APPENDIX K
WATER SUPPLY STUDY

Water Model Study for 1250 Del Mar Drive Proposed Retail Shopping Center

Fort Bragg Water Model

Proposed Project Description

PROJECT NAME: Hare Creek Center

DESCRIPTION: The purpose of the proposed project is to develop a shopping mall to accommodate the retailer Discount Grocery, four unidentified retail tenants, and one unidentified restaurant. New shopping center consisting of three buildings, including: Building A at 15,000 square feet, Building B at 10,000 square feet and Building C at 4,500 square feet of retail space. The project would be served by a new access road, proposed for the west edge of the development that would connect Bay View Avenue (CR #439A) to the southwest to Ocean View Drive at the intersection of Ocean View and Harbor Avenue. The project also includes a new 99 space parking lot, loading zones, pedestrian improvements, rainwater storage tanks, utilities, drainage improvements and associated landscaping.

The project includes a boundary line adjustment between parcels 018-450-40 and 018-450-41, adding 32,586 square feet (0.75 acres) to parcel 018-450-40 (currently 2.42 acres), the combined parcel would be 3.16 acres. The boundary line adjustment is proposed so that the proposed development is on one parcel.

LOCATION: The proposed 3.16 acre project site is located at 1250 Del Mar Drive on Todd Point within the City of Fort Bragg city limits just north and west of the Highway 20/Highway 1 intersection. The parcel is located within the coastal zone. APN 018-450-40 & 018-450-41. The site is bounded to the north by a hotel and mini-golf course, to the east by Highway 1 and to the south and west by undeveloped property. The Project is approximately three quarters of a mile west of the existing Highway 20 water tank.

Figure 1: Project Site

Estimated Water Demands

Estimated water demands for the Project were determined by comparing four different resources. See Table 1: Estimated Water Demands for Proposed 1250 Del Mar Drive Retail Center. Estimated demands applied to the node closest to the Project are as follows:

Average Day Demand:	8,260 gpd (5.7 gpm)
Maximum Day Demand:	16,520 gpd (11.5 gpm)
Peak Hour Demand:	23,128 gpd (16.1 gpm)

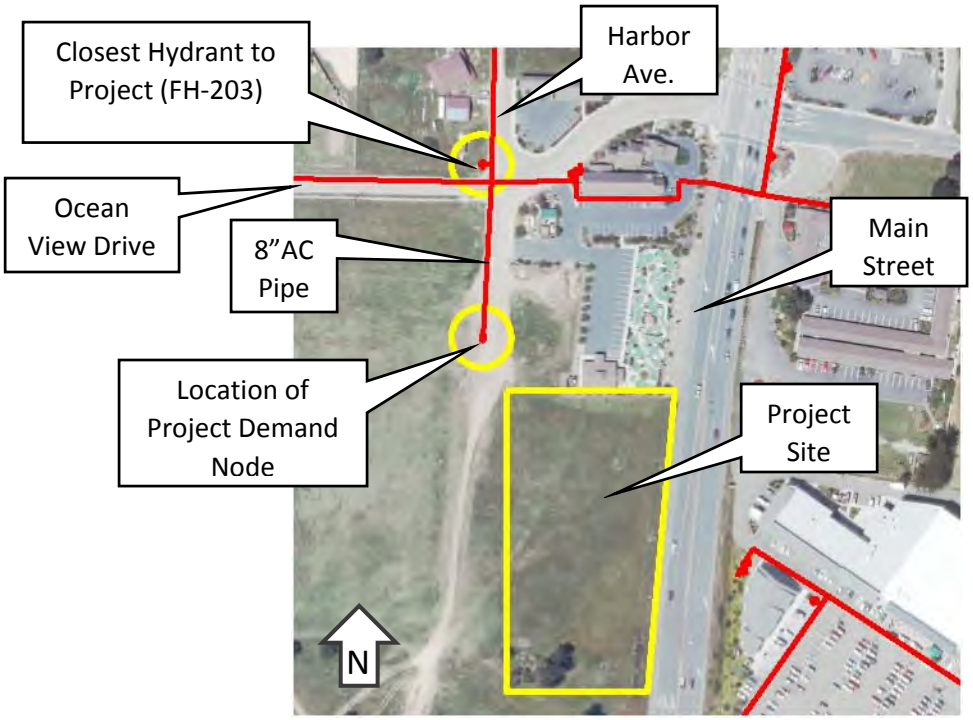

Figure 2: Existing Water System Near Project

Existing system demands were taken from the City of Fort Bragg, Phase 1 Water Facilities Study: Existing Water Collection, Distribution and Capacity, Nov. 2013 (Phase 1 Water Study). The existing system was modeled with the projected demands for 2022.

Model Results

To determine the impact of the Project on the City's water system, six different scenarios were modeled:

1) 2022 Maximum Day Demands, Existing System without Project
2) 2022 Maximum Day Demands, Existing System plus Project
3) 2022 Peak Hour Demands, Existing System without Project
4) 2022 Peak Hour Demands, Existing System plus Project
5) Fire Flow Analysis, 2022 Maximum Day Demands, Existing System without Project

6) Fire Flow Analysis, 2022 Maximum Day Demands, Existing System plus Project

See model results in Table 2, Water Model Results and Comparison. Results are shown for Scenarios 1) through 4) as the difference between the pressure at each hydrant of the existing system before the Project and the existing system plus the Project. Similarly, fire flow analysis results for 5) and 6) results are shown as the difference in available fire flow. Available fire flow is defined in the appendix titled "Description of Fire Flows in Hydraulic Modeling". Also see the Phase 1 Water Study referenced above for a further explanation of available fire flow as well as detailed explanations of the water model developed for the City of Fort Bragg.

2022 MAXIMUM DAY DEMANDS PRESSURE DIFFERENCE

Results from the hydraulic model show no significant difference in pressure between the existing water system with and without the Project. A maximum difference of 0.1 psi is observed. These results are presented in Table 2.

2022 PEAK HOUR DEMANDS PRESSURE DIFFERENCE

Similar to the 2022 maximum day demands comparison, results from the hydraulic model show no significant difference in pressure between the existing water system with and without the Project. A maximum difference of 0.1 psi is observed. These results are also presented in Table 2.

2022 MAXIMUM DAY DEMANDS FIRE FLOW ANALYSIS, AVAILABLE FIRE FLOW DIFFERENCE

Per the Phase 1 Water Study, the required minimum fire flow is 1,500 gpm. As explained in the Phase 1 Water Study, not all of the existing Fort Bragg hydrants meet minimum fire flow requirements. Improvements to the water system were recommended in the Phase 1 Water Study to improve the system's fire flows.

Results from the hydraulic model show no significant difference in pressure between the existing water system with and without the Project. For hydrants with available fire flow less than 1,500 gpm, the maximum flow difference is 3 gpm. For hydrants with available fire flows above 1,500 gpm, the maximum flow difference is 16 gpm, or less than 1% change. These results are presented in Table 2.

Summary

Using the calibrated Fort Bragg network hydraulic model and with input from the water system staff at the City of Fort Bragg, no significant changes to the existing water system are anticipated with the addition of the proposed project at 1250 Del Mar Drive.

Table 1: Estimated Water Demands for Proposed 1250 Del Mar Drive Retail Center

Fort Bragg Water Model

Building Area	29,500	SF
Parcel Size (After LLA)	3.16	AC
Assumed Building Frontage	200	ft

Resource 1: Phase 1 Water Study [1]

Ave. Day Demand / SF	0.28	gpd/SF, Table 1
Ave. Day Demand	**8,260**	**gpd**
Max. Day Factor	2	
Max. Day Demand / SF	0.56	gpd/SF
Max. Day Demand	**16,520**	**gpd**

Resource 2: West Yost Study [2]

Ave. Day Demand / AC	2,520	gpd/AC, p.4
Ave. Day Demand	**7,963**	**gpd**
Max. Day Factor	2	, p.5
Max. Day Demand / AC	5,040	gpd/AC, p.4
Max. Day Demand	**15,926**	**gpd**

Resource 3: Water Capital Improvement Fee Study [3]

Ave. Day Demand / SF	0.11	gpd/SF
Ave. Day Demand	**3,245**	**gpd**
Assumed Max. Day Factor	2	
Assumed Max. Day Demand / SF	0.22	gpd/SF
Max. Day Demand	**6,490**	**gpd**

Resource 4: Wastewater Engineering, Metcalf & Eddy [4]

Ave. Day Demand	450	gpd for first 25' of frontage
	400	gpd for each additional 25' of frontage
Ave. Day Demand	**3,250**	**gpd**
Assumed Max. Day Factor	2	
Max. Day Demand	**6,500**	**gpd**

Water Demands Selected for 1250 Del Mar Drive Retail Center

Average Day Demand	8,260	gpd	5.7	gpm
Maximum Day Demand	16,520	gpd	11.5	gpm
Peak Hour Demand (1.4 * MDD)	23,128	gpd	16.1	gpm

(1) City of Fort Bragg, Phase 1 Water Facilities Study: Existing Water Collection, Distribution and Capacity, Nov. 2013, KASL Engineers

(2) Technical Memorandum No. 1, Georgia-Pacific Fort Bragg Mill Site Redevelopment Project - GP and City of Fort Bragg Potable Water Demand and Supply Projections, Jan. 10, 2011, West Yost

(3) Water Capital Improvement Fee Study, 2000, Bartle Wells Associates

(4) Wastewater Engineering, Metcalf & Eddy, Inc. McGraw-Hill, Table 2-6, 1972

Table 2: Water Model Results and Comparison for Proposed 1250 Del Mar Dr. Retail Center

Fort Bragg Water Model

Minimum Desired Available Fire Flow (gpm): 1,500

Model Hydrant Label	Max Day 2022 (926 gpm) Pressure (psi)	Max Day 2022 Plus 1250 Del Mar Dr. (937 gpm) Pressure (psi)	Max Day 2022 Press. Difference Pressure (psi)	Peak Hour 2022 (1296 gpm) Pressure (psi)	Peak Hour 2022 1250 Del Mar Dr. (1313 gpm) Pressure (psi)	Peak Hour 2022 Pressure Difference Pressure (psi)	Max Day 2022 Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 + 1250 Del Mar Dr. Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 Available Fire Flow Difference Flow (gpm) [2]
FH-1	21.4	21.4	0	21.4	21.4	0	2,500	2,500	0
FH-2	51.1	51.1	0	51.1	51.1	0	**538**	**538**	0
FH-2A	52	52	0	51.9	51.9	0	**538**	**538**	0
FH-3	53.2	53.2	0	53.2	53.2	0	**877**	**877**	0
FH-4	53.1	53.1	0	53.1	53.1	0	**877**	**877**	0
FH-5	52.9	52.9	0	52.8	52.8	0	**509**	**509**	0
FH-5A	55.8	55.8	0	55.8	55.8	0	**547**	**547**	0
FH-6	57.4	57.4	0	57.4	57.4	0	**549**	**549**	0
FH-7	57.7	57.7	0	57.7	57.7	0	**833**	**833**	0
FH-8	35.3	35.3	0	35.2	35.2	0	2,376	2,368	-8
FH-8A	60.8	60.8	0	60.8	60.8	0	**943**	**943**	0
FH-9	58.2	58.2	0	58.2	58.2	0	**1,423**	**1,423**	0
FH-10	59.1	59.1	0	59	59	0	1,971	1,970	-1
FH-11	57.8	57.8	0	57.8	57.8	0	1,715	1,715	0
FH-12	55.9	55.9	0	55.9	55.9	0	**1,388**	**1,388**	0
FH-13	54	54	0	54	54	0	**1,222**	**1,222**	0
FH-14	52.7	52.7	0	52.6	52.6	0	**1,150**	**1,150**	0
FH-15	52	52	0	52	52	0	**1,123**	**1,123**	0
FH-16	53.1	53.1	0	53.1	53.1	0	**1,291**	**1,291**	0
FH-17	56.4	56.4	0	56.4	56.4	0	**1,468**	**1,468**	0
FH-18	57.3	57.3	0	57.3	57.3	0	1,603	1,603	0
FH-19	57.4	57.4	0	57.3	57.3	0	1,650	1,650	0
FH-20	50.6	50.6	0	50.5	50.5	0	**978**	**978**	0
FH-21	50.1	50.1	0	50.1	50.1	0	**994**	**994**	0
FH-22	60.4	60.4	0	60.4	60.4	0	1,583	1,583	0
FH-23	51.5	51.5	0	51.5	51.5	0	**1,436**	**1,436**	0
FH-24	50.5	50.5	0	50.4	50.4	0	**939**	**939**	0
FH-25	39.2	39.2	0	39	39	0	**668**	**668**	0
FH-26	39.4	39.4	0	39.2	39.2	0	**851**	**849**	**-2**
FH-26A	38.1	38.1	0	37.9	37.9	0	**800**	**798**	**-2**
FH-27	62.2	62.2	0	62.2	62.2	0	2,035	2,035	0
FH-28	61.7	61.7	0	61.7	61.7	0	2,035	2,035	0
FH-29	61.6	61.6	0	61.6	61.6	0	2,007	2,007	0
FH-30	60.4	60.4	0	60.4	60.4	0	2,023	2,023	0
FH-31	60.3	60.3	0	60.2	60.2	0	2,028	2,027	-1
FH-32	61	61	0	61	61	0	1,992	1,991	-1
FH-33	59.5	59.5	0	59.5	59.5	0	2,009	2,009	0

Model Hydrant Label	Max Day 2022 (926 gpm) Pressure (psi)	Max Day 2022 Plus 1250 Del Mar Dr. (937 gpm) Pressure (psi)	Max Day 2022 Press. Difference Pressure (psi)	Peak Hour 2022 (1296 gpm) Pressure (psi)	Peak Hour 2022 1250 Del Mar Dr. (1313 gpm) Pressure (psi)	Peak Hour 2022 Pressure Difference Pressure (psi)	Max Day 2022 Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 + 1250 Del Mar Dr. Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 Available Fire Flow Difference Flow (gpm) [2]
FH-34	58.5	58.5	0	58.4	58.4	0	1,991	1,991	0
FH-35	53.4	53.4	0	53.4	53.4	0	1,879	1,879	0
FH-35A	51.4	51.4	0	51.4	51.4	0	1,758	1,757	-1
FH-36	52.3	52.3	0	52.3	52.3	0	**892**	**892**	0
FH-37	55.7	55.7	0	55.7	55.7	0	**1,261**	**1,261**	0
FH-38	55.2	55.2	0	55.2	55.2	0	**1,367**	**1,367**	0
FH-39	39.5	39.5	0	39.4	39.4	0	**612**	**612**	0
FH-40	40.7	40.7	0	40.6	40.6	0	**691**	**690**	**-1**
FH-41	38.4	38.4	0	38.3	38.3	0	2,087	2,080	-7
FH-42	61.5	61.5	0	61.5	61.5	0	1,973	1,973	0
FH-43	41.1	41.1	0	40.9	40.9	0	**991**	**989**	**-2**
FH-44	63	63	0	63	63	0	2,099	2,098	-1
FH-45	61.6	61.6	0	61.6	61.6	0	**1,023**	**1,023**	0
FH-46	56.5	56.5	0	56.5	56.5	0	1,893	1,892	-1
FH-47	58.2	58.2	0	58.1	58.1	0	1,582	1,582	0
FH-48	41.4	41.4	0	41.2	41.2	0	**1,136**	**1,133**	**-3**
FH-49	40.6	40.6	0	40.4	40.4	0	**1,220**	**1,219**	**-1**
FH-50	41	41	0	40.8	40.8	0	**1,237**	**1,236**	**-1**
FH-51	65.4	65.4	0	65.4	65.4	0	**1,171**	**1,171**	0
FH-52	64.5	64.5	0	64.5	64.5	0	1,980	1,980	0
FH-53	41.9	41.9	0	41.7	41.7	0	1,805	1,803	-2
FH-54	67.8	67.8	0	67.8	67.8	0	**1,378**	**1,378**	0
FH-55	61.6	61.6	0	61.6	61.6	0	2,109	2,101	-8
FH-56	58.9	58.9	0	58.9	58.9	0	2,109	2,101	-8
FH-57	58.4	58.4	0	58.3	58.3	0	2,109	2,101	-8
FH-58	33.8	33.8	0	33.5	33.5	0	**986**	**984**	**-2**
FH-59	68.2	68.2	0	68.2	68.2	0	1,685	1,685	0
FH-60	43.7	43.7	0	43.5	43.5	0	2,105	2,098	-7
FH-61	42.4	42.4	0	42.1	42.1	0	1,833	1,828	-5
FH-62	43.1	43.1	0	42.8	42.8	0	**1,360**	**1,358**	**-2**
FH-63	42.2	42.2	0	41.9	41.9	0	**638**	**638**	0
FH-64	43.2	43.2	0	42.8	42.8	0	**1,349**	**1,347**	**-2**
FH-65	41.2	41.2	0	40.9	40.9	0	**808**	**807**	**-1**
FH-66	43.9	43.9	0	43.6	43.6	0	**1,081**	**1,080**	**-1**
FH-66A	41.8	41.8	0	41.5	41.5	0	**927**	**925**	**-2**
FH-67	42.5	42.5	0	42.3	42.2	-0.1	**573**	**572**	**-1**
FH-68	37.9	37.9	0	37.6	37.6	0	**554**	**554**	0
FH-69	45.3	45.3	0	45	44.9	-0.1	2,160	2,152	-8
FH-70	44.4	44.4	0	44.1	44.1	0	**1,244**	**1,243**	**-1**
FH-71	38.8	38.8	0	38.5	38.5	0	**1,231**	**1,228**	**-3**

Model Hydrant Label	Max Day 2022 (926 gpm) Pressure (psi)	Max Day 2022 Plus 1250 Del Mar Dr. (937 gpm) Pressure (psi)	Max Day 2022 Press. Difference Pressure (psi)	Peak Hour 2022 (1296 gpm) Pressure (psi)	Peak Hour 2022 1250 Del Mar Dr. (1313 gpm) Pressure (psi)	Peak Hour 2022 Pressure Difference Pressure (psi)	Max Day 2022 Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 + 1250 Del Mar Dr. Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 Available Fire Flow Difference Flow (gpm) [2]
FH-72	40.8	40.8	0	40.4	40.4	0	**893**	**891**	**-2**
FH-73	43.8	43.8	0	43.5	43.4	-0.1	**1,093**	**1,091**	**-2**
FH-74	52	52	0	51.7	51.7	0	**1,105**	**1,103**	**-2**
FH-75	45.4	45.4	0	45.1	45.1	0	2,129	2,122	-7
FH-76	45.1	45.1	0	44.7	44.7	0	2,137	2,131	-6
FH-77	44.2	44.2	0	43.8	43.8	0	2,145	2,138	-7
FH-78	45.5	45.5	0	45.1	45.1	0	2,149	2,142	-7
FH-79	48.8	48.8	0	48.5	48.5	0	1,575	1,574	-1
FH-80	38.8	38.8	0	38.5	38.5	0	**1,153**	**1,151**	**-2**
FH-81	46.1	46.1	0	45.8	45.8	0	**1,255**	**1,252**	**-3**
FH-82	41.1	41	-0.1	40.7	40.7	0	**953**	**951**	**-2**
FH-83	45.3	45.3	0	45	44.9	-0.1	**1,128**	**1,126**	**-2**
FH-84	48.9	48.9	0	48.6	48.5	-0.1	2,006	1,999	-7
FH-85	47.2	47.2	0	46.9	46.9	0	1,625	1,624	-1
FH-86	46.3	46.3	0	46	46	0	2,145	2,138	-7
FH-87	46.7	46.7	0	46.4	46.4	0	**1,368**	**1,366**	**-2**
FH-88	46.5	46.5	0	46.2	46.2	0	**1,387**	**1,386**	**-1**
FH-89	44.7	44.7	0	44.3	44.3	0	2,144	2,135	-9
FH-90	49.1	49.1	0	48.8	48.7	-0.1	**1,491**	**1,490**	**-1**
FH-91	44.6	44.6	0	44.3	44.2	-0.1	**804**	**802**	**-2**
FH-92	40.2	40.2	0	39.9	39.8	-0.1	**625**	**624**	**-1**
FH-93	47.7	47.7	0	47.4	47.3	-0.1	1,546	1,541	-5
FH-94	48.8	48.8	0	48.4	48.4	0	1,604	1,600	-4
FH-95	49.8	49.8	0	49.5	49.4	-0.1	1,821	1,820	-1
FH-96	47.5	47.5	0	47.2	47.2	0	2,146	2,137	-9
FH-97	49.1	49.1	0	48.8	48.8	0	1,513	1,511	-2
FH-98	51	51	0	50.6	50.6	0	1,616	1,615	-1
FH-99	51.2	51.2	0	50.9	50.9	0	1,952	1,944	-8
FH-100	43.9	43.9	0	43.6	43.6	0	**852**	**850**	**-2**
FH-101	51	51	0	50.7	50.7	0	1,754	1,748	-6
FH-102	51	51	0	50.6	50.6	0	2,134	2,125	-9
FH-103	50.5	50.5	0	50.2	50.2	0	1,755	1,754	-1
FH-104	53.6	53.6	0	53.3	53.3	0	1,879	1,878	-1
FH-105	49	49	0	48.7	48.6	-0.1	**1,383**	**1,381**	**-2**
FH-106	45	45	0	44.7	44.7	0	**1,083**	**1,082**	**-1**
FH-107	50.2	50.2	0	49.9	49.9	0	1,717	1,714	-3
FH-108	51.9	51.9	0	51.6	51.6	0	1,813	1,806	-7
FH-109	51.7	51.7	0	51.3	51.3	0	1,894	1,887	-7
FH-110	51.5	51.4	-0.1	51.1	51.1	0	1,908	1,906	-2
FH-111	50.8	50.8	0	50.5	50.5	0	1,566	1,565	-1

Model Hydrant Label	Max Day 2022 (926 gpm) Pressure (psi)	Max Day 2022 Plus 1250 Del Mar Dr. (937 gpm) Pressure (psi)	Max Day 2022 Press. Difference Pressure (psi)	Peak Hour 2022 (1296 gpm) Pressure (psi)	Peak Hour 2022 1250 Del Mar Dr. (1313 gpm) Pressure (psi)	Peak Hour 2022 Pressure Difference Pressure (psi)	Max Day 2022 Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 + 1250 Del Mar Dr. Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 Available Fire Flow Difference Flow (gpm) [2]
FH-112	54.2	54.2	0	53.9	53.9	0	1,745	1,744	-1
FH-113	53.6	53.6	0	53.3	53.3	0	2,003	1,995	-8
FH-114	49.6	49.6	0	49.2	49.2	0	2,139	2,131	-8
FH-115	55.4	55.4	0	55	55	0	2,118	2,110	-8
FH-116	54.2	54.2	0	53.9	53.9	0	2,119	2,111	-8
FH-117	55.1	55.1	0	54.8	54.8	0	2,059	2,058	-1
FH-118	50.9	50.9	0	50.6	50.6	0	**1,446**	**1,445**	**-1**
FH-119	51.6	51.6	0	51.3	51.2	-0.1	**1,299**	**1,298**	**-1**
FH-120	53.9	53.9	0	53.6	53.6	0	1,949	1,942	-7
FH-121	57.3	57.3	0	56.9	56.9	0	1,954	1,947	-7
FH-122	57.7	57.7	0	57.4	57.4	0	1,954	1,946	-8
FH-123	53.9	53.9	0	53.6	53.5	-0.1	2,004	2,003	-1
FH-124	50.8	50.8	0	50.5	50.5	0	2,074	2,065	-9
FH-125	53.3	53.3	0	53	53	0	1,702	1,701	-1
FH-126	56.5	56.5	0	56.2	56.1	-0.1	1,860	1,859	-1
FH-127	56.4	56.4	0	56.1	56.1	0	2,028	2,019	-9
FH-128	56.9	56.9	0	56.6	56.5	-0.1	1,676	1,674	-2
FH-129	56.6	56.6	0	56.3	56.3	0	1,942	1,934	-8
FH-130	58.9	58.9	0	58.6	58.6	0	2,107	2,099	-8
FH-131	54.5	54.5	0	54.1	54.1	0	2,074	2,065	-9
FH-132	55.4	55.4	0	55	55	0	2,088	2,079	-9
FH-133	58	58	0	57.6	57.6	0	2,093	2,084	-9
FH-134	57.3	57.3	0	57	57	0	2,038	2,030	-8
FH-135	59.8	59.8	0	59.5	59.5	0	1,818	1,817	-1
FH-136	62.1	62.1	0	61.8	61.7	-0.1	1,768	1,767	-1
FH-137	61.8	61.8	0	61.4	61.4	0	2,020	2,012	-8
FH-138	59	58.9	-0.1	58.6	58.6	0	2,008	1,999	-9
FH-139	55.1	55.1	0	54.8	54.8	0	2,005	1,997	-8
FH-140	50.5	50.5	0	50.2	50.1	-0.1	2,036	2,028	-8
FH-141	48.1	48.1	0	47.8	47.8	0	**1,407**	**1,405**	**-2**
FH-142	47.4	47.4	0	47.1	47.1	0	**1,343**	**1,341**	**-2**
FH-143	48.7	48.7	0	48.4	48.4	0	2,129	2,120	-9
FH-144	50.5	50.5	0	50.1	50.1	0	2,021	2,012	-9
FH-145	48.9	48.9	0	48.6	48.6	0	2,010	2,002	-8
FH-145A	47	47	0	46.7	46.6	-0.1	1,633	1,631	-2
FH-146	48.1	48.1	0	47.8	47.8	0	1,708	1,705	-3
FH-147	50.6	50.6	0	50.3	50.3	0	1,502	1,500	-2
FH-148	53.4	53.4	0	53.1	53.1	0	1,613	1,611	-2
FH-149	57.6	57.6	0	57.3	57.3	0	1,747	1,744	-3
FH-150	50.8	50.7	-0.1	50.4	50.4	0	1,647	1,644	-3

Model Hydrant Label	Max Day 2022 (926 gpm) Pressure (psi)	Max Day 2022 Plus 1250 Del Mar Dr. (937 gpm) Pressure (psi)	Max Day 2022 Press. Difference Pressure (psi)	Peak Hour 2022 (1296 gpm) Pressure (psi)	Peak Hour 2022 1250 Del Mar Dr. (1313 gpm) Pressure (psi)	Peak Hour 2022 Pressure Difference Pressure (psi)	Max Day 2022 Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 + 1250 Del Mar Dr. Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 Available Fire Flow Difference Flow (gpm) [2]
FH-151	45.6	45.6	0	45.3	45.3	0	1,558	1,555	-3
FH-152	45.1	45.1	0	44.8	44.7	-0.1	1,500	**1,497**	**-3**
FH-153	46.4	46.4	0	46	46	0	1,808	1,805	-3
FH-153A	48.6	48.6	0	48.3	48.2	-0.1	2,021	2,013	-8
FH-154	45	45	0	44.7	44.7	0	1,792	1,788	-4
FH-155	45.4	45.4	0	45.1	45.1	0	1,660	1,659	-1
FH-156	44.9	44.8	-0.1	44.5	44.5	0	1,513	1,510	-3
FH-157	46.5	46.5	0	46.2	46.2	0	**1,317**	**1,315**	**-2**
FH-158	45.6	45.6	0	45.3	45.3	0	**1,424**	**1,422**	**-2**
FH-159	45.2	45.2	0	44.9	44.9	0	2,069	2,064	-5
FH-160	45.8	45.7	-0.1	45.4	45.4	0	1,510	1,508	-2
FH-161	48.6	48.6	0	48.3	48.3	0	1,942	1,939	-3
FH-162	47.4	47.4	0	47.1	47.1	0	1,765	1,762	-3
FH-163	57.3	57.3	0	57.1	57.1	0	2,500	2,500	0
FH-163A	76	76	0	75.8	75.8	0	2,500	2,500	0
FH-164	90.4	90.4	0	90.2	90.2	0	2,500	2,500	0
FH-165	90.4	90.4	0	90.2	90.2	0	2,500	2,500	0
FH-166	90.1	90.1	0	89.9	89.9	0	2,500	2,500	0
FH-167	89.9	89.9	0	89.6	89.6	0	2,500	2,500	0
FH-168	89.9	89.9	0	89.6	89.6	0	2,500	2,500	0
FH-169	56.4	56.4	0	56	56	0	2,072	2,064	-8
FH-170	60.1	60.1	0	59.7	59.7	0	2,095	2,086	-9
FH-171	60.8	60.8	0	60.5	60.4	-0.1	1,905	1,904	-1
FH-172	61	60.9	-0.1	60.6	60.5	-0.1	**1,441**	**1,441**	0
FH-173	62.3	62.3	0	61.9	61.9	0	**1,449**	**1,449**	0
FH-174	63.6	63.6	0	63.3	63.2	-0.1	1,836	1,835	-1
FH-175	54.5	54.5	0	54.2	54.2	0	2,031	2,022	-9
FH-176	48.6	48.6	0	48.3	48.3	0	2,194	2,185	-9
FH-177	62.2	62.2	0	61.9	61.9	0	2,043	2,035	-8
FH-178	64.5	64.5	0	64.2	64.1	-0.1	2,037	2,028	-9
FH-179	60	60	0	59.7	59.7	0	2,022	2,014	-8
FH-180	52	52	0	51.6	51.6	0	2,040	2,032	-8
FH-181	47.6	47.6	0	47.3	47.3	0	2,090	2,081	-9
FH-182	49.3	49.3	0	49	49	0	**1,258**	**1,257**	**-1**
FH-183	51.4	51.4	0	51.1	51.1	0	**887**	**886**	**-1**
FH-184	59.7	59.7	0	59.4	59.4	0	2,271	2,255	-16
FH-185	49.9	49.9	0	49.6	49.6	0	1,832	1,819	-13
FH-185A	59.8	59.8	0	59.5	59.5	0	1,868	1,855	-13
FH-186	51.3	51.3	0	51	51	0	1,758	1,745	-13
FH-187	44.5	44.5	0	44.2	44.2	0	1,618	1,609	-9

Model Hydrant Label	Max Day 2022 (926 gpm) Pressure (psi)	Max Day 2022 Plus 1250 Del Mar Dr. (937 gpm) Pressure (psi)	Max Day 2022 Press. Difference Pressure (psi)	Peak Hour 2022 (1296 gpm) Pressure (psi)	Peak Hour 2022 1250 Del Mar Dr. (1313 gpm) Pressure (psi)	Peak Hour 2022 Pressure Difference Pressure (psi)	Max Day 2022 Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 + 1250 Del Mar Dr. Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 Available Fire Flow Difference Flow (gpm) [2]
FH-188	44.1	44.1	0	43.8	43.8	0	1,579	1,568	-11
FH-189	43.2	43.2	0	43	43	0	1,605	1,600	-5
FH-190	44.8	44.7	-0.1	44.6	44.5	-0.1	1,846	1,839	-7
FH-191	47.6	47.6	0	47.4	47.4	0	2,029	2,022	-7
FH-192	46.6	46.5	-0.1	46.4	46.4	0	**1,494**	**1,491**	**-3**
FH-193	45.3	45.3	0	45.1	45.1	0	1,655	1,652	-3
FH-194	54	54	0	53.9	53.9	0	2,432	2,423	-9
FH-194A	53.5	53.5	0	53.3	53.3	0	2,500	2,500	0
FH-194B	53	53	0	52.9	52.9	0	2,500	2,500	0
FH-195	51.7	51.7	0	51.5	51.5	0	2,500	2,500	0
FH-196	75.3	75.3	0	75.1	75	-0.1	1,979	1,979	0
FH-198	45.4	45.4	0	45.2	45.2	0	2,500	2,500	0
FH-198A	43.4	43.4	0	43.2	43.2	0	**1,371**	**1,368**	**-3**
FH-199	37.5	37.5	0	37.4	37.4	0	2,500	2,500	0
FH-200	26.7	26.7	0	26.6	26.6	0	2,500	2,500	0
FH-201	19.3	19.3	0	19.3	19.3	0	2,500	2,500	0
FH-202	46.5	46.5	0	46.2	46.1	-0.1	1,544	1,533	-11
FH-203 [4]	48.6	48.6	0	48.3	48.3	0	1,584	1,573	-11
FH-204	51.5	51.5	0	51.2	51.2	0	1,744	1,731	-13
FH-205	53.7	53.7	0	53.4	53.3	-0.1	1,578	1,566	-12
FH-205A	59.2	59.2	0	59	58.9	-0.1	1,578	1,566	-12
FH-206	63.6	63.6	0	63.2	63.2	0	2,057	2,048	-9
FH-207	59.4	59.4	0	59.1	59.1	0	2,073	2,064	-9
FH-208	58	58	0	57.6	57.6	0	2,082	2,073	-9
FH-209	58.8	58.8	0	58.4	58.4	0	2,087	2,078	-9
FH-210	60	60	0	59.6	59.6	0	2,092	2,084	-8
FH-211	63.7	63.7	0	63.3	63.3	0	1,708	1,707	-1
FH-212	61.7	61.7	0	61.3	61.3	0	1,755	1,754	-1
FH-213	68.5	68.5	0	68.1	68.1	0	2,052	2,044	-8
FH-214	65.2	65.2	0	64.9	64.8	-0.1	2,010	2,009	-1
FH-215	68	68	0	67.7	67.6	-0.1	2,057	2,048	-9
FH-216	65.5	65.5	0	65.2	65.2	0	2,062	2,054	-8
FH-217	61.8	61.8	0	61.5	61.4	-0.1	2,069	2,060	-9
FH-218	59.6	59.6	0	59.3	59.2	-0.1	2,036	2,034	-2
FH-219	59.4	59.4	0	59	59	0	2,086	2,078	-8
FH-220	60.4	60.4	0	60.1	60.1	0	2,092	2,084	-8
FH-221	60.7	60.7	0	60.4	60.4	0	2,092	2,084	-8
FH-222	62.3	62.3	0	61.9	61.9	0	1,915	1,914	-1
FH-223	63.7	63.7	0	63.3	63.3	0	1,763	1,762	-1
FH-224	65.5	65.5	0	65.1	65.1	0	**1,027**	**1,027**	0

Model Hydrant Label	Max Day 2022 (926 gpm) Pressure (psi)	Max Day 2022 Plus 1250 Del Mar Dr. (937 gpm) Pressure (psi)	Max Day 2022 Press. Difference Pressure (psi)	Peak Hour 2022 (1296 gpm) Pressure (psi)	Peak Hour 2022 1250 Del Mar Dr. (1313 gpm) Pressure (psi)	Peak Hour 2022 Pressure Difference Pressure (psi)	Max Day 2022 Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 + 1250 Del Mar Dr. Available Fire Flow Flow (gpm) [1][3]	Max Day 2022 Available Fire Flow Difference Flow (gpm) [2]
FH-225	67.2	67.2	0	66.8	66.8	0	1,547	1,547	0
FH-226	80.1	80.1	0	79.6	79.6	0	**793**	**793**	0
FH-227	75.6	75.6	0	75.1	75.1	0	**866**	**865**	**-1**
FH-228	76.7	76.7	0	76.1	76.1	0	**783**	**783**	0
FH-229	82.8	82.8	0	82.3	82.3	0	**608**	**608**	0
FH-230	80.8	80.8	0	80.3	80.2	-0.1	**578**	**578**	0
FH-231	79.1	79.1	0	78.5	78.5	0	**568**	**568**	0
FH-232	74.4	74.4	0	73.8	73.8	0	**553**	**552**	**-1**
FH-232A	73.4	73.4	0	72.8	72.8	0	**542**	**542**	0
FH-232B	70.3	70.3	0	69.8	69.7	-0.1	**568**	**568**	0
FH-233	74.2	74.2	0	73.7	73.7	0	**1,055**	**1,055**	0
FH-234	61.2	61.2	0	60.8	60.8	0	2,089	2,081	-8
FH-235	67.5	67.5	0	67.1	67.1	0	1,729	1,728	-1
FH-236	66.3	66.3	0	65.9	65.9	0	1,746	1,746	0
FH-237	69.3	69.3	0	68.9	68.9	0	1,646	1,645	-1
FH-238	67.9	67.9	0	67.5	67.5	0	1,686	1,685	-1
FH-239	68.8	68.7	-0.1	68.3	68.3	0	1,657	1,656	-1
FH-240	69.6	69.6	0	69.2	69.2	0	1,664	1,663	-1
FH-241	69.7	69.7	0	69.3	69.3	0	1,798	1,797	-1
FH-242	69.8	69.8	0	69.4	69.4	0	1,726	1,725	-1
FH-243	71.8	71.8	0	71.4	71.4	0	1,738	1,737	-1
FH-244	71.3	71.3	0	70.9	70.9	0	1,724	1,724	0
FH-245	70	70	0	69.6	69.6	0	1,680	1,679	-1
FH-246	70.9	70.9	0	70.5	70.5	0	1,564	1,564	0
FH-247	72.6	72.6	0	72.2	72.2	0	**1,469**	**1,469**	0
FH-248	64.4	64.4	0	64	64	0	2,003	2,002	-1
FH-249	67.1	67.1	0	66.7	66.7	0	2,092	2,084	-8
FH-250	62.6	62.6	0	62.2	62.2	0	2,091	2,082	-9
FH-251	64.1	64.1	0	63.8	63.7	-0.1	2,092	2,083	-9
FH-252	65.3	65.3	0	64.9	64.9	0	1,953	1,952	-1
FH-253	67.4	67.4	0	67	67	0	2,048	2,047	-1
FH-500	50.3	50.3	0	50	50	0	1,986	1,984	-2
FH-501	61.1	61.1	0	60.7	60.7	0	1,624	1,623	-1
FH-WARF1-2.5	67.9	67.9	0	67.5	67.5	0	2,055	2,047	-8

Notes:
(1) Values highlighted in red indicate hydrants whose available fire flow is less than the desired 1,500 gpm.
(2) Values highlighted in red indicate hydrants whose available fire flow is less than the desired 1,500 gpm, and the difference between pre-project vs. post-project is greater than 0.
(3) Tank levels conservatively estimated at 0 volume for fire flow tests.
(4) FH-203 is the closest hydrant to the Project. See Figure 2.

Appendix: Description of Fire Flows in Hydraulic Modeling

1. Field measured fire flow

- Hydrant flow is measured with flow meter
- 2.5” opening vs. 4.5” opening will give different flow results

2. Modeled Automated Fire Flow Analysis (Available fire flow)

- Available flow values indicate the maximum flow at each hydrant such that residual pressures at the hydrant stay above 20 PSI and all system components stay above 35 PSI during maximum day demands
- Available fire flows are computed by iteratively assigning demands and computing system pressures at each demand increment. For example:

  Hydrant A is being tested.

  1. 1 GPM is added to Hydrant A.
  2. All other pressures in the system are checked to see if they are above 35 PSI.
  3. Hydrant A is checked to see if its own pressure is above 20 PSI.
  4. If both 2. and 3. pass the test, then another 1 GPM is added to Hydrant A, and the system pressures are checked again.
  5. If both 2. and 3. do not pass the test, the available flow total is stopped and reported.
- All hydrants can be checked at once using the automated fire flow analysis.
- Automated Fire Flow Analysis does not take into account losses in the hydrant.

3. Modeled discharge to atmosphere fire flow (Simulates field measured fire flow)

- Emitter coefficient is assumed for each hydrant type. Assumed emitter coefficients:
  - 150 - 180 for 2.5” outlets
  - 167 - 185 for 2 - 2.5” outlets
  - 380 - 510 for the 4.5” outlets
- Pressure head is converted to velocity at outlet
- Each hydrant needs to be modeled separately
- Discharge to atmosphere fire flow does take into account losses in the hydrant.

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MEMORANDUM

DATE: April 21, 2017
TO: Scott Perkins, Associate Planner
FROM: Sergio Fuentes, Engineering Tech.
SUBJECT: Water Availability for the Hare Creek Center Development

Scott,

Per Marie's request, I have evaluated water availability for the proposed Hare Creek Center Development ("Hare Creek") using the Water-Supply Model ("model") developed by Lawrence and Associates. The model shows how changes to demand and supply affect water availability. Below is a short summary of the investigation and the results.

Input Parameters

Hare Creek Water Demand: The water quantity used for the analysis was based on data submitted by the applicant. The applicant quotes an average daily use of 943 gallons per day (gpd). Due to the inherit variability that occurs in water demand, a range of water demand was also reviewed. The range of water demand evaluated was approximately 25% of the demand quoted by the applicant, 700 -1,200 gpd.

Water Model Inputs:

a. City Demand- The model incorporated City demand data from 2012-2013.

b. Year Modeled- The model incorporated the City's municipal water supply system data from 2015.

Findings

Based on the model's analysis, the City's municipal water supply system can support the development of the proposed Hare Creek project; even with the development of the proposed project there will be an adequate water supply in the system.

This evaluation did not include water demand for landscape irrigation. A new analysis shall be completed if the applicant anticipates the aggregate water demand for landscape and the quoted daily water use to exceed the range investigated in the report, i.e. greater than 1,200 gpd.