suppes, 1965],** R.D. Luce and P. Suppes, *Handbook of Mathematical Psychology*, 1965.
- **[Rogers et al., 1970],** K.G. Rogers, G.M. Townsend and A.E. Metcalf, *Planning for the work. Journey –a generalized explanation of modal choice*, Report C67, Reading, 1970.
- **[Wilson, 1967],** A.G. Wilson, *A Statistical Theory of Spatial Distribution models*, Transport Research, Vol. 1, 1967.
- **[Quarmby, 1967],** D. Quarmby, *Choice of Travel Mode for the Journey to Work: Some Findings*, Journal of Transport Economics and Policy, Vol. 1, No. 3, 1967.
- **[Yai, et.al., 1997],** T. Yai, S. Iwakura, and S. Morichi, *Multinominal probit with structured covariance for route choice behavior, Transportation Research B, 31(3):195-208, 1997.*

Appendix C – TRACKMAN™ Files

1. Norfolk Southern, Petersburg to Norfolk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SR 504
SR 608 (John
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0.15
0.20
0.10
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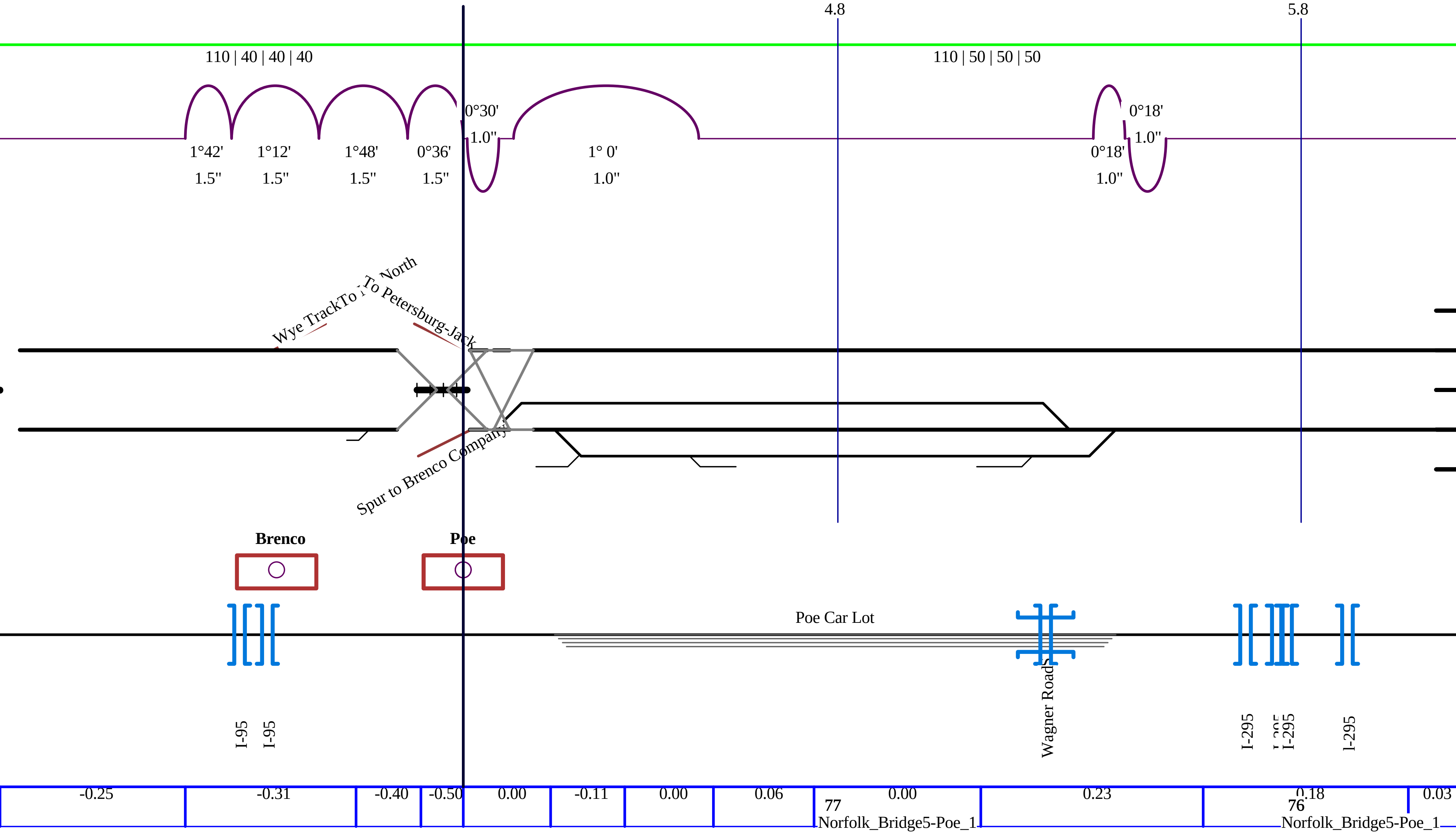
3
Petersburg_Beltline
2
Petersburg_Beltline
1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1.0"
1°42'
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1°12'
1.5"
1°48'
1.5"
0°36'
1.5"
1° 0'
1.0"
0°18'
1.0"
Wye TrackTo : To North
To Petersburg-Jack
Spur to Brenco Company
Brenco
Poe
Poe Car Lot
I-95
I-95
Wagner Road
I-295
I-295
I-295
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-0.50
0.00
-0.11
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76
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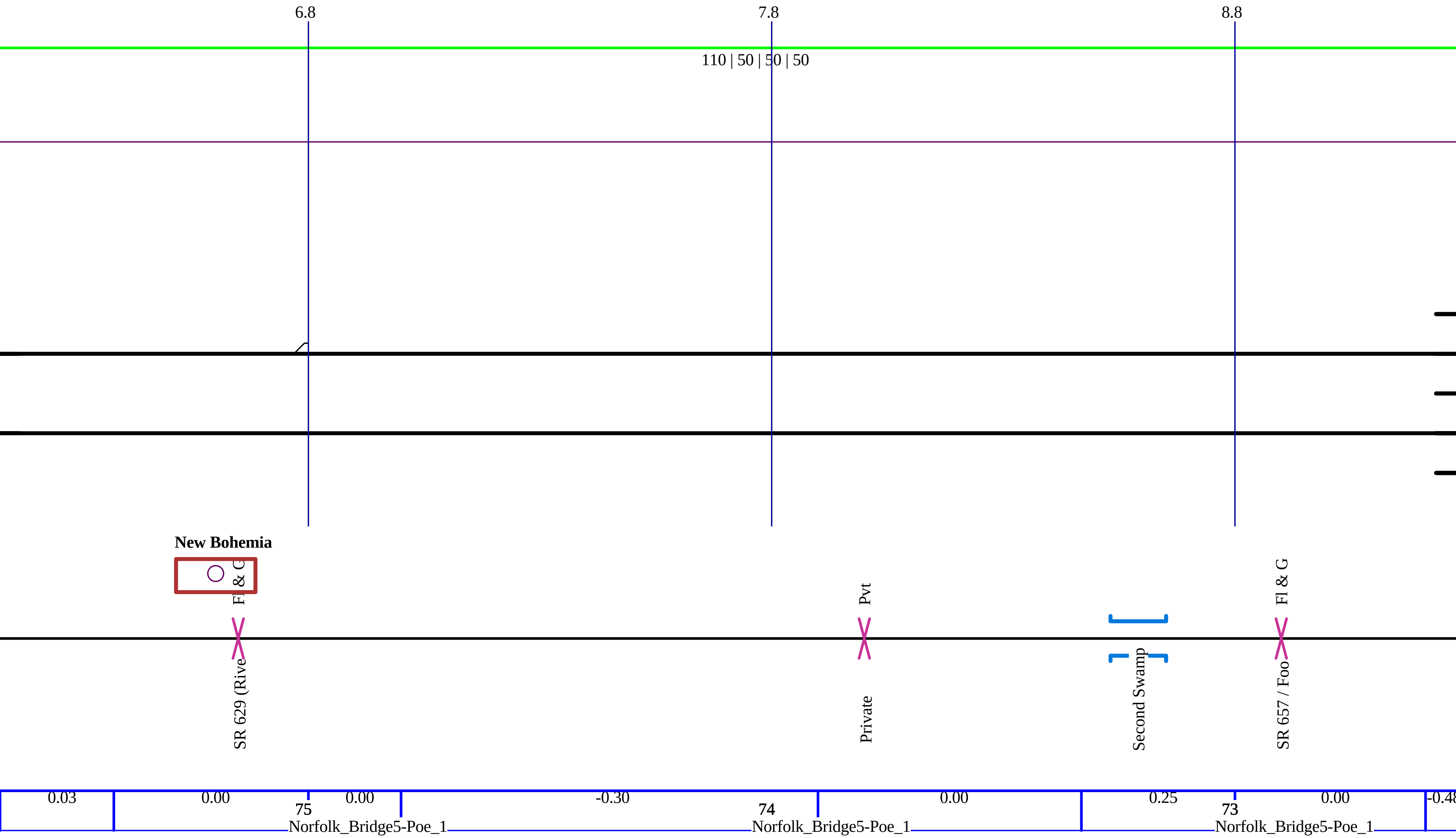

6.8
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New Bohemia
Fl & G
SR 629 (Rive
Pvt
Private
Second Swamp
Fl & G
SR 657 / Foo
0.03
0.00
0.00
-0.30
0.00
0.25
0.00
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75
74
73
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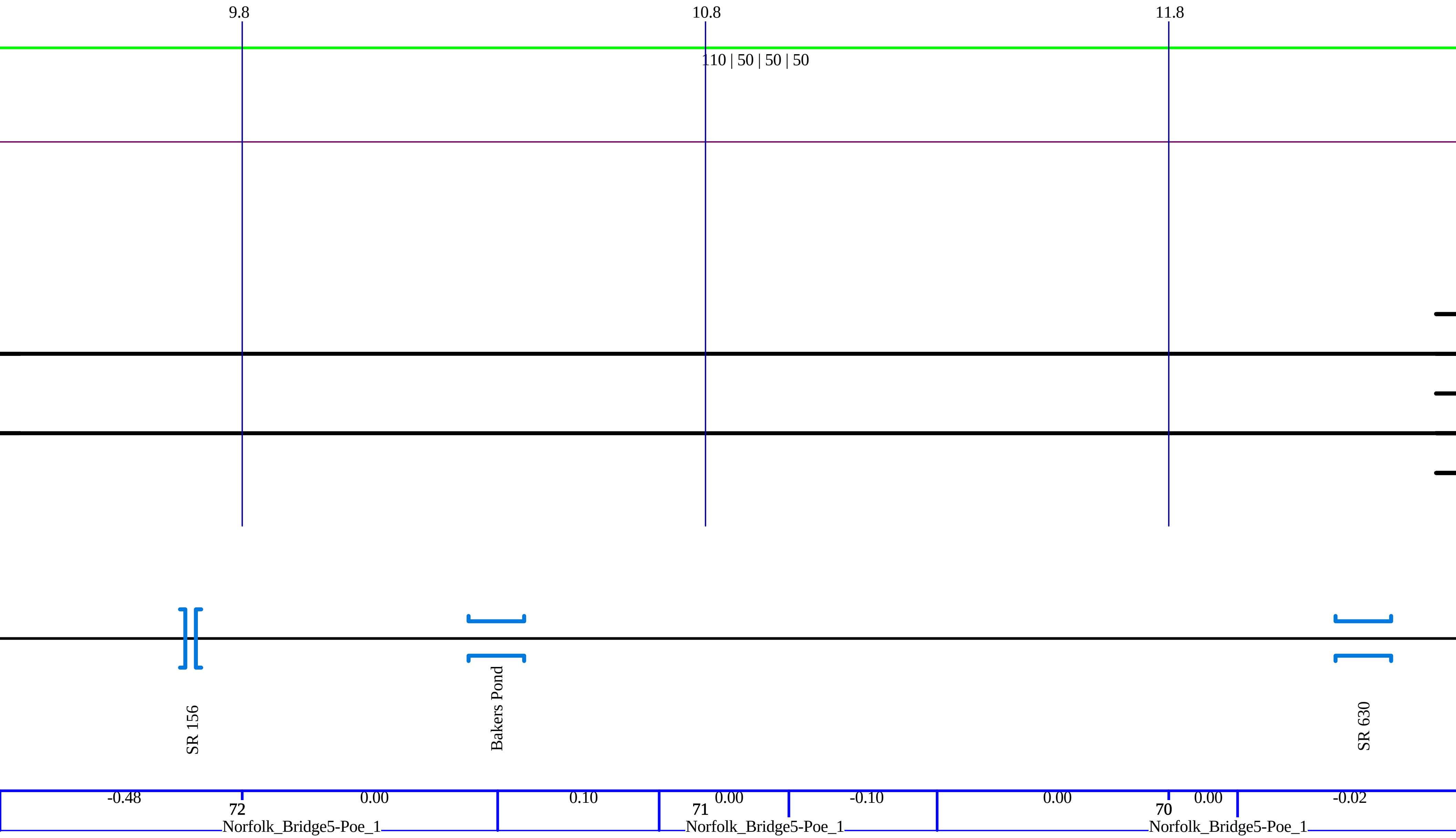
Norfolk_Bridge5-Poe_1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10.8
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110 | 50 | 50 | 50
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Bakers Pond
SR 630
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-0.10
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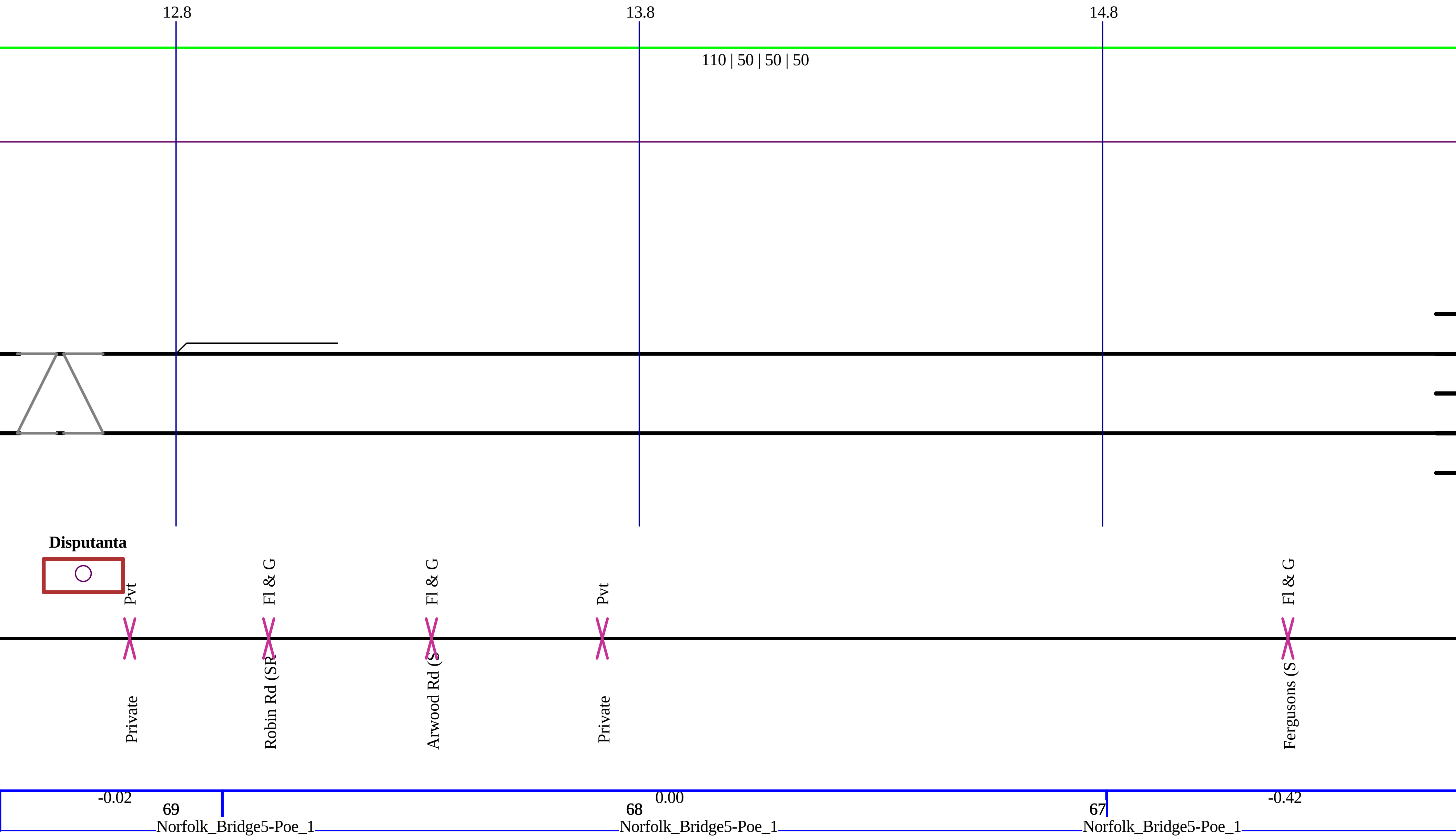
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Private
Fl & G
Fergusons (S
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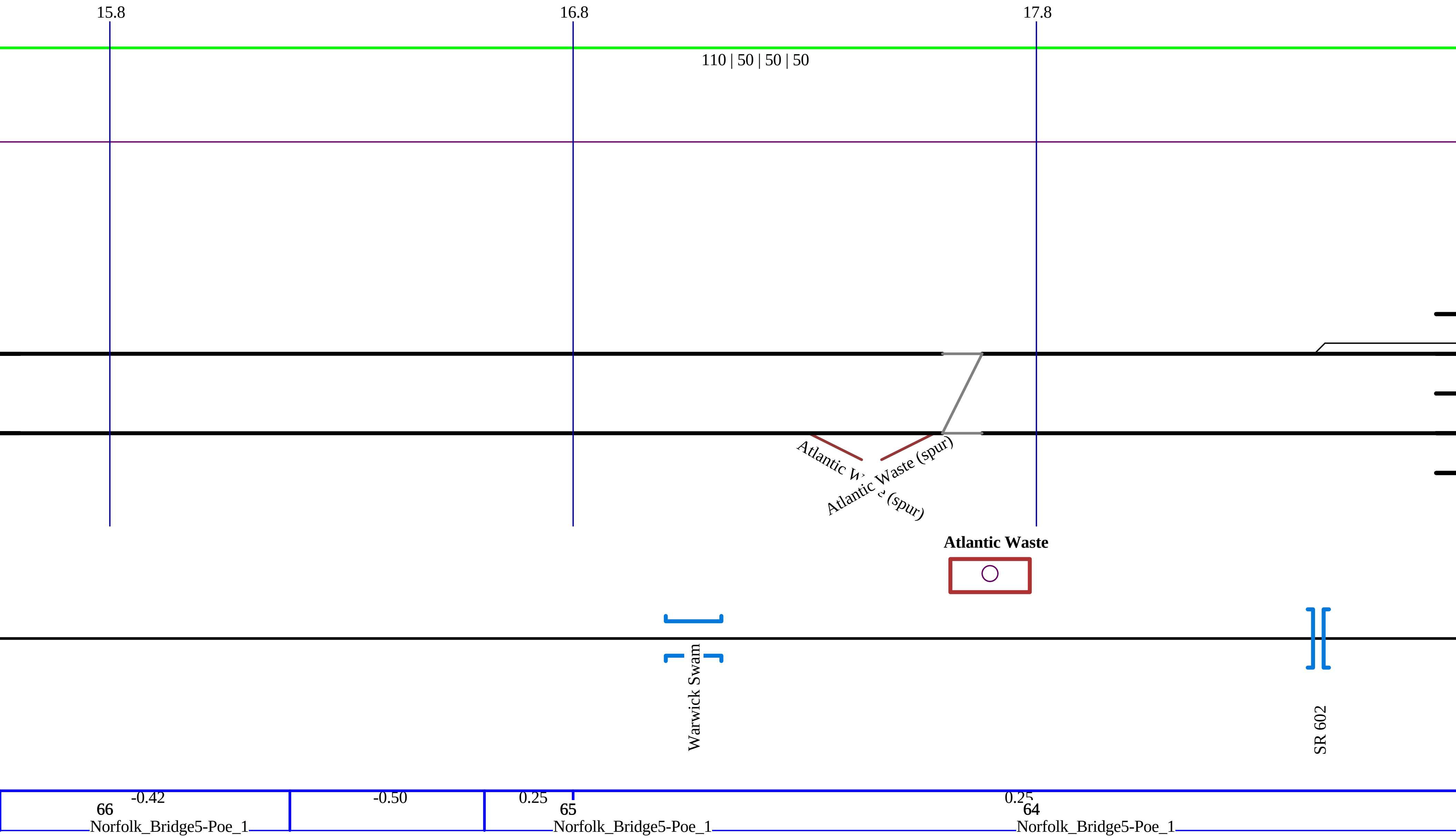
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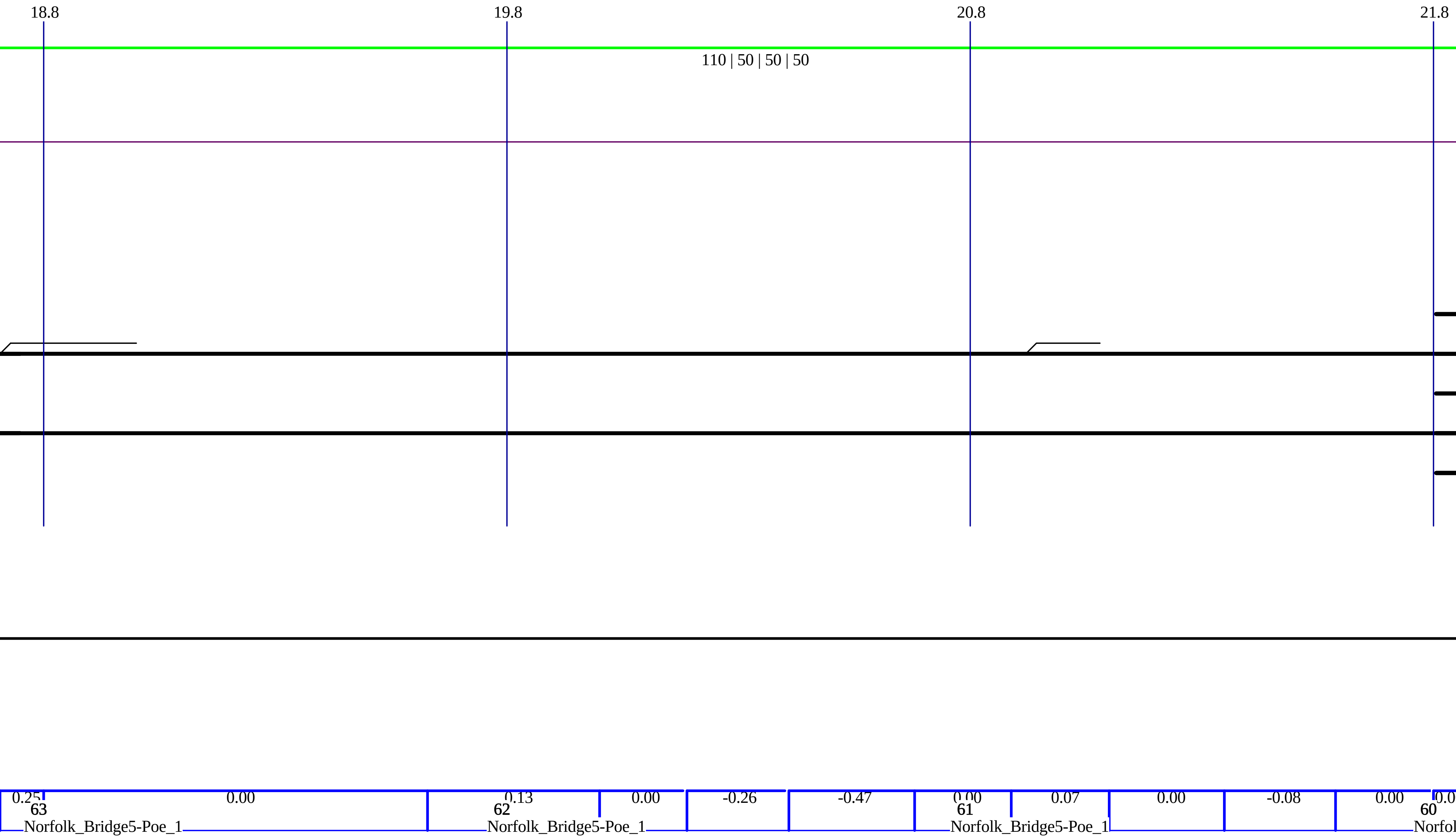
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20.8
21.8
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0.00
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0.00
0.07
0.00
-0.08
0.00
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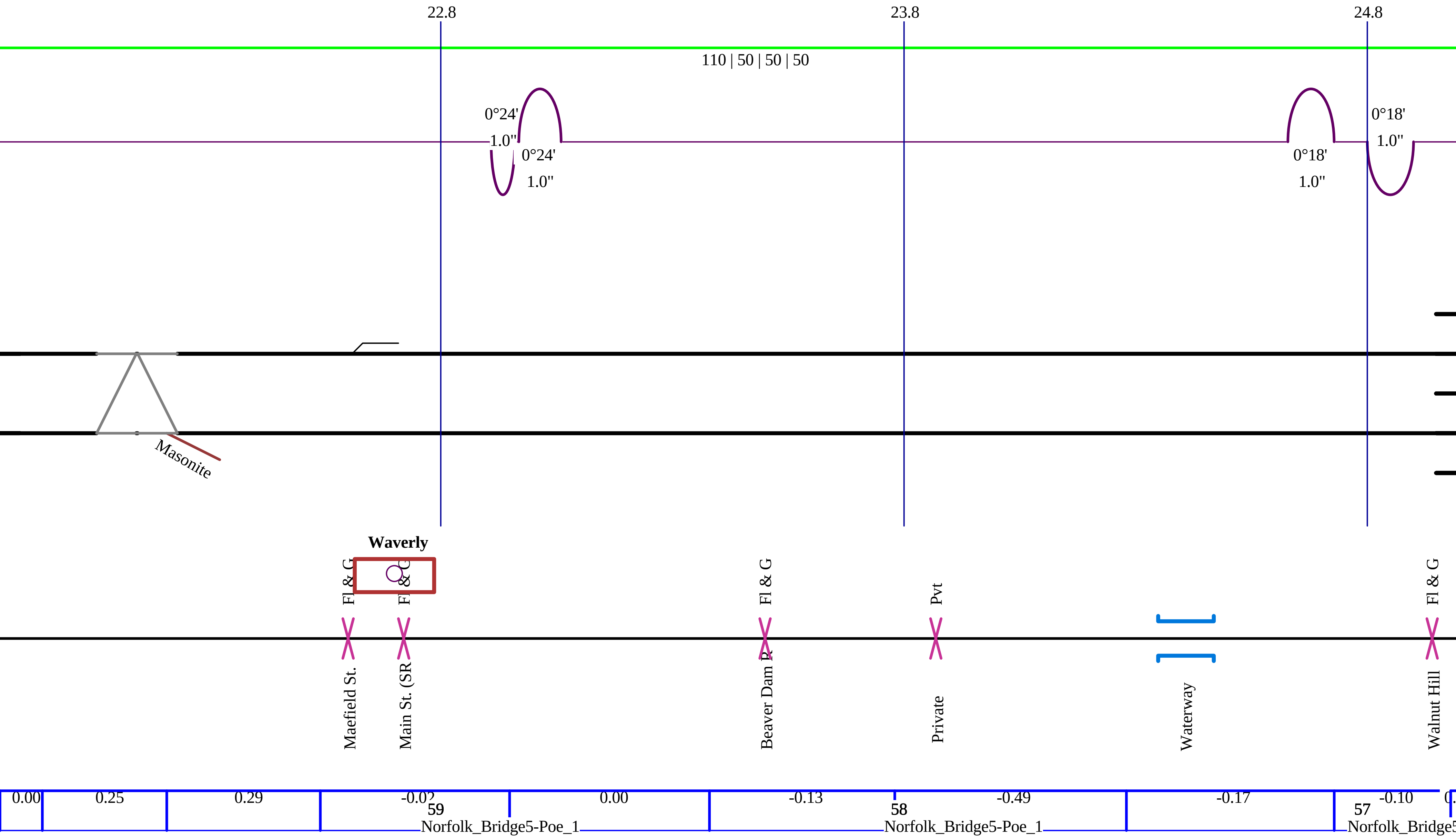
62
61
60
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1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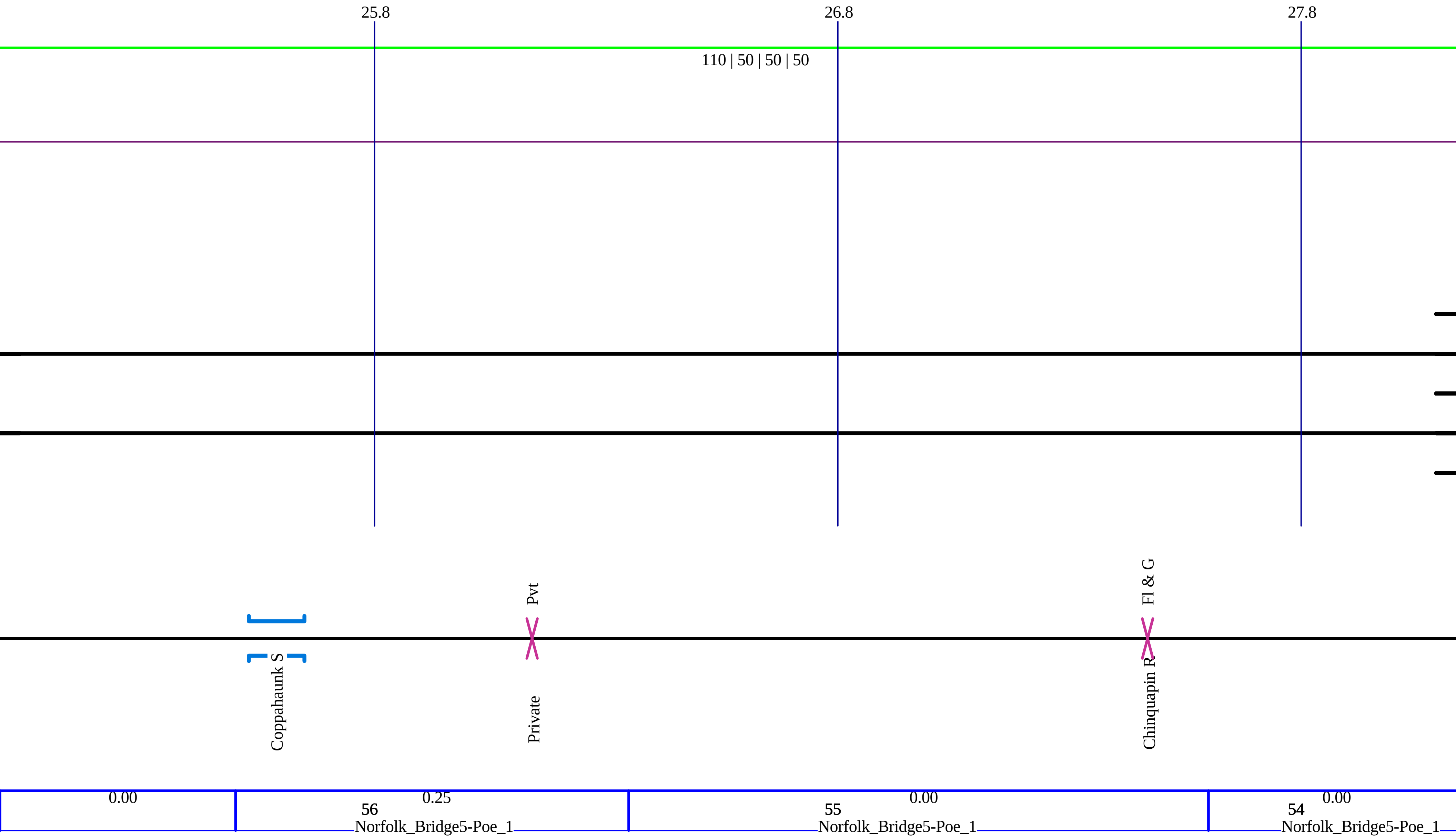
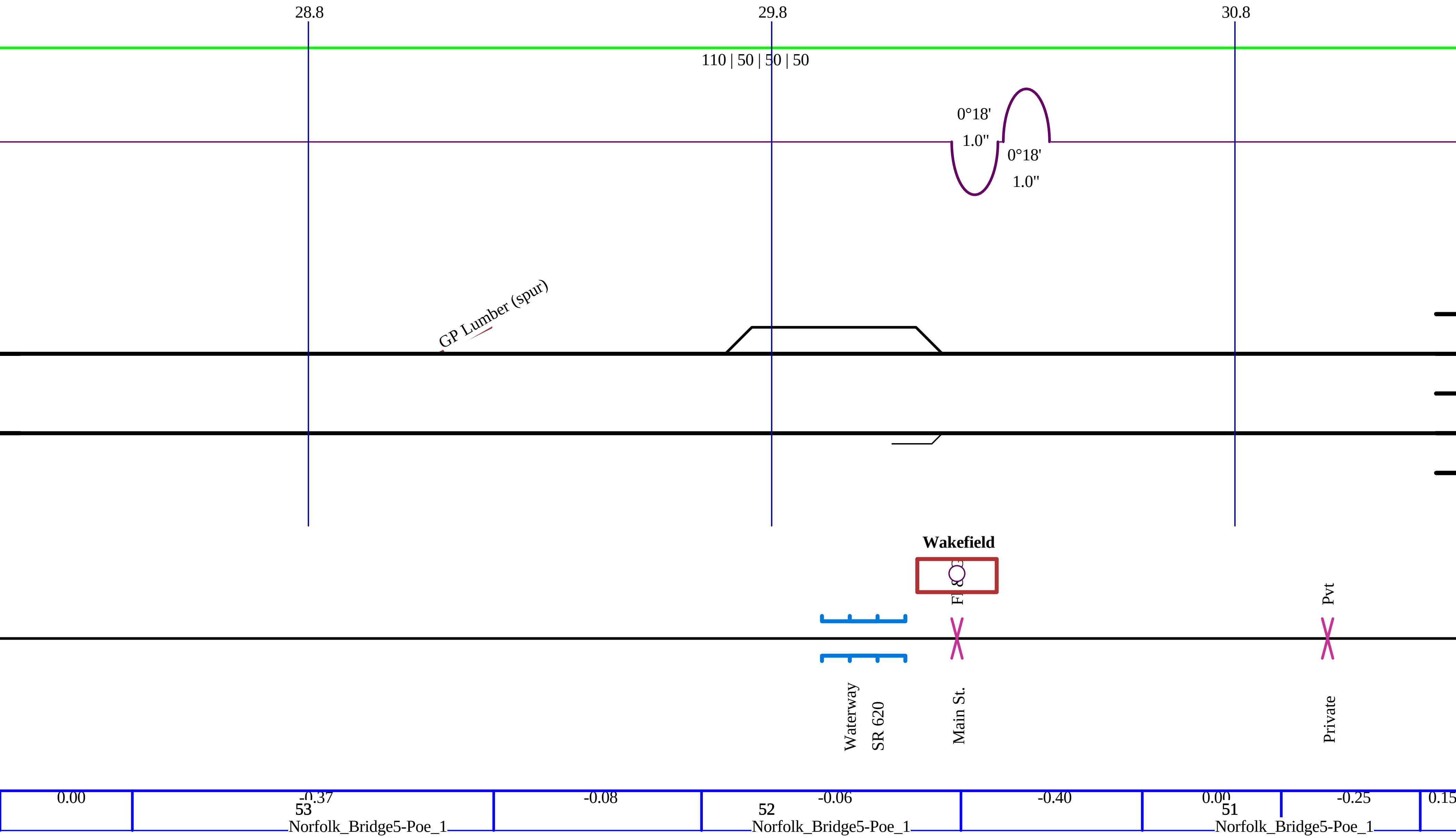
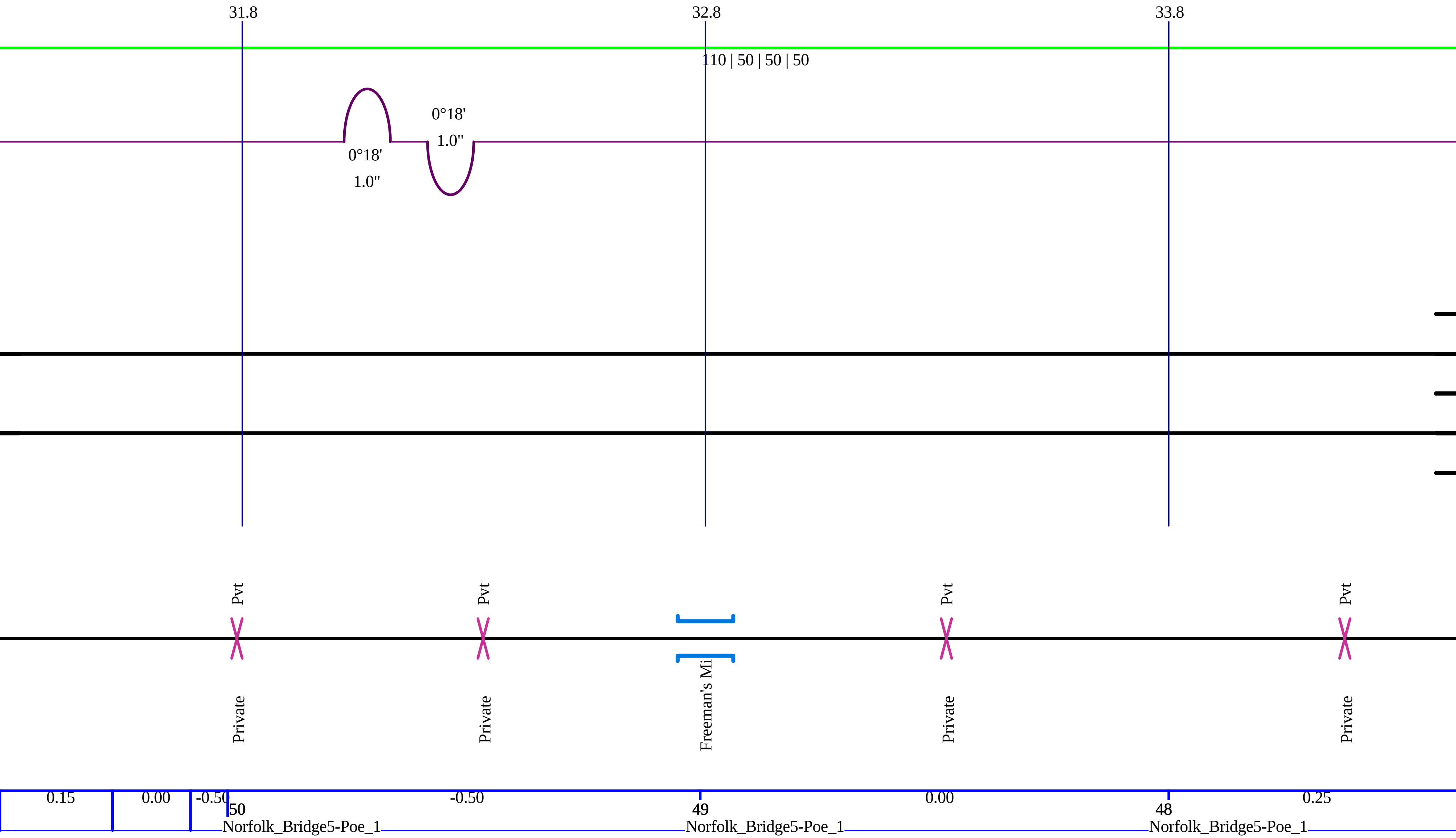
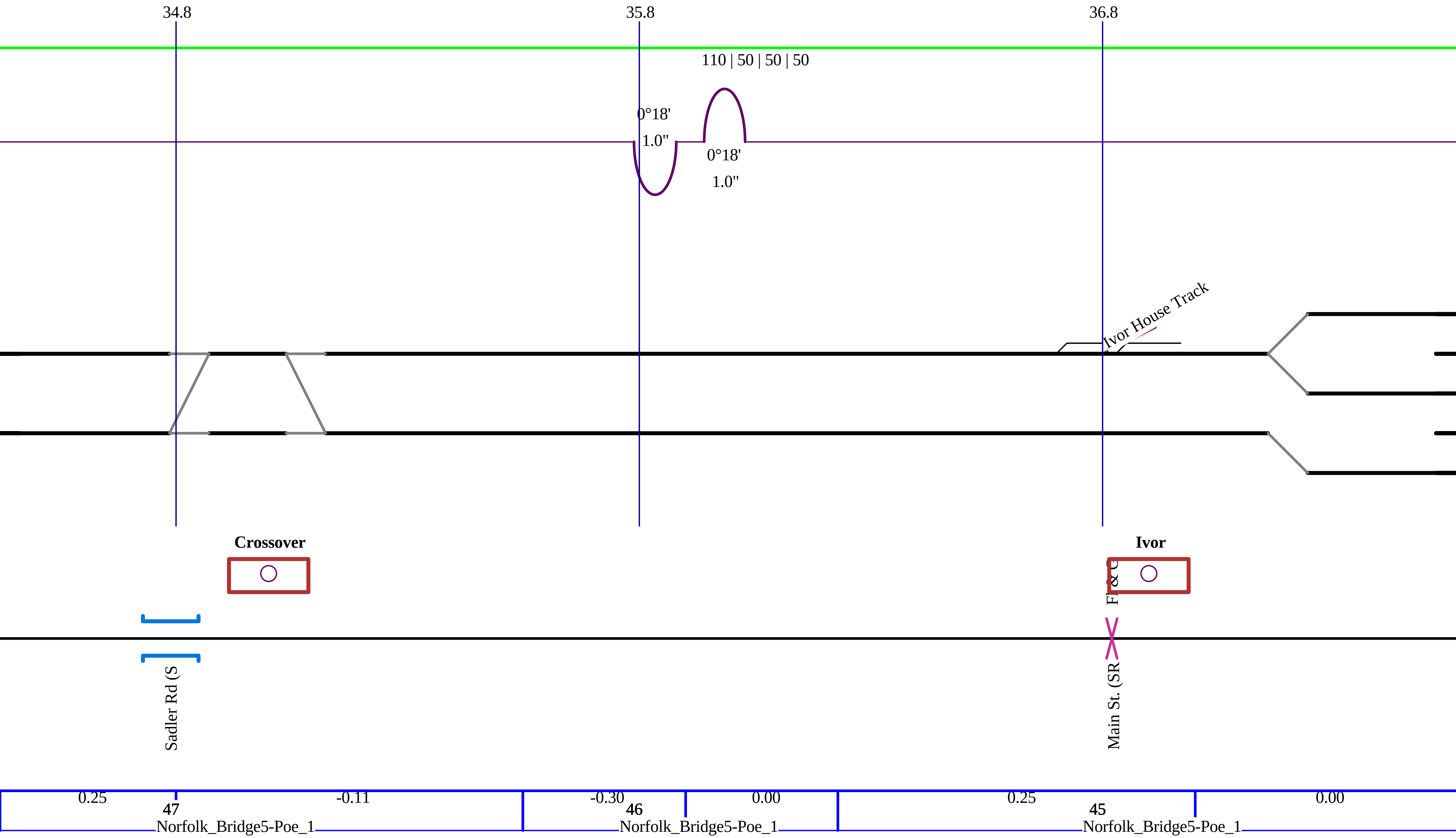
23.8
24.8
110 | 50 | 50 | 50
0°24'
1.0"
0°24'
1.0"
0°18'
1.0"
0°18'
1.0"
Masonite
Waverly
Fl & G
Fl & G
Fl & G
Pvt
Fl & G
Maefield St.
Main St. (SR
Beaver Dam R
Private
Waterway
Walnut Hill
0.00
0.25
0.29
-0.02
0.00
-0.13
-0.49
-0.17
-0.10
59
58
57
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5

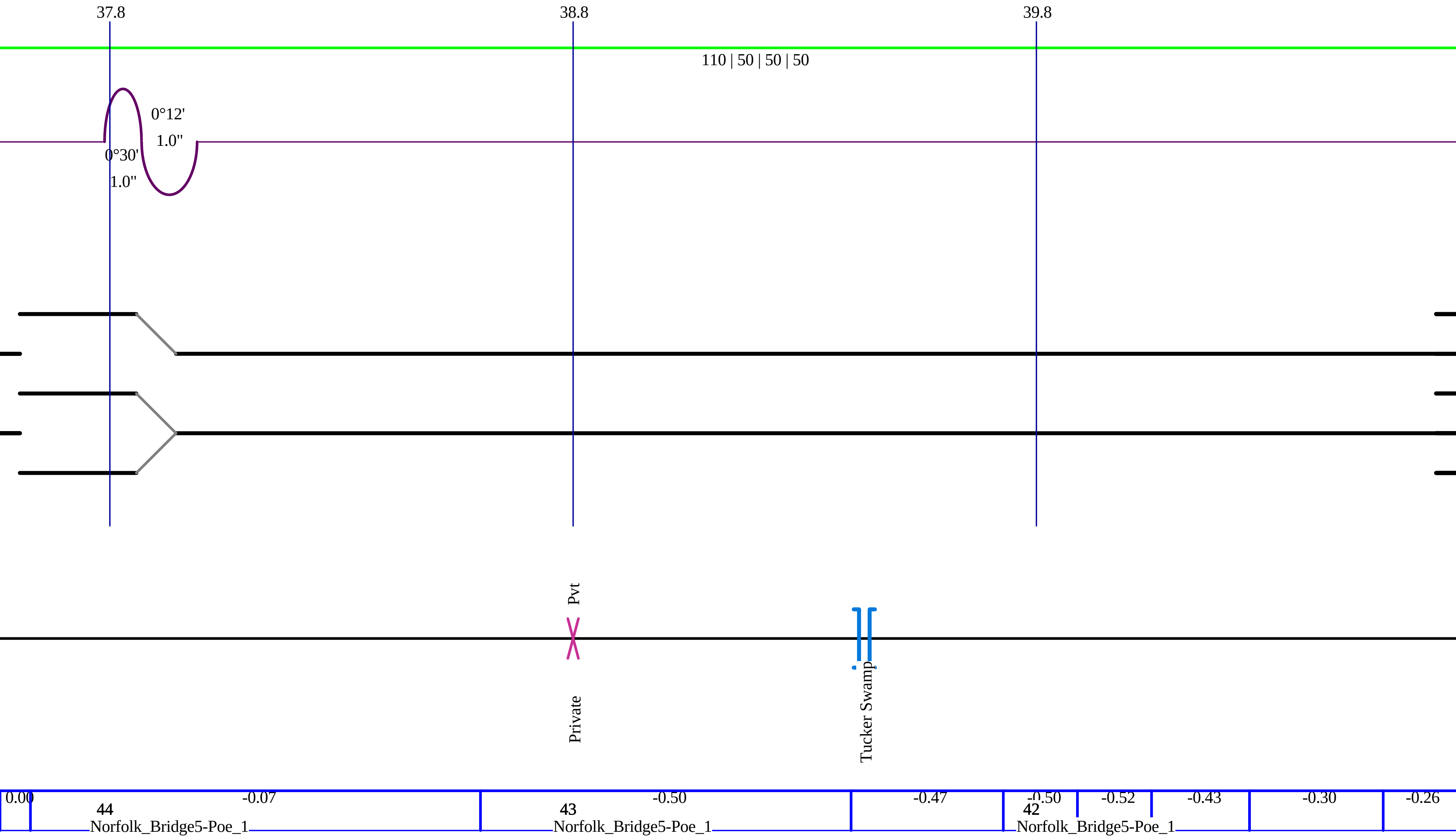

25.8
26.8
27.8
110 | 50 | 50 | 50
Coppahaunk S
Pvt
Private
Fl & G
Chinquapin R
0.00
0.25
0.00
0.00
56
55
54
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1

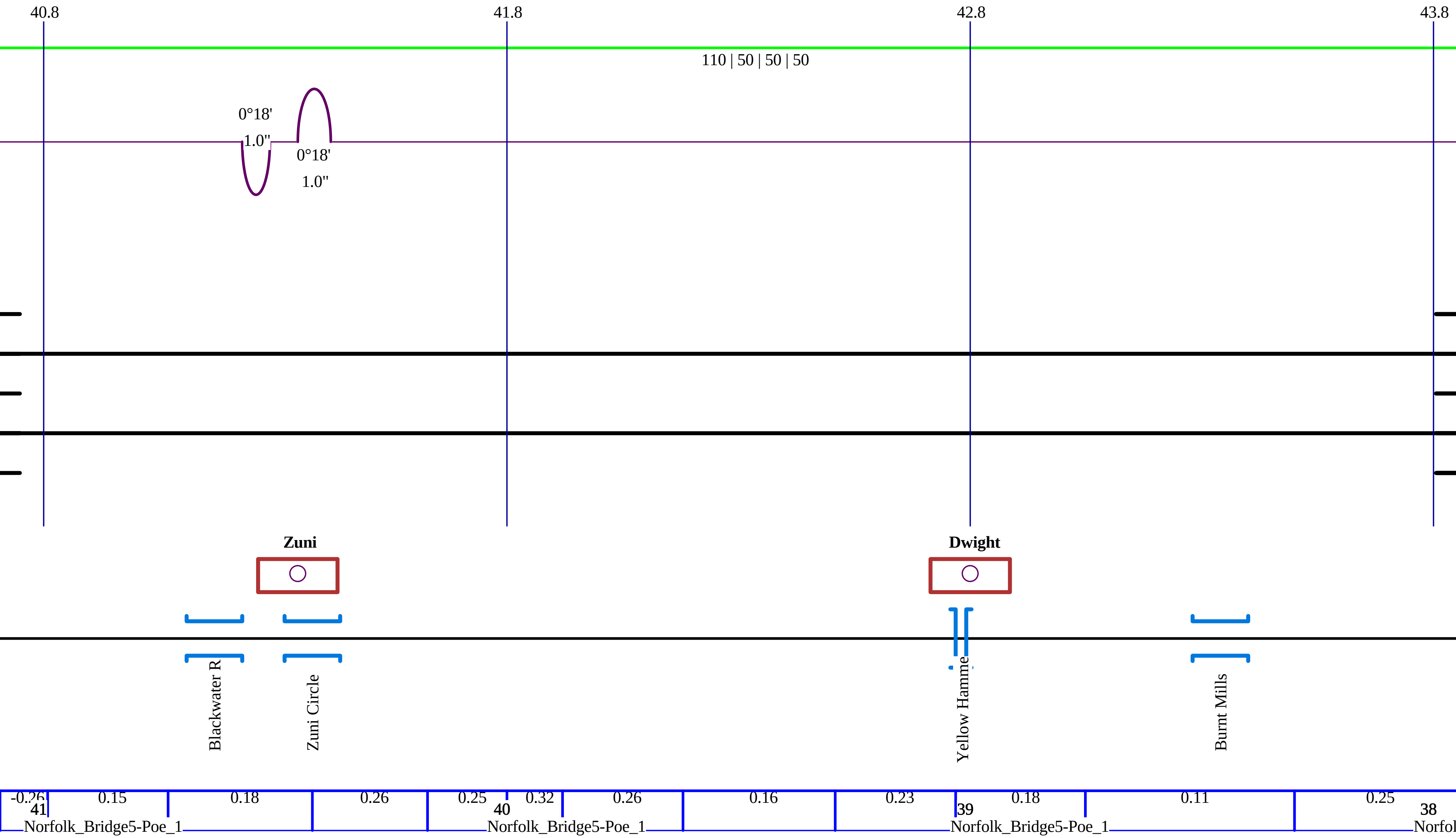

28.8
29.8
30.8
110 | 50 | 50 | 50
0°18'
1.0"
0°18'
1.0"
GP Lumber (spur)
Wakefield
Pvt
Waterway
SR 620
Main St.
Private
0.00
-0.37
-0.08
-0.06
-0.40
0.00
-0.25
0.15
53
52
51
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1

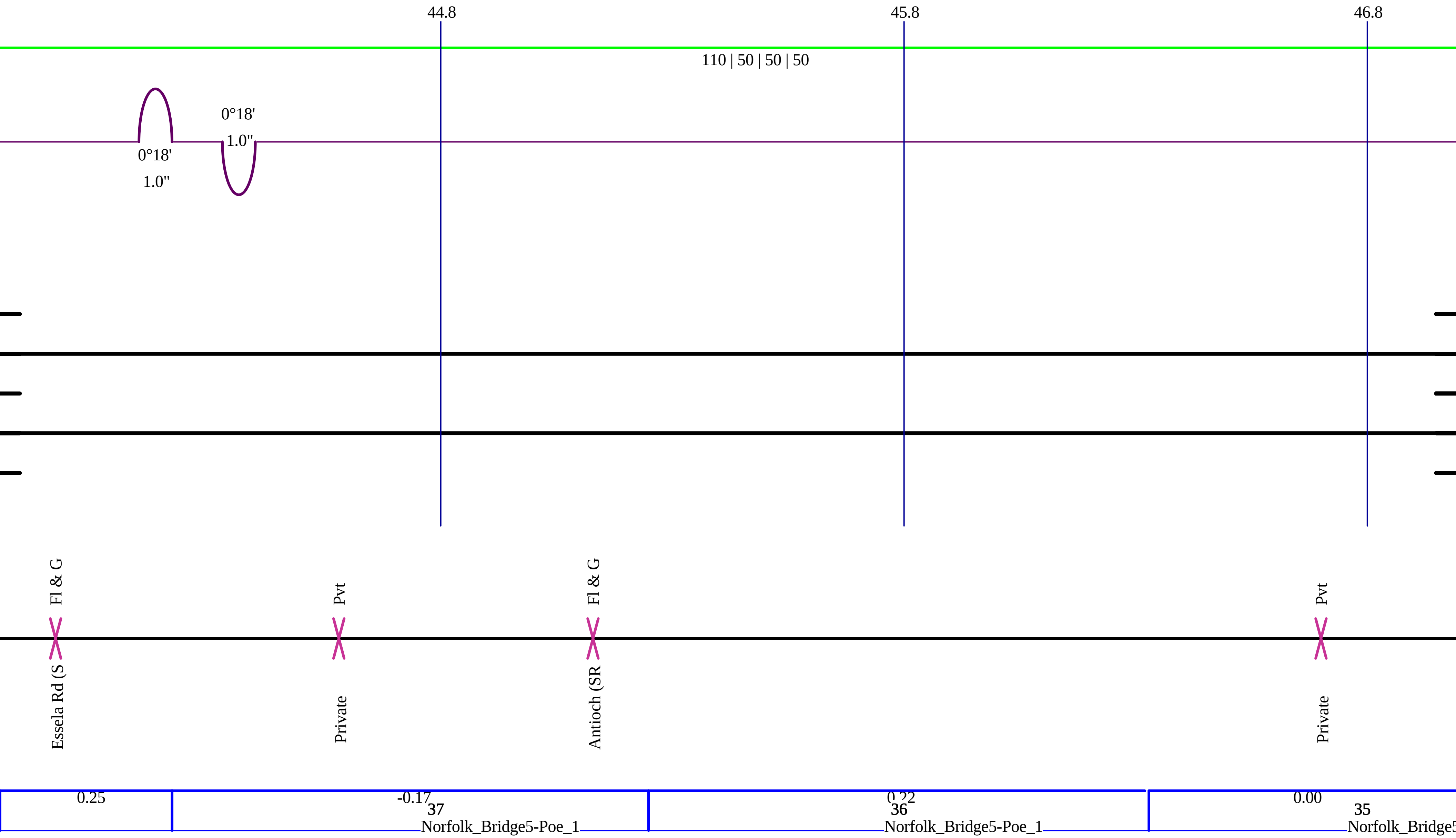

31.8
32.8
33.8
110 | 50 | 50 | 50
0°18'
1.0"
0°18'
1.0"
Pvt
Pvt
Pvt
Pvt
Private
Private
Freeman's Mi
Private
Private
0.15
0.00
-0.50
-0.50
0.00
0.25
50
49
48
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1

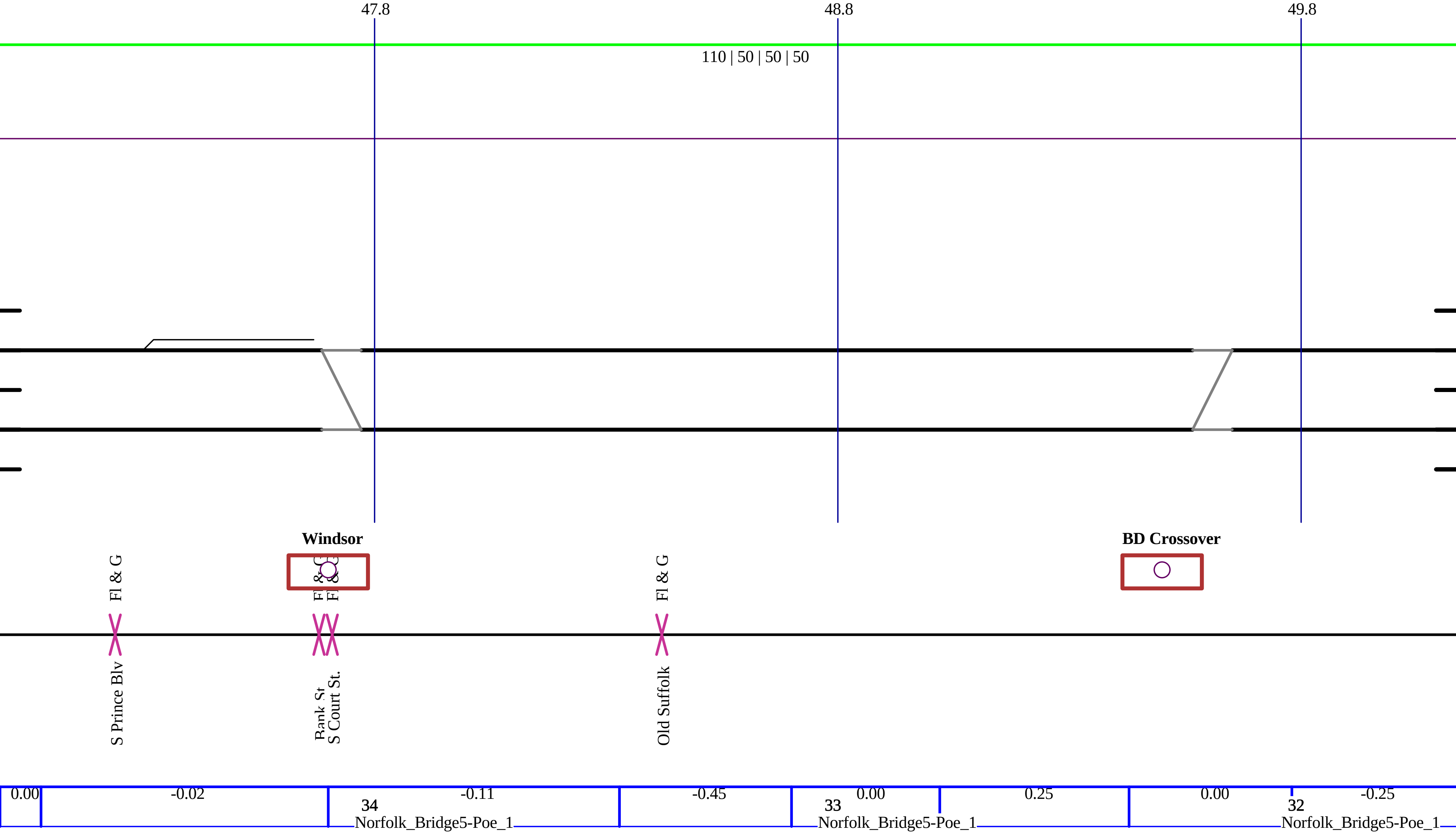


34.8
35.8
36.8
110 | 50 | 50 | 50
0°18'
1.0"
0°18'
1.0"
Ivor House Track
Crossover
Ivor
Sadler Rd (S
Main St. (SR
0.25
-0.11
-0.30
0.00
0.25
0.00
47
46
45
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1

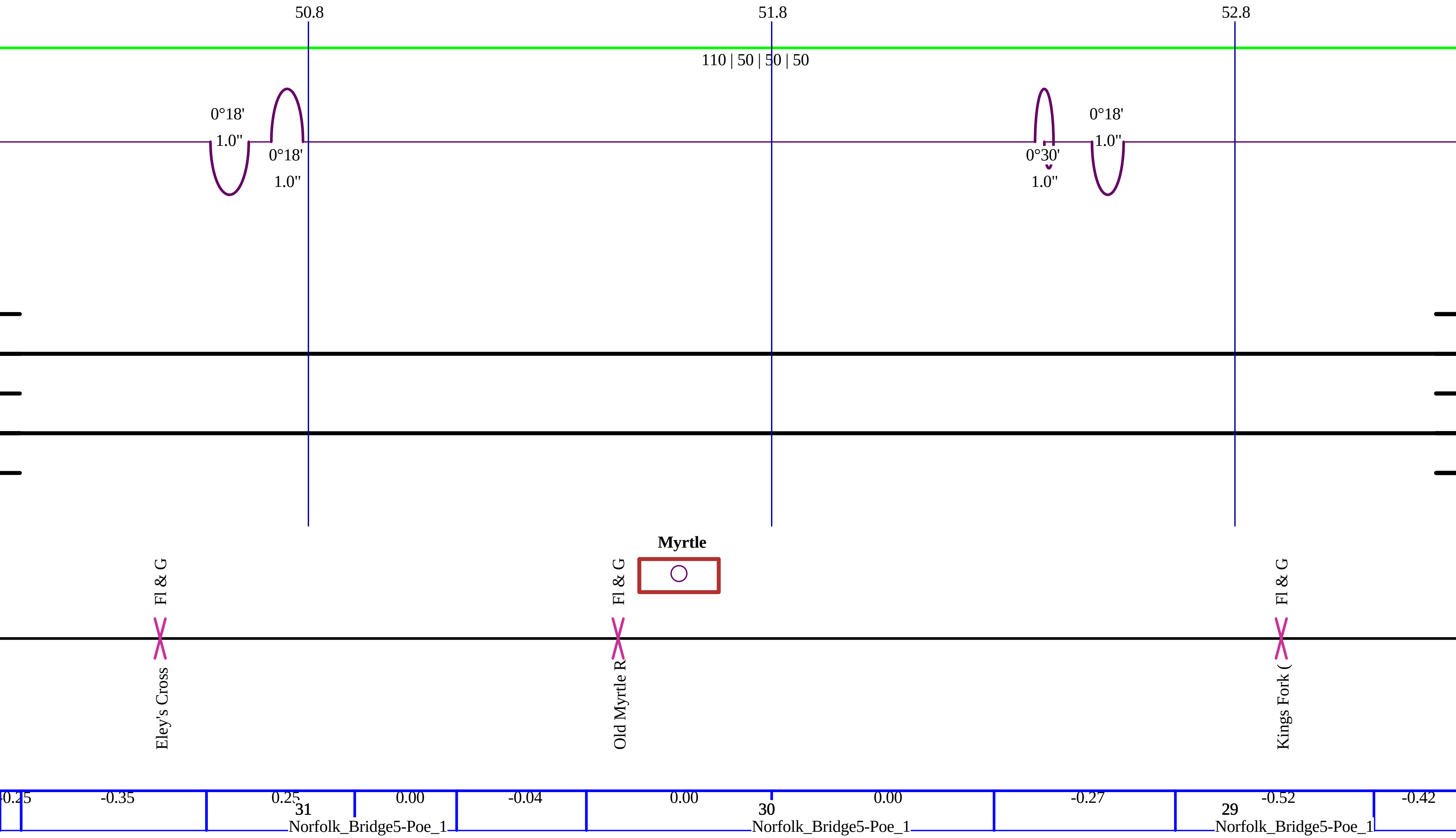

37.8
38.8
39.8
110 | 50 | 50 | 50
0°12'
1.0"
0°30'
1.0"
Pvt
Private
Tucker Swamp
0.00
-0.07
-0.50
-0.47
-0.50
-0.52
-0.43
-0.30
-0.26
44
43
42
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1

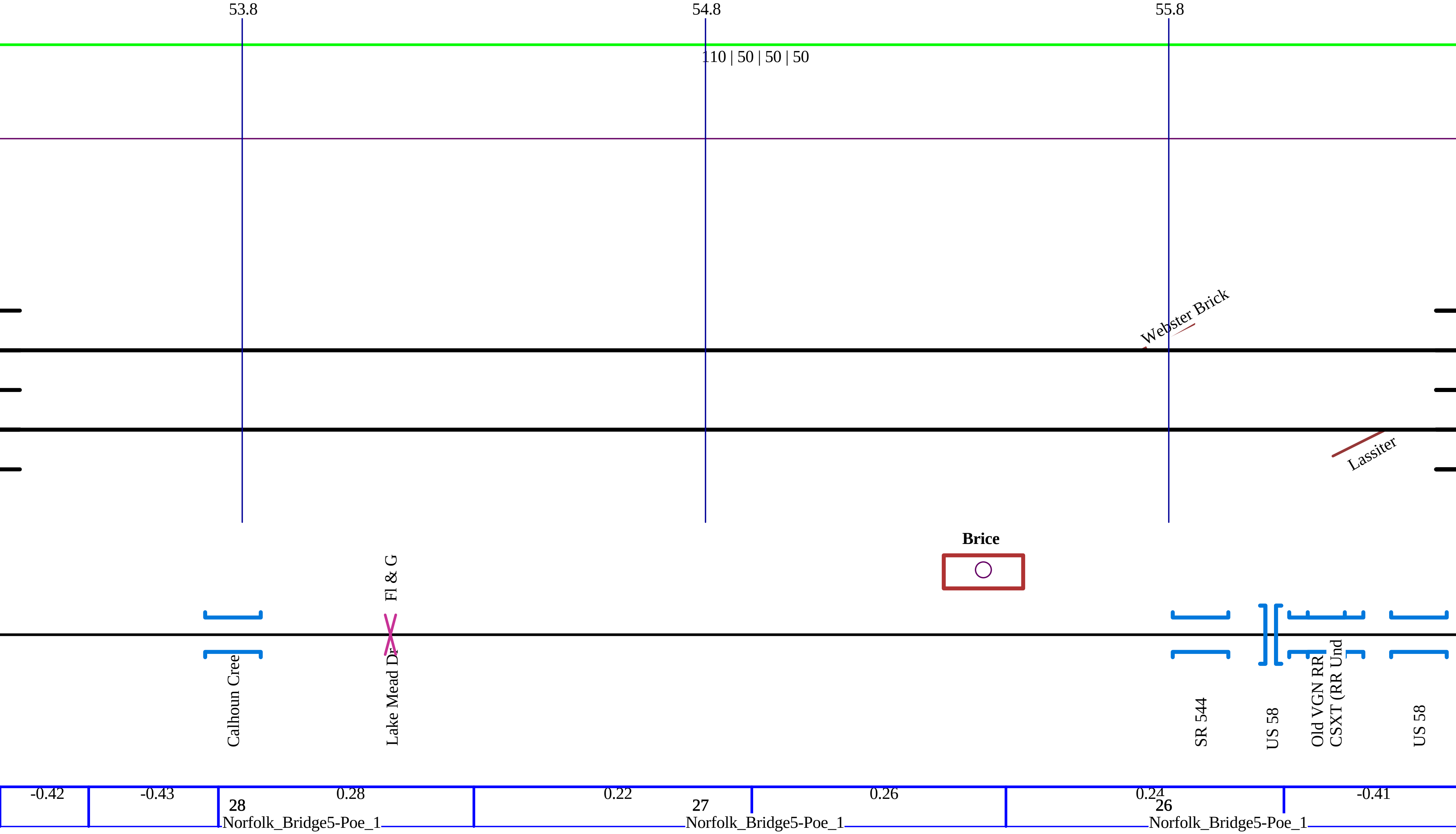

40.8
41.8
42.8
43.8
110 | 50 | 50 | 50
0°18'
1.0"
0°18'
1.0"
Zuni
Dwight
Blackwater R
Zuni Circle
Yellow Hamme
Burnt Mills
-0.26
0.15
0.18
0.26
0.25
0.32
0.26
0.16
0.23
0.18
0.11
0.25
41
40
39
38
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1
Norfol

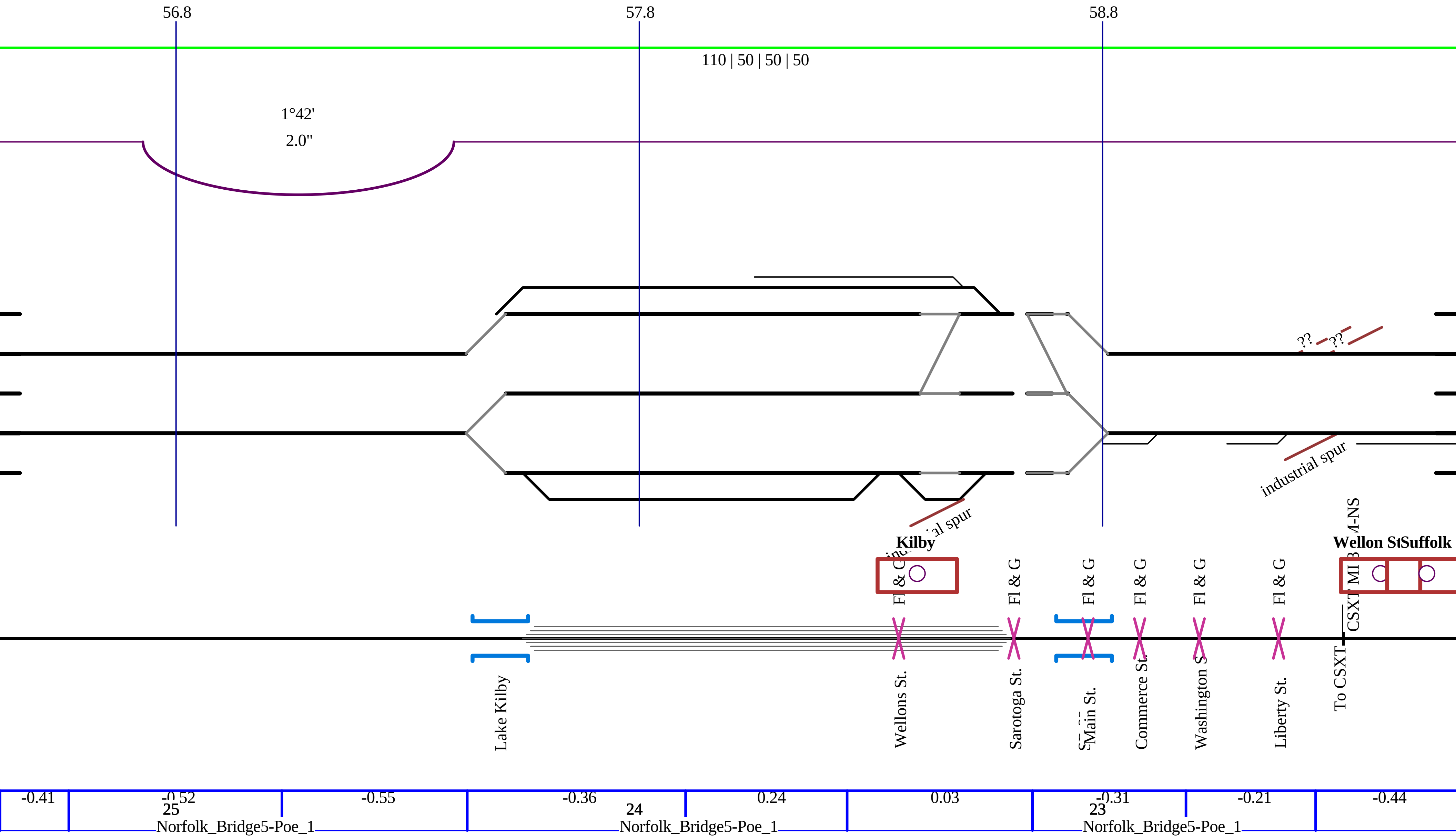

44.8
45.8
46.8
110 | 50 | 50 | 50
0°18'
1.0"
0°18'
1.0"
Fl & G
Essela Rd (S
Pvt
Private
Fl & G
Antioch (SR
Pvt
Private
0.25
-0.17
37
Norfolk_Bridge5-Poe_1
0.22
36
Norfolk_Bridge5-Poe_1
0.00
35
Norfolk_Bridge5

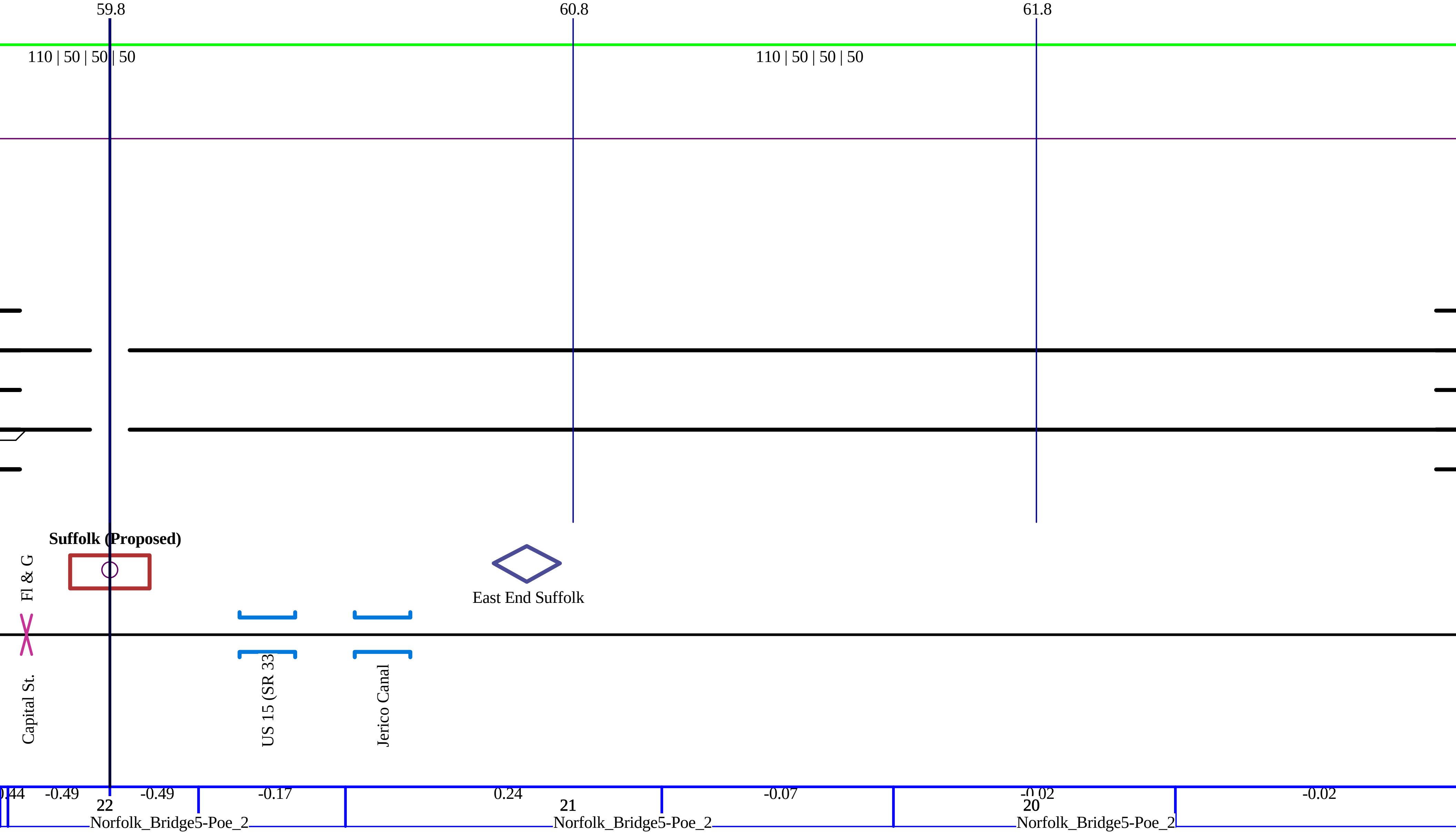


47.8
48.8
49.8
110 | 50 | 50 | 50
Windsor
BD Crossover
Fl & G
Fl & G
Fl & G
Fl & G
S Prince Blv
Bank St
S Court St.
Old Suffolk
0.00
-0.02
-0.11
-0.45
0.00
0.25
0.00
-0.25
34
33
32
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1

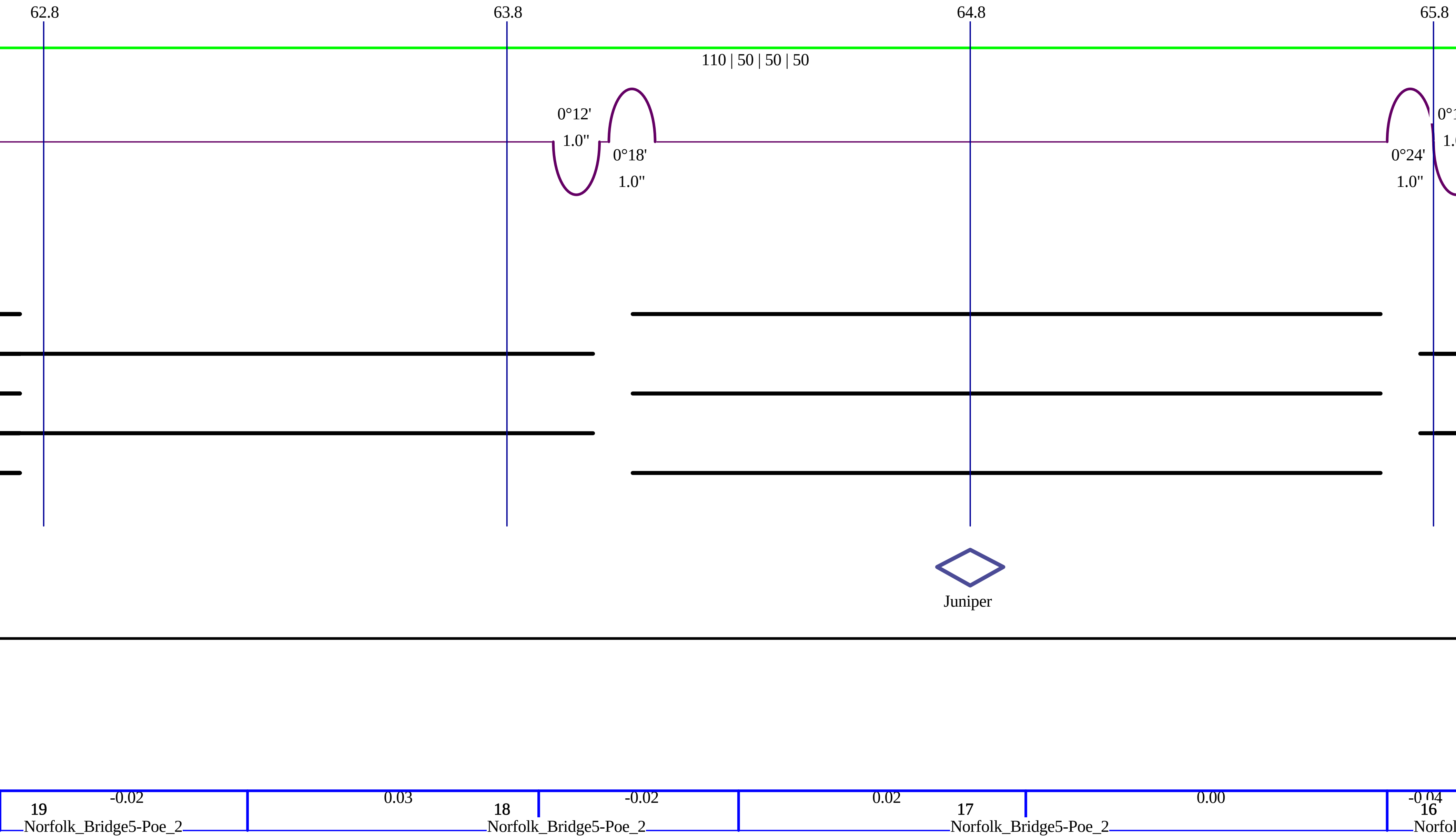

50.8
51.8
52.8
110 | 50 | 50 | 50
0°18'
1.0"
0°18'
1.0"
0°30'
1.0"
0°18'
1.0"
Myrtle
Fl & G
Eley's Cross
Fl & G
Old Myrtle R
Fl & G
Kings Fork (
-0.25
-0.35
0.25
0.00
-0.04
0.00
0.00
-0.27
-0.52
-0.42
31
30
29
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1

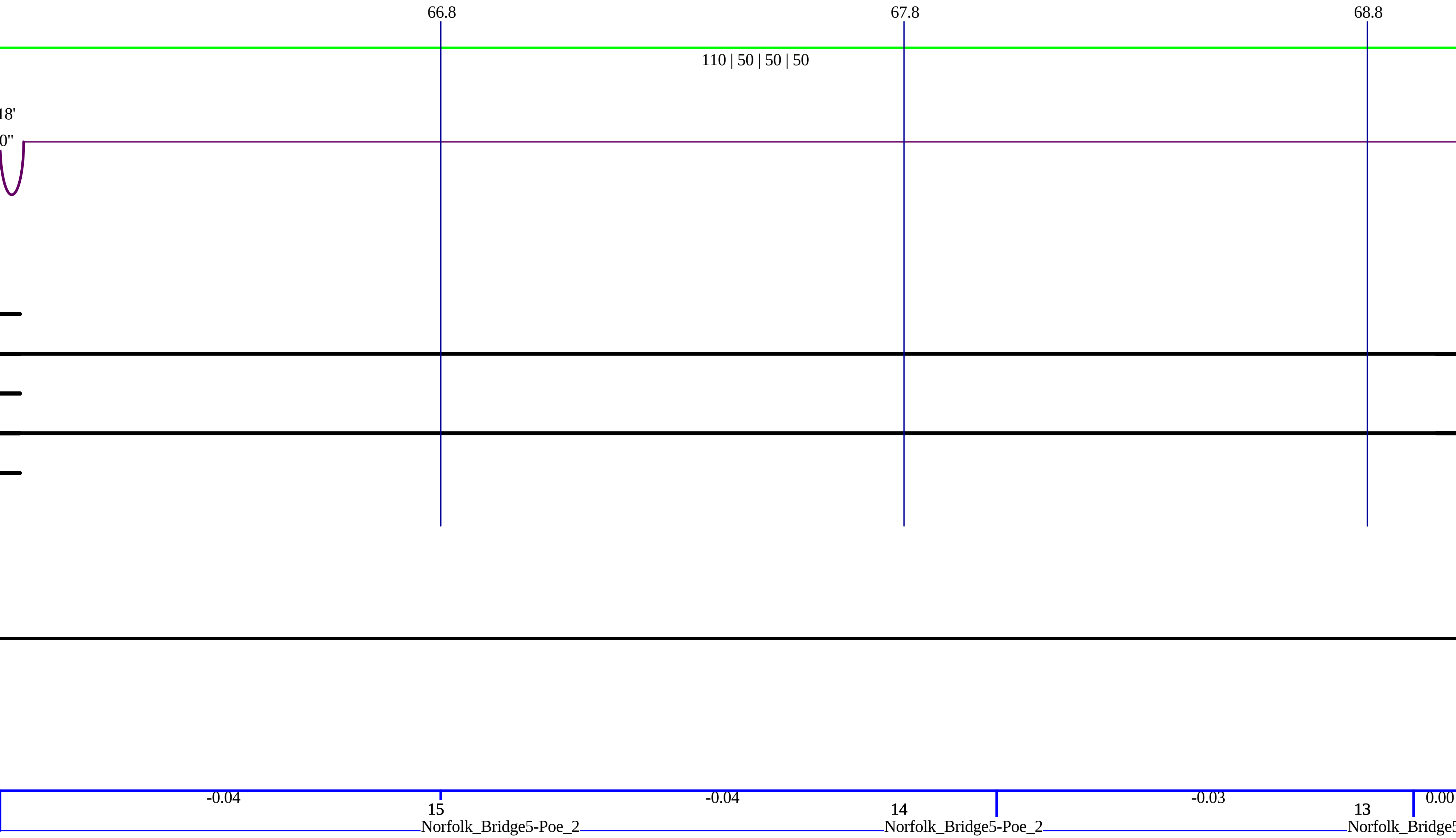

53.8
54.8
55.8
110 | 50 | 50 | 50
Webster Brick
Lassiter
Brice
Fl & G
Calhoun Cree
Lake Mead Dr
SR 544
US 58
Old VGN RR
CSXT (RR Und
US 58
-0.42
-0.43
0.28
0.22
0.26
0.24
-0.41
28
27
26
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1

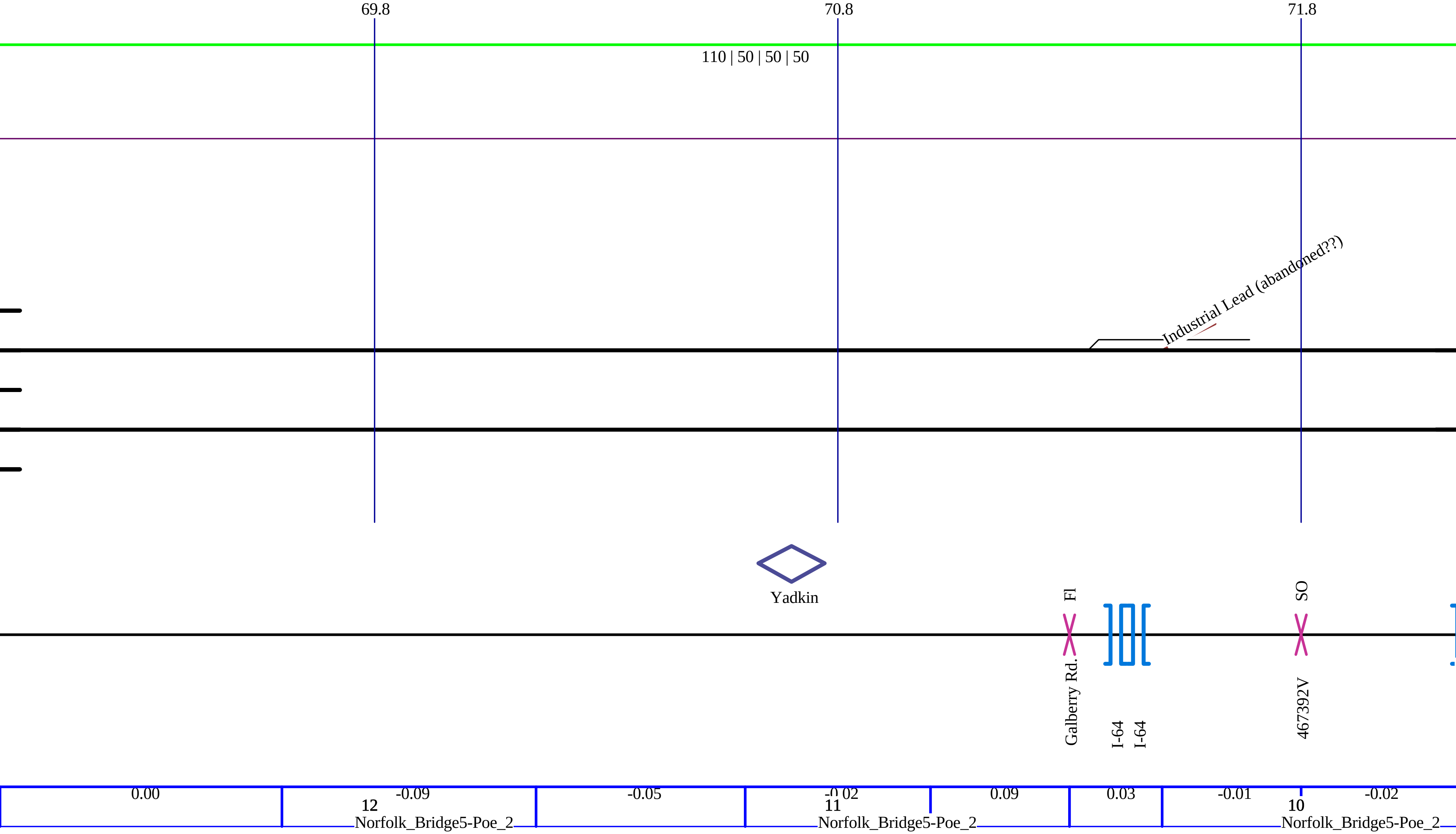

56.8
57.8
58.8
110 | 50 | 50 | 50
1°42'
2.0"
industrial spur
Kilby
Wellon St
Suffolk
Fl & G
Fl & G
Fl & G
Fl & G
Fl & G
Fl & G
Lake Kilby
Wellons St.
Sarotoga St.
Main St.
Commerce St.
Washington S
Liberty St.
To CSXT
industrial spur
??
??
-0.41
-0.52
-0.55
-0.36
0.24
0.03
-0.31
-0.21
-0.44
25
24
23
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1
Norfolk_Bridge5-Poe_1

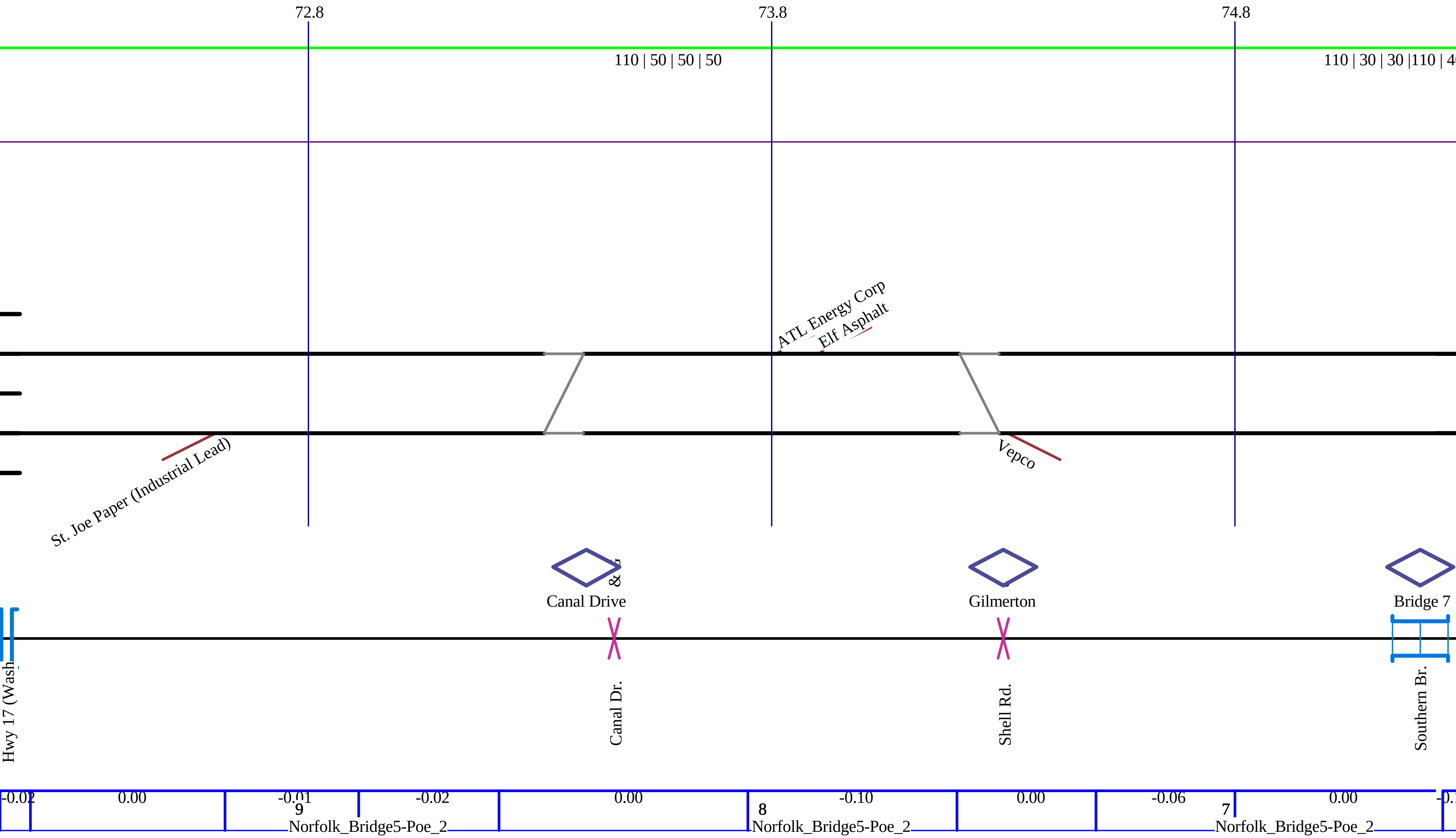


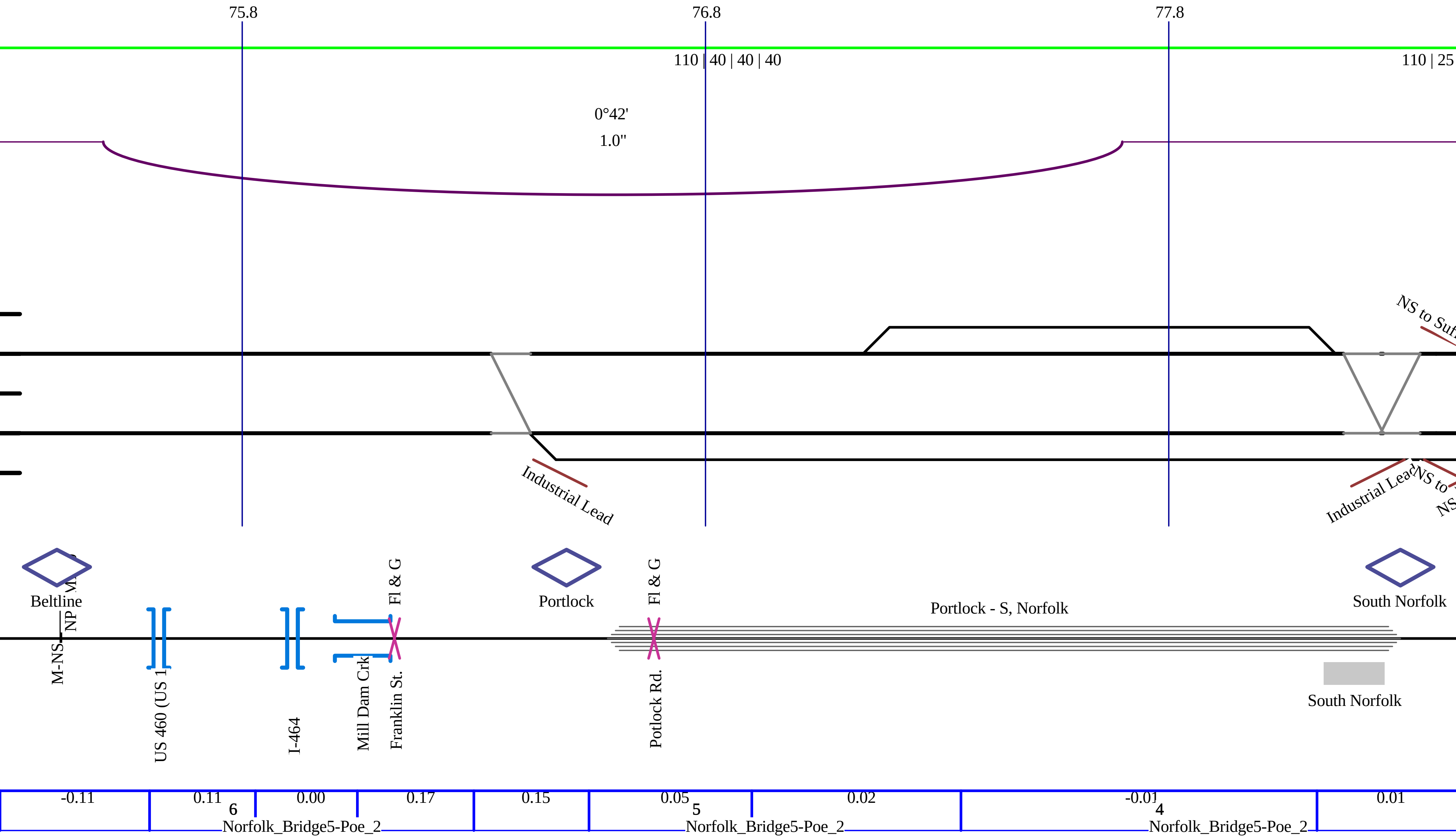
59.8
60.8
61.8
110 | 50 | 50 | 50
110 | 50 | 50 | 50
Suffolk (Proposed)
Fl & G
Capital St.
US 15 (SR 33
Jerico Canal
East End Suffolk
0.44
-0.49
-0.49
-0.17
0.24
-0.07
-0.02
-0.02
22
21
20
Norfolk_Bridge5-Poe_2
Norfolk_Bridge5-Poe_2
Norfolk_Bridge5-Poe_2

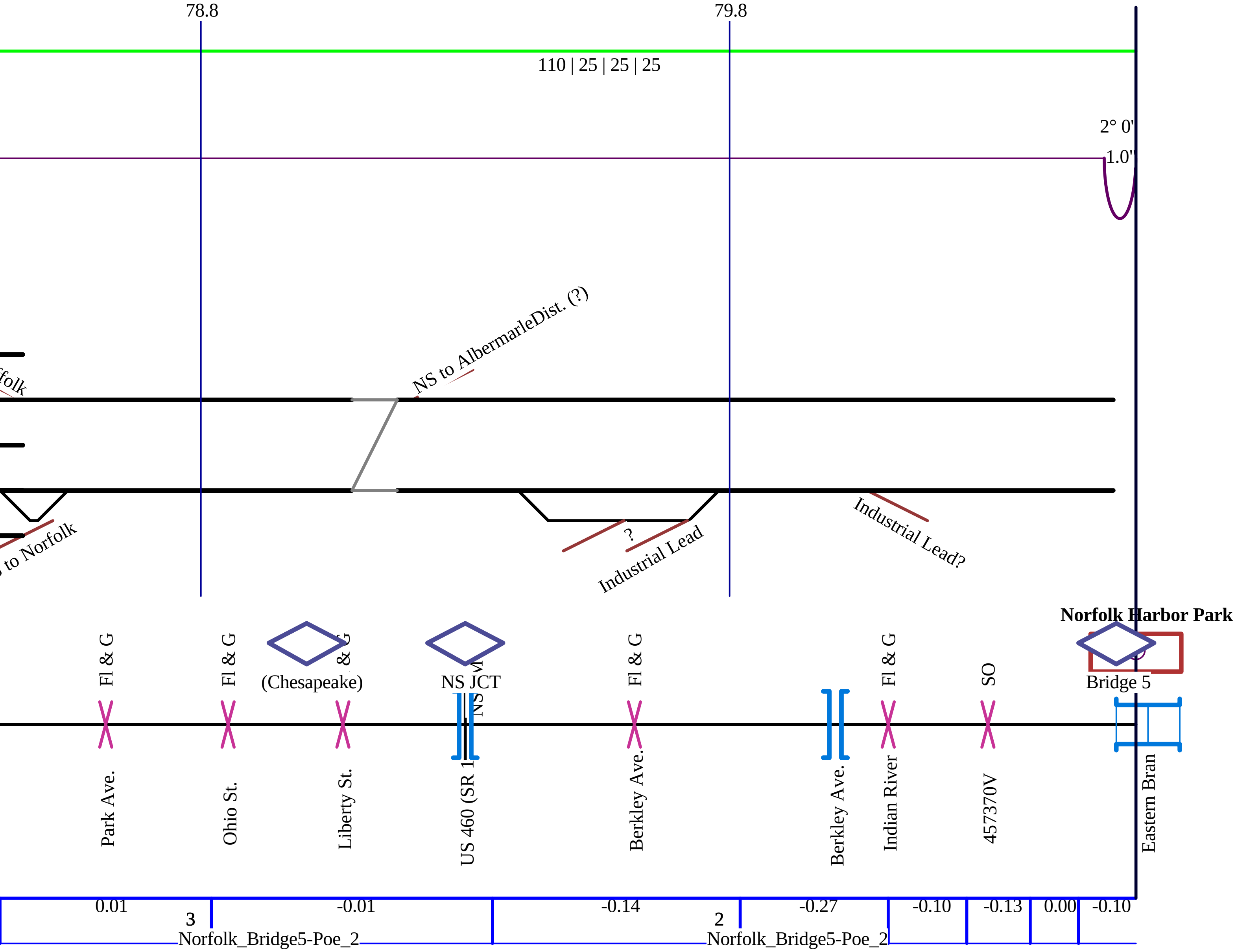

62.8
63.8
64.8
65.8
110 | 50 | 50 | 50
0°12'
1.0"
0°18'
1.0"
0°24'
1.0"
Juniper
19
18
17
16
-0.02
0.03
-0.02
0.02
0.00
Norfolk_Bridge5-Poe_2
Norfolk_Bridge5-Poe_2
Norfolk_Bridge5-Poe_2


66.8
67.8
68.8
110 | 50 | 50 | 50
18'
0"
-0.04
-0.04
-0.03
0.00
15
14
13
Norfolk_Bridge5-Poe_2
Norfolk_Bridge5-Poe_2
Norfolk_Bridge5


69.8
70.8
71.8
110 | 50 | 50 | 50
Industrial Lead (abandoned??)
Yadkin
Fl
Galberry Rd.
I-64
I-64
SO
467392V
0.00
-0.09
-0.05
-0.02
0.09
0.03
-0.01
-0.02
12
11
10
Norfolk_Bridge5-Poe_2
Norfolk_Bridge5-Poe_2
Norfolk_Bridge5-Poe_2


72.8
73.8
74.8
110 | 50 | 50 | 50
110 | 30 | 30 |110 | 4
ATL Energy Corp
Elf Asphalt
St. Joe Paper (Industrial Lead)
Vepco
Canal Drive
Gilmerton
Bridge 7
Hwy 17 (Wash
Canal Dr.
Shell Rd.
Southern Br.
-0.02
0.00
-0.01
-0.02
0.00
-0.10
0.00
-0.06
0.00
9
8
7
Norfolk_Bridge5-Poe_2
Norfolk_Bridge5-Poe_2
Norfolk_Bridge5-Poe_2


75.8
76.8
77.8
110 | 40 | 40 | 40
110 | 25
0°42'
1.0"
NS to Suf
Industrial Lead
Industrial Lead
NS to
NS
Beltline
NP
M-NS
US 460 (US 1
I-464
Mill Dam Crk
Fl & G
Franklin St.
Portlock
Fl & G
Potlock Rd.
Portlock - S, Norfolk
South Norfolk
South Norfolk
-0.11
0.11
0.00
0.17
0.15
0.05
0.02
-0.01
0.01
6
5
4
Norfolk_Bridge5-Poe_2
Norfolk_Bridge5-Poe_2
Norfolk_Bridge5-Poe_2

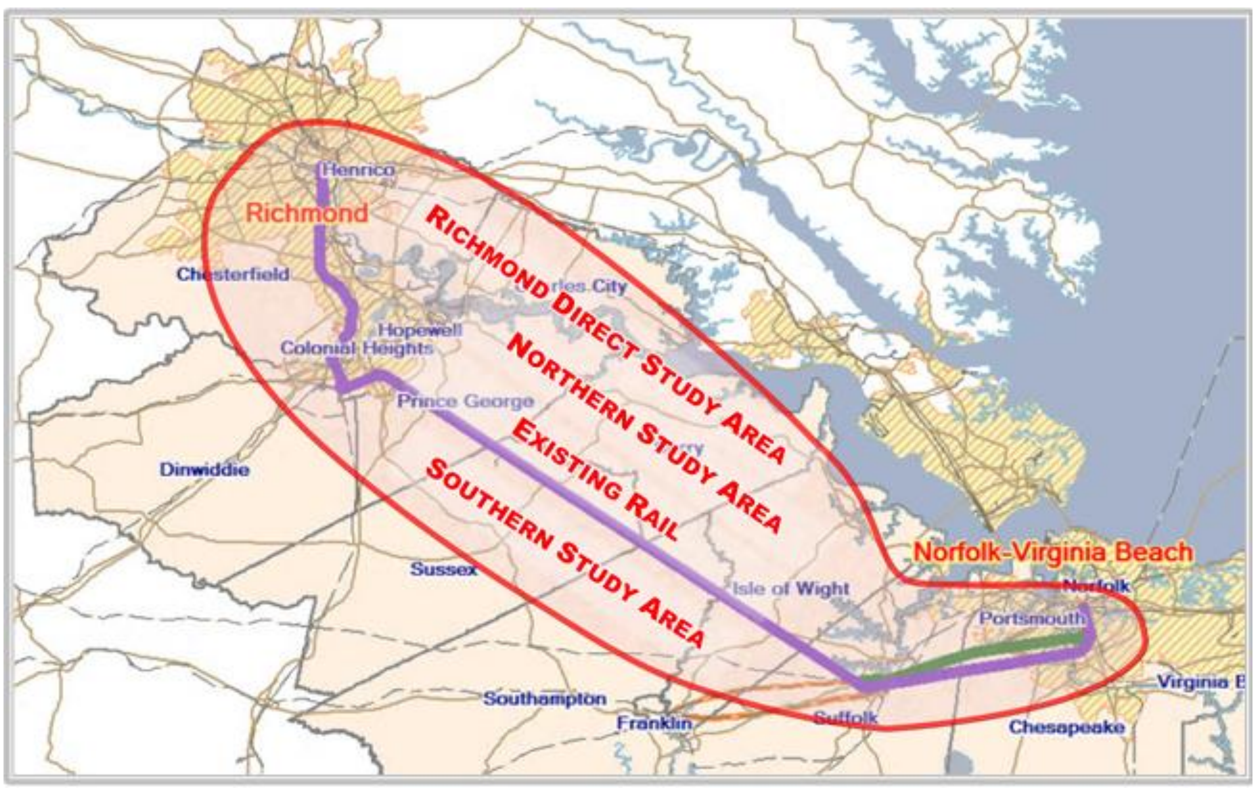

78.8
79.8
110 | 25 | 25 | 25
2° 0'
1.0"
NS to AlbermarleDist. (?)
folk
to Norfolk
?
Industrial Lead
Industrial Lead?
Norfolk Harbor Park
Fl & G
Fl & G
& G
(Chesapeake)
NS JCT
Fl & G
Fl & G
SO
Bridge 5
Park Ave.
Ohio St.
Liberty St.
US 460 (SR 1
Berkley Ave.
Berkley Ave.
Indian River
457370V
Eastern Bran
0.01
3
Norfolk_Bridge5-Poe_2
-0.01
-0.14
2
Norfolk_Bridge5-Poe_2
-0.27
-0.10
-0.13
0.00
-0.10

APPENDIX D: ENVIRONMENTAL SCAN (UPDATED)

1. OVERVIEW

This appendix is an environmental scan/analysis update to Chapter 5 of the "*Hampton Roads Passenger Rail Study Data Collection – Phase 2A Norfolk – Hampton Roads Corridor*" report that was produced by TEMS, Inc. in March of 2013. This includes environmental updates to the full corridor study area going from Richmond to Norfolk. All data collection figures have been updated for the expanded study area shown in Exhibit D-1. (Note: The previous report only reflected environmental data collection results and exhibits for the Petersburg to Norfolk segment of the corridor.) Specifically, this appendix updates environmental scans for cultural resources, conservation lands, historic resources, ecology (wetlands, wildlife and recreational resources), environmental justice, and agricultural land and soil values; and, the conclusion section has been updated accordingly. This appendix also includes brief summaries of data collection results for the following environmental impacts: hazardous materials, air quality, noise and vibration, utilities, and public health and safety. In addition, this environmental update includes discussion and data exhibits on natural land networks and biodiversity found within the Richmond to Norfolk study area; and in particular, discusses the usage of the Virginia Natural Landscape Assessment (VaNLA) tool for identifying and prioritizing linked natural habitats based on their ecological value to the region overall.

Exhibit D-1: Environmental Study Area



*Alignment will not be determined until the Tier II Environmental Process is complete.

2. CULTURAL RESOURCES

As part of the overall environmental scan of the Richmond to Norfolk study area, potential impacts to cultural resources were identified. Cultural resources include parks, wildlife refuges, heritage preserves, archaeology resources, historical resources, federal lands, etc. The Department of Virginia Conservation and Recreation (DCR) provides information on parks, wildlife refuge, heritage preserves, federal lands, etc. The National Park Service (NPS) provides information on historic resources. In the next sections of this report, conservation lands and historic resources for the environmental study area from Richmond to Norfolk are discussed.

2.1 CONSERVATION LANDS

Conservation lands in Virginia are classified into four categories: forest, parks, wildlife, and other. Exhibit D-2 shows conservation lands located within the Richmond to Norfolk environmental study area for these four types. The 'forest' category includes national and state forests; 'parks' include national and state parks; 'wildlife' includes refuge and management areas; and 'other' conservation lands mainly include land holdings and area preserves. For the environmental study area from Richmond to Norfolk, the total acreage of conservation land is approximately 222,168 acres, of which the National Wildlife Refuge is approximately 95,969 acres (Exhibit D-3). In the next phase of the study, these conservation lands would need to be taken into consideration when choosing the alternatives. For any greenfield sections of the corridor between Richmond and Suffolk, care should be taken to avoid impacts with conservation lands by having the new rail alignment take a path around such sites.

Exhibit D-2: DCR Conservation Lands in the Richmond to Norfolk Environmental Study Area

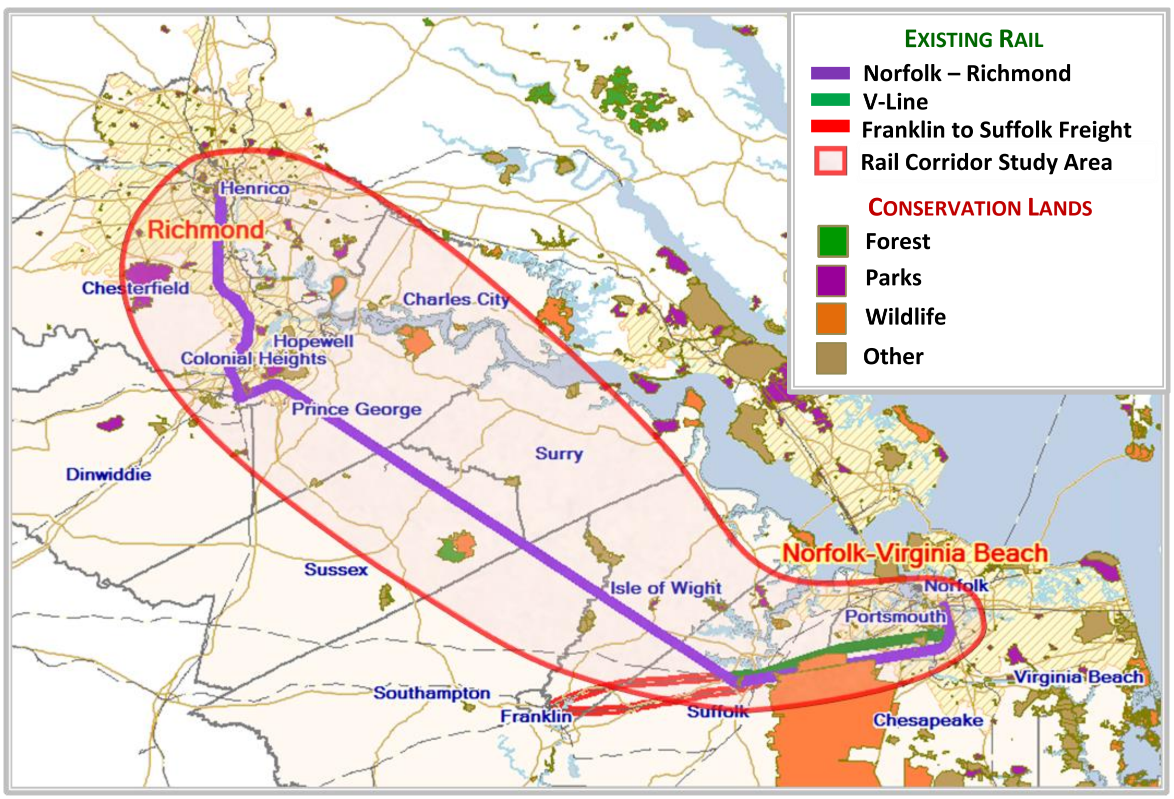


Exhibit D-3: DCR Conservation Lands Total Acres in the Petersburg/Richmond to Norfolk Environmental Study Area[1]

Main Category	Sub-Category	Acres (Approx.)
Forest		2,414
	State Forest	2,200
	State Forestry Center	214
Other		63,318
	Locality Land Holding	2,300
	Military Installation	32,011
	Non-Profit Fee Simple Holding	3,221
	State Natural Area Preserve	13,861
	TNC Land Holding	354
	TNC Preserve	11,571
Park		43,550
	Local Park	20,261
	State Park	16,457
	National Park	6,832
Wildlife		112,886
	National Wildlife Refuge	95,169
	State Wildlife Management Area	17,717
Total		222,168

2.2 Historic Resources

The National Park Service (NPS) U.S Department of the Interior[2] provides state-wide historic resources information. This includes providing data on protected historic sites such as Churches, Chapels, Monuments, Schools, Cemeteries, etc. Approximately 300 protected historical sites or resources fall within the environmental study area. Exhibit D-4 shows the approximate locations of these protected historical sites. As seen in the exhibit, the largest numbers of protected historical sites fall within the section of the corridor between Richmond and Petersburg. In areas where the rail alignment follows existing rail or highway 'right of ways', and where historical sites have already been avoided or mitigated, any conflicts with historical resources here should be minimal or non-existent. For greenfield sections of the corridor, care should be taken to avoid impacts with historical sites by having the new rail alignment bypass or take a path around such sites. Exhibit D-5 shows an example of a historical site within the environmental study area that must be avoided by the new alignment.

[1] This table was based the information provided in shapefile data provided by http://www.dcr.virginia.gov/
[2] http://nrhp.focus.nps.gov/natreg/docs/Download.html

Exhibit D-4: Historic Resources in the Richmond to Norfolk Environmental Study Area*

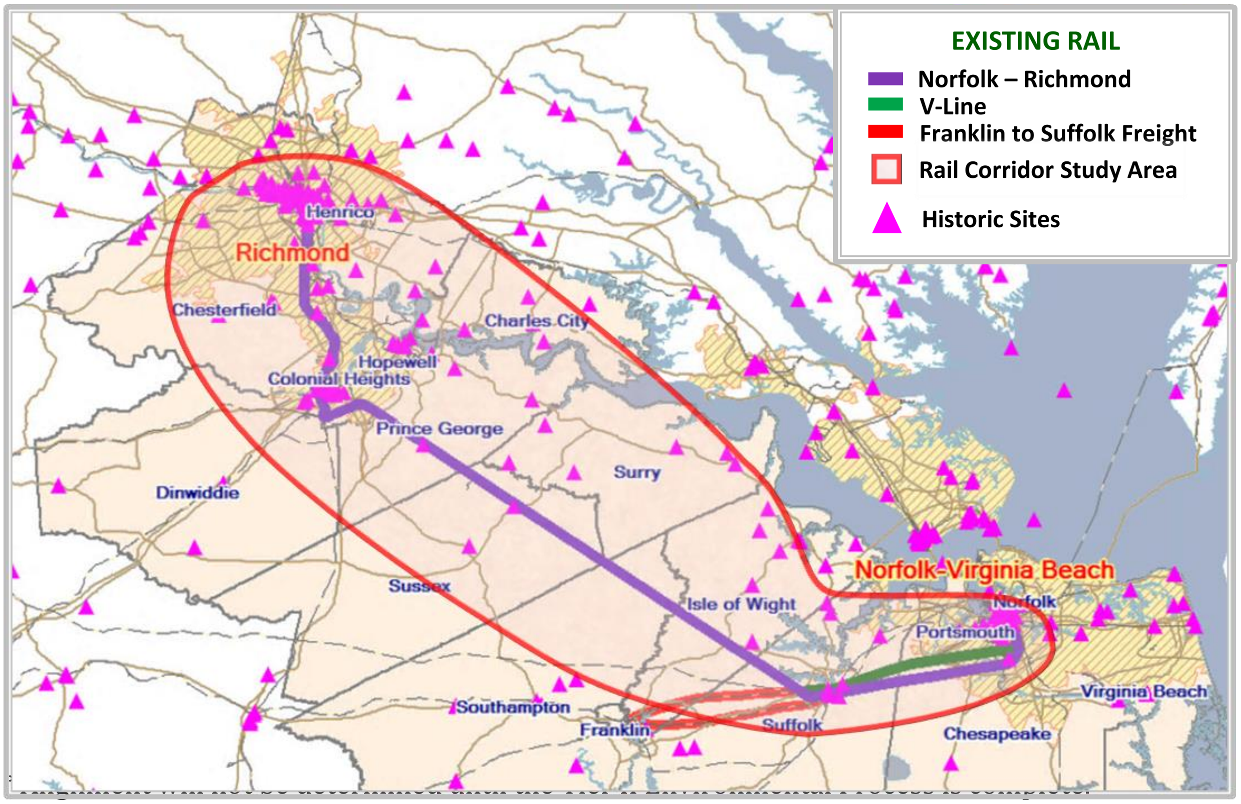


Exhibit D-5: Historic Site – Church in Walters, VA within the Environmental Study Area

3. Ecology

A scanning of ecological resources was conducted as part of the overall environmental scan for the environmental study area. This ecological scan included identifying potential ecological impacts: wetlands, hydric soils, streams, waterways (US & State waters), federally protected species, state protected species, critical stream habitats, migratory bird habitats, floodplain encroachment/impacts, and coastal zone encroachments come under ecology. These ecology systems are discussed in the next subsections.

3.1 Wetlands

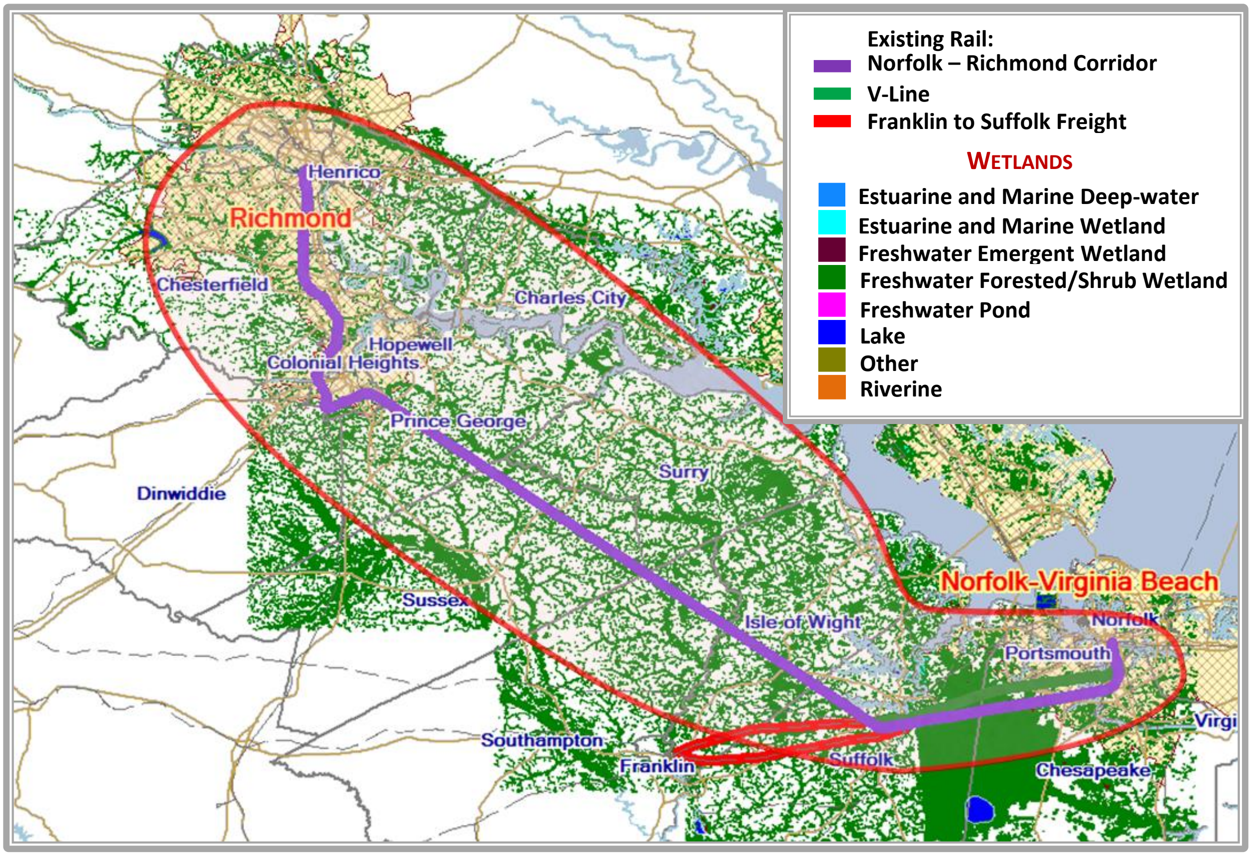
Wetlands are defined by the United States Fish and Wildlife Service (USFWS) as: "Land that has a predominance of hydric soils and that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances does support, hydrophytic vegetation adapted for saturated soil conditions."[3] Wetlands are one of the most important resources for the Virginia landscape; and, they are particularly critical in the tidal regions of the Chesapeake Bay where they support a variety of vegetation and wildlife that are vital to the entire region's ecosystem. The US Fish and Wildlife Service provides information on wetlands throughout the US. through its National Wetlands Inventory Program.[4] The inventory program classifies wetlands into the following types:

- Estuarine and Marine Deepwater
- Estuarine and marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine and
- Other wetlands

Exhibit D-6 displays wetlands located in the Richmond to Norfolk study area. It can be seen that wetlands are a ubiquitous landscape feature across the whole study area and as such, are not completely avoidable. In this study, an attempt has been made to minimize wetland impacts in order to be in compliance with Executive Order 11990[5] for Protection of Wetlands. This has been done by shifting the alignment to avoid wetlands where possible, attempting to cross wetlands as near to a right angle as possible, and by bridging over all wetland areas that are in flood plains. Where wetland takes are deemed necessary, coordination with the U.S. Army Corps of Engineers is required to ensure that appropriate measures are used to mitigate any impacted wetlands, including replacing wetlands where necessary, at the required ratios.

[3] www.fws.gov/wetlands/nwi
[4] www.fws.gov/wetlands/nwi
[5] http://www.archives.gov/federal-register/codification/executive-order/11990.html

Exhibit D-6: Wetlands for the Petersburg to Norfolk Environmental Study Area



Within the environmental study area, there are notable 'Freshwater Forested/ Shrub' wetlands especially in the Dismal Swamp area which lies between Suffolk and Norfolk.

Some sample images of the wetland areas are shown in Exhibits D-7 to D-10. Exhibit D-7 shows a wetland along the existing tracks and Exhibit D-8 shows wetland along the abandoned "V" line corridor, just east of Suffolk and north of the Great Dismal swamp. Exhibits D-9 and D-10 show ponds within the environmental study area.

Exhibit D-7: Wetland along the Rail Track

Exhibit D-8: Abandoned Rail Bridge on "V" Line over a Wetland Area

Exhibit D-9: Bakers Pond in Disputanta, VA

Exhibit D-10: Bakers Pond in Disputanta, VA

Exhibit D-11 shows that the majority of wetlands for the Richmond to Norfolk study area are freshwater forested/shrub wetlands (311,500 acres approx.); and, a major portion of the area between Suffolk and Norfolk, is dense wetland area (as shown previously in Exhibit D-6). Depending on the area of coverage, many of these freshwater forested/shrub wetlands, if not bridged because they are in a flood plain, can be mitigated by filling or replacing at the required ratios specified by current regulations. It should be noted however that the proposed crossing of the Dismal Swamp east of Suffolk will be along a corridor of rail and highway right of way (Norfolk Southern "V"-Line, CSX Portsmouth Subdivision paralleling US-58) which has already been filled. No additional wetland takings affecting the Dismal Swamp have been identified by this preliminary scan for development of the rail infrastructure improvements. In a future phase of work, an effort needs to be made to minimize or avoid any wetland takings that may be associated with development of the Bowers Hill station.

Exhibit D-11: Wetland Total Area in the Environmental Study Area from Richmond to Norfolk

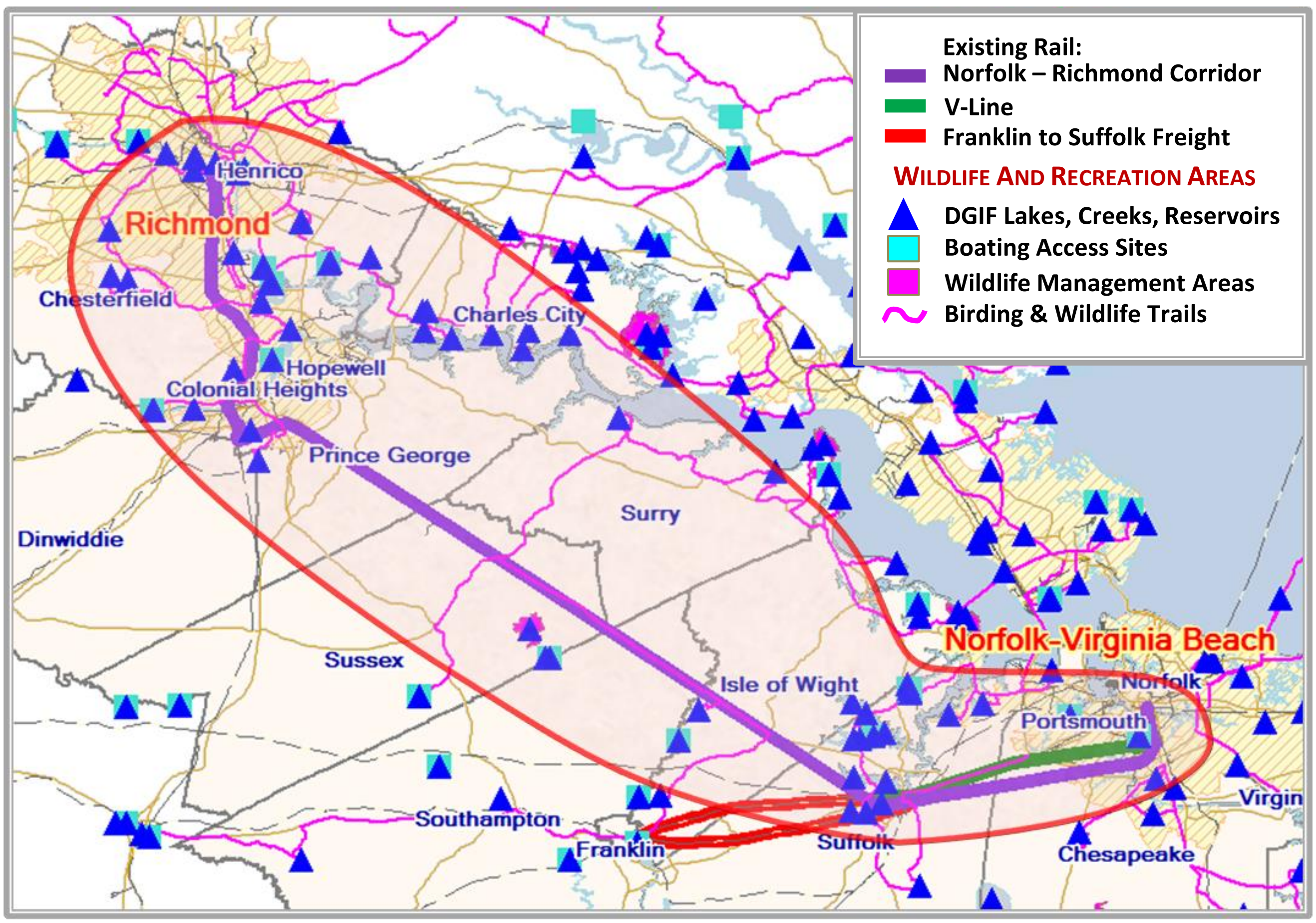
Wetland Types	Total Acres
Freshwater Forested/Shrub Wetland	311,537
Freshwater Emergent Wetland	19,257
Lake	17,547
Freshwater Pond	13,195
Estuarine and Marine Wetland	11,073
Riverine	3,174
Estuarine and Marine Deepwater	812.3
Other	254.2
TOTAL	376,850

The next highest levels of wetlands fall into the 'Freshwater Emergent Wetland' classification at approximately (19,257 acres) and "Lake" wetlands (17,547 acres); followed by freshwater ponds, estuarine and marine wetlands. Freshwater lakes, ponds, and riverine impacts can be minimized by constructing bridges at the required specifications rather than by filling, depending on the area of coverage.

3.2 Wildlife And Recreational Resources

The Virginia Department of Game and Inland Fisheries (DGIF)[6] provide data on Wildlife Management Areas (WMAs) and public fishing lakes. This data also includes information on lakes, creeks, swamps, reservoirs, fishing areas, inland navigable waters, boating sites, and bird trails and wildlife loops. The goal of DGIF's Wildlife Management Area Program is to maintain and enhance habitats that support game and nongame wildlife while providing opportunities for the public to hunt, fish, trap, and view wildlife. Other uses of WMAs may be allowed, as long as they do not interfere with these goals and uses. Exhibit D-12 shows wildlife and recreational resources located in the environmental study area from Richmond to Norfolk.

Exhibit: D-12: Wild Life Habitat in the Environmental Study Area* from Petersburg to Norfolk



[6] http://www.dgif.virginia.gov/wildlife/

The prospective alignments considered for this preliminary study have avoided wildlife and recreational areas where possible. To the extent that endangered species locations have been identified in the relevant databases, these have been avoided also. In the next phase of the study, the U.S. Fish and Wildlife Service will need to be consulted to provide guidance, and assistance in addressing any impacts to endangered species or species habitat areas that may be identified in a future field survey of these resources.

4. Preservation of Natural Land Networks and Biodiversity

The Virginia Natural Landscape Assessment (VaNLA) is a landscape-scale GIS analysis[7] provided by the Virginia Department of Conservation and Recreation through its Virginia Natural Heritage Program (VNHP). It identifies, prioritizes and links natural habitats based on their overall ecological value in forming natural land networks connecting species habitats throughout Virginia.[8,9] The VaNLA identifies large patches of natural land with at least one hundred acres of interior cover known as core areas; as well as small patches (ten to ninety-nine acres of interior cover) that are included as habitat fragments that support landscape corridors allowing for wildlife movement across broader geographical areas. Maintaining this connectivity is important in areas having few large patches of natural land.[10,11] Using these ecological core area assessments, the VaNLA has developed a landscape model of connected landscape corridors and nodes based on ecological cores from the two highest categories (i.e. C1 and C2), to create a statewide network of natural lands.[12] Exhibit (D-13) shows the Richmond to Norfolk study area with an overlay of the VaNLA network of natural lands color-coded by value.

[7] http://www.dcr.virginia.gov/natural_heritage/vclnavnla.shtml

[8] The Virginia DCR explains several key purposes of this analysis including its use: "for guidance in comprehensive planning efforts by localities; for review of proposed projects for potential impacts to ecological cores and corridors.

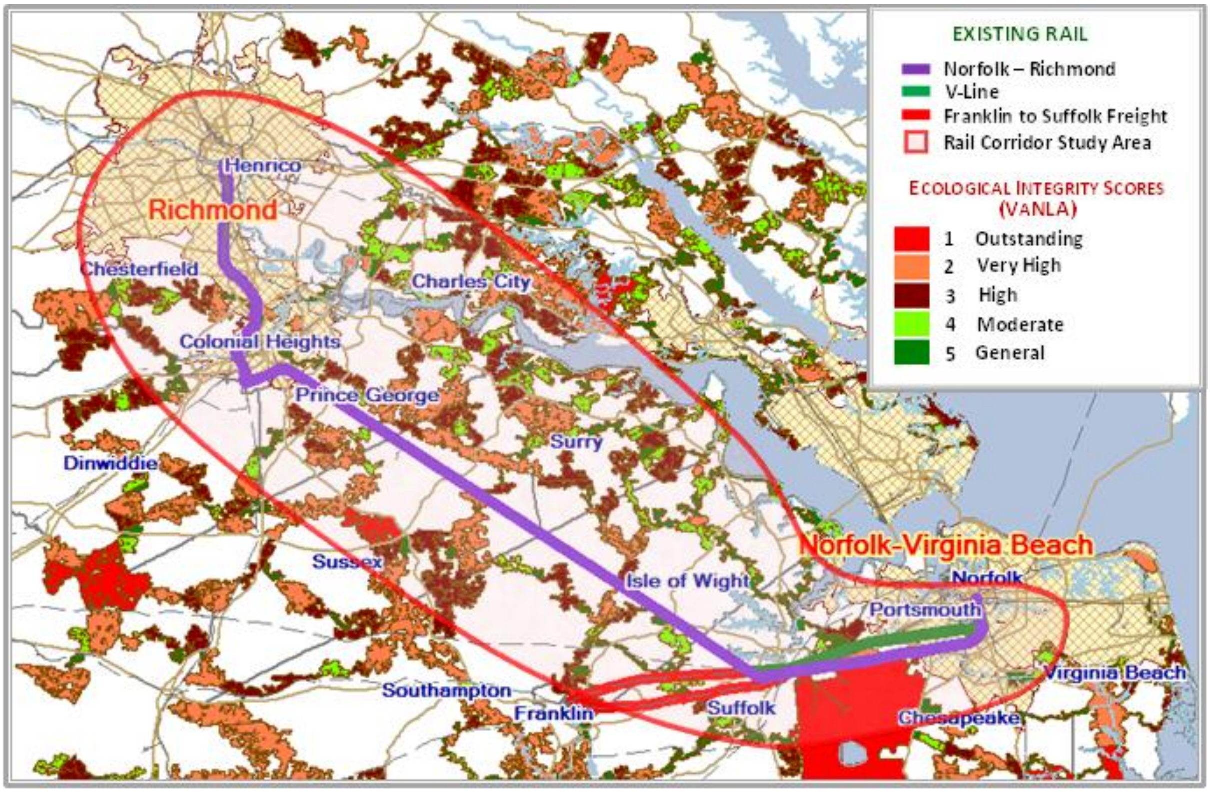
[9] http://www.dcr.virginia.gov/natural_heritage/vclnavnla.shtml

[10] http://www.dcr.virginia.gov/natural_heritage/vclnavnla.shtml

[11] To assess the value of these core areas and habitat fragments, the VaNLA has assigned each core and habitat fragment an Ecological Integrity Score that rates the relative contribution of that area to the surrounding ecosystem. In general, larger, more biologically diverse areas are given higher scores; and, core or habitat fragments that form part of a larger complex of natural lands are also rated higher. Likewise, core areas and habitat fragments that contribute to water quality have higher scores as well. The VaNLA has classified the compiled scores into five categories of ecological integrity: C1 - Outstanding; C2 - Very High; C3 - High; C4 - Moderate; and C5 - General.

[12] http://www.dcr.virginia.gov/natural_heritage/vclnavnla.shtml

Exhibit D-13: Preservation of Natural Land Networks and Biodiversity



Based on this knowledge of natural land networks, the selection of rail options/ alignments have tried as much as possible to avoid fragmenting natural land networks and/or maintain habitat passageways that allow for the movement of bio-diverse species of wildlife. Where fragmentation of highly valued core areas or habitats cannot be avoided, it is best to confine fragmentation to the edge areas in-order to preserve the core areas as much possible.

However, fragmentation of core areas is sometimes unavoidable due to the need to avoid other critical impacts such as structural impacts (ex. commercial and residential areas) and/or other environmental impacts (i.e. cultural resources, conservation areas, etc.) Somewhat similar to wetlands, it can be seen that wildlife corridors are a ubiquitous landscape feature, so it will impossible to completely avoid impacts in the development of new rail alignments. For those cases where it is necessary to cut across or through an established wildlife corridor or area, it will be necessary to agree on appropriate mitigation measures (possibly including wildlife underpasses or overpasses, for example) with the Virginia Department of Conservation and Recreation. In the current report, costs estimates for bridging or elevating sections of the proposed rail alignments include cost estimates for the recommended bridging of critical wetland areas that fall within the VaNLA network.

Likewise, this knowledge of potential impacts to natural land networks can be used along with other data gathered about environmental impacts in the area (i.e. wetlands, conservation areas, wildlife habits, etc.), to assist in the process of prioritizing which impacts are most critical. For example, an unmodified wetland falling within the VaNLA network of links and nodes would be viewed as having a higher priority for mitigation or avoidance than other similar wetlands.

5. HAZARDOUS MATERIALS

A database search was conducted using standard environmental record sources (see Exhibit D-14). These databases contain the names and/or locations of reported hazardous waste sites, treatment, storage and disposal facilities, pollution and hazardous waste spills, including Leaking Underground Storage Tanks (LUSTs), and landfills in Virginia. The Hazardous Materials Technical Report describes more fully the approach and analysis methods used to determine identified hazardous material sites.[13] Any incident or facility identified within the search distance was reviewed to identify past activities that could potentially result in Recognized Environmental Conditions (RECs) at the subject property or within the search distance.

Exhibit D-14: Standard Environmental Record Sources[14]

Source	Search Distance (miles)
Federal and State Equivalent – National Priorities List (NPL)	1.0
Federal and State Equivalent - Comprehensive Environmental Response, Compensation and Liability System (CERCLIS)	0.5
Federal and State Equivalent - Comprehensive Environmental Response, Compensation, and Liability System (CERCLIS), No Further Remedial Action Planned (NFRAP)	Subject and Adjoining Properties
Federal List of Treatment, Storage and Disposal (TSD) Facilities Subject to Corrective Action (CORRACTS) under the Resource Conservation and Recovery Act (RCRA)	1.0
Federal RCRA Non-CORRACTS	0.5
Federal RCRA Generators List	Subject and Adjoining Properties
Federal Emergency Response Notification System (ERNS) List	Subject Property Only
State Landfill and/or Solid Waste Disposal Site Lists	0.5
State Leaking Underground Storage Tanks (LUST) List	0.5
State Registered Underground and Aboveground Storage Tanks (USTs/ASTs) List	Subject and Adjoining Properties

At this stage of the project, superfund sites have been identified in the environmental study area. Superfund is the name given to the environmental program established to address abandoned hazardous waste sites. It is also the name of the fund established by the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA statute, CERCLA overview). This law was enacted in the wake of the discovery of toxic waste dumps such as the Love Canal and Times Beach sites in the 1970s, and it enables the EPA to clean up such sites and/or to compel responsible parties to perform cleanups or reimburse the government for EPA-lead cleanups. Exhibit D-15 and Exhibit D-16

[13] http://www.virginiadot.org/projects/resources/TCP_Hazardous_Materials_Tech_Rpt_072704.pdf
[14] Source: 460_DEIS_Section_4_5-6.pdf

show the final NPL sites and proposed NPL sites within the environmental study area and show the site name, EPA ID, NPL status and addresses.[15, 16]

Exhibit D-15: Final National Priority List (NPL) sites from Richmond to Norfolk Environmental Study Area

Site Name	EPA ID	NPL Status	City	County	Zip
Abex Corp	VAD980551683	Final	Portsmouth	Portsmouth	23704
Atlantic Wood Industries	VAD990710410	Final	Portsmouth	Portsmouth	23704
C & R Battery	VAD049957913	Final	Richmond	Chesterfield	23234
Defense General Supply Center	VA3971520751	Final	Richmond	Chesterfield	23297
Former Nansemond Ordnance Depot	VAD123933426	Final	Suffolk	Suffolk	23434
Naval Amphibious Base	VA5170022482	Final	Norfolk	Virginia Beach	23521
Norfolk Naval Base	VA6170061463	Final	Norfolk	Norfolk	23511
Norfolk Naval Shipyard	VA1170024813	Final	Portsmouth	Portsmouth	23709
Rentokil, Inc.	VAD071040752	Final	Richmond	Henrico	23228
St Julien's Creek Annex (US Navy)	VA5170000181	Final	Chesapeake	Chesapeake	23702
Saunders Supply Co.	VAD003117389	Final	Chuckatuck	Suffolk	23432

Exhibit D-16: Proposed National Priority List (NPL) sites – Richmond to Norfolk Environmental Study Area

Site Name	EPA ID	NPL Status	City	County	Zip
Peck Iron and Metal	VAN000306115	Proposed	Portsmouth	Portsmouth	23704

In development of new alignments, as a rule, it is best to try to avoid passing through a hazardous waste site. However, should it prove necessary to pass through such a site, this is not necessarily a negative from an environmental perspective. It may then become necessary to clean up the site first before the rail alignment can pass through it; which is good for the environment but adds cost to the rail project.

6. AIR QUALITY

The Environmental Protection Agency (EPA) has set National Ambient Air Quality Standards (NAAQS) for six principal pollutants. These six principle pollutants are: Carbon Monoxide (CO), Lead, Nitrogen Dioxide (NO2), Ozone, Particle matter and Sulfur Dioxide (SO2) – these are called "criteria" pollutants. Exhibit D-17 shows the criteria for all the pollutants based on the NAAQS[17]. For the environmental study area from Richmond to Norfolk, Ozone has been the only problem criteria pollutant. The 2008 8-hour Ozone classifications for 2008 still in use today, are as follows:

[15] http://www.epa.gov/superfund/about.htm
[16] Virginia Department of Environmental Quality
[17] http://www.epa.gov/air/criteria.html

- Extreme: Area with a design value of 0.175 ppm and above.
- Severe 17: Area with a design value of 0.119 up to but not including 0.175 ppm.
- Severe 15: Area with a design value of 0.113 up to but not including 0.119 ppm.
- Serious: Area with a design value of 0.100 up to but not including 0.113 ppm.
- Moderate: Area with a design value of 0.086 up to but not including 0.100 ppm.
- Marginal: Area with a design value of 0.076 up to but not including 0.086 ppm.

On April 30, 2004 (69 FR 23941), the environmental study area was designated as "marginal nonattainment" for the 1997 ozone NAAQS, which was set at a level of 0.08 ppm or 84 ppb[18]. However, the area implemented a number of control measures that resulted in significant reductions in ozone, and the area qualified for attainment (maintenance) status in June 2007. On November 21, 2011, the DEQ Director submitted air quality designation recommendations for Virginia for the 2008 ozone National Ambient Air Quality Standard (NAAQS) to U.S. Environmental Protection Agency (EPA)[19]. In April 2012, the EPA concurred and designated this area as attaining the 2008 ozone NAAQS.

[18] Page 3, *Ozone Advance Action Plan for the Richmond-Petersburg Area,* http://www.deq.virginia.gov/Portals/0/DEQ/Air/PublicNotices/Drafts/rppro.pdf

[19] See: http://www.deq.virginia.gov/Programs/Air/AirQualityPlanningEmissions/2008OzoneStandardDesignationRecommendations.aspx

Exhibit D-17: National Ambient Air Quality Standards (NAAQS) [20]

Pollutant [final rule cite]	Primary/ Secondary		Averaging Time	Level	Form
Carbon Monoxide	Primary		8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead	Primary and Secondary		Rolling 3 month average	0.15 µg/m³	Not to be exceeded
Nitrogen Dioxide	Primary		1-hour	100 ppb	98th percentile, averaged over 3 years
	Primary and secondary		Annual	53 ppb	Annual Mean
Ozone	Primary and Secondary		8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution	$PM_{2.5}$	Primary	Annual	12 µg/m³	Annual mean, averaged over 3 years
		Secondary	Annual	15 µg/m³	Annual mean, averaged over 3 years
		Primary and Secondary	24-hour	35 µg/m³	98th percentile, averaged over 3 years
	PM_{10}	Primary and Secondary	24-hour	150 µg/m³	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide	Primary		1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary		3-hour	0.5 ppm	Not to be exceeded more than once per year

As a result, the environmental study area has now been upgraded to an attainment area for all air pollutants. The implementation of a rail system might reasonably be expected to further improve air quality, by reducing automobile use and hence automobile emissions throughout the study area.

It should be noted that these air quality measures are all defined across a very broad geographic area. They are not location specific to the level that they are likely to impact specific rail corridor location

[20] http://www.epa.gov/air/criteria.html

decisions. The best way to optimize the performance of this measure will be to select a very attractive rail option that will be able to maximize diversion from the automobile.

7. Noise and Vibration

Railroad activity, street level traffic, and large truck traffic account for the majority of the noise and vibration impacts within the Richmond to Norfolk study area. In a future phase of work, the methodology used for measuring noise and vibration should be conducted in accordance with Federal Railroad Administration's (FRA) High-Speed Ground Transportation Noise and Vibration Impact Assessment guidelines[21], and Richmond Hampton Roads Passenger Rail Project Tier I Draft EIS report[22] . At this phase of study, only the methodology is identified. Typically, mitigations for noise and vibration are construction of noise fencing, elimination of horn noise associated with trains passing though the grade crossings, and prohibiting use of trucks on bridges. In the current study, an allowance for sound wall protection has been included where the alignment passes close to existing development in urbanized areas. This is based on a very preliminary assessment and will need to be updated in a future phase of work, based on the results of a more detailed engineering analysis of noise impacts.

8. Utilities

Selection of alternatives should take into consideration the potential impacts on utility lines located along the alignment. These utility lines can be identified by reviewing aerial images and aerial mapping available from several internet sites and site specific photographs[23]. Exhibit D-18 shows a sample utility line located in the environmental study area. Any utilities situated in the right-of-way may need to be relocated.

[21] High-Speed Ground Transportation Noise and Vibration Impact Assessment, U.S. Department of Transportation, Federal Railroad Administration, Washington, DC, December 1998 standards.
[22] Richmond Hampton Roads Passenger Rail Project Tier I Draft EIS report. Chapter 3 http://www.drpt.virginia.gov/projects/hamptonpassenger.aspx
[23] This information was based on the Richmond Hampton Roads Passenger Rail Project Tier I Draft EIS report. Chapter 3 http://www.drpt.virginia.gov/projects/hamptonpassenger.aspx

Exhibit D-18: Utility Line at Windsor, VA within Environmental Study Area FROM Richmond to Norfolk

9. ENVIRONMENTAL JUSTICE

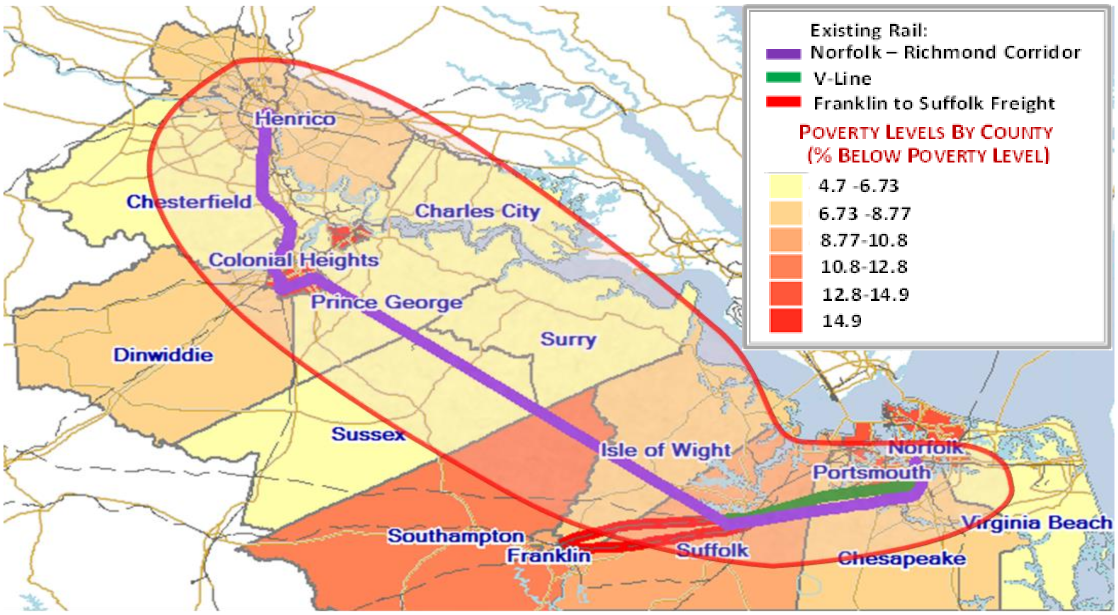
Title VI of the Civil Rights Act and the Executive Order on Environmental Justice (EJ) (#12898) do not provide specific guidance to evaluate Environmental Justice (EJ) issues within a region's transportation planning process[24]. Thus, for this study, the Delaware Valley Regional Planning Commission (DVRPC)'s 2001 EJ technical assessment[25] has been used as a model for evaluating potential EJ issues within the Richmond to Norfolk study area. Using this model, the following population groups need to be assessed as defined by the US Census Bureau:

- Non-Hispanic Minority
- Carless Households
- Households in Poverty
- Persons with a Physical Disability
- Female Head of Household with Child
- Elderly (over 75 years)
- Hispanic
- Limited English Proficiency

Poverty level data for all population groups is provided by the US Census Bureau. Exhibit D-19 shows the percent of families falling below the poverty level (by county) within the Richmond to Norfolk study area. The majority of counties within the study area have between 4% and 9% of families falling below the poverty level in family income; with Chesterfield, Charles City, Colonial Heights, Prince George's, Surry, Sussex and Virginia Beach having poverty levels that are below 7%, while the counties of Norfolk, Portsmouth and Southhampton have the highest poverty levels at over 12%.

[24] http://www.dvrpc.org/webmaps/ej
[25] http://www.dvrpc.org/webmaps/ej/

Exhibit D-19: Families below Poverty Level for Petersburg to Norfolk Environmental Study Area



Within the study area, the EJ assessment population density is minimal in the rural areas from Richmond and Petersburg to Suffolk, where most of the greenfield mileage is proposed. In the portions of the study area where the majority of the EJ population lives, the corridor tends to follow existing rail lines so development of the system is not expected to disproportionately impact the EJ population groups.. EJ issues, will need to be further analyzed in more detail in the next phase of the study.

10. GEOLOGY AND SOILS

The impact of dynamic loads of active trains on the soil may result in very intense compression cycles. For this reason, the type of soil and soil stability are very important factors. In order to provide a good foundation, thick layers of aggregate, and frequent and expensive maintenance may be required depending on the soil stability[26]. In order to determine the soil stability, identification of the soil type is essential. This could affect the final alignment location. Soil data for prime farmland is provided by the National Resource Conservation Service (NRCS), State Soil Geographic (STATSGO) Database and Soil Survey Geographic Database (SSURGO).[27] Exhibit D-20 shows usage of the Interactive Soil Survey Tool from the US Department of Agriculture's Natural Resources Conservation Services (NRCS) site to display soil data for an area located within in Charles City County, VA.
Soil data obtained from the STATSGO site is available in both tabular and spatial format for each county and is expressed in proportion values that range from 0.01 to 0.87. These values represent the probability of finding prime farmland at a geographical location and are subdivided into 5 equal intervals of classes with ranking as below[28].

[26] http://www.haywardbaker.com/WhatWeDo/Applications/RRSubgradeStabilization/default.aspx; http://www.prestogeo.com/railroad_industry; http://www.tenaxus.com/en/geosynthetics/soil-stabilization/railroads-and-airport-runways.htm.
[27] See: http://www.ncgc.nrcs.usda.gov
[28] http://www.dcr.virginia.gov/natural_heritage/documents/AgriculturalModelTechReport.pdf

Range[29]	Rank
0.8015686 – 1	5 (High)
0.6031372 – 0.8015686	4
0.4047058 – 0.6031372	3
0.2062745 – 0.4047058	2
[1]0.0078431 – 0.2062745	1 (Low)

[29] According to Agricultural model Tech Report the final agricultural model describes that the ranges and ranking were based on prime farmland grid was weighted at 80%, the historic archaeological farms were weighted at 10% and the historic architectural farms were weighted at 10%.

Exhibit D-20: Sample Usage of the USDA's Interactive Soil Survey Tool to Display Soil Data within the Lewis Tyler Lane Area of Charles City County.[30]

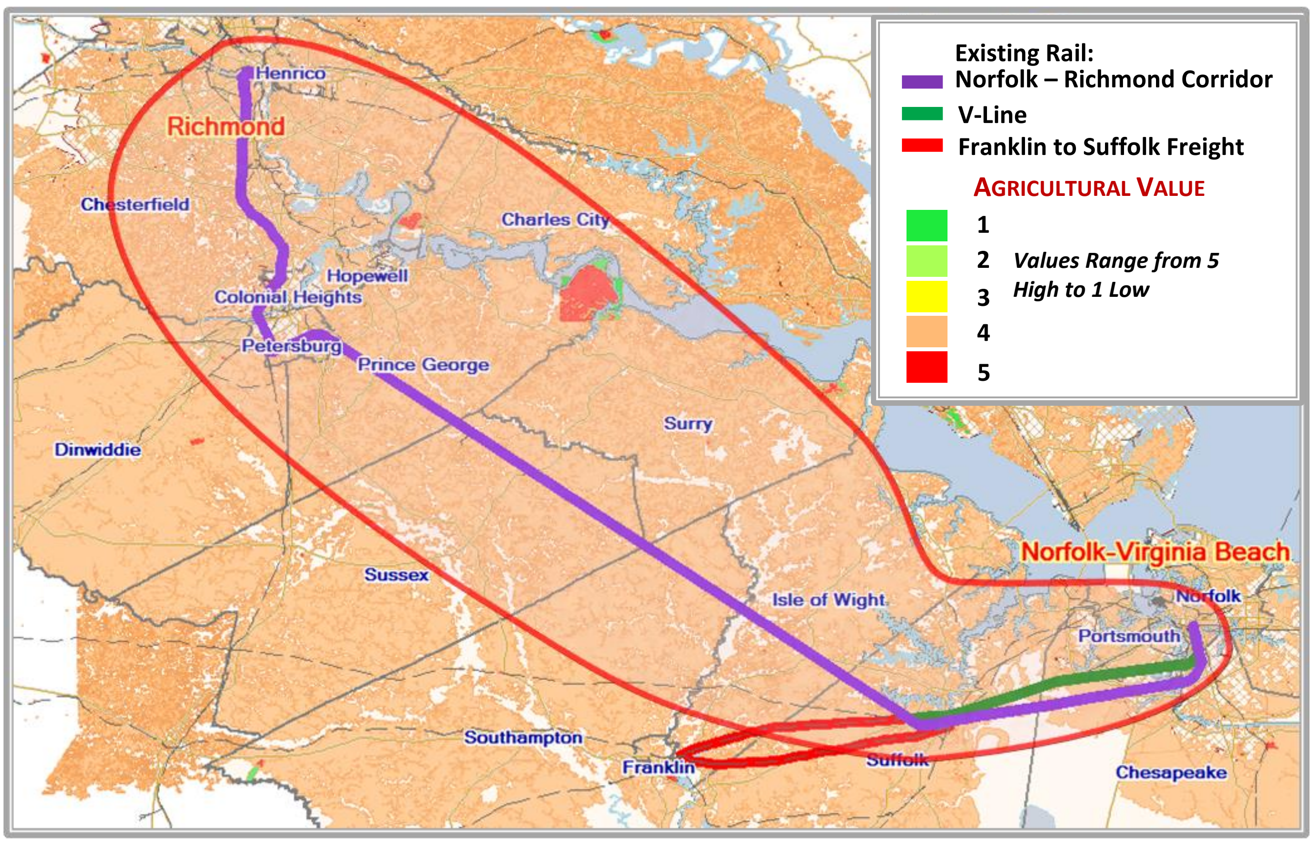
Charles City County, Virginia (VA036)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1A	Altavista fine sandy loam, 0 to 3 percent slopes	987.8	0.8%
2A	Augusta sandy loam, 0 to 2 percent slopes	972.4	0.7%
3A	Bethera silt loam, 0 to 2 percent slopes	799.9	0.6%
4A	Bibb fine sandy loam, 0 to 2 percent slopes, frequently flooded	6,744.8	5.1%
5A	Bojac loamy fine sand, 0 to 2 percent slopes	110.8	0.1%
5B	Bojac loamy fine sand, 2 to 6 percent slopes	486.6	0.4%
6B	Caroline silt loam, 2 to 6 percent slopes	311.3	0.2%
7B	Caroline-Emporia complex, 2 to 6 percent slopes	6,557.9	5.0%
7C	Caroline-Emporia complex, 6 to 10 percent slopes	241.2	0.2%
8B	Catpoint loamy	479.1	0.4%

[30] http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Exhibit D-21 shows the agricultural ranking values within the environmental study area ranging from a high of 5 to a low of 1. The ranking was based on final prime farmland and historic farm grids. It is seen that at this stage of data collection, most of the environmental study area falls under rank 4. For instance, much of Virginia's soil[31] is *Pamunkey* soil formed in stream terrace sediments in the James River drainage basin of Virginia. This soil needs to be preserved, as in recent years these soils produced high yields of corn and wheat[32]. Once rail alternatives have been selected in the next stage of the study, a more detailed soil inspection will be needed, both for development of a detailed alignment options and for identification of farmland impacts. However, it should be noted that farmland impacts for a rail system should be less than those for a comparable highway development. The agricultural land impacts can be minimized by not purchasing any wider right of way than is needed for the actual development of the rail line (typically 50') or if a wider right of way is purchased in order to secure a buffer zone, leasing back any excess right of way within prime agricultural lands for continued agricultural use.

Exhibit D-21: Agricultural Values within the Environmental Study Area



[31] According to Natural Resources Conservation Service (NRCS) of US Department of Agriculture, A state soil is a soil that has special significance to a particular state. Each state in the United States has selected a state soil, twenty of which have been legislatively established. These "Official State Soils" share the same level of distinction as official state flowers and birds. Also, representative soils have been selected for Puerto Rico and the Virgin Islands. http://soils.usda.gov/gallery/state_soils/

[32] ftp://ftp-fc.sc.egov.usda.gov/NSSC/StateSoil_Profiles/va_soil.pdf

11. Transportation; Land Status, Land Use and Zoning; and Socioeconomic Conditions

- Transportation: The presence of interstates, highways or any major roadway impacts must be identified for the proposed alternatives

- Land Status, Land Use, and Zoning: Right-of-ways for the proposed rail tracks must be taken into consideration as part of the study.

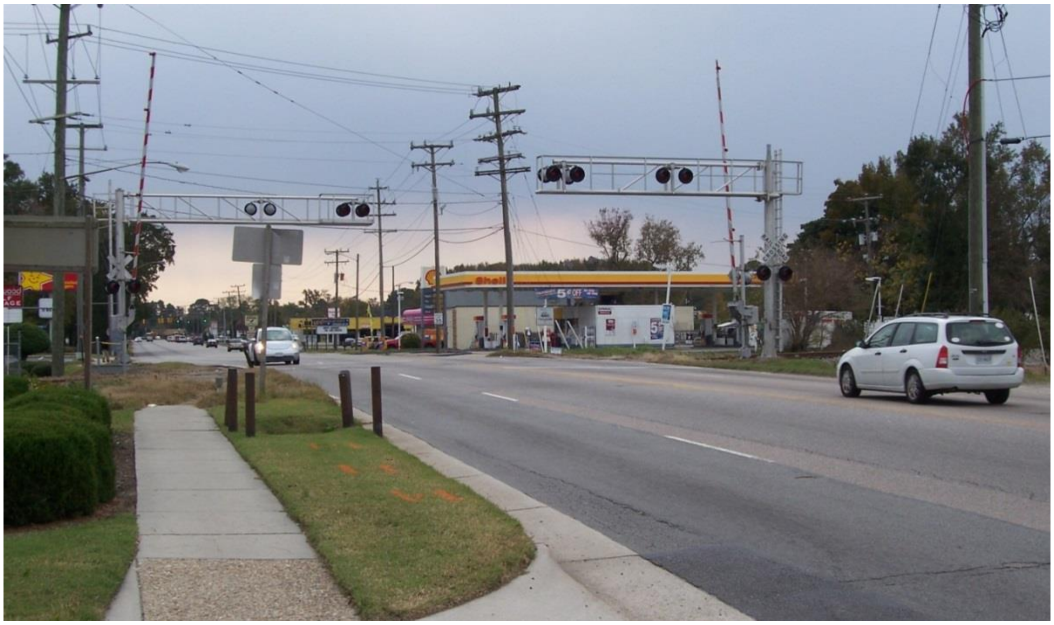
- Socioeconomic Conditions: The hierarchical population density of the cities and counties for the Richmond to Norfolk environmental study area are Norfolk City, Richmond City, Portsmouth City, Colonial Heights City, Virginia Beach City, Petersburg City, Henrico Co., Franklin City, Chesterfield Co., Chesapeake City, Suffolk City, Prince George County, Isle of Wight County, Dinwiddie County, Sussex County, and Surry County, with the city of Norfolk being the most densely populated and Surry County being the least populated. Major densely populated residential city areas with major transportation hubs are very important in the consideration and selection of proposed alternatives.

12. Public Health and Safety

Typical safety features that must be taken into consideration when proposing rail alignment alternatives include: the age of bridges that may be used by the alignment, water runoff, basal erosion, and accidents at railroad crossings. Railroad crossings, pedestrian safety and rail operations are also main factors contributing to the safety[33]. Exhibit D-22 shows a typical rail crossing located in Chesapeake, VA. Since the majority of the proposed rail system is proposed to be developed on grade-separated alignment it is anticipated that its development will improve safety. In urban areas where speeds are reduced, grade crossings may be considered with appropriate (but vastly improved) grade crossing protection and signage. Trespasser risks will be mitigated by security and sound wall fencing, particularly in urban areas, to "seal" and secure the corridor.

[33] Based on Federal Highway Railroad (FRA, Federal Highway Administration (FHWA), and Richmond to Hampton Roads Passenger Rail Study, Tier I Environmental Impact Statement, Virginia DRPT.

Exhibit D-22: Rail Road Crossings at Chesapeake, VA within Environmental Study Area from Petersburg to Norfolk



13. Conclusion and Further Analysis

The environmental scanning/analysis discussed this appendix, identified and summarized potential environmental impacts within the environmental study area going from Richmond to Norfolk. This included collecting data on and mapping potential environmental impacts: conservation areas, historical resources, wetlands, wildlife resources, natural land networks, environmental justice, hazardous materials (data only), and air quality (data only). In addition, suggestions for possible mitigation measures for each of the potential environmental impact types were outlined. The highlights of the environmental scan, data collected and suggested mitigation measures are as follows:

- Conservation lands were identified and mapped within the environmental study area approximating 222,168 total acres including: 2,414 acres of forest area, 43,550 acres of federal, national and state park areas, 112,886 acres of wild life refuge and preserves area, and 63,318 acres of other conservation lands (ex. land holdings, military installation, preserves, etc.) Suggested mitigation measures include designing alignments so that they take a path that avoids or by-passes potential impacts with conservation land areas.

- Approximately 300 Protected historical resources were identified and mapped within the environmental study area including: churches, buildings, houses, etc. Suggested mitigation measures include designing alignments so that they take a path that avoids or by-passes potential impacts with protected historic sites.

- Wetlands within the environmental study area were identified and mapped. Wetland totals for the environmental study area approximated 376,850 total acres that include approximately: 311,537 acres of 'Freshwater Forested/Scrub' wetlands; 19,256 acres of 'Freshwater Emergent' wetlands; 17,547 acres of 'lake' wetlands; 13,195 acres of 'Freshwater Pond' wetlands; 11,073 acres of 'Estuarine and Marine' wetlands; 3,174 acres of

'Riverine' wetlands; 812 acres of 'Estuarine and Marine Deepwater' wetlands; and 254 acres of 'other' wetlands. Suggested mitigation for impacted wetlands include coordinating with the US Army Corps of Engineers to design appropriate mitigating measures that meet compliance with Executive Order 1199034 for Protection of Wetlands, including avoiding, filling, bridging, or replacing wetlands at the required ratios.

- Wildlife resources within the environmental study area were identified and mapped including the location of: lakes creeks, reservoirs, wildlife preserves, bird and wild life trails, fishing areas, and boating access sites. Suggested mitigation measures include designing alignments so that they take a path that avoids or by-passes potential impacts with wildlife preserves and wildlife resources.

- The environmental study area was also reviewed with regard to the location of important natural land links, nodes, and core areas identified by the VaNLA as being vital to the preservation of natural land networks and biodiversity in the regional ecosystem. Vital intact natural land networks in the HRTPO region were identified and mapped. Suggested mitigation measures include designing alignments so that they take a path that avoids fragmenting intact land networks and intact core areas that have a high to excellent ecological integrity score rating. Where fragmentation cannot be avoided, it is recommended to keep impacts confined to the edges of highly valued core areas and/or to provide natural passageways that allow for the natural movement or migration of plant and animal species.

- Hazardous material superfund sites of 11 final NPL sites and 1 proposed NPL site were identified within the Richmond to Norfolk environmental study area. These issues will be more thoroughly examined in the next phase of the study once route alignment options have been decided upon for further study.

- Air quality within the Richmond to Norfolk environmental study area shows that the only pollutant that has recently been in the marginal levels was ozone. However in April 2012 the EPA designated the area as in compliance for ozone under the 2008 standards, so the study area is now in compliance status for all air pollutants.

- Other human environmental elements that include noise and vibrations, utilities, environmental justice, geology and soils, transportation, land status, land use, and zoning, socioeconomic conditions, and public health and safety were briefly reviewed at a landscape level scan and should be discussed in more thorough detail in the next phase of the study once the final route alignment options have been selected.

Using the summary of identified environmental resources and potential environmental impacts outlined in this chapter as a base, a more intensive environmental study (Service NEPA) can be performed in the next phase of the study once the route alignment options have been even more carefully defined and optimized.

[34] http://www.archives.gov/federal-register/codification/executive-order/11990.html

APPENDIX E: PHASE 2A ENGINEERING FIELD SURVEY: PETERSBURG TO NORFOLK

1. INTRODUCTION

One of the key elements in developing higher and high speed intercity passenger rail options for the Norfolk to Richmond Corridor is a review of the existing rail infrastructure, along with development of an understanding of the potential corridor constraints and opportunities for improvements for supporting passenger rail service. As a part of the Phase 2A data collection effort in 2012, a field survey for understanding the general topographic, demographic and environmental conditions along potential Greenfield corridors between Norfolk, Petersburg and Richmond was undertaken. For the purpose of a preliminary analysis, this assessment was accomplished by using the following process:

- Gathering of information from a route review of the existing rail corridor from Norfolk – Suffolk – Petersburg – Richmond area, and to understand the existing conditions along corridors that might include potential new Greenfield alignments.
- Gathering of information from prior Engineering analyses of the Norfolk – Richmond – Washington, DC and Newport News – Richmond – Washington, DC rail corridors and Preliminary Vision Plan including a review of available right-of-way documentation and cost data.
- Identification of typical corridor infrastructure issues and constraints.
- Identification of the design standards typically applied for the various classes of passenger rail service.
- Development of an initial conceptual capital cost estimate of rail improvements to support the implementation of high speed passenger rail service.

It should be noted that for the purposes of this preliminary analysis no detailed corridor mapping or route specific inspection of the potential Greenfield rail corridors was completed, since exact alignments for the prospective Greenfield routes has yet to be determined.

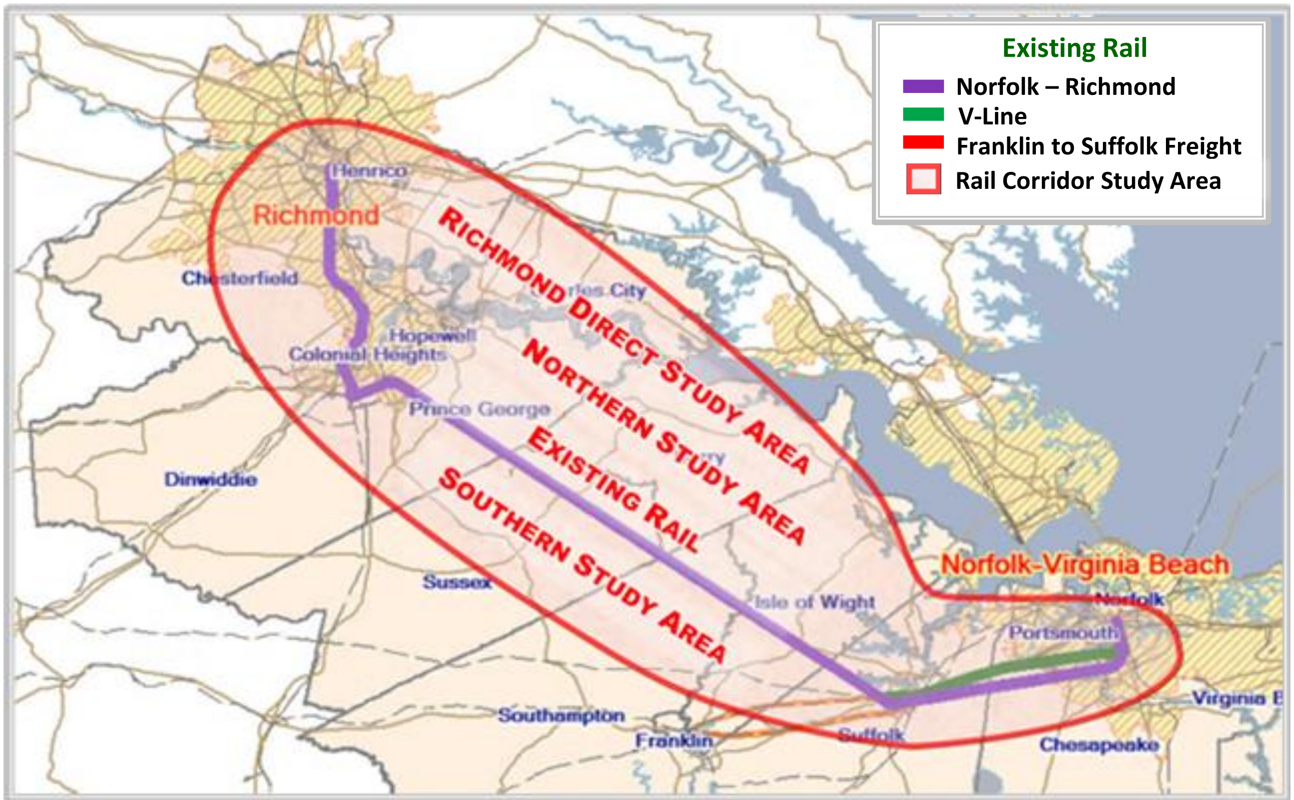
This Appendix documents the Engineering Database that includes the *TRACKMAN*™ databases, and the preliminary infrastructure data that was collected for the high speed and intercity passenger rail assessment. It presents an overview of existing conditions between Petersburg/Richmond and the Norfolk area. Typical design standards used for the development of the various speeds of passenger rail service and unit cost data are included in Chapter 4 in the main body of this report.

2. POTENTIAL HIGH SPEED ROUTES FROM PETERSBURG TO NORFOLK

To support the data collection effort in Phase 2B, it was clear that at least a preliminary definition of the Environmental Study Area would be needed. The Environmental Study Area is considered to be the potential region or envelope within which potential rail alignments might lie. This contrasts with a broader "Study Area" or Zone System that is used for ridership forecasting. Because of the ability to use auto as an access mode as well as connecting rail service, the "Ridership Study Area" encompasses a much larger territory than does the "Environmental Study Area." The Environmental Study Area defines the geographic boundaries of the area within which engineering and environmental data must be collected and reviewed. This Environmental Study Area is shown in Exhibit 1.

These options allow a great deal of flexibility for locating the final alignments between Richmond and the west end of Suffolk within a broad envelope. All options assume that the existing "V-line" right-of-way will be used through downtown Suffolk to Norfolk. As seen in Exhibit 1 an envelope has been created to define the Environmental Study Area. The engineering, environmental databases are focused within this envelope. The major areas of concern along the existing rail alignment are Disputanta, Waverly, Wakefield, Ivor, Zuni and Windsor. These areas are discussed in the following sections.

Exhibit 1: Norfolk to Richmond Environmental Study Area



*Alignment will not be determined until the Tier II Environmental Process is complete.

Clearly, one possible option is to develop a high speed rail service from Petersburg to Suffolk paralleling the existing Norfolk Southern tracks. Presumably the existing tracks would not be used because they are needed for the current freight service, and Norfolk Southern has a policy of not permitting speeds above 79 mph on tracks they own. Therefore, the task is to assess the corridor in close proximity, either within the existing right-of-way or closely paralleling the right-of-way, for the ability to add high speed tracks to the corridor. In a general sense, since the existing rail alignment is straight, geometry is not the challenge, but there are a number of instances (particularly in small towns) where adjacent development closely hugs the right-of-way. The need for potential property displacement is a definite challenge for the development of this alignment – although any greenfield alignments will also require displacements.

3. *TRACKMAN™* DATABASE

The *TRACKMAN™* Track Management System was used in this analysis to provide a milepost-by-milepost record of the rail gradients and track geometry of the existing right-of-way. The data that has been compiled from existing sources includes railroad timetables, track charts, ordinance survey maps, and land stat photometry for the existing NS alignment and will be complied for the possible greenfield alignments to be developed in the next phase of the study. The following has been assessed for the NS route alignment and will similarly be used to assess the other possible corridor options:

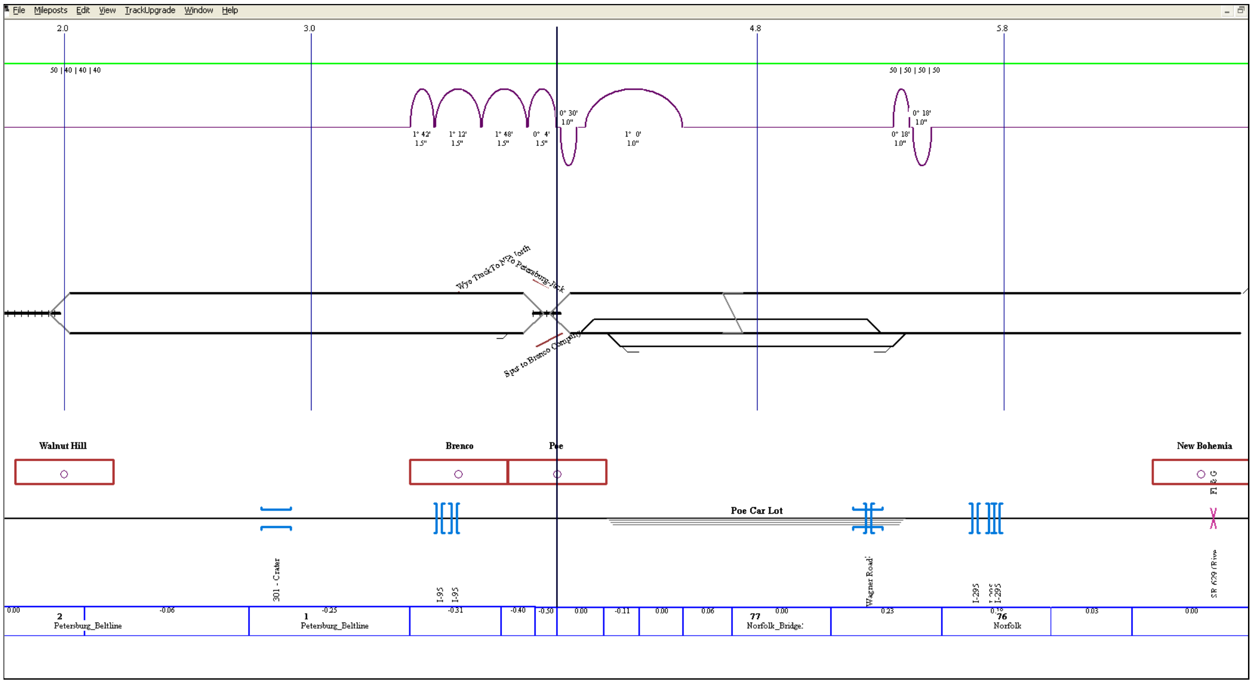
- Potential track upgrades
- Improvements for different passenger rail speeds
- Operations

The possible alternatives will be derived from the preliminary analysis of the environmental data and engineering standards required for each technology. The options are at the conceptual landscape level of route assessment and will serve as preliminary options. However, entirely new options could be selected in the Tier I Environmental Alternative Analysis in the Analysis Phase of the project.

Engineering notes were developed and entered into the *TRACKMAN™* program, which is used to maintain the database, to provide a clear understanding of basic track conditions, and the upgrades needed to support higher passenger rail speeds. *LOCOMOTION™* and *MISS-IT™* are used for operation simulations.

A sample output from *TRACKMAN™* is given below in Exhibit 2. The full *TRACKMAN™* file for the existing Norfolk Southern rail route is given at the end of this Appendix.

Exhibit 2: Sample NS Petersburg Data



4. PRELIMINARY PHASE 2A INFRASTRUCTURE DATA COLLECTION FOR PETERSBURG TO NORFOLK

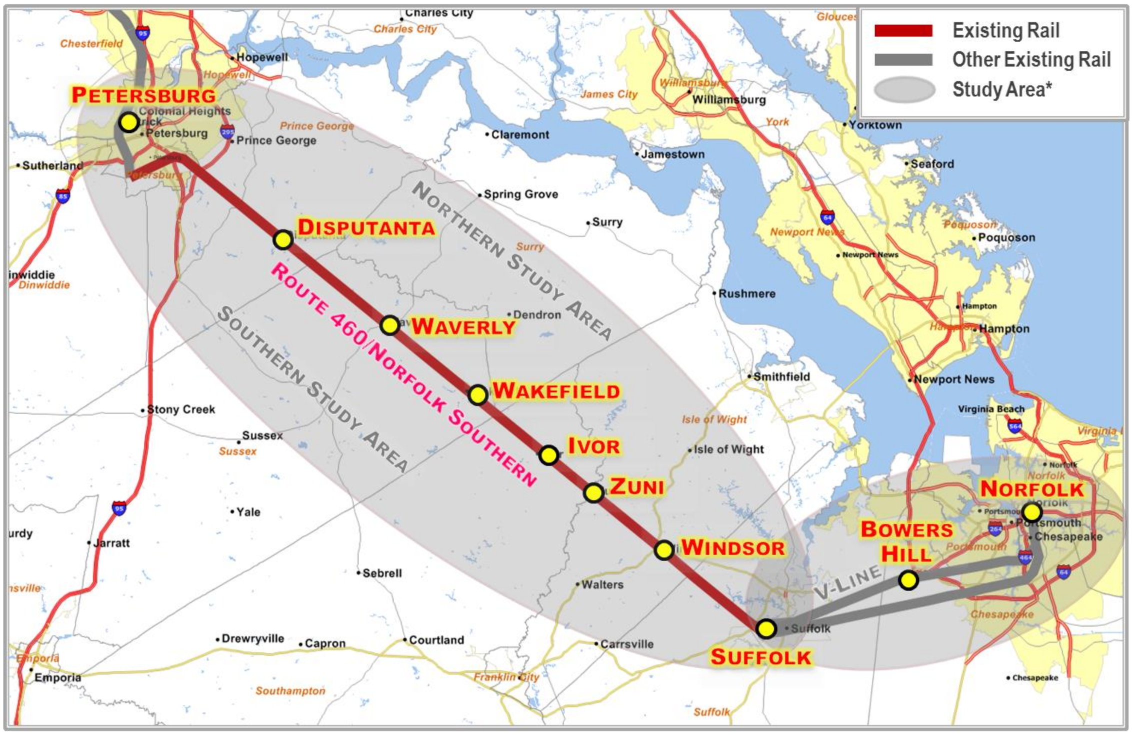
In the earlier phase of the study of the preliminary Vision Plan, existing passenger rail conditions were examined for the Norfolk Southern and the CSX Transportation (CSXT) rail lines between Richmond and the Hampton Roads area along with field review of the section of the Richmond to Petersburg rail lines south of the Amtrak Staples Mill Station. In this phase of the study, possible greenfield options from the Richmond area to Norfolk were added. The earlier inspection of the existing NS corridor from Norfolk to Petersburg was updated and a thorough inspection (as is possible from publicly accessible locations) was conducted. The existing conditions review was completed by a survey of the potential rail corridors together with detailed Google mapping. The existing conditions review was accomplished by driving to access crossing (intersecting streets, overpasses) of the rail lines and seeing the rail corridors at these access points.

The following photos provide an overview of the existing conditions along the rail corridor alternatives between Petersburg and Norfolk. In addition, Harbor Park Station in Norfolk was reviewed.

4.1 NORFOLK SOUTHERN EXISTING RAILROAD– SUFFOLK TO PETERSBURG

From Petersburg to Suffolk, one alternative is to follow the existing NS rail alignment. (See Exhibit 3) As part of Step 1 this has been recently upgraded to allow 79-mph passenger rail from Petersburg to Norfolk.

Exhibit 3: NS Existing Alignment from Suffolk to Petersburg



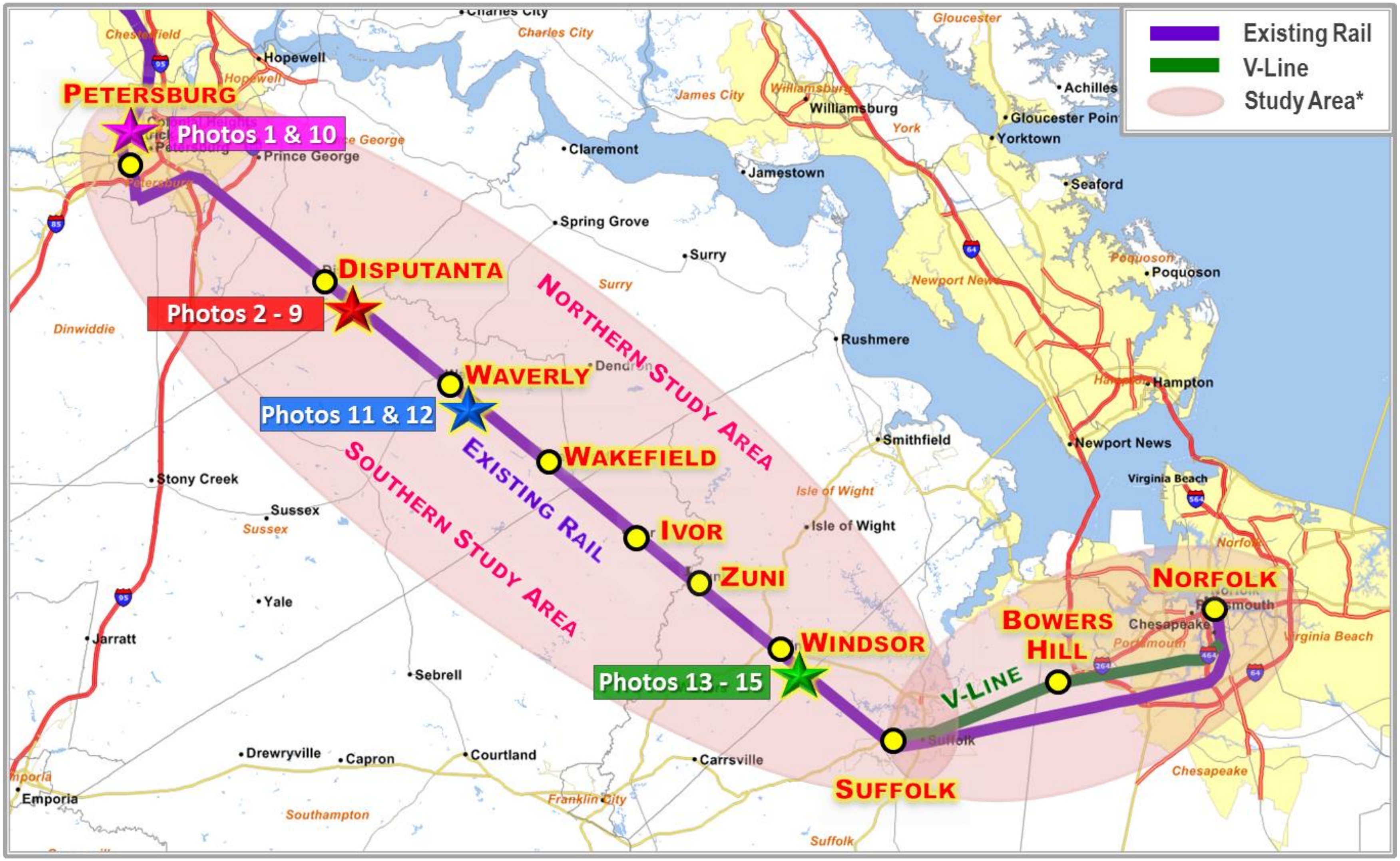
*Alignment will not be determined until the Tier II Environmental Process is complete.

The improvements that have been made from the new connection at Collier (in south Petersburg) to Norfolk include:

- New bidirectional signaling system
- New crossovers
- Track speed improvements

Some of the improvements can be seen in Photos 1 and 2 below that show the new CSXT/NS connection at Collier, and the new bidirectional signaling system.

Exhibit 4: Photo Locations along NS Existing Alignment from Suffolk to Petersburg



*Alignment will not be determined until the Tier II Environmental Process is complete.

Photo 1: New Collier connection near Halifax Road south of Petersburg.

Photo 2: New Bi-directional signaling system at Disputanta, VA.

The assumption is that in order to run high speed service at least one or two new tracks must be added to the corridor separate from the existing rail lines. Norfolk Southern's policy does not allow trains with speeds greater than 79 mph[1]. The Federal Railroad Administration (FRA) only requires 14 feet of track separation but according to *Adjacent Track Rule*[2] the track separation should be at least 25 feet to avoid interference with track maintenance operations. Increased spacing even beyond 25 feet will be considered where practical.

For adding track to the rail corridor, photos 3 through 15 (also located in Exhibit 4) show the area adjacent to the NS existing track with major areas of concerns being Disputanta, Waverly, Wakefield, Ivor, Zuni, and Windsor.

[1]Norfolk Southern to increase maximum speeds for Amtrak trains between Norfolk and Petersburg. http://www.nscorp.com/nscportal/nscorp/Media/News%20Releases/2012/ns_amtrak_speed.html

[2] http://www.gpo.gov/fdsys/pkg/FR-2011-11-30/pdf/2011-30250.pdf

Some of the environmental issues noted along the existing NS tracks were:

- The presence of small towns with residential property, historic places
- Presence of wetlands very close to the existing NS tracks
- Presence of over and under bridges which narrow downs the track separation distance, or else requires replacement of the bridges
- Highway crossing to develop grade separations for a high speed rail
- Access to private lands across tracks must be maintained
- Rail-served industry access must be maintained
- Rail access to connecting lines and junctions must be maintained

Photo 3: Railroad crossing at Disputanta, VA would require grade separation.

Photo 4: Industrial development near tracks at Disputanta, VA

Photo 5: Overhead rail bridge on Golf Course Drive at Disputanta, VA would have to be widened or replaced.

Photo 6: On south side of the NS Tracks Prince George Golf Course entrance at Disputanta, VA.

Photo 7: On south side of the NS tracks Bakers Pond at Disputanta, VA.

Photo 8: Private grade crossing at Disputanta, VA.

Another track may be added under the bridge, which should be at least 25 feet away according the FRA adjacent track rule for not interfering with freight operations.

Photo 9: Bridge at Disputanta, VA allows room for one track at 14 feet center, but not two tracks or wider separation. This bridge may have to be replaced to allow room for additional tracks.

Photo 10: Junction to Old NS Mainline at Poe, near Petersburg. Room for new track on the south side here would not interfere with the junction on the north side.

Photo 11: Old building in close proximity to tracks at Waverly, VA.

Photo 12: Room to add track north of existing rail alignment at Waverly, VA.

Photo 13: Industrial access at Windsor, VA.

Photo 14: Streets on both sides of tracks at Windsor, VA.

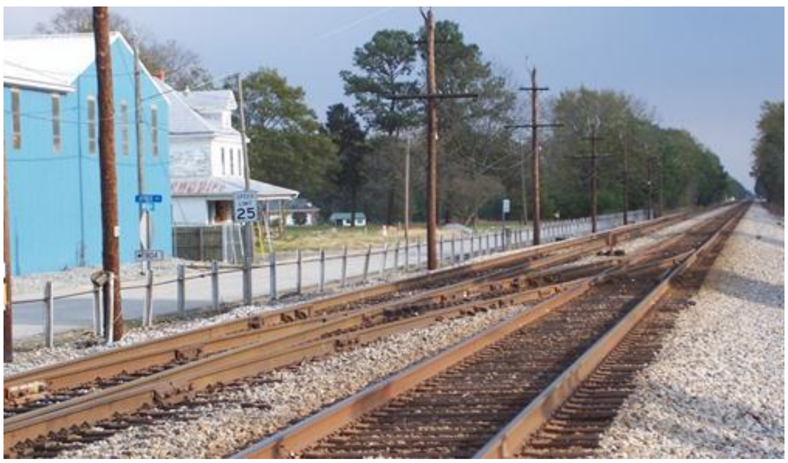


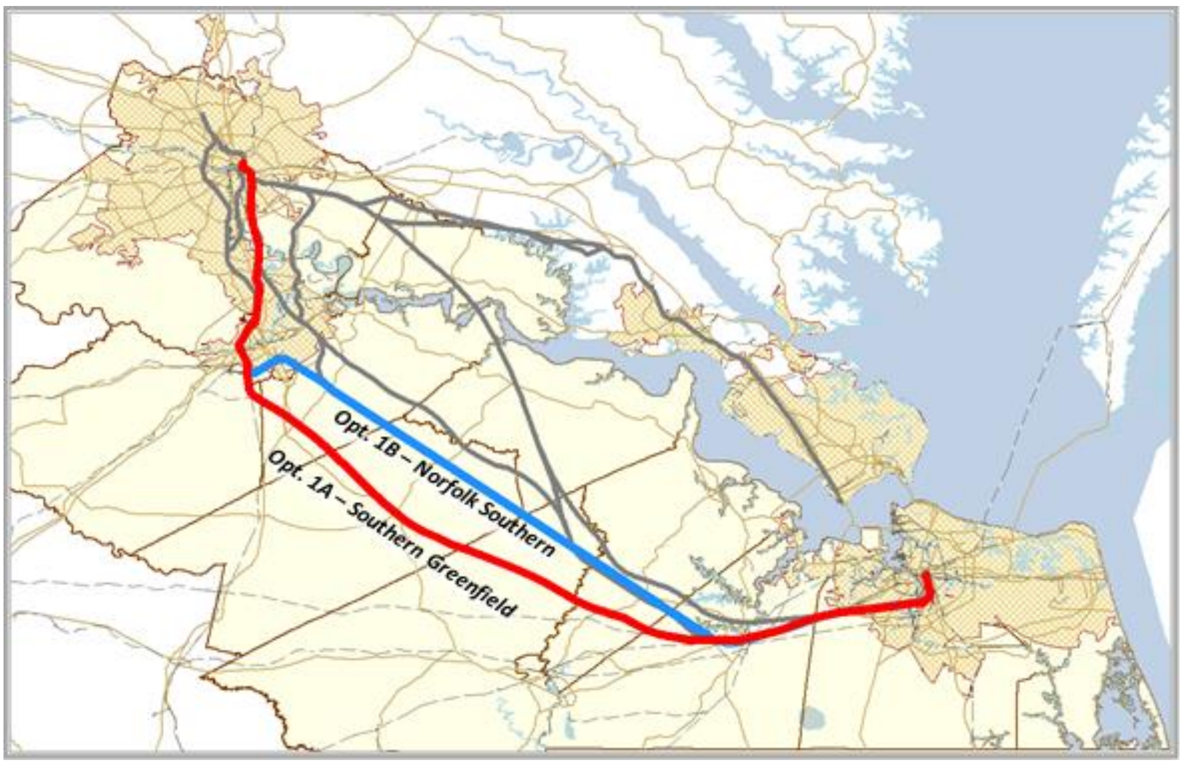
Photo 15: Railroad crossover at Windsor, VA.

The purpose of this inspection effort was to provide data for use in the preliminary engineering and environmental work for developing a capital cost estimate for improving the existing rail corridor. The example photographs show the specific kinds of measures that will be needed to implement high speed rail service while avoiding interference with existing freight operations.

4.2 POSSIBLE SOUTHERN GREENFIELD – SUFFOLK TO PETERSBURG OPTION 1A

The Suffolk to Petersburg segment of Option 1A, otherwise known as the Southern Greenfield, has also been reviewed (See Exhibit 5). The original concept was to follow the abandoned Virginian right-of-way as far as possible, to the vicinity of Walters. From Walters, a new greenfield would head straight towards Collier to meet CSX. But this has two problems: at the east end, this would pass through the middle of the town of Walters. At the west end, Photo 16 shows a residential community and Photo 17 shows Richard Bland College which lie along this direct path between Walters and Collier. However, these obstacles can be avoided by shifting the conceptual option. The revised greenfield would pass north of Walters, rather than directly through it. At the west end, the option is shifted south to meet CSX at the south end of Collier Yard, (near the SEHSR's[3] Burgess Connection) rather than at the north end. This eliminates any conflicts with the college and golf course community. See Exhibit 6 for photo locations within the possible southern greenfield study area.

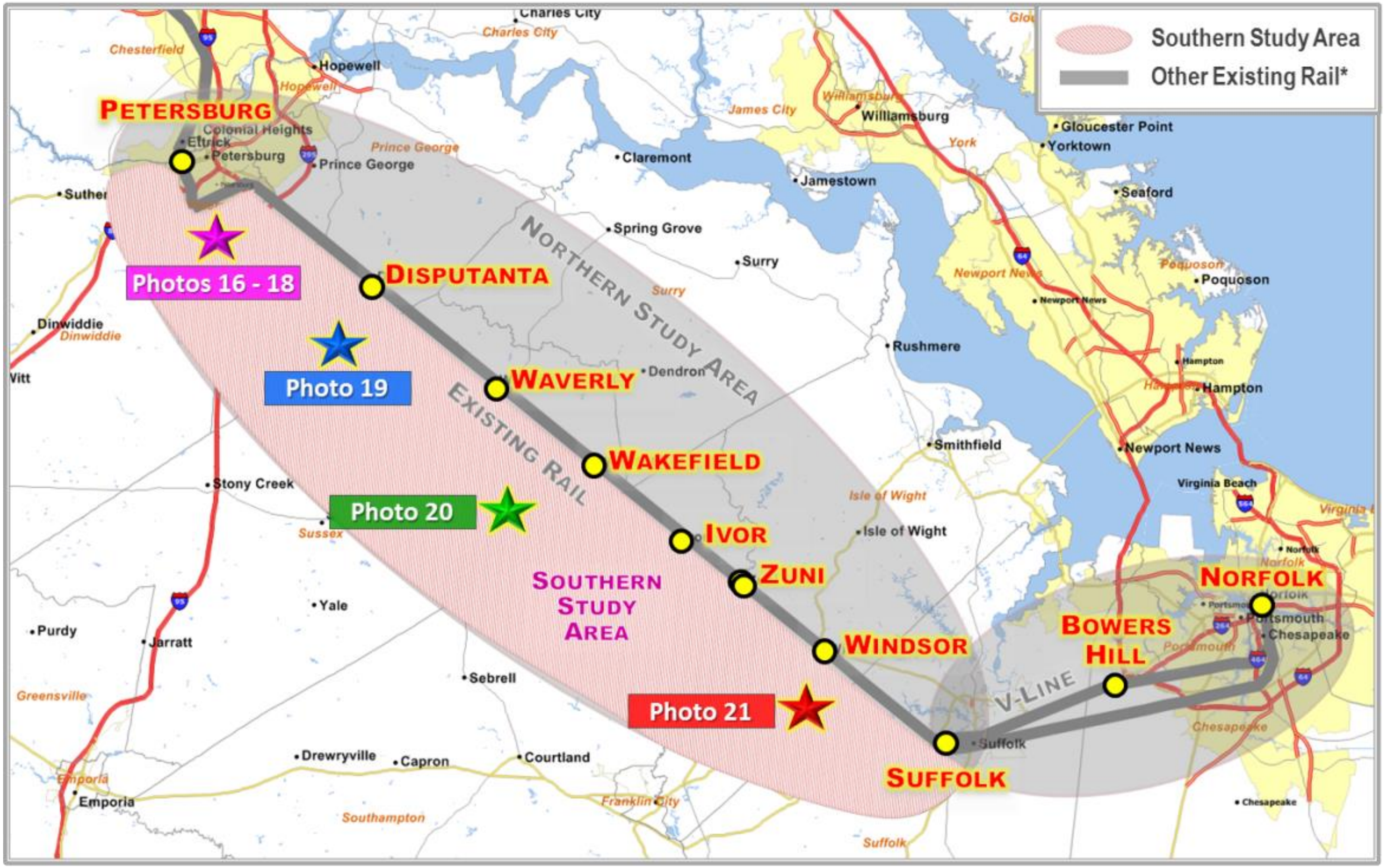
Exhibit 5: Southern Greenfield Option 1A from Suffolk to Petersburg



*Alignment will not be determined until the Tier II Environmental Process is complete.

[3] SEHSR – Southeast High Speed Rail

Exhibit 6: Photo Locations along Possible Southern Greenfield Option 1A from Suffolk to Petersburg



*Alignment will not be determined until the Tier II Environmental Process is complete.


Photo 16: Golf course and residential community at Halifax Road near Petersburg.


Photo 17: Richard Bland College at Petersburg

From Burgess north to Petersburg, the SEHSR and Norfolk services could share a dedicated passenger track around Collier yard. From Burgess, the southern high speed line would head southeast towards Suffolk, Photo 18 shows the open countryside looking east from Burgess. Photos 19 through 21 show open country side along the southern alignment, which would connect the south end of the Collier Yard to the western outskirts of Suffolk.

The greenfield right-of-way would skirt the Warwick Swamp heading through generally open countryside (cotton fields and scrub forest) to meet the abandoned “Virginian” rail right-of-way somewhere in the vicinity of Walters, VA. The alignment would then continue along the abandoned “V-Line” right-of-way into downtown Suffolk.

Photo 18: Open country side looking east, from the south end of Collier Yard.

Photo 19: Pine Scrub Forest territory to be traversed near Disputanta.

Photo 20: Cotton field in general area to be traversed near Wakefield.

Photo 21: Section of abandoned "Virginian" railroad right-of-way from Suffolk to Walters.

4.3 POSSIBLE NORTHERN GREENFIELD – SUFFOLK TO HOPEWELL – OPTION 2A

A northern greenfield from Petersburg to Suffolk (see Exhibit 7) might roughly parallel route 10 from south of James River Bridge near Hopewell to Zuni and then parallel the utility line and NS rail line from Zuni to Suffolk. Photos 22-25 show the bridge over James River on I-295 near Hopewell, the Median on Interstate I-295 near Prince George which has room to add track, Tucker Swamp which was identified as a potential environmental concern, and the utility line which is parallel to NS alignment/US Route 460. These photos are identified in Exhibit 8. The generic Greenfield would be located by identifying and avoiding the Tucker Swamp area, and utilizing the I-295 median to pass through the Petersburg/Hopewell community.

Exhibit 7: Northern Greenfield from Suffolk to Hopewell

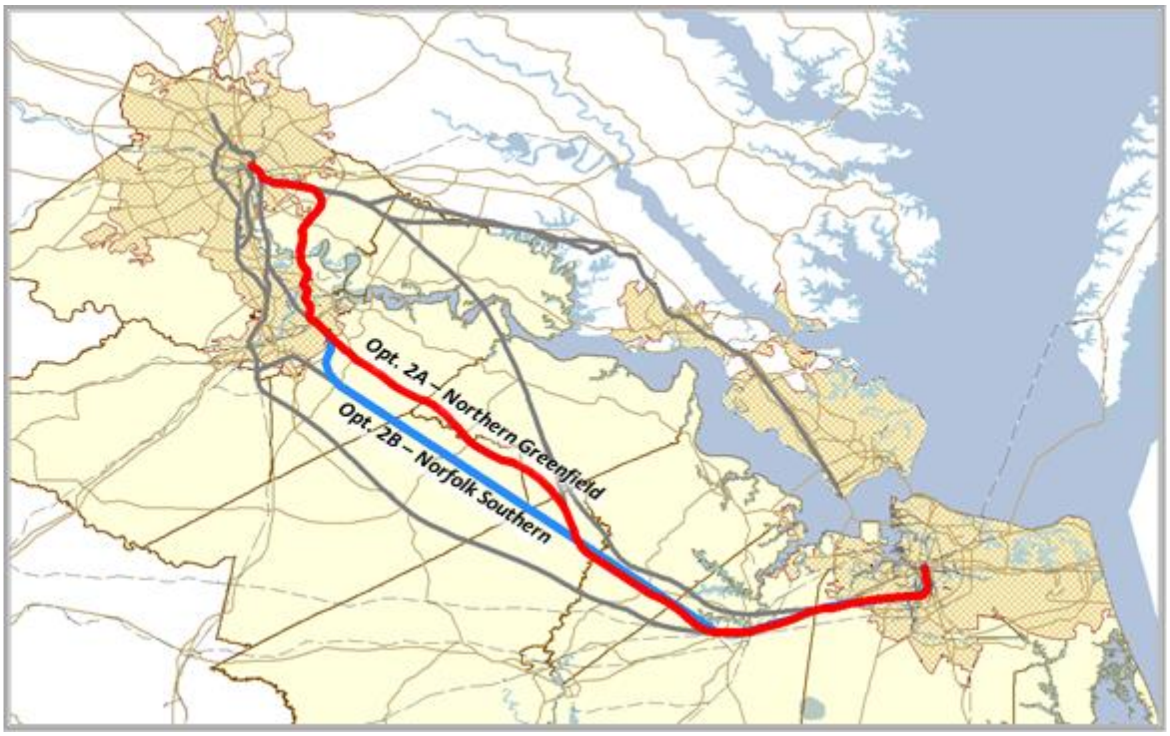
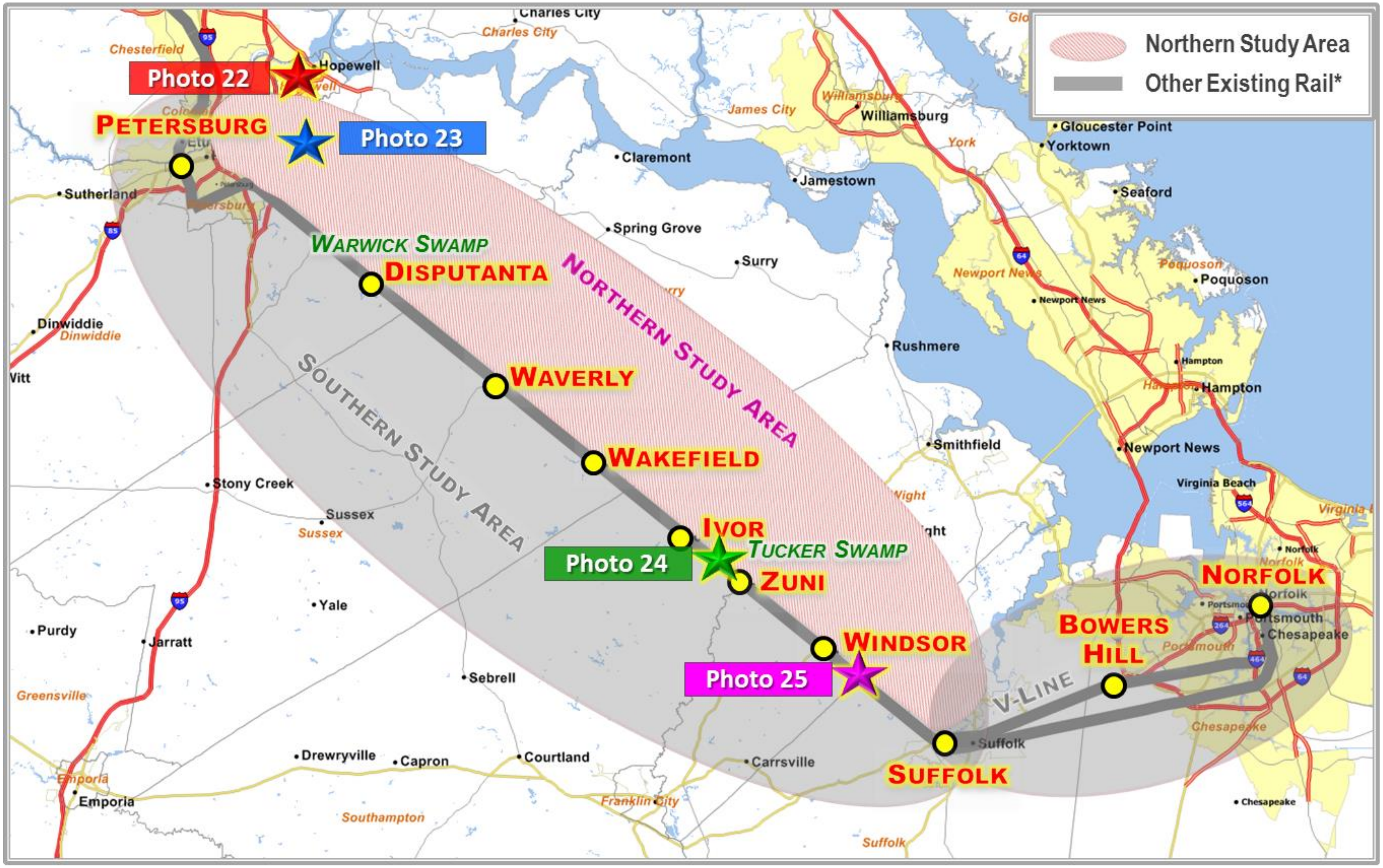


Exhibit 8 Photo Locations along Northern Greenfield from Suffolk to Hopewell



*Alignment will not be determined until the Tier II Environmental Process is complete.

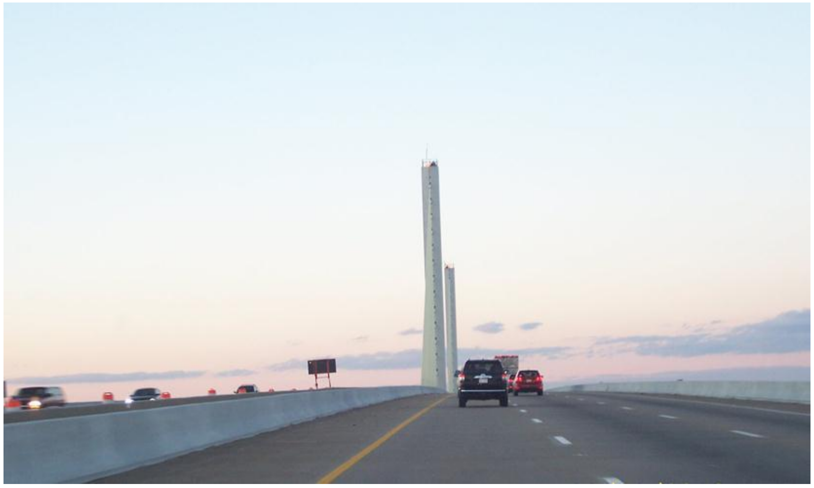


Photo 22: Bridge on I-295 near Hopewell James River.

Photo 23: Median on I-295 near Prince George.

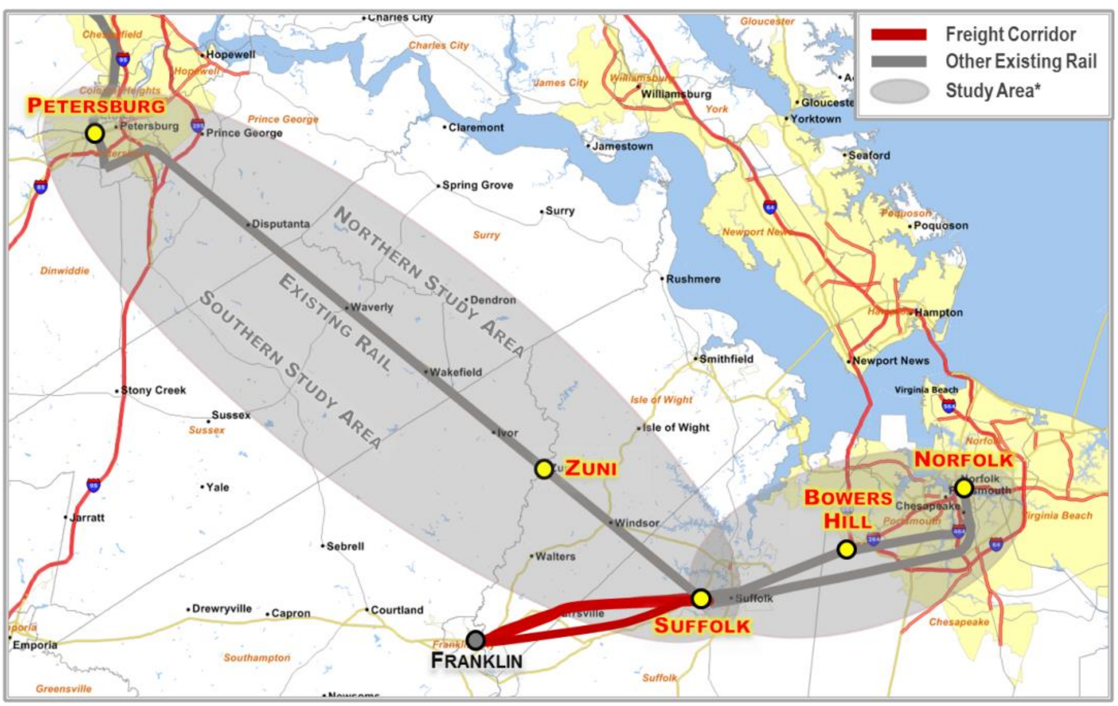
Photo 24: Tucker Swamp at the NS alignment.

Photo 25: Northern greenfield - utility line corridor at Windsor.

4.4 EXISTING RAIL – FRANKLIN TO SUFFOLK, AND DOWNTOWN SUFFOLK

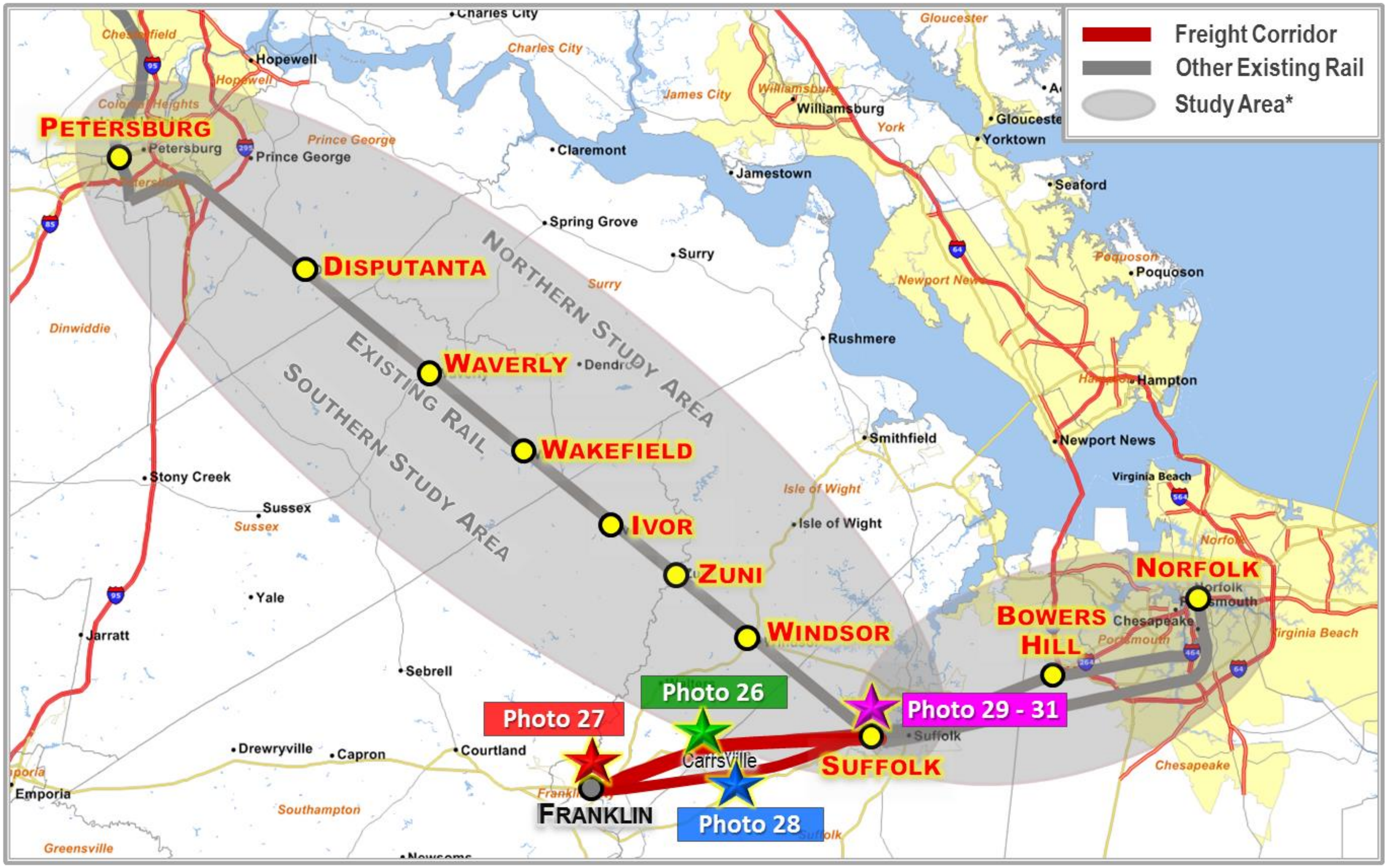
A possible freight rail alternative for developing a dedicated passenger line through downtown Suffolk could alleviate potential conflicts with CSXT double track container trains that now use the CSX Portsmouth subdivision through downtown Suffolk on their way to VPA container port. It is intended for the development of an alternative rail access for CSXT container trains, to avoid conflict with passenger trains through downtown Suffolk on the proposed "V-Line alignment". The existing CSXT and NS freight lines from Franklin to Suffolk (See Exhibit 9) have been reviewed in the following photos from 26 through 28. These photos show that the NS line is in good condition, and could be a practical alternative to the CSXT line through downtown Suffolk. Exhibit 10 shows the location of these photos along the existing rail line Franklin to Suffolk and downtown Suffolk.

Exhibit 9: Franklin to Suffolk Freight Alternative



*Alignment will not be determined until the Tier II Environmental Process is complete.

Exhibit 10: Photo Locations along Franklin to Suffolk Freight Alternative



*Alignment will not be determined until the Tier II Environmental Process is complete.

Photo 26: CSXT Portsmouth subdivision near Franklin. This is current route for CSXT double stack trains.

Photo 27: NS Bridge over CSXT in Franklin.

Photo 28: Welded rail on NS line from Franklin to Suffolk.

Photo 29 shows the roadway that has displaced about 0.8 miles of railroad right-of-way in downtown Suffolk. It extends from the junction of W Constance road/Prentis Street to the Suffolk Seaboard Station. This was a recently constructed roadway which can be seen in Photo 30. In the vicinity of this old seaboard Suffolk station, there is a development on the other side of the CSXT tracks while there is more room to add track if necessary, on the station side. This suggests that the station be shifted back from its current place to make room for added tracks if the CSXT freight traffic cannot be relocated.

Photo 29: Rail right-of-way taken over by Highway close to Suffolk Old Station.

Photo 30: Seaboard Suffolk Old Station.

To implement the Franklin to Suffolk rerouting of CSXT trains, a grade separation may be needed at the rail junction in downtown Suffolk, as shown in Photo 31.

Photo 31: Part of Franklin to Suffolk freight reroute.

4.5 "V" LINE EXISTING RAIL – NORFOLK TO SUFFOLK

The corridor from Norfolk to Suffolk is heavily built up, and there are only a limited number of ways of getting between the two cities because of the significant environmental obstacles as well, particularly, the Dismal Swamp.

- Currently NS has a double tracked mainline from Suffolk to Norfolk which carries heavy freight traffic and additionally, the Virginia Department of Rail and Public Transportation (DRPT) has purchased up to three slots for operating Amtrak passenger service over this line into downtown Norfolk.
- However, NS also has a parallel, partially abandoned line, the "V Line" which could provide a dedicated passenger access route into downtown Norfolk separate from the current freight line. DRPT's Hampton Roads Tier I FEIS has selected this route.

As a result, this analysis assumes that the "V" line alternative will be followed, for the following reasons. The "V" line alternative follows the US Route 460 alignment north of the Dismal Swamp, whereas the existing NS mainline goes directly across the swamp. Adding tracks to the existing NS alignment would either entail filling parts of the swamp – unlikely to be environmentally acceptable – or else bridging the swamp, which would be very expensive. It is likely that the Dismal Swamp issue alone would be sufficient to environmentally disqualify such an alternative. There are additional operational issues along the NS mainline at Portlock Yard which would also be bypassed by using the proposed "V Line" alignment.

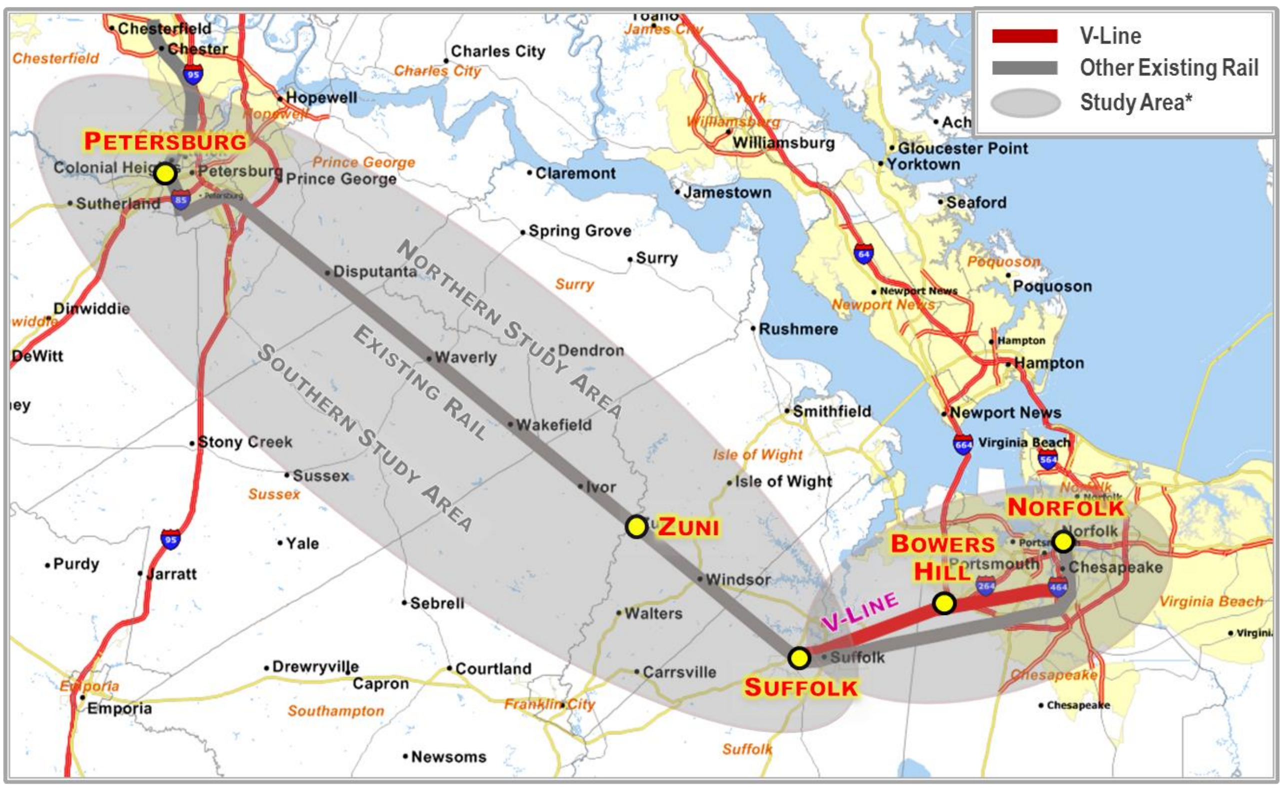
However, development of the "V Line" option is not without some challenges:

- At Algren on the west side of Suffolk, a new connection track may be needed to link the Norfolk Southern mainline to the CSXT Portsmouth subdivision through Suffolk.
- From Algren through Suffolk, passenger trains may need to share tracks with CSXT double stack trains to a connection with the Commonwealth Railway, which provides access to the Portsmouth Marine Terminal at Craney Island. As already described, the right-of-way is highly restricted through downtown Suffolk, since the abandoned former Virginian right-of-way has been converted into a city street (Prentis Street) occupying the land that would be needed to develop a separated passenger alignment through this area.
- Beyond the Commonwealth Railway, the CSXT Portsmouth subdivision is lightly-used to its junction with the abandoned "V-Line" in the vicinity of the Hampton Roads Executive Airport.

- The tracks are in place, but the "V-Line" is out of service from the Hampton Roads Executive Airport to the Cavalier Industrial Park, just west of Cavalier Boulevard.
- From the Cavalier Industrial Park, crossing the Western Branch of the Elizabeth River on a lift bridge, to NS Main Line junction north of Portlock Yard (Seaboard Avenue and Richmond Streets in South Norfolk in Chesapeake) the "V-Line" is lightly used for industrial traffic.
- From the "V" Line junction into the Harbor Park train station (Seen in Photo 36), passenger trains must share right-of-way with the NS main line. This section includes a second major bridge crossing the Southern Branch of the Elizabeth River just south of the Harbor Park station. In this area, an out-of-service former Virginian Railroad bascule bridge is proposed to be rehabilitated and restored to service so as not to displace freight capacity of the existing NS main line.

These challenges will be shown in the following photos 32 through 36 covering Portsmouth, Chesapeake, and Norfolk following the V-line track from Norfolk to Suffolk (as shown in Exhibit 11). The location of these photos are shown in Exhibit 12.

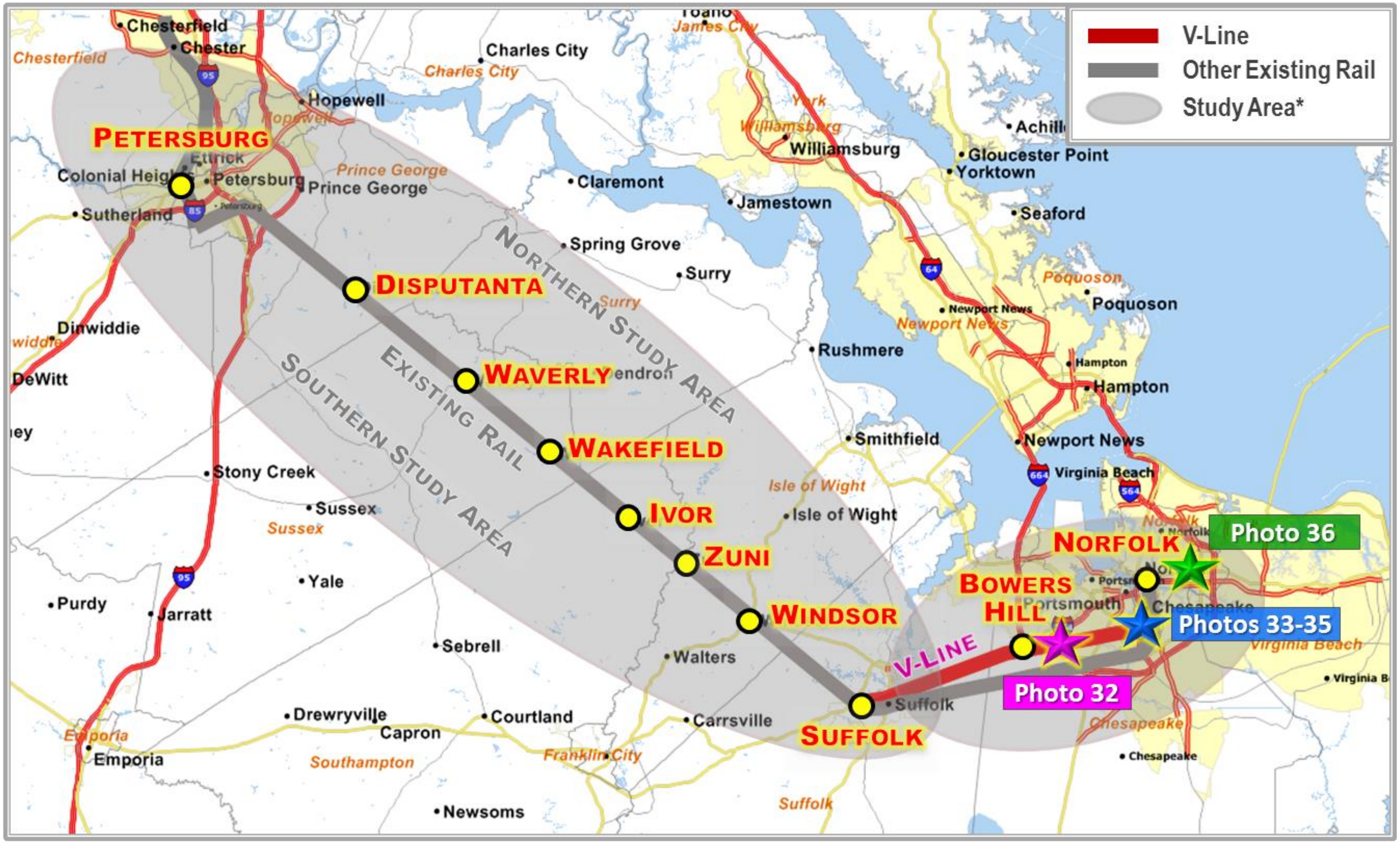
Exhibit 11: Existing V-line from Norfolk to Suffolk



*Alignment will not be determined until the Tier II Environmental Process is complete.

The following photos from 32 through 36 show abandoned tracks near I-64 and I-664, railroad crossings in Portsmouth, the humped railroad crossing at Chesapeake, tracks that requires roadwork and the improved Harbor Park station in Norfolk (See Exhibit 12 for location of these photos).

Exhibit 12: Photo Locations along Existing V-line from Norfolk to Suffolk



*Alignment will not be determined until the Tier II Environmental Process is complete.

Photo 32: Abandoned V-Line under the Bridge at Rotunda under I-664 and I-64.

Photo 33: Railroad crossing at Chapin Road in Portsmouth.

Photo 34: V-line joining the NS Main Line in South Norfolk, at the north end of Portlock Yard.

Photo 35: Humped Railroad Crossings at Park Avenue in Portsmouth.

Photo 36: Harbor Park Station in Norfolk.

APPENDIX F: TRANSPORTATION USE OF UTILITY CORRIDORS REFERENCE

High Voltage Transmission Line (HVTL) Right-of-Way Usage for Transportation Facilities

FEASIBILITY STUDY

FINAL REPORT

April, 2002

Maryland Department of Transportation

Office of Planning & Capital Programming

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- ***Conectiv – Richard Galster Jr., Transmission and Distribution Planning***
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- ***Michael Bartholf - Deputy Administrator***
- ***Henry Kay - Director, Office of Planning***

Executive Summary

Executive Summary

Finding locations for new transportation corridors has grown more difficult as Maryland becomes more developed and available land in urbanized areas becomes scarce. Beginning with a proposal to the Montgomery County Council, the Maryland Department of Transportation agreed to conduct a study that would determine the feasibility of using existing high voltage transmission line (HVTL) corridors for transportation purposes as well. This involved locating a transportation facility in a corridor that often has very different characteristics from a traditional transportation alignment. Important considerations include the types of HVTL structures and corridor dimensions in comparison with various design requirements for different transportation modes. Because of the variability of these factors in Maryland, the study does not identify specific HVTL corridors for adaptation to transportation use. Rather, the study concludes with recommendations based upon general feasibility and lists the local conditions that would either favor or preclude joint use of HVTL corridors with transportation facilities.

In Maryland, five power companies transmit electricity on separate and individually maintained HVTL rights-of-way. The HVTL corridors vary in geographic location and transmission line voltage. The land within an HVTL corridor is either owned outright by the power company or purchased through an easement. Some common layouts of corridor width and structure location within the corridor are used as a starting point for further feasibility study. Footprints of towers on the ground as well as the necessary safety clearances, based on voltage and transportation type, reveal available portions of the corridor viable for transportation use.

Standards and guidelines for power structures vary by utility company. There is little precedent for guidelines regarding how power companies accommodate transportation along their rights-of-way or vice versa. The Maryland State Highway Administration (SHA) has a Utility Policy that outlines acceptable amounts of impact for HVTL structures in highway rights-of-way; however, it does not address sharing rights-of-way for long parallel sections. The necessary clearances and functionality stated in the Utility Policy would need to be achieved with no negative impact on the capability of the HVTL corridor as required by the power company's needs. Any improvements that would require modifications to the HVTL structures would require compensation to the Power Company and extensive modification could rapidly diminish any of the initial cost savings by using previously existing rights-of-way.

Design criteria for different modes of transportation are similarly documented. In addition to highway improvements, busways, light rail, sky train[1], and high speed rail (including Maglev technology) options are also considered along with each of their unique requirements. The possible combinations of these modes in several typical HVTL corridors are presented in the body of the report.

The Issues and Consequences chapter addresses the different design philosophies for HVTL and transportation corridors. HVTL corridors are not sensitive to elevation and can span many obstacles. Transportation corridors, however, need to have even grades and smooth transitions and often must go around major geographical obstructions. Maintenance of facilities is an issue

[1] A hybrid of light-rail and metro transit technology on elevated track and stations.

for both transportation facilities and utilities in the event of an incident or emergency. Safety concerns and sufficient clearance from the base of HVTL towers are also a major concern. Limiting the access to the towers causes an extra burden on the power company to maintain its property and could also preclude future expansion of the HVTL corridor to meet growing electrical demand. Costs increase and the ability to adapt transportation to an HVTL corridor decrease when the terrain is mountainous or there are multiple steep slopes. Examples of successful joint use occur in Louisiana where the land is flat and power companies benefit from having paved access to their structures. Within Maryland, there are numerous examples where HVTL and transportation share a corridor, but not over large distances where a previously existing HVTL corridor is adapted to transportation use.

The study reached five primary recommendations. The first recommendation is that only short segments of HVTL corridors should be utilized. Long distance use of HVTL corridors for transportation purposes is unlikely since a long HVTL corridor has a higher probability of rapid changes in direction or obstacles not easily negotiated by a transportation facility. A second recommendation is for low speed transportation options in HVTL corridors. Lowering operating speeds offers increased flexibility through less rigid design requirements and higher safety margins. Additionally, lower speed highway and transit modes have more tolerance for the grades and uneven ground that characterize an HVTL corridor in rolling terrain. A third recommendation calls for the use of guided transportation vehicles. Guided technology offers a higher safety margin and vehicles can operate closer to structures, thus better utilizing narrow HVTL corridors. A fourth recommendation is for a wide HVTL corridor on level terrain. The width of HVTL corridors analyzed within this report generally varied from 150 feet to 250 feet. Corridors less than 250 feet, afford little room for roads or rail to negotiate obstacles. Level terrain is important, as transportation facilities often require cuts or fills through rolling terrain, which may be incompatible in an HVTL and require costly retrofits. The fifth and final recommendation is for HVTL corridors with steel poles supporting the transmission wires. Steel poles have a smaller footprint on the ground and can offer increased buffer space between the base of the structure and the transportation facility. The recommendations are general in nature further study would be required for a particular corridor within Maryland. Even after a candidate HVTL corridor has been identified, the report emphasizes that only with an appropriate transportation mode and under a special set of circumstances would joint use likely be feasible.

In summary, the overall recommendations of this study for those conditions that would best support the implementation of a transportation facility within an existing HVTL corridor are as follows:

- Utilization of short HVTL corridor segments instead of long segments
- Lower speed
- Guided transportation systems
- Wider corridors with level terrain
- Steel poles used as HVTL structures

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I. Introduction

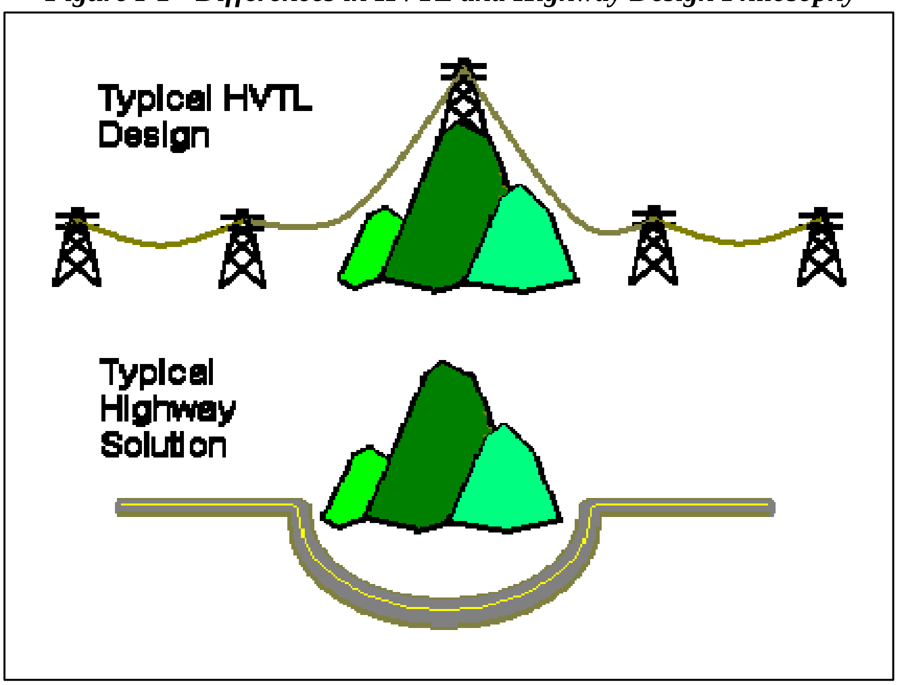
I. Introduction

Introduction / Project Purpose

As Maryland becomes more urbanized, there is a need to identify new strategies for locating transportation facilities. The traditional approach of purchasing an exclusive use right-of-way has become cost prohibitive. As a result, the Maryland Department of Transportation (MDOT) is interested in alternative ways to locate transportation facilities when the cost and availability of land would otherwise prevent the outright acquisition of a new transportation right-of-way. The goal of this study is to analyze the feasibility of using HVTL rights-of-way for transportation purposes while maintaining the utility companies' ability to maintain a safe, reliable, and economic electric supply. This general feasibility approach involves examining the different design philosophies of HVTL and transportation corridors and determining the conditions that would favor joint use.

The selection of transportation and HVTL corridors is based upon many factors. Transportation corridors are very sensitive to elevation changes and every effort is made to minimize grades. HVTL corridors use straight alignments where possible and are much less dependent on elevation differences. An HVTL corridor also has the ability to span certain obstacles or obstructions, while a transportation corridor often needs to go around such impediments (see Figure I-1). Across Maryland, there are many different HVTL structure configurations, each based upon specific conditions. The line voltage, number of circuits, available span lengths, and number of angles in the line route all determine types of poles and towers and their placement within the corridor. Transportation facility design is impacted by many factors including design speed, method of vehicle guidance, vehicle performance, and safety. This variability requires a broad examination of transportation requirements and HVTL corridor conditions across Maryland.

Figure I-1 - Differences in HVTL and Highway Design Philosophy



This study was initiated by MDOT subsequent to interest outlined by the Montgomery County Council, based upon a proposal submitted by Mr. Byrne Kelly, the principal of a Takoma Park planning and landscape architecture firm. Study recommendations identify the combinations of HVTL corridors and transportation modes that are most compatible and the circumstances that make the economic and environmental benefits of using HVTL rights-of-way superior to other rights-of-way for transportation purposes.

HVTL corridors are networked throughout the State of Maryland. The corridors are managed and maintained under the jurisdiction of five separate utility companies. A ‘high voltage’ transmission line is defined as one with an electrical phase-to-phase voltage in excess of 69,000 volts (69kv) or higher. The lines are located primarily above ground and supported by various types of tower structures. The corridors range in right-of-way width from 50 to 500 feet, with overall corridor width dependent upon the voltage of the electricity in the line. Higher voltages require more physical separation both within and along the corridor for safety considerations and this may necessitate larger corridor widths. The utility company may either own the corridor right-of-way in fee simple or be granted easements from the property owners in which to place their lines and structures. Likewise, higher voltages require more physical separation both within and along the corridor for safety considerations and this necessitates larger corridor widths.

The original intention of the study was to look at several specific corridors within Maryland and to recommend which corridors may be viable for transportation use. It was soon realized, however, that it would be difficult to base corridor specific feasibility of joint HVTL and transportation on only a few examples. Other concerns that arose included heightened public sensitivity towards the study of specific corridors, possibly raising public concerns and creating perceptions that transportation facilities were indeed being planned and designed within these corridors. As a result, the study was refined to look at general feasibility across the State. First, the study investigated the characteristics of various HVTL corridors in Maryland. The second phase included an analysis of various transportation options that could potentially utilize an HVTL right-of-way. Following these two steps, the study identified issues and consequences of for combined usage through discussions with stakeholders. Finally, the study concluded with recommendations concerning general feasibility of various transportation options in different corridors. The recommendations steer any future study of corridor specific implementation to the most promising candidates of transportation options based upon the HVTL corridor conditions. Throughout the study, national and statewide examples were gathered to represent some of the various possibilities for joint use, highlighting their practical benefits and issues.

Scope Summary

To prepare this feasibility study, the following activities were undertaken:

- Gather information and create a database of local and national examples of transportation facilities that were either built within HVTL corridors or contain HVTL issues, such as crossings, easements, etc.
- Initiate a Technical Advisory Committee, comprised of representatives from the statewide power companies and the transportation modal administrations, to serve as a ‘two-way’ sounding board throughout the study.
- Develop typical sections for several transportation modes and analyze the impact of locating these sections within generic HVTL corridors.
- Develop a comprehensive list of the issues associated with using HVTL rights-of-way for transportation use.

- Determine the anticipated difficulties that will arise through constructability concerns, applying to both the utility and transportation infrastructure.
- Summarize the above-mentioned tasks and key project activities and offer recommendations for possible transportation facility design concepts for different HVTL corridor types, geographical regions, and power company jurisdictions within a final report.

In developing typical sections, the study analyzed HVTL corridors of 150 and 250-foot right-of-way width, which included standard placements of towers within each type of corridor. To further reduce the complexity and number of typical sections to generate, transportation design criteria were established from the onset of the study. Design criteria identified the safety and performance requirements of certain transportation options that must be satisfied within the limits of an existing HVTL right-of-way.

This report can be used as a tool during the alternatives development phase of a transportation planning project and aid in determining whether or not to consider an HVTL corridor as a viable alternative for study through the project planning development process.

II. Statewide HVTL Characteristics

II. Statewide HVTL Characteristics

Maryland Power Companies

The electrical power transmission lines, steel structure and corridors dispersed throughout Maryland are owned, designed and maintained by five power companies, all with specific jurisdictions (see *Figure II-1*). The companies are listed and briefly described below:

- ***Allegheny Power (The Potomac Edison Company)*** – Within Maryland, Allegheny Power serves Maryland's westernmost counties and small portions of Montgomery, Howard and Carroll counties. Its jurisdiction also extends into Pennsylvania, West Virginia, Virginia and Ohio.

- ***Baltimore Gas and Electric (BGE)*** **-** Includes all or part of the nine counties within central Maryland, including Baltimore City.

- ***Conectiv*** – Serves all the Maryland Eastern Shore counties, Cecil County and part of Harford County, all of Delaware and the southern portion of New Jersey.

- ***Potomac Electric Power Company (PEPCO)*** – Serves the majority of Prince George's and Montgomery counties and the entire District of Columbia.

- ***Southern Maryland Electric Cooperative (SMECO)*** **-** Serves Charles, St. Mary's and Calvert (except the northeastern tip) Counties, and the southernmost portion of Prince George's County.

Representatives from the five power companies have been involved with the study since its inception in 2001. They met five times as part of the Technical Advisory Committee (TAC) and contributed ideas and voiced comments and concerns throughout the study. Other members of the TAC included utility experts from SHA's Offices of Construction and Highway Development, a representative from SHA's Office of Planning and Preliminary Engineering, representatives from the Maryland Transit Administration (MTA), and representatives from MDOT's Office of Planning and Capital Programming.

The TAC meetings were quite helpful and provided the groundwork for this report.

Typical Corridors

Each power company serves a different geographic region and coverage area throughout Maryland. The result is that each company's HVTL corridor characteristics vary. The density of the power company's network affects corridors when customers are located at large distances from generating facilities. For efficient transmission, this necessitates longer HVTL corridors that require increased right-of-way width for safety clearances. Typically, corridor width increases as the transmission line voltage increases. The final step in delivering electricity to customers involves localized and low voltage power distribution lines to residential or retail/business communities. These lines, with their lower voltage and safety requirements, often utilize an existing transportation right-of-way and run along existing arterial roadways and collector streets. See the Transportation Options section for typical section sketches.

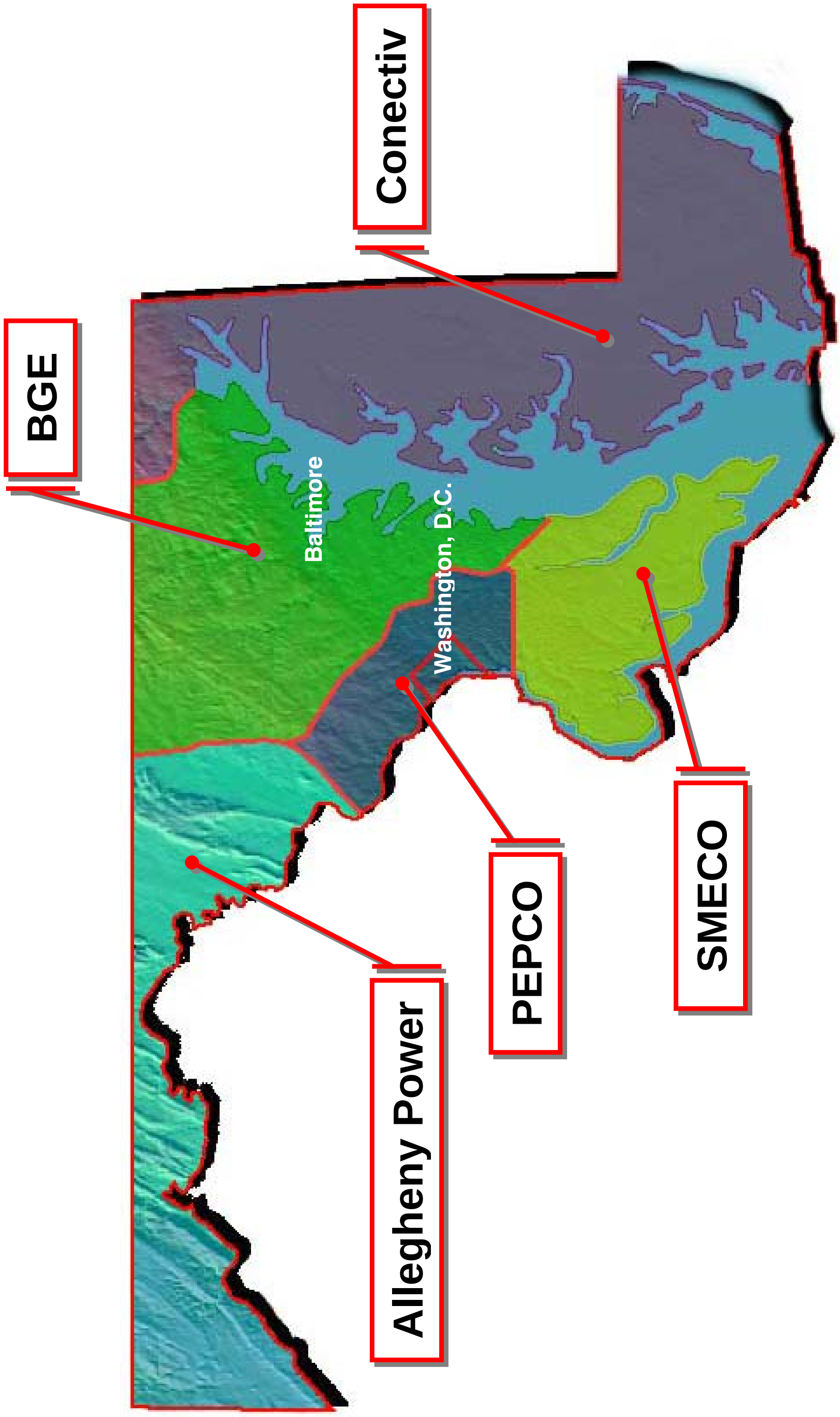


Figure II-1 Power Company Jurisdictions within Maryland the wires that must be maintained. Also, it usually means the HVTL structures must be built stronger to carry the increased weight of lines carrying the higher voltage.

Other factors affecting HVTL structures include the span lengths, the available land, and the number of angles in the transmission line route. The severity of the angle is a very important criterion in transmission line design. It takes a stronger or more stable structure to support the wires turning an angle versus a tangent section. *Photo 1* shows a pole supporting wires turning an angle. Its construction is much sturdier than the pole shown in *Photo 2*, which is along a straight segment.

The strength to support heavier wires and span large distances dictate that HVTL structures be of substantial construction. For these reasons, usually only the lighter, lower voltage lines (typically less than 100 kv) are considered for wood structures. In the past, the only choice other then wood poles was the steel (lattice) tower configuration. Beginning about 40 years ago, tubular steel poles were manufactured to replace steel (lattice) towers. These steel poles provided sufficient strength while occupying less space at the ground level. Initially, steel poles were very expensive and used sparingly, but improved manufacturing and design processes have now made this type of structure more economical and its use has increased throughout the State.

Figures II-2 and II-3 are detailed sketches of a typical steel pole structure with 230kv dual circuits. *Figure II-2* shows the dimensions for a pole within a tangent section of the corridor. *Figure II-3* shows the dimensions of a pole used to support wires with medium and heavy angles.

Photo 1 - Large Steel Pole / Tower

This pole is 4 feet in diameter and is designed to withstand higher loads since the transmission lines and conductors form an angle. The voltage carried by this pole is 115 kv.

Photo 2 - Steel Pole in Tangent Section

The steel poles carrying 115kv transmission lines shown here are along the edge of the public right-of-way for MD 3, near Crofton, Maryland. The pole diameter is 3 feet.

Lattice towers are the most common structures found in Maryland's HVTL corridors. As shown in *Photos 3 and 4*, lattice towers have a much larger footprint than steel poles. This is due to the lattice tower's expanded base. The size of the structure footprint is important in determining the viability of implementing a transportation facility within the HVTL corridor right-of-way.

The base of a lattice tower is generally square and ranges from 16 feet per side to over 40 feet per side. The size depends on the height of the tower (the higher the tower, the wider the base) and the loading on the tower from the weight of transmission lines.

Photo 3 - Dual Lattice Tower Configuration

This photo shows the dual lattice tower configuration, one of the most common HVTL corridor configurations in Maryland. Figure II-4 describes the dimensions and spacing at this location.

Photo 4 – Single Lattice Tower Configuration

This is an example of a single lattice tower configuration. It has a narrower corridor due to the single row of towers.

The exact shape and placement of transmission wires can vary among lattice towers. This depends on the amount of support needed for the particular transmission wire circuitry. As evidenced by *Photo 5*, this tower was designed to handle only one horizontal row of transmission wires.

Photo 5 – 'Short and Wide' Lattice Tower

This corridor carries 230kv wires within BGE's jurisdiction. The base members of these structures are similar to those of the 'common' lattice towers, but the difference is that this tower widens at the top.

When the lattice towers need to be upgraded to handle higher loads (more circuits, higher voltage, etc.), they are often replaced with steel poles. Eventually there will be more steel poles than lattice towers throughout Maryland, especially if corridors are upgraded to handle 500kv transmission lines. Currently, there are very few 500kv HVTLs in Maryland, which typically connect power plants to main substations.

Photo 6 - Steel Poles Supporting 500kvWires

Photo 6 shows typical steel pole structures within 500kv corridors.

Photo 7 - 500kv Corridor

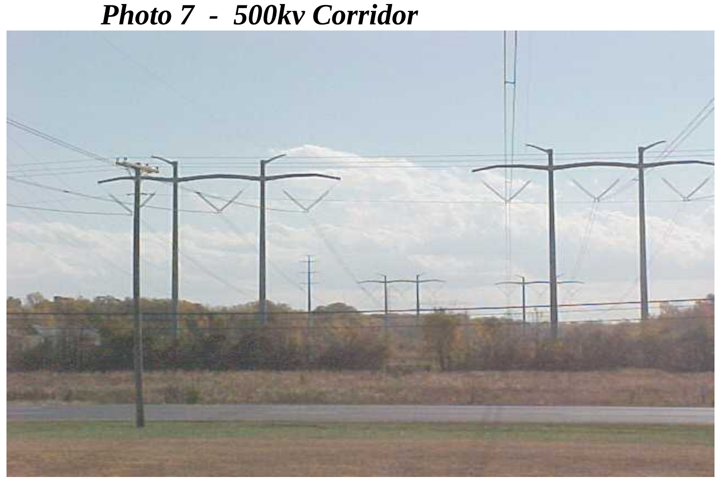


Photo 7 shows the same corridor, as in Photo 6, crossing a limited access highway (MD 3 in Crofton).

Photo 8 – Multiple Steel Poles

The steel poles in this photo need to provide extra support for the 500kv transmission wires due to the angle in the corridor. Absent any angles, fewer poles would be needed.

Standards and Guidelines

Each power company has their own general design standards and guidelines that are based in part on the National Electrical Safety Code (NESC). The purpose of the NESC is to provide the minimum accepted standards and guidelines for the practical safeguarding of persons during the installation, operation, and maintenance of electric supply and communication lines and associated equipment. Naturally, these safeguards would need to be extended to the vehicles using any transportation facilities placed in the vicinity of the HVTLs.

The NESC contains the basic provisions that are considered necessary for the safety of employees and the public under specified conditions. The NESC is not intended to be used as a design specification or an instruction manual. Individual power companies develop their own design standards and guidelines.

Table II-1 on the following page summarizes each power company's general guidelines for HVTL spacing and clearance requirements between transmission line structures and transportation facilities. NESC guidelines are also shown for comparison reasons. The horizontal clearances between the structure and the roadway facilities are generally determined on a case-by-case basis, depending on the transportation facility's design speed, types of protection barriers, and MDOT's fixed object safety standards. The vertical clearance categories are determined by the transmission line voltages.

See *Figure II-5* for a three-dimensional visual representation of the clearance locations.

Table II-1 - Safety Spacing/Clearance Guidelines in Maryland

	Allegheny Power	BGE	Conectiv	PEPCO	SMECO	NESC minimums
Horizontal Clearance from tower base to the edge of hwy. shoulder or rail track	15’	30’	25’	35’ preferred	MDOT req.+ barrier	Not specified
Horizontal Clearance between the vertical projection of the overhead conductor to the edge of hwy. shoulder or rail track	Not given	Not given	Not given	10’	Not given	8.7’
Horizontal Clearance from tower base to excavation work (blasting, grading, etc.)	Not given	40’	25’	Not given	Not given	Not given
Vertical Clearance between 115kv – 138kv conductor wires to the highway surface	25’	Exceed NESC	Exceed NESC	Not given	Exceed NESC	20.6’[1]
Vertical Clearance between 230kv conductor wires to the highway surface	27’	Exceed NESC	Exceed NESC	35’	Exceed NESC	22.4’[1]
Vertical Clearance between 500kv conductor wires to the highway surface	35’	Exceed NESC	Exceed NESC	Not given	Exceed NESC	27.9’[2]
Vertical Clearance between 115kv – 138kv conductor wires to the rail track surface	33’	Exceed NESC	Exceed NESC	Not given	Exceed NESC	28.6’[1]
Vertical Clearance between 230kv conductor wires to the rail track surface	35’	Exceed NESC	Exceed NESC	35’	Exceed NESC	30.4’[1]
Vertical Clearance between 500kv conductor wires to the rail track surface	43’	Exceed NESC	Exceed NESC	Not given	Exceed NESC	35.9’[2]

[1]The NESC computes minimum vertical clearances by adding 0.4 inches of clearance for each kilovolt over 22kv, up to 470kv. This spacing is added to the overall minimum clearance of 18.5 feet over highways, and 26.5 feet for rail tracks. For example, to calculate the additional clearance above 18.5 feet for a 230kv line spanning a highway, multiply the 230 kv * 105% (to obtain maximum operating voltage); then 242kv * √3 (this give the voltage to ground), then you would multiply (140kv-22kv) * (0.4”) * (1 foot/12”).

[2]The formula for determining additional spacing for transmission lines above 470kvkv is more complicated than for lines less than 470kv.

<u>Note</u>: Transmission wires naturally sag between tower connections due to the span length between towers and the downward force of gravity. However, the sag distance (drop in elevation at the low point of the wire) can vary depending on a number of factors. They include the conductor wire material, conductor wire tension, current flow, temperature, and precipitation (especially ice). For spans upwards of 1000 feet, the sag increase can be as much as 6.5 feet closer to the ground.

III. Transportation Options

III. Transportation Options

Overview

Transportation options or typical sections were developed as part of this study with the purpose of demonstrating the feasibility of implementation within existing HVTL corridors, or incorporated within the design of new HVTL corridors. The study team was unable to evaluate all possible scenarios due to almost unlimited number of typical sections that could be applied, particularly since the HVTL corridor vary tremendously. Modal options include heavy rail and light rail transit lines, general-purpose or managed highway lanes, and bus rapid transitways (BRT).

In developing these transportation options, the guidelines set forth by the five power companies and the National Electrical Safety Code (NESC) were important requirements. The power companies currently work with the Department of Transportation while designing their infrastructure improvements within or near transportation corridors. The power companys' designs must gain the approval of the administration, which owns rights to the transportation corridor or facility before any implementation can take place. This often requires complicated agreements for design, maintenance, and operations.

The next section discusses an example policy set forth by the Maryland State Highway Administration (SHA), regarding guidelines for utility lines adjacent to or crossing state highway facilities.

Maryland Utility Policy

The Maryland Department of Transportation, State Highway Administration's Utility Policy (SHA Utility Policy) regulates utility occupancy in SHA highway rights-of-way. This policy was developed in 1989, following a declaration by the Federal Highway Administration (FHWA) that granted approval authority of longitudinal occupancy of utility installations within highway rights-of-way to the state governments.

Potential impacts of HVTL installations upon the functions of a highway include the disruption of traffic flow, safety, and provisions for maintenance and future expansion of the highway. These impacts are addressed in several broad categories of regulation contained in the SHA Utility Policy, including:

- Obstruction of, or interference to, the operation of a State highway.
- Maintaining State highway safety during access and maintenance of utility installations.
- Utility design specifications and minimum construction standards within State highway right-of-way.
- Cost responsibility for any required modifications or relocation of utility facilities as required by State highway regulations.

Of most concern to utility companies currently enjoying unrestricted access to their facilities are the following safety precautions set forth by the SHA Utility Policy[1]:

[1] SHA Utility Policy, 1989. Page 2-4.

- Utilities will take precautions to protect the traveling public. No lane closures during the peak hours will be allowed. In some cases, it may be necessary to perform the work during off peak times or at night.
- Private automobiles and non-essential construction vehicles shall not be parked on SHA rights-of-way.
- Mud and debris tracked or spilled on the roadway shall be removed promptly.
- Appropriate protective measures, approved by the SHA, including warning signs and barricades, may be necessary around excavations or construction sites.

In general, the SHA Utility Policy states that longitudinal utility lines, whether above ground or underground, are not permitted within the right-of-way of existing highways. Wireless telecommunication installations are permissible within expressway rights-of-way and the requirements governing this use could also apply to highway locations around pre-existing HVTL structures. The priority order of utility structure location within expressway rights-of-way is stated as follows:

1) Vehicle access to the site can be obtained from outside the through roadway and connecting ramps.
2) Within interchanges, vehicle access can be obtained from the right hand side of the diagonal ramps.
3) Within interchanges, vehicle access can be obtained from the left hand side of the diagonal ramps.
4) Vehicle access can be obtained from the outside shoulder of the mainline.
5) Vehicle access can be obtained from the inside shoulder (median side) of the mainline.

Arterial and collector highways do not require such strict location criteria. In general, a lower design speed of the highway allows for more flexibility in utility structure placement and affords an extra margin of safety that helps to reduce some concerns regarding access to, and the maintenance of, the structure itself.

Federal Policy

Federal-aid policy states that a lack of sufficient right-of-way width to accommodate utilities outside the roadside border, in and of itself, is not a valid reason to preclude highway facilities and utility structures to coexist. In fact, the policy only presents guidelines rather than a fixed requirement for horizontal separation. Vertical separation is explicitly governed by State policy. However, these minimum clearances are less than the NESC and power companies' guidelines. For longitudinal lines, the following minimums must be maintained:

Table III-1 - Vertical Clearances (SHA)

Minimum Vertical Clearance (feet)	**Transmission Lines**
18	Guy wires and secondary power wires below 750V.
20	750V – 22kv
21	22kv – 50kv
21 feet plus 0.4" per kv in excess of 50kv	50kv – 470kv

When the state agency lacks authority over the right-of-way, Federal policy dictates that an agreement must be reached with the utility such that the degree of protection to the highway is at least equal to the protection provided by the State agency's utility accommodation policy. In this case, SHA requirements must be upheld in any agreement reached with a utility company for the use of utility right-of-way for highway purposes. The specifics of these requirements can be referenced in the SHA Utility Policy[2].

Federal participation for funding the replacement and modification costs incurred by the utility company is available under certain conditions. Replacement right-of-way costs may be provided when the portion of the utility's existing right-of-way is transferred to the State Highway Administration (SHA) at no cost to the project. When relocation work is shared between SHA and the utility company, a written agreement stating the shared responsibilities of each entity is required for Federal-aid. The provisions of the FHWA's regulations covering reimbursement for utility work is for actual costs incurred to functionally restore a utility's existing operating facilities prior to the commencement of the highway project. The utility's financial and productive situation is to be maintained as if the highway project had not occurred. Where possible, this would not require construction of a replica facility, rather that the utility service is to be made whole by restoring the existing functions of the impacted facilities.

Use and occupancy agreements are used to establish the terms and conditions under which utility and highway installations co-exist. Federal-aid policy[3] stipulates what such an agreement must include, with the following being critical to this study:

- The State agency standards for accommodating utilities. Since all of the standards will not be applicable to each individual utility installation, the agreement at a minimum must describe the requirements for location, construction, protection of traffic, maintenance, access restriction, and any special conditions applicable to each installation.
- The extent of liability and responsibilities associated with future adjustment of the utilities to accommodate highway improvements.
- The action to be taken in case of noncompliance with the requirements.

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[2] Maryland State Highway Administration, Utility Policy
[3] Federal-Aid Policy Guide, 23 CFR 645 A, Sec. 645.213

Transportation Design Criteria

Introduction

The design criteria for any transportation facility will ultimately determine the feasibility of its use in an HVTL corridor. The criteria determine the accuracy and the specification of the design and establishes the physical constraints that must be applied. Depending on the type of transportation facility or mode certain guidelines apply. Examples include the size and characteristics of the design vehicle, method of operation, the intended level of service, as well as the number of people expected to use a transportation facility. "Design criteria" are more specific. Some examples include the lane or track width, grades, sidewalk width, maximum and minimum superelevation (banking), maximum travel speed, maximum structure width or span, and horizontal and vertical clearances. Environmental considerations are vital since permits are needed and environmental documents must be approved before a facility is ultimately constructed. Also, the designs must be reasonable and practical from an economic standpoint.

Design Criteria for Highways

AASHTO Design Standards

The American Association of State Highway and Transportation Officials (AASHTO) publishes a design criteria standards manual, entitled: 'A Policy on Geometric Design of Highways and Streets', approximately every five years. It aids state highway administrations in the design of their facilities. The following is a list of the primary guidelines that were used to develop the highway options for this study (assuming a fully access-controlled, 4-lane highway).

- The ideal 4-lane highway consists of two, 12-foot traffic lanes in each direction, separated by a wide grassy median. If a wide median (54 feet or wider) is not feasible, then roadside barriers need to be implemented. AASHTO guidelines state that an 8-foot wide outside shoulder is the minimum, but it ultimately depends on the anticipated amount of traffic. Also, in some cases an 11-foot wide travel lane can be used, but the percent of truck usage has to be low.
- Design speed for urban and rural expressways vary from 40 mph to 70 mph, respectively. Terrain has a major influence on the selection of a design speed. This study uses a 'rolling' terrain with a design speed of 60 mph.
- With a 60 mph design speed, the minimum radius of horizontal curvature is approximately 1,350 feet. Therefore, if a HVTL corridor makes an abrupt turn, adjacent rights-of-way may need to be purchased to 'round-out' the curve.
- Grades depend on the type of terrain as well as the type of highway vehicle. For a 60 mph highway, a 4% maximum grade is used for rolling terrain, and up to 6% for freeways in mountainous terrain. A maximum grade of 5% is used in this study.
- A 16-foot vertical clearance should be provided for any bridge structure spanning the entire roadway width. Some additional clearance has to be taken into consideration for future resurfacing of the under passing roadway.

Design Criteria for Transit

Light Rail

The design speed of a light rail system depends on the type of vehicle and the type of terrain. It is normal for a light rail vehicle to operate between 40 and 50 mph along restricted access rights-of-way. The horizontal curves can be tighter than that required for a 60 mph freeway because the operating speed is controlled and can be lowered to a safe speed while maneuvering curves. The maximum grade for a long, sustained segment is 4%, but up to 6% for short segments of less than 2,500 feet between the crests and sags. At light rail stations, grades can vary from a desirable 0.5% to a maximum of 2.5%, but this is also dependent on the type of rail vehicle. Track spacing for two-way service varies based on vehicle specification, superelevation, and terrain. Using this standard, minimum track spacing of 12.25 feet center to center would be acceptable. A more desirable track spacing of 14 feet center to center would be used. Vertical clearance depends on the type of vehicle as well. Light rail vehicles receiving power from overhead wires require a clearance of 15 feet from the top of the rail to the overhead wire.

Busways

The design guidelines for busways are similar to light rail. However, busways can accommodate steeper grades and tighter turns. For this report, we will group them together. Of note, is that busways are flexible and can be either exclusive alignments or shared with highways.

High Speed Rail / Maglev

The design constraints are much more stringent for high-speed rail options. Included in this category is Amtrak and local commuter rail services (MARC, etc.), SkyTrain and Magnetic Levitation (Maglev).

Basic design requirements for high-speed rail systems are listed below:

- Speed – The design speed of high speed rail lines primarily depend on the type of vehicle that will be utilizing the tracks. For many existing commuter rail lines, the tracks are shared with freight trains and in most cases were initially designed for the lower speeds associated with the freight lines, which would mean tighter horizontal curves. Even though commuter train systems (Amtrak, MARC, etc.) are capable of speeds in excess of 100 mph, they would be limited to the maximum design speed used when the tracks were initially built. The design speed for commuter rail using new tracks implemented within HVTL corridor rights-of-way would depend on the lengths of the tangent sections and the severity of the corridor angles. The scenario would change quite drastically though, if a Maglev line were to be implemented, with speeds reaching 240 mph.
- The minimum horizontal curve radii increases almost exponentially as the design speed of the facility increases. Therefore, for tracks that are designed to carry a Maglev train designed for 240 mph, it may take over a mile to complete a single curve.
- Grades – Similar to the speed, the grade depends on the type of vehicle that will be used. Generally, a maximum grade is about to 2% to maintain speeds, but there are exceptions. In fact, the Maglev could travel on a maximum 10% grade. Other heavy rail systems, such as the Washington Area Metropolitan Transit Authority's Metrorail line, have segments with grades as high as 4.5% where operating speeds must be lowered. At

station locations, the maximum grades are reduced to a desirable grade of 0.35%. This would be the same for surface, underground and raised platforms station.

- Track Spacing – The minimum track spacing between the centerlines of parallel tracks is 14 feet, but can be up to 15 feet due to the size of rail cars used.
- Vertical Clearance - Vertical clearance depends on the type of structure, and the type of vehicle. Vertical clearance is usually measured from the top of a rail to the bottom of a structure. A preferable minimum vertical clearance for a heavy rail corridor is usually 22 feet. In some cases, such as the Washington Area Metrorail (a fixed structure in an open environment), the minimum clearance is as little as 13 feet. Vehicles that require overhead contact wiring would require additional vertical clearance.

SkyTrain is a rail system built primarily on an elevated guideway consisting of concrete pylons. It has been in use in other countries besides the United States for over 20 years. SkyTrain is faster and more environmentally safe than most existing rail lines since it runs exclusively on electricity, therefore producing no harmful emissions. Even though SkyTrain systems travel at speeds in excess of 50 mph, they are relatively quiet compared to other rail systems, and much quieter than a diesel truck. As an automated system, SkyTrain runs more frequently and efficiently than other transit systems, with as little as a 75-second gap separating trains. Because it operates along a dedicated guideway separate from the road system, SkyTrain does not interfere with highway traffic operations. The cost to design and construct a SkyTrain system is between \$30 million and \$40 million per-mile, dependent upon a number of factors. This cost incorporates approximately \$20 million per-mile of concrete elevated guideway, \$5 million to \$7.5 million per station, various “cut and cover” tunnel and related structures along the line, and other miscellaneous items.

Maglev is a newer technology incorporating an electromagnetic, non-contact levitation and propulsion system that is an alternative to traditional wheel-on-rail trains with a system that lifts, guides and propels the vehicle along a guideway at speeds up to 240 mph. Still in its planning stages in the Baltimore/Washington corridor, it could be implemented within the next 10 to 12 years. Test tracks have been built in Europe and the results are positive thus far. The cost to design and construct a Maglev system is between \$70 million and \$80 million per-mile, incorporating the same elements and contingencies as the SkyTrain system.

Hypothetical Corridor(s)

Based on the above criteria, typical sections were developed for a variety of potential HVTL corridor configurations. The purpose of this was to create a template to evaluate the typical section through a hypothetical HVTL corridor, consisting of the common tower configurations and corridor widths found in Maryland. The results help the study team determine what impacts the transportation typical section would cause to the HVTL infrastructure and what cost might be necessary to mitigate these impacts.

Two HVTL right-of-way widths were analyzed; 150 feet and 250 feet. Each corridor width was analyzed along an actual 5-mile tangent section that exists within Maryland. Several tower configurations were hypothetically considered within each corridor width with upwards of 3 large steel poles and two wooden poles per corridor. This would serve to represent a future ‘full build-out’ scenario, or most highly constrained HVTL corridor.

Topographically, these corridor(s) represent the terrain found in a typical HVTL corridor throughout almost all counties west of the Chesapeake Bay. Several of the towers are placed on hills while the transmission wires span ravines and valleys. To stay within the guidelines set forth by both AASHTO and the SHA / MTA, it was realized that several large cuts and/or fills would be required, along with retaining walls to protect the foundations of the towers. Otherwise, to move one tower is to move or affect the system of towers. Vertical profiles were created under each scenario, noting that the grade requirements for highways, light-rail systems and BRT were all quite similar, but highly constrained for the heavy rail option.

Typical Sections

The following series of figures (*Figures III-1 through III-7A*) represents the various combinations of typical sections with corresponding ‘elevation’ sketches illustrating the projected clearance distances. Note that several other typical sections were developed and initially analyzed, but were found to be less desirable than the sections evaluated here. Some proved impractical while others violated the standards and policy guidelines for highway and HVTL use (these typical section figures can be found in *Appendix B*). An explanation of the reasons why those typical sections were not carried for further analysis is also in *Appendix B.*

Ownership of the corridors varies by power company. PEPCO is the only company in Maryland that purchased and continues to own the land rights (with a few exceptions) for their HVTL corridors. BGE owns roughly half of their HVTL corridor rights-of-way. SMECO, Allegheny Power and Conectiv have limited land rights through easements from private property owners. Essentially, the amount of land purchased or obtained through easements depends on the land area needed to construct, operate, maintain, and expand the HVTL corridor.

ALLEGHENY POWER

Allegheny Power's typical HVTL corridors vary dependent upon the transmission voltage. For 500kv corridors, the right-of-way widths are typically 200 feet and the primary structures used are steel (lattice) towers. For 230kv corridors, the right-of-way width is usually 125 feet and the structures can be steel lattice towers, steel poles, or multiple wood 'H' frame structures. For 138kv corridors, the right-of-way width is usually 100 feet, and the steel structures can be steel poles, steel towers, or multiple wood 'H' frame structures.

BGE

There are several types of HVTL corridors within BGE's jurisdiction. The corridors vary in width and contain several different types of structures. Voltages carried in the various corridors include 115kv, 230kv and 500kv. BGE has examples of shared use corridors in its system, including shared right-of-way with Amtrak along the Northeast Corridor and a short corridor shared with the Baltimore Light Rail Transit (LRT).

CONECTIV

Conectiv's corridor easements are typically 150 feet wide and have long tangent segments due to the flat topography and a larger percentage of available land, primarily with agricultural land-uses. Most corridors have at least one wood pole H-frame line in the center of the easement.

PEPCO

PEPCO's 230kv corridors are typically 250 feet wide. The width of 500kv corridors varies. Most of the corridors have dual steel (lattice) towers. PEPCO's ultimate build-out scenario for 230kv corridors is a triple steel pole configuration with the third line of structures constructed along the centerline of the corridor. The corridors also have lower voltage transmission lines, primarily wooden poles carrying 69kv lines, near the edge of the corridor. Due to PEPCO's high service demand within the Washington Metropolitan region, many of the existing 230kv corridors already include one or more 69kv lines along the edge of the corridor.

SMECO

SMECO's only HVTL corridor is a 230kv line with an average right-of-way width of 150 feet. Within this corridor, there is a single line of steel poles down the centerline of the corridor, with wooden poles carrying lower voltages approximately 25 feet from the corridor edge. The opposite side of the corridor will be used for future expansion needs, possibly dualization of the wooden poles.

Typical Tower Structures

Statewide, there are various structure configurations for HVTL corridors. Different utilities use different configurations depending on the specific conditions in the corridors. The differences are due to factors such as line voltage, the number of circuits, the current capacity required and the line route. In general terms, the higher the voltage, the larger the required safety area surrounding

IV. Issues and Consequences

IV. Issues and Consequences

Types of Issues

The study identifies several issues and concerns related to the utilization of HVTL rights-of-way for transportation facilities, especially compared to potential rights-of-way in undisturbed areas. Utility company representatives and highway officials have also identified issues and concerns. The issues represent the specific interests of the stakeholders but can also have a broader effect upon the likelihood of an HVTL corridor being selected for use as a transportation corridor. These issues may be an advantage, a disadvantage, or even both, dependent upon the stakeholder. A generalized collection of issues have been prepared and their effects, based upon the individual stakeholders, summarized below:

Access Issues:

- **HVTL rights-of-way generally do not run in areas of high transportation demand.** Most HVTL corridors are in rural or low-density areas. The areas where HVTL corridors exist generally do not generate travel demand sufficient to support transit service or a highway. The corridor may not easily connect with the existing transportation network. And due to safety concerns associated with development near HVTLs, it could be difficult to target growth to the corridor.

- **Easier access for maintenance equipment to towers and lines.** If a transportation facility is in the HVTL corridor, it should facilitate the power company's ability to bring maintenance workers and equipment from its storage facility to the structures and lines. Many HVTL corridors have rugged terrain and the addition of a graded, paved road would facilitate access. Having a better and quicker means of access would also be beneficial in emergencies.

- **Power line maintenance could become less time efficient.** In many cases today, rights-of-way are already accessible for the power companies' maintenance needs, including the use of access agreements with adjacent property owners. A paved corridor could result in quicker access times, but the time savings could be reduced because of the additional time needed to restrict and control traffic so that maintenance activities can be performed in a safe manner for workers and the general public.

- **Traffic Impacts.** Maintenance and repair of the HVTL and associated structures could impact traffic flow on the transportation facility.

- **Loss of private property owners' individual crossing rights.** When HVTL rights-of-way have been purchased by the utility companies in fee simple, most adjacent property owners have been granted crossing rights. In a number of cases, adjacent property owners are allowed to continue to use the land for agricultural purposes. Should a transportation facility be constructed in the corridor, the adjacent property owners' rights would be eliminated. Multiple parcels along a corridor require extensive title searches to determine the property owners affected and negotiation and compensation with these adjacent property owners for this loss. This could slow down any land acquisition process, which would cause this issue to be categorized as an economic issue as well.

Safety Issues:

- **Increased hazards for transportation facility users.** Constructing a transportation facility in an HVTL corridor increases the number of hazards a transportation user would encounter on the facility. The towers are fixed object hazards that drivers could hit. Towers or parts of towers could fall onto the facility, which could cause delays and accidents. If severed or faulted wires come into contact with the facility, users could experience fatal or severe electrical shock.

- **Increased risk to workers during construction and maintenance of the transportation facility.** Using large trucks and construction equipment, such as construction cranes, around HVTLs increases the possibility of a worker being killed or severely injured by electrical shock. A truck or crane could touch, or simply come too close, to the transmission line and cause an electrical shock. Death or severe burns and injuries happen instantly if contact is made with an electrical transmission line. However, the risk for electrical shock is minimal if sufficient clearance is maintained.

- **Impacts on emergency response times.** Depending on power wire converge, a medi-vac helicopter may not be able to land in the corridor. This could increase medical response times as compared to those on other transportation facilities. However, the improved access provided by the transportation facility could provide shorter medical response times over current times to power company employees maintaining the lines.

Environmental Issues:

- **Reduced need to clear forested and wooded areas.** Many HVTL rights-or-way have been substantially cleared of trees to allow clearance for power line sag and sway. This would reduce the need to clear the right-of-way for transportation uses. If a transportation facility is constructed in an HVTL corridor, the incremental negative effects of the transportation facility on water quality, wetlands, air quality, flora and fauna could be similar to or less than in the impacts of a facility constructed in undisturbed woodlands.

- **Negative aesthetic characteristics of the facility.** The sight of the towers, poles and transmission lines could decrease the visual appearance of the transportation facility for some users.

- **Brownfields redevelopment opportunities.** Many HVTL corridors meet the broad definition of a “brownfield” - vacant or underutilized property with real or perceived contamination. If a transportation facility was constructed within a brownfield, it could make better use of the vacant or underutilized property.

- **Environmental Permitting.** Because HVTL corridors are previously disturbed, the number of environmental permits required may be less than for a corridor that is not disturbed. If the number of permits is the same as a disturbed corridor, it may be easier to obtain new permits. However, in order to obtain Federal funds for the project, wetland, tree conservation and sediment and erosion control permits would still be necessary. Although it has not been proved, the potential association between electromagnetic fields (EMF) and certain types of cancer could cause possible permitting issues.

Socio-Economic Issues:

- **Reduced socio-economic and community impacts.** Due to buffer width requirements for HVTL towers and lines, and depending on the design of the transportation facility, homes could be located further from the facility. For example, if a four-lane roadway were located in the center of a 250-foot wide HVTL right-of-way, there would be approximately 100 feet between the edge of pavement and the adjacent property line. This results in a greater distance than typical HVTL scenarios utilized in a majority of highways and arterials.

- **Localizes the effect on people.** Utilizing HVTL rights-of-way should simplify social-economic issues with adjacent property owners and the surrounding public, since the HVTL corridors are generally an accepted land-use within the community. The implementation of a transportation facility would alter this use, but the effects to this change would be less than if the use was previously an environmental conservation area for example.

- **Creates an incremental impact, instead of new impact.**

- **Concentrates linear land uses.**

Cost Issues:

- **Faster, less costly land acquisition process.** If the HVTL corridor right-of-way were owned primarily by the power company, the government would need only deal with one property owner opposed to potentially hundreds. Land acquisition could be resolved in one negotiation and be a minimization of eminent domain issues, speeding the acquirement process. In addition, where adjacent property owners have been granted crossing or agricultural rights, significant negotiations may be needed to eliminate these rights.

- **HVTL and transportation facility geometry.** Depending upon the topography of the HVTL corridor, the cost of building a transportation facility could either increase or decrease accordingly. If the corridor is flat and straight, such as many Maryland HVTL corridors, construction costs may decrease. If the corridor traverses mountainous areas, low-lying wetlands or includes 90-degree turns, construction of the facility could be quite costly. In addition, to ensure safe clearances between power and transportation functions are maintained, it may be necessary to make significant and expensive modifications to the existing power facilities.

- **Limited expansion opportunities.** If a transportation facility is built within the HVTL right-of-way, there will be limited space available to construct additional HVTL towers. Future expansion would require the power companies to purchase additional rights-of-way. This process may be a disadvantage to both power companies and Maryland citizens as the demands upon available electricity increase.

- **Relocation of other utilities.** Within several HVTL corridors, easements have been granted to utility companies for gas and phone lines and fiber optic cables. Construction,

Potential Costs

Developing accurate implementation cost estimates for various transportation options is not possible because they are within hypothetical corridors with unknown variables and a large number of assumptions about the corridors have been made. To prepare a detailed cost estimate, a specific corridor must be selected and an environmental inventory be conducted. This study estimates costs using a ‘cost-per-mile’ approach. For example, the average ***base*** cost for building a new 4-lane divided freeway ranges between $5 million-per-mile on flat terrain and $6 million-per-mile over mountainous terrain. The base cost excludes “intangibles” such as right-of-way acquisition, structures, utilities, signing, lighting, marking, beautification, preliminary engineering, contingency, and overhead. Because the base cost typically covers earthwork, paving and drainage, base costs would be similar for any highway improvement, regardless of whether it is located within an HVTL corridor. It is the intangibles that create the cost differences. Building a transportation facility in an HVTL corridor will reduce some of the base-cost exclusions, but will increase others.

Cost savings can occur through a simplified right-of-way purchasing process if the power company owns the land and would be willing to allow areas of dedication or to enter into joint usage agreements. Clearing and grubbing costs would be significantly lower, and reforestation mitigation and other environmental costs would be minimized. The light poles and overhead sign lighting associated with interchanges should be easier to construct because of the land has already been cleared. However, even though the transportation facility is located in an electricity corridor, the power for the lights cannot come directly from the HVTL’s because the voltages are too high. A separate, lower voltage electrical line would need to be used. Some HVTL corridors already have lower voltage lines within them, and in those cases, costs would be reduced.

The primary additional costs associated with building a transportation facility in an HVTL corridor occur if the terrain is mountainous with multiple steep slopes or there are impacts to avoid with grading. This is because bridges will need to span ravines and retaining walls and barriers will need to be constructed to protect the towers and provide sufficient clearances. The average cost for a bridge is $100 per square foot. Retaining walls cost approximately $50 per square foot. Depressing the transportation facility through the crests to eliminate high grades and to increase safety clearances will increase construction costs and take longer to build as the HVTL structures would need to be protected or moved.

Another cost associated with building a transportation facility in the HVTL right-of-way is relocating existing HVTL towers or poles if they are impacted by the transportation facility. The redesign, relocation or modification of an existing steel lattice towers or large steel pole can cost between $100,000 and $400,000 per structure. In addition, it is not uncommon to find that the relocation or modification of one tower creates the need to relocate or modify the adjacent towers until the transmission lines can be set at a constant tension throughout the tangent section of the corridor. If given the choice between relocating towers or constructing new ones, the power companies would rather construct new, large steel poles adjacent to the existing line because it will be easier to build and will allow for future expansion. Burying the conductor wires is an option, but the cost can be up to 10 times more expensive than relocating the lines above-ground. The increased cost is due to design complexity, cost of materials, electrical arching prevention and construction of casing pipes filled with oil to insulate the wires. Because of the extreme costs and safety requirements associated with insulating 500kv transmissions lines, they cannot be placed underground.

To determine the estimated implementation costs, the study adds the base cost-per-mile for a particular transportation facility to the cost-per-mile increase associated with using the HVTL corridor that occurs and subtracts the cost-per-mile savings associated with using the HVTL corridor. *In general, the cost savings equal the additional costs, leaving little difference between the costs of implementing a transportation facility within an HVTL corridor versus an undisturbed corridor.* However, this finding could vary depending on the specific characteristics of the HVTL corridor. If the corridor's right-of-way is mountainous, is owned by several property owners, and has restrictive tower and/or pole placement, then the cost to construct the transportation facility could be more than 50% greater than building in an undisturbed corridor. Conversely, if the HVTL corridor is owned by one power company, the power lines and structures do not need to be relocated and some environmental mitigation has taken place as part of the HVTL construction, it could cost 50% less to build the transportation facility in the HVTL than in an undisturbed corridor.

Table IV-1 is a cost comparison matrix that breaks down the costs between the various transportation options and corridor configurations.

which would require the relocation or avoidance of these utilities, could impact both maintenance and building costs of the transportation facility.

- **Additional tower protection.** Possibilities exist that vehicles may collide with the stationary power towers, requiring increased protection at the tower base. Examples of such include additional protective fencing and barriers at ground level, or constructing retaining walls.

- **Possible power line relocation.** If a transportation facility built in an HVTL right-of-way requires expansion, the costs associated with the relocation of the power lines would be incurred by the taxpayers.

- **Vertical clearance Constraints.** Design of the transportation facility must take into account the maximum wire sag between towers. Wire sag could limit the allowable vertical clearance of vehicles.

Miscellaneous Issues:

- **Electrical interference.** Electromagnetic Interference (EMI) is the disturbance or electrical noise electromagnetic fields within HVTL's can cause to vehicular radios, cell phones or other electronic devices. The EMI range is dependent on climate and a number of weather variables. For instance, it is such a problem in Hawaii that a "Faraday Shield" was designed and implemented to abate the interference on vehicles traveling along Interstate H-3 , but at high costs.

- **Reciprocity Concerns.** If a transportation facility is built in a HVTL corridor, how will fair compensation be determined? Can the utility companies be compensated for aggravation and loss of time associated with routine HVTL maintenance? Does allowing transportation facilities in existing HVTL corridors create a precedent for allowing HVTL's in existing transportation corridors? These questions illustrate the types of concerns that need to be resolved once the physical and environmental concerns about constructing transportation facilities in HVTL corridors are addressed. Answers will need to be researched thoroughly and possibly with input from lawyers.

V. National and Statewide Examples

V. National and Statewide Examples of Shared Corridor Use

Joint Transportation and HVTL Use Corridors

This section documents examples of power lines and transportation facilities sharing the same corridor. The examples highlight the circumstances that made joint use possible and may not represent typical HVTL and transportation design standards. However, the examples provide opportunities to learn about the types of projects and level of integration possible and to find out the case-specific circumstances that made joint use feasible. The examples cover two types of joint-use corridors. The most common type of joint use corridor is one in which the HVTL use comes in to the corridor after the transportation facility exists. Because of strict guidelines regarding placement of HVTL structures, the safety and operation of the transportation facility is not diminished by the combined use. The second type of joint use corridor – and the one that is the primary concern of this study – is a corridor in which the power company uses the right-of-way and the transportation facility is built after the HVTL line is in place. There are a limited number of examples of this type of joint use corridor, especially over long distances. A final type of corridor would be the design and construction of the HVTL and highway uses together from the outset. However, there are no examples of this type of activity in the United States.

HVTL Corridors Adapted for Transportation Use

The following examples show HVTL corridors adapted to allow for transportation uses in the corridor. The examples illustrate how different transportation modes can be accommodated in close proximity to HVTL structures. Because the examples have unique topography, political will and engineering, the findings they present may not be applicable to conditions in Maryland.

JEFFERSON PARISH, LOUISIANA

In Jefferson Parish, Louisiana, several roads have been constructed almost entirely within existing Louisiana Power and Electric Company's (LaPALCO) HVTL rights-of-way.

- Lapalco Blvd. — 8 miles, 4-lane open section, partial control of access.
- Power Blvd. — 4 to 6-lane open and closed sections, partial control of access
- Gretna Blvd. — 2 to 4-lane residential street, no controls of access
- Stumph Blvd. — 4-lane closed section, no controls of access (industrial land use)
- Dickory Avenue — 4-lane open and closed section, no controls of access

The highways were designed and built in a way that allows the existing single tower configuration to remain in place as part of the highway median. LaPALCO supported the highway projects because the towers did not have paved access roads for HVTL maintenance and the LaPALCO vehicles were frequently getting stuck in the low-lying, wet terrain.

Photo 18

Trains pass directly beneath and through lattice HVTL towers. I-76 is visible to the right. Both modes share corridor space for approximately ¼ mile.

Photo 19

Even though this lattice structure has a wider base than the one from the above photograph, both, permit two tracks to pass beneath. They also have sufficient vertical clearance (minimum of 22 -feet) to allow double stack container trains.

MD 3 in Crofton

These highways have proved to function safely beside the HVTL's and some of the roads are programmed for widening improvements.

- Power Blvd. (Vet.-W.Espl.)	Widen from 4 to 6 lanes
- Lapalco Blvd. (Barataria-Destrehan)	Widen from 4 to 6 lanes
- Lapalco Blvd. (Westwood-Barataria)	Widen from 4 to 6 lanes

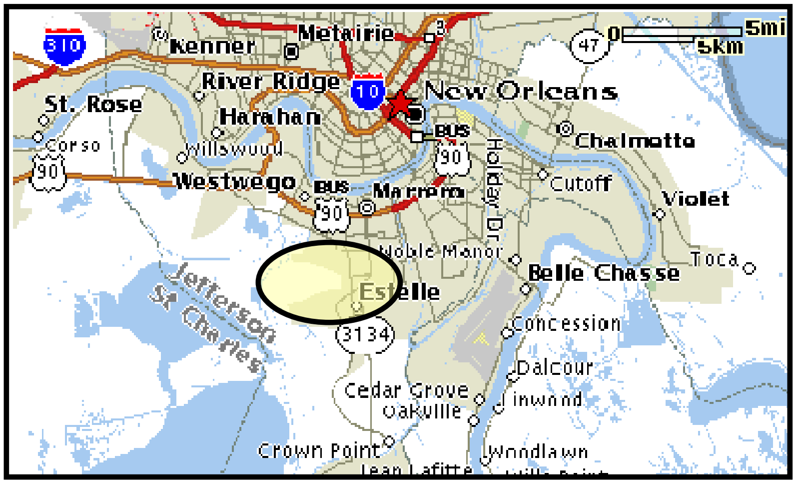


Figure V-1 - Jefferson Parish HVTL Corridor Location.

Photo 9 - Lapalco Blvd. westbound

The outside shoulder of Lapalco Blvd., with oncoming traffic. The towers are in the median. Notice the utility piping bridging over a stream crossing.

Photo 10 - Lapalco Blvd. eastbound

Lapalco Blvd., looking along the outside edge of pavement.

KING OF PRUSSIA, PENNSYLVANIA

An HVTL corridor near King of Prussia, PA (Figure V-2) provides an example of a using a short segment of an existing HVTL corridor to build a new highway interchange. The surrounding region was completely developed, and the ¾-mile segment needed to connect three major highways was only available along an HVTL right-of-way. This new construction highlights the use (see Photos 11 and 12) of an HVTL corridor to enhance highway connectivity. The exiting steel lattice towers were replaced with steel poles in the joint-use section to provide more flexibility in highway and ramp design.

Figure V-2 - King of Prussia Corridor
I-76, US 202, US 422 Interchange

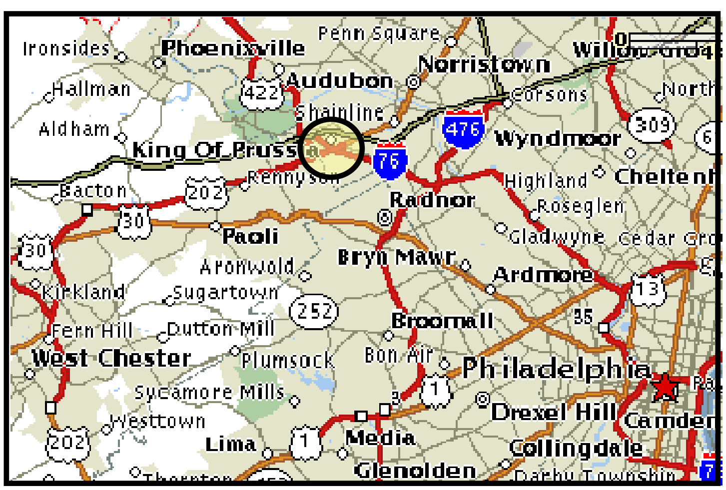


Photo 11

This photo shows that a cut slope and retaining wall is utilized to maintain sufficient vertical clearance between the overpass and the power lines.

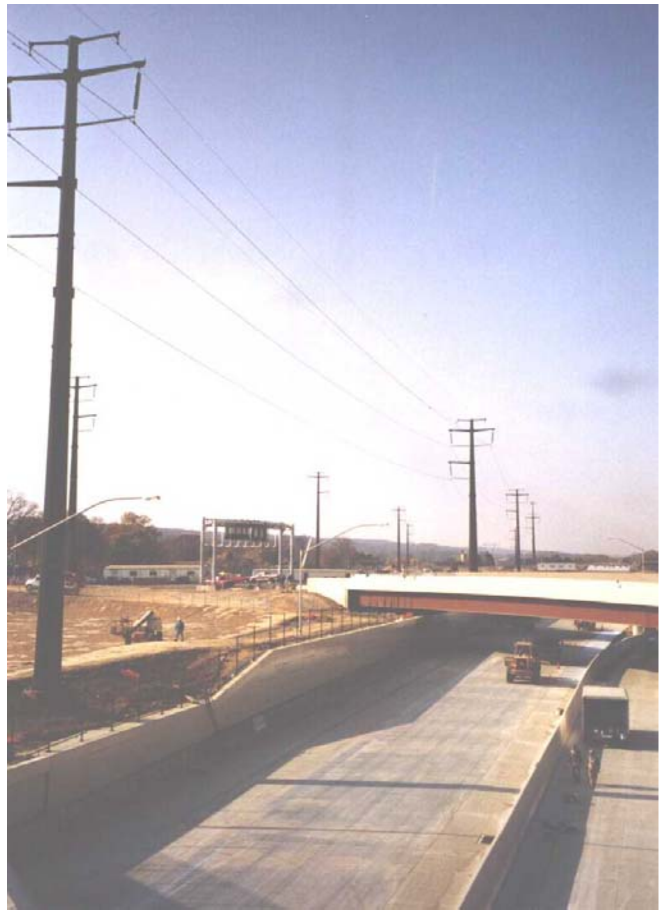


Photo 12

Here, *a service road intersection lies directly adjacent to a steel pole. The service road runs at times through the middle of the corridor and between the two lines and also along the outside of the pole bases. The corridor width is generous, at approximately 400’ across.*

BALTIMORE LIGHT-RAIL TRANSIT SYSTEM

The Baltimore Light Rail Transit system provides an excellent example of implementing rail transit in close proximity to HVTL structures. In the mid-to-late 1980's, the Maryland Transit Administration (MTA) constructed a light rail line between Westport and Baltimore Highlands that utilized the existing HVTL corridor. Part of the corridor was originally owned by CSX for rail freight purposes, but portions of it were bought by BGE for HVTL's. The light rail tracks run between double circuit steel poles for a short segment near the Westport Stop (see Photos 13 through 17) and run parallel to the poles for a longer segment near Baltimore Highlands Stop.

Initially, BGE was opposed to building the rail line because it was concerned about potential conflicts with HVTL maintenance activities. However, funding and strong political support allowed the transit system to be built. Access to and maintenance of the HVTL structures has been arranged at the least possible inconvenience of either MTA or BGE in the extremely tight quarters illustrated in the following photos. Using the HVTL corridor allowed the light rail line to be built without disrupting adjacent properties while preserving a critical HVTL corridor into the city.

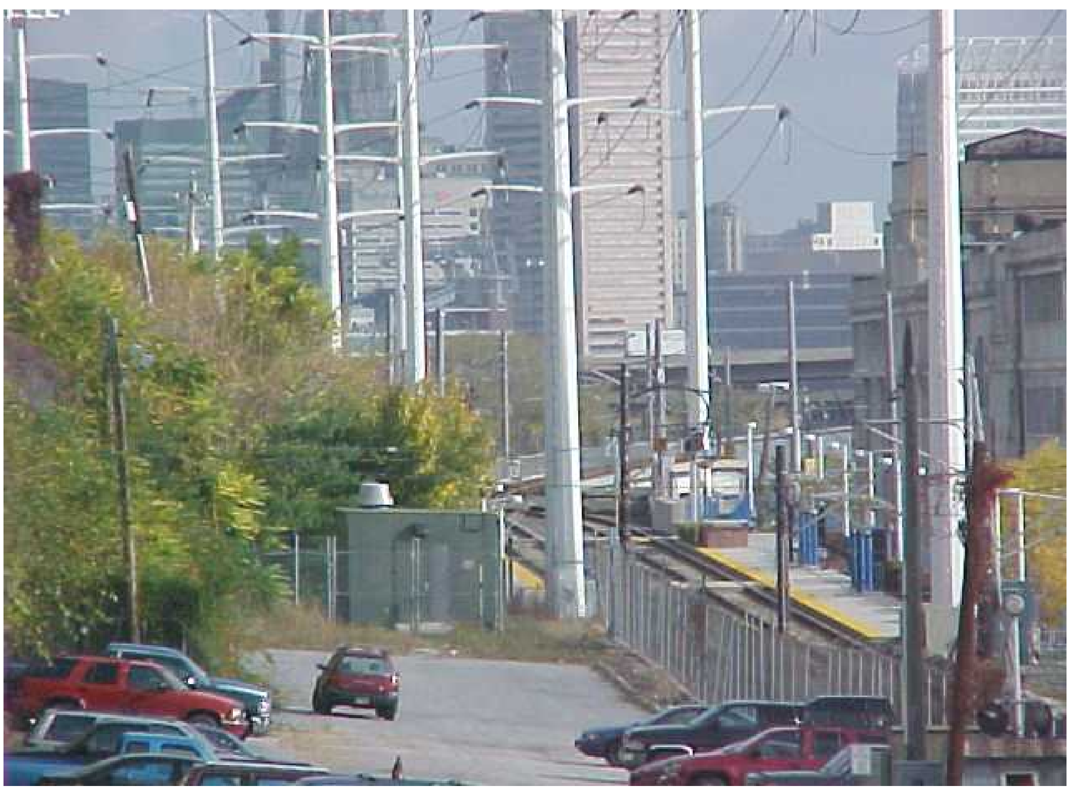


Photo 13

Looking north toward the Westport Station. The train lines are located between the two sets of HVTL towers.

Photo 14

The towers afford little horizontal clearance for passing trains in this view from Westport station.

Photo 15

A steel and concrete barrier provides the steel pole with protection from northbound trains (see Figure V-3).

Photo 16
Another view of the steel pole shown in Figure 1. It has a 52-inch diameter with an 8 ft diameter concrete base.

Photo 17
Looking across tracks at the steel pole and concrete barrier adjacent to the southbound track.

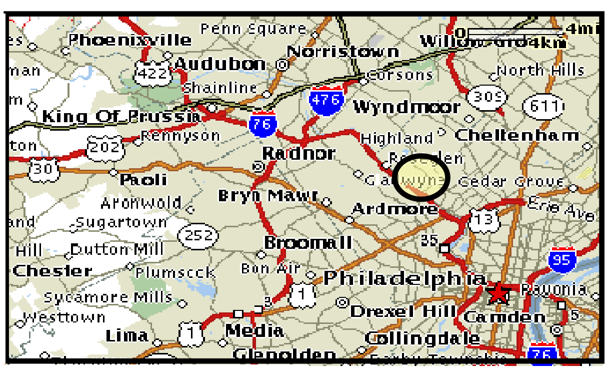
Transportation Corridors Adapted for HVTL Use

There are many more examples of transportation corridors being used for HVTL use, than HVTL corridors being used for transportation purposes. Transportation corridors have higher design standards than HVTL design standards. This is because of vehicle performance limitations and safety considerations. A result of the higher design standards is that it is easier to develop an HVTL in a transportation corridor than the other way around.

Philadelphia, PENNSYLVANIA

Topography limited the space available for an HVTL corridor along the Schuylkill River approaching Center City (see Figure V-4). Along this particularly narrow point, both the local power company and the Pennsylvania Department of Transportation were able to utilize the same segment of this corridor in very close proximity. The topography and constraints of the corridor required specially engineered structures to be used. (See Photos 18 and 19). The corridor had been initially purchased to construct a rail freight line in the late 1800's.

Figure V-4 - Norfolk Southern Main Line



Whereas the Baltimore LRT located within segments of a previously existing HVTL corridor, it is far more common for utility companies to locate within existing transportation corridors. An example from Maryland is along MD 3 near Crofton. The Maryland Department of Transportation State Highway Administration (SHA) has specific policy that governs the placement of such utility structures within highway rights-of-way. The SHA Utility Policy indicates the necessary clear zone required for safety reasons beside highways. These standards are represented by the horizontal separation between road and steel poles, while in this example the transmission line is located just outside the highway right-of-way on private land. The need for increased safety buffers along highways contrasts with the Baltimore Westport LRT example, where tight spacing was allowable between poles and light rail vehicles. The horizontal clearances are shown in detail in Figure V-5.

Photo 20

Looking south along MD 3 southbound lanes. The 2.5-foot diameter steel poles carry transmission lines of 115,000 volts.

The previous examples are either functional facilities or are very near completion. Locally, there are several projects in the planning stages that could potentially have joint-use HVTL implications. These projects would provide the most immediate application of the recommendations of this HVTL study. Descriptions of some example projects within Maryland and West Virginia are provided below.

- ***The Baltimore-Washington Maglev Project***

  This Federally funded study is evaluating several high-speed rail alignments to connect Baltimore and Washington. One alignment utilizes for several miles an HVTL right-of-way that has a dual configuration of steel and lattice towers. All alternatives are still under evaluation and no date has been set for an alternate to be chosen.

- ***College Park Connection from I-95 (2012 Olympics)***

  SHA's Regional Planning Office is conducting this study. One of the options is utilizing the HVTL right-of-way that extends south from the I-95/I-495 interchange towards College Park and beyond.

- ***Northeast Baltimore Corridor Study***

  This feasibility study was conducted by MTA to explore opportunities to extend rail transit from downtown Baltimore to the White Marsh area. Several alternatives looked at using the HVTL corridor that connects northeastern Baltimore City and the White Marsh Area. This project has recently been funded for further study

- ***West Virginia Route 9***

  West Virginia Division of Highways initiated this study based on a future highway alignment shown in the adopted local Master Plan. As part of the NEPA evaluation process, other alignments were evaluated. While the study was being conducted, Allegheny Power built HVTL's within the master plan alignment. Joint usage is still a possibility since no highway alignment has been selected.

Transportation Facilities with HVTL Crossings

Maryland has many examples of transportation facilities and HVTL structures crossing.

The study team took some trips to the field to investigate HVTL crossings of existing transportation facilities in order to witness the clearance distances between the HVTL towers, transmission lines and highway / rail track. The purpose was to determine if there were any issues associated with these crossings that may help to develop an understanding of joint-usage possibilities.

One observation was discovering how many HVTL crossings there are within Maryland, and realizing how close some of the tower structures are to the edge of highway / rail track. The following paragraphs and photos represent key examples of these crossings and how they hinder future expansion possibilities for the transportation facility.

MD 32 – ANNE ARUNDEL COUNTY

This 115,000-volt transmission line corridor crosses MD 32 several times and runs parallel to the roadway for several miles (see Photo 21 through 23). One key observation was the close proximity of one of the towers situated in the median of MD 32, near the National Security Agency. The HVTL corridor crosses at a skewed angle in this instance.

Photo 21

The photographer is looking west along the median barrier of westbound MD 32. The HVTL tower is a lattice tower with a square base of 30 feet on each side. There is 19-foot horizontal clearance between the concrete base of the tower and the face of steel barrier.

Photo 22

This photo shows another view of the lattice tower shown in Photo 21. This view is from the outside of MD 32 westbound, looking towards the eastbound lanes. (See Figure V-6 for a plan view sketch.)

Photo 23

The HVTL Corridor is parallel to MD 32, south of the freeway. Note that the closest two lattice towers have extended heights to accommodate a long span and still maintain minimum vertical clearance distances between the transmission wire midpoint sag and the ground elevations.

MD 170 – ODENTON

This HVTL corridor crosses MD 170 at a skewed angle, near the town of Odenton. Note how the transmission wires span from a lattice tower to a steel pole in the distance; refer to Photo 24 below. The observation here is how close the towers are to the curbs, with no barriers. This was accepted most likely due to the lower design speed of 35mph along MD 170, which caused less of fixed object hazard risk. The sidewalk is even closer to the towers.

Photo 24

Looking north along the MD 170 southbound lanes. The steel (lattice) tower is 15 feet from the travel lane. (See Figure V-7 for a plan view sketch.)

Photo 25

Looking north along the sidewalk adjacent to the northbound lanes of MD 170. The diameter of the steel pole is slightly more than 4 feet. The distance between the base of the pole and the travel lane is 9.5 feet. (See Figure V-8 for a plan view sketch.)

Photo 26

A closer look at the wide steel pole adjacent to northbound MD 170.

I-95 / I-495 INTERCHANGE – COLLEGE PARK

This is feasible and practical since the towers / poles can be places within the acres of underutilized land areas between the ramps and travel lanes of these major interchange configurations (see Photo 27).

Photo 27 - *Large HVTL structures within the I-95/I-495 interchange*

Photo provided by Bryne Kelly

There are several completed or ongoing transportation studies in Maryland with HVTL corridor right-of-way impacts, primarily due to perpendicular crossings HVTL crossings under study in the region include:

- ***MD 43 – Middle River Extension (Baltimore County)***

  This project led by SHA is in Final Design. To accommodate maximum sag conditions, the transmission line height need to be at least 30-feet over the proposed highway. BGE is working with SHA to adjust tower and transmission line heights. Preliminary cost estimates for tower and transmission line modifications and relocations are approximately $600,000.

- ***MD 33 – St. Michael's Bypass (Talbot County)***

  This project led by SHA almost made it through Final Design before the project was canceled due to an inability to obtain environmental permits. Some HVTL rights-of-way were purchased from, but will now be sold back.

- ***US 301 – Waldorf Upgrade / Bypass Study (Charles County)***

  The eastern bypass alternative for Waldorf crosses an existing HVTL corridor several times and runs either within or alongside the corridor for several hundred yards. This alternative is still being evaluated and a Public Hearing on the alternatives is scheduled for 2002.

Appendix B

Typical Sections Pursued but Dropped

Appendix B

The following typical sections (Figures B-1 through B-14) were considered but dropped because of design and implementation difficulties and potential safety hazards for users of the transportation facility.   Minimum horizontal clearances not being met and not having enough available land between HVTL structures to even place the transportation facility, excluding the additional buffer areas required for safety, were the overriding issues. Otherwise, only a two-lane highway or a single-track rail line could fit. For the case of the full build-out (three steel poles, with diameters representing the maximum concrete base or footer), a two-lane highway “inside configuration” had to be used, satisfying a 15 foot clearance requirement on both sides. For rail transit, an inside and outside configuration was considered, but that hinders HVTL maintenance activities. Any “split rail option” (outside configuration) will complicate transit system operations, primarily at stations. Any inside configuration for a full build-out scenario would serve as the ‘worst-case’ option from a transportation facility user’s viewpoint, as well as for HVTL maintenance operations. For a dual steel pole structure scenario, some specific designs can be accommodated. For example, a four-lane highway “inside configuration” could fit between the HVTL structures, but it would limit any possibility for future expansion to the highway or to the HVTL, unless the entire HVTL structures are relocated.

Safety and aesthetics are also important. An additional concrete median barrier used to separate opposing traffic flows could present a safety issue if the required shoulders were unable to fit within the right-of-way. The dual steel lattice tower scenario represents the configuration with the least amount of available land between the towers for transportation facility implementation.   Any transportation system had to be located on the “outside” of the these towers.

TABLE VI-2 Transportation Options Comparison Matrix

Corridor / Structure Configuration	HIGHWAY			RAIL			
	2-Lane Highway	4 Lanes Highways /Expressways	4 Lanes Expressway with Rail Option	Light Rail / Busway	Heavy Rail (AMTRAK / MARC)	SkyTrain	Maglev
250' Corridor Dual Steel (Lattice) Towers	Good Horizontal Clearance Minor HVTL Maint. Access Issues Construction Less Costly	Does Not Meet Clearance Req. w/out Barriers Structure within median HVTL Maint. Access Issues Construction More Costly	Does Not Meet Clearance Req. w/out Barriers Structure(s) within median(s) Major HVTL Maint. Access Issues Construction More Costly	Good Horizontal Clearance Minor HVTL Maint. Access Issues Construction Less Costly	Does Not Meet Clearance Req. w/out Barriers Minor HVTL Maint. Access Issues Construction More Costly	Does Not Meet Clearance Req. w/out Barriers Minor HVTL Maint. Access Issues No difference in Construction Costs, unless there are vertical clearance issues	Does Not Meet Clearance Req. w/out Barriers Minor HVTL Maint. Access Issues Construction more costly, especially when HVTL structures are located on crests
250' Corridor One Steel (Lattice) Tower, One Steel Pole	Good Horizontal Clearance Minor HVTL Maint. Access Issues Construction Less Costly	Does Not Meet Clearance Req. w/out Barriers Structure within median HVTL Maint. Access Issues No difference in Construction Costs	Does Not Meet Clearance Req. w/out Barriers Structure(s) within median(s) HVTL Maint. Access Issues No difference in Construction Costs	Good Horizontal Clearance Minor HVTL Maint. Access Issues Construction Less Costly	Does Not Meet Clearance Req. w/out Barriers Minor HVTL Maint. Access Issues Construction More Costly	Does Not Meet Clearance Req. w/out Barriers Minor HVTL Maint. Access Issues No difference in Construction Costs, unless there are vertical clearance issues	Does Not Meet Clearance Req. w/out Barriers Minor HVTL Maint. Access Issues Construction more costly, especially when HVTL structures are located on crests
250' Corridor Dual Steel Poles	Best Horizontal Clearance Minor HVTL Maint. Access Issues Construction Less Costly Best Vertical Clearance	Does Not Meet Clearance Req. w/out Barriers Structure within median Minor HVTL Maint. Access Issues No difference in Construction Costs	Does Not Meet Clearance Req. w/out Barriers Structure(s) within median(s) HVTL Maint. Access Issues No difference in Construction Costs	Good Horizontal Clearance Minor HVTL Maint. Access Issues Construction Less Costly	Does Not Meet Clearance Req. w/out Barriers Minor HVTL Maint. Access Issues Construction More Costly	Does Not Meet Clearance Req. w/out Barriers Minor HVTL Maint. Access Issues No difference in Construction Costs, unless there are vertical clearance issues	Does Not Meet Clearance Req. w/out Barriers Minor HVTL Maint. Access Issues Construction more costly, especially when HVTL structures are located on crests
250' Corridor Triple Steel Poles (Full Buildout)	Good Horizontal Clearance Minor HVTL Maint. Access Issues Construction Less Costly	Does Not Meet Clearance Req. w/out Barriers Structure(s) within median HVTL Maint. Access Issues Construction More Costly	Does Not Meet Clearance Req. w/out Barriers Structure(s) within median(s) Major HVTL Maint. Access Issues Construction More Costly	Good Horizontal Clearance Minor HVTL Maint. Access Issues Construction Less Costly	Does Not Meet Clearance Req. w/out Barriers Minor HVTL Maint. Access Issues Construction More Costly	Does Not Meet Clearance Req. w/out Barriers Minor HVTL Maint. Access Issues No difference in Construction Costs, unless there are vertical clearance issues	Does Not Meet Clearance Req. w/out Barriers Minor HVTL Maint. Access Issues Construction more costly, especially when HVTL structures are located on crests
150' Corridor (Full Buildout)	Good Horizontal Clearance Minor HVTL Maint. Access Issues Construction Less Costly	Considered, but Dropped *due to lack of available space between structures*	Considered, but Dropped *due to lack of available space between structures*	Good Horizontal Clearance Existing low-voltage Wooden Poles to be Relocated or Altered HVTL Maint. Access Issues Construction More Costly	Does Not Meet Clearance Req. w/out Barriers Existing low-voltage Wooden Poles to be Relocated or Altered HVTL Maint. Access Issues Construction More Costly	Does Not Meet Clearance Req. w/out Barriers Existing low-voltage Wooden Poles to be Relocated or Altered HVTL Maint. Access Issues Construction More Costly	Does Not Meet Clearance Req. w/out Barriers Existing low-voltage Wooden Poles to be Relocated or Altered Construction more costly, especially when HVTL structures are located on crests

NOTES:

Color coding - - **Blue is positive,** Green is Neutral, **Orange is sligtly negative**, and **Red is negative**

Costs are based on the positive or negative percentage values shown in Figure IV-1

APPENDIX G: 1993 PENINSULA ROUTE ASSESSMENT BY D. W. DODSON

J. O. Austin's Copy

Preliminary Engineering Feasibility Study

of an

Additional High Speed Track

between

Richmond, Virginia and Newport News, Virginia

August 1993

for

Commonwealth of Virginia

Department of Rail and Public Transportation

by
D. W. Dodson
Consulting Engineer

Acknowledgement and Disclaimer

This report was prepared in cooperation with the Virginia Department of Rail and Public Transportation and the Virginia Department of Transportation.

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Purpose and Scope

The Department of Rail and Public Transportation and the Virginia Department of Transportation have undertaken a preliminary feasibility study of constructing an additional track for high speed rail passenger service between Richmond, Virginia, and Newport News, Virginia. The proposed track will use the same general alignment as the existing CSX trackage. The Commonwealth has retained D. W. Dodson to make this preliminary study.

The study will be conducted in two parts. The first part will assume the additional track will follow the existing CSX alignment with an operating speed of 150 mph, except where limited by track restrictions. The second part of the study will assume an operating speed of 150 mph is to be attained wherever practical, with necessary alignment changes. Both parts will include speed restrictions in congested areas such as the cities of Richmond, Williamsburg, Newport News, and adjacent suburbs.

This report contains the results of this feasibility study. Contained herein are the following items, supporting each of the two parts:

1. An assessment of the existing conditions between Newport News and Richmond

2. A series of sketches indicating tentative track locations for a proposed additional track between Newport News and Richmond

3. An analysis of the problem areas including highways and railroad bridges

4. Preliminary cost estimate with electrification costs if deemed desirable

5. Where additional track is on CSX right-of-way, a minimum of 20 feet between existing main line track and a proposed high speed track is recommended.

Assessment of Existing Conditions

CSX Corporation owns and operates the rail corridor between Fulton Yard (M.P. 82) in Richmond and Old Point Junction (M.P. 11.5±) in Newport News. The width of the right-of-way is normally 100 feet. The entire right-of-way was designed for double main line operation but, with the use of automatic block signal systems, much of the former eastbound main track has been retired; where the former eastbound track is still in place, it is used as a passing track or lead track for industry sidings. Due to the abandonment of the track, most unused right-of-way is on the south side and is now used for a company access road. Also, most bridges and drainage structures, which formerly supported the eastbound main, were abandoned in place and a structural study would have to be made to determine the integrity of each structure and its ability to handle high speed passenger trains, if desired.

Curvature of the track is not overly severe; the worst curve is a 3°00′ curve right with a delta of 37°34′ and length of 2540 feet, followed immediately by a 3°00′ curve left with a delta of 36°00; and a length of 1400 feet. These two curves are immediately adjacent to the north bank of the Chickahominy River in New Kent County. The river bluffs in this vicinity constitute some of the worst terrain within the area of study. Additionally, there are three curves between 0°30′ and 0°59′; 13 curves between 1°00′ and 1°59′; and 7 curves between 2°00′ and 2°30′, for a total of 23 curves over 0°30′.

Existing right-of-way contains ample track drainage facilities, from 12" pipes to 4′ brick and/or concrete arches. Major facilities include 15 highway overpasses, 8 highway underpasses, 16 railway bridges over water, and 6 major arch structures for streams.

There are 32 private grade crossings and 25 public grade crossings, for a total of 57 at-grade crossings over the main line. Of the public grade crossings, 12 have train activated automatic flashing light gate signals, 6 have train activated automatic flashing light signals, and 7 have passive warning devices. The private crossing in the Williamsburg Pottery Factory in Lightfoot has warning devices which consist of train activated flashing light gate signals. The crossing is located adjacent to a pedestrian underpass.

Overall, the south side of the right-of-way allows the greater flexibility in constructing an additional track on or near CSX property. However, there are several problems which will have to be further analyzed and solved. Approximately four miles of private roadway currently are being used and, in all probability, the user(s) either have a deed reservation or prescriptive right to the roadway. Further, approximately 2.5 miles of public roads are located on CSX property. The right-of-way for US Rt. 60 is adjacent to CSX right-of-way on the south side for approximately 35 miles and on the north side for approximately seven miles. In some areas of CSX right-of-way, between Williamsburg and Newport News, Interstate 64 and US 143 are located close to the railway and will further complicate any track relocation or construction.

From the yard limit sign at the west end of the Newport News Classification Yards to the yard limit sign at the east end of the Fulton Yards, there are 17 switches coming off the south side of the main line(s) and 20 switches coming off the north side. It is possible that some of these can be removed, but many cannot. However, the most active sidings are in or near the urban centers and will be in slow speed areas.

Due to CSX Corporation's acquisition of the trackage of the former Richmond, Fredericksburg & Potomac Railroad Company in 1991, in particular the RF&P's yards north of Richmond, CSX's Fulton Yard in the City of Richmond is being studied to determine if the yard can be significantly reduced. For the purpose of this report, it will be assumed that the yard will stay in place and the study will be terminated on the east end of the yard.

As previously alluded to, there are three areas of congestion: Richmond, Williamsburg, and Newport News. The area on the east side of Fulton Yards is fairly open and should not require any significant relocation of homes or industries. The only potential problem noted would be the possible disruption of some facilities of Virginia Air National Guard and Richmond's Richard Evelyn Byrd International Airport. It is believed that part of a roadway used by the National Guard is on the south side of CSX property. Many airports have "clear zone easements" adjacent to their approach runways. This will have to be considered if electrification towers and/or microwave towers were to be erected in the vicinity of the airport.

The entry into Newport News could be more difficult. Whereas CSX has ample right-of-way for an additional track, it is not known if they have any future development plans for the property. Both sides of CSX are virtually full of adjacent and cross streets, private living quarters, and industries, both large and small. Therefore, it is essential to stay on or as close to CSX property as feasible.

The urban and suburban areas around the City of Williamsburg, including the Town of Lightfoot, the Williamsburg Pottery Factory, and historic Colonial Williamsburg, will present the more challenging problem. The area through the pottery factory complex is fully developed and an additional high speed track would disrupt the business and parking facilities. Also, it would be very expensive to compensate for this disruption. The existing trackage through the City of Williamsburg lies in a depressed area with embankments in excess of 15' above the top of rail. Any attempt to use existing CSX right-of-way would disrupt adjacent streets, parking lots, and stores on the south side, including some facilities of Colonial Williamsburg, such as the Colonial Parkway.

The recommendation is to review the possibility of bypassing Williamsburg and the above-named facilities. From county and geological maps and a cursory review of the terrain, it appears feasible to leave CSX right-of-way at approximately railway milepost 45.5, approaching Interstate 64 approximately one mile east of the Norge Interchange and continue paralleling the interstate into the northwest corner of Newport News where I-64, US Rt. 60, SR 143, and the railway converge. From that point to the end, CSX property may be utilized.

The advantage of the CSX route appears to be very conducive to a high speed rail operation. Generally, there are no large, populated areas, with the exception of those noted above, resulting in little disruption to individuals and/or businesses. Much public and/or railroad right-of-way can be utilized for such an endeavor, including portions of CSX, US Rt. 60, SR 143, and Interstate 64. As noted above, the only intermediate populated area would be Williamsburg and adjacent suburban areas.

The final consideration to discuss would be the terrain. A general review of the geodetic maps of area and a cursory review of the entire area, there is only one notable area where the terrain becomes erratic, both with rough landscape and adjacent or nearby water. This occurs generally on the Walkers geodetic map south of US Rt. 60, west of Rt. 627, north of the Wilcox Neck of the Chickahominy River, and ending east of Rt. 601 and the Hicks Island area. This general area coincides with portions of CSX valuation maps Y-2/34 and V-2/35. From the CSX maps, the two worst curves, each in excess of 3°00', are in this area and, by realignment, these two curves could be eliminated. Even by staying on CSX property, terrain features would make it difficult and expensive to construct a high speed track within this approximately three mile strip. Therefore, it is recommended that entirely new alignment from a point east of Walkers to point near the New Kent-James City County line be considered. This would be approximately 2.5 miles.

As noted above, the writer feels the south side of CSX right-of-way offers the most advantageous location of the high speed track and all discussions will be based on this premise.

Existing Alignment Scenario
Analysis of Problem Areas

M.P. 11.5± - 14.36 - Classification Yards for Old Point Junction in Newport News:
CSX will have to determine if room is available for separate track. From the right-of-way and track map, there is a small area on the south side, east of Mercury Blvd., where there is insufficient room for a third main line.

M.P. 14.24 - Center Av. underpass:
There are four tracks over bridge with approximately 40 feet on south side. Part of the bridge has been retired in place and room is available for an additional track.

M.P. 14.97 - Main St. (Rt. 152) underpass:
There are two tracks over bridge with a portion of bridge retired in place. However, width is insufficient for third main line and will have to be widened or replaced.

M.P. 15.37 - Switch on south side to various facilities:
Business interests will decree whether track can be eliminated.

M.P. 16.53 - End of passing track:
Single track for next 5.9 miles.

M.P. 16.55 - Harpersville Rd. grade crossing:
Traffic control devices consist of automatic flashing light signals with

short arm gates. Double-track grade separation required.

M.P. 17.55	-	10′ brick and concrete arch structure for Causey's Mill Pond: Structure will have to be lengthened or rebuilt for high speed tracks.
M.P. 17.58	-	8′ x 8′ concrete box underpass: Will have to be lengthened or rebuilt for high speed tracks.
M.P. 17.74	-	J. Clyde Morris Blvd. overpass: A survey will be necessary to determine adequacy of clearance for an additional track.
M.P. 17.67 - 19.52	-	A private road is on south side of right-of-way and would have to be relocated.
M.P. 19.55	-	Private grade crossing: Should be closed and alternate access provided at Bell King Road, M.P. 19.77, including a parallel drive on north side of right-of-way.
M.P. 20.01 - 20.50	-	Private road on south side of right-of-way will require relocation.
M.P. 20.21 - 20.38	-	0°40′ curve left, 867 feet long: 0°30′ curve can be constructed with minimal effort.

M.P. 20.47	-	Oyster Point Rd. overpass: Adequate room to add a high speed track.
M.P. 20.87	-	12′ concrete arch structure for Deep Creek: Will require lengthening or reconstruction for high speed track.
M.P. 22.0	-	Eastwood Bland Connection Rd. overpass: Should be adequate for an additional high speed track.
M.P. 22.30 - 22.65	-	Private road on south side of right-of-way: Will require relocation.
M.P. 22.41 - 35.24	-	Second main line included on south side.
M.P. 22.76	-	Point of switch to two industrial sidings, Nos. 487 and 2921, on south side: Track No. 487 would negate an additional high speed track on south side of right-of-way. Interstate 64 would deter any shifting of track in a northerly direction.
M.P. 22.84	-	Rt. 173 overpass: This structure further complicates the installation of a high speed track, as it spans industrial sidings, Nos. 487 and 2921, as noted at M.P. 22.76.
M.P. 23.3	-	Deck Girder Bridge over Stony Creek: New single-track structure will be required.

M.P. 25.3 - Industrial Park Dr. grade crossing: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A grade separation structure will be required.

M.P. 25.51 - Point of switch to track No. 490: Track retired in place and can be removed.

M.P. 26.00 - Rt. 105 overpass: Should be adequate for an additional track.

M.P. 26.43 - 12′ arch for Warwick River: Will require widening or reconstruction for a high speed track.

M.P. 26.49 - PS for passing siding No. 493 on south side, length is 5661 feet.

M.P. 26.73 - PS for Ft. Eustis track No. 491 on south side off passing siding No. 493.

M.P. 26.83 - PS for storage track No. 492, length is 3577 feet, on south side off passing siding No. 493.

M.P. 27.38 - PS for track No. 494 off storage track on south side.

M.P. 27.52 - Yorktown Rd. grade crossing: Traffic control devices consist of train activated automatic flashing light signals. Grade separation structure will be required.

M.P. 27.53 - PS for track No. 495 off south side of passing siding No. 493 with track No. 2104 coming off track No. 495.

M.P. 27.62 - Elmhurst Dr. grade crossing:
Traffic control devices consist of train activated automatic flashing light signals and short arm gates. Grade separation structure will be required.

Note: The section of track from M.P. 26.49 to 27.77 will require additional study to determine if any of sidings Nos. 493, 491, 492, 494, 495, and 2104 can be removed. Also, it will have to be determined if the grade crossings of Yorktown Road and Elmhurst Drive can be combined, thereby closing one crossing and eliminating the need for two new grade separation structures.

M.P. 28.06 - Private grade crossing:
Either alternate access or an underpass will be necessary if required to maintain access.

M.P. 28.33 - 29.16 - 0°44′ curve left:
Any attempt to obtain a 0°30′ curve left will require the relocation of approximately 3000 feet of US Rt. 60.

M.P. 29.86 - 30.23 - 0°56′ curve right:
To obtain a 0°30′ curve would require the relocation of portions of SR 168, the two main lines, and Dow Chemical Track No. 2791.

M.P. 30.0 - 30.81	-	Private road on right-of-way will have to be relocated.
M.P. 30.60	-	PS to Dow Chemical Track No. 2791, on south side of right-of-way
M.P. 31.92 - 32.19	-	2°00′ curve left: No practical way to improve curvature due to proximity of US Rt. 60 on south side of right-of-way.
M.P. 32.46	-	PS to track No. 2990 on south side: Tracks Nos. 2991, 3013, and 3015 also come off track No. 2990, in a southerly direction. Track No. 2991 serves Busch Gardens facilities. Due to close proximity of SR 168 on north side and US Rt. 60 on the south side, a detailed survey will have to be made for any alternatives.
M.P. 32.81 - 33.09	-	2°00′ curve right: No practical way to improve curvature at this location, as may be noted under comments for PS at M.P. 32.46.
M.P. 34.11	-	Rt. 199 overpass twin highway bridge: Should be good for additional high speed track.
M.P. 35.24 - 42.87	-	Single track
M.P. 36.15	-	Page Rd. overpass highway bridge: Need survey to determine if adequate for additional high speed track.

M.P. 36.02 - 36.77 - 1°00′ curve left:
Possible to decrease curvature for high speed track by shifting CSX track in a northerly direction. However, this could affect clearances at Page Road overpass and the Capitol Landing Road overpass.

M.P. 36.30 - Capitol Landing overhead highway structure:
Should be adequate for an additional high speed track.

M.P. 36.64 - Pedestrian underpass:
Will require lengthening.

M.P. 36.75 - Colonial National Parkway underpass:
Will require lengthening.

M.P. 37.00 - 38.26 - 1°00′ curve right:
In the Williamsburg city limits. No practical way to reduce curvature.

M.P. 37.15 - Henry Street grade crossing:
Traffic control devices consist of train activated automatic flashing light signals and short arm gates. Crossing will have to be closed or bridged.

M.P. 37.30 - Covered platform and station facilities for City of Williamsburg on south side.

M.P. 37.76 - PS for track No. 504 on south side:
Shows little apparent use and possibly could be removed.

M.P. 38.25	-	Rt. 60 overhead highway bridge: Should be adequate for an additional high speed track.
M.P. 38.60	-	Private grade crossing: Arrangements will have to be made to provide access.
M.P. 38.95	-	Private grade crossing: Arrangements will have to be made to provide access. One underpass may suffice for the two crossings or an alternate access may be provided by extending Rt. 603.
M.P. 40.17	-	Rt. 645 grade crossing: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. Will need underpass to span CSX and high speed track.
M.P. 40.84 - 41.17	-	1°00′ curve left: Impractical to reduce curvature due to close proximity of US Rt. 60 on the south side.
M.P. 42.40	-	Rt. 646 grade crossing: Traffic control devices consist of train activated automatic flashing light signals. If not feasible to closed, a double-track grade separation will be required.
M.P. 42.87 - 49.22	-	Double track
M.P. 42.93 - 43.24	-	1°00′ compound curve right

M.P. 43.11	-	PS for passing track No. 515 on south side: Length of track is 7518 feet.
M.P. 43.15	-	Private grade crossing for Williamsburg Pottery complex: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. Immediately adjacent to east side of at-grade crossing is a pedestrian underpass. Will be very difficult to make any changes in this complex.
M.P. 43.40	-	Private farm crossing: Four track grade separation required if access is deemed necessary.
M.P. 43.70	-	Private farm crossing: Four track grade separation required if access is deemed necessary. No apparent connection to farm crossing at M.P. 43.40.
M.P. 43.95	-	Private grade crossing for one house: No other apparent access.
M.P. 44.25	-	Private farm crossing: Four-track grade separation required if access is deemed necessary. No other apparent access.
M.P. 44.60	-	Private grade crossing for three houses: No other apparent access.
M.P. 44.74 - 45.83	-	1°18′ compound curve left: Difficult to decrease curvature due to county road on south side.

M.P. 45.70	-	SR 602 overhead highway bridge: Adequacy of the clearance depends on layout of track structure.
M.P. 45.86	-	PS for track No. 3066 on south side: Review for retirement.
M.P. 46.32 - 46.63	-	2°00′ curve right: A detailed survey of the terrain on the north side required to determine if a curvature reduction would be satisfactory. No other problems noted.
M.P. 45.56	-	PS to track No. 520 on south side: Possible to retire all tracks.
M.P. 46.84 - 47.14	-	2°00′ curve right: No apparent problems to shift all tracks in a northerly direction for decreased curvature.
M.P. 47.07	-	US Rt. 60 overpass: Appears adequate for an additional high speed track.
M.P. 47.36 - 47.60	-	2°00′ curve left: No apparent reason on south side not to decrease curvature for a high speed line.
M.P. 47.79 - 48.26	-	1°52′ curve left: No apparent reason on south side not to decrease curvature for a high speed line.
M.P. 49.24 - 49.80	-	3°00′ compound curve right: North side has potential for decreasing curvature. Detailed land survey will be required to determine feasibility.

M.P. 50.19 - 50.65 - 1°55′ curve left:
South side has potential for decreasing curvature. Detailed land survey will be required to determine feasibility.

M.P. 50.77 - 12′ brick arch:
Will need lengthening or reconstruction.

M.P. 50.82 - 51.25 - 1°10′ curve right:
Does not appear to be feasible for further shift in southerly direction due to terrain and houses.

M.P. 51.02 - Forge Rd. grade crossing:
Traffic control devices consist of train activated automatic flashing light signals with short arm gates. Double-track grade separation structure will be required.

M.P. 51.0 - 52.0 - Publicly used road on right-of-way:
Right of individuals to use roadway will have to be established and legally dealt with.

M.P. 52.35 - Rt. 601 underpass:
Will have to be lengthened or reconstructed for high speed track.

M.P. 52.51 - Diascund Creek bridge:
Single-track bridge will be required for high speed track.

M.P. 52.69 - 52.97 - 2°30′ curve left:
Terrain does not appear feasible to shift track in a southerly direction. Total realignment may be necessary in this area. Recommend eliminating curve by extending

track relocation as outlined for curves at M.P. 53.18 - 53.05 and at M.P. 53.51 - 54.00 noted below.

M.P. 52.97	-	SR 1010 grade crossing: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A double-track grade separation structure will be required.
M.P. 53.18 - 53.45	-	3°04′ curve left: Terrain not conducive for a track shift in a southerly direction. Recommend total realignment. See recommendation for curve at M.P. 53.51 - 54.00 below.
M.P. 53.49 - 53.70	-	SR 627 on right-of-way: A road shift will be difficult and expensive due to nearby private homes.
M.P. 53.51 - 54.00	-	3°00′ compound curve right: Total realignment will be necessary to decrease track curvature. Recommend relocating tracks approximately 1500′ north, beginning at about M.P. 55.25 and designing a 0°30 curve right, ending at approximately M.P. 53.50.
M.P. 53.67	-	6′ brick arch, 72′ long: Probably adequate for an additional track.
M.P. 53.90	-	Private grade crossing to several residences: Access could be provided from SR 627.

M.P. 54.23 - Rt. 627 grade crossing:
Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A double-track grade separation structure will be required.

M.P. 55.22 - Public grade crossing, SR 647 to Chickahominy Lake outpost, easement to USA:
Will have to be provided for unless crossing can be consolidated with private crossings at M.P. 55.37 and 55.49.

M.P. 55.37 - Private grade crossing to four homes:
Investigate alternate access.

M.P. 55.49 - Private grade crossing to Chickahominy Lake:
Investigate alternate access.

M.P. 56.04 - 56.45 - 1°00′ curve left:
Any potential CSX shift would be minimal due to location of US Rt. 60 on the north side. A 0°30′ curve can be constructed on south side of right-of-way without disturbing CSX track.

M.P. 56.57 - Private grade crossing:
There does not appear to be an alternate access. An underpass will be required, if access deemed necessary, due to close proximity of US Rt. 60 on north side.

M.P. 56.93 - Private grade crossing:
There does not appear to be an alternate

access unless a parallel access road is constructed.

M.P. 57.08	-	Brick arch and 96" liner plate: Both drainage structures will have to be lengthened.
M.P. 57.15	-	Public grade crossing, SR 647, leading to Osborn Landing: Access will have to be maintained.
M.P. 57.35	-	Private grade crossing leading to several houses: Access will have to be maintained.
M.P. 57.70	-	Rt. 650 grade crossing: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. Access will have to be maintained with a grade separation structure.
M.P. 57.95	-	Private grade crossing: No alternate access available.
M.P. 57.86 - 58.14	-	0°30′ curve right: No problem.
M.P. 58.55	-	Private grade crossing to state game farm: Access will have to be maintained.
M.P. 58.65 - 61.13	-	Double track
M.P. 58.72	-	Private grade crossing: No alternate access available.

Note: The private and public grade crossings at M.P. 56.57, 56.93, 57.15, 57.35, 57.70, 57.95, 58.55, and 58.72 could be consolidated with one underpass if a parallel access road could be constructed. The structure would have to be an underpass due to the close proximity of US Rt. 60.

M.P. 59.27 - 59.42	-	0°30′ curve left: No problem.
M.P. 59.93	-	PS to track No. 534 (passing track) on south side, length is 5805 feet: (To stay on right-of-way, track No. 534 will have to be eliminated.)
M.P. 60.12	-	Private farm crossing: Alternate access may be available.
M.P. 60.53 - 60.74	-	0°30′ curve left: No problem.
M.P. 60.80	-	Rt. 602 grade crossing: Traffic control devices consist of passive warning signs. A double-track grade separation structure will be required.
M.P. 60.98	-	PS for track No. 536 on south side: Two additional industry tracks, Nos. 2869 and 2939, lead from track No. 536.
M.P. 61.13 - 76.20	-	Single track
M.P. 61.27	-	SR 155 grade crossing: Traffic control devices consist of train activated automatic flashing light signals

with short arm gates. A grade separation structure will be required. The structure could be used to close the Rt. 602 grade crossing at M.P. 60.80.

M.P. 61.54 - Deck plate girder bridge over Jones Run (Mill Tail Creek):
A new single-track railroad bridge will have to be constructed. Private undergrade access will have to be included.

M.P. 61.80 - Private grade crossing:
Alternate access from SR 618 available. Serves one house only.

M.P. 61.50 - 61.72 - 1°00′ curve right:
Any reduction of curvature would not be feasible on either side as curve is in the center of the town of Providence Forge.

M.P. 61.95 - Concrete arch with pipe liner, length is 71 feet, will have to be lengthened.

M.P. 62.32 - Rt. 618 grade crossing:
Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A double-track underpass will be required due to close proximity of US Rt. 60.

M.P. 62.55 - 62.66 - 1°04′ curve left:
It would be feasible to design a 0°30′ curve. Terrain conducive to this and will probably stay on right-of-way.

M.P. 62.85	-	Private grade crossing, serving two families: No alternate access available but could be connected to Rt. 618.
M.P. 63.64	-	Private grade crossing: No alternate access available. An underpass will probably be required if access deemed necessary.
M.P. 63.99	-	Bridge over Schiminoe Creek: A single-track railroad bridge will be required.
M.P. 64.01	-	PS for industrial track No. 3009 on south side, length is 1171 feet: Railroad will have to determine if track is necessary.
M.P. 64.27	-	SR 615 grade crossing: Traffic control devices consist of passive warning signs. A two-track grade separation structure may be required.
M.P. 64.41 - 64.74	-	Private road on south side of right-of-way
M.P. 65.36 - 65.86	-	Five bridges over branches of the Chickahominy River. A new single-track bridge will be required for each branch if branches cannot be consolidated.
M.P. 66.04	-	PS to industrial track No. 542 on south side, length is 747 feet: Railroad will have to determine if track can be retired.

M.P. 66.20 - Bridge over Opossum Creek:
A new single-track railroad bridge will be required.

M.P. 66.45 - SR 609 grade crossing:
Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A double-track grade separation structure will be required.

M.P. 66.99 - SR 106 grade crossing:
Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A grade separation structure could be combined with the SR 609 facility at M.P. 66.45.

M.P. 66.94 - 67.48 - 0°30′ curve:
No problem.

M.P. 67.75 - Private grade crossing:
No alternate access available but appears feasible from Rt. 600 on north side of right-of-way.

M.P. 68.55 - Private grade crossing:
No alternate access available. Double-track grade separation required if access deemed necessary.

M.P. 69.03 - 70.03 - 1°00′ curve left:
Terrain not conducive to reducing curvature.

M.P. 69.25 - Private grade crossing:
No alternate access available. Double-

track grade separation required if access deemed necessary.

M.P. 69.68 - Double concrete arch, length is 36.5 feet: Will need lengthening or a new single-track bridge constructed.

M.P. 70.05 - Bridge over creek: New single-track structure will be required.

M.P. 70.15 - Bridge over White Oak Swamp: New single-track structure will be required.

M.P. 71.26 - White Oak Rd. (Rt. 156) grade crossing: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A double-track grade separation structure will be required.

M.P. 71.43 - 10′ concrete flat top culvert: New structure will be required.

M.P. 71.71 - 6′ rail top culvert: New structure will be required.

M.P. 71.62 - 73.07 - 0°40′ curve right: Not feasible to reduce curvature unless all tracks are relocated in a northerly direction. Terrain does not appear conducive for such a shift.

M.P. 72.78 - Bridge over White Oak Swamp: A new single-track structure will be required for a high speed track.

M.P. 73.26	-	Bridge over White Oak Swamp: A new single-track structure will be required for a high speed track.
M.P. 73.87	-	Bridge over White Oak Swamp: A new single-track structure will be required for a high speed track. Note: There is a potential to either relocate the channel for White Oak Swamp in a northerly direction or keep track south of the loop made by the stream, thereby eliminating the need for structures at M.P. 73.26 and 73.87.
M.P. 74.48 - 74.80	-	1°00′ curve left: A 0°30′ curve may be constructed if a survey indicates minimal disruption in the Village of Poplar Springs.
M.P. 74.68	-	Poplar Springs Rd. grade crossing: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A two-track grade separation structure will be required.
M.P. 74.88	-	Bridge over White Oak Swamp: A new single-track structure will be required for a high speed track.
M.P. 75.36	-	Private grade crossing to Henrico County police shooting range: Access will have to be maintained. Recommend a two-track underpass in line with La France Road approximately 500 feet

west of existing crossing, due to Richmond drag strip complex.

M.P. 76.20 - 81.39 - Double track to beginning of Fulton Yard in Richmond and the end of this study.

M.P. 76.21 - I-295 overpass:
Clearance appears feasible for a high speed track.

M.P. 76.82 - Beulah Rd. grade crossing:
Traffic control devices consist of train activated automatic flashing light signals with short arm gates. Richmond International airport on north side of track. Further study will be necessary to determine ultimate solution.

M.P. 77.93 - 78.12 - Roadway on south side of right-of-way:
Appears feasible to remove, if deemed necessary.

M.P. 78.40 - Charles City Rd. grade crossing:
Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A single-track grade separation structure will be required.

M.P. 78.48 - PS to industrial track No. 3049:
Railroad will determine if business is adequate to maintain service. Also, industrial track Nos. 3050, 3051, and 3057 go off track No. 3049.

M.P. 79.00 - Miller Rd. grade crossing:
Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A single-track grade separation structure will be required if access at this location is deemed necessary. Recommend closure.

M.P. 79.24 - Laburnum Av. overpass:
Ample room for an additional track on south side but may require some track realignment.

M.P. 79.50 - PS for industrial track No. 3001 on south side, includes switches to industrial track Nos. 3002 and 3003:
Railroad will have to determine if traffic is sufficient to maintain service.

M.P. 79.65 - PS for industrial track No. 2969 on south side leading into several tracks for A. H. Robins Company facilities.

M.P. 80.59 - 80.69 - 2°00′ curve left:
In yard limits and not feasible to deduce curvature.

M.P. 80.91 - 8′ brick arch (almond Creek), length is 126 feet:
Appears adequate for additional high speed track.

M.P. 80.97 - Darbytown Rd. overpass:
Adequate room for high speed track but may require some realignment of CSX trackage.

M.P. 81.38 - Undergrade highway crossing:
Adequate room for high speed track but may require some realignment of CSX trackage.

Existing Alignment Scenario
Allowable Speeds
Maximum Speed of 150 MPH

Milepost	Route Miles	Restriction	Speed MPH
11.5 - 14.36	2.86	Yard limits	20
14.36 - 28.33	13.97		150
28.33 - 29.16	0.83	0°44′ curve	134
29.16 - 29.86	0.70		150
29.86 - 30.23	0.37	0°56′ curve	119
30.23 - 31.92	1.69		150
31.92 - 32.19	0.27	2°00′ curve	80
32.19 - 32.81	0.62		150
32.81 - 33.09	0.28	2°00′ curve	80
33.09 - 36.02	2.93		150
36.02 - 36.77	0.75	1°00′ curve	113
36.77 - 37.00	0.23		150
37.00 - 38.26	1.26	1°00′ curve	113
38.26 - 40.84	2.58		150
40.84 - 41.17	0.33	1°00′ curve	113
41.17 - 42.93	1.76		150
42.93 - 43.24	0.31	1°00′ curve	113
43.24 - 46.32	3.08		150
46.32 - 46.63	0.31	2°00′ curve	80
46.63 - 46.84	0.21		150
46.84 - 47.14	0.30	2°00′ curve	80
47.14 - 47.36	0.22		150
47.36 - 47.60	0.24	2°00′ curve	80
47.60 - 47.79	0.19		150
47.79 - 48.26	0.47	1°52′ curve	84
48.26 - 49.24	0.98		150
49.24 - 49.80	0.56	3°00′ curve	50
49.80 - 50.19	0.39		150
50.19 - 50.65	0.46	1°55′ curve	83
50.65 - 50.82	0.17		150
50.82 - 51.25	0.43	1°10′ curve	105
51.25 - 52.69	1.44		150

Existing Alignment Scenario
Allowable Speeds
Maximum Speed of 150 MPH
(continued)

Milepost	Route Miles	Restriction	Speed MPH
52.69 - 52.97	0.28	2°30′ curve	72
52.97 - 53.18	0.21		150
53.18 - 53.45	0.27	3°04′ curve	50
53.45 - 53.51	0.06		150
53.51 - 54.00	0.49	3°00′ curve	50
54.00 - 56.04	2.04		150
56.04 - 56.45	0.41	1°00′ curve	113
56.45 - 61.50	5.05		150
61.50 - 61.72	0.22	1°00′ curve	113
61.72 - 62.55	0.83		150
62.55 - 62.66	0.11	1°04′ curve	112
62.66 - 69.03	6.37		150
69.03 - 70.03	1.00	1°00′ curve	113
70.03 - 71.62	1.59		150
71.62 - 73.07	1.45	1°20′ compound curve	99
73.07 - 74.48	1.41		150
74.48 - 74.80	0.32	1°00′ curve	113
74.80 - 81.25	6.45		150
81.25		Yard limits	20

Estimate of Costs
Existing Alignment Scenario
Non-Electrified

Item	Cost Per Mile	Route Miles	Cost
Clearing, grading, drainage, subgrade	$ 73,000	70	$ 5,110,000
Track	850,000	70	59,500,000
Signal	250,000	70	17,500,000
Utility Relocation	214,000	70	14,980,000
Fencing (both sides)	38,000	140	5,320,000
Bridges:			
Grade Separations			19,320,000
Railroad Bridges			16,500,000
Highway Bridges			33,770,000
Misc. Items			6,000,000
Total			178,000,000
+25% Contingency			44,500,[illegible]
Grand Total			$222,500,000

RIGHT-OF-WAY NOT INCLUDED

Electrification Estimate
Existing Alignment Scenario

Item	Cost Per Mile	Cost
Electrification	$700,000	$ 49,000,000
Overhead bridge modification		12,000,000
Total		$ 61,000,000
+25% Contingency		15,250,000
Grand Total		$ 76,250,000

Assumptions and Notes for Estimate
Existing Alignment Scenario

1. Utilized south side of right-of-way as much as deemed feasible, maintaining a minimum of 20 feet from nearest main line where feasible.

2. In general, minimum right-of-way is 100 feet.

3. Speeds based on FRA curve speeds, with 3" unbalanced super elevation.

4. Concrete ties used.

5. No cross-sections were plotted and grading costs are general railroad approved figures.

6. Right-of-way costs are not included.

7. No CSX track relocation costs or retirement of industrial spurs are included.

8. 25% contingency costs are for engineering and ultimate design factors.

9. Signal costs include CSX track changes and traffic control systems.

10. Miscellaneous items include station work, retirement of structures, track drainage facilities, highway relocations, stations and parallel roadways.

11. Estimated costs are based on approved railway procedure.

12. No costs included for stations or terminals.

150 MPH Scenario
Analysis of Problem Areas

M.P. 11.5± - 14.36 - Classification Yards for Old Point Junction in Newport News:
CSX will have to determine if room is available for separate track. From the right-of-way and track map, there is a small area on the south side, east of Mercury Blvd., where there is insufficient room for a third main line.

M.P. 14.24 - Center Av. underpass:
There are four tracks over bridge with approximately 40 feet on south side. Part of the bridge has been retired in place and room is available for an additional track.

M.P. 14.97 - Main St. (Rt. 152) underpass:
There are two tracks over bridge with a portion of bridge retired in place. However, width is insufficient for third main line and will have to be widened or replaced.

M.P. 15.37 - Switch on south side to various facilities:
Business interests will decree whether track can be eliminated.

M.P. 16.53 - End of passing track:
Single track for next 5.9 miles.

M.P. 16.55 - Harpersville Rd. grade crossing:
Traffic control devices consist of automatic flashing light signals with

		short arm gates. Double-track grade separation required.
M.P. 17.55	-	10' brick and concrete arch structure for Causey's Mill Pond: Structure will have to be lengthened or rebuilt for high speed tracks.
M.P. 17.58	-	8' x 8' concrete box underpass: Will have to be lengthened or rebuilt for high speed tracks.
M.P. 17.74	-	J. Clyde Morris Blvd. overpass: A survey will be necessary to determine adequacy of clearance for an additional track.
M.P. 17.67 - 19.52	-	A private road is on south side of right-of-way and would have to be relocated.
M.P. 19.55	-	Private grade crossing: Should be closed and alternate access provided at Bell King Road, M.P. 19.77, including a parallel drive on north side of right-of-way.
M.P. 19.77	-	Bell King Rd.: Recommend an underpass due to close proximity of US Rt. 60. Underpass will have to include CSX main line.
M.P. 20.01 - 20.50	-	Private road on south side of right-of-way will require relocation.

M.P. 20.21 - 20.38	-	0°40′ curve left, 867 feet long: 0°30′ curve can be constructed with minimal effort.
M.P. 20.47	-	Oyster Point Rd. overpass: Adequate room to add a high speed track.
M.P. 20.87	-	12′ concrete arch structure for Deep Creek: Will require lengthening or reconstruction for high speed track.
M.P. 22.0	-	Eastwood Bland Connection Rd. overpass: Should be adequate for an additional high speed track.
M.P. 22.30 - 22.65	-	Private road on south side of right-of-way: Will require relocation.
M.P. 22.41 - 35.24	-	Second main line included on south side
M.P. 22.76	-	Point of switch to two industrial sidings, Nos. 487 and 2921, on south side: Track No. 487 would negate an additional high speed track on south side of right-of-way. Interstate 64 would deter any shifting of track in a northerly direction.
M.P. 22.84	-	Rt. 173 overpass: This structure further complicates the installation of a high speed track, as it spans industrial sidings, Nos. 487 and 2921, as noted at M.P. 22.76.

M.P. 23.3	-	Deck girder bridge over Stony Creek: New single-track structure will be required.
M.P. 25.3	-	Industrial Park Dr. grade crossing: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A grade separation structure will be required.
M.P. 25.51	-	Point of switch to track No. 490: Track retired in place and can be removed.
M.P. 26.00	-	Rt. 105 overpass: Should be adequate for an additional track.
M.P. 26.43	-	12' arch for Warwick River: Will require widening or reconstruction for a high speed track.
M.P. 26.49	-	PS for passing siding No. 493 on south side, length is 5661 feet
M.P. 26.73	-	PS for Ft. Eustis track No. 491 on south side off passing siding No. 493
M.P. 26.83	-	PS for storage track No. 492, length is 3577 feet, on south side off passing siding No. 493
M.P. 27.38	-	PS for track No. 494 off storage track on south side
M.P. 27.52	-	Yorktown Rd. grade crossing: Traffic control devices consist of train activated automatic flashing light

signals. Grade separation structure will be required.

M.P. 27.53 - PS for track No. 495 off south side of passing siding No. 493 with track No. 2104 coming off track No. 495.

M.P. 27.62 - Elmhurst Dr. grade crossing:
Traffic control devices consist of train activated automatic flashing light signals and short arm gates. Grade separation structure will be required.

Note: The section of track from M.P. 26.49 to 27.77 will require additional study to determine if any of sidings Nos. 493, 491, 492, 494, 495, and 2104 can be removed. Also, it will have to be determined if the grade crossings of Yorktown Road and Elmhurst Drive can be combined, thereby closing one crossing and eliminating the need for two new grade separation structures.

M.P. 28.06 - Private grade crossing:
Either alternate access or an underpass will be necessary if required to maintain access.

M.P. 28.33 - 29.16 - 0°44′ curve left:
Any attempt to obtain a 0°30′ curve left will require the relocation of approximately 3000 feet of US Rt. 60.

M.P. 29.86 - 30.23 - 0°56′ curve right:
To obtain a 0°30′ curve would require the relocation of portions of SR 168, the two

		main lines, and Dow Chemical Track No. 2791.
M.P. 30.0 - 30.81	-	Private road on right-of-way will have to be relocated
M.P. 30.60	-	PS to Dow Chemical Track No. 2791, on south side of right-of-way
M.P. 31.92 - 45.83	-	A detailed survey, economical analysis, environmental review, and other impact statements will be required to determine the feasibility of relocation the track in this area to bypass the Williamsburg historical areas and related businesses.
Pro. M.P. 32.26	-	SR 143 interchange
Pro. M.P. 32.70	-	King Creek
Pro. M.P. 33.47	-	Whiteman Swamp Stream
Pro. M.P. 34.00	-	SR 641
Pro. M.P. 34.54	-	Jones Pond
Pro. M.P. 35.42	-	Colonial National Historical Parkway
Pro. M.P. 35.76	-	Stream
Pro. M.P. 36.02	-	SR 716
Pro. M.P. 36.67	-	Queen Creek
Pro. M.P. 37.62	-	SR 143 Interchange
Pro. M.P. 38.11	-	Stream

Pro. M.P. 38.40	-	SR 713
Pro. M.P. 38.76	-	SR 645
Pro. M.P. 39.88	-	Stream
Pro. M.P. 40.08	-	Access to Schenck Estates
Pro. M.P. 40.36	-	SR 602
Pro. M.P. 41.30	-	SR 602
Pro. M.P. 41.87	-	SR 646
Pro. M.P. 43.00	-	Skimino Creek
Pro. M.P. 43.71	-	Unnamed Roadway
Pro. M.P. 44.50	-	Roadway
Pro. M.P. 44.65	-	SR 602
Pro. M.P. 44.85	-	Roadway
M.P. 46.0 - 51.0	-	There are seven curves in this five-mile area, varying from 1°10′ to 3°00′. A detailed survey would be required to determine if it would be economically feasible to realign trackage to have a maximum 0°30′ curve. This is engineeringly feasible but the survey would determine the best alignment.
M.P. 51.02	-	Forge Rd. grade crossing: Traffic control devices consist of train activated automatic flashing light signals

with short arm gates. Double-track grade separation structure will be required.

M.P. 51.0 - 52.0	-	Publicly used road on right-of-way: Right of individuals to use roadway will have to be established and legally dealt with.
M.P. 52.35	-	Rt. 601 underpass: Will have to be lengthened or reconstructed for high speed track.
M.P. 52.51	-	Diascund Creek bridge: Single-track bridge will be required for high speed track.
M.P. 52.69 - 55.49	-	Engineeringly feasible to realign trackage to have a maximum of 0°30′ curve replacing the three curves of 2°30′, 3°00′, and 3°04′, thereby allowing an operating speed of 150 mph. A detailed survey will be required to determine economical feasibility.
M.P. 55.49	-	Private grade crossing to Chickahominy Lake: Investigate alternate access.
M.P. 56.04 - 56.45	-	1°00′ curve left: Any potential CSX shift would be minimal due to location of US Rt. 60 on the north side. A 0°30′ curve can be constructed on south side of right-of-way without disturbing CSX track.
M.P. 56.57	-	Private grade crossing: There does not appear to be an alternate

access. An underpass will be required, if access deemed necessary, due to close proximity of US Rt. 60 on north side.

M.P. 56.93	-	Private grade crossing: There does not appear to be an alternate access unless a parallel access road is constructed.
M.P. 57.08	-	Brick arch and 96" liner plate: Both drainage structures will have to be lengthened.
M.P. 57.15	-	Public grade crossing, SR 647, leading to Osborn Landing: Access will have to be maintained.
M.P. 57.35	-	Private grade crossing leading to several houses: Access will have to be maintained.
M.P. 57.70	-	Rt. 650 grade crossing: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. Access will have to be maintained with a grade separation structure.
M.P. 57.95	-	Private grade crossing: No alternate access available.
M.P. 57.86 - 58.14	-	0°30′ curve right: No problem.
M.P. 58.55	-	Private grade crossing to state game farm: Access will have to be maintained.

M.P. 58.65 - 61.13	-	Double track
M.P. 58.72	-	Private grade crossing: No alternate access available. Note: The private and public grade crossings at M.P. 56.57, 56.93, 57.15, 57.35, 57.70, 57.95, 58.55, and 58.72 could be consolidated with one underpass if a parallel access road could be constructed. The structure would have to be an underpass due to the close proximity of US Rt. 60.
M.P. 59.27 - 59.42	-	0°30′ curve left: No problem.
M.P. 59.93	-	PS to track No. 534 (passing track) on south side, length is 5805 feet: (To stay on right-of-way, track No. 534 will have to be eliminated.)
M.P. 60.12	-	Private farm crossing: Alternate access may be available.
M.P. 60.53 - 60.74	-	0°20′ curve left: No problem.
M.P. 60.80	-	Rt. 602 grade crossing: Traffic control devices consist of passive warning signs. A single-track grade separation structure will be required.
M.P. 60.98	-	PS for track No. 536 on south side: Two additional industry tracks, Nos. 2869 and 2939, lead from track No. 536.

M.P. 61.13 - 76.20	-	Single track
M.P. 61.27	-	SR 155 grade crossing: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A grade separation structure will be required. The structure could be used to close the Rt. 602 grade crossing at M.P. 60.80.
M.P. 61.54	-	Deck plate girder bridge over Jones Run (Mill Tail Creek): A new single-track railroad bridge will have to be constructed. Private under-grade access will have to be included.
M.P. 61.80	-	Private grade crossing: Alternate access from SR 618 available. Serves one house only.
M.P. 61.50 - 61.72	-	1°00′ curve right: Any reduction of curvature would not be feasible on either side as curve is in the center of the town of Providence Forge.
M.P. 61.95	-	Concrete arch with pipe liner, length is 71 feet, will have to be lengthened
M.P. 62.32	-	Rt. 618 grade crossing: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A double-track underpass will be required due to close proximity of US Rt. 60.

M.P. 62.55 - 62.66	-	1°04′ curve left: It would be feasible to design a 0°30′ curve. Terrain conducive to this and will stay on right-of-way.
M.P. 62.85	-	Private grade crossing, serving two families: No alternate access available but could be connected to Rt. 618.
M.P. 63.64	-	Private grade crossing: No alternate access available. An underpass will probably be required if access deemed necessary.
M.P. 63.99	-	Bridge over Schiminoe Creek: A single-track railroad bridge will be required.
M.P. 64.01	-	PS for industrial track No. 3009 on south side, length is 1171 feet: Railroad will have to determine if track is necessary.
M.P. 64.27	-	SR 615 grade crossing: Traffic control devices consist of passive warning signs. A two-track grade separation structure may be required.
M.P. 64.41 - 64.74	-	Private road on south side of right-of-way
M.P. 65.36 - 65.86	-	Five bridges over branches of the Chickahominy River. A new single-track bridge will be required for each branch if branches cannot be consolidated.

M.P. 66.04	-	PS to industrial track No. 542 on south side, length is 747 feet: Railroad will have to determine if track can be retired.
M.P. 66.20	-	Bridge over Opossum Creek: A new single-track railroad bridge will be required.
M.P. 66.45	-	SR 609 grade crossing: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A double-track grade separation structure will be required.
M.P. 66.99	-	SR 106 grade crossing: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A grade separation structure could be combined with the SR 609 facility at M.P. 66.45.
M.P. 66.94 - 67.48	-	0°30′ curve: No problem.
M.P. 67.75	-	Private grade crossing: No alternate access available but appears feasible from Rt. 600 on north side of right-of-way.
M.P. 68.55	-	Private grade crossing: No alternate access available. Double-track grade separation required if access deemed necessary.

M.P. 69.03 - 70.03 - 1°00′ curve left:
Terrain not conducive to reducing curvature.

M.P. 69.25 - Private grade crossing:
No alternate access available. Double-track grade separation required if access deemed necessary.

M.P. 69.68 - Double concrete arch, length is 36.5 feet:
Will need lengthening or a new single-track bridge constructed.

M.P. 70.05 - Bridge over creek:
New single-track structure will be required.

M.P. 70.15 - Bridge over White Oak Swamp:
New single-track structure will be required.

M.P. 71.26 - White Oak Rd. (Rt. 156) grade crossing:
Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A double-track grade separation structure will be required.

M.P. 71.43 - 10′ concrete flat top culvert:
New structure will be required

M.P. 71.71 - 6′ rail top culvert:
New structure will be required.

M.P. 71.62 - 73.07 - 0°40′ curve right:
Not feasible to reduce curvature unless all tracks are relocated in a northerly

direction. Terrain does not appear conducive for such a shift.

M.P. 72.78 - Bridge over White Oak Swamp: A new single-track structure will be required for a high speed track.

M.P. 73.26 - Bridge over White Oak Swamp: A new single-track structure will be required for a high speed track.

M.P. 73.87 - Bridge over White Oak Swamp: A new single-track structure will be required for a high speed track.

Note: There is a potential to either relocate the channel for White Oak Swamp in a northerly direction or keep track south of the loop made by the stream, thereby eliminating the need for structures at M.P. 73.26 and 73.87.

M.P. 74.47 - 74.80 - 1°00′ curve left: A 0°30′ curve may be constructed if a survey indicates minimal disruption in the Village of Poplar Springs.

M.P. 74.68 - Poplar Springs Rd. grade crossing: Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A two-track grade separation structure will be required.

M.P. 74.88 - Bridge over White Oak Swamp: A new single-track structure will be required for a high speed track.

M.P. 75.36 - Private grade crossing to Henrico County police shooting range:
Access will have to be maintained. Recommend a two-track underpass in line with La France Road approximately 500 feet west of existing crossing, due to Richmond drag strip complex.

M.P. 76.20 - 81.39 - Double track to beginning of Fulton Yard in Richmond and the end of this study

M.P. 76.21 - I-295 overpass:
Appears feasible for a high speed track.

M.P. 76.82 - Beulah Rd. grade crossing:
Traffic control devices consist of train activated automatic flashing light signals with short arm gates. Richmond International airport on north side of track. A three-track grade separation structure will be required if closure not feasible.

M.P. 77.93 - 78.12 - Roadway on south side of right-of-way:
Appears feasible to remove, if deemed necessary.

M.P. 78.40 - Charles City Rd. grade crossing:
Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A single-track grade separation structure will be required.

M.P. 78.48 - PS to industrial track No.3049:
Railroad will determine if business is adequate to maintain service. Also,

industrial track Nos. 3050, 3051, and 3057 go off track No. 3049.

M.P. 79.00 - Miller Rd. grade crossing:
Traffic control devices consist of train activated automatic flashing light signals with short arm gates. A single-track grade separation structure will be required if access at this location is deemed necessary. Recommend closure.

M.P. 79.24 - Laburnum Av. overpass:
Ample room for an additional track on south side but may require some track realignment.

M.P. 79.50 - PS for industrial track No. 3001 on south side, includes switches to industrial track Nos. 3002 and 3003:
Railroad will have to determine if traffic is sufficient to maintain service.

M.P. 79.65 - PS for industrial track No. 2969 on south side leading into several tracks for A. H. Robins Company facilities

M.P. 80.59 - 80.69 - 2°00′ curve left:
In yard limits and not feasible to deduce curvature.

M.P. 80.91 - 8′ brick arch (Almond Creek), length is 126 feet:
Appears adequate for additional high speed track.

M.P. 80.97 - Darbytown Rd. overpass:
Adequate room for high speed track but may require some realignment of CSX trackage.

M.P. 81.38 - Undergrade highway crossing:
Adequate room for high speed track but may require some realignment of CSX trackage.

Estimate of Costs
150 MPH Scenario
Non-Electrified

Item	Cost per Mile On R/W	Cost per Mile Off R/W	On R/W 62.2 Miles	Off R/W 7.80 Miles
Clearing, grading drainage, subgrade	$ 73,000	$138,500	$ 4,500,600	$ 1,080,300
Track	850,000	850,000	52,870,000	6,630,000
Signal	250,000	250,000	15,550,000	1,950,000
Utility Relocation	214,000	13,400	13,310,800	104,500
Fencing (Both sides)	38,000	38,000	4,727,200	592,800
Bridges:				
Grade Separations			24,680,000	
Railroad Bridges			16,500,000	
Highway Bridges			33,770,000	
Misc. Items			13,050,000	
			$165,948,000	$ 10,357,600
Total				$176,306,200
25% Contingency				44,076,600
Grand Total				$220,382,800

RIGHT-OF-WAY NOT INCLUDED

Electrification Estimate
150 MPH Scenario

Item	Cost per Mile	On R/W 62.2 Miles	Off R/W 7.80 Miles
Electrification	$700,000	$43,540,000	$5,460,000
Overhead Bridge Modification		12,000,000	___
		$55,540,000	$5,460,000
Total		$61,000,000	
25% Contingency		15,250,000	
Grand Total		$76,250,000	

Summary

In this preliminary engineering feasibility study of a high speed track between Richmond and Newport News, two separate scenarios were reviewed, which have been referred to as the existing alignment scenario and the 150 MPH scenario, both shown and supported on attached sketches 1-19. The existing alignment scenario is estimated to cost $222,500,000 non-electrified, or $298,750,000 electrified. The 150 MPH scenario is estimated to cost $220,382,000 non-electrified, or $296,632,800 electrified. As may be noted, the estimated costs are virtually the same, and the main difference will be the cost of additional right-of-way. As may be noted on pages 39, 40, and 41 of this report, there are three areas where alignment relocation will eliminate much of the speed restrictions. These are between mileposts 31.92 and 45.83, mileposts 46.0 and 51.0, and mileposts 52.69 and 55.49. Much of the required right-of-way between mileposts 31.92 and 45.83 necessary to bypass the Williamsburg metropolitan area may be on state property, namely adjacent to Interstate 64 and other state highways.

Current and future legal and economic restrictions will ultimately determine which of the two scenarios will be the most desirable. From an engineering standpoint, both schemes will be feasible.

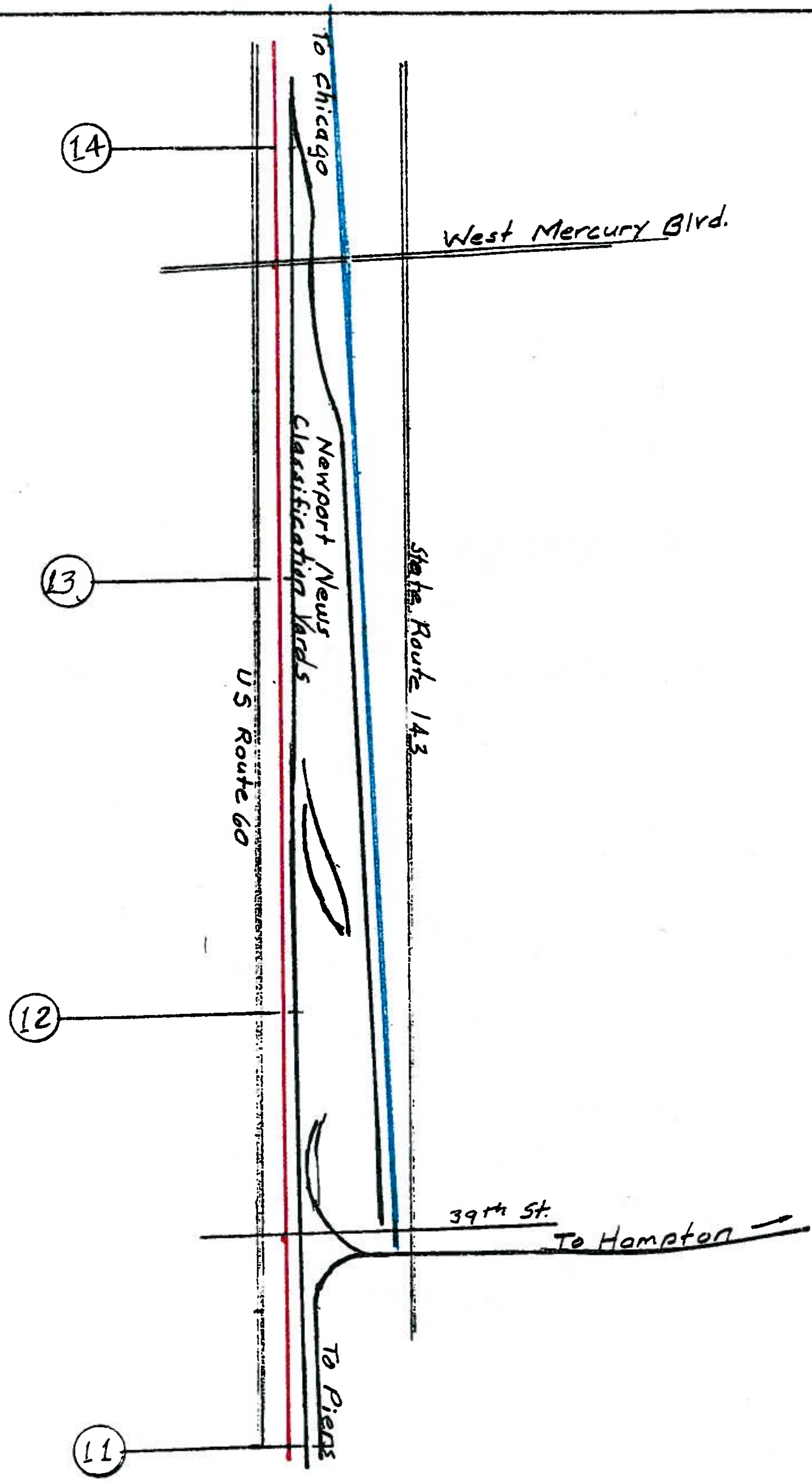
Proposed High Speed Passenger Track
Richmond, Virginia, to Newport News, Virginia
September 1993

Legend

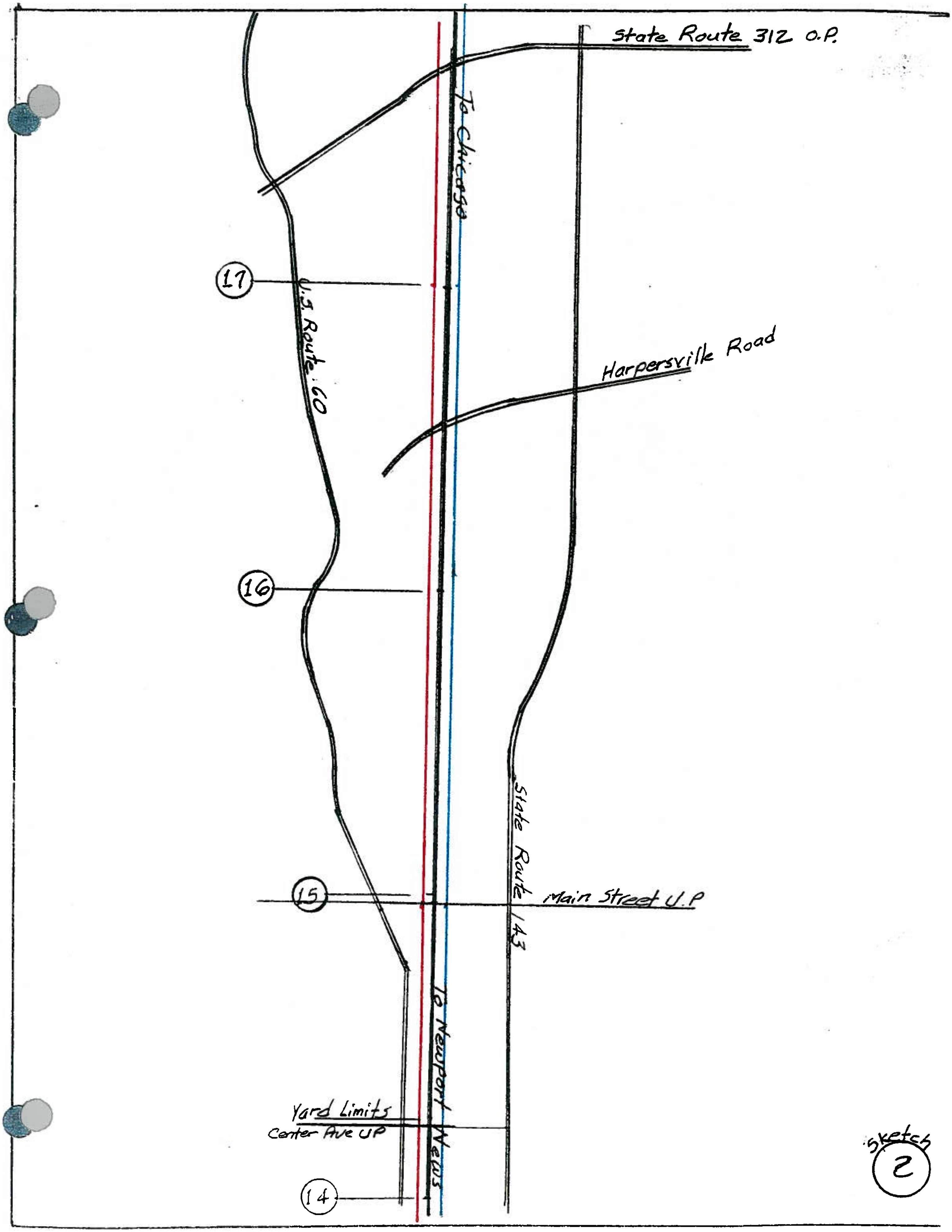
Additional High Speed Track
Existing Alignment Scenario

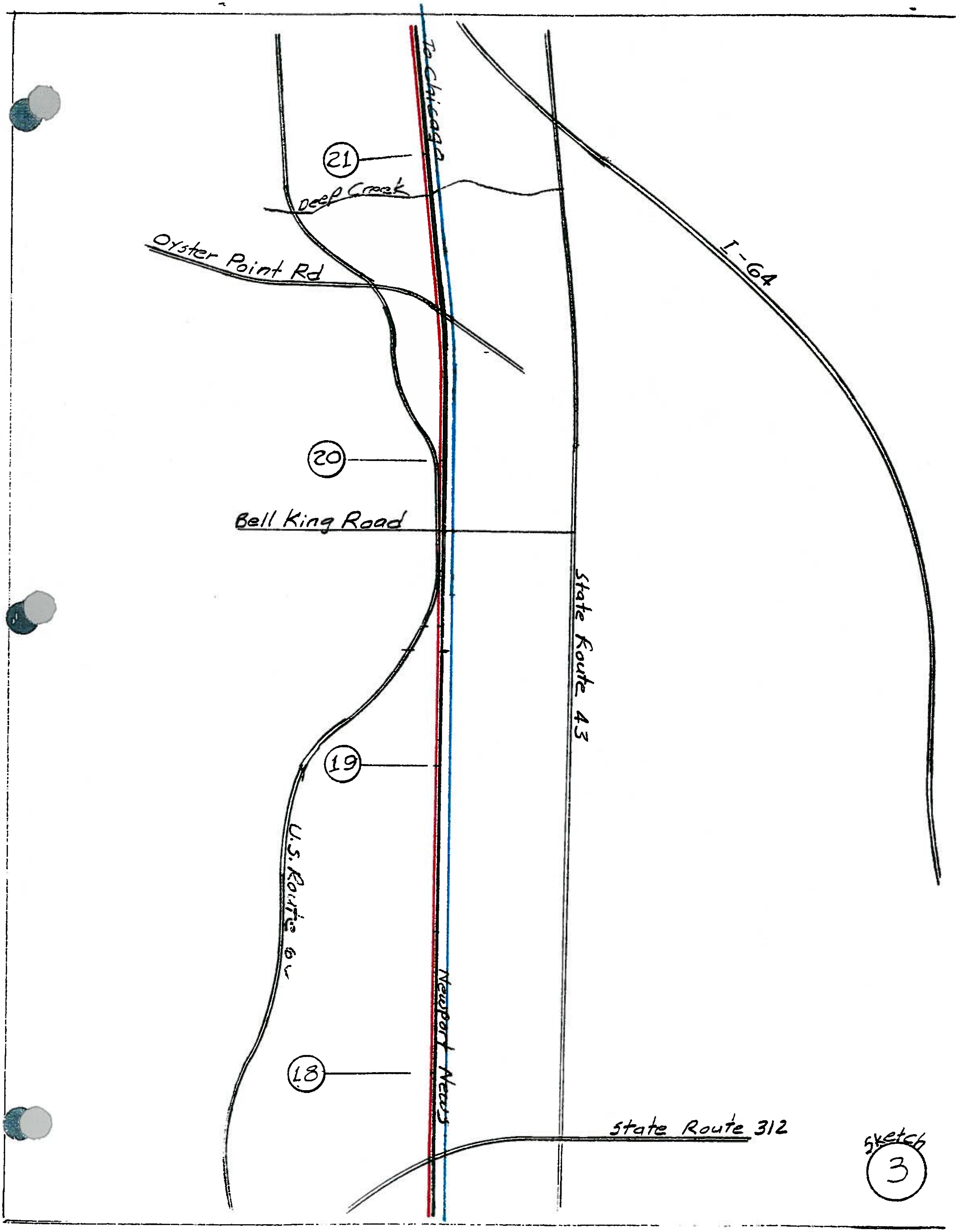
Additional High Speed Track
150 MPH Scenario

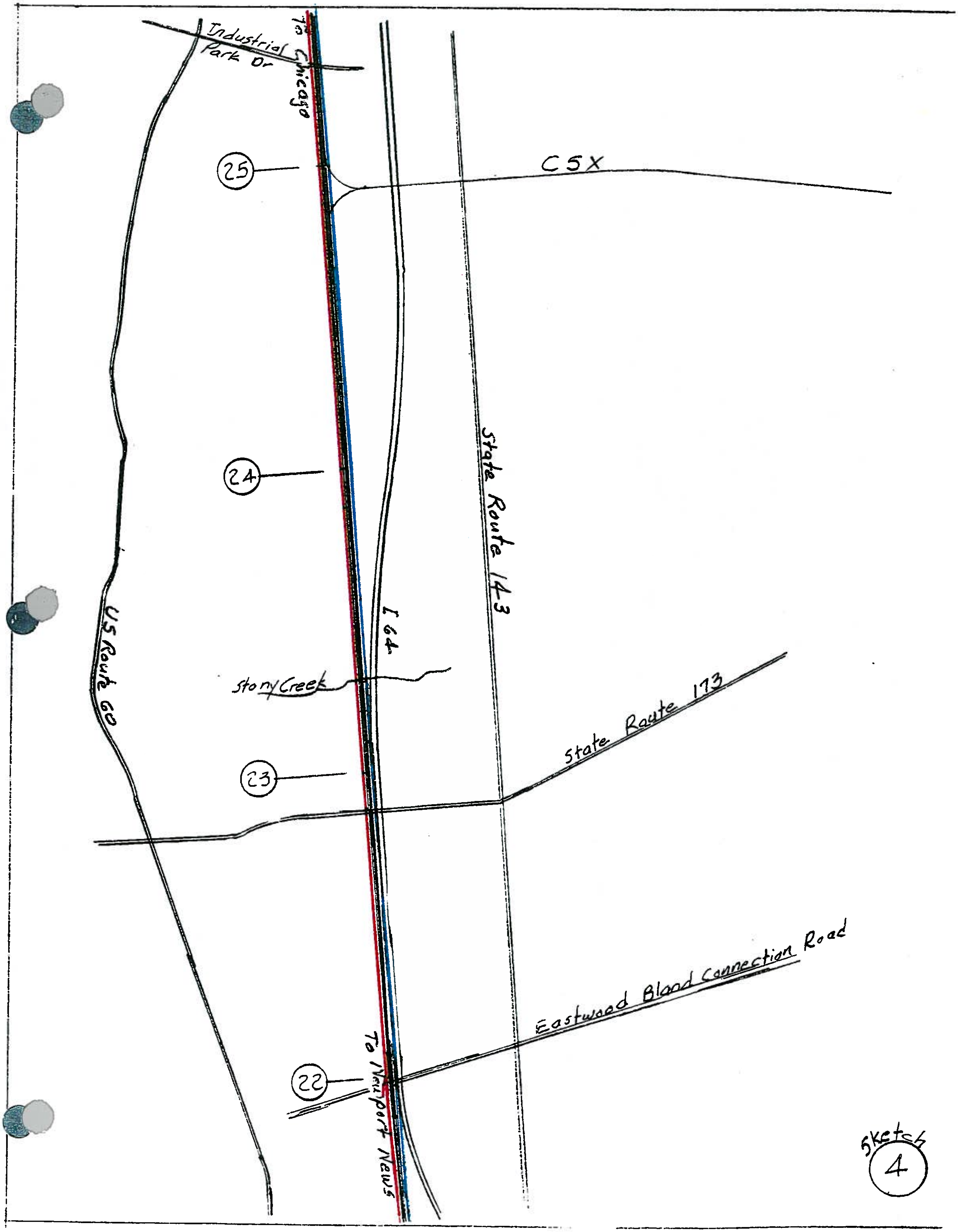
Existing Main Line


14
To Chicago
West Mercury Blvd.
13
Newport News Classification Yards
State Route 143
US Route 60
12
39th St.
To Hampton
To Piers
11

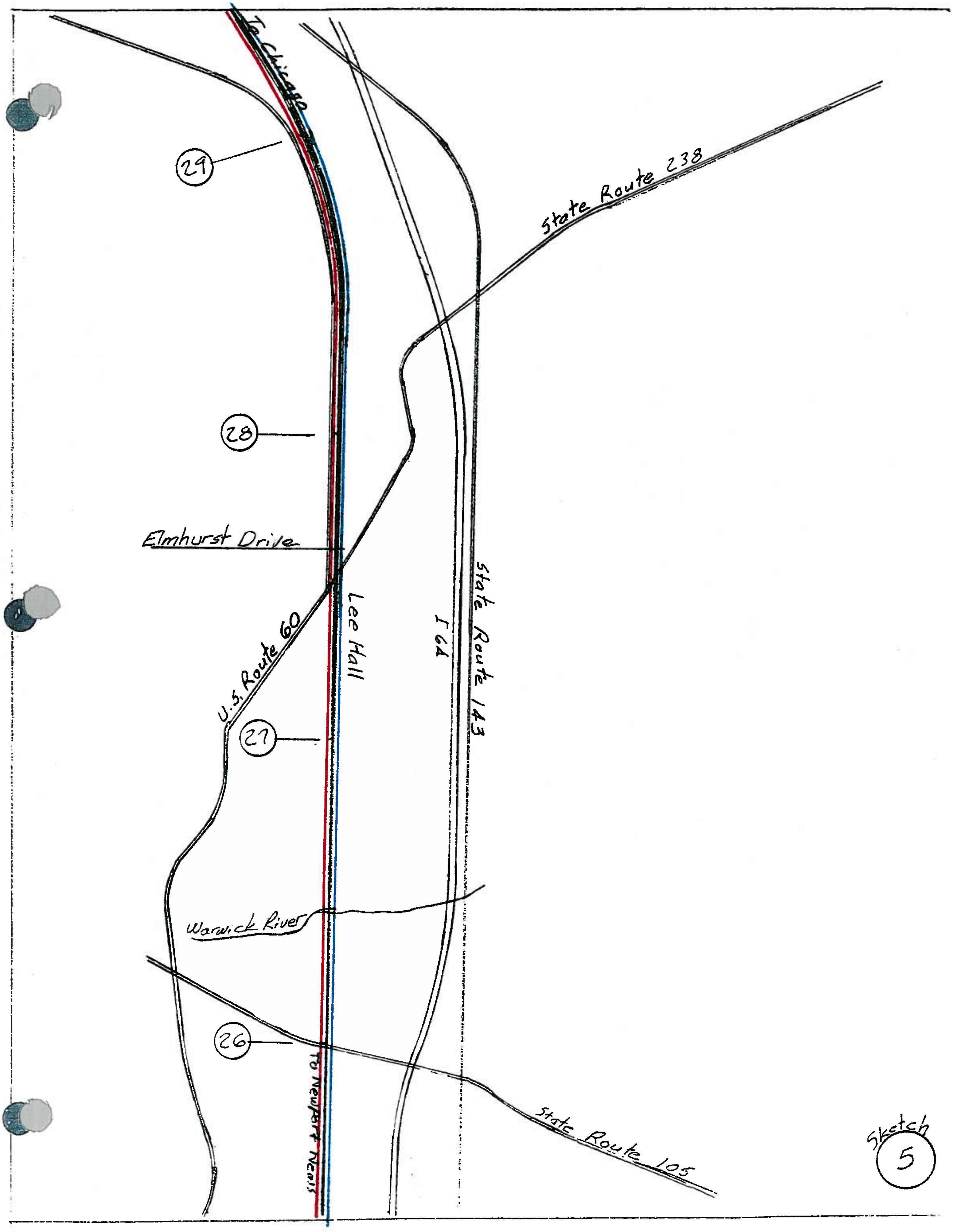
Sketch 1


State Route 312 O.P.
To Chicago
17
U.S. Route 60
Harpersville Road
16
15
Main Street U.P
State Route 143
To Newport News
Yard Limits
Center Ave UP
14
Sketch
2

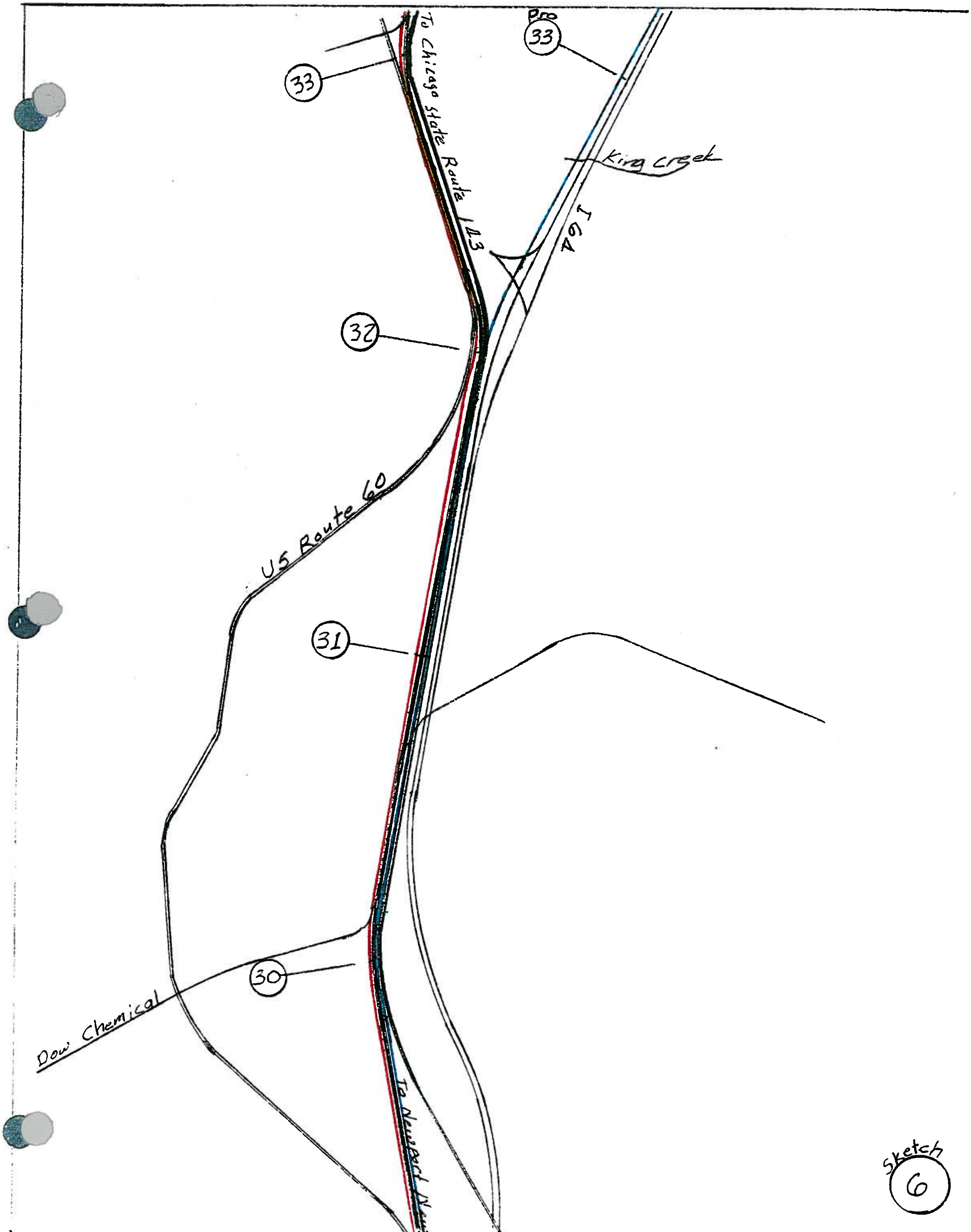

To Chicago
21
Deep Creek
Oyster Point Rd
I-64
20
Bell King Road
State Route 43
19
U.S. Route 60
18
Newport News
State Route 312
sketch
3



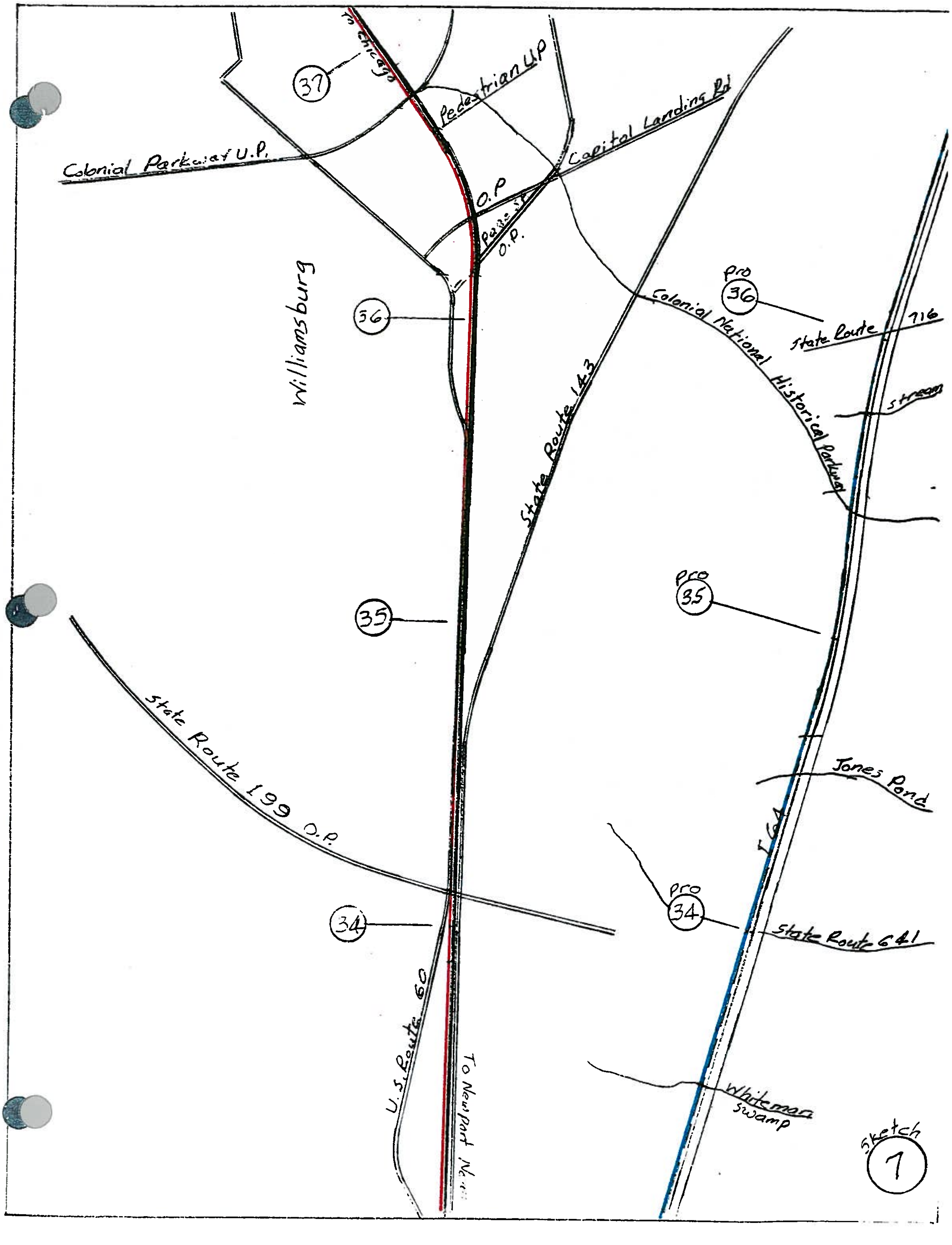
Industrial Park Dr
To Chicago
25
CSX
24
State Route 143
I 64
US Route 60
Stony Creek
State Route 173
23
Eastwood Bland Connection Road
To Newport News
22
Sketch 4



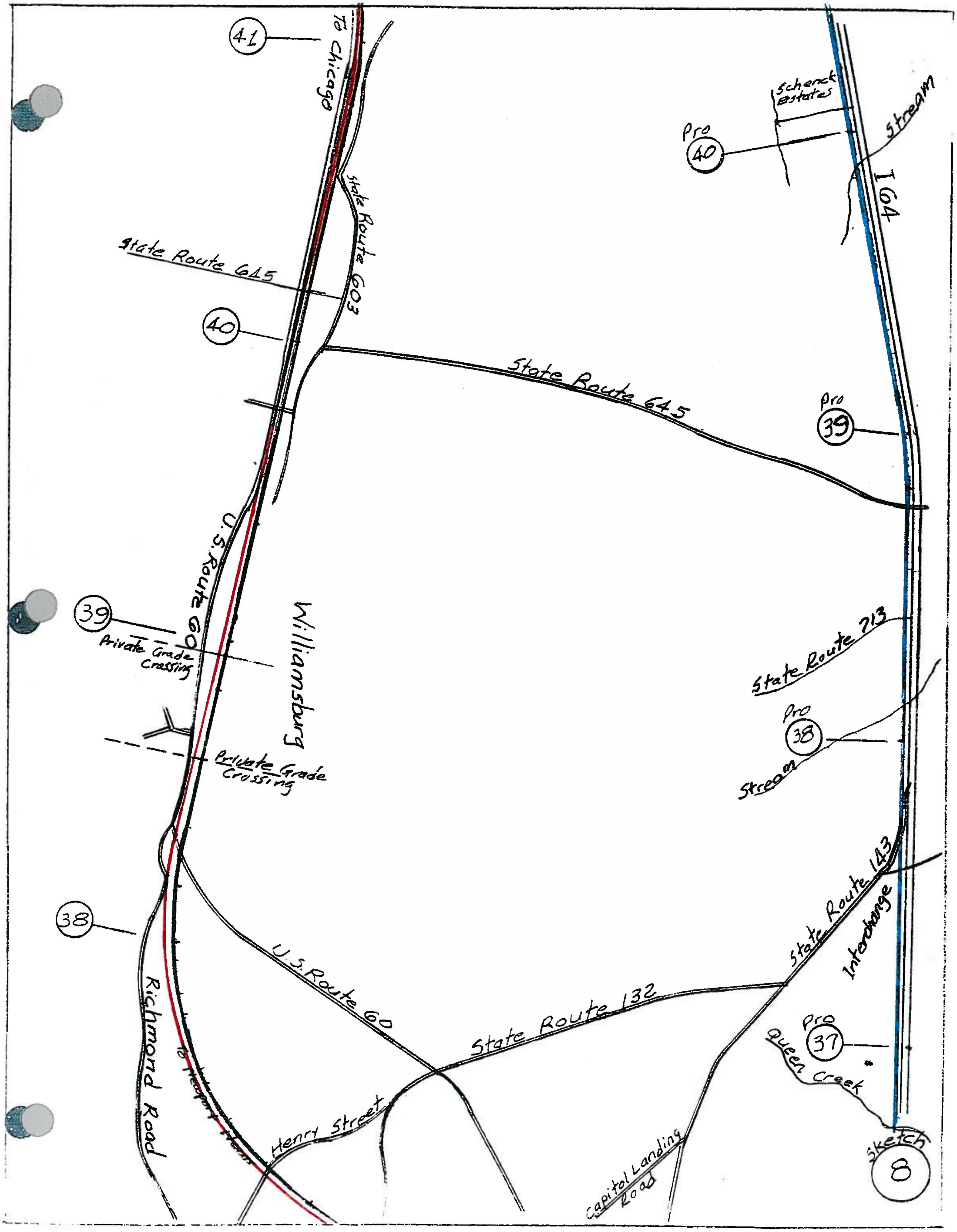
To Chicago
29
State Route 238
28
Elmhurst Drive
Lee Hall
I 64
State Route 143
U.S. Route 60
27
Warwick River
26
To Newport News
State Route 105
Sketch
5

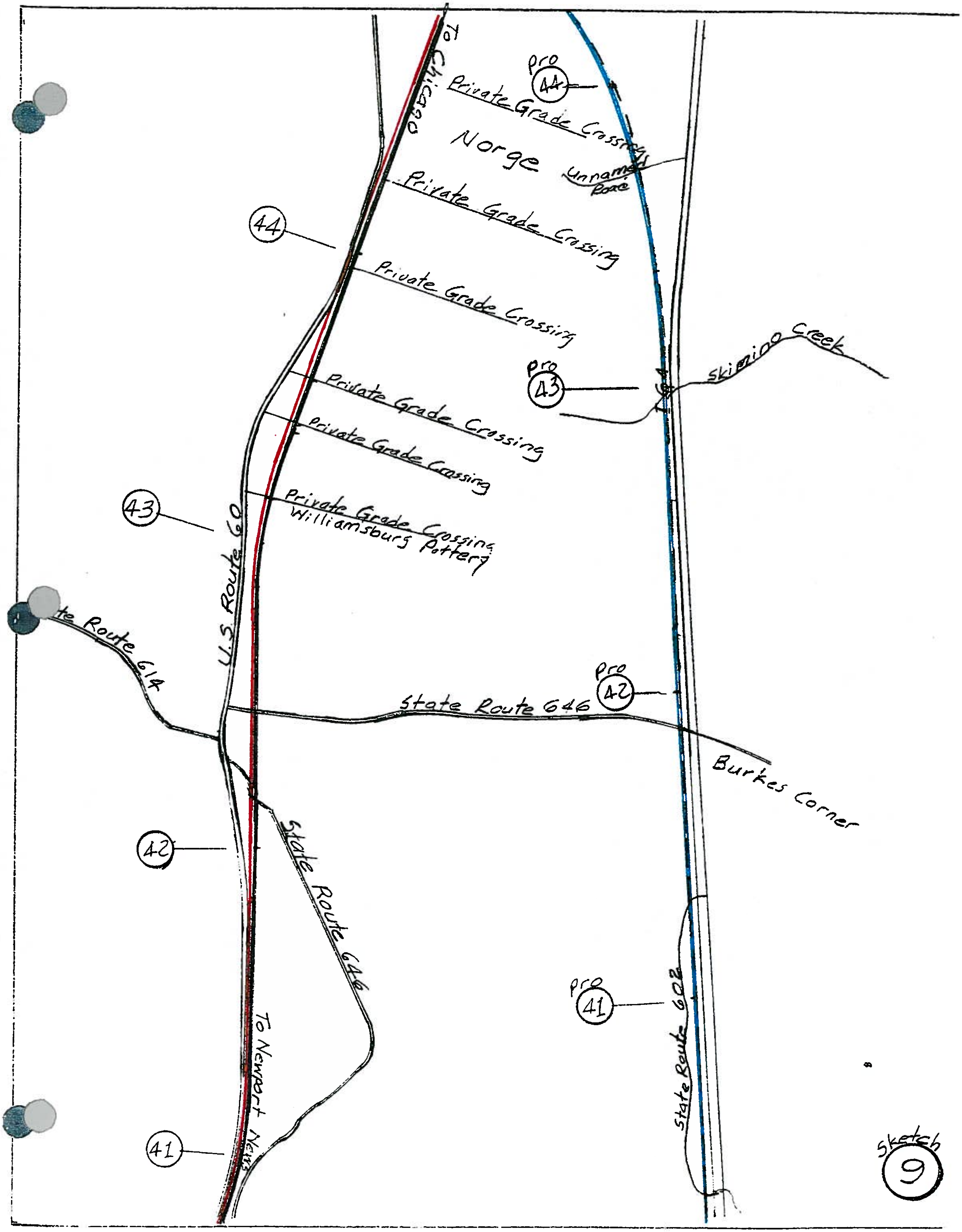


Pro
33
33
To Chicago state Route 113
King creek
I 64
32
US Route 60
31
30
Dow Chemical
To Newport
Sketch 6

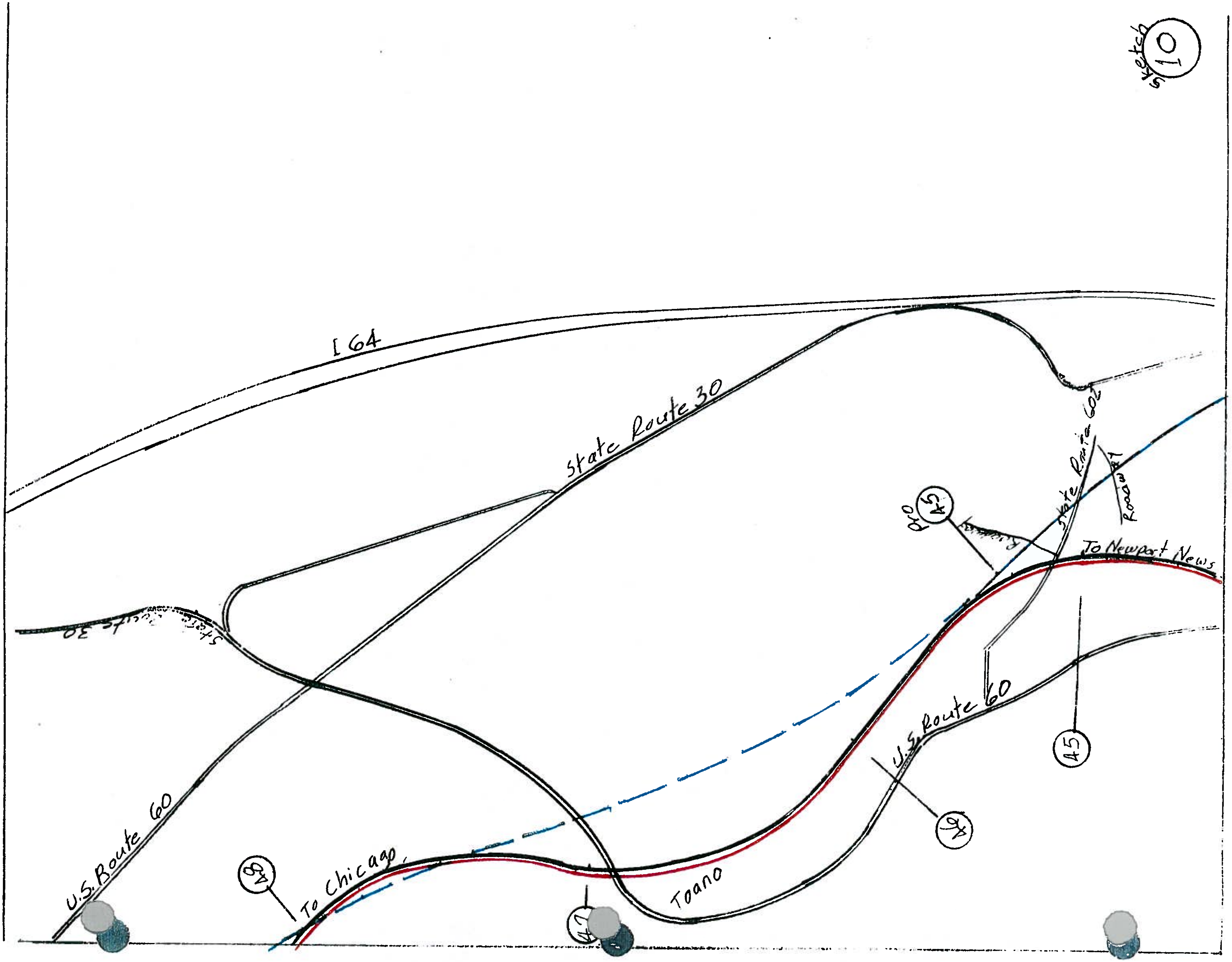


To Chicago
37
Pedestrian U.P
Capitol Landing Rd
Colonial Parkway U.P.
O.P
Page St
O.P.
Williamsburg
56
pro
36
Colonial National Historical Parkway
State Route 716
State Route 143
stream
pro
35
35
State Route 199 O.P.
Jones Pond
I-64
pro
34
34
State Route 641
U.S. Route 60
To Newport N
Whiteman swamp
Sketch
7

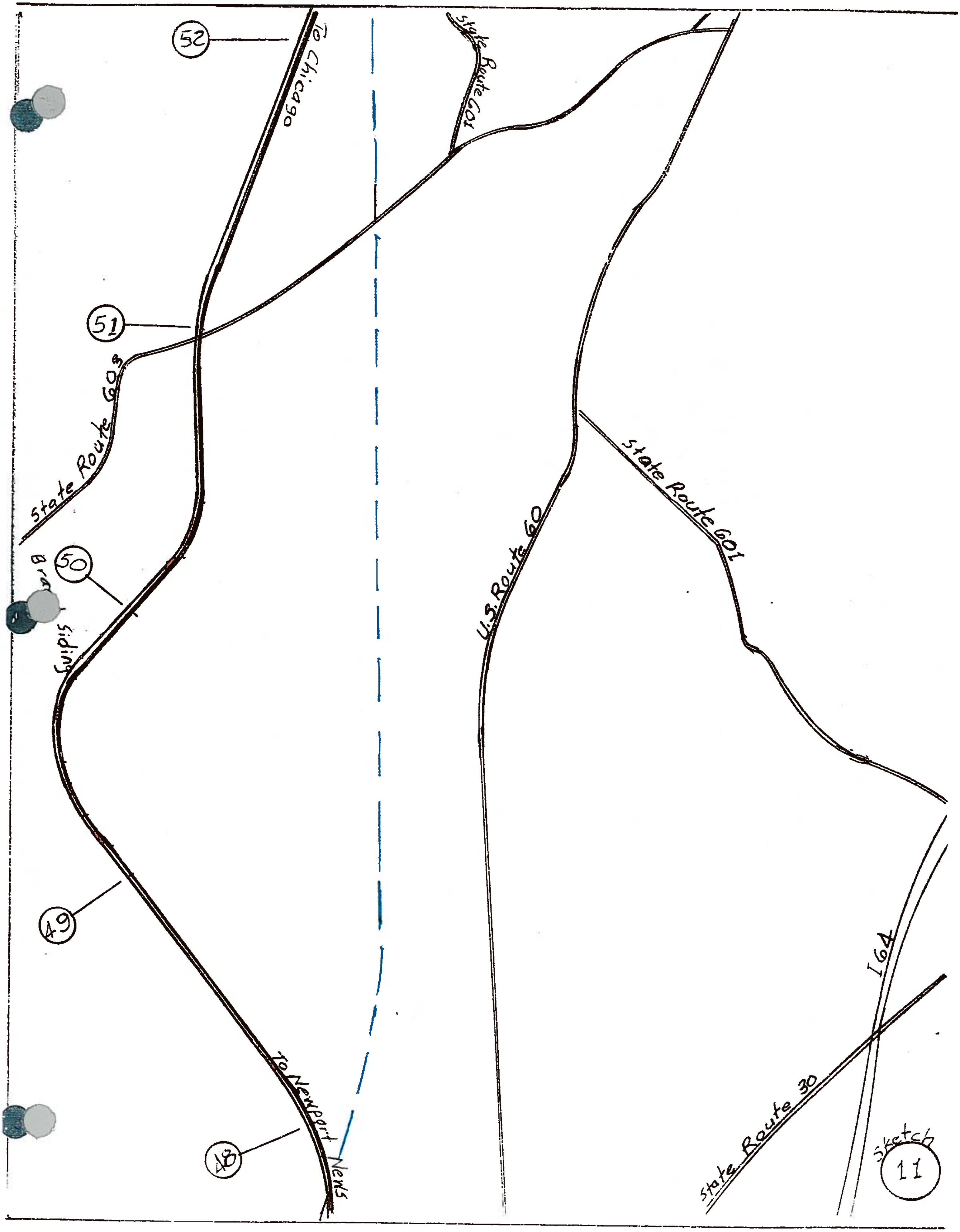

41
To Chicago
State Route 615
State Route 603
40
State Route 645
Pro
39
Schenck Estates
Pro
40
Stream
I 64
39
Private Grade Crossing
U.S. Route 60
Williamsburg
Private Grade Crossing
State Route 713
Pro
38
Stream
38
Richmond Road
U.S. Route 60
State Route 132
State Route 143
Interchange
Pro
37
Queen Creek
Henry Street
Capitol Landing Road
Sketch
8

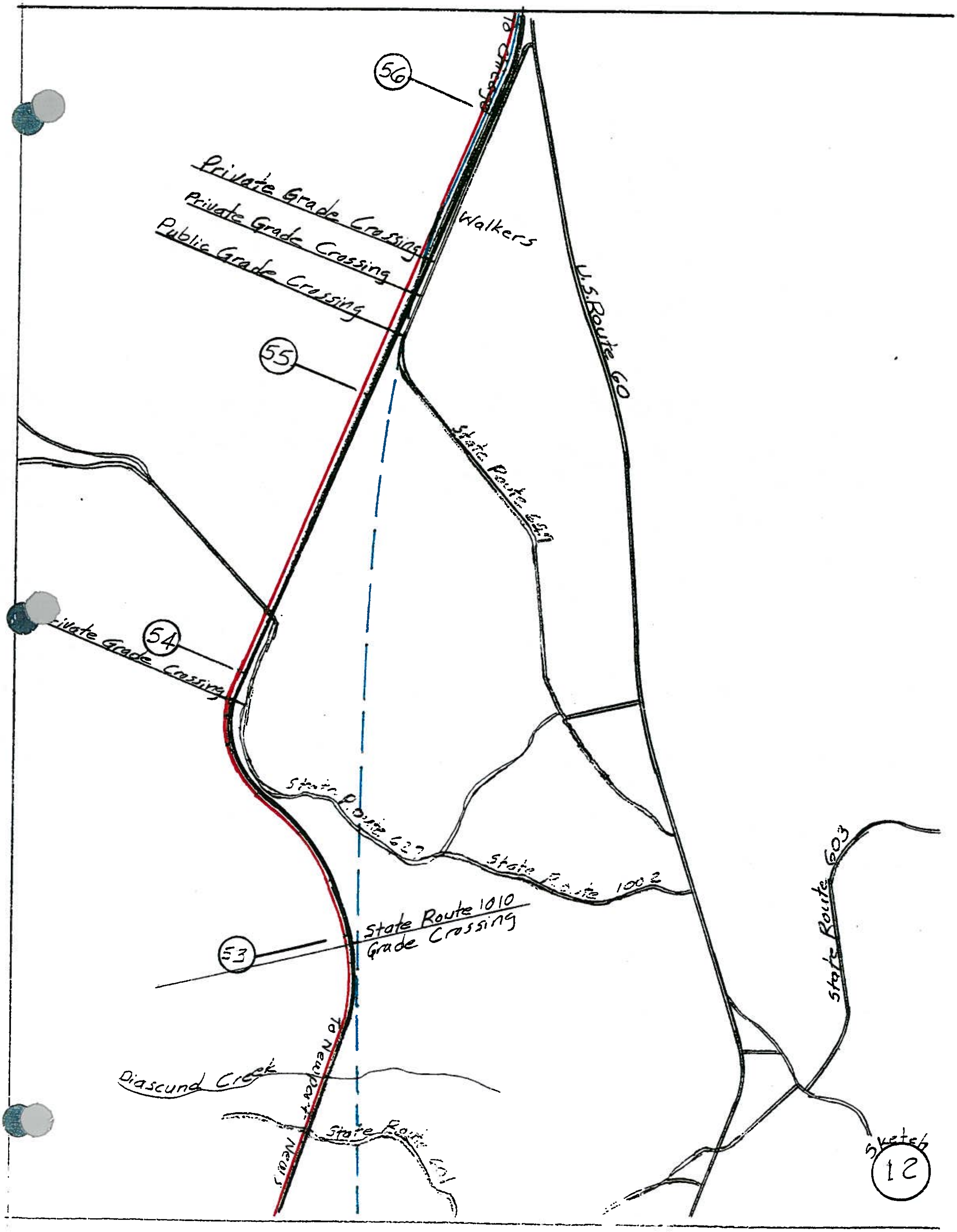


To Chicago
Pro 44
Private Grade Crossing
Norge
Unnamed Road
Private Grade Crossing
44
Private Grade Crossing
Skimino Creek
Pro 43
I-64
Private Grade Crossing
Private Grade Crossing
43
Private Grade Crossing
Williamsburg Pottery
U.S. Route 60
State Route 614
Pro 42
State Route 646
Burkes Corner
42
State Route 646
Pro 41
State Route 602
To Newport News
41
Sketch 9

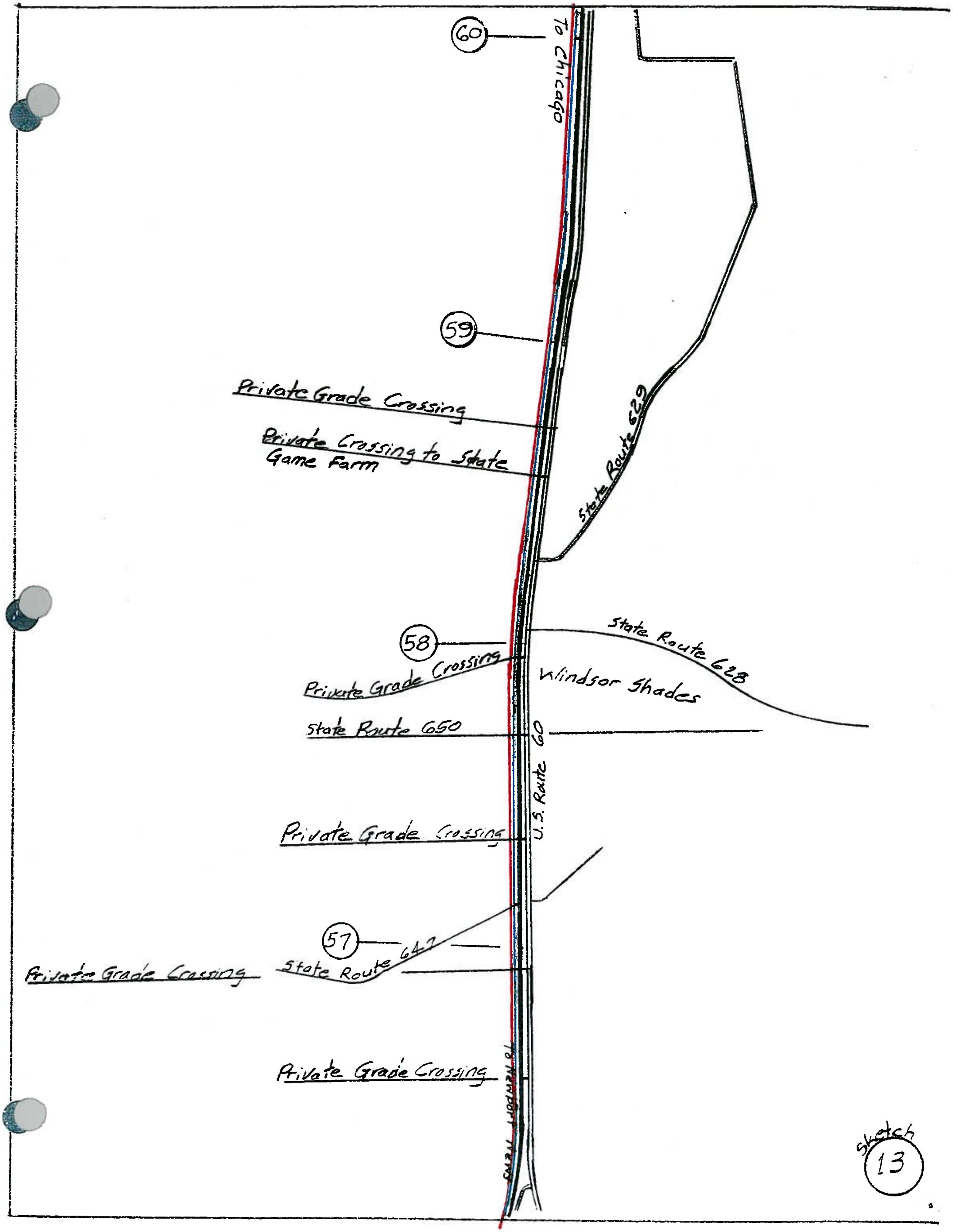


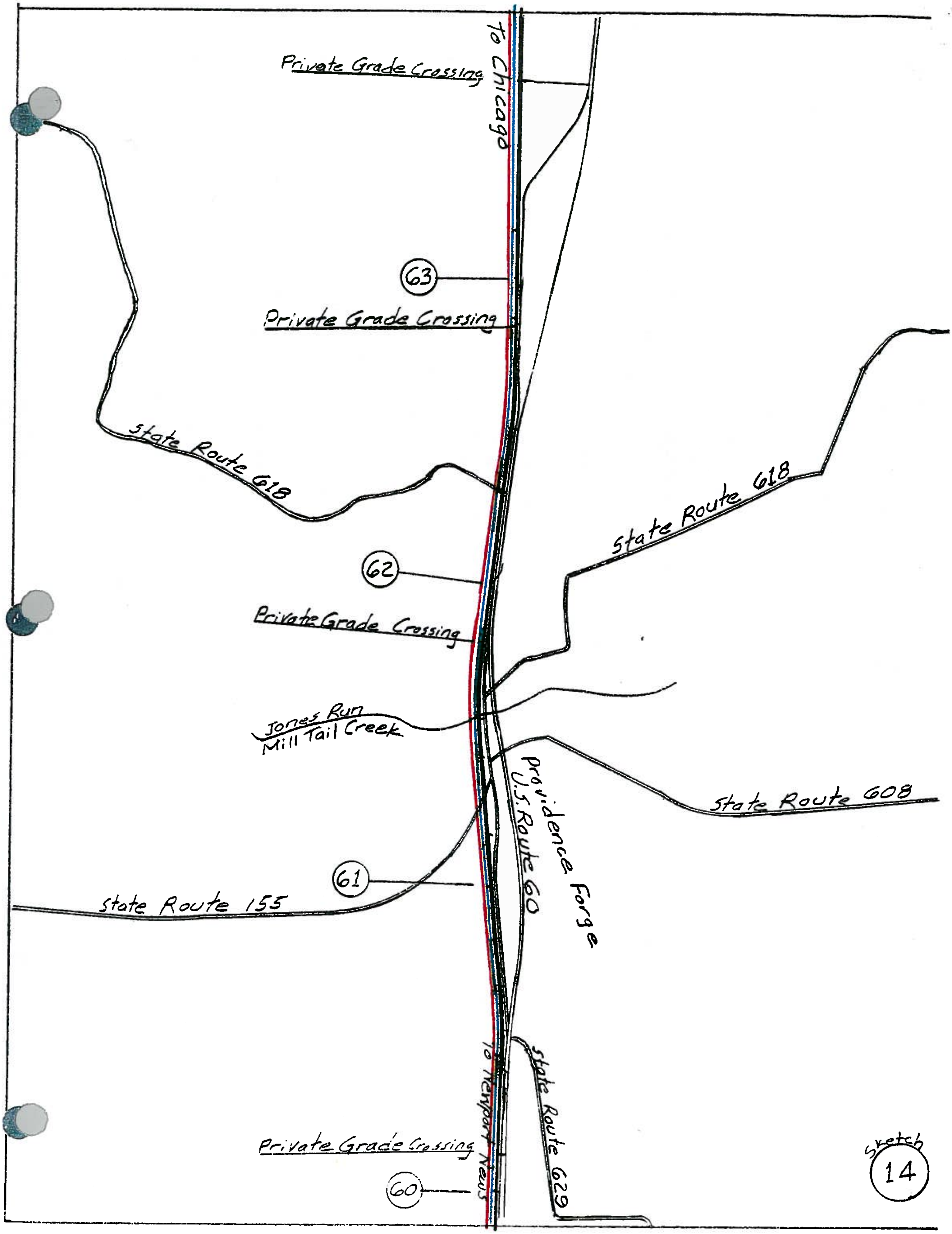
Sketch 10
I 64
State Route 30
U.S. Route 60
48
To Chicago
47
Toano
46
U.S. Route 60
45
Pro 45
State Route 602
Roadway
To Newport News

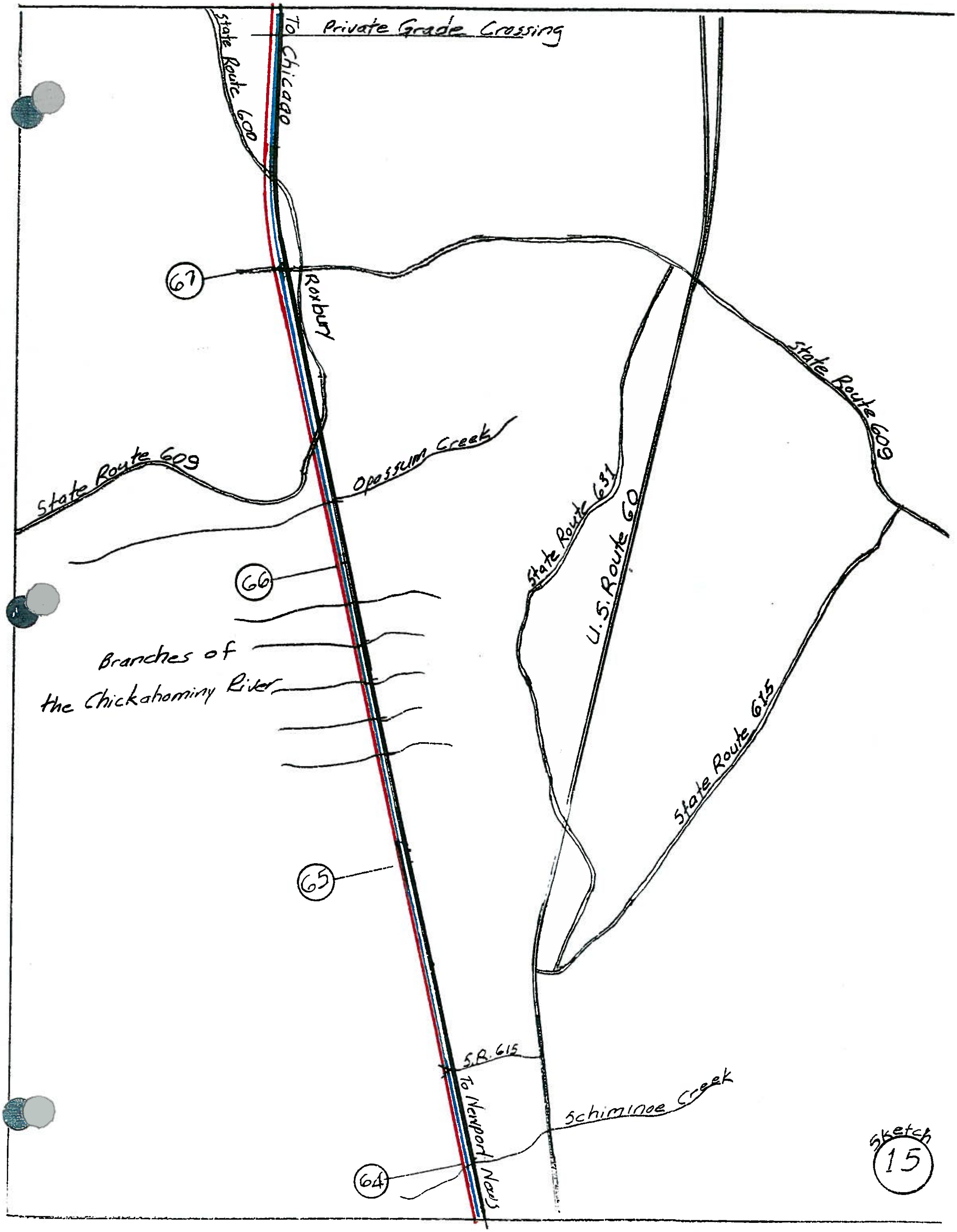

52
To Chicago
State Route 601
51
State Route 603
50
Bra
Siding
49
To Newport News
48
U.S. Route 60
State Route 601
I 64
State Route 30
Sketch
11

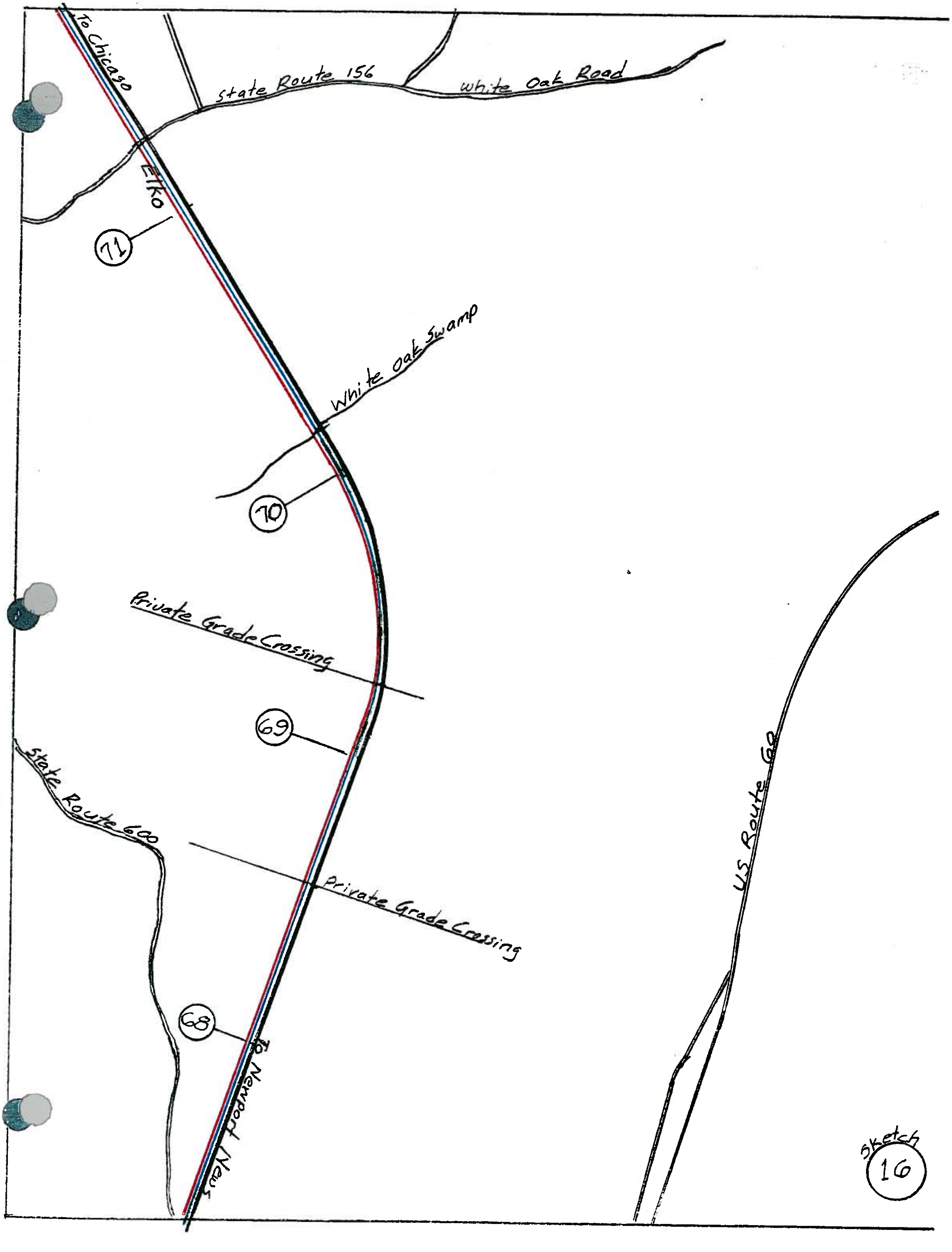


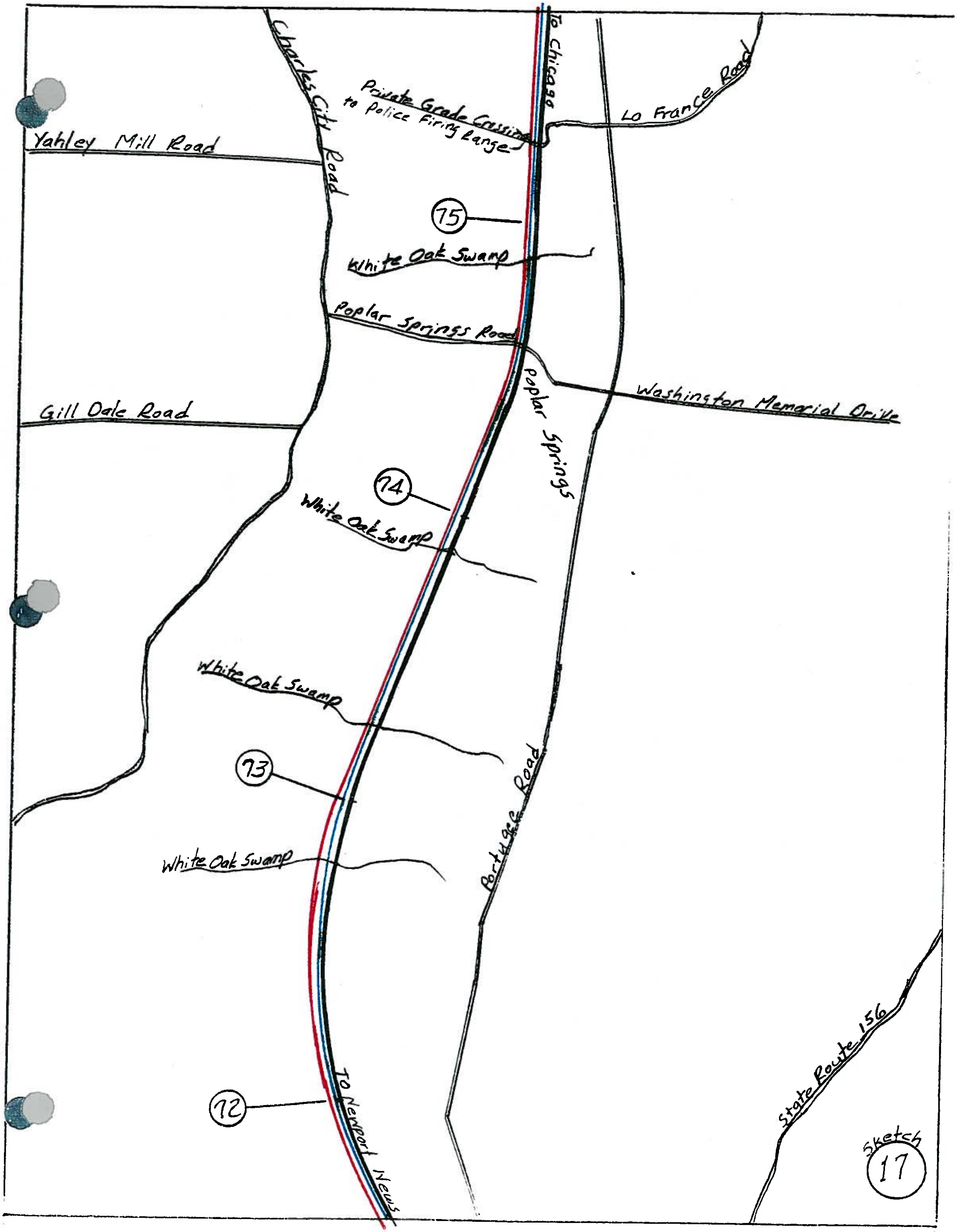
to Chicago
56
Private Grade Crossing
Private Grade Crossing
Public Grade Crossing
Walkers
U.S. Route 60
55
State Route 659
Private Grade Crossing
54
State Route 627
State Route 1002
State Route 1010
Grade Crossing
53
State Route 603
to Newport News
Diascund Creek
State Route 601
Sketch
12


60
To Chicago
59
Private Grade Crossing
Private Crossing to State Game Farm
State Route 629
58
State Route 628
Private Grade Crossing
Windsor Shades
State Route 650
U.S. Route 60
Private Grade Crossing
57
State Route 647
Private Grade Crossing
Private Grade Crossing
To Newport News
Sketch 13

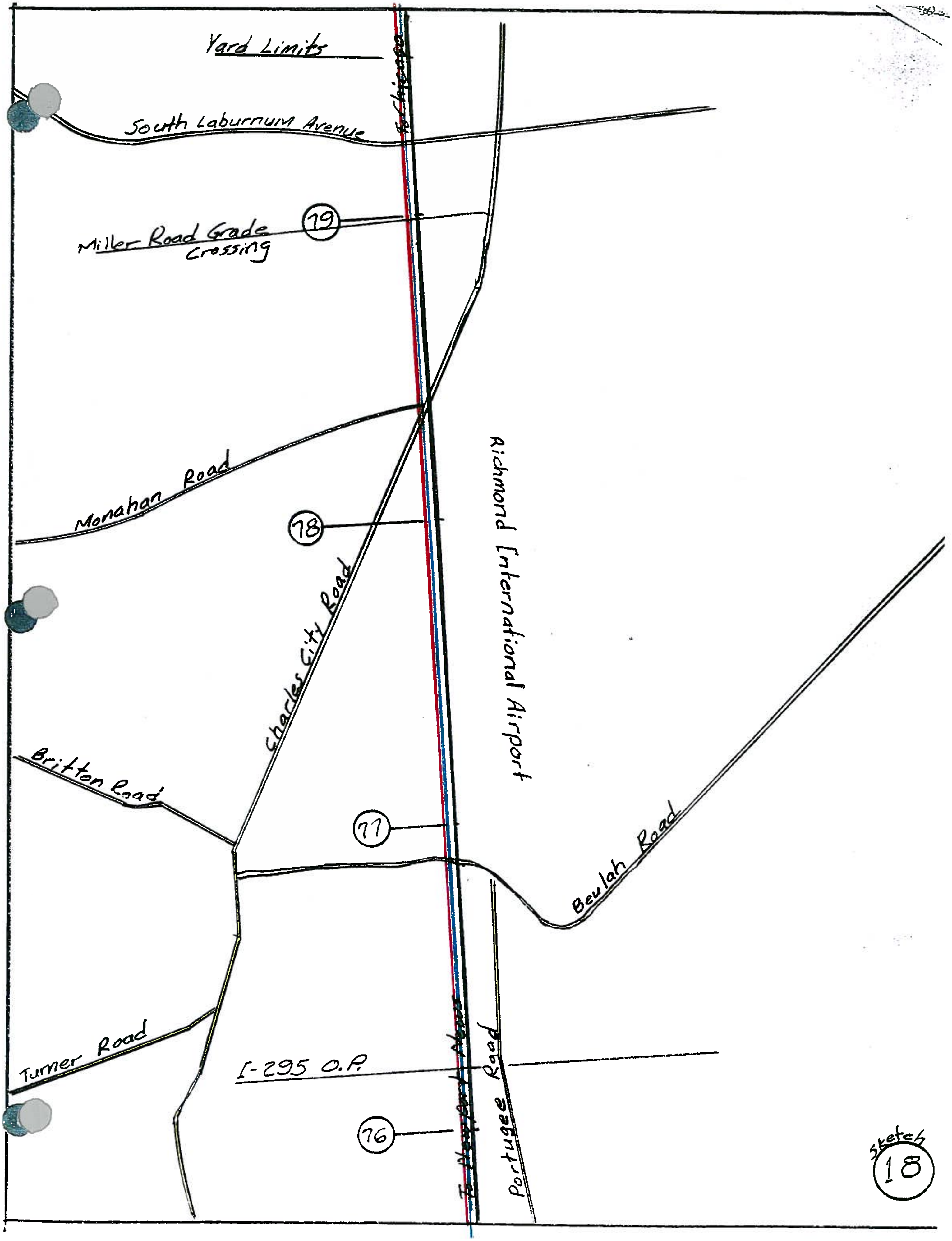

To Chicago
Private Grade Crossing
63
Private Grade Crossing
State Route 618
State Route 618
62
Private Grade Crossing
Jones Run
Mill Tail Creek
Providence Forge
U.S. Route 60
State Route 608
61
State Route 155
To Newport News
State Route 629
Private Grade Crossing
60
sketch
14

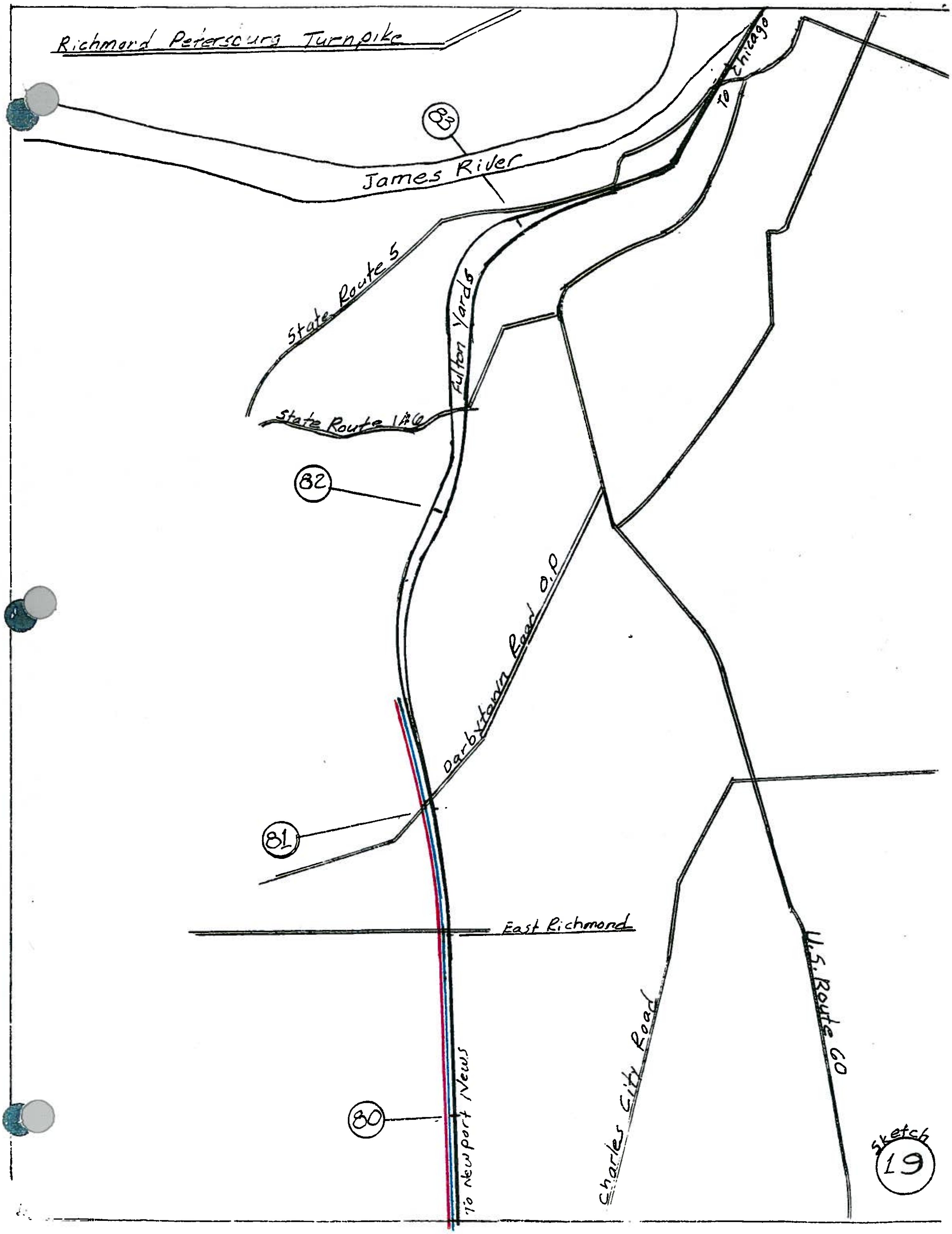

Private Grade Crossing
State Route 600
To Chicago
67
Roxbury
State Route 609
Opossum Creek
State Route 609
66
Branches of
the Chickahominy River
State Route 631
U.S. Route 60
State Route 615
65
S.R. 615
To Newport News
Schiminoe Creek
64
Sketch
15


To Chicago
State Route 156
White Oak Road
Elko
71
White Oak Swamp
70
Private Grade Crossing
69
State Route 600
Private Grade Crossing
US Route 60
68
To Newport News
Sketch
16



To Chicago
Charles City Road
Private Grade Crossing to Police Firing Range
Lo France Road
Yahley Mill Road
75
White Oak Swamp
Poplar Springs Road
Washington Memorial Drive
Gill Dale Road
Poplar Springs
74
White Oak Swamp
White Oak Swamp
73
Portugee Road
White Oak Swamp
State Route 156
72
To Newport News
Sketch 17


Yard Limits
South Laburnum Avenue
79
Miller Road Grade Crossing
Monahan Road
78
Charles City Road
Richmond International Airport
Britton Road
77
Beulah Road
Turner Road
I-295 O.P.
76
sketch 18


Richmond Petersburg Turnpike
To Chicago
83
James River
State Route 5
Fulton Yards
State Route 1&6
82
Darbytown Road O.P.
81
East Richmond
Charles City Road
U.S. Route 60
To Newport News
80
Sketch
19

APPENDIX H: PUBLIC COMMENTS

Norfolk Southern Corporation
3 Commercial Place
Norfolk, VA 23510-9207

Chris Wichman
Transportation Planner
Hampton Roads Transportation Planning Organization
723 Woodlake Drive
Chesapeake, VA 23320

Mr. Wichman,

Norfolk Southern (NS) appreciates the opportunity to continue to comment on the Hampton Roads Passenger Rail Vision Plan. NS submitted comments to HRTPO in February, and those comments were incorporated into a revised version of the study. We believe that there is still some ambiguity related to the use of NS right-of-way between Norfolk, VA and Petersburg, VA, even in this revised version. Hopefully the material we describe below will resolve those ambiguities.

We would appreciate two sets of clarifications in the final version of the study. The language appearing first below should appear at the front of the report to provide clarity and context regarding the use of NS right-of-way. Additionally, where there is a reference, textual, visual, or otherwise to our right-of-way, we ask that a footnote be placed on that page that reminds the reader of the restrictions NS places on high-speed passenger trains utilizing its corridors. That footnote language appears below as well.

Section 1.1.1

Throughout this study, there will be textual and visual references, explicit or otherwise, to the Norfolk Southern (NS) right-of-way that runs from Norfolk, VA to Petersburg, VA where it then connects to CSX to head to Richmond, VA and points north. NS has strict policies regarding passenger rail and how fast passenger trains may travel on NS right of way (ROW). Those policies are summarized below:

- Where higher speed passenger trains share tracks with conventional freight trains, those high speed trains may not exceed 79 mph.
- Passenger trains operating in excess of 79 mph will require dedicated tracks, and may not exceed 90 mph.
- Passenger trains exceeding 90 mph require their own private right-of-way with at least a 50 foot separation between high speed tracks and freight tracks.

These policies are important in the context of this report as they govern any and all high speed passenger train options utilizing NS right-of-way.

Norfolk Southern Corporation
3 Commercial Place
Norfolk, VA 23510-9207

Footnote to be placed at any mention, textual, visual or otherwise, of Norfolk-Petersburg, Norfolk Southern, Norfolk – Richmond along 460 and any other mention where use of NS ROW is referred to either explicitly or is inferred.

*Any use, implied, explicit, or otherwise, of NS right-of-way will be subject to the concurrence of NS, and to NS' Passenger Rail Policy which governs the speed of passenger trains utilizing it or encroaching upon it.

We believe this additional language is necessary to ensure that readers clearly understand the use of NS right-of-way, if permitted, would only be permitted in a manner that consistent with NS policy, which has conditions not completely compatible with high-speed rail service.

Additionally, NS requests that its passenger policy requirements regarding passenger rail speeds be included in any and all future presentations where NS right-of-way is referred to in any manner.

Lastly, NS requests that any and all references to its Michigan line transaction, specifically in Section 3.1.1 on page 3-3, be removed from future versions of these reports. That transaction was unique and NS does not intend to pursue such a transaction with the Norfolk-Petersburg corridor.

NS appreciates having a voice at the table with the HRTPO and we look forward to continuing our relationship in the future.

Best regards,

Scott Plum

FUTURE OF HAMPTON ROADS, INC.

Visioning the Future for America's First Region

P.O. Box 2212
Chesapeake, VA 23327-2212
757-547-1988
www.fhrinc.org

Since 1983

September 25, 2014

RESOLUTION BY THE BOARD OF DIRECTORS, FUTURE OF HAMPTON ROADS, INC.

Whereas the Hampton Roads Transportation Planning Organization (HRTPO) began the development of a High Speed Rail Vision Plan in 2009 to evaluate the potential of high speed and enhanced passenger rail service alternatives for the region, the search has resulted in a number of technical reports and has been described as near completion; and

Whereas rail service, specifically high speed rail, has been identified by Future of Hampton Roads as the key transportation element necessary to maintain regional economic competitiveness by effectively connecting the region to economic centers in the northeast, southeast and around the country; and

Whereas it is the opinion of Future of Hampton Roads' Board of Directors that a final report "High Speed Rail Vision Plan" from HRTPO is vital to the region's ability to pursue funding and support for key studies, and improvements in infrastructure for rail service;

Therefore, be it resolved by the Board of Directors for Future of Hampton Roads that the organization formally urges the HRTPO to complete and release the High Speed Rail Vision Plan as soon as possible.

Respectfully submitted,

William W. Crow
Chairman, Future of Hampton Roads

COMMONWEALTH *of* VIRGINIA

Jennifer L. Mitchell
Director

DEPARTMENT OF RAIL AND PUBLIC TRANSPORTATION
600 EAST MAIN STREET, SUITE 2102
RICHMOND, VA 23219-2416

(804) 786-4440
FAX (804) 225-3752
Virginia Relay Center
800-828-1120 (TDD)

October 28, 2014

Camelia Ravanbakht
Interim HRTPO Executive Director
The Regional Building
723 Woodlake Drive
Chesapeake, VA 23320

Dear Camelia:

Thank you for the opportunity to work with the Hampton Roads Transportation Planning Organization (HRTPO) and provide comments to HRTPO's High Speed Rail Vision Plan Alternatives Analysis. As the Alternatives Analysis has been underway, the Department of Rail and Public Transportation (DRPT) has enhanced intercity passenger rail service to Hampton Roads, as evidenced by new service to Norfolk, concluded the Richmond to Hampton Roads Tier I EIS in 2012, and the included three Hampton Roads area legislators in the Virginia-North Carolina Rail Compact. Additionally, DRPT has programmed $82 million in funding in the approved FY2015 – FY2020 six-year plan for service expansion to Norfolk and $20 million in rail funds for the proposed multimodal station in Newport News. As always, we urge the HRTPO to work with DRPT, FRA and the host railroads for coordinated intercity passenger rail improvements. We are committed to working with HRTPO to advancing higher speed rail improvements in a constructive manner that is consistent with Federal priorities and reasonably expected estimates for future funding.

In 2002, the Federal Railroad Administration published the Tier I Record of Decision (ROD) for the Southeast High Speed Rail (SEHSR) from Washington D.C. to Charlotte, North Carolina. The Tier I ROD identified the CSX right-of-way (ROW) as the preferred corridor between Richmond, VA and Washington, D.C. for high speed rail in order to minimize impacts, reduce initial capital investment, and generate benefits of higher speeds in an achievable timeframe. Since 2003, DRPT has been working in collaboration with the North Carolina Department of Transportation and the Federal Railroad Administration (FRA) to conduct the Southeast High Speed Rail (SEHSR) Tier II Environmental Impact Statement (EIS) from Richmond, Virginia, to Raleigh, North Carolina.

In 2010, DRPT was awarded funding from the FRA's High Speed Rail Program to advance the SEHSR Washington D.C. to Richmond segment Tier II EIS. DRPT is actively advancing the

SEHSR Washington D.C. to Richmond Tier II EIS, as well as other potential capital improvements in the corridor that would benefit current passenger rail services. It is critical that DRPT strictly adhere to the requirements of National Environmental Policy Act (NEPA) of 1969 and that clear communication is provided to the public throughout the Washington D.C. to Richmond Tier II EIS process.

FRA has demonstrated that it will support and invest in rail projects that are consistent with its nationwide policies, and projects that have clear and consistent support from the residents of the region. The Alternatives Analysis has been presented as a parallel/concurrent study (to SEHSR efforts) that has the effect of confusing the audience and potentially risking FRA's support of existing plans in the region. As such, DRPT requests that the HRTPO discontinue making reference to the HRTPO High Speed Passenger Rail Vision Plan Alternatives Analysis as a parallel/concurrent study to the FRA sponsored SEHSR studies that are being conducted by DRPT and/or in collaboration with North Carolina DOT in written format and/or public forum.

DRPT wishes to provide the following observations regarding assumptions that have been made in the HRTPO's Hampton Roads High Speed Passenger Rail Vision Plan Alternatives Analysis that have recently been conducted.

- The 2025 ridership forecast assumptions include development of SEHSR service and NEC Future service. This level of ridership is based on approximately $165 billion of capital improvements in the NEC, for which there is no committed sources of funding identified. Absent any committed sources of state or Federal revenues, there is no guarantee that SEHSR service will be implemented by 2025, and NEC Future service is currently projected out to 2040. As such, we believe the 2025 ridership forecasts may be overly optimistic.

- The market analysis was based on travel markets outside of the SEHSR corridor and well outside of the Hampton Roads Region travel market. The ridership forecasts assume speeds of 130MPH and 220MPH that are unobtainable between Richmond and Washington, D.C. without a fully separated greenfield alignment. This assumption is inconsistent with the SEHSR Tier I EIS ROD issued in 2002.

- The Alternatives Analysis report claims no environmental fatal flaws for the recommended alternative. However given the significant presence of wetlands and sensitive resources in this corridor, DRPT has serious concern with this assumption. The U.S. Route 460 Location Study: Draft Supplemental EIS prepared by VDOT documents many of the environmental impacts associated with a potential greenfield project in this corridor. This study assumes use of CSX and Norfolk Southern (NS) ROW in the description of alternatives at speeds of 130MPH and 220MPH. The HRTPO staff and their consultant have been notified that speeds of 79MPH on NS and 90MPH on CSX ROW are the maximum allowable speeds. Further, ROW is not available for the barrier separation that has been identified in the Alternatives Analysis report to accommodate speeds in excess of 130MPH on the CSX or NS ROW.

- The HRTPO study assumes the use of push-pull or double ended trains that have diesel power cars; however, Amtrak does not allow push-pull or double ended trains and will require a "wye" track to turn the trains.

- DRPT is concerned that the capital cost estimate of $8B ($2013) for 193 mile greenfield project between Washington D.C. and Norfolk, VA may be low. Compared to the capital costs identified in the 2010 Amtrak's Vision for High Speed Rail in the Northeast Corridor, which provides a 220MPH service on the existing Northeast Corridor ROW between Washington D.C. and New York City and separate ROW between New York City and Boston MA at $117B for 439 miles. At $260M/mile, the actual cost of the 220MPH service between Washington D.C. to Norfolk, VA would cost in the neighborhood of $51B. We understand and appreciate that the costs of purchasing a 100-foot section of right-of-way in the proposed corridor would be lower than urban greenfield costs in the northeast corridor. However based on this benchmarking, the actual costs of positive train control systems and electrification, and the number of river crossings in the corridor that will require new infrastructure, we are concerned that the capital cost estimates identified in the Alternative Analysis may be understated. As such the resulting cost-benefit ratios to be overly optimistic. As stated in section 4.4, additional capital cost estimating will need to be conducted during any future studies.

- Any assessment of project delivery methods, including public-private partnerships, should be based on realistic prospective of funding resources including the availability of state and Federal funding sources. The comparison of potential project delivery options to the public-private partnerships for managed lane projects does not take into account that in the managed lane projects, the developer has assumed toll revenue risk. The study has cited a number of news articles as evidence of a viable business model for this project. While section 8.2 cites "the lack of political will on the part of the public sector partner" as the primary reason that these previous initiatives have failed, we suspect that the actual reasons are much more complicated and market-driven. DRPT would expect that any future analyses of higher speed rail alternatives would provide a more detailed analysis of project delivery options that would take into account Virginia's legislative framework, market conditions, approaches to risk allocation and achievable implementation timeframes.

Thank you for your ongoing collaboration in transportation and high speed rail planning initiatives. We appreciate your strong support and advocacy for passenger rail service in the Commonwealth, and we look forward to working with HRTPO to advance these initiatives in the future. Please feel free to contact me if you have any questions or concerns.

Best regards,

Jennifer Mitchell

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