Attachment 1
Emission Calculations

Table A1-1
Nonroad Heavy Equipment Emissions

Project	NO_x (tons)	VOC (tons)	$PM_{2.5}$ (tons)	SO_2 (tons)
Family Travel Camp, Clearing and Grading	0.99	0.09	0.07	0.15
MDA (2007), Building Construction	3.85	0.36	0.23	0.55
MDA, Clearing and Grading	0.15	0.01	0.01	0.02
NGA Admin (EPG), Clearing and Grading	14.79	1.27	1.05	2.24
PEO EIS Administrative Facility - Parking Garage, Building Construction	37.27	3.50	2.25	5.30
PEO EIS Administrative Facility, Building Construction	37.27	3.50	2.25	5.30
PEO EIS Administrative Facility, Clearing and Grading	1.77	0.15	0.13	0.27
Secure Admin Facility (EPG) (WHS), Clearing and Grading	16.76	1.44	1.19	2.54
EPG Infrastructure (EPG) (2008), Building Construction	0.98	0.09	0.06	0.15
EPG Infrastructure (EPG), Clearing and Grading	5.60	0.36	0.37	0.89
Family Travel Camp, Building Construction	1.77	0.16	0.11	0.27
Gunston Road Improvements, Clearing and Grading	3.41	0.22	0.22	0.54
Gunston Road Improvements, Paving	5.07	0.33	0.34	0.80
Hospital (2008), Building Construction	30.74	2.82	1.89	4.64
Hospital, Clearing and Grading	10.92	0.71	0.72	1.74
MDA (2008), Building Construction	5.52	0.51	0.34	0.83
Network Enterprise Communications Facility (AKO), Building Construction	4.49	0.41	0.28	0.68
Network Enterprise Communications Facility (AKO), Clearing and Grading	0.73	0.05	0.05	0.12
Network Enterprise Communications Facility (AKO), Demolition	0.17	0.01	0.01	0.03
NGA Admin (EPG), Building Construction	64.20	5.89	3.95	9.68
NGA Admin (EPG), Building Construction	64.20	5.89	3.95	9.68
PEO EIS Administrative Facility, Landscaping	0.25	0.03	0.01	0.04
PEO EIS Administrative Facility, Paving	0.20	0.01	0.01	0.03
Secure Admin Facility (EPG) (WHS) (2008), Building Construction	117.78	10.81	7.25	17.76
Structured Parking Facility, 200 Area, Clearing and Grading	0.91	0.06	0.06	0.15
Structured Parking Facility, 200 Area, Demolition	0.04	0.00	0.00	0.01

Table A1-1
Nonroad Heavy Equipment Emissions *(continued)*

Project	NO_x (tons)	VOC (tons)	$PM_{2.5}$ (tons)	SO_2 (tons)
USANCA Support Facility, Building Construction	1.05	0.10	0.06	0.16
USANCA Support Facility, Clearing and Grading	0.10	0.01	0.01	0.02
Access Road/Control Point, Clearing and Grading	0.07	0.00	0.00	0.01
Access Road/Control Point, Paving	0.09	0.01	0.01	0.01
Emergency Services Center (EPG), Building Construction	1.29	0.12	0.08	0.21
Emergency Services Center (EPG), Clearing and Grading	0.04	0.00	0.00	0.01
EPG Infrastructure (EPG) , Paving	1.08	0.07	0.07	0.18
Family Travel Camp, Paving	0.16	0.01	0.01	0.03
Gunston Road Improvements, Landscaping	0.37	0.04	0.02	0.06
Hospital (2009), Building Construction	28.92	2.63	1.83	4.64
MDA, Landscaping	0.03	0.00	0.00	0.00
MDA, Paving	0.06	0.00	0.00	0.01
NARMC HQ Building, Building Construction	0.66	0.06	0.04	0.11
NARMC HQ Building, Clearing and Grading	0.06	0.00	0.00	0.01
NARMC HQ Building, Landscaping	0.01	0.00	0.00	0.00
NARMC HQ Building, Paving	0.02	0.00	0.00	0.00
Network Enterprise Communications Facility (AKO), Landscaping	0.02	0.00	0.00	0.00
Network Enterprise Communications Facility (AKO), Paving	0.28	0.02	0.02	0.05
Network Operations Center (part of PEO EIS), Building Construction	0.29	0.03	0.02	0.05
Network Operations Center (part of PEO EIS), Clearing and Grading	0.09	0.01	0.01	0.02
NGA Admin (EPG), Building Construction	60.39	5.50	3.82	9.68
Secure Admin Facility (EPG) (WHS) (2009 Parking Garage), Building Construction	99.85	9.10	6.31	16.01
Secure Admin Facility (EPG) (WHS) (2009), Building Construction	110.79	10.09	7.00	17.77
Structured Parking Facility, 200 Area (2009), Building Construction	12.78	1.16	0.81	2.05
USANCA Support Facility, Landscaping	0.01	0.00	0.00	0.00
USANCA Support Facility, Paving	0.06	0.00	0.00	0.01
Admin Bldg, MEDCOM, Building Construction	0.56	0.05	0.04	0.09
Admin Bldg, MEDCOM, Clearing and Grading	0.04	0.00	0.00	0.01

Table A1-1
Nonroad Heavy Equipment Emissions *(continued)*

Project	NO_x (tons)	VOC (tons)	$PM_{2.5}$ (tons)	SO_2 (tons)
Administrative Facility (Bldgs 211, 215, 219, 220), Clearing and Grading	0.31	0.02	0.02	0.06
Administrative Facility (Bldgs 211, 215, 219, 220), Demolition	0.02	0.00	0.00	0.00
Administrative Facility (Bldgs 211, 215, 219, 220), Parking Garage	8.24	0.75	0.54	1.40
Child Dev Center – 244 (EPG), Building Construction	0.91	0.08	0.06	0.15
Child Dev Center – 244 (EPG), Clearing and Grading	0.32	0.02	0.02	0.06
Child Development Center (EPG), Building Construction	1.68	0.15	0.11	0.28
Child Development Center (EPG), Clearing and Grading	0.40	0.03	0.03	0.07
Dental Clinic, Building Construction	1.40	0.13	0.09	0.24
Dental Clinic, Clearing and Grading	0.08	0.00	0.01	0.01
Emergency Services Center (EPG), Paving	0.01	0.00	0.00	0.00
Family Travel Camp, Landscaping	0.08	0.01	0.00	0.01
Hospital (2010), Building Construction	27.29	2.48	1.78	4.64
Infrastructure Upgrades - Fort Belvoir, Building Construction	1.74	0.16	0.11	0.30
Infrastructure Upgrades - Fort Belvoir, Clearing and Grading	25.22	1.63	1.77	4.56
Infrastructure Upgrades - Fort Belvoir, Paving	9.56	0.61	0.67	1.71
Network Operations Center (part of PEO EIS), Landscaping	0.01	0.00	0.00	0.00
Network Operations Center (part of PEO EIS), Paving	0.03	0.00	0.00	0.01
NGA Admin (EPG) , Landscaping	0.68	0.08	0.04	0.12
NGA Admin (EPG) , Paving	0.18	0.01	0.01	0.03
NGA Admin (EPG), Building Construction	57.00	5.19	3.71	9.68
NGA Admin (EPG), Parking Structure, Building Construction	227.99	20.76	14.83	38.74
Secure Admin Facility (EPG) (WHS), Landscaping	0.81	0.10	0.05	0.14
Secure Admin Facility (EPG) (WHS), Paving	0.30	0.02	0.02	0.05
Structured Parking Facility, 200 Area (2010), Building Construction	2.97	0.27	0.19	0.51
Structured Parking Facility, 200 Area, Landscaping	0.03	0.00	0.00	0.01
Admin Bldg, MEDCOM, Landscaping	0.01	0.00	0.00	0.00
Admin Bldg, MEDCOM, Paving	0.01	0.00	0.00	0.00
Administrative Facility (Bldgs 211, 215, 219, 220), Landscaping	0.03	0.00	0.00	0.01

Table A1-1
Nonroad Heavy Equipment Emissions *(continued)*

Project	NO_x (tons)	VOC (tons)	$PM_{2.5}$ (tons)	SO_2 (tons)
Administrative Facility (Bldgs 211, 215, 219, 220), Paving	0.05	0.00	0.01	0.01
Child Dev Center – 244 (EPG), Landscaping	0.02	0.00	0.00	0.00
Child Dev Center – 244 (EPG), Paving	0.09	0.01	0.01	0.02
Child Development Center (EPG), Landscaping	0.02	0.00	0.00	0.00
Child Development Center (EPG), Paving	0.06	0.00	0.01	0.01
Dental Clinic , Landscaping	0.01	0.00	0.00	0.00
Dental Clinic , Paving	0.03	0.00	0.00	0.01
Hospital (2011 Parking Garage), Building Construction	85.77	8.27	7.57	15.47
Hospital , Landscaping	0.42	0.06	0.04	0.08
Hospital , Paving	0.27	0.02	0.03	0.05
Infrastructure Upgrades - Fort Belvoir, Clearing and Grading	30.99	2.09	2.89	5.97
Infrastructure Upgrades - Fort Belvoir, Landscaping	1.30	0.17	0.12	0.24
Infrastructure Upgrades - Fort Belvoir, Paving	8.71	0.58	0.81	1.65

Source: USEPA NONROAD2004; SQAQMD 1993.

Table A1-2
Worker Vehicle Emissions

Project	Trips Per Day	Duration (days)	VMT	EFNO$_x$ (g/mile)	NO$_x$ (tons)	EFVOC (g/mile)	VOC (tons)	EF PM$_{2.5}$ (g/mile)	PM$_{2.5}$ (tons)	EF SO$_2$ (g/mile)	SO$_2$ (tons]
Family Travel Camp, Clearing and Grading	2	170	10605	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
MDA (2007), Building Construction	37	151	169865	0.32	0.06	0.29	0.05	0.01	0.00	0.01	0.00
MDA, Clearing and Grading	3	19	1560	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
NGA Admin (EPG), Clearing and Grading	46	113	157765	0.32	0.05	0.29	0.05	0.01	0.00	0.01	0.00
PEO EIS Administrative Facility - Parking Garage, Building Construction	322	170	1644177	0.32	0.57	0.29	0.53	0.01	0.02	0.01	0.02
PEO EIS Administrative Facility, Building Construction	322	170	1644177	0.32	0.57	0.29	0.53	0.01	0.02	0.01	0.02
PEO EIS Administrative Facility, Clearing and Grading	17	38	18860	0.32	0.01	0.29	0.01	0.01	0.00	0.01	0.00
Secure Admin Facility (EPG) (WHS), Clearing and Grading	53	113	178771	0.32	0.06	0.29	0.06	0.01	0.00	0.01	0.00
EPG Infrastructure (EPG) (2008), Building Construction	18	85	45937	0.32	0.02	0.29	0.01	0.01	0.00	0.01	0.00
EPG Infrastructure (EPG), Clearing and Grading	23	85	57780	0.32	0.02	0.29	0.02	0.01	0.00	0.01	0.00

Table A1-2
Worker Vehicle Emissions *(continued)*

Project	Trips Per Day	Duration (days)	VMT	EFNO_x (g/mile)	NO_x (tons)	EFVOC (g/mile)	VOC (tons)	EF $PM_{2.5}$ (g/mile)	$PM_{2.5}$ (tons)	EF SO_2 (g/mile)	SO_2 (tons]
Family Travel Camp, Building Construction	12	230	82757	0.32	0.03	0.29	0.03	0.01	0.00	0.01	0.00
Gunston Road Improvements, Clearing and Grading	21	57	35157	0.32	0.01	0.29	0.01	0.01	0.00	0.01	0.00
Gunston Road Improvements, Paving	16	170	79902	0.32	0.03	0.29	0.03	0.01	0.00	0.01	0.00
Hospital (2008), Building Construction	209	230	1438733	0.32	0.50	0.29	0.46	0.01	0.02	0.01	0.01
Hospital, Clearing and Grading	33	113	112727	0.32	0.04	0.29	0.04	0.01	0.00	0.01	0.00
MDA (2008), Building Construction	37	230	258336	0.32	0.09	0.29	0.08	0.01	0.00	0.01	0.00
Network Enterprise Communications Facility (AKO), Building Construction	53	132	210085	0.32	0.07	0.29	0.07	0.01	0.00	0.01	0.00
Network Enterprise Communications Facility (AKO), Clearing and Grading	7	38	7538	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Network Enterprise Communications Facility (AKO), Demolition	1	57	1702	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
NGA Admin (EPG), Building Construction	435	230	3004398	0.32	1.04	0.29	0.96	0.01	0.04	0.01	0.03
NGA Admin (EPG), Building Construction	435	230	3004398	0.32	1.04	0.29	0.96	0.01	0.04	0.01	0.03
PEO EIS Administrative Facility, Landscaping	5	28	4377	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
PEO EIS Administrative Facility, Paving	4	28	3203	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Secure Admin Facility (EPG) (WHS) (2008), Building Construction	799	230	5511996	0.32	1.92	0.29	1.76	0.01	0.07	0.01	0.06

Table A1-2
Worker Vehicle Emissions *(continued)*

Project	Trips Per Day	Duration (days)	VMT	EFNO$_x$ (g/mile)	NO$_x$ (tons)	EFVOC (g/mile)	VOC (tons)	EF PM$_{2.5}$ (g/mile)	PM$_{2.5}$ (tons)	EF SO$_2$ (g/mile)	SO$_2$ (tons]
Structured Parking Facility, 200 Area, Clearing and Grading	3	113	9392	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Structured Parking Facility, 200 Area, Demolition	0	38	423	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
USANCA Support Facility, Building Construction	14	113	48999	0.32	0.02	0.29	0.02	0.01	0.00	0.01	0.00
USANCA Support Facility, Clearing and Grading	2	19	1038	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Access Road/Control Point, Building Construction	0	38	229	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Access Road/Control Point, Clearing and Grading	1	19	721	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Access Road/Control Point, Paving	1	38	1423	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Emergency Services Center (EPG), Building Construction	14	151	64353	0.32	0.02	0.29	0.02	0.01	0.00	0.01	0.00
Emergency Services Center (EPG), Clearing and Grading	1	19	456	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
EPG Infrastructure (EPG) , Paving	21	28	18037	0.32	0.01	0.29	0.01	0.01	0.00	0.01	0.00
Family Travel Camp, Paving	1	170	2664	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Gunston Road Improvements, Landscaping	4	57	6818	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Hospital (2009), Building Construction	209	230	1438733	0.32	0.50	0.29	0.46	0.01	0.02	0.01	0.01
MDA, Landscaping	1	28	509	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
MDA, Paving	1	28	1068	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00

Table A1-2
Worker Vehicle Emissions *(continued)*

Project	Trips Per Day	Duration (days)	VMT	EFNO_x (g/mile)	NO_x (tons)	EFVOC (g/mile)	VOC (tons)	EF $PM_{2.5}$ (g/mile)	$PM_{2.5}$ (tons)	EF SO_2 (g/mile)	SO_2 (tons]
NARMC HQ Building, Building Construction	6	170	33075	0.32	0.01	0.29	0.01	0.01	0.00	0.01	0.00
NARMC HQ Building, Clearing and Grading	1	19	649	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
NARMC HQ Building, Landscaping	0	19	117	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
NARMC HQ Building, Paving	1	19	356	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Network Enterprise Communications Facility (AKO), Landscaping	0	28	360	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Network Enterprise Communications Facility (AKO), Paving	6	28	4754	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Network Operations Center (part of PEO EIS), Building Construction	4	132	14292	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Network Operations Center (part of PEO EIS), Clearing and Grading	1	38	1038	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
NGA Admin (EPG), Building Construction	435	230	3004398	0.32	1.04	0.29	0.96	0.01	0.04	0.01	0.03
Secure Admin Facility (EPG) (WHS) (2009 Parking Garage), Building Construction	720	230	4968000	0.32	1.73	0.29	1.59	0.01	0.06	0.01	0.05
Secure Admin Facility (EPG) (WHS) (2009), Building Construction	799	230	5511996	0.32	1.92	0.29	1.76	0.01	0.07	0.01	0.06
Structured Parking Facility, 200 Area (2009), Building Construction	92	230	635904	0.32	0.22	0.29	0.20	0.01	0.01	0.01	0.01

Table A1-2
Worker Vehicle Emissions *(continued)*

Project	Trips Per Day	Duration (days)	VMT	EFNO$_x$ (g/mile)	NO$_x$ (tons)	EFVOC (g/mile)	VOC (tons)	EF PM$_{2.5}$ (g/mile)	PM$_{2.5}$ (tons)	EF SO$_2$ (g/mile)	SO$_2$ (tons]
USANCA Support Facility, Landscaping	0	28	196	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
USANCA Support Facility, Paving	1	28	1068	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Admin Bldg, MEDCOM, Building Construction	6	151	29400	0.32	0.01	0.29	0.01	0.01	0.00	0.01	0.00
Admin Bldg, MEDCOM, Clearing and Grading	1	19	440	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Administrative Facility (Bldgs 211, 215, 219, 220), Clearing and Grading	3	38	3592	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Administrative Facility (Bldgs 211, 215, 219, 220), Demolition	0	19	221	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Administrative Facility (Bldgs 211, 215, 219, 220), Parking Garage	96	151	434462	0.32	0.15	0.29	0.14	0.01	0.01	0.01	0.00
Child Dev Center – 244 (EPG), Building Construction	14	113	47995	0.32	0.02	0.29	0.02	0.01	0.00	0.01	0.00
Child Dev Center – 244 (EPG), Clearing and Grading	3	38	3717	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Child Development Center (EPG), Building Construction	17	170	88331	0.32	0.03	0.29	0.03	0.01	0.00	0.01	0.00
Child Development Center (EPG), Clearing and Grading	3	57	4710	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Dental Clinic, Building Construction	12	214	74044	0.32	0.03	0.29	0.02	0.01	0.00	0.01	0.00
Dental Clinic, Clearing and Grading	2	19	878	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Emergency Services Center (EPG), Paving	0	19	135	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Family Travel Camp, Landscaping	1	57	1466	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00

Table A1-2
Worker Vehicle Emissions *(continued)*

Project	Trips Per Day	Duration (days)	VMT	EFNO$_x$ (g/mile)	NO$_x$ (tons)	EFVOC (g/mile)	VOC (tons)	EF PM$_{2.5}$ (g/mile)	PM$_{2.5}$ (tons)	EF SO$_2$ (g/mile)	SO$_2$ (tons]
Hospital (2010), Building Construction	209	230	1438733	0.32	0.50	0.29	0.46	0.01	0.02	0.01	0.01
Infrastructure Upgrades - Fort Belvoir, Building Construction	18	170	91874	0.32	0.03	0.29	0.03	0.01	0.00	0.01	0.00
Infrastructure Upgrades - Fort Belvoir, Clearing and Grading	58	170	294734	0.32	0.10	0.29	0.09	0.01	0.00	0.01	0.00
Infrastructure Upgrades - Fort Belvoir, Paving	50	113	169488	0.32	0.06	0.29	0.05	0.01	0.00	0.01	0.00
Network Operations Center (part of PEO EIS), Landscaping	0	28	98	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Network Operations Center (part of PEO EIS), Paving	1	28	534	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
NGA Admin (EPG) , Landscaping	16	28	13214	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
NGA Admin (EPG) , Paving	4	28	3203	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
NGA Admin (EPG), Building Construction	435	230	3004398	0.32	1.04	0.29	0.96	0.01	0.04	0.01	0.03
NGA Admin (EPG), Parking Structure, Building Construction	1742	230	12017592	0.32	4.18	0.29	3.84	0.01	0.15	0.01	0.12
Secure Admin Facility (EPG) (WHS), Landscaping	19	28	15746	0.32	0.01	0.29	0.01	0.01	0.00	0.01	0.00

Table A1-2
Worker Vehicle Emissions *(continued)*

Project	Trips Per Day	Duration (days)	VMT	EFNO$_x$ (g/mile)	NO$_x$ (tons)	EFVOC (g/mile)	VOC (tons)	EF PM$_{2.5}$ (g/mile)	PM$_{2.5}$ (tons)	EF SO$_2$ (g/mile)	SO$_2$ (tons]
Secure Admin Facility (EPG) (WHS), Paving	6	28	5329	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Structured Parking Facility, 200 Area (2010), Building Construction	46	113	156798	0.32	0.05	0.29	0.05	0.01	0.00	0.01	0.00
Structured Parking Facility, 200 Area, Landscaping	1	19	626	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Admin Bldg, MEDCOM, Landscaping	0	19	117	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Admin Bldg, MEDCOM, Paving	0	19	147	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Administrative Facility (Bldgs 211, 215, 219, 220), Landscaping	1	28	651	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Administrative Facility (Bldgs 211, 215, 219, 220), Paving	1	28	1068	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Child Dev Center – 244 (EPG), Landscaping	0	28	383	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Child Dev Center – 244 (EPG), Paving	2	28	1830	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Child Development Center (EPG), Landscaping	1	28	470	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Child Development Center (EPG), Paving	1	28	1179	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Dental Clinic , Landscaping	0	28	313	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Dental Clinic , Paving	1	28	534	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Hospital (2011 Parking Garage), Building Construction	720	230	4968000	0.32	1.73	0.29	1.59	0.01	0.06	0.01	0.05
Hospital , Landscaping	11	28	9141	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00

Table A1-2
Worker Vehicle Emissions *(continued)*

Project	Trips Per Day	Duration (days)	VMT	EFNO$_x$ (g/mile)	NO$_x$ (tons)	EFVOC (g/mile)	VOC (tons)	EF PM$_{2.5}$ (g/mile)	PM$_{2.5}$ (tons)	EF SO$_2$ (g/mile)	SO$_2$ (tons]
Hospital , Paving	6	28	5329	0.32	0.00	0.29	0.00	0.01	0.00	0.01	0.00
Infrastructure Upgrades - Fort Belvoir, Clearing and Grading	58	230	398436	0.32	0.14	0.29	0.13	0.01	0.00	0.01	0.00
Infrastructure Upgrades - Fort Belvoir, Landscaping	12	76	28149	0.32	0.01	0.29	0.01	0.01	0.00	0.01	0.00
Infrastructure Upgrades - Fort Belvoir, Paving	50	113	169488	0.32	0.06	0.29	0.05	0.01	0.00	0.01	0.00

Sources: USEPA and FAA 2002; *MOBILE 6.2*; SQAQMD 1993.

Table A1-3
Architectural Coating Emissions

Project	Heated Area	Wall Surface	VOC (tons)
Expand and Renovate PX and Commissary, Building Construction	186300	372600	10.3
MDA (2007), Building Construction	52000	104000	2.9
PEO EIS Administrative Facility - Parking Garage, Building Construction	447400	894800	24.8
PEO EIS Administrative Facility, Building Construction	447400	894800	24.8
EPG Infrastructure (EPG) (2008), Building Construction	25000	50000	1.4
Family Travel Camp, Building Construction	16658	33316	0.9
Hospital (2008), Building Construction	289600	579200	16.1
MDA (2008), Building Construction	52000	104000	2.9
Network Enterprise Communications Facility (AKO), Building Construction	73500	147000	4.1
NGA Admin (EPG), Building Construction	604750	1209500	33.6
NGA Admin (EPG), Building Construction	604750	1209500	33.6
Secure Admin Facility (EPG) (WHS) (2008), Building Construction	1109500	2219000	61.6
USANCA Support Facility, Building Construction	20000	40000	1.1
Access Road/Control Point, Building Construction	280	560	0.0
Emergency Services Center (EPG), Building Construction	19700	39400	1.1
Hospital (2009), Building Construction	289600	579200	16.1
NARMC HQ Building, Building Construction	9000	18000	0.5
Network Operations Center (part of PEO EIS), Building Construction	5000	10000	0.3
NGA Admin (EPG), Building Construction	604750	1209500	33.6
Secure Admin Facility (EPG) (WHS) (2009 Parking Garage), Building Construction	1000000	2000000	55.5
Secure Admin Facility (EPG) (WHS) (2009), Building Construction	1109500	2219000	61.6
Structured Parking Facility, 200 Area (2009), Building Construction	128000	256000	7.1
Admin Bldg, MEDCOM, Building Construction	9000	18000	0.5
Administrative Facility (Bldgs 211, 215, 219, 220), Parking Garage	133000	266000	7.4
Child Dev Center – 244 (EPG), Building Construction	19590	39180	1.1
Child Development Center (EPG), Building Construction	24036	48072	1.3
Dental Clinic, Building Construction	16000	32000	0.9
Hospital (2010), Building Construction	289600	579200	16.1

Table A1-3
Architectural Coating Emissions *(continued)*

Project	Heated Area	Wall Surface	VOC (tons)
Infrastructure Upgrades - Fort Belvoir, Building Construction	25000	50000	1.4
NGA Admin (EPG), Building Construction	604750	1209500	33.6
NGA Admin (EPG), Parking Structure, Building Construction	2419000	4838000	134.3
Structured Parking Facility, 200 Area (2010), Building Construction	64000	128000	3.6
Hospital (2011 Parking Garage), Building Construction	1000000	2000000	55.5

Source: SQAQMD 1993.

Table A1-4
Paving Off-gas Emissions

Project	Paved Area (Acres)	EFVOC (lbs/acre)	VOC (tons)
Gunston Road Improvements, Paving	12.52	2.62	0.016
PEO EIS Administrative Facility, Paving	3.01	2.62	0.004
Access Road/Control Point, Paving	1	2.62	0.001
EPG Infrastructure (EPG) , Paving	16.96	2.62	0.022
Family Travel Camp, Paving	0.42	2.62	0.001
MDA, Paving	1	2.62	0.001
NARMC HQ Building, Paving	0.5	2.62	0.001
Network Enterprise Communications Facility (AKO), Paving	4.47	2.62	0.006
USANCA Support Facility, Paving	1	2.62	0.001
Emergency Services Center (EPG), Paving	0.19	2.62	0.000
Infrastructure Upgrades - Fort Belvoir, Paving	39.85	2.62	0.052
Network Operations Center (part of PEO EIS), Paving	0.5	2.62	0.001
NGA Admin (EPG) , Paving	3.01	2.62	0.004
Secure Admin Facility (EPG) (WHS), Paving	5.01	2.62	0.007
Admin Bldg, MEDCOM, Paving	0.21	2.62	0.000
Administrative Facility (Bldgs 211, 215, 219, 220), Paving	1	2.62	0.001
Child Dev Center – 244 (EPG), Paving	1.72	2.62	0.002
Child Development Center (EPG), Paving	1.11	2.62	0.002
Dental Clinic , Paving	0.5	2.62	0.001
Hospital , Paving	5.01	2.62	0.007
Infrastructure Upgrades - Fort Belvoir, Paving	39.85	2.62	0.052

Source: SQAQMD 1993.

Table A1-5
Fugitive Particle Emissions

Project	PM10/TSP	$PM_{2.5}$/ PM_{10}	EF TSP (lb/ac/d)	Capture Fraction	Duration of Grading (days)	Cleared Area (acres)	$PM_{2.5}$ (tons)
Family Travel Camp, Clearing and Grading	0.45	0.15	80	0.5	170.14	1.66	0.04
MDA, Clearing and Grading	0.45	0.15	80	0.5	18.9	2.2	0.01
NGA Admin (EPG), Clearing and Grading	0.45	0.15	80	0.5	113.42	37.09	0.57
PEO EIS Administrative Facility, Clearing and Grading	0.45	0.15	80	0.5	37.81	13.3	0.07
Secure Admin Facility (EPG) (WHS), Clearing and Grading	0.45	0.15	80	0.5	113.42	42.03	0.64
EPG Infrastructure (EPG), Clearing and Grading	0.45	0.15	80	0.5	85.07	18.11	0.21
Gunston Road Improvements, Clearing and Grading	0.45	0.15	80	0.5	56.71	16.53	0.13
Hospital, Clearing and Grading	0.45	0.15	80	0.5	113.42	26.5	0.41
Network Enterprise Communications Facility (AKO), Clearing and Grading	0.45	0.15	80	0.5	37.81	5.32	0.03
Network Enterprise Communications Facility (AKO), Demolition	0.45	0.15	80	0.5	56.71	0.8	0.01
Structured Parking Facility, 200 Area, Clearing and Grading	0.45	0.15	80	0.5	113.42	2.21	0.03
Structured Parking Facility, 200 Area, Demolition	0.45	0.15	80	0.5	37.81	0.3	0.00
USANCA Support Facility, Clearing and Grading	0.45	0.15	80	0.5	18.9	1.46	0.00
Access Road/Control Point, Clearing and Grading	0.45	0.15	80	0.5	18.9	1.02	0.00
Emergency Services Center (EPG), Clearing and Grading	0.45	0.15	80	0.5	18.9	0.64	0.00
NARMC HQ Building, Clearing and Grading	0.45	0.15	80	0.5	18.9	0.92	0.00

Table A1-5
Fugitive Particle Emissions *(continued)*

Project	PM10/TSP	$PM_{2.5}$/ PM_{10}	EF TSP (lb/ac/d)	Capture Fraction	Duration of Grading (days)	Cleared Area (acres)	$PM_{2.5}$ (tons)
Network Operations Center (part of PEO EIS), Clearing and Grading	0.45	0.15	80	0.5	37.81	0.73	0.00
Admin Bldg, MEDCOM, Clearing and Grading	0.45	0.15	80	0.5	18.9	0.62	0.00
Administrative Facility (Bldgs 211, 215, 219, 220), Clearing and Grading	0.45	0.15	80	0.5	37.81	2.53	0.01
Administrative Facility (Bldgs 211, 215, 219, 220), Demolition	0.45	0.15	80	0.5	18.9	0.31	0.00
Child Dev Center – 244 (EPG), Clearing and Grading	0.45	0.15	80	0.5	37.81	2.62	0.01
Child Development Center (EPG), Clearing and Grading	0.45	0.15	80	0.5	56.71	2.21	0.02
Dental Clinic, Clearing and Grading	0.45	0.15	80	0.5	18.9	1.24	0.00
Infrastructure Upgrades - Fort Belvoir, Clearing and Grading	0.45	0.15	80	0.5	170.14	46.2	1.06
Infrastructure Upgrades - Fort Belvoir, Clearing and Grading	0.45	0.15	80	0.5	230	46.2	1.43
Total Fugitive Dust Emissions							4.86

Sources: AP-42 Section 13.2.3; USEPA 2005c.

Table A1-6
Emissions from Small Heating and Cooling Activities

Project Name	Heated Area	Fuel Used (cubic feet)	NO_x	VOC	$PM_{2.5}$	SO_2
Access Road/Control Point, Operations	280	26796	0.0013	0.0001	0.0001	0
EPG Infrastructure (EPG) (2008), Operations	25000	2392500	0.1196	0.0066	0.0091	0.0007
MDA (2007), Operations	104000	3036800	0.1518	0.0084	0.0115	0.0009
NARMC HQ Building, Operations	9000	861300	0.0431	0.0024	0.0033	0.0003
NARMC HQ Building, Operations	39825	3811252.5	0.1906	0.0105	0.0145	0.0011
Network Enterprise Communications Facility (AKO), Operations	73500	2528400	0.1264	0.007	0.0096	0.0008
Network Enterprise Communications Facility (AKO), Operations	73500	2528400	0.1264	0.007	0.0096	0.0008
USANCA Support Facility, Operations	20000	1914000	0.0957	0.0053	0.0073	0.0006
Dental Clinic, Operations	16000	1531200	0.0766	0.0042	0.0058	0.0005

Table A1-6
Emissions from Small Heating and Cooling Activities *(continued)*

Project Name	Heated Area	Fuel Used (cubic feet)	NOx	VOC	PM2.5	SO2
Family Travel Camp, Operations	16658	1594170.5	0.0797	0.0044	0.0061	0.0005
Network Operations Center (part of PEO EIS), Operations	5000	478500	0.0239	0.0013	0.0018	0.0001
Admin Bldg, MEDCOM, Operation	9000	861300	0.0431	0.0024	0.0033	0.0003
Administrative Facility (Bldgs 211, 215, 219, 220), Operations	133600	3901120	0.1951	0.0107	0.0148	0.0012
Child Dev Center – 244 (EPG), Operations	19590	1874763	0.0937	0.0052	0.0071	0.0006
Child Development Center (EPG), Operations	24036	2300245.25	0.115	0.0063	0.0087	0.0007

Sources: AP-42 Section 1.4; DOE 1999.

Table A1-7
Employee Vehicle Emissions

Project Name	Number of Employees	Average Commute[a]	$EFNO_x$ (tons)	NO_x (tons)	EFVOC (tons)	VOC (tons)	EF $PM_{2.5}$ (tons)	$PM_{2.5}$ (tons)	EF SO_2 (tons)	SO_2 (tons)
PEO EIS, Commuters	480	-3	0.31	-0.24	0.31	-0.25	0.01	-0.01	0.01	-0.01
Realigned Away From Belvoir, Commuters	-1769	14	0.31	-4.2	0.31	-4.3	0.01	-0.15	0.01	-0.13
NGA , Commuters	8500	-3	0.31	-4.32	0.31	-4.43	0.01	-0.16	0.01	-0.14
MDA, Commuters	292	-3	0.31	-0.15	0.31	-0.15	0.01	-0.01	0.01	0
WHS , Commuters	9263	-3	0.31	-4.71	0.31	-4.82	0.01	-0.17	0.01	-0.15
MEDCOM , Commuters	2069	-3	0.31	-1.05	0.31	-1.08	0.01	-0.04	0.01	-0.03
Army Lease , Commuters	2720	-3	0.31	-1.38	0.31	-1.42	0.01	-0.05	0.01	-0.04

Sources: USEPA and FAA 2002, *MOBILE6.2*.
[a] Represents the net change in commuting distance due to the action.

APPENDIX E.2
VEHICLE MICROSCALE
CO CONCENTRATION MODELING

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The CO microscale air quality analysis is based on procedures outlined in the following documents:

- Guideline for Modeling CO From Roadway Intersections (USEPA 1992); and
- Mobile 6.2 User's Guide (USEPA 2003).

Carbon monoxide concentrations are determined in two steps: 1) vehicle exhaust emission factors are calculated using the USEPA Mobile 6.2 computer model; and 2) these emission factors are subsequently used as input for the USEPA CAL3QHC dispersion model. The models used are described as follows:

- Mobile 6.2 generates vehicular emission factors based on locality-specific vehicle fleet characteristics including vehicle age, operating mode of vehicles (hot/cold starts), and percentage of oxygenated fuel used. Input files containing the latest planning assumptions for Fairfax County were provided by the Metropolitan Washington Council of Governments (MWCOG) (MWCOG 2005).
- CAL3QHC predicts the level of CO or other pollutant concentrations from motor vehicles traveling near roadway intersections. The model incorporates inputs such as roadway geometry, traffic volumes, vehicular emission rates, and meteorological conditions.

The intersection location determinations and CO estimations were made through the following process:

1. Traffic, operating conditions, roadway configurations and geometry information was gathered for roadways and intersections of interest.
2. Potential worst-case roadways were identified based on the level of service and traffic flow.
3. Worst-case receptor locations were identified as the location of maximum CO concentration.
4. Mobile 6.2 and CAL3QHC were used to calculate CO concentrations due to vehicle traffic at identified "worst-case" roadway and receptor locations. Assumptions outlined in the 1985 Caltrans Report, Development of Worst Case Meteorology Criteria (Nokes and Benson 1985) were used for the analysis.
5. Persistence factor of 0.7 was used to estimate the 8-Hour concentration from the 1-Hour concentration.
6. Background concentrations at the intersection were determined using local monitoring data obtained from the VDEQ and added to modeled concentrations.

Data Inputs and results tabulated below (Table E.2-1).

Table E.2-1
Peak hour CO levels for all alternative and intersections analyzed

Intersection Location		1-hour [CO]	8-hour [CO]
Fairfax County Parkway./ John J Kingman Rd.	Existing	6.6	4.6
Fairfax County Parkway./ John J Kingman Rd.	No-Action	6.7	4.7
Fairfax County Parkway./ John J Kingman Rd.	Preferred	6.8	4.8
Fairfax County Parkway./ John J Kingman Rd.	Town Center	7.0	4.9
Fairfax County Parkway./ John J Kingman Rd.	City Center	6.7	4.7
Fairfax County Parkway./ John J Kingman Rd.	Satellite	7.0	4.9
Franconia Springfield Parkway EB Ramp./ Backlick Rd.	Existing	7.6	5.3
Franconia Springfield Parkway EB Ramp./ Backlick Rd.	No-Action	7.6	5.3
Franconia Springfield Parkway EB Ramp./ Backlick Rd.	Preferred	7.6	5.3
Franconia Springfield Parkway EB Ramp./ Backlick Rd.	City Center	7.6	5.3
Franconia Springfield Parkway./ Beulah St.	Existing	6.7	4.7
Franconia Springfield Parkway./ Beulah St.	No-Action	7.0	4.9
Franconia Springfield Parkway./ Beulah St.	Preferred	6.8	4.8
Franconia Springfield Parkway./ Beulah St.	Town Center	6.8	4.8
Franconia Springfield Parkway./ Beulah St.	City Center	6.8	4.8
Franconia Springfield Parkway./ Beulah St.	Satellite	6.8	4.8
Franconia Springfield Parkway/ Spring Village Dr.	Existing	6.2	4.3
Franconia Springfield Parkway/ Spring Village Dr.	No-Action	6.7	4.7
Franconia Springfield Parkway/ Spring Village Dr.	Preferred	7.3	5.1
Franconia Springfield Parkway/ Spring Village Dr.	City Center	7.3	5.1
Route 1./ Backlick Rd. - Pohick Rd.	Existing	5.2	3.6
Route 1/ Backlick Rd. - Pohick Rd.	No-Action	5.6	3.9
Route 1/ Backlick Rd. - Pohick Rd.	Preferred	6.0	4.2
Route 1/ Backlick Rd. - Pohick Rd.	Town Center	6.3	4.4
Route 1/ Backlick Rd. - Pohick Rd.	City Center	5.7	4.0
Route 1/ Backlick Rd. - Pohick Rd.	Satellite	6.1	4.3
Route 1./ Belvoir Rd.	Existing	5.0	3.5
Route 1./ Belvoir Rd.	No-Action	5.0	3.5
Route 1./ Belvoir Rd.	Preferred	5.7	4.0
Route 1./ Belvoir Rd.	Town Center	5.4	3.8
Route 1/Fairfax County Parkway.	Existing	5.8	4.1
Route 1/ Fairfax County Parkway.	No Action	5.9	4.1
Route 1/ Fairfax County Parkway.	Preferred	6.2	4.3
Route ./ Fairfax County Parkway.	Town Center	6.6	4.6
Route 1/ Fairfax County Parkway.	City Center	6.1	4.3
Route 1/ Fairfax County Parkway.	Satellite	6.4	4.5
Route 1./ Telegraph Rd. - Old Colchester Rd.	Existing	6.2	4.3
Route 1./ Telegraph Rd. - Old Colchester Rd.	No-Action	6.6	4.6
Route 1./ Telegraph Rd. - Old Colchester Rd.	Preferred	6.9	4.8
Route 1./ Telegraph Rd. - Old Colchester Rd.	Town Center	6.8	4.8
Route 1./ Telegraph Rd. - Old Colchester Rd.	City Center	6.8	4.8
Route 1./ Telegraph Rd. - Old Colchester Rd.	Satellite	6.8	4.8

INTERSECTION DESCRIPTION - Fairfax County Parkway./ John J Kingman Rd.

IDLE EMISSION FACTOR [GRAMS/HOUR]	53.715
MOVING EMISSION FACTOR	4.972
LANE WIDTH (FEET)	12
SOURCE HEIGHT (FEET)	0
SIGNAL LENGTH (S)	208
CLEARANCE LOST TIME (S)	2

Existing Conditions

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
START X1 (FEET)	-96	-96		108	108	108	18	36	54	-24	-48	-66
START YI (FEET)	-6	-18		6	18	30	-72	-72	-60	84	84	-60
END X2 (FEET)	-500	-500		500	500	500	18	36	54	-24	-48	-66
END Y2 (FEET)	-6	-18		6	18	108	-500	-500	-500	500	500	500
TRAFFIC VOLUME [VPH]	15	60	20	20	20	130	30	940	395	1095	910	60
EMISSION FACTOR	53.715	53.715		53.715	53.715	53.715	53.715	53.715	53.715	53.715	53.715	53.715
SOURCE HEIGHT	0	0		0	0	0	0	0	0	0	0	0
MIXING ZONE WIDTH	12	12		12	12	12	12	24	12	24	24	12
NUMBER OF LANES IN QUEUE	1	1		1	1	1	1	2	1	2	2	1
TOTAL SIGNAL LENGTH	208	208		208	208	208	208	208	208	208	208	208
AVERAGE RED	176	176		161	161	84	186	156	156	131	101	101
CLEARANCE LOST TIME	2	2		2	2	2	2	2	2	2	2	2
SATURATION FLOW RATE (per lane)	1770	1792		1681	1770	1583	1770	1769.5	1583	1716.5	1769.5	1583
AVERAGE GREEN	32	32		47	47	124	22	52	52	77	107	107
SATURATION FLOW RATE	1770	1792		1681	1770	1583	1770	3539	1583	3433	3539	1583
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
START X1 (FEET)	0	0		0	0		36	36		-48	-48	
START YI (FEET)	-18	-18		18	18		0	0		0	0	
END X2 (FEET)	-500	500		500	-500		36	36		-48	-48	
END Y2 (FEET)	-18	-18		18	18		-500	500		500	-500	
TRAFFIC VOLUME [VPH]	95	1550		170	110		2430	1085		2065	950	
EMISSION FACTOR	4.972	4.972		4.972	4.972		4.972	4.972		4.972	4.972	
SOURCE HEIGHT	0	0		0	0		0	0		0	0	
MIXING ZONE WIDTH	34	34		46	22		46	34		70	34	
NUMBER OF LANES IN QUEUE	2	2		3	1		3	2		5	2	

No-Action Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	50	30	70	490	20	1130	40	970	60	200	820	10
TOTAL SIGNAL LENGTH	208	208		208	208	208	208	208	208	208	208	208
AVERAGE RED	196	196		87	87	73	196	149	149	194	147	147
AVERAGE GREEN	12	12		121	121	135	12	59	59	14	61	61
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	150	290		1640	70		1230	2150		1030	1380	

Preferred Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	50	40	60	450	20	1140	40	1280	70	250	1080	20
TOTAL SIGNAL LENGTH	208	208		208	208	208	208	208	208	208	208	208
AVERAGE RED	196	196		101	101	85	196	137	137	192	133	133
AVERAGE GREEN	12	12		107	107	123	12	71	71	16	75	75
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	150	360		1610	80		1600	2470		1350	1590	

Town Center Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	20	90	20	70	20	340	40	1930	900	1810	1840	50
TOTAL SIGNAL LENGTH	208	208		208	208	208	208	208	208	208	208	208
AVERAGE RED	194	194		196	196	111	195	111	111	123	39	39
AVERAGE GREEN	14	14		12	12	97	13	97	97	85	169	169
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	130	2800		430	110		4640	2290		3700	1930	

City Center Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	50	30	70	560	20	1080	40	1230	80	240	1090	10
TOTAL SIGNAL LENGTH	208	208		208	208	208	208	208	208	208	208	208
AVERAGE RED	196	196		102	102	85	196	137	137	191	132	132
AVERAGE GREEN	12	12		106	106	123	12	71	71	17	76	76
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	150	350		1660	70		1550	2360		1340	1720	

Satellite Campus Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	430	30	230	690	20	1360	60	1400	150	340	1020	20
TOTAL SIGNAL LENGTH	208	208		208	208	208	208	208	208	208	208	208
AVERAGE RED	174	174		121	121	103	196	141	141	190	135	135
AVERAGE GREEN	34	34	34	87	87	105	12	67	67	18	73	73
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	690	520		2070	100		1890	3190		1380	1940	

INTERSECTION DESCRIPTION - FSP and Backlick

IDLE EMISSION FACTOR [GRAMS/HOUR]	53.715
MOVING EMISSION FACTOR	4.972
LANE WIDTH (FEET)	12
SOURCE HEIGHT (FEET)	0
SIGNAL LENGTH (S)	150
CLEARANCE LOST TIME (S)	2

Existing Conditions

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
START X1 (FEET)	-48		-48				6	60			-6	-18		
START YI (FEET)	-12		-30				-48	-48			48	48		
END X2 (FEET)	-500		500				6	24			-6	-18		
END Y2 (FEET)	-12		-30				-500	-500			500	500		
TRAFFIC VOLUME [VPH]	1375		250				170	1380			565	85		
EMISSION FACTOR	53.715		53.715				53.715	53.715			53.715	53.715		
SOURCE HEIGHT	0		0				0	0			0	0		
MIXING ZONE WIDTH	12		12				12	24			24	12		
NUMBER OF LANES IN QUEUE	1		1				1	2			2	1		
TOTAL SIGNAL LENGTH	150		150				150	150			150	150		
AVERAGE RED	101		59				101	101			131			
CLEARANCE LOST TIME	2		2				2	2			2	2		
SATURATION FLOW RATE (per lane)	1681		1583				1770	1769.5			1769.5	1583		
AVERAGE GREEN	49		91				49	49			19	19		
SATURATION FLOW RATE	1681		1583				1770	3539			3539	1583		
	EBA				**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	**FSP WB**	**FSP EB**	**I95**
START X1 (FEET)	0				0		60	60		-6	-6	144	144	264
START YI (FEET)	-18				24		0	0		0	0	0	-120	1000
END X2 (FEET)	-500				-500		60	60		-6	-6	0	0	264
END Y2 (FEET)	-18				24		-500	500		500	-500	-114	-222	-1000
TRAFFIC VOLUME [VPH]	1625				255		1380	2755		650	815	1270	2120	22800
EMISSION FACTOR	4.972				4.972		4.972	4.972		4.972	4.972	4.972	4.972	4.972
SOURCE HEIGHT	0				0		0	0		0	0	0	0	0
MIXING ZONE WIDTH	46				34		46	34		46	34	46	82	178
NUMBER OF LANES IN QUEUE	3				2		3	2		3	2	3	6	14

No-Action Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
TRAFFIC VOLUME [VPH]	1500	10	220	10	10	10	170	1410	10	10	620	110		
TOTAL SIGNAL LENGTH	150		150				150	150			150	150		
AVERAGE RED	81		51				51	81			111	111		
AVERAGE GREEN	69		99				99	69			39	39		
	EBA			**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**			
TRAFFIC VOLUME [VPH]	1730			30	290		1430	2920		740	850			

Preferred Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
TRAFFIC VOLUME [VPH]	1510	0	140	10	10	10	140	1420	10	10	780	190		
TOTAL SIGNAL LENGTH	150		150				150	150			150	150		
AVERAGE RED	81		51				51	81			111	111		
AVERAGE GREEN	69		99				99	69			39	39		
	EBA			**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**			
TRAFFIC VOLUME [VPH]	1650			30	340		1440	2940		980	930			

City Center Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
TRAFFIC VOLUME [VPH]	1510	0	140	10	10	10	140	1420	10	10	780	190		
TOTAL SIGNAL LENGTH	150		150				150	150			150	150		
AVERAGE RED	81		51				51	81			111	111		
AVERAGE GREEN	69		99				99	69			39	39		
	EBA			**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**			
TRAFFIC VOLUME [VPH]	1650			30	340		1440	2940		980	930			

INTERSECTION DESCRIPTION - Franconia Springfield Parkway./ Beulah St. 13

IDLE EMISSION FACTOR [GRAMS/HOUR]	53.715
MOVING EMISSION FACTOR	4.972
LANE WIDTH (FEET)	12
SOURCE HEIGHT (FEET)	0
SIGNAL LENGTH (S)	180
CLEARANCE LOST TIME (S)	2

Existing Conditions

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
START X1 (FEET)	-60	-60		60	60		0	24		-6	-24	
START YI (FEET)	-6	-24		-6	12		-60	-60		48	48	
END X2 (FEET)	-500	-500		500	500		0	24		-6	-24	
END Y2 (FEET)	-6	-24		-6	12		-500	-500		500	500	
TRAFFIC VOLUME [VPH]	410	2120	860	205	1270	165	780	515	235	220	445	365
EMISSION FACTOR	53.715	53.715		53.715	53.715	53.715	53.715	53.715		53.715	53.715	
SOURCE HEIGHT	0	0		0	0		0	0		0	0	
MIXING ZONE WIDTH	12	24		12	24		24	24		12	24	
NUMBER OF LANES IN QUEUE	1	2		1	2		2	2		1	2	
TOTAL SIGNAL LENGTH	180	180		180	180		180	180		180	180	
AVERAGE RED	91	91		80	106		146	146		149	149	
CLEARANCE LOST TIME	2	2		2	2		2	2		2	2	
SATURATION FLOW RATE (per lane)	1641	1769.5		1770	1769.5		1716.5	1769.5		1770	1769.5	
AVERAGE GREEN	89	89		100	74		34	34		31	31	
SATURATION FLOW RATE	1641	3539		1770	3539		3433	3539		1770	3539	
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
START X1 (FEET)	0	0		0	0		24	24		-24	-24	
START YI (FEET)	-24	-24		12	12		0	0		0	0	
END X2 (FEET)	-500	500		500	-500		24	24		-24	-24	
END Y2 (FEET)	-24	-24		12	12		-500	500		500	-500	
TRAFFIC VOLUME [VPH]	3390	2575		1640	2415		970	1090		1030	1510	
EMISSION FACTOR	4.972	4.972		4.972	4.972		4.972	4.972		4.972	4.972	
SOURCE HEIGHT	0	0		0	0		0	0		0	0	
MIXING ZONE WIDTH	58	46		58	46		58	46		58	46	
NUMBER OF LANES IN QUEUE	4	3		4	3		4	3		4	3	

No-Action Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	480	2260	810	230	1400	220	760	680	260	290	570	430
TOTAL SIGNAL LENGTH	180	180		180	180		180	180		180	180	
AVERAGE RED	44	84		88	106		145	140		154	149	
AVERAGE GREEN	136	96		92	74		35	40		26	31	
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	3550	2810		1850	2590		1230	1380		1290	1610	

Preferred Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	540	2320	860	220	1340	230	720	680	240	290	580	440
TOTAL SIGNAL	180	180		180	180		180	180		180	180	

LENGTH												
AVERAGE RED	36	80		90	107		148	143		154	149	
AVERAGE GREEN	144	100		90	73		32	37		26	31	
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	3720	2850		1790	2500		1210	1450		1310	1660	

Town Center Alternative

	EBL	**EBT**	**EBR**	**WBL**	**WBT**	**WBR**	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**
TRAFFIC VOLUME [VPH]	540	2320	860	220	1340	230	720	680	240	290	580	440
TOTAL SIGNAL LENGTH	180	180		180	180		180	180		180	180	
AVERAGE RED	36	80		90	107		148	143		154	149	
AVERAGE GREEN	144	100		90	73		32	37		26	31	
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	3720	2850		1790	2500		1210	1450		1310	1660	

City Center Alternative

	EBL	**EBT**	**EBR**	**WBL**	**WBT**	**WBR**	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**
TRAFFIC VOLUME [VPH]	510	2300	870	230	1320	230	730	670	250	290	590	420
TOTAL SIGNAL LENGTH	180	180		180	180		180	180		180	180	
AVERAGE RED	41	83		89	107		147	141		154	148	
AVERAGE GREEN	139	97		91	73		33	39		26	32	
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	3680	2840		1780	2470		1210	1410		1300	1690	

Satellite Campus Alternative

	EBL	**EBT**	**EBR**	**WBL**	**WBT**	**WBR**	**NBL**	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**
TRAFFIC VOLUME [VPH]	420	2330	790	220	1410	200	840	740	290	280	580	410
TOTAL SIGNAL LENGTH	180	180		180	180		180	180		180	180	
AVERAGE RED	51	84		83	100		144	138		155	149	
AVERAGE GREEN	129	96		97	80		36	42		25	31	
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	3540	2900		1830	2660		1310	1360		1270	1590	

INTERSECTION DESCRIPTION - Franconia Springfield Parkway/ Spring Village Dr.

IDLE EMISSION FACTOR [GRAMS/HOUR]	53.715
MOVING EMISSION FACTOR	4.972
LANE WIDTH (FEET)	12
SOURCE HEIGHT (FEET)	0
SIGNAL LENGTH (S)	180
CLEARANCE LOST TIME (S)	2

Existing Conditions

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
START X1 (FEET)	-48	-48	-48	48	48	48	-6	6	18	6	-6	-18
START YI (FEET)	-6	-30	-42	-6	18	42	-72	-72	-72	72	72	72
END X2 (FEET)	-500	-500	-500	500	500	500	-6	6	18	6	-6	-18
END Y2 (FEET)	-6	-30	-42	-6	18	42	-500	-500	-500	500	500	500
TRAFFIC VOLUME [VPH]	70	1905	95	250	4130	100	45	5	150	90	10	50
EMISSION FACTOR	53.715	53.715	53.715	53.715	53.715	53.715	53.715	53.715	53.715	53.715	53.715	53.715
SOURCE HEIGHT	0	0	0	0	0	0	0	0	0	0	0	0
MIXING ZONE WIDTH	12	36	12	12	36	12	12	12	12	12	12	12
NUMBER OF LANES IN QUEUE	1	3	1	1	3	1	1	1	1	1	1	1
TOTAL SIGNAL LENGTH	180	180	180	180	180	180	180	180	180	180	180	180
AVERAGE RED	53	53	53	45	45	45	152	152	152	152	152	152
CLEARANCE LOST TIME	2	2	2	2	2	2	2	2	2	2	2	2
SATURATION FLOW RATE (per lane)	60	1695	1583	1770	1695	1583	1770	1863	1583	1711	1863	1583
SATURATION FLOW RATE	60	5085	1583	1770	5085	1583	1770	1863	1583	1711	1863	1583
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
START X1 (FEET)	0	0		0	0		6	6		-6	-6	
START YI (FEET)	-30	-30		18	18		0	0		0	0	
END X2 (FEET)	-500	500		500	-500		6	6		-6	-6	
END Y2 (FEET)	-30	-30		18	18		-500	500		500	-500	
TRAFFIC VOLUME [VPH]	2070	2145		4480	4225		245	175		150	355	
EMISSION FACTOR	4.972	4.972		4.972	4.972		4.972	4.972		4.972	4.972	
SOURCE HEIGHT	0	0		0	0		0	0		0	0	
MIXING ZONE WIDTH	46	46		46	46		34	34		34	34	
NUMBER OF LANES IN QUEUE	3	3		3	3		2	2		2	2	

No-Action Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	100	1900	110	270	4130	130	50	10	160	110	20	70
TOTAL SIGNAL LENGTH	180	180	180	180	180	180	180	180	180	180	180	180
AVERAGE RED	76	88	88	16	58	58	134	134	134	134	134	134
AVERAGE GREEN	104	92	92	164	122	122	46	46	46	46	46	46
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	2110	2170		4530	4250		280	240		200	400	

Preferred Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	60	3820	250	670	1570	80	170	20	470	60	60	30
TOTAL SIGNAL LENGTH	276	276	276	276	276	276	276	276	276	276	276	276
AVERAGE RED	108	120	120	58	58	58	230	230	230	230	230	230
AVERAGE GREEN	168	156	156	218	218	218	46	46	46	46	46	46
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	4130	4350		2320	1770		550	160		150	980	

City Center Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	60	3800	270	680	1600	80	180	30	480	60	60	30
TOTAL SIGNAL LENGTH	276	276	276	276	276	276	276	276	276	276	276	276
AVERAGE RED	108	120	120	58	58	58	230	230	230	230	230	230
AVERAGE GREEN	168	156	156	218	218	218	46	46	46	46	46	46
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	4130	4340		2360	1810		570	170		150	1010	

INTERSECTION DESCRIPTION - Route 1/ Backlick Rd. - Pohick Rd.

IDLE EMISSION FACTOR [GRAMS/HOUR]	53.715
MOVING EMISSION FACTOR	4.972
LANE WIDTH (FEET)	12
SOURCE HEIGHT (FEET)	0
SIGNAL LENGTH (S)	180
CLEARANCE LOST TIME (S)	2

Existing Conditions

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
START X1 (FEET)	-60	-60	-60	48	48		-6	6		-30	-18	-6
START YI (FEET)	6	-12	-30	-6	12		-60	-60		60	60	-72
END X2 (FEET)	-500	-500	500	500	500		-6	6		-30	-18	-6
END Y2 (FEET)	6	-12	-30	-6	12		-500	-500		500	500	500
TRAFFIC VOLUME [VPH]	5	1220	140	10	1430	90	110	70	25	185	15	10
EMISSION FACTOR	53.715	53.715	53.715	53.715	53.715		53.715	53.715		53.715	53.715	53.715
SOURCE HEIGHT	0	0	0	0	0		0	0		0	0	0
MIXING ZONE WIDTH	12	24	12	12	24		12	12		12	12	12
NUMBER OF LANES IN QUEUE	1	2	1	1	2		1	1		1	1	1
TOTAL SIGNAL LENGTH	180	180	180	180	180		180	180		180	180	180
AVERAGE RED	74	90.5	90.5	74	90.5		130	130		156	156	156
CLEARANCE LOST TIME	2	2	2	2	2		2	2		2	2	2
SATURATION FLOW RATE (per lane)	1770	1769.5	1583	1770	1753.5		1681	1689		1593	1676	1478
AVERAGE GREEN	106	89.5	89.5	106	89.5		50	50		24	24	24
SATURATION FLOW RATE	1770	3539	1583	1770	3507		1681	1689		1593	1676	1478

	EBA	EBD		WBA	WBD		NBA	NBD		SBA	SBD	
START X1 (FEET)	0	0		0	0		6	6		-18	-18	
START YI (FEET)	-12	-12		12	12		0	0		0	0	
END X2 (FEET)	-500	500		500	-500		6	6		-18	-18	
END Y2 (FEET)	-12	-12		12	12		-500	500		500	-500	
TRAFFIC VOLUME [VPH]	1365	1430		1530	1550		280	165		210	165	
EMISSION FACTOR	4.972	4.972		4.972	4.972		4.972	4.972		4.972	4.972	
SOURCE HEIGHT	0	0		0	0		0	0		0	0	
MIXING ZONE WIDTH	58	34		58	34		34	22		46	22	
NUMBER OF LANES IN QUEUE	4	2		4	2		2	1		3	1	

No-Action Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	10	1280	140	20	1490	60	1180	110	40	190	20	10
TOTAL SIGNAL LENGTH	180	180	180	180	180		180	180		180	180	180
AVERAGE RED	96	107.5	107.5	96	107.5		121	121		143	143	143
AVERAGE GREEN	84	72.5	72.5	84	72.5		59	59		37	37	37
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	1430	1510		1570	2680		340	180		220	180	

Preferred Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	10	1680	180	80	1850	110	890	350	110	170	90	10
TOTAL SIGNAL LENGTH	180	180	180	180	180		180	180		180	180	180
AVERAGE RED	89	100.5	100.5	89	100.5		128	128		143	143	143
AVERAGE GREEN	91	79.5	79.5	91	79.5		52	52		37	37	37
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	1870	1960		2040	2750		630	470		270	350	

Town Center Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	10	1500	270	120	1670	100	1210	430	150	150	110	10
TOTAL SIGNAL LENGTH	180	180	180	180	180		180	180		180	180	180
AVERAGE RED	98	109.5	109.5	98	109.5		119	119		143	143	143
AVERAGE GREEN	82	70.5	70.5	82	70.5		61	61		37	37	37
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	1780	1800		1890	2890		730	540		270	500	

City Center Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	10	1530	200	10	1570	90	1060	200	70	210	50	10
TOTAL SIGNAL LENGTH	180	180	180	180	180		180	180		180	180	180
AVERAGE RED	94	105.5	105.5	94	105.5		123	123		123	123	123
AVERAGE GREEN	86	74.5	74.5	86	74.5		57	57		57	57	57
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	1740	1810		1670	2640		480	300		270	260	

Satellite Campus Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	10	1570	260	80	1640	80	110	390	100	140	120	10
TOTAL SIGNAL LENGTH	180	180	180	180	180		180	180		180	180	180
AVERAGE RED	96	107.5	107.5	96	107.5		121	121		143	143	143
AVERAGE GREEN	84	72.5	72.5	84	72.5		59	59		37	37	37
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	1840	1810		1800	1760		630	480		270	460	

INTERSECTION DESCRIPTION - Route 1/ Belvoir

IDLE EMISSION FACTOR [GRAMS/HOUR]	53.715
MOVING EMISSION FACTOR	4.972
LANE WIDTH (FEET)	12
SOURCE HEIGHT (FEET)	0
SIGNAL LENGTH (S)	180
CLEARANCE LOST TIME (S)	2

Existing Conditions

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
START X1 (FEET)		-36	-36	36	36		6		18			
START YI (FEET)		-12	-18	6	24		-48		-48			
END X2 (FEET)		-500	500	500	500		6		18			
END Y2 (FEET)		-12	-18	6	24		-500		-500			
TRAFFIC VOLUME [VPH]		1720	295	270	1590		155		85			
EMISSION FACTOR		53.715	53.715	53.715	53.715		53.715		53.715			
SOURCE HEIGHT		0	0	0	0		0		0			
MIXING ZONE WIDTH		24	12	12	24		12		12			
NUMBER OF LANES IN QUEUE		2	1	1	2		1		1			
TOTAL SIGNAL LENGTH		180	180	180	180		180		180			
AVERAGE RED		65	65	138.5	23.5		156.5		156.5			
CLEARANCE LOST TIME		2	2	2	2		2		2			
SATURATION FLOW RATE (per lane)		1769.5	1583	1770	1769.5		1770		1583			
AVERAGE GREEN		115	115	41.5	156.5		23.5		23.5			
SATURATION FLOW RATE		3539	1583	1770	3539		1770		1583			
	EBA	**EBD**		**WBA**	**WBD**		**NBA**				**SBD**	
START X1 (FEET)	0	0		0	0		0				0	
START YI (FEET)	-12	-12		24	24		0				0	
END X2 (FEET)	-500	500		500	-500		0				0	
END Y2 (FEET)	-12	-12		24	24		-500				0	
TRAFFIC VOLUME [VPH]	2015	1805		1860	1745		85				565	
EMISSION FACTOR	4.972	4.972		4.972	4.972		4.972				4.972	
SOURCE HEIGHT	0	0		0	0		0				0	
MIXING ZONE WIDTH	34	34		46	34		34				34	
NUMBER OF LANES IN QUEUE	2	2		3	2		2				2	

No-Action Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]		1760	210	310	1590		120		110			
TOTAL SIGNAL LENGTH		180	180	180	180		180		180			
AVERAGE RED		66	66	23	23		137		157			
AVERAGE GREEN		114	114	157	157		43		23			
	EBA	**EBD**		**WBA**	**WBD**		**NBA**				**SBD**	
TRAFFIC VOLUME [VPH]	1970	1870		1900	1710		110				520	

Preferred Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]		2050	320	410	1600		430		390			
TOTAL SIGNAL LENGTH		180	180	180	180		180		180			
AVERAGE RED		80	80	143	43		137		137			
AVERAGE GREEN		100	100	37	137		43		43			
	EBA	**EBD**		**WBA**	**WBD**		**NBA**				**SBD**	
TRAFFIC VOLUME [VPH]	2370	2440		2010	2030		390				730	

Town Center Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]		1780	130	650	1790		220		630			
TOTAL SIGNAL LENGTH		180	180	180	180		180		180			
AVERAGE RED		92	92	32	32		148		148			
AVERAGE GREEN		88	88	148	148		32		32			
	EBA	**EBD**		**WBA**	**WBD**		**NBA**				**SBD**	
TRAFFIC VOLUME [VPH]	1910	2410		2440	2010		630				780	

INTERSECTION DESCRIPTION - Route 1/ Fairfax County Parkway

IDLE EMISSION FACTOR [GRAMS/HOUR]	53.715
MOVING EMISSION FACTOR	4.972
LANE WIDTH (FEET)	12
SOURCE HEIGHT (FEET)	0
SIGNAL LENGTH (S)	180
CLEARANCE LOST TIME (S)	2

Existing Conditions

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
START X1 (FEET)	-60	-60			60					-24		-42
START YI (FEET)	-12	-36			12					60		48
END X2 (FEET)	-500	-500			500					-24		-42
END Y2 (FEET)	-12	-36			12					500		500
TRAFFIC VOLUME [VPH]	340	2085			650	920				840		20
EMISSION FACTOR	53.715	53.715			53.715					53.715		53.715
SOURCE HEIGHT	0	0			0					0		0
MIXING ZONE WIDTH	24	24			24					24		12
NUMBER OF LANES IN QUEUE	2	2			2					2		1
TOTAL SIGNAL LENGTH	180	180			180					180		180
AVERAGE RED	150	57.5			87.5					122.5		150
CLEARANCE LOST TIME	2	2			2					2		2
SATURATION FLOW RATE (per lane)	1716.5	1769.5			1769.5					1716.5		1583
AVERAGE GREEN	30	122.5			92.5					57.5		30
SATURATION FLOW RATE	3433	3539			3539					3433		1583
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**		
START X1 (FEET)	0	0		0	0		0	0		0		
START YI (FEET)	-36	-36		12	12		0	0		0		
END X2 (FEET)	-500	500		500	-500		0	0		0		
END Y2 (FEET)	-36	-36		12	12		-500	500		500		
TRAFFIC VOLUME [VPH]	2425	2925		1570	670		840	1260		860		
EMISSION FACTOR	4.972	4.972		4.972	4.972		4.972	4.972		4.972		
SOURCE HEIGHT	0	0		0	0		0	0		0		
MIXING ZONE WIDTH	58	34		46	34		46	34		46		
NUMBER OF LANES IN QUEUE	4	2		3	2		3	2		3		

No-Action Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	390	2050			660	1000				930		30
TOTAL SIGNAL LENGTH	180	180			180					180		180
AVERAGE RED	147	59			92					121		88
AVERAGE GREEN	33	121			88					59		92
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	2440	2980		1660	690		930	1390		960	0	

Preferred Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	710	1860			1070	1240				1260		90
TOTAL SIGNAL LENGTH	180	180			180					180		180
AVERAGE RED	150	57.5			87.5					122.5		92.5
AVERAGE GREEN	30	122.5			92.5					57.5		87.5
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	2570	3120		2310	1160		1260	1950		1350	0	

Town Center Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	1090	1730			1070	1420				1560		160
TOTAL SIGNAL LENGTH	180	180			180					180		180
AVERAGE RED	128	74			126					106		54
AVERAGE GREEN	52	106			54					74		126
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	2820	3290		2490	1230		1560	2510		1720	0	

City Center Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	580	1910			980	1090				1120		70
TOTAL SIGNAL LENGTH	180	180			180					180		180
AVERAGE RED	150	57.5			87.5					122.5		92.5
AVERAGE GREEN	30	122.5			92.5					57.5		87.5
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	2490	3030		2070	1050		1120	1670		1190	0	

Satellite Campus Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	940	1620			980	1420				1550		140
TOTAL SIGNAL LENGTH	180	180			180					180		180
AVERAGE RED	131	78			127					102		53
AVERAGE GREEN	49	102			53					78		127
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	2560	3170		2400	1120		1550	2360		1690	0	

INTERSECTION DESCRIPTION - Route 1/ Telegraph

IDLE EMISSION FACTOR [GRAMS/HOUR]	53.715
MOVING EMISSION FACTOR	4.972
LANE WIDTH (FEET)	12
SOURCE HEIGHT (FEET)	0
SIGNAL LENGTH (S)	180
CLEARANCE LOST TIME (S)	2

Existing Conditions

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
START X1 (FEET)	-72	-72		84	84	84	-6	6	18	0	-18	-42
START YI (FEET)	-12	-42		-6	12	42	-84	-84	-84	60	60	60
END X2 (FEET)	-500	-500		-500	500	-500	-6	6	18	0	-18	-42
END Y2 (FEET)	-12	-42		-6	12	42	500	500	500	500	500	500
TRAFFIC VOLUME [VPH]	220	715	55	150	1960	35	5	25	30	70	175	800
EMISSION FACTOR	53.715	53.715		53.715	53.715	53.715	53.715	53.715	53.715	53.715	53.715	53.715
SOURCE HEIGHT	0	0		0	0	0	0	0	0	0	0	0
MIXING ZONE WIDTH	24	36		12	48	12	12	12	12	24	12	36
NUMBER OF LANES IN QUEUE	2	3		1	4	1	1	1	1	2	1	3
TOTAL SIGNAL LENGTH	180	180		180	180	180	180	180	180	180	180	180
AVERAGE RED	154.5	84		162.5	92	92	158	158	158	135.5	135.5	135.5
CLEARANCE LOST TIME	2	2		2	2	2	2	2	2	2	2	2
SATURATION FLOW RATE (per lane)	1716.5	1695		1770	1602	1583	1770	1863	1583	1716.5	1860	1203.333
AVERAGE GREEN	25.5	96		17.5	88	88	22	22	22	44.5	44.5	44.5
SATURATION FLOW RATE	3433	5085		1770	6408	1583	1770	1863	1583	3433	1860	3610
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
START X1 (FEET)	0	0		0	0		-84	-84		60	60	
START YI (FEET)	-42	-42		12	12		0	0		0	0	
END X2 (FEET)	-500	500		500	-500		-84	-84		60	60	
END Y2 (FEET)	-42	-42		12	12		-500	500		500	-500	
TRAFFIC VOLUME [VPH]	990	815		2145	2765		125	280		1045	380	
EMISSION FACTOR	4.972	4.972		4.972	4.972		4.972	4.972		4.972	4.972	
SOURCE HEIGHT	0	0		0	0		0	0		0	0	
MIXING ZONE WIDTH	70	46		82	58		46	34		82	22	
NUMBER OF LANES IN QUEUE	5	3		6	4		3	2		6	1	

No-Action Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	280	700	50	150	1990	60	10	30	30	100	190	950
TOTAL SIGNAL LENGTH	180	180	180	180	180	180	180	180	180	180	180	180
AVERAGE RED	158	129		158	122	122	130	130	130	130	130	130
AVERAGE GREEN	22	51		22	58	58	50	50	50	50	50	50
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	1030	830		2200	2950		160	370		1240	390	

Preferred Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	260	1040	40	210	2000	80	10	30	40	200	140	860
TOTAL SIGNAL LENGTH	180	180	180	180	180	180	180	180	180	180	180	180
AVERAGE RED	158	128		149	119	72	130	130	130	133	133	133
AVERAGE GREEN	22	52		31	61	108	50	50	50	47	47	47
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	1340	1280		2290	2870		270	370		1200	390	

Town Center Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	240	910	40	200	2340	90	10	30	40	190	150	840
TOTAL SIGNAL LENGTH	180	180	180	180	180	180	180	180	180	180	180	180
AVERAGE RED	158	127		144	113	72	130	130	130	139	139	139
AVERAGE GREEN	22	53		36	67	108	50	50	50	41	41	41
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	1190	1140		2630	3190		260	360		1180	390	

City Center Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	270	980	50	180	2030	130	10	30	40	170	170	870
TOTAL SIGNAL LENGTH	180	180	180	180	180	180	180	180	180	180	180	180
AVERAGE RED	158	124		153	119	130	130	130	130	133	133	133
AVERAGE GREEN	22	56		27	61	50	50	50	50	47	47	47
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	1300	1190		2340	2910		240	430		1210	400	

Satellite Campus Alternative

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
TRAFFIC VOLUME [VPH]	230	930	30	160	2170	90	10	30	40	240	200	990
TOTAL SIGNAL LENGTH	180	180	180	180	180	180	180	180	180	180	180	180
AVERAGE RED	158	127		149	118	72	130	130	130	134	134	134
AVERAGE GREEN	22	53		31	62	108	50	50	50	46	46	46
	EBA	**EBD**		**WBA**	**WBD**		**NBA**	**NBD**		**SBA**	**SBD**	
TRAFFIC VOLUME [VPH]	1190	1210		2420	3170		310	350		1430	390	

APPENDIX E.3
CRITERIA AIR POLLUTANTS—SOURCES AND IMPACTS

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Criteria Pollutants—Sources and Impacts

Pollutants and Their Sources	Health and Environmental Impacts
Ozone (O_3): a gas composed of three oxygen atoms. It is not usually emitted directly into the air, but at ground level is created by a chemical reaction between oxides of NO_x and VOC in the presence of heat and sunlight. Ozone has the same chemical structure whether it occurs miles above the earth or at ground level and can be "good" or "bad," depending on its location in the atmosphere. "Good" ozone occurs naturally in the stratosphere approximately 10 to 30 miles above the earth's surface and forms a layer that protects life on earth from the sun's harmful rays. In the earth's lower atmosphere, ground-level ozone is considered "bad." **a) VOC + NOx + Heat + Sunlight = Ozone** Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents are some of the major sources of NO_x and VOC, that help to form ozone. Sunlight and hot weather cause ground-level ozone to form in harmful concentrations in the air. As a result, it is known as a summertime air pollutant. Many urban areas tend to have high levels of "bad" ozone, but even rural areas are also subject to increased ozone levels because wind carries ozone and pollutants that form it hundreds of miles away from their original sources.	**Health Problems**: Ozone can irritate lung airways and cause inflammation much like a sunburn. Other symptoms include wheezing, coughing, pain when taking a deep breath, and breathing difficulties during exercise or outdoor activities. People with respiratory problems are most vulnerable, but even healthy people that are active outdoors can be affected when ozone levels are high. Repeated exposure to ozone pollution for several months may cause permanent lung damage. Anyone who spends time outdoors in the summer is at risk, particularly children, and other people who are active outdoors. Even at very low levels, ground-level ozone triggers a variety of health problems including aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses like pneumonia and bronchitis. **Plant and Ecosystem Damage**: Ground-level ozone interferes with the ability of plants to produce and store food, which makes them more susceptible to disease, insects, other pollutants, and harsh weather. Ozone damages the leaves of trees and other plants, ruining the appearance of cities, national parks, and recreation areas. Ozone reduces crop and forest yields and increases plant vulnerability to disease, pests, and harsh weather.
Carbon Monoxide (CO): a colorless, odorless gas that is formed when carbon in fuel is not burned completely. It is a component of motor vehicle exhaust, which contributes about 56 percent of all CO emissions nationwide. Other non-road engines and vehicles (such as construction equipment and boats) contribute about 22 percent of all CO emissions nationwide. Higher levels of CO generally occur in areas with heavy traffic congestion. In cities, 85 to 95 percent of all CO emissions may come from motor vehicle exhaust. Other sources of CO emissions include industrial processes (such as metals processing and chemical manufacturing), residential wood burning, and natural sources such as forest fires. Woodstoves, gas stoves, cigarette smoke, and unvented gas and kerosene space heaters are sources of CO indoors. The highest levels of CO in the outside air typically occur during the colder months of the year when inversion conditions are more frequent. The air pollution becomes trapped near the ground beneath a layer of warm air.	**Health Problems** CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. **Cardiovascular Effects.** The health threat from lower levels of CO is most serious for those who suffer from heart disease, like angina, clogged arteries, or congestive heart failure. For a person with heart disease, a single exposure to CO at low levels may cause chest pain and reduce that person's ability to exercise; repeated exposures may contribute to other cardiovascular effects. **Central Nervous System Effects.** Even healthy people can be affected by high levels of CO. People who breathe high levels of CO can develop vision problems, reduced ability to work or learn, reduced manual dexterity, and difficulty performing complex tasks. At extremely high levels, CO is poisonous and can cause death. **Smog.** CO contributes to the formation of smog and ground level O_3, which can trigger serious respiratory problems.
Sulfur Dioxide (SO_2): SO_2 belongs to the family of sulfur oxide gases (SO_x). Sulfur is prevalent in all raw materials, including crude oil, coal, and ore that contains common metals like aluminum, copper, zinc, lead, and iron. SO_x gases are formed when fuel containing sulfur, such as coal and oil, is burned, and when gasoline is extracted from oil, or metals are extracted from ore. SO_2 dissolves in water vapor to form acid, and interacts with other gases and particles in the air to form sulfates and other products that can be harmful to people and their environment.	SO_2 causes a wide variety of health and environmental impacts because of the way it reacts with other substances in the air. Particularly sensitive groups include people with asthma who are active outdoors and children, the elderly, and people with heart or lung disease. **Health Problems**: **Respiratory Effects from Gaseous SO_2** Peak levels of SO_2 in the air can cause temporary breathing difficulty for people with asthma who are active outdoors. Longer-term exposures to high levels of SO_2 gas and particles cause respiratory illness and aggravate existing heart disease.

Over 65% of SO_2 released to the air, or more than 13 million tons per year, comes from electric utilities, especially those that burn coal. Other sources of SO_2 are industrial facilities that derive their products from raw materials like metallic ore, coal, and crude oil, or that burn coal or oil to produce process heat. Examples are petroleum refineries, cement manufacturing, and metal processing facilities. Also, locomotives, large ships, and some non-road diesel equipment currently burn high sulfur fuel and release SO_2 emissions to the air in large quantities.	**Respiratory Effects from Sulfate Particles** SO_2 reacts with other chemicals in the air to form tiny sulfate particles. When these are breathed, they gather in the lungs and are associated with increased respiratory symptoms and disease, difficulty in breathing, and premature death. **Visibility Impairment** Haze occurs when light is scattered or absorbed by particles and gases in the air. Sulfate particles are the major cause of reduced visibility in many parts of the U.S., including our national parks. **Plant and Ecosystem Damage**: **Acid Rain** SO_2 and nitrogen oxides react with other substances in the air to form acids, which fall to earth as rain, fog, snow, or dry particles. Some may be carried by the wind for hundreds of miles. **Plant and Water Damage** Acid rain damages forests and crops, changes the makeup of soil, and makes lakes and streams acidic and unsuitable for fish. Continued exposure over a long time changes the natural variety of plants and animals in an ecosystem. **Aesthetic Damage** SO_2 accelerates the decay of building materials and paints, including irreplaceable monuments, statues, and sculptures that are part of our nation's cultural heritage.
Nitrogen Dioxide (NO_2): the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. Many of the nitrogen oxides are colorless and odorless. However, one common pollutant, NO_2, along with particles in the air can often be seen as a reddish-brown layer over many urban areas. Nitrogen oxides form when fuel is burned at high temperatures, as in a combustion process. The primary sources of NO_x are motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels.	NO_x causes a wide variety of health and environmental impacts because of various compounds and derivatives in the family of nitrogen oxides, including nitrogen dioxide, nitric acid, nitrous oxide, nitrates, and nitric oxide. **Health Problems**: Ground-level ozone (smog) is formed when NOx and volatile organic compounds (VOCs) react in the presence of heat and sunlight. Children, people with lung diseases such as asthma, and people who work or exercise outside are susceptible to adverse effects such as damage to lung tissue and reduction in lung function. Ozone can be transported by wind currents and cause health impacts far from original sources. Millions of Americans live in areas that do not meet the health standards for ozone. **Particles** NO_x reacts with ammonia, moisture, and other compounds to form nitric acid and related particles. Human health concerns include effects on breathing and the respiratory system, damage to lung tissue, and premature death. Small particles penetrate deeply into sensitive parts of the lungs and can cause or worsen respiratory disease such as emphysema and bronchitis, and aggravate existing heart disease. **Toxic Chemicals** In the air, NOx reacts readily with common organic chemicals and even ozone, to form a wide variety of toxic products, some of which may cause biological mutations. Examples of these chemicals include the nitrate radical, nitroarenes, and nitrosamines.

	Visibility Impairment Nitrate particles and nitrogen dioxide can block the transmission of light, reducing visibility in urban areas and on a regional scale in our national parks. **Plant and Ecosystem Damage**: Direct impacts from ozone include damaged vegetation and reduced crop yields. **Acid Rain** NOx and sulfur dioxide react with other substances in the air to form acids, which fall to earth as rain, fog, snow, or dry particles. Some may be carried by wind for hundreds of miles. Acid rain damages; causes deterioration of cars, buildings and historical monuments; and causes lakes and streams to become acidic and unsuitable for many fish. **Water Quality Deterioration** Increased nitrogen loading in water bodies, particularly coastal estuaries, upsets the chemical balance of nutrients used by aquatic plants and animals. Additional nitrogen accelerates "eutrophication," which leads to oxygen depletion and reduces fish and shellfish populations. NOx emissions in the air are one of the largest sources of nitrogen pollution in the Chesapeake Bay. **Global Warming** One member of the NOx family, nitrous oxide, is a greenhouse gas. It accumulates in the atmosphere with other greenhouse gasses causing a gradual rise in the earth's temperature. This will lead to increased risks to human health, a rise in the sea level, and other adverse changes to plant and animal habitat.
Particulates (PM_{10} and $PM_{2.5}$): Particulate matter (PM) is the term for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets. Particles can be suspended in the air for long periods of time. Some particles are large or dark enough to be seen as soot or smoke. Others are so small that individually they can only be detected with an electron microscope. Some particles are directly emitted into the air. They come from a variety of sources such as cars, trucks, buses, factories, construction sites, tilled fields, unpaved roads, stone crushing, and burning of wood. Other particles may be formed in the air from the chemical change of gases. They are indirectly formed when gases from burning fuels react with sunlight and water vapor. These can result from fuel combustion in motor vehicles, at power plants, and in other industrial processes.	**Health Problems**: Many scientific studies have linked breathing PM to a series of health problems, including: • aggravated asthma • increases in respiratory symptoms like coughing and difficult or painful breathing • chronic bronchitis • decreased lung function • premature death **Visibility Impairment** PM is the major cause of reduced visibility (haze) in parts of the United States, including many of our national parks. **Plant and Ecosystem Damage**: **Atmospheric deposition** Particles can be carried over long distances by wind and then settle on ground or water. The effects of this settling include: • making lakes and streams acidic • changing the nutrient balance in coastal waters and

	large river basins • depleting the nutrients in soil • damaging sensitive forests and farm crops • affecting the diversity of ecosystems **Aesthetic damage** Soot, a type of PM, stains and damages stone and other materials, including culturally important objects such as monuments and statues.
Lead (Pb): a metal found naturally in the environment as well as in manufactured products. The major sources of lead emissions have historically been motor vehicles (such as cars and trucks) and industrial sources. Due to the phase out of leaded gasoline, metals processing is the major source of lead emissions to the air today. The highest levels of lead in air are generally found near lead smelters. Other stationary sources are waste incinerators, utilities, and lead-acid battery manufacturers.	People, animals, and fish are mainly exposed to lead by breathing and ingesting it in food, water, soil, or dust. Lead accumulates in the blood, bones, muscles, and fat. Infants and young children are especially sensitive to even low levels of lead. **Health Problems**: **Damages organs** - Lead causes damage to the kidneys, liver, brain and nerves, and other organs. Exposure to lead may also lead to osteoporosis (brittle bone disease) and reproductive disorders. **Affects the brain and nerves** - Excessive exposure to lead causes seizures, mental retardation, behavioral disorders, memory problems, and mood changes. Low levels of lead damage the brain and nerves in fetuses and young children, resulting in learning deficits and lowered IQ. **Affects the heart and blood** - Lead exposure causes high blood pressure and increases heart disease, especially in men. Lead exposure may also lead to anemia, or weak blood. **Plant and Ecosystem Damage**: **Affects animals and plants** - Wild and domestic animals can ingest lead while grazing. They experience the same kind of effects as people who are exposed to lead. Low concentrations of lead can slow down vegetation growth near industrial facilities. Lead can enter water systems through runoff and from sewage and industrial waste streams. Elevated levels of lead in the water can cause reproductive damage in some aquatic life and cause blood and neurological changes in fish and other animals that live there.

Source: (USEPA 2006a)

APPENDIX E.4
PERMITTED SOURCES OF AIR EMISSIONS—
POTENTIAL-TO-EMIT CALCULATIONS

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ARMY CORP OF ENGINEERS - PROPOSED NGA OPERATIONS AT FORT BELVIOR
POTENTIAL EMISSION ESTIMATES FOR FACILITY BOILERS

ANNUAL EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS AND EXPECTED PERFORMANCE LEVELS

FUEL USAGE	Natural Gas Fired	365 days/year	8,760 hr/yr, or
	No. 2 Fuel Oil Fired	365 days/year	8,760 hr/yr
NATURAL GAS	Heat Input =	24.49 mmBtu/hr	214.6 mmCF/yr (max. one boiler)
	Firing Rate =	0.024 mmCF/hr or	858.3 mmCF/yr (max. four boilers)
	Heat Capacity =	1,000 Btu/CF	
NO. 2 FUEL OIL	Heat Input =	24.49 mmBtu/hr	1511.0 mgal/yr (max. one boiler)
	Firing Rate =	0.172 mgal/hr or	6,044.2 mgal/yr (max.four boilers)
	Heat Capacity =	142,000 Btu/gal	
	Sulfur In Fuel Oil =	0.2 % by weight	

Pollutant Emissions	Emission Factors (lb/mmCF or lb/mgal)		Ind. Boiler Emission Rates (lb/hr)		Facility Boilers Potential Emissions (tons/year)
	Natural Gas	2FO	Natural Gas	2FO	
VOC	5.5	0.34	0.13	0.06	2.4
NO_x	35	36	0.86	6.12	107.3
CO	84	27	2.06	4.58	80.2
SO_2	0.6	28.4	0.01	4.90	85.8
PM/PM_{10}	10	6.36	0.24	1.10	19.2
Lead	0.0005	0.00034	0.10	0.53	1.0E-03

Notes:

*1 Emission factors for natural gas and fuel oil combustion (except those specified in *2 below) based upon values presente in the USEPA reference document AP-42 Section 1.4 and 1.3, respectively.

*2 Emissions factors for NOx, CO for fuel oil firing and PM from natural gas firing based upon manufacturer's expected performance levels.

*3 Maximum annual fuel usage presented above is based upon maximum usage of a particular fuel for the entire year.

*4 Emissions rates calculated based upon the following equation:

Emission Rate (lb/hr) = Emission factor (lb/mmCF or lb/mgal) * Fuel Input (mmCF/hr or mgal/hr)

*5 Potential emissions for both facility boilers based upon worst-case operating scenario (i.e. natural gas or fuel oil) based upon the following equations:

For VOC:
Annual Emissions (TPY) = [Gas Usage (mmCF/yr for four boilers) * Emission Factor (lb/mmCF)]* 1 Ton/2,000 lb

For NO_x, CO, SO_2, PM/PM_{10} and Pb:
Annual Emissions (TPY)=[(Oil Usage (mgal/yr for four boilers)*Emission Factor (lb/mgal)]*1Ton/2,000 lb

ARMY CORP OF ENGINEERS - PROPOSED WHS OPERATIONS AT FORT BELVIOR
POTENTIAL EMISSION ESTIMATES FOR FACILITY BOILERS

ANNUAL EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS AND EXPECTED PERFORMANCE LEVELS

FUEL USAGE	Natural Gas Fired	365 days/year	8,760 hr/yr, or
	No. 2 Fuel Oil Fired	365 days/year	8,760 hr/yr
NATURAL GAS	Heat Input =	28.58 mmBtu/hr	250.3 mmCF/yr (max. one boiler)
	Firing Rate =	0.029 mmCF/hr or	751.0 mmCF/yr (max. three boilers)
	Heat Capacity =	1,000 Btu/CF	
NO. 2 FUEL OIL	Heat Input =	28.98 mmBtu/hr	1787.9 mgal/yr (max. one boiler)
	Firing Rate =	0.204 mgal/hr or	5,363.7 mgal/yr (max.three boilers)
	Heat Capacity =	142,000 Btu/gal	
	Sulfur In Fuel Oil =	0.2 % by weight	

Pollutant Emissions	Emission Factors (lb/mmCF or lb/mgal)		Ind. Boiler Emission Rates (lb/hr)		Facility Boilers Potential Emissions (tons/year)
	Natural Gas	2FO	Natural Gas	2FO	
VOC	5.5	0.34	0.16	0.07	2.1
NO_x	35	36	1.00	7.25	95.2
CO	84	27	2.40	5.42	71.2
SO_2	0.6	28.4	0.02	5.80	76.2
PM/PM_{10}	10	6.36	0.29	1.30	17.1
Lead	0.0005	0.00034	0.10	0.53	9.1E-04

Notes:

*1 Emission factors for natural gas and fuel oil combustion (except those specified in *2 below) based upon values presente in the USEPA reference document AP-42 Section 1.4 and 1.3, respectively.

*2 Emissions factors for NOx, CO for fuel oil firing and PM from natural gas firing based upon manufacturer's expected performance levels.

*3 Maximum annual fuel usage presented above is based upon maximum usage of a particular fuel for the entire year.

*4 Emissions rates calculated based upon the following equation:

Emission Rate (lb/hr) = Emission factor (lb/mmCF or lb/mgal) * Fuel Input (mmCF/hr or mgal/hr)

*5 Potential emissions for both facility boilers based upon worst-case operating scenario (i.e. natural gas or fuel oil) based upon the following equations:

For VOC:
Annual Emissions (TPY) = [Gas Usage (mmCF/yr for four boilers) * Emission Factor (lb/mmCF)]* 1 Ton/2,000 lb

For NO_x, CO, SO_2, PM/PM_{10} and Pb:
Annual Emissions (TPY)=[(Oil Usage (mgal/yr for four boilers)*Emission Factor (lb/mgal)]*1Ton/2,000 lb

ARMY CORP OF ENGINEERS - PROPOSED NGA OPERATIONS AT FORT BELVIOR
ANTICIPATED ACTUAL EMISSION ESTIMATES FOR FACILITY BOILERS

ANNUAL EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS AND EXPECTED PERFORMANCE LEVELS

BOILER DISPATCH 66% of maximum capacity of each boiler
1000 hours per year each boiler on oil

NATURAL GAS	Heat Input =	24.49 mmBtu/hr	566.5 mmCF/yr (both boilers no oil)
	Firing Rate =	0.024 mmCF/hr or	468.5 mmCF/yr (four boilers w/ oil)
	Heat Capacity =	1,000 Btu/CF	
NO. 2 FUEL OIL	Heat Input =	24.49 mmBtu/hr	690.0 mgal/yr (four boilers)
	Firing Rate =	172.5 gal/hr or	
	Heat Capacity =	142,000 Btu/gal	
	Sulfur In Fuel Oil =	0.2 % by weight	

Pollutant Emissions	Emission Factors (lb/mmCF or lb/mgal)		Ind. Boiler Emission Rates (lb/hr)		Facility Boilers Actual Emissions (tons/year)
	Natural Gas	2FO	Natural Gas	2FO	
VOC	5.5	0.34	0.13	0.06	1.56
NO_x	35	36	0.86	6.12	8.20
CO	84	27	2.06	4.58	19.68
SO_2	0.6	28.4	0.01	4.90	0.14
PM/PM_{10}	10.0	6.36	0.24	1.10	2.34
Lead	0.0005	0.00034	1.2E-05	5.8E-05	1.2E-04

Notes:

*1 Emission factors for natural gas and fuel oil combustion (except those specified in *2 below) based upon values presente in the USEPA reference document AP-42 Section 1.4 and 1.3, respectively.

*2 Emissions factors for NOx, CO for fuel oil firing and PM from natural gas firing based upon manufacturer's expected performance levels.

*3 Emissions rates calculated based upon the following equation:

Emission Rate (lb/hr) = Emission factor (lb/mmCF or lb/mgal) * Fuel Input (mmCF/hr or mgal/hr)

*4 Actual emissions for both facility boilers based upon worst-case actual operating scenario (i.e. natural gas or fuel oil) for anticipated actual boiler utilization using the following equations:

For VOC and CO:
Annual Emissions (TPY) = [Gas Usage (mmCF/yr) * Emission Factor (lb/mmCF)]* 1 Ton/2,000 lb

For NO_x, SO_2, PM/PM_{10} and Pb:
Annual Emissions (TPY) = [(Gas Usage (mmCF/yr)*Emission Factor (lb/mmCF))+(Oil Usage (mgal/yr)*Emission Factor (lb/mgal))]

ARMY CORP OF ENGINEERS - PROPOSED WHS OPERATIONS AT FORT BELVIOR
ANTICIPATED ACTUAL EMISSION ESTIMATES FOR FACILITY BOILERS

ANNUAL EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS AND EXPECTED PERFORMANCE LEVELS

BOILER DISPATCH 66% of maximum capacity of each boiler
1000 hours per year each boiler on oil

NATURAL GAS	Heat Input =	28.58 mmBtu/hr	495.6 mmCF/yr (three boilers no oil)
	Firing Rate =	0.029 mmCF/hr or	409.9 mmCF/yr (three boilers w/ oil)
	Heat Capacity =	1,000 Btu/CF	
NO. 2 FUEL OIL	Heat Input =	28.98 mmBtu/hr	0.6 mgal/yr (three boilers)
	Firing Rate =	0.204 gal/hr or	
	Heat Capacity =	142,000 Btu/gal	
	Sulfur In Fuel Oil =	0.2 % by weight	

Pollutant Emissions	Emission Factors (lb/mmCF or lb/mgal)		Ind. Boiler Emission Rates (lb/hr)		Facility Boilers Actual Emissions (tons/year)
	Natural Gas	2FO	Natural Gas	2FO	
VOC	5.5	0.34	0.16	0.00	1.36
NO_x	35	36	1.00	0.01	7.17
CO	84	27	2.40	0.01	17.22
SO_2	0.6	28.4	0.02	0.01	0.12
PM/PM_{10}	10.0	6.36	0.29	0.00	2.05
Lead	0.0005	0.00034	1.4E-05	6.9E-08	1.0E-04

Notes:

*1 Emission factors for natural gas and fuel oil combustion (except those specified in *2 below) based upon values presente in the USEPA reference document AP-42 Section 1.4 and 1.3, respectively.

*2 Emissions factors for NOx, CO for fuel oil firing and PM from natural gas firing based upon manufacturer's expected performance levels.

*3 Emissions rates calculated based upon the following equation:

Emission Rate (lb/hr) = Emission factor (lb/mmCF or lb/mgal) * Fuel Input (mmCF/hr or mgal/hr)

*4 Actual emissions for both facility boilers based upon worst-case actual operating scenario (i.e. natural gas or fuel oil) for anticipated actual boiler utilization using the following equations:

For VOC and CO:
Annual Emissions (TPY) = [Gas Usage (mmCF/yr) * Emission Factor (lb/mmCF)]* 1 Ton/2,000 lb

For NO_x, SO_2, PM/PM_{10} and Pb:
Annual Emissions (TPY) = [(Gas Usage (mmCF/yr)*Emission Factor (lb/mmCF))+(Oil Usage (mgal/yr)*Emission Factor (lb/mgal))]

ARMY CORP OF ENGINEERS - PROPOSED NGA OPERATIONS AT FORT BELVIOR
POTENTIAL EMISSION ESTIMATES FOR 20 MW EMERGENCY GENERATORS

ANNUAL EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS

FUEL USAGE No. 2 Fuel Oil Fired 500 hr/yr

Heat Input =	24.61 mmBtu/hr	3515.514286	hp-hr
Firing Rate =	0.173 mgal/hr or	12,304	mmBtu/yr
Heat Capacity =	142,000 Btu/CF	86.7	mgal/yr
Fuel Oil Sulfur Content =	0.2 % by weight		

Pollutant Emissions	Emission Factors (lb/mmBtu)	Emission Factors (g/hp-hr)	Emission Rates (lb/hr)	Potential Emissions (tons/year)
VOC		0.1	0.78	1.6
NO_x		5.05	39.14	78.3
CO		0.41	3.18	6.4
SO_2	0.29		7.14	14.3
PM/PM_{10}	0.31		7.63	15.3

Notes:

*1 VOC, NOx and CO emission factors for diesel fired emergency generators are based upon values provided by the engine vendor.

*2 SO2 and PM/PM10 emission factors for diesel fired emergency generators are based upon values presented in the USEPA reference document AP-42 Section 3.4.

*3 Emissions rates calculated based upon the following equation:

Emission Rate (lb/hr) = Emission factor (lb/mmBtu) * Fuel Input (mmBtu/hr)

*4 Annual emissions based upon the following equation.

Annual Emissions (TPY) = Fuel Input (mmBtu/hr)*Emission Factor (lb/mmBtu)*500 hr/yr*1Ton/2,000 lb

ARMY CORP OF ENGINEERS - PROPOSED WHS OPERATIONS AT FORT BELVIOR
POTENTIAL EMISSION ESTIMATES FOR EMERGENCY GENERATORS

ANNUAL EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS

FUEL USAGE No. 2 Fuel Oil Fired 500 hr/yr

Heat Input =	17.71	mmBtu/hr	2639 hp-hr
Firing Rate =	0.125	mgal/hr or	8,854 mmBtu/yr
Heat Capacity =	142,000	Btu/CF	62.4 mgal/yr
Fuel Oil Sulfur Content =	0.05	% by weight	

Pollutant Emissions	Emission Factors (lb/mmBtu)	Emission Factors (g/hp-hr)	Emission Rates (lb/hr)	Potential Emissions (tons/year)
VOC		0.1	0.58	0.7
NO_x		5.05	29.38	36.7
CO		0.41	2.39	3.0
SO_2	0.29		5.14	6.4
PM/PM_{10}	0.31		5.49	6.9

Notes:

*1 VOC, NOx and CO emission factors for diesel fired emergency generators are based upon values provided by the engine vendor.

*2 SO2 and PM/PM10 emission factors for diesel fired emergency generators are based upon values presented in the USEPA reference document AP-42 Section 3.4.

*3 Emissions rates calculated based upon the following equation:

Emission Rate (lb/hr) = Emission factor (lb/mmBtu) * Fuel Input (mmBtu/hr)

*4 Annual emissions based upon the following equation.

Annual Emissions (TPY) = Fuel Input (mmBtu/hr)*Emission Factor (lb/mmBtu)*500 hr/yr*1Ton/2,000 lb

ARMY CORP OF ENGINEERS - PROPOSED NGA OPERATIONS AT FORT BELVIOR
ANTICIPATED ACTUAL EMISSION ESTIMATES FOR 20 MW EMERGENCY GENERATORS

ANNUAL EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS

FUEL USAGE No. 2 Fuel Oil Fired 250 hr/yr

Heat Input =	24.61 mmBtu/hr	3515.5 hp-hr
Firing Rate =	0.173 mgal/hr or	6,152 mmBtu/yr
Heat Capacity =	142,000 Btu/CF	43.3 mgal/yr
Fuel Oil Sulfur Content =	0.2 % by weight	

Pollutant Emissions	Emission Factors (lb/mmBtu)	Emission Factors (g/hp-hr)	Emission Rates (lb/hr)	Actual Emissions (tons/year)
VOC		0.1	0.78	0.8
NO_x		5.05	39.14	39.1
CO		0.41	3.18	3.2
SO_2	0.29		7.14	7.1
PM/PM_{10}	0.31		7.63	7.6

Notes:

*1 VOC, NOx and CO emission factors for diesel fired emergency generators are based upon values provided by the engine vendor.

*2 SO2 and PM/PM10 emission factors for diesel fired emergency generators are based upon values presented in the USEPA reference document AP-42 Section 3.4.

*3 Emissions rates calculated based upon the following equation:

Emission Rate (lb/hr) = Emission factor (lb/mmBtu) * Fuel Input (mmBtu/hr)

*4 Annual emissions based upon the following equation.

Annual Emissions (TPY) = Fuel Input (mmBtu/hr)*Emission Factor (lb/mmBtu)*250 hr/yr*1Ton/2,000 lb

ARMY CORP OF ENGINEERS - PROPOSED WHS OPERATIONS AT FORT BELVIOR
ANTICIPATED ACTUAL EMISSION ESTIMATES FOR 20 MW EMERGENCY GENERATORS

ANNUAL EMISSIONS CALCULATIONS BASED UPON AP-42 EMISSION FACTORS

FUEL USAGE No. 2 Fuel Oil Fired 250 hr/yr

Heat Input =	17.71 mmBtu/hr	2639 hp-hr
Firing Rate =	0.125 mgal/hr or	4,427 mmBtu/yr
Heat Capacity =	142,000 Btu/CF	31.2 mgal/yr
Fuel Oil Sulfur Content =	0.2 % by weight	

Pollutant Emissions	Emission Factors (lb/mmBtu)	Emission Factors (g/hp-hr)	Emission Rates (lb/hr)	Actual Emissions (tons/year)
VOC		0.1	0.58	0.4
NO_x		5.05	29.38	18.4
CO		0.41	2.39	1.5
SO_2	0.29		5.14	3.2
PM/PM_{10}	0.31		5.49	3.4

Notes:

*1 VOC, NOx and CO emission factors for diesel fired emergency generators are based upon values provided by the engine vendor.

*2 SO2 and PM/PM10 emission factors for diesel fired emergency generators are based upon values presented in the USEPA reference document AP-42 Section 3.4.

*3 Emissions rates calculated based upon the following equation:

Emission Rate (lb/hr) = Emission factor (lb/mmBtu) * Fuel Input (mmBtu/hr)

*4 Annual emissions based upon the following equation.

Annual Emissions (TPY) = Fuel Input (mmBtu/hr)*Emission Factor (lb/mmBtu)*250 hr/yr*1Ton/2,000 lb

ARMY CORP OF ENGINEERS - PROPOSED NGA AND WHS OPERATIONS AT FORT BELVIOR
SUMMARY OF ANTICIPATED WORST-CASE ACTUAL EMISSIONS FOR 20MW GENERATOR SCENARIO

CONTAMINANT	NGA Boilers	NGA 20 MW Emergency Generators	WHS Boilers	WHS Emergency Generators	Facility Total Emissions	Major Source Threshold
VOC	1.56	0.78	1.36	0.36	**4.1**	**50**
NO_x	8.20	39.14	7.17	18.36	**72.9**	**100**
CO	19.68	3.18	17.22	1.49	**41.6**	**100**
SO_2	0.14	7.14	0.12	3.21	**10.6**	**100**
PM/PM_{10}	2.34	7.63	2.05	3.43	**15.5**	**100**
HAPs						**25**
Lead	1.17E-04		1.02E-04		**2.2E-04**	10

NOTES:
*1 - Please refer to individual spreadsheets for detailed emissions calculations for each unit
*2 - Worst-Case Anticipated Actual Emissionscalculated based upon asumptions presented for each unit.
*3 - PSD threshold based upon the definition of "najor stationary source" presented in Section 808 of the Virginia DEQ regulations for facility with boilers with a total heat input of greater than 250 mmBtu/hr.
*4 - NA-NSR threshold based upon status of Fairfax County as Ozone Transport Region.

Preferred Alternative– Stationary Source Emissions

Project Name	Heated Area	CO [tons]	NOx [tons]	PM [tons]	SO_2 [tons]	VOC [tons]
EPG Infrastructure (EPG) (2008), Operations	25000	0.10	0.12	0.01	0.00	0.01
Child Dev Center – 244 (EPG), Operations	19590	0.08	0.09	0.01	0.00	0.01
Child Development Center (EPG), Operations	24036	0.10	0.12	0.01	0.00	0.01
Emergency Services Center (EPG), Operations	14700	0.06	0.07	0.01	0.00	0.00
Secure Admin Facility (EPG) (WHS) (2008), Operations	2219000	17.22	7.17	2.05	0.12	1.36
NGA Admin (EPG), Operations	2419000	16.98	8.2	2.34	0.14	1.56
EPG Total	4721326	34.53	15.77	4.42	0.26	2.94

Project Name	Number of Generators	Size of Generators	Hours of Operation	CO [tons]	NOx [tons]	PM [tons]	SO_2 [tons]	VOC [tons]
Secure Admin Facility (EPG) (WHS) (2008), Operations	5	2000	250	1.49	18.36	3.43	3.21	0.36
NGA Admin (EPG), Operations	8	2500	250	3.18	39.14	7.63	7.14	0.78
			EPG Total	4.67	57.5	11.06	10.35	1.14

Project Name	Heated Area	CO [tons]	NOx [tons]	PM [tons]	SO_2 [tons]	VOC [tons]
Access Road/Control Point, Operations	280	0.00	0.00	0.00	0.00	0.0001
MDA (2007), Operations	104000	0.13	0.15	0.01	0.00	0.0084
NARMC HQ Building, Operations	9000	0.04	0.04	0.00	0.00	0.0024
NARMC HQ Building, Operations	39825	0.16	0.19	0.01	0.00	0.0105
Network Enterprise Communications Facility (AKO), Operations	73500	0.11	0.13	0.01	0.00	0.007
Network Enterprise Communications Facility (AKO), Operations	73500	0.11	0.13	0.01	0.00	0.007
Dental Clinic, Operations	16000	0.06	0.08	0.01	0.00	0.0042
Family Travel Camp, Operations	16658	0.07	0.08	0.01	0.00	0.0044
Medical Guest House, Operations	100000	0.12	0.15	0.01	0.00	0.008
Admin Bldg, MEDCOM, Operation	9000	0.04	0.04	0.00	0.00	0.0024
Administrative Facility (Bldgs 211, 215, 219, 220), Operations	133600	0.16	0.20	0.01	0.00	0.0107
Hospital (2008), Operations	868800	1.17	1.39	0.11	0.01	0.0767
USANCA Support Facility, Operations	20000	0.08	0.10	0.01	0.00	0.0053

Preferred Alternative– Stationary Source Emissions

Network Operations Center (part of PEO EIS), Operations	5000	0.02	0.02	0.00	0.00	0.0013
Main Post Total	1469163	2.26	2.69	0.20	0.02	0.1484

Sources: AP-42 Section 1.4 and DOE 1999

Project Name	Number of Generators	Size of Generators	Hours of Operation	CO [tons]	NOx [tons]	PM [tons]	SO_2 [tons]	VOC [tons]
Hospital (2008), Operations	6	1500	500	0.00	33.21	0.20	0.66	1.53
USANCA Support Facility, Operations	1	125	500	0.28	1.29	0.09	0.09	0.29
Emergency Services Center (EPG), Operations	1	45	500	0.10	0.46	0.03	0.03	0.1
Network Operations Center (part of PEO EIS), Operations	1	30	500	0.07	0.31	0.02	0.02	0.07
Total			Main Post Total	0.45	35.27	0.34	0.80	1.99

Sources: AP-42 and Manufacturers Specification

Roll-up	CO [tons]	NOx [tons]	PM [tons]	SO2 [tons]	VOC [tons]
Main Post	3	38	1	1	2
EPG	39	73	15	11	4

Town Center and Satellite Campuses Alternative– Stationary Source Emissions

Project Name	Heated Area	CO [tons]	NOx [tons]	PM [tons]	SO_2 [tons]	VOC [tons]
Access Road/Control Point, Operations	280	0.00	0.00	0.00	0.00	0.00
EPG Infrastructure (EPG) (2008), Operations	25000	0.10	0.12	0.01	0.00	0.01
MDA (2007), Operations	104000	0.13	0.15	0.01	0.00	0.01
NARMC HQ Building, Operations	9000	0.04	0.04	0.00	0.00	0.00
NARMC HQ Building, Operations	39825	0.16	0.19	0.01	0.00	0.01
Network Enterprise Communications Facility (AKO), Operations	73500	0.11	0.13	0.01	0.00	0.01
Network Enterprise Communications Facility (AKO), Operations	73500	0.11	0.13	0.01	0.00	0.01
Dental Clinic, Operations	16000	0.06	0.08	0.01	0.00	0.00
Family Travel Camp, Operations	16658	0.07	0.08	0.01	0.00	0.00
Medical Guest House, Operations	100000	0.12	0.15	0.01	0.00	0.01
Admin Bldg, MEDCOM, Operation	9000	0.04	0.04	0.00	0.00	0.00
Administrative Facility (Bldgs 211, 215, 219, 220), Operations	133600	0.16	0.20	0.01	0.00	0.01
Child Dev Center – 244 (EPG), Operations	19590	0.08	0.09	0.01	0.00	0.01
Child Development Center (EPG), Operations	24036	0.10	0.12	0.01	0.00	0.01
Hospital (2008), Operations	868800	1.17	1.39	0.11	0.01	0.08
USANCA Support Facility, Operations	20000	0.08	0.10	0.01	0.00	0.01
Emergency Services Center (EPG), Operations	14700	0.06	0.07	0.01	0.00	0.00
Network Operations Center (part of PEO EIS), Operations	5000	0.02	0.02	0.00	0.00	0.00
Secure Admin Facility (EPG) (WHS) (2008), Operations	2219000	17.22	7.17	2.05	0.12	1.36
NGA Admin (EPG), Operations	2419000	16.98	8.20	2.34	0.14	1.56
Main Post Total	6495489	36.80	18.46	4.63	0.28	3.09

Sources: AP-42 Section 1.4 and DOE 1999

Town Center and Satellite Campuses Alternative– Stationary Source Emissions

Project Name	Number of Generators	Size of Generators	Hours of Operation	CO [tons]	NOx [tons]	PM [tons]	SO_2 [tons]	VOC [tons]
Hospital (2008), Operations	6	1500	500	0.00	33.21	0.20	0.66	1.53
USANCA Support Facility, Operations	1	125	500	0.28	1.29	0.09	0.09	0.29
Emergency Services Center (EPG), Operations	1	45	500	0.10	0.46	0.03	0.03	0.10
Network Operations Center (part of PEO EIS), Operations	1	30	500	0.07	0.31	0.02	0.02	0.07
Secure Admin Facility (EPG) (WHS) (2008), Operations	5	2000	250	2.98	18.36	3.43	3.21	0.36
NGA Admin (EPG), Operations	8	2500	250	3.18	39.14	7.63	7.14	0.78
Main Post Total				6.61	92.77	11.40	11.15	3.13

Source: AP-42 and manufacturer specifications

Roll-up	CO [tons]	NOx [tons]	PM [tons]	SO_2 [tons]	VOC [tons]
Main Post	43	111	16	11	6
EPG	0	0	0	0	0

City Center Alternative – Stationary Source Emissions

Project Name (EPG)	Heated Area	CO [tons]	NOx [tons]	PM [tons]	SO_2 [tons]	VOC [tons]
EPG Infrastructure (EPG) (2008), Operations	25000	0.10	0.12	0.01	0.00	0.01
MDA (2007), Operations	104000	0.13	0.15	0.01	0.00	0.01
NARMC HQ Building, Operations	9000	0.04	0.04	0.00	0.00	0.00
NARMC HQ Building, Operations	39825	0.16	0.19	0.01	0.00	0.01
Network Enterprise Communications Facility (AKO), Operations	73500	0.11	0.13	0.01	0.00	0.01
Family Travel Camp, Operations	16658	0.07	0.08	0.01	0.00	0.00
Medical Guest House, Operations	100000	0.12	0.15	0.01	0.00	0.01
Child Dev Center – 244 (EPG), Operations	19590	0.08	0.09	0.01	0.00	0.01
Child Development Center (EPG), Operations	24036	0.10	0.12	0.01	0.00	0.01
Hospital (2008), Operations	868800	1.17	1.39	0.11	0.01	0.08
Emergency Services Center (EPG), Operations	14700	0.06	0.07	0.01	0.00	0.00
Network Operations Center (part of PEO EIS), Operations	5000	0.02	0.02	0.00	0.00	0.00
Secure Admin Facility (EPG) (WHS) (2008), Operations	2219000	17.22	7.17	2.05	0.12	1.36
NGA Admin (EPG), Operations	2419000	16.98	8.20	2.34	0.14	1.56
EPG Total		36.35	17.92	4.58	0.28	3.06

Project Name (EPG)	Number of Generators	Size of Generators	Hours of Operation	CO [tons]	NOx [tons]	PM [tons]	SO_2 [tons]	VOC [tons]
Hospital (2008), Operations	6	1500	500	0.00	33.21	0.20	0.66	1.53
Emergency Services Center (EPG), Operations	1	45	500	0.10	0.46	0.03	0.03	0.1
Network Operations Center (part of PEO EIS), Operations	1	30	500	0.07	0.31	0.02	0.02	0.07
Secure Admin Facility (EPG) (WHS) (2008), Operations	5	2000	500	2.98	18.36	3.43	3.21	0.36
NGA Admin (EPG), Operations	8	2500	500	3.18	39.14	7.63	7.14	0.78
EPG Total				6.33	91.48	11.31	11.06	2.84

City Center Alternative – Stationary Source Emissions

Project Name (Main Post)	Heated Area	CO [tons]	NOx [tons]	PM [tons]	SO_2 [tons]	VOC [tons]
Access Road/Control Point, Operations	280	0.00	0.00	0.00	0.00	0.00
Network Enterprise Communications Facility (AKO), Operations	73500	0.11	0.13	0.01	0.00	0.01
Dental Clinic, Operations	16000	0.06	0.08	0.01	0.00	0.00
Admin Bldg, MEDCOM, Operation	9000	0.04	0.04	0.00	0.00	0.00
Administrative Facility (Bldgs 211, 215, 219, 220), Operations	133600	0.16	0.20	0.01	0.00	0.01
USANCA Support Facility, Operations	20000	0.08	0.10	0.01	0.00	0.01
Main Post Total	6495489	0.45	0.54	0.04	0.00	0.03

Project Name(Main Post)	Number of Generators	Size of Generators	Hours of Operation	CO [tons]	NOx [tons]	PM [tons]	SO_2 [tons]	VOC [tons]
USANCA Support Facility, Operations	1	125	500	0.28	1.29	0.09	0.09	0.29
Main Post Total				0.28	1.29	0.09	0.09	0.29

Roll-up	CO [tons]	NOx [tons]	PM [tons]	SO_2 [tons]	VOC [tons]
Main Post	1	2	0	0	0
EPG	43	109	16	11	6

Notes: Only actual equipment for the NGA and WHS facilities has been chosen at this time. Detailed methodologies for emissions calculations for boilers can be located in the Appendix E.1. Potential to emit estimation for emergency generators were based on a 250 hours of operations federally enforceable permit limitation for NGA and WHS facilities, and 500 hours for all the other facilities.

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Appendix F

Storm Water and Watershed Modeling Methodology

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Storm Water Runoff Modeling

To estimate baseline storm water runoff and peak flow volumes and the potential impacts of each of the proposed development scenarios on Fort Belvoir, affected streams were modeled using Technical Release 55 (TR-55), *Urban Hydrology for Small Watersheds* (NRCS, 1986). TR-55 includes simplified procedures for estimating storm-event runoff and peak discharges in small watersheds.

An assessment of land cover and hydrologic factors that characterize the current flow conditions of streams located within proposed development areas was made to determine the potential environmental consequences that would result from the adoption of each of the BRAC proposed alternatives. The assessment included analysis of the existing distribution of land uses and soil types, characterization of surface elevations, subwatersheds, and stream networks. TR-55 model input data were developed based on the proposed development footprint coverage for each of the alternatives and current GIS data layers for land cover, streams, soils, topography, and other watershed attributes.

Hydrologic conditions on Fort Belvoir are characterized based on storm water management units. The delineation of these subwatersheds was provided by the Fort Belvoir GIS Center (US Army Garrison Fort Belvoir DPW GIS Center, 2005). Hydrologic soil types and areas were characterized using the State Soil Geographic (STATSGO) coverage for Virginia, developed by the Natural Resources Conservation Service (NRCS). Land cover, surface elevations, and stream networks were derived from the 2001 National Land Cover Dataset (NLCD), 30-meter Digital Elevation Model (DEM), and National Hydrography Dataset (NHD), developed by the United States Geological Survey (USGS). The assessment of current conditions was used as a baseline from which potential impacts on storm water runoff volumes and stream flow velocity were estimated for each of the proposed alternatives. Note that BMPs required by state and federal regulations have various percent efficiencies depending on their design and site characteristics; therefore, BMP implementation was not considered in the storm water modeling scenarios.

Model Background

TR-55 model scenarios for each subwatershed were run using local precipitation data for the 1, 2, 5, 10, 25, 50, and 100-year design storm events over a 24-hour period. 24-hour rainfall distributions for the Washington, DC, metropolitan region were packaged with the TR-55 model and were used to simulate precipitation and runoff conditions for each of the subwatersheds modeled. These data were derived from NOAA isoline precipitation maps for the eastern United States. Precipitation data were used to estimate runoff volumes by assigning a weighted curve number to the land area of each modeled subwatershed based on the distribution of land cover and hydrologic soil types. Peak stream flow was then estimated based on flow routing procedures that calculate runoff travel time, also known as time of concentration, through the subwatershed. Runoff travel time between two locations was used as a measure of flow velocity. For each TR-55 model scenario, travel time was assumed to be implicitly dependent on stream flow length. Other important model parameters are discussed below.

The runoff curve number determines the fraction of total precipitation that either infiltrates into ground water storage or enters surface water as over-land runoff. Curve numbers are calculated based on the distribution of land use/cover and hydrologic soil types within each subwatershed. Area weighted curve numbers for Fort Belvoir subwatersheds were calculated using available land cover (2001 NLCD) and soils (STATSGO) GIS data layers.

To estimate stream flow velocity, TR-55 divides surface flow into three distinct types—sheet flow, shallow concentrated flow, and open channel flow—that together form a continuous flow route from the most hydrologically distant point to the farthest downstream point within a watershed. The algorithm to

calculate flow velocity varies for each type, but all consider slope and surface roughness. Calculated velocities for sheet flow and concentrated shallow flow are impacted primarily by land use and slope, while channel flow also considers channel geometry.

Sheet flow usually occurs at the headwaters of a stream and is characterized by the volume of water that flows over land surfaces. Sheet flow is restricted in the model to a maximum length of 300 feet. This maximum was assumed for all subwatersheds due to the lack of site-specific information. The flow velocity associated with sheet flow is a function of Manning's roughness coefficient for overland flow and slope of the hydrologic grade line. Manning's roughness coefficients were derived from land cover data (NLCD), and hydraulic grade lines (land slope) were calculated using 30-meter DEM data.

Sheet flow is usually conveyed into shallow concentrated flow once the maximum length of 300 feet is reached. The velocity of shallow concentrated flow is a function of slope and land cover. Land cover types were simplified and classified as either pervious or impervious surfaces. Shallow concentrated flow was assumed to occur at the end of sheet flow and beginning of stream channel flow, based on the location of streams depicted in the NHD streams coverage (USGS).

Average channel flow velocity was calculated using Manning's roughness coefficient for open channel flow, channel slope, and channel geometry. It was assumed that no natural channels would be converted to artificial materials (concrete, metal, or polyethylene). Stream channel geometries were estimated using regional curves that depict the relationship between bankfull and drainage area for the Eastern United States hydro-physiographic province (Dunn and Leopold, 1978).

For each of the BRAC proposed alternatives (Preferred, Town Center, City Center, and Satellite Campuses), the current land use grid (2001 NLCD) was edited to reflect the locations of the proposed development projects. Estimated footprints for planned facilities and associated developed areas within each subwatershed were added to the land cover grid as either high or medium intensity development areas. These changes in land cover were used to update the weighted curve number and time of concentration values for each subwatershed and estimate potential changes in peak flow discharge that may result from each of the proposed alternatives.

Table F-1 presents the peak flow modeling results for all subwatersheds under each of the proposed alternatives. The percent change in peak flow discharge for the 1, 2, 5, 10, 25, 50, and 100-year storm event scenarios are shown in this table. The results for the 1-year and 10-year storm events are summarized in Section 4.7.

Table F-1
TR-55 Runoff modeling results (percent change from baseline to future condition)

Sub-watershed	Preferred Alternative Peak discharge % change							Town Center Alternative Peak discharge % change							City Center Alternative Peak discharge % change							Satellite Campuses Alternative Peak discharge % change						
	Storm Frequency (years)							*Storm Frequency (years)*							*Storm Frequency (years)*							*Storm Frequency (years)*						
	1	*2*	*5*	*10*	*25*	*50*	*100*	*1*	*2*	*5*	*10*	*25*	*50*	*100*	*1*	*2*	*5*	*10*	*25*	*50*	*100*	*1*	*2*	*5*	*10*	*25*	*50*	*100*
1	100	83	70	63	61	56	51	131	106	86	75	71	65	59	10	6	5	4	4	4	3	54	41	30	25	24	20	16
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	12	7	6	5	5	4	4	22	15	12	10	9	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	9	7	6	5	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	36	23	19	16	14	12	10	36	23	19	16	14	12	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	25	19	15	13	12	11	11	0	0	0	0	0	0	0	25	19	15	13	12	11	11
30	0	0	0	0	0	0	0	24	16	12	10	9	8	7	0	0	0	0	0	0	0	25	16	12	10	9	8	7
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table F-1
TR-55 Runoff modeling results (percent change from baseline to future condition) *(continued)*

Sub-watershed	Preferred Alternative Peak discharge % change							Town Center Alternative Peak discharge % change							City Center Alternative Peak discharge % change							Satellite Campuses Alternative Peak discharge % change						
	Storm Frequency (years)							*Storm Frequency (years)*							*Storm Frequency (years)*							*Storm Frequency (years)*						
	1	*2*	*5*	*10*	*25*	*50*	*100*	*1*	*2*	*5*	*10*	*25*	*50*	*100*	*1*	*2*	*5*	*10*	*25*	*50*	*100*	*1*	*2*	*5*	*10*	*25*	*50*	*100*
32	0	0	0	0	0	0	0	15	11	7	6	5	5	4	0	0	0	0	0	0	0	15	11	7	5	5	4	4
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	29	20	16	14	13	11
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	14	10	9	8	7	6
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91	72	53	42	38	33	28
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	77	46	27	22	20	18	16	0	0	0	0	0	0	0	77	46	27	22	20	18	16	0	0	0	0	0	0	0
54	29	20	13	10	10	9	8	0	0	0	0	0	0	0	14	13	6	4	5	4	4	0	0	0	0	0	0	0
55	56	35	21	17	15	13	12	0	0	0	0	0	0	0	53	33	20	17	15	13	12	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	93	58	40	33	29	26	23	0	0	0	0	0	0	0	93	58	40	32	29	25	22	0	0	0	0	0	0	0
58	70	51	38	31	28	25	21	0	0	0	0	0	0	0	70	51	38	31	28	25	21	0	0	0	0	0	0	0
59	82	59	42	34	31	27	22	0	0	0	0	0	0	0	82	60	42	34	31	27	22	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Watershed Modeling (Nutrient Analysis and Cumulative Impacts Analysis)

The Generalized Watershed Loading Functions (GWLF) model was used to estimate current (baseline) conditions and potential changes in flow volume and pollutant loads. Separate watershed models were developed for Accotink Creek, Pohick Creek, and Dogue Creek. A fourth watershed model was developed to incorporate direct drainage areas (watershed areas that flow directly into Gunston Cove, Accotink Bay, Pohick Bay, and the Potomac River). Average annual flow volume and nutrient loads (total nitrogen (TN) and total phosphorus (TP)) were calculated in order to assess potential cumulative impacts on water quality that may result from the Preferred Alternative and anticipated future development within each watershed. In addition, loading coefficients were calculated for TN and TP based on the Accotink Creek watershed model results in order to estimate the percent change in nutrient loads for the modeled subwatersheds under each BRAC development alternative. Table F-2 presents the subwatershed nutrient loading results. Subwatersheds with greater than a ten percent change in nitrogen and phosphorus loads are summarized in Section 4.7. Watershed results for the cumulative impacts analysis are presented in Section 5.7.

The 2001 NLCD GIS coverage was modified to account for future development in each watershed as a result of the BRAC Preferred Alternative and planned development within these watersheds based on information provided by the Fairfax County Department of Planning and Zoning (2006). The NLCD grid was modified as discussed in the storm water modeling section above. Future development locations within the vicinity of Fort Belvoir were represented in a GIS point coverage provided by the Fairfax County Planning Department. The planned development area associated with each location was reclassified as high intensity development. BRAC and other future on- and off-post development projects located within each watershed that drains part of Fort Belvoir are shown in Table F-3. Fairfax County development projects located in other watersheds are shown in Table F-4. Note that BMPs required by state and federal regulations have various percent efficiencies depending on their design and site characteristics; therefore, BMP implementation was not considered in the watershed modeling scenarios.

Model Background

The watershed models for Accotink Creek, Pohick Creek, Dogue Creek, and Direct Drainage watersheds were developed using GWLF and the BasinSim 1.0 interface. The GWLF model, which was originally developed by Cornell University (Haith et al., 1992), provides the ability to simulate runoff and pollutant loadings from watersheds given variable-size source areas (e.g., agricultural, forested, and developed land). GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations. Monthly calculations are made for pollutant loads based on daily water balance totals that are summed to give monthly values. The BasinSim 1.0 watershed simulation program is a Windows based modeling system that facilitates the development of model input data and provides additional functionality for simulating daily flows and flow and pollutant routing (Dai et al., 2000)

GWLF is an aggregate distributed/lumped parameter watershed model. For surface loading, it is distributed in the sense that it allows multiple land use/cover scenarios. Each area is assumed to be homogeneous with respect to various attributes considered by the model. In addition, the model does not spatially distribute the source areas, but aggregates the loads from each area into a watershed total. In other words, there is no spatial routing. For subsurface loading, the model acts as a lumped parameter model using a water balance approach. No distinctly separate areas are considered for subsurface flow contributions. Daily water balances are computed for an unsaturated zone as well as for a saturated subsurface zone, where infiltration is computed as the difference between precipitation and snowmelt minus surface runoff plus evapotranspiration.

GWLF models surface runoff using the Natural Resources Conservation Service Curve Number (NRCS-CN) approach with daily weather inputs of temperature and precipitation. Erosion and sediment yield are estimated using monthly erosion calculations based on the Universal Soil Loss Equation (USLE) algorithm (with monthly rainfall-runoff coefficients) and a monthly composite of KLSCP values for each source area (e.g., land cover/soil type combination). The KLSCP factors are variables used in the calculations to depict changes in soil loss/erosion (K), the length/slope factor (LS), the vegetation cover factor (C), and the conservation practices factor (P). A sediment delivery ratio, based on watershed size, and a transport capacity, based on average daily runoff, are applied to the calculated erosion to determine pollutant yield for each source area.

Surface nutrient losses are determined by applying dissolved nitrogen and phosphorus coefficients to surface runoff and applying a sediment coefficient to the yield portion for each agricultural source area. Urban nutrient inputs are all assumed to be solid phase, and the model uses an exponential accumulation and washoff function for these loadings. Subsurface losses are calculated using dissolved nitrogen and phosphorus coefficients for shallow groundwater contributions to stream nutrient loads, and the subsurface submodel considers only a single, lumped-parameter contributing area. Evapotranspiration is determined using daily weather data and a cover factor dependent on land use/cover type. Finally, a water balance is performed daily using supplied or computed precipitation, snowmelt, initial unsaturated zone storage, maximum available zone storage, and evapotranspiration values. All the equations used by the model can be found in the original GWLF paper (Haith and Shoemaker, 1987) and GWLF User's Manual (Haith et al., 1992).

Nonpoint source pollution is driven by rainfall, and therefore precipitation data are necessary to drive the watershed model. Local rainfall and temperature data were used to simulate flow conditions in modeled watersheds. Daily precipitation and temperature data were obtained from local National Climatic Data Center (NCDC) weather stations. There was one station in close proximity to the modeled watersheds—Reagan National Airport. Temperature and precipitation data recorded at this station from April 1995 through December 2004 were used in the simulations.

Table F-2
GWLF nutrient loading results (percent change from baseline to future condition)

Sub-watershed	Preferred		Town Center		City Center		Satellite Campuses	
	TP	TN	TP	TN	TP	TN	TP	TN
1	-3	-4	9	15	4	6	-9	-10
2	0	0	0	0	0	0	0	0
3	-1	-4	-1	-4	2	3	0	-1
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	-1	-1	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0

Table F-2
GWLF nutrient loading results (percent change from baseline to future condition) *(continued)*

Sub-watershed	Preferred		Town Center		City Center		Satellite Campuses	
	TP	TN	TP	TN	TP	TN	TP	TN
14	1	2	1	1	1	1	1	1
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0
25	-2	-6	5	3	0	0	0	0
26	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0
29	2	3	5	6	2	3	12	13
30	3	4	-3	-3	3	4	2	2
31	0	0	0	0	0	0	0	0
32	0	0	3	3	0	0	3	3
33	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	-2
39	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	2
43	0	0	0	0	0	0	-6	2
44	0	0	0	0	0	0	0	-1
45	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0
53	51	68	0	0	61	83	0	0

Table F-2
GWLF nutrient loading results (percent change from baseline to future condition) *(continued)*

Sub-watershed	Preferred		Town Center		City Center		Satellite Campuses	
	TP	TN	TP	TN	TP	TN	TP	TN
54	8	17	0	0	7	14	0	0
55	26	39	0	0	26	39	0	0
56	0	0	0	0	0	0	0	0
57	19	31	1	1	11	19	1	1
58	22	33	0	0	13	19	0	0
59	2	-3	0	0	5	0	0	0
60	0	0	0	0	0	-1	0	0

Table F-3
Projects located in modeled watersheds (Fort Belvoir drainage area)

Watershed name	Map number	Project number	Project description
Accotink Creek			**BRAC PROJECTS**
	8	67959/ 67487/ 64097	INFRASTRUCTURE (INCLUDES GUNSTON ROAD IMPROVEMENTS)
	4	64238	HOSPITAL
	5	64241	DENTAL CLINIC
	16	66228	PURCHASE AMC RELOCATABLES
	15	63571	ACCESS ROAD/CONTROL POINT
	2	64234	WHS
	1	65416	NGA
	12	55661	CHILD DEV CENTER – 244 (NGA)
	13	55662	CHILD DEV CENTER – 303 (EPG)
	7	N/A	CORPS OF ENGINEERS INTERGRATION OFFICE
	6	65871	NARMC HEADQUARTERS BLDG
	19	62892	MODERNIZE BARRACKS
	9	64076	EMERGENCY SVCS CENTER (EPG)
			OTHER ON-POST PROJECTS
	26a	58466	MUSEUM OF THE US ARMY ALTERNATIVE LOCATION AT NORTH POST
	17	65317	GOLF CLUBHOUSE/CART STORAGE
	31	n/a	INFO DOMINANCE CENTER
	2	61458	RELIGIOUS EDUCATION CENTER
	20	57495	SOLDIER SUPPORT CENTER
	3	64231	PHYSICAL FITNESS CENTER (TROOP CANTONMENT AREA)
	18	63206	ADDITION TO MP STATION

Table F-3
Projects located in modeled watersheds (Fort Belvoir drainage area) *(continued)*

Watershed name	Map number	Project number	Project description
	15	n/a	DCNG RESOURCES TRAINING CENTER
	14	65139	EXPAND ARTS/CRAFT/AUTO
	19	55523/ 52694	POTOMAC HERITAGE NATIONAL SCENIC TRAIL
	29	n/a	OPERATIONS SECURITY EVALUATION GROUP TRAINING FACILITY
	16	62134	DLA RECEIVING AND SCREENING FACILITY
	30	n/a	FAIRFAX COUNTY PARKWAY EXTENSION
	28	n/a	FLIGHT CONTROL TOWER
	25	64230	PHYSICAL FITNESS CENTER (EPG)
	24	64742	CONSTRUCT SHOPPETTE
	30	64531	PX EXPANSION
			OFF-POST PROJECTS
	84	002463-Sp -002-2	OLD KEENE MILL PROFESSIONAL OFFICES
	1	002981-SP-004-2	WEST SPRINGFIELD BUSINESS CENTRE SITE 5 PARKING ADDN
	30	003330-SP -007-2	TELEGRAPH ROAD WAREHOUSE
	31	006839-SP-006-2	THE FAIRFAX BUILDING ADDITION
	25	006384-SD-001-3	MAZZELLO COVE
	55	000187-SP-002-1	UPS IN NEWINGTON
	128	000503-SP-001-3	U-HAUL RETAIL CENTER 8207 TERMINAL ROAD
	130	004198-SP-009-2	M AND S HOLDINGS LLC (FORM MILLERS OFFICE PRODUCTS)
	129	009730-SP-001-2	CROWN CENTER
	125	000497-SP-002-2	HUNTER PLAZA PHASE 2
	124	000497-SP-001-2	HUNTER PLAZA, PHASE ONE
	16	008082-SP-001-3	HOOES ROAD PARK
	106	005833-SP-002-2	ECHO INC
	3	005219-PI-001-2	ACCOTINK STREAM VALLEY TRAIL (REVIT AREA) (BR/SP)
	4	006945-SP-001-2	ACCOTINK PARK
	131	003189-SP -004-2	8501 BACKLICK ROAD (FORMERLY 8521)
	126	000230-SP-001-2	TAVARES/ALLEN PROPERTY
	127	001130-SP-001-2	ISLAND CREEK ELEMENTARY SCHOOL
	15	004998-PI-001-2	MOHTARAM MOZAFARI RESIDENCE
	107	007207-SP-002-2	VW SPRINGFIELD
	14	005694-SP-001-2	VA TIRE AND AUTO REPAIR
	87	006754-SD-005-3	TALBERT SUBDIVISION
	70	009990-SP -003-2	SPRINGFIELD METRO CENTER II ROAD IMPROVEMENTS

Table F-3
Projects located in modeled watersheds (Fort Belvoir drainage area) *(continued)*

Watershed name	Map number	Project number	Project description
	99	006561-SP-001-2	6715 COMMERCE STREET
	64	004072-SP-003-1	BOB EVANS RESTAURANT (SP) OLD KEENE MILL ROAD
	40	001988-SP-002-1	RESIDENCE INN SPRINGFIELD
	60	024588-SP-001-1	HOA NGHIEM PAGODA
	44	013408-SD-001-1	KENDRICK
	17	006836-SP-009-2	METRO PARK PHASE SEVEN
	112	009639-SP-008-2	SILVER LAKE IHOP RESTAURANT
	110	006836-SP-010-2	METRO PARK PHASE SIX
	108	001414-SP-001-2	2ND PARK STRUCTURE AT FRANC-SPRINGFIELD METRO STATION
	73	000438-SP-002-3	LOYAL ORDER OF THE MOOSE FRANCONIA LODGE 646 INC
	109	000677-SP-003-2	CALVARY ROAD BAPTIST CHURCH EXPANSION
	118	004099-SD-001-2	CHAPEL BRIDGE ESTATES
	2	002981-SP-005-2	WEST SPRINGFIELD BUSINESS CENTRE SITE 6
	178	009754-SP-005-2	GUNSTON COMMERCE CENTER LAND BAY B
	24	001343-SP-003-2	CIFUENTES PROPERTY PCLS 15 AND 15A
	181	RZ-2005-LE-025	Mid-Town Springfield Development (mixed use)
	182	PA-506-IV-SI	Springfield Mall Expansion
	183	05-IV-2MV	Mixed Use (Office, Hotel, Retail)
	184	05-IV-4MV	Mixed Use (Residential, Office, Retail, Hotel)
	185	05-IV-10S	Mixed Use (Residential, Office, Recreation/Open Space, Retail)
	186	05-IV-6S	Mixed Use (Office, Industrial)
	187	05-IV-1LP	Mixed Use (Office, Retail)
Direct Drainage			**BRAC PROJECTS**
	4	64238	HOSPITAL
	5	64241	DENTAL CLINIC
	16	66228	PURCHASE AMC RELOCATABLES
	17	65592/ 67321	PEO EIS ADMIN FACILITY
	8	64097/ 67487/ 67959	INFRASTRUCTURE (INCLUDES GUNSTON ROAD IMPROVEMENTS)
	6	66877	NARMC HQ BLDG
	15	63571	ACCESS ROAD/ CONTROL POINT
	18	54347	STRUCTURED PARKING FACILITY, 200 AREA
	14	65450	ADMINISTRATIVE BLDG (211, 214, 215, 220)
	3	MDA 580	MDA
	11	65447	USANCA REPLACEMENT
	10	65448	NETWORK OPS – PEO EIS

Table F-3
Projects located in modeled watersheds (Fort Belvoir drainage area) *(continued)*

Watershed name	Map number	Project number	Project description
			OTHER ON-POST PROJECTS
	10	58697	MUSEUM SUPPORT CENTER
	26c	58466	MUSEUM OF THE US ARMY ALTERNATIVE LOCATIONS AT PENCE GATE
	4	54897	MARINA MODERNIZATION AND DOGUE CREEK DREDGING
	23	61453	REPLACE SOUTH POST FIRE STATION
	5	65218	EXPAND MAIN POST LIBRARY
	12	59554	BATTALION HEADQUARTERS FOR 249 ENGINEER BATTALION
	13	63035	SHOPETTE WITH GAS, BURGER KING, CAR WASH (SOUTH POST)
	21	65141	EXPAND BOWLING CENTER
	22	57837/ 51326	SOUTH POST FITNESS FACILITY & MULTIPURPOSE FIELDS
	6	65314	EXPAND RECREATION CENTER
	11	50356	INSTALLATION INDUSTRIAL SUPPORT CENTER
	9	62539	VET CLINIC ADDITION
	8	56184	JPRA RENOVATION/ADDITION (BLDG) 358
	7	63815	ADMINISTRATIVE BUILDING PEO SOLDIER
			OFF POST PROJECTS
	161	003642-SD-007-2	LORTON TOWN CENTER LANDBAY G
	34	008461-SP-001-2	ST JAMES EPISCOPAL CHURCH
Dogue Creek			**OTHER ON-POST PROJECTS**
	27	n/a	DCEETA Remote Delivery Facility
	29	n/a	Operations Security Evaluation Group Training Facility

Table F-3
Projects located in modeled watersheds (Fort Belvoir drainage area) *(continued)*

Watershed name	Map number	Project number	Project description
			OFF- POST PROJECTS
	133	001881-SD-001-2	ASHBY HEIGHTS
	132	001497-SD-001-2	PINEY GLEN
	74	003365-SP-006-1	HILLTOP RECLAMATION PROJECT (3365-LF-01, FOR BOND ONLY)
	111	007818-SD-002-2	GAYFIELDS ROAD
	90	006105-SP-002-1	FIRST BAPTIST CHURCH OF KINGSTOWNE
	19	004388-SD-001-2	WINDSOR KNOLL
	88	005318-SP-007-2	BB+T BANK DRIVE THRU ADDN- MANCHESTER LAKES SC
	6	006790-SP-001-2	SAINT JOHN'S LUTHERAN CHURCH
	8	000623-SP-002-4	NORTHAMPTON (FORMERLY OVERBROOK)
	43	006105-SP-023-1	APPLE FEDERAL CREDIT UNION
	89	009405-SP-001-2	WALMART STORE #2194 KINGSTOWNE CENTRE
	18	006105-SP-082-2	KINGSTOWNE SECTION 36A
	91	004838-SP-001-2	HAYFIELD ANIMAL HOSPITAL
	136	004124-SP-001-3	EVERGREEN FARM
	32	001938-SP-001-2	JETT MECHANICAL 8753 RICHMOND HIGHWAY
	161	003642-SD-007-2	LORTON TOWN CENTER LANDBAY G
	33	009465-SP-002-2	MOUNT VERNON COUNTRY CLUB GOLF COURSE IMPROVEMENTS
	34	008461-SP-001-2	ST JAMES EPISCOPAL CHURCH
	96	001900-SP-001-2	EPIPHANY LUTHERAN CHURCH
	81	024570-SD-001-2	HALLEY FARM SUBDIVISION
	27	006090-SP-001-2	HOPKINS HOUSE
	137	004989-SD-001-2	CECIL CASE ESTATES
	57	005223-SP-002-2	MASTER ROOFING AND SIDING INC (MV) 8463 RICHMOND HY
	67	008375-SD-001-2	ROSE HILL RESERVE
	10	000542-SP-001-2	COX COMMUNICATIONS SOUTHEAST HUB SITE
	76	002697-SD-001-2	LOFTY OAKS PLACE LOTS 41A 41B 41C
	45	022564-SP-001-1	GROVETON HEIGHTS
	134	005127-SP-003-2	FEDERAL REALTY INVESTMENT/SOUTH VALLEY SHOP CTR
	173	004687-SP-004-2	MT VERNON ORIENTATION CNTR EDUCATION CENTER AND MUSEUM
Pohick Creek			**OFF-POST PROJECTS**
	72	006454-SD-023-2	SILVERBROOK FARMS LOT 7
	12	005466-SD-002-2	LAKEWOOD HILLS SECTION 10 PHASE 2

Table F-3
Projects located in modeled watersheds (Fort Belvoir drainage area) *(continued)*

Watershed name	Map number	Project number	Project description
	104	005466-SD-001-2	LAKEWOOD HILLS SECT 10 PHASE I
	97	001687-SP-001-2	THEMEADOWBROOK DRIVE PROPERTY
	122	001697-SD-001-2	MONACAN ESTATES
	54	004698-PI-003-1	8404 HELLER ROAD SANITARY SEWER SERVICE
	51	008043-SD-003-2	COVINGTON WOODS ADDITION
	50	000258-SD-002-1	7706 GAMBRILL ROAD (MV)
	119	001225-SP-001-2	ST RAYMOND PENAFORT CHURCH
	105	003303-SP-002-2	FAIRFAX PARK
	175	002144-SD-001-2	EVANS PROPERTY
	61	005787-SD-001-1	FERRY LANDING PRESERVE
	169	003642-SP-008-2	LORTON STATION SCHOOL
	79	006441-SP-006-1	AAA VEHICLE MAINTENANCE FACILITY
	176	005395-SP-007-3	GUNSTON SQUARE SECTION 2 PARCEL D
	167	004865-SP-010-2	LORTON STATION SOUTH SECTION 6
	168	006909-SD-001-2	BARNES PROPERTY
	80	005430-SP-003-2	COMMONWEALTH CONSTRUCTION MANAGEMENT INC
	158	003642-SP-010-2	LORTON TOWN CENTER LANDBAY D/F
	159	003864-SD-002-2	MEEKER PROPERTY
	160	001276-SP-001-2	LAUREL RIDGE CROSSING (FORMERLY PULTE PLASKETT LANE)
	162	003642-SD-008-2	GRACE BIBLE CHURCH
	157	001565-SP-001-2	POHICK ROAD SELF STORAGE FACILITY
	123	001859-SD-001-2	ROLLING OAKS
	52	000122-SP-006-2	GIANT #149 SARATOGA SHOPPING CENTER
	121	008043-SD-002-2	COVINGTON WOODS
	53	005638-SD-001-1	SABINA ESTATES
	120	005638-SP-002-2	HARVESTER PRESBYTERIAN CHURCH
	172	006839-SP-004-2	COOK INLET RESIDENTIAL SECTION THREE
	13	007732-SD-001-2	STREAM VALLEY ESTATES
	83	015444-SD-001-2	CARDINAL ESTATES
	94	006441-SP-005-2	BEST FOODS INC 9525 GUNSTON COVE ROAD
	95	004478-SD-001-2	ADKINS PROPERTY
	154	001183-SP-009-2	LAUREL HILL ELEMENTARY SCHOOL
	164	003642-SP-009-2	LORTON TOWN CENTER LANDBAY "B-2"
	163	003642-SP-011-2	LORTON TOWN CENTER LANDBAY C

Table F-4
Off-post projects located outside modeled watersheds

Watershed name	Map number	Project number	Project description
Occoquan			
	78	001183-SP-014-1	LORTON WORK HOUSE
	145	001657-SD-001-2	OCCOQUAN PARK
	153	001183-SP-006-2	SOUTH COUNTY HIGH SCHOOL
	144	001811-SD-001-2	OCCOQUAN OVERLOOK
	142	001222-SD-001-2	DAVISON WOODS
	46	001653-SP-002-1	GROVETON PHASE II
	156	001183-SP-010-2	LAUREL HILL RECREATION CENTER
	147	001183-SD-002-2	LAUREL HILL SOUTH SEC 1 LANDBAY C
	148	001183-SD-003-2	LAUREL HILL NORTH
	149	001183-SD-005-2	LAUREL HILL SOUTH LANDBAY D SECTION 1
	151	001183-SP-004-2	LAUREL HILL SOUTH LANDBAYS E AND F, SECTION 1
	152	001183-SP-005-2	LAUREL HILL SOUTH LANDBAY E AND F SECTION 2
Mill Branch			
	143	001100-SD-001-2	NIRVANA PALACE
	29	001183-SP-011-2	LAUREL HILL GOLF COURSE MAINTENANCE FACILITY
	28	001733-SD-001-2	MALCOLM AT OX ROAD
	93	008036-SP-002-2	NEW HOPE CHURCH
	150	001183-SD-007-2	LAUREL HILL SOUTH LANDBAY D SECTION 2
	58	004204-SD-001-1	LAUREL OVERLOOK (FORMERLY HOOES ROAD-BLACKSTONE)
	141	000848-SD-001-2	COOKE PROPERTY
	140	008733-SD-001-2	REMINGTON PLACE FORMERLY COOKE PROPERTY
	69	006510-SP-002-1	SOUTH RUN RECREATIONAL CENTER FITNESS CENTER ADDN
	37	009754-SP-004-2	GUNSTON COMMERCE CENTER BUILDING 1
	180	001001-SP-001-2	GUNSTON CENTER
	35	003800-SP-001-3	FURNACE ROAD RECYCLING FACILITY
	82	001883-SP-001-1	LORTON DEBRIS LAND FILL
	166	009101-SP-002-2	GUNSTON COMMONS TOWNHOUSES
	165	001126-SP-004-2	LORTON VALLEY RECREATION CENTER
	155	001183-SP-009-2	SPRING HILL SENIOR CAMPUS SENIOR HOUSING BUILDING
	170	007713-SP-015-1	GUNSTON CORNER RESTAURANT
	174	007334-SP-002-4	GUNSTON COVE BUSINESS CENTER
	62	001664-SD-001-1	CRANFORD AT GUNSTON COVE
	36	006103-SP-003-5	ROCK STONE AND SAND YARD INC
	171	004865-SP-011-2	LORTON STATION SOUTH SECTION 7
	63	009754-SP-009-2	GUNSTON COMMERCE CENTER LAND BAY D
	155	001183-SP-012-2	SPRING HILL SENIOR CAMPUS
	177	009754-SP-006-2	GUNSTON COMMERCE CENTER LAND BAY C
Little Hunting Creek			
	113	001653-SP-001-2	GROVETON WOODS
	114	002174-SP-001-2	HOLLY ACRES
	146	001183-SD-001-2	LAUREL HILL LAND BAY A SECTION 1
	20	000871-SP-002-2	PROVIDENT BANK
	47	001860-SP-001-2	K AND M SHOPPING CENTER
	116	000871-SP-001-2	MOUNT VERNON SQUARE SHOPPING CENTER

Table F-4
Off-post projects located outside modeled watersheds *(continued)*

Watershed name	Map number	Project number	Project description
	115	009644-SP-002-2	SHURGARD MOUNT VERNON
	135	000106-SD-001-2	THE WOODLANDS
	138	015459-SD-001-2	GALLAHAN PROPERTY
	56	008972-SP-002-1	MOUNT VERNON GATEWAY
	139	004097-SP-001-2	VERNON HEIGHTS
	75	001850-SP-001-3	8214 AND 8218 RICHMOND HIGHWAY
	179	009754-SP-002-2	GUNSTON COMMERCE CENTER BUILDING 2 LB A
	92	007175-PI -001-1	SHERWOOD HALL LIBRARY
	77	009083-SP-004-1	INOVA MOUNT VERNON
	71	007473-SP-011-1	BEACON MALL FAMOUS DAVES
	48	007473-SP-010-1	BEACON MALL SILVER DINNER
	23	003484-SP-002-2	COMMERCE BANK BEACON HILL GROVETON
	21	007473-SP-008-2	BEACON MALL PROP DRIVE-THRU BANK AND FAST FOOD
	26	006468-SP-005-2	ROXBURY MEWS
Cameron Run			
	38	001381-SP-023-1	LOT 16 SHELL OIL PARK
	39	006367-SP-005-3	BREN MAR IV
	98	003195-SP-002-2	BACKLICK PLAZA
	42	006989-SP-002-2	VERIZON ADDITION TO FRANCONIA CENTRAL OFFICE
	102	009163-SD-009-2	DEVERS PROPERTY
	41	005307-SD-001-1	WOODLAND CREST
	86	002725-SP-002-3	RICKS CARPET AND FLOORS
	100	009163-SD-006-2	HIGHGROVE ESTATES SECTION 5
	101	004178-SP-001-2	JEFFERSON AT SULLIVAN PLACE
	5	017901-SP-001-2	PBS
	103	000623-SP-001-2	LDS CHURCH FRANCONIA WARD
	7	000220-SD-002-2	ANNE LY ESTATE 2
	9	001656-SD-001-2	CROWN ROYAL GATE
	65	000220-SD-003-1	WHEELER PROPERTY
	67	008375-SD-001-2	ROSE HILL RESERVE
	11	001260-SD-001-3	HIGHLANDS ESTATES
	66	000542-SP-002-1	SPICER CENTER
	85	007364-SP-004-1	PARCEL 8A SHELL OIL PARK
Belle Haven			
	49	016842-SP-001-1	MOUNT CALVARY BAPTIST CHURCH
	22	000180-SP-003-2	DEL RAY GLASS
	117	007950-SP-001-2	CHILIS BEACON HILL, 6601 RICHMOND HIGHWAY

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Appendix G

Economic Impact Forecast System (EIFS) Analysis and Population Estimations

G.1 – EIFS Model Analysis for Fort Belvoir, Virginia

G.2 – Population Estimate Calculations

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APPENDIX G.1

ECONOMIC IMPACT FORECAST SYSTEM (EIFS) MODEL ANALYSIS FOR FORT BELVOIR, VIRGINIA

Socioeconomic Impact Assessment

Socioeconomic impacts are linked through cause-and-effect relationships. Military payrolls and local procurement contribute to the economic base for the ROI. In this regard, base realignment at Fort Belvoir would have a multiplier effect on the local and regional economy. With the proposed action, local expenditures would increase, generating new business sales, employment, and income. This spending generally creates secondary jobs, increases business volume, and increases revenues for schools and other social services.

The EIFS Model

The U.S. Army, with the assistance of academic and professional economists and regional scientists, developed EIFS to address the economic impacts of NEPA-requiring actions and to measure their significance. As a result of its designed applicability, and in the interest of uniformity, EIFS should be used in NEPA assessments for BRAC. The entire system is designed for the scrutiny of a populace affected by the actions being studied. The algorithms in EIFS are simple and easy to understand but still have firm, defensible bases in regional economic theory.

EIFS was developed under a joint project of the U.S. Army Corps of Engineers, the U.S. Army Environmental Policy Institute, and the Computer and Information Science Department of Clark Atlanta University. EIFS is implemented as an online system supported by the U.S. Army Corps of Engineers, Mobile District. The system is available to anyone with an approved user-ID and password. U.S. Army Corps of Engineers staff are available to assist with the use of EIFS.

The databases in EIFS are national in scope and cover the approximately 3,700 counties, parishes, and independent cities that are recognized as reporting units by federal agencies. EIFS allows the user to define an economic ROI by identifying the counties, parishes, or cities to be analyzed. Once the ROI is defined, the system aggregates the data, calculates multipliers and other variables used in the various models in EIFS, and prompts the user for forecast input data.

The basis of the EIFS analytical capabilities is the calculation of multipliers that are used to estimate the impacts resulting from Army-related changes in local expenditures or employment. In calculating the multipliers, EIFS uses the economic base model approach, which relies on the ratio of total economic activity to basic economic activity. Basic, in this context, is defined as the production or employment engaged to supply goods and services outside the ROI or by federal activities (such as military installations and their employees). According to economic base theory, the ratio of total income to basic income is measurable (as the multiplier) and sufficiently stable so that future changes in economic activity can be forecast. This technique is especially appropriate for estimating aggregate impacts and makes the economic base model ideal for the EA and EIS process.

The multiplier is interpreted as the total impact on the economy of the region resulting from a unit change in its base sector; for example, a dollar increase in local expenditures due to an expansion of its military installation. EIFS estimates its multipliers using a location quotient approach on the

basis of the concentration of industries within the region relative to the industrial concentrations for the nation.

The user inputs into the EIFS model the data elements that describe the Army action: definition of the ROI; the change in local expenditures; number of affected (moving) civilian personnel and their salaries; number of affected (moving) military employees and their salaries; and the percent of affected military living on-post.

Although there would be a net gain of about 22,000 jobs (military and civilian) to Fort Belvoir, the installation would also lose some jobs due the proposed realignment. Per the *2005 Defense BRAC Commission Report to the President, Volumes I and 2*, almost 1,800 jobs would be realigned from Fort Belvoir to several other DoD installations in the continental U.S. (Defense Base Closure and Realignment Commission 2005). It is assumed these jobs would be transferred in 2011, the year when BRAC actions must be completed. Because the jobs would be transferred outside the ROI, they were entered in to the EIFS model as the change in military and civilian employment. Average annual income for the military personnel was estimated at $30,000, and average annual income for civilian personnel was about $45,000 (Webster 2005). It was assumed that 100 percent of the military personnel would relocate to their new assignment, and it was estimated that 50 percent of the civilian personnel would relocate.

Implementation of the proposed realignment action also would require renovation of existing facilities and construction of new facilities to accommodate the increase in personnel and functions assigned to Fort Belvoir. The installation would construct about 6.2 million square feet of new built space and renovate about 320,000 square feet of existing space (see Table 2-3). These facilities would be new work space for the incoming personnel and general support facilities to meet the needs of the larger working population. Construction would begin about 2007 and be completed by 2011 (5 years). The EIFS model output assumes that changes occur at one time, when in fact the effects of the preferred alternative's changes in construction expenditures and employment would be spread out over the 5-year development period. Therefore, the multiyear activity was modeled using EIFS by determining the changes in amount of construction spending and employment in each year of the project cycle (2007 through 2011), and a separate EIFS model run was completed for each year. Fort Belvoir's expected construction expenditures for the BRAC action and associated other facility projects were input into the model as the change in local expenditures. The realignment of almost 1,800 jobs from Fort Belvoir to other DoD installations in 2011 was entered as the change in employment. Table G.1-1 lists the EIFS model input parameters for each year.

Once the input variables are entered into the EIFS model, the model is run and it projects changes to the local economy's business sales volume, income, employment, and population. These four indicator variables are used to measure and evaluate socioeconomic impacts. Sales volume is the direct and indirect change in local business activity and sales (total retail and wholesale trade sales, total selected service receipts, and value-added by manufacturing). Employment is the total change in local employment due to the proposed action, including the direct and secondary changes in local employment. Income is the total change in local wages and salaries due to the proposed action, which includes the sum of the direct and indirect wages and salaries, plus the income of the civilian and military personnel affected by the proposed action. Population is the increase or decrease in the local population as a result of the proposed action.

Table G.1-1
EIFS Model Input Parameters for the Proposed BRAC Action at Fort Belvoir

Input Parameter	2007	2008	2009	2010	2011
Construction Expenditures[a]	$161,337,500	$2,134,221,000	$655,818,800	$578,870,800	$254,050,000
Change in Civilian Employment[b]	0	0	0	0	-1,560
Average Income of Affected Civilian[c]	$45,000	$45,000	$45,000	$45,000	$45,000
Percent Civilian Expected to Relocate	0	0	0	0	50%
Change in Military Employment[b]	0	0	0	0	-210
Average Income of Affected Military[c]	$30,000	$30,000	$30,000	$30,000	$30,000
Percent of Military Living On-Post	0	0	0	0	0

Sources:
[a]Fort Belvoir Detailed Facilities Project List, November 6, 2006 (updated February 15, 2007)
[b]Defense Base Closure and Realignment Commission 2005
[c]Webster 2005

The Significance of Socioeconomic Impacts

Once model projections are obtained, the RTV profile allows the user to evaluate the significance of the impacts. This analytical tool reviews the historical trends for the defined region and develops measures of local historical fluctuations in sales volume, income, employment, and population. These evaluations identify the positive and negative changes within which a project can affect the local economy without creating a significant impact. The greatest historical changes define the boundaries that provide a basis for comparing an action's impact on the historical fluctuation in an area. Specifically, EIFS sets the boundaries by multiplying the maximum historical deviation of the following variables:

		Increase	Decrease
Sales volume	X	100%	75%
Income	X	100%	67%
Employment	X	100%	67%
Population	X	100%	50%

These boundaries determine the amount of change that will affect an area. The percentage allowances are arbitrary, but sensible. The maximum positive historical fluctuation is allowed with expansion because economic growth is beneficial. While cases of damaging economic growth have been cited, and although the zero-growth concept is being accepted by many local planning groups, military base reductions and closures generally are more injurious to local economics than are expansion.

The major strengths of the RTV are its specificity to the region under analysis and its basis on actual historical data for the region. The EIFS impact model, in combination with the RTV, has proven successful in addressing perceived socioeconomic impacts. The EIFS model and the RTV

technique for measuring the intensity of impacts have been reviewed by economic experts and have been deemed theoretically sound.

The following are the EIFS inputs and output data and the RTV values for the ROI. These data form the basis for the socioeconomic impact analysis presented in Section 4.10.2.1.2.

EIFS REPORT

PROJECT NAME: Fort Belvoir BRAC EIS

STUDY AREA

11001	District of Columbia
24009	Calvert County, MD
24017	Charles County, MD
24021	Frederick County, MD
24031	Montgomery County, MD
24033	Prince George's County, MD
51013	Arlington County, VA
51059	Fairfax County, VA
51107	Loudoun County, VA
51153	Prince William County, VA
51179	Stafford County, VA
51510	Alexandria City, VA
51600	Fairfax City, VA
51610	Falls Church City, VA
51683	Manassas City, VA
51685	Manassas Park City, VA

2007 FORECAST INPUT

Change In Local Expenditures	$161,337,500	
Change In Civilian Employment	0	
Average Income of Affected Civilian	$0	
Percent Expected to Relocate	0	
Change In Military Employment	0	
Average Income of Affected Military	$0	
Percent of Military Living On-post	0	

2007 FORECAST OUTPUT

Employment Multiplier	2.76	
Income Multiplier	2.76	
Sales Volume – Direct	$161,337,500	
Sales Volume – Induced	$283,954,000	
Sales Volume – Total	$445,291,500	0.21%
Income – Direct	$34,259,020	
Income - Induced	$60,295,860	
Income – Total (place of work)	$94,554,870	0.06%
Employment – Direct	702	
Employment – Induced	1,235	
Employment – Total	1,937	0.06%
Local Population	0	
Local Off-base Population	0	0.00%

2008 FORECAST INPUT		
Change In Local Expenditures	$2,134,221,000	
Change In Civilian Employment	0	
Average Income of Affected Civilian	$0	
Percent Expected to Relocate	0	
Change In Military Employment	0	
Average Income of Affected Military	$0	
Percent of Military Living On-post	0	
2008 FORECAST OUTPUT		
Employment Multiplier	2.76	
Income Multiplier	2.76	
Sales Volume – Direct	$2,134,221,000	
Sales Volume – Induced	$3,756,228,000	
Sales Volume – Total	$5,890,449,000	2.82%
Income – Direct	$453,188,500	
Income - Induced	$797,611,700	
Income – Total (place of work)	$1,250,800,000	0.84%
Employment – Direct	9,286	
Employment – Induced	16,343	
Employment – Total	25,628	0.85%
Local Population	0	
Local Off-base Population	0	0.00%

2009 FORECAST INPUT		
Change In Local Expenditures	$655,818,800	
Change In Civilian Employment	0	
Average Income of Affected Civilian	$0	
Percent Expected to Relocate	0	
Change In Military Employment	0	
Average Income of Affected Military	$0	
Percent of Military Living On-post	0	
2009 FORECAST OUTPUT		
Employment Multiplier	2.76	
Income Multiplier	2.76	
Sales Volume – Direct	$655,818,800	
Sales Volume – Induced	$1,154,241,000	
Sales Volume – Total	$1,810,060,000	0.87%
Income – Direct	$139,259,000	
Income - Induced	$245,095,900	
Income – Total (place of work)	$384,354,900	0.26%
Employment – Direct	2,853	
Employment – Induced	5,022	
Employment – Total	7,875	0.26%
Local Population	0	
Local Off-base Population	0	0.00%

2010 FORECAST INPUT		
Change In Local Expenditures	$578,870,800	
Change In Civilian Employment	0	
Average Income of Affected Civilian	$0	
Percent Expected to Relocate	0	
Change In Military Employment	0	
Average Income of Affected Military	$0	
Percent of Military Living On-post	0	
2010 FORECAST OUTPUT		
Employment Multiplier	2.76	
Income Multiplier	2.76	
Sales Volume – Direct	$578,870,800	
Sales Volume – Induced	$1,018,813,000	
Sales Volume – Total	$1,597,683,000	0.77%
Income – Direct	$122,919,600	
Income - Induced	$216,338,500	
Income – Total (place of work)	$339,258,100	0.23%
Employment – Direct	2,519	
Employment – Induced	4,433	
Employment – Total	6,951	0.23%
Local Population	0	
Local Off-base Population	0	0.00%

2011 FORECAST INPUT		
Change In Local Expenditures	$254,050,000	
Change In Civilian Employment	-1,560	
Average Income of Affected Civilian	$45,000	
Percent Expected to Relocate	50	
Change In Military Employment	-210	
Average Income of Affected Military	$30,000	
Percent of Military Living On-post	0	
2011 FORECAST OUTPUT		
Employment Multiplier	2.76	
Income Multiplier	2.76	
Sales Volume – Direct	$194,528,500	
Sales Volume – Induced	$342,370,200	
Sales Volume – Total	$536,898,700	0.26%
Income – Direct	$-22,554,060	
Income - Induced	$72,700,180	
Income – Total (place of work)	$50,146,120	0.03%
Employment – Direct	-924	
Employment – Induced	1,490	
Employment – Total	566	0.02%
Local Population	-2,465	
Local Off-base Population	-2,465	-0.06%

RTV SUMMARY

	Sales Volume	Income	Employment	Population
Positive RTV	12.03%	11.56%	3.44%	1.15%
Negative RTV	-4.46%	-3.85%	-2.92%	-0.75%

RTV DETAILED

SALES VOLUME

Year	Value	Adj_Value	Change	Deviation	%Deviation
1969	12487987	54572502	0	0	0
1970	13822532	57087059	2514557	-464206	-0.81
1971	15319874	60666702	3579643	600880	0.99
1972	16879944	64650184	3983483	1004720	1.55
1973	18540008	66929427	2279243	-699520	-1.05
1974	20302148	65981981	-947446	-3926209	-5.95
1975	22302194	66460539	478558	-2500205	-3.76
1976	24627620	69449887	2989348	10585	0.02
1977	27185027	71768474	2318587	-660176	-0.92
1978	30016402	73840350	2071876	-906887	-1.23
1979	33336113	73672811	-167539	-3146302	-4.27
1980	37300698	72363356	-1309455	-4288218	-5.93
1981	41309891	72705408	342052	-2636711	-3.63
1982	44564161	73976506	1271098	-1707665	-2.31
1983	48491783	78071771	4095266	1116503	1.43
1984	54481740	83901878	5830106	2851343	3.4
1985	60194608	89689966	5788089	2809326	3.13
1986	65885847	96193339	6503373	3524610	3.66
1987	72734574	112738586	16545247	13566484	12.03
1988	80522543	109510660	-3227927	-6206690	-5.67
1989	86932341	112142717	2632057	-346706	-0.31
1990	91886260	113020102	877385	-2101378	-1.86
1991	94796472	111859832	-1160270	-4139033	-3.7
1992	100451351	114514539	2654707	-324056	-0.28
1993	105432219	117029765	2515226	-463537	-0.4
1994	109805076	118589487	1559722	-1419041	-1.2
1995	113723153	119409305	819818	-2158945	-1.81
1996	118472471	120841918	1432613	-1546150	-1.28
1997	125654346	125654346	4812428	1833665	1.46
1998	135111444	132409218	6754872	3776109	2.85
1999	146647589	140781682	8372465	5393702	3.83
2000	161175166	149892906	9111223	6132460	4.09

INCOME

Year	Value	Adj_Value	Change	Deviation	%Deviation
1969	14319990	62578355	0	0	0
1970	16042780	66256683	3678329	195972	0.3
1971	17719588	70169569	3912886	430529	0.61
1972	19433040	74428542	4258973	776616	1.04
1973	21318070	76958230	2529689	-952668	-1.24
1974	23463564	76256583	-701647	-4184004	-5.49
1975	25725858	76663057	406474	-3075883	-4.01
1976	28261512	79697462	3034405	-447952	-0.56
1977	31032678	81926273	2228811	-1253546	-1.53
1978	34216866	84173492	2247218	-1235139	-1.47
1979	38043291	84075675	-97817	-3580174	-4.26
1980	42908340	83242182	-833493	-4315850	-5.18
1981	48269158	84953718	1711536	-1770821	-2.08
1982	52670305	87432705	2478987	-1003370	-1.15
1983	57174793	92051418	4618713	1136356	1.23
1984	64363606	99119951	7068533	3586176	3.62
1985	70729098	105386357	6266406	2784049	2.64
1986	76800017	112128028	6741671	3259314	2.91
1987	84333410	130716781	18588754	15106397	11.56
1988	93310155	126901812	-3814969	-7297326	-5.75
1989	101616400	131085152	4183340	700983	0.53
1990	107884900	132698429	1613277	-1869080	-1.41
1991	112366744	132592752	-105677	-3588034	-2.71
1992	118331091	134897442	2304690	-1177667	-0.87
1993	124570964	138273772	3376330	-106027	-0.08
1994	130517765	140959192	2685420	-796937	-0.57
1995	135260856	142023892	1064701	-2417656	-1.7
1996	141360695	144187906	2164014	-1318343	-0.91
1997	149327565	149327565	5139659	1657302	1.11
1998	161042530	157821682	8494117	5011760	3.18
1999	172078384	165195245	7373562	3891205	2.36
2000	187111593	174013783	8818538	5336181	3.07

EMPLOYMENT

Year	Value	Change	Deviation	%Deviation
1969	1546829	0	0	0
1970	1579734	32905	-22196	-1.41
1971	1618189	38455	-16646	-1.03
1972	1667964	49775	-5326	-0.32
1973	1722489	54525	-576	-0.03
1974	1755495	33006	-22095	-1.26
1975	1775487	19992	-35109	-1.98
1976	1803567	28080	-27021	-1.5
1977	1852213	48646	-6455	-0.35
1978	1927282	75069	19968	1.04
1979	1989586	62304	7203	0.36
1980	2027170	37584	-17517	-0.86
1981	2052751	25581	-29520	-1.44
1982	2056252	3501	-51600	-2.51
1983	2120560	64308	9207	0.43
1984	2253186	132626	77525	3.44
1985	2382829	129643	74542	3.13
1986	2509977	127148	72047	2.87
1987	2642149	132172	77071	2.92
1988	2749641	107492	52391	1.91
1989	2824890	75249	20148	0.71
1990	2858498	33608	-21493	-0.75
1991	2791759	-66739	-121840	-4.36
1992	2781002	-10757	-65858	-2.37
1993	2827096	46094	-9007	-0.32
1994	2860240	33144	-21957	-0.77
1995	2913551	53311	-1790	-0.06
1996	2952105	38554	-16547	-0.56
1997	3015129	63024	7923	0.26
1998	3078562	63433	8332	0.27
1999	3175123	96561	41460	1.31
2000	3310059	134936	79835	2.41

POPULATION

Year	Value	Change	Deviation	%Deviation
1969	2983912	0	0	0
1970	3048875	64963	15489	0.51
1971	3098045	49170	-304	-0.01
1972	3163102	65057	15583	0.49
1973	3178494	15392	-34082	-1.07
1974	3183067	4573	-44901	-1.41
1975	3204590	21523	-27951	-0.87
1976	3219203	14613	-34861	-1.08
1977	3220039	836	-48638	-1.51
1978	3242642	22603	-26871	-0.83
1979	3245124	2482	-46992	-1.45
1980	3266262	21138	-28336	-0.87
1981	3321358	55096	5622	0.17
1982	3361545	40187	-9287	-0.28
1983	3411617	50072	598	0.02
1984	3484327	72710	23236	0.67
1985	3559580	75253	25779	0.72
1986	3646331	86751	37277	1.02
1987	3738922	92591	43117	1.15
1988	3828498	89576	40102	1.05
1989	3895185	66687	17213	0.44
1990	3936904	41719	-7755	-0.2
1991	3994176	57272	7798	0.2
1992	4053539	59363	9889	0.24
1993	4109779	56240	6766	0.16
1994	4164663	54884	5410	0.13
1995	4212186	47523	-1951	-0.05
1996	4267192	55006	5532	0.13
1997	4326258	59066	9592	0.22
1998	4392813	66555	17081	0.39
1999	4477130	84317	34843	0.78
2000	4567091	89961	40487	0.89

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Appendix G.2

Population Estimate Calculations

The following tables list the data and calculations for the population estimates presented in Section 4.10.2.1.2. The number and percentage of Fort Belvoir employees by location, as well as the number of Arlington (WHS and DoD) and NGA employees by location, was derived by VHB (2006). The transportation model assumed that 50 percent of the current Arlington employees and 50 percent of the current NGA employees would be redistributed as the current Fort Belvoir employees are distributed. It was assumed that one employee represents one household. The percentage of households that are family households (65 percent) and nonfamily households (35 percent) is from the U.S. Census Bureau Washington Metropolitan Statistical Area (MSA) Demographic Characteristics for 2005 (U.S. Census Bureau, 2006c). The average family size (3.27 persons) also is from the U.S. Census Bureau Washington MSA Demographic Characteristics for 2005 (U.S. Census Bureau, 2006c). The number of children per family (1.8) is from the 2000 Census, Average Number of Children Per Family for Maryland, Virginia, and Washington, D.C. (U.S. Census Bureau, 2000).

Table G.2-1
Home zip code of existing Fort Belvoir employees

District	Location	Derived number of employees	Fort Belvoir % of employees by location
A	Arlington/Alexandria	986	4%
B	Northern Fairfax Co./Loudoun Co.	1,601	7%
C	Southern Fairfax Co.	8,607	38%
D	Prince William Co.	5,116	23%
E	Near South (Fredericksburg/Stafford Co)	2,069	9%
F	Remainder of Virginia	1,613	7%
G	District of Columbia	266	1%
H	Prince Georges Co.	1,045	5%
I	Montgomery Co.	240	1%
J	Remainder of Maryland	949	4%
	Total	22,492	100%

Source: VHB 2006

Table G.2-2
Calculations for Arlington (WHS and DoD) employees

District	Location	Home zip code of existing Arlington (WHS & DOD) employees	Assume 50% would move by 2011	Percent distribution of current Fort Belvoir employees by location	Arlington redistribution based on current Fort Belvoir distribution	Percentage that would be family households	Number that would be family households	Percentage that would be nonfamily households	Number that would be nonfamily households
A	Arlington/ Alexandria	1,302	651	4%	203	0.65	132	0.35	71
B	Northern Fairfax Co./Loudoun Co.	1,349	675	7%	329	0.65	214	0.35	115
C	Southern Fairfax Co.	1,638	819	38%	1,769	0.65	1,150	0.35	619
D	Prince William Co.	1,230	615	23%	1,051	0.65	683	0.35	368
E	Near South (Fredericksburg/ Stafford Co)	557	279	9%	425	0.65	276	0.35	149
F	Remainder of Virginia	358	179	7%	331	0.65	215	0.35	116
G	District of Columbia	437	219	1%	55	0.65	36	0.35	19
H	Prince Georges Co.	1,149	575	5%	215	0.65	140	0.35	75
I	Montgomery Co.	336	168	1%	49	0.65	32	0.35	17
J	Remainder of Maryland	889	445	4%	195	0.65	127	0.35	68
	Total	9,245	4,623	100%	4,623		3,005		1,618

Table G.2-3
Calculations for NGA Employees

District	Location	Derived number of employees	Assume 50% would move by 2011	Percent distribution of current Fort Belvoir employees by location	NGA redistribution based on current Fort Belvoir distribution	Percentage that would be family households	Number that would be family households	Percentage that would be nonfamily households	Number that would be nonfamily households
A	Arlington/ Alexandria	574	287	4%	167	0.65	109	0.35	59
B	Northern Fairfax Co./Loudoun Co.	2,313	1,157	7%	293	0.65	191	0.35	103
C	Southern Fairfax Co.	649	325	38%	1,591	0.65	1,034	0.35	557
D	Prince William Co.	645	323	23%	963	0.65	626	0.35	337
E	Near South (Fredericksburg/ Stafford Co)	95	48	9%	377	0.65	245	0.35	132
F	Remainder of Virginia	306	153	7%	293	0.65	191	0.35	103
G	District of Columbia	399	200	1%	42	0.65	27	0.35	15
H	Prince Georges Co.	791	396	5%	209	0.65	136	0.35	73
I	Montgomery Co.	1,218	609	1%	42	0.65	27	0.35	15
J	Remainder of Maryland	1,384	692	4%	167	0.65	109	0.35	59
	Total		4,187	99%	4,145		2,694		1,451

Table G.2-4
Estimated redistribution of population due to Fort Belvoir BRAC action

District	Location	Number of employees (i.e., households) that would be redistributed (Arlington + NGA)	Number redistributed that would be family households	Average Family Size	Family Pop	Average number of children per family	Total number of children (18 and under) in family households	Total number of adults in family households	Number redistributed that would be non-family households	Total number of adults in non-family households	Total population that would be redistributed
A	Arlington/ Alexandria	370	229	3.27	749	1.80	411	338	123	461	872
B	Northern Fairfax Co./Loudoun Co.	622	401	3.27	1,311	1.80	720	591	216	806	1,527
C	Southern Fairfax Co.	3,360	2176	3.27	7,115	1.80	3,909	3,206	1,172	4,378	8,287
D	Prince William Co.	2,014	1317	3.27	4,307	1.80	2,366	1,941	709	2,650	5,016
E	Near South (Fredericksburg/ Stafford Co)	805	515	3.27	1,685	1.80	926	759	277	1,037	1,963
F	Remainder of Virginia	625	401	3.27	1,311	1.80	720	591	216	806	1,527
G	District of Columbia	97	57	3.27	187	1.80	103	84	31	115	218
H	Prince Georges Co.	424	286	3.27	936	1.80	514	422	154	576	1,090
I	Montgomery Co.	91	57	3.27	187	1.80	103	84	31	115	218
J	Remainder of Maryland	363	229	3.27	749	1.80	411	338	123	461	872
	Total	8,768	5,669		18,537	1.80	10,184	8,353	3,052	11,406	21,590

Appendix H

Off-Post Cumulative Projects List

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Table H-1
Proposed off-post development projects

Map ID	Project name	Total acres
1	West Springfield Business Centre Site 5 Parking Addn.	5.1
2	West Springfield Business Centre Site 5 Parking Addn.	6.3
3	Accotinck Stream Valley Trail (Revitalization Area)	9.1
4	Accotink Park	4.8
5	PBS	4.3
6	Saint John's Lutheran Church	3.8
7	Anne Ly Estate 2	2.6
8	Northampton (formerly Overbrook)	18.3
9	Crown Royal Gate	1.3
10	Cox Communications Southeast Hub Site	0.9
11	Highlands Estates	3.9
12	Lakewood Hills Section 10 Phase 2	17.0
13	Stream Valley Estates	7.3
14	VA Tire and Auto Repair	0.4
15	Mohtaram Mozafari Residence	1.6
16	Hooes Road Park	21.4
17	Metro Park Phase Seven	3.5
18	Kingstowne Section 36A	4.5
19	Windsor Knoll	9.0
20	Provident Bank	1.1
21	Beacon Mall Prop Drive-Thru Bank and Fast Food	2.0
22	Del Ray Glass	2.0
23	Commerce Bank Beacon Hill Groveton	1.6
24	Cifuentes Property PCLS 15 and 15A	8.6
25	Mazzello Cove	3.1
26	Roxbury Mews	1.8
27	Hopkins House	1.8
28	Malcolm at Ox Road	20.2
29	Laurel Hill Golf Course Expansion	348.6
30	Telegraph Road Warehouse	5.7
31	The Fairfax Building Addition	5.2
32	Jett Mechanical 8753 Richmond Highway	2.9
33	Mount Vernon Country Club Golf Course Improvements	127.7
34	St. James Episcopal Church	5.1
35	Furnace Road Recycling Facility	9.7
36	Rock Stone and Sand Yard Inc.	1.6

Table H-1
Proposed off-post development projects *(continued)*

Map ID	Project name	Total acres
37	Gunston Commerce Center Building 1	1.9
38	Lot 16 Shell Oil Park	2.8
39	Bren Mar IV	5.7
40	Residence Inn Springfield	1.3
41	Woodland Crest	2.8
42	Verizon addition to Franconia Central Office	2.0
43	Apple Federal Credit Union	1.0
44	Kendrick	3.0
45	Groveton Heights	4.6
46	Groveton Phase II	11.6
47	K and M Shopping Center	0.7
48	Beacon Mall Silver Dinner	1.1
49	Mount Calvary Baptist Church	1.5
50	7706 Gambrill Road	1.2
51	Covington Woods addition	1.9
52	Giant #149 Saratoga Shopping Center	11.3
53	Sabina Estates	3.6
54	8404 Heller Road Sanitary Sewer Service	0.0
55	UPS in Newington	21.2
56	Mount Vernon Gateway	17.0
57	Master Roofing and Siding Inc. 8463 Richmond HY	1.2
58	Laurel Overlook (Formerly Hooes Road-Blackstone)	10.1
59	Spring Hill Senior Campus Senior Housing Building	46.8
60	Hoa Nghiem Pagoda	1.3
61	Ferry Landing Preserve	5.4
62	Cranford at Gunston Cove	8.0
63	Gunston Commerce Center Land Bay D	23.7
64	Bob Evans Restaurant Old Keene Mill Road	1.6
65	Wheeler Property	0.8
66	Spicer Center	0.9
67	Rose Hill Reserve 1	23.7
68	Rose Hill Reserve 2	23.7
69	South Run Recreational Center Fitness Center Addn.	182.3
70	Springfield Metro Center II Road Improvements	4.9
71	Beacon Mall Famous Daves	1.1

Table H-1
Proposed off-post development projects *(continued)*

Map ID	Project name	Total acres
72	Silverbrook Farms Lot 7	1.0
73	Loyal Order of The Moose Franconia Lodge 646 Inc.	6.2
74	Hilltop Reclamation Project (3365-LF-01, for bond only)	1.0
75	8214 and 8218 Richmond Highway	1.2
76	Lofty Oaks Place Lots 41A 41B 41C	1.6
77	Inova Mount Vernon	1.7
78	Lorton Work House	52.1
79	AAA Vehicle Maintenance Facility	5.3
80	Commonwealth Construction Management Inc.	2.7
81	Halley Farm Subdivision	3.7
82	Lorton Debris Land Fill (1883-LF-002-2, for bond only)	1.0
83	Cardinal Estates	1.8
84	Old Keene Mill Professional Offices	2.3
85	Parcel 8A Shell Oil Park	6.0
86	Ricks Carpet and Floors	1.2
87	Talbert Subdivision	1.2
88	BB+T Bank Drive Thru Addn- Manchester Lakes SC	1.3
89	Wal-Mart Store #2194 Kingstowne Centre	14.8
90	First Baptist Church of Kingstowne	2.0
91	Hayfield Animal Hospital	1.5
92	Sherwood Hall Library	4.4
93	New Hope Church	8.9
94	Best Foods Inc 9525 Gunston Cove Road	5.6
95	Adkins Property	25.7
96	Epiphany Lutheran Church	3.0
97	Meadowbrook Drive Property	2.2
98	Backlick Plaza	7.8
99	6715 Commerce Street	4.4
100	Highgrove Estates Section 5	26.9
101	Jefferson at Sullivan Place	17.2
102	Devers Property	2.1
103	LDS Church Franconia Ward	7.6
104	Lakewood Hills Sect. 10 Phase I	35.1
105	Fairfax Park	5.3
106	Echo Inc.	0.9

Table H-1
Proposed off-post development projects *(continued)*

Map ID	Project name	Total acres
107	VW Springfield	6.8
108	2nd Park Structure at Frank-Springfield Metro Station	0.0
109	Calvary Road Baptist Church Expansion	8.1
110	Metro Park Phase Six	11.2
111	Gayfields Road	13.9
112	Silver Lake IHOP Restaurant	1.1
113	Groveton Woods	11.6
114	Holly Acres	8.9
115	Shurgard Mount Vernon	5.3
116	Mount Vernon Square Shopping Center	8.7
117	Chilis Beacon Hill 6601 Richmond Highway	1.9
118	Chapel Bridge Estates	6.6
119	St. Raymond Penafort Church	9.9
120	Harvester Presbyterian Church	3.9
121	Covington Woods	4.7
122	Monacan Estates	3.6
123	Rolling Oaks	8.0
124	Hunter Plaza, Phase One	0.8
125	Hunter Plaza Phase 2	1.3
126	Tavares/Allen Property	11.4
127	Island Creek Elementary School	18.1
128	U-Haul Retail Center 8297 Terminal Road	2.5
129	Crown Center	13.2
130	M and S Holdings LLC (formerly Millers Office Prod.)	11.4
131	8501 Backlick Road (formerly 8521)	4.6
132	Piney Glen	9.3
133	Ashby Heights	6.1
134	Federal Reality Investment/South Valley Shop Ctr.	24.1
135	Woodlands, The	4.0
136	Evergreen Farm	2.5
137	Cecil Case Estates	8.1
138	Gallahan Property	3.4
139	Vernon Heights	7.7
140	Remington Place (formerly Cooke Property)	14.4
141	Cooke Property	10.3

Table H-1
Proposed off-post development projects *(continued)*

Map ID	Project name	Total acres
142	Davison Woods	5.1
143	Nirvana Palace	30.3
144	Occoquan Overlook	100.6
145	Occoquan Park	15.8
146	Laurel Hill Land Bay A Section 1	24.5
147	Laurel Hill South Sec 1 Landbay C	24.7
148	Laurel Hill North	23.2
149	Laurel Hill South Landbay D Section 1	22.7
150	Laurel Hill South Landbay D Section 2	33.2
151	Laurel Hill South Landbays E and F, Section 1	48.0
152	Laurel Hill South Landbay E and F Section 2	33.1
153	South County High School	69.4
154	Laurel Hill Elementary School	18.5
155	Spring Hill Senior Campus	59.7
156	Laurel Hill Recreation Center	2.5
157	Pohick Road Self Storage Facility	3.9
158	Lorton Town Center Landbay D/F	18.9
159	Meeker Property	5.6
160	Laurel Ridge Crossing (formerly Pulte Plaskett Lane)	4.9
161	Lorton Town Center Landbay G	13.1
162	Grace Bible Church	3.5
163	Lorton Town Center Landbay C	3.0
164	Lorton Town Center Landbay "B-2"	1.7
165	Lorton Valley Recreation Center	0.5
166	Gunston Commons Townhouses	3.1
167	Lorton Station South Section 6	4.7
168	Barnes Property	8.7
169	Lorton Station School	12.8
170	Gunston Corner Restaurant	1.1
171	Lorton Station South Section 7	20.2
172	Cook Inlet Residential Section Three	60.6
173	Mt. Vernon Orientation Cntr. Education Center and Museum	8.4
174	Gunston Cove Business Center	8.8
175	Evans Property	6.2
176	Gunston Square Section 2 Parcel D	0.9

Table H-1
Proposed off-post development projects *(continued)*

Map ID	Project name	Total acres
177	Gunston Commerce Center Land Bay C	39.9
178	Gunston Commerce Center Land Bay B	11.7
179	Gunston Commerce Center Building 2 LB A	10.2
180	Gunston Center	14.1
181	Mid-Town Springfield Development (mixed use)	9.5
182	Springfield Mall Expansion	82.0
183	Mixed Use (Office, Hotel, Retail)	5.0
184	Mixed Use (Residential, Office, Retail, Hotel)	8.5
185	Mixed Use (Residential, Office, Recreation/Open Space, Retail)	160.5
186	Mixed Use (Office, Industrial)	117.8
187	Mixed Use (Office, Retail)	6.0