TECHNICAL MEMORANDUM

To: Town of Cape Charles, Virginia

From: Stearns & Wheler, LLC

Date: February 1, 2007

Re: Demand Projections
Water Treatment Facilities Study and Expansion
S&W No. 61177.0

The following Technical Memorandum summarizes how the future water demand projections were estimated based on data provided by the Town of Cape Charles and Baymark Construction.

FLOW DATA FROM 1999 TO 2006

The following table summarizes the growth in average daily water production from 1999 to 2006. Data was provided to the Town as reported to the Virginia Department of Health (VDH) in their monthly reports.

TABLE 1

AVERAGE DAILY FLOW AND YEARLY GROWTH RATES

YEAR	AVERAGE DAILY FLOW (gpd)	GROWTH RATE FROM PREVIOUS YEAR (%)
1999	116,256	---
2000	116,910	0.56
2001	119,882	2.54
2002	122,747	2.39
2003	131,189	6.88
2004	146,304	11.52
2005	156,039	6.65
2006	158,121	1.33 (1)

(1) Only partial year of flow data available (from January to July 2006).

From 1999 to 2006, the average growth rate in water production was 4.5 percent. The average growth from 2003 to 2005 was 8.5 percent (2006 data was excluded because only a partial year of data was available). The likely cause of the higher growth rates from 2003 to 2005 was that this was probably the period that Baymark development activities began to exert an increasing water demand.

The following table summarizes various flow rates from 1999 to 2006. The same values are presented on Figure 1:

TABLE 2

FLOW RATES FROM 1999 TO 2006

YEAR	FLOW (gpd)			
	MINIMUM DAY	AVERAGE DAY	MAXIMUM MONTH	MAXIMUM DAY
1999	55,100	116,256	152,269	238,200
2000	58,900	116,910	144,380	268,700
2001	65,700	119,882	149,403	259,500
2002	58,000	122,747	175,520	236,500
2003	35,100	131,189	168,554	289,300
2004	61,000	146,304	175,910	276,600
2005	53,800	156,039	192,977	278,300
2006	54,100	158,121	194,138	325,200

(1) Maximum daily flow values reflect actual demand values. Extreme flows, due to main breaks or other anomalous events, were excluded from the calculation of flows (such as those events on July 18, 1999, January 25 & 27, 2003, August 31, 2005, and May 28, 2006).

The minimum day values typically remain around 50,000 gpd. There has been a steady upward trend in average day, maximum month, and maximum day flows (from 120,000 to 160,000 gpd, from 150,000 to 190,000 gpd, and from about 250,000 gpd to 330,000 gpd, respectively).

The following table summarizes factors that relate the average daily flow to minimum daily flow, maximum month flow, and maximum daily flow.

TABLE 3

FLOW RELATIONSHIP FACTORS

YEAR	FACTOR RELATING AVERAGE DAILY FLOW TO…		
	MINIMUM DAY	MAXIMUM MONTH	MAXIMUM DAY
1999	0.47	1.31	2.05
2000	0.50	1.23	2.30
2001	0.55	1.25	2.16
2002	0.47	1.43	1.93
2003	0.27	1.28	2.21
2004	0.42	1.20	1.89
2005	0.34	1.24	1.78
2006	0.34	1.23	2.06
Average	**0.42**	**1.27**	**2.05**
Median	**0.44**	**1.24**	**2.05**

The average factor relating average daily flow to maximum daily flow is 2.05 with a range from about 1.8 to 2.3. For planning purposes, the data suggests preliminary factors of 0.5, 1.3, and 2.0 for average day flow to minimum day flow, maximum month flow, and maximum day flow, respectively.

FLOW PER CONNECTION

The following table summarizes the approximate flow per existing connection based on data provided by the Town on the number of actual connections being served per year:

TABLE 4

FLOW RATE PER EXISTING CONNECTION FROM 1999 TO 2006

YEAR	ERC (1)	gpd/connection			
		MINIMUM DAY	AVERAGE DAY	MAXIMUM MONTH	MAXIMUM DAY
1999	742	74	157	205	321
2000	762	77	153	189	353
2001	791	83	152	189	328
2002	813	71	151	216	291
2003	866	41	151	195	334
2004	973	63	150	181	284
2005	1,026	52	152	188	271
2006	1,053	51	150	184	309
Average	**---**	**64**	**152**	**193**	**311**

(1) Number of actual billed connections in December of the given year.

Table 4 shows that even though each of the existing connections is not an equivalent residential connection, the averages suggest that the number of existing connections can be practically equated to the number of existing equivalent residential connections (ERCs) for planning purposes. This assumption may not be valid in the future because the proportion of demands attributed to non-residential connections (i.e., multiple ERCs per connection) may grow such that connections and ERCs need to be tracked separately. However, for now, this simplifying assumption appears to be reasonable.

Use of 150 gpd/ERC approximates the average daily flow but fails to account for maximum month, maximum daily, and peak hourly demands. 225 gpd/ERC (rate currently allowed by the VDH for the Town of Cape Charles) accounts for flows greater than the maximum month but still less than the maximum day or peak hourly flows. The historic value used by the Town of 300 gpd/ERC approximates the maximum daily flow.

PROJECTED ERCs FROM 2007 TO 2040

The following table summarizes the number of ERCs expected to be added each year from 2007 to 2040 based on data provided by the Town and Baymark. In addition, the possibility exists that the Town might expand its boundaries to the east to approximately State Route 13. That expansion will add additional ERCs, which are accounted for in Table 5.

TABLE 5

PROJECTED ERCs FROM 2007 TO 2040

YEAR	ENTITY				
	HISTORIC TOWN	BAYMARK	EXPANDED TOWN	TOTAL PER YEAR	CUMULATIVE TOTAL
	ERCs TO BE ADDED EACH YEAR				
2006	852	201	0	---	1,053
2007	30	45	0	75	1,128
2008	30	45	0	75	1,203
2009	143	101	0	244	1,447
2010	143	101	0	244	1,691
2011	148	146	0	294	1,985
2012	148	146	0	294	2,279
2013	148	146	0	294	2,573
2014	148	146	0	294	2,867
2015	148	146	0	294	3,161
2016	66	191	0	257	3,418
2017	66	191	122	379	3,797
2018	66	191	122	379	4,176
2019	66	191	122	379	4,555
2020	66	191	122	379	4,934
2021	31	120	122	273	5,207
2022	31	120	106	257	5,464
2023	31	120	106	257	5,721
2024	31	120	106	257	5,978
2025	31	120	106	257	6,235
2026	29	90	106	225	6,460
2027	29	90	106	225	6,685
2028	29	90	106	225	6,910
2029	29	90	106	225	7,135
2030	29	90	106	225	7,360
2031	29	60	106	195	7,555
2032	29	60	106	195	7,750
2033	29	0	106	135	7,885
2034	29	0	106	135	8,020
2035	29	0	106	135	8,155
2036	0	0	106	106	8,261
2037	0	0	106	106	8,367
2038	0	0	106	106	8,473
2039	0	0	106	106	8,579
2040	0	0	106	106	8,685
TOTAL	**1,861**	**3,147**	**2,624**	**7,632**	**---**

Over the next 25 years, the Baymark developments will add between 30 to 80 percent of the total ERCs each year. If the Town's boundaries do not expand, between 40 and 80 percent of the yearly ERCs will be contributed by Baymark with an average yearly addition of 67 percent. Should the Town expand its boundaries, the yearly contribution of ERCs by Baymark will be 30 to 75 percent with an average yearly contribution of about 50 percent. Therefore, the Baymark developments will contribute, on average, 50 percent or more of the annual ERCs added over the next 25 years. This is graphically shown in Figures 2 and 3.

PROJECTED FLOWS FROM 2007 TO 2040 BASED ON ERCs

Based on the number of ERCs added each year (see Table 5), the projected flows from 2007 to 2040 can be estimated. Those flows are shown in Table 6. The flows indicated are those expected at the end of each year, based on the number of ERCs to be added each year. The flows presented are average daily flow (assuming 150 gpd/ERC based on the values provided in Table 4) and maximum daily flow (assuming 300 gpd/ERC; see Table 4). At the end of 2006, there were 1,053 ERCs (852 ERCs allocated to the Town and 201 ERCs to Baymark); those ERCs are included in the total ERCs shown for both the Town and Baymark.

TABLE 6

PROJECTED FLOWS BASED ON ERCs FROM 2007 TO 2040

YEAR	HISTORIC TOWN			BAYMARK			EXPANDED TOWN			TOTAL		
	ERCs	AVERAGE DAILY FLOW (gpd)	MAXIMUM DAILY FLOW (gpd)	ERCs	AVERAGE DAILY FLOW (gpd)	MAXIMUM DAILY FLOW (gpd)	ERCs	AVERAGE DAILY FLOW (gpd)	MAXIMUM DAILY FLOW (gpd)	ERCs	AVERAGE DAILY FLOW (gpd)	MAXIMUM DAILY FLOW (gpd)
2010	1,198	179,700	359,400	493	73,950	147,900	0	0	0	1,691	253,650	507,300
2015	1,938	290,700	581,400	1,223	183,450	366,900	0	0	0	3,161	474,150	948,300
2020	2,268	340,200	680,400	2,178	326,700	653,400	488	73,200	146,400	4,934	740,100	1,480,200
2025	2,423	363,450	726,900	2,778	416,700	833,400	1,034	155,100	310,200	6,235	935,250	1,870,500
2030	2,568	385,200	770,400	3,228	484,200	968,400	1,564	234,600	469,200	7,360	1,104,000	2,208,000
2035	2,713	406,950	813,900	3,348	502,200	1,004,400	2,094	314,100	628,200	8,155	1,223,250	2,446,500
2040	2,713	406,950	813,900	3,348	502,200	1,004,400	2,624	393,600	787,200	8,685	1,302,750	2,605,500

Currently, the Baymark developments represent about 20 percent of the average daily water demand. The historic Town accounts for the remaining 80 percent of the demand. By 2021, Baymark will represent 50 percent of the average daily demand (assumes no expansion of the Town boundaries). By 2040, Baymark accounts for 55 percent of the total daily water demand. If the Town expands its boundaries, after 2020, the Baymark developments will consistently exert 45 percent of the average daily water demand. This is all shown graphically on Figures 4 and 5.

ALTERNATE MEANS OF ESTIMATING FUTURE WATER DEMANDS

A. Flow per Acre.

As of 2006, the existing Town water system serves a total area of about 413 acres. Of those 413 acres, about 135 acres are actually developed. Based on the developed area, the water production per acre can be calculated using flow data summarized in Table 2. The calculated flows per acre based on the 2006 flow data are presented in Table 7.

TABLE 7

FLOW PER ACRE IN 2006

FLOW RATE	gpd/acre
Minimum Day	401
Average Day	1,171
Maximum Month	1,438
Maximum Day	2,409

Based on the development of undeveloped areas within the Town's historic boundaries and the areas to be developed by Baymark, the following estimated future flows were calculated based on the values from Table 7. The estimated flow rates assume full build out of the developed areas (or the flows anticipated in 2040). Based on data provided by Baymark, Baymark expects to develop about 781 acres into commercial and residential properties. The Town expects about 315 additional acres within the Towns historic boundaries to be developed into residential and commercial properties. There also exists the possibility that the Town could expand its boundaries to the east to approximately State Route 13. That expansion could add another 676 acres of commercial and residential properties.

TABLE 8

ESTIMATED FLOWS IN BASED ON DEVELOPED ACREAGE

FLOW RATE	GPD/ACRE	CURRENT		HISTORIC TOWN		BAYMARK		EXPANDED TOWN		TOTAL	
		ACRES	FLOW (gpd)	ACRES	FLOW (gpd)	ACRES	FLOW (gpd)	ACRES	FLOW (gpd)	ACRES	FLOW (gpd)
Minimum Day	401	135	54,135	315	126,315	805	322,805	676	271,076	1,931	774,331
Average Day	1,171	135	158,085	315	368,865	805	942,655	676	791,596	1,931	2,261,201
Maximum Month	1,438	135	194,130	315	452,970	805	1,157,590	676	972,088	1,931	2,776,778
Maximum Day	2,409	135	325,215	315	758,835	805	1,939,245	676	1,628,484	1,931	4,651,779

Full build out of the Baymark properties is expected by 2032. The Town expects all the properties within the boundaries of the historic Town to be developed by 2035. An expansion of the Town, if it occurs, is estimated to begin around 2017 and last until 2040.

Assuming the Town boundaries do not expand, by 2035, the water plant will need to meet an average daily demand of about 1,500,000 gpd and a maximum daily flow of about 3,000,000 gpd. The flows estimated based on ERCs (see Table 6) are about 900,000 gpd (average day) and 1,800,000 gpd (maximum day). The difference in the flow values between the two estimating methods is 40 percent.

If the Town were to expand its boundaries to the east, by 2040, the estimated average daily flow based on developed acreage is about 2,300,000 gpd with a maximum daily flow of 4,700,000 gpd. The flows estimated based on ERCs are about 1,300,000 gpd (average day) and 2,600,000 gpd (maximum day). The difference in flows between the two estimating methods (ERCs and flow per acre) under this growth scenario is also about 40 percent.

B. Flow per Capita.

Typically, a value of 100 gallons per day per capita is used to estimate demand (12VAC-590-690 – Capacity of waterworks). This value represents an average daily flow. Based on recent census data and average daily flow values, the flow per capita for each year since 1999 can be estimated (see Table 9):

TABLE 9

ESTIMATED AVERAGE DAILY FLOW PER CAPITA FROM 1999 TO 2006

YEAR	AVERAGE DAILY FLOW (gpd)	POPULATION	FLOW/CAPITA (gpd/capita)
1999	116,256	1,320	88
2000	116,910	1,134	103
2001	119,882	1,106	108
2002	122,747	1,090	113
2003	131,189	1,108	118
2004	146,304	1,180	124
2005	156,039	1,423	110
2006	158,121	1,423	111
AVERAGE	**---**	**---**	**109**

(1) Only Year 2000 data is based on actual census data collection. The other values are based on U.S. Census population estimates. This population data does not account for transient seasonal populations.

(2) No census data (estimated or otherwise) is available for 2006 at this time. Therefore, the population from 2005 was used.

The average flow per capita for the Town (109 gpd/capita) is very similar to the typical value used for planning purposes.

Using the number of ERCs from 1999 to 2006 (see Table 4) and population data from the same period (see Table 9), the number of capita per ERC can be estimated (see Table 10).

TABLE 10

ESTIMATED CAPITA PER ERC FROM 1999 TO 2006

YEAR	ERCs	POPULATION	CAPITA/ERC
1999	742	1,320	1.78
2000	762	1,134	1.49
2001	791	1,106	1.40
2002	813	1,090	1.34
2003	866	1,108	1.28
2004	973	1,180	1.21
2005	1026	1,423	1.39
2006	1053	1,423	1.35
AVERAGE	**---**	**---**	**1.41**

For planning purposes, the number of capita per ERC will be assumed to be 1.4 (Table 10). The number of gallons per capita will be assumed to be 110 gpd/capita (Table 9). Using the number of ERCs from 2010 to 2040 from Table 5, the average daily flow can be estimated (see Table 11).

TABLE 11

ESTIMATED FUTURE FLOWS BASED ON PER CAPITA DATA

YEAR	HISTORIC TOWN			BAYMARK			EXPANDED TOWN			TOTAL		
	ERCs	EST. CAPITA	AVERAGE DAILY FLOW (gpd)	ERCs	EST. CAPITA	AVERAGE DAILY FLOW (gpd)	ERCs	EST. CAPITA	AVERAGE DAILY FLOW (gpd)	ERCs	EST. CAPITA	AVERAGE DAILY FLOW (gpd)
2010	1,198	1,677	184,492	493	690	75,922	0	0	0	1,691	2,367	260,414
2015	1,938	2,713	298,452	1,223	1,712	188,342	0	0	0	3,161	4,425	486,794
2020	2,268	3,175	349,272	2,178	3,049	335,412	488	683	75,152	4,934	6,908	759,836
2025	2,423	3,392	373,142	2,778	3,889	427,812	1,034	1,448	159,236	6,235	8,729	960,190
2030	2,568	3,595	395,472	3,228	4,519	497,112	1,564	2,190	240,856	7,360	10,304	1,133,440
2035	2,713	3,798	417,802	3,348	4,687	515,592	2,094	2,932	322,476	8,155	11,417	1,255,870
2040	2,713	3,798	417,802	3,348	4,687	515,592	2,624	3,674	404,096	8,685	12,159	1,337,490

Comparing the estimated average daily flow data in Table 11 with the estimated average daily flow values in Table 6 show there to be less than a 3 percent difference between the two estimates. The maximum daily flow can be estimated by applying a factor of 2.0 to the average daily flow values (refer to Table 3).

C. Future Flows based on Previous Growth Rates.

Another means of estimating future flows is to examine the changes in flow from the past. As shown in Table 1, the average yearly increase in average daily flow from 1999 to 2006 was 4.5 percent. The average growth rate from 2003 to 2005 was 8.5 percent per year. Assuming similar growth patterns in average daily flow until 2040, the following flow rates were estimated (see Table 12). The basis of the estimates is an average daily flow in 2006 of 158,121 gpd (see Table 1).

TABLE 12

ESTIMATED FUTURE FLOWS BASED ON PAST GROWTH RATES

YEAR	4.5 PERCENT GROWTH	8.5 PERCENT GROWTH
	AVERAGE DAILY FLOW (gpd)	
2010	188,562	219,133
2015	234,983	329,501
2020	292,831	495,457
2025	364,921	744,977
2030	454,758	1,120,220
2035	566,711	1,684,426
2040	706,226	2,532,799

USING FLOW DATA TO ESTIMATE SIZE OF FUTURE TREATMENT FACILITIES

There are marked differences between the flows estimated by each method especially as longer planning horizons are considered. Figures 6 and 7 graphically show the similarities and differences between the various methods of estimating flows. Figure 6 assumes that the Town will expand its boundaries in the future. Figure 7 assumes that the Town will not expand its boundaries except for the Baymark developments.

Because of the differences in the various estimating methods, the 30+ year planning horizon, inadequacies in the existing data, and the uncertainty in the estimates, we recommend that the Town consider a phased upgrade approach to the water treatment facilities. Such an approach would allow the Town to expand the facility now to meet short-term future projected demands and then upgrade the facilities further if and when actual water demands dictate the need for expansion. If flow projections ultimately prove too conservative, then future upgrade phases can be postponed until such time as they are necessary, thereby preventing unnecessary capital expenditures. Should the projections prove accurate or even less conservative than anticipated, then the facilities could be upgraded with less potential need to completely replace the existing facilities, as future phases of the upgrade would be accounted for in the design and construction of the previous phases.

A phased upgrade plan would also save capital expenses on upgrades that might not be needed for 20 years or more (a typical design life for a water treatment plant). Also, equipment infrequently used over a long period time typically will deteriorate. Therefore, if equipment were unnecessarily installed now, that same equipment might need to be replaced in the future when the time came for its actual use.

Based on Figures 6 and 7, we recommend a two- to three-phased approach to the expansion of the water treatment facilities. Should the Town's boundaries not expand, a two-phased approach appears reasonable. Should the Town expand its boundaries, a three-phased approach appears appropriate. Table 13 summarizes the proposed upgrade phases.

TABLE 13

PROPOSED UPGRADE PHASES

PHASE	PLANT CAPACITY (gpd)	
	NO TOWN EXPANSION	EXPANDED TOWN
I	1,000,000	1,000,000
II	2,000,000	2,000,000
III	---	3,000,000

Assuming growth occurs at the rates estimated in Figures 6 and 7, Phase I is expected to meet average daily flows until about 2026 (assuming expanded Town boundaries) or beyond 2040 if the Town's boundaries to not expand. Maximum daily demands are expected to begin exceeding plant capacity in 2015 under both growth scenarios.

Phase II would likely handle average daily flows beyond 2040 under both growth scenarios. Maximum daily demands could begin exceeding plant capacity in 2026 (if Town expands its boundaries). With no Town expansion, Phase II would satisfy maximum daily demands beyond 2040.

Phase III would only be necessary more than 20 years from now should the Town expand its boundaries.

Common practice among municipalities is to begin planning for expansions of their treatment facilities when the daily flows frequently exceed 50 percent of the plant capacity. VDH requires municipalities to prepare plans and specifications for plant expansions when the daily flow exceeds 80 percent of the plant capacity during three consecutive months (12VAC5-590-520 – Waterworks expansion). The following table summarizes the years when these milestones are expected to be reached for the various phases of the plant expansion (based on ERC flow projections). The ERC projections were used as they appear to be the most reasonable values, the methodology is generally accepted within the industry and VDH, and the values compare reasonably well with other flow projection methods.

TABLE 14

DATES WHEN FLOW MILESTONES ARE EXPECTED TO BE REACHED

PHASE	PLANT CAPACITY (gpd)	50% OF CAPACITY	80% OF CAPACITY	100% OF CAPACITY (max. day)
Current Facility	360,000	1999	2006	2008
I	1,000,000	2010	2013	2016
II	2,000,000	2016	2020 - 2023	2027+
III	3,000,000	2020 - 2023	2034+	2040+

Given the existing VDH waterworks design capacity of 360,000 gpd, the observed daily flows for the Town exceeded 50 percent of this design capacity for three consecutive months in 1999. Daily flow exceeded 80 percent of design capacity for three consecutive months from May to July 2006.

Based on the projected growth rates and the VDH requirements, the Town rightly began considering an expansion of the existing facilities in 2006. Assuming Phase I is constructed in the near future and depending on how the demand projections evolve, the Town might need to begin considering upgrading to Phase II around 2013 even though the upgrades might not truly be necessary for several more years.

WATER PRODUCTION AND WATER SOLD

Although being sure that sufficient capacity is built into the water treatment facilities and distribution storage to meet whatever demands are exerted on the system is of critical importance, of equal importance is the need to sell as much of the water that is produced as possible to maximize revenue and minimize un-metered uses. By minimizing un-metered uses, the water system is better able to generate the necessary revenue to maintain and upgrade the treatment and distribution systems.

The following table summarizes the approximate amount of water that was pumped to the distribution system on a monthly basis (water used within the treatment plant is not included in the volumes) and compares that to the approximate amount of water sold.

TABLE 15

WATER PRODUCED VERSUS WATER SOLD

MONTH & YEAR	VOLUME TO DIST. SYS. (gallons)	VOLUME SOLD (gallons)	PERCENT UNACCOUNTED FOR
October 2005	4,007,180	2,156,053	46
November 2005	3,844,800	3,288,981	14
December 2005	3,689,700	1,585,317	57
January 2006	3,612,100	2,236,614	38
February 2006	3,079,700	2,238,271	27
March 2006	3,929,500	2,014,367	49
April 2006	3,714,400	3,550,789	4
May 2006	4,593,292	2,397,923	48
June 2006	4,884,900	3,834,003	22
July 2006	5,131,800	3,386,682	34
TOTAL	40,487,372	26,689,000	34
AVERAGE	**---**	**---**	**34**

Based on the available data, on average the Town sells only 65 percent of the water that the Town sends to the distribution system. An audit of water use, meters, and un-metered uses is recommended to determine whether the volume of water sold can be increased.

Another issue of concern is the amount of water used for filter backwashing and softener regeneration at the treatment plant. A waste rate of about 5 to 7 percent of raw water production for filter backwashing and other processes is generally considered acceptable within the industry. From February 1999 to

October 2003, waste rates averaged about 6 percent on a monthly basis (range was 5 to 7 percent). However, after October 2003, the average waste rate has been about 12 percent (ranging from 7 to 14 percent). Thus, since October 2003, waste rates have been about double of what is generally considered acceptable. The primary cause of this problem is attributed to the short filter runs times currently being experienced due to deteriorations in raw water quality (i.e., high iron and manganese concentrations). Once the new filter media is installed, further treatment plant optimizations and/or additional pretreatment steps should be explored to reduce the waste rate to more acceptable levels.

STORAGE ANALYSIS

In addition to providing sufficient equipment capacity to produce enough water to meet demands on a maximum day basis, the Town needs to have sufficient storage capacity to meet instantaneous peak demands that are even greater than a maximum day demand. These instantaneous demands can be caused by water use, fires, main breaks, flushings, or combinations of these and other uses occurring at the same time. The following is a brief analysis of the minimum storage that is estimated to be required under current conditions as well as the various phases of the proposed treatment system upgrades.

The VDH requires, as a minimum, the storage tank volume be based on 200 gallons per ERC. Also, consideration needs to be given to whether the storage provided under this 200 gallons per ERC requirement is sufficient to meet fire protection needs. Based on the number of ERCs projected (see Table 6), the following minimum storage requirement were developed assuming 200 gallons of storage per ERC. Additional storage was assumed for fire protection assuming 1,000 gpm for 2 hours and 2,000 gpm for 2 hours.

TABLE 16

ESTIMATED MINIMUM WATER STORAGE REQUIREMENTS

YEAR	ERCs	MINIMUM DOMESTIC STORAGE (GALLONS)	MINIMUM FIRE PROTECTION REQUIREMENTS (GALLONS)	TOTAL MINIMUM STORAGE (GALLONS)
2006	1,053	210,600	120,000	330,600
2010	1,691	338,200	120,000	458,200
2015	3,161	632,200	120,000	752,200
2020	4,934	986,800	240,000	1,226,800
2025	6,235	1,247,000	240,000	1,487,000
2030	7,360	1,472,000	240,000	1,712,000
2035	8,155	1,631,000	240,000	1,871,000
2040	8,685	1,737,000	240,000	1,977,000

Current conditions suggest a storage tank of about 350,000 gallons is required, slightly more than the current 300,000 gallons available. Future storage requirements range from about 1 to 2 million gallons.

CONCLUSIONS

1. Average daily water demand has increased, on average, about 4.5 percent per year since 1999. Since 2003, the average daily water demand has increased by about 8.5 percent per year. The recent higher growth rates are attributed to the new Baymark developments, which began being built in 2003.

2. The peaking factor between average daily flow and maximum daily flow is about 2.

3. 150 gpd/ERC reasonably approximates average daily flow based on 1999 to 2006 water production data. 300 gpd/ERC reasonably approximates maximum daily flow.

4. Over the next 25 years, Baymark developments will contribute, on average, 50 to 67 percent of the new ERCs.

5. The average daily flows for the historic Town, Baymark, and an expanded Town using the ERC projection method are summarized in the following table:

YEAR	HISTORIC TOWN		BAYMARK		EXPANDED TOWN		TOTAL	
	ERCs	FLOW (gpd)	ERCs	FLOW (gpd)	ERCs	FLOW (gpd)	ERCs	FLOW (gpd)
2010	1,198	179,700	493	73,950	0	0	1,691	253,650
2020	2,268	340,200	2,178	326,700	488	73,200	4,934	740,100
2030	2,568	385,200	3,228	484,200	1,564	234,600	7,360	1,104,000
2040	2,713	406,950	3,348	502,200	2,624	393,600	8,685	1,302,750

6. Currently, the Town sells about 65 percent of the water, on average, that is pumped to the distribution system.

7. Currently, about 12 percent of the water pumped from the wells is used for filter backwashing, softener regeneration, and other plant activities. This waste rate is about double what is generally considered acceptable in the industry, but may not be unreasonable for the particular raw water conditions faced by the plant. Therefore, additional pretreatment upstream of the filters may be warranted to improve finished water quality.

RECOMMENDATIONS

- Plan for the following approximate number of ERCs over time:

YEAR	ERCs			
	HISTORIC TOWN	BAYMARK	EXPANDED TOWN	TOTAL
2006	852	201	0	1,053
2010	1,200	500	0	1,700
2020	2,300	2,200	500	5,000
2030	2,600	3,200	1,600	7,400
2040	2,700	3,300	2,600	8,600

- The ERC estimates should be re-evaluated every five years. Demand projections should be re-evaluated with each revision of the ERC estimates and compared to then current water demands.

- Implement a phased upgrade approach for construction of new and expanded water treatment facilities as follows:

PHASE	PLANT CAPACITY (million gallons per day)	STORAGE (million gallons)
I	1	1
II	2	2
III	3	2

- Conduct system-wide audit to determine if most water uses are being metered. Tasks would include attempting to quantify un-metered water uses, determination of the error between the various water meters used to compare water production and water sold, and evaluation of the error associated with meters in the distribution system.

- Conduct further evaluations of the water treatment facilities to determine cost effective means to reduce water use to levels below current use.

- After Phase I is implemented, use 300 gpd/ERC to estimate system demand allocations.

- Build additional finished water storage corresponding to plant expansion phases.

Figure 1
Flow Rates from 1999 to 2006

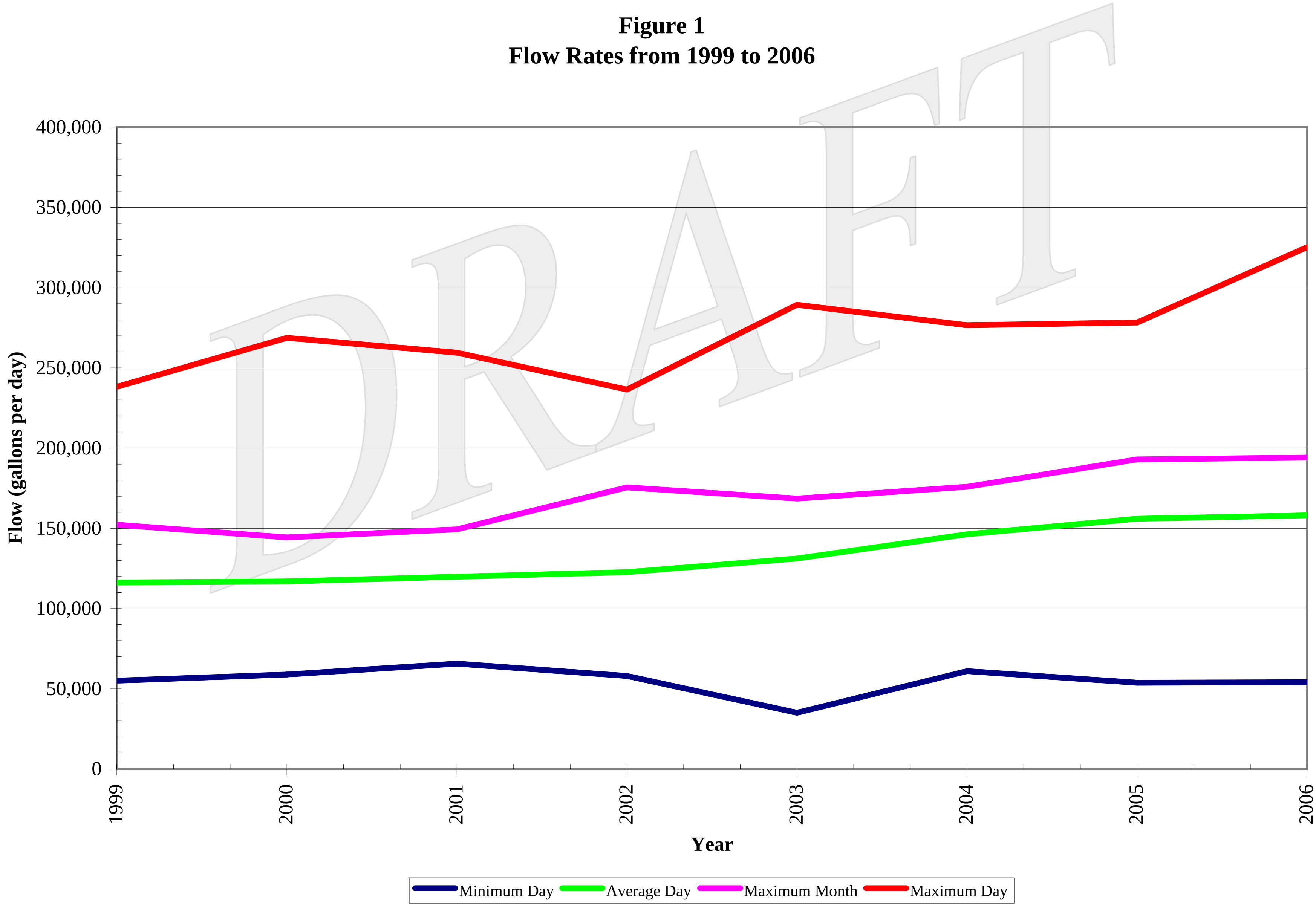

Figure 2
Allocation of Future ERCs
(assumes expansion of Town boundaries)

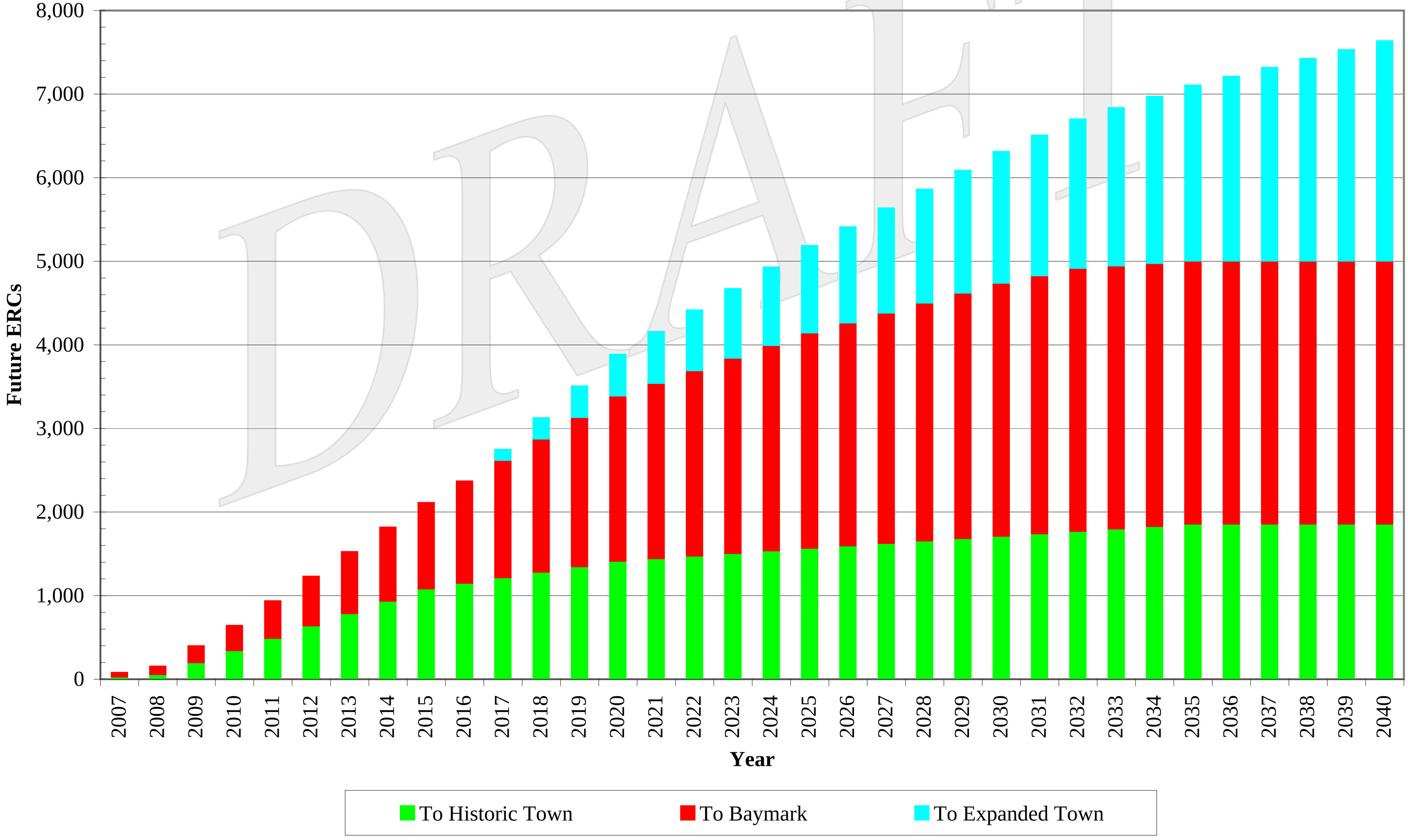

Figure 3
Allocation of Future ERCs
(assumes no expansion of Town boundaries)

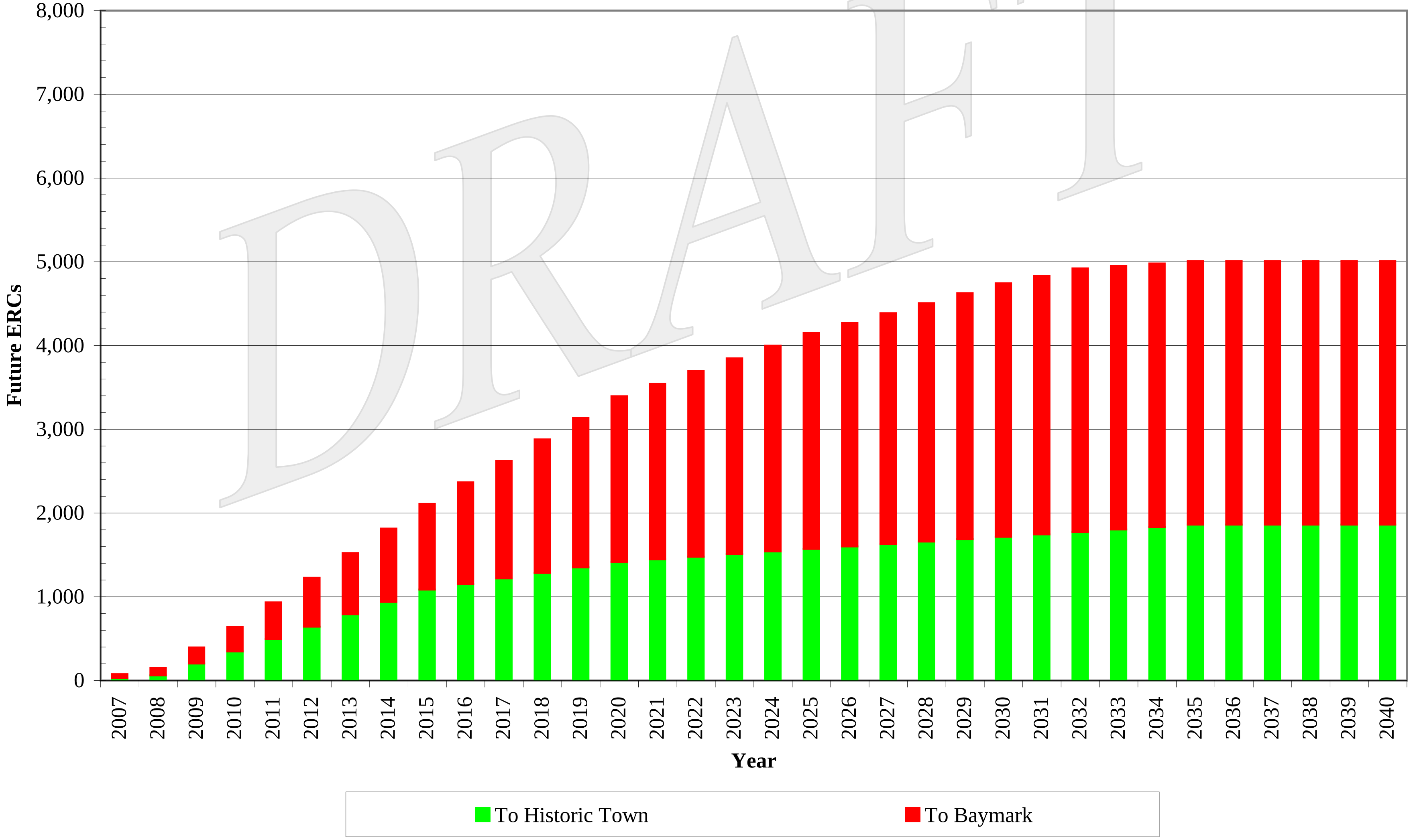

Figure 4
Distribution of Average Daily Flow between Historic Town, Baymark, and Expanded Town

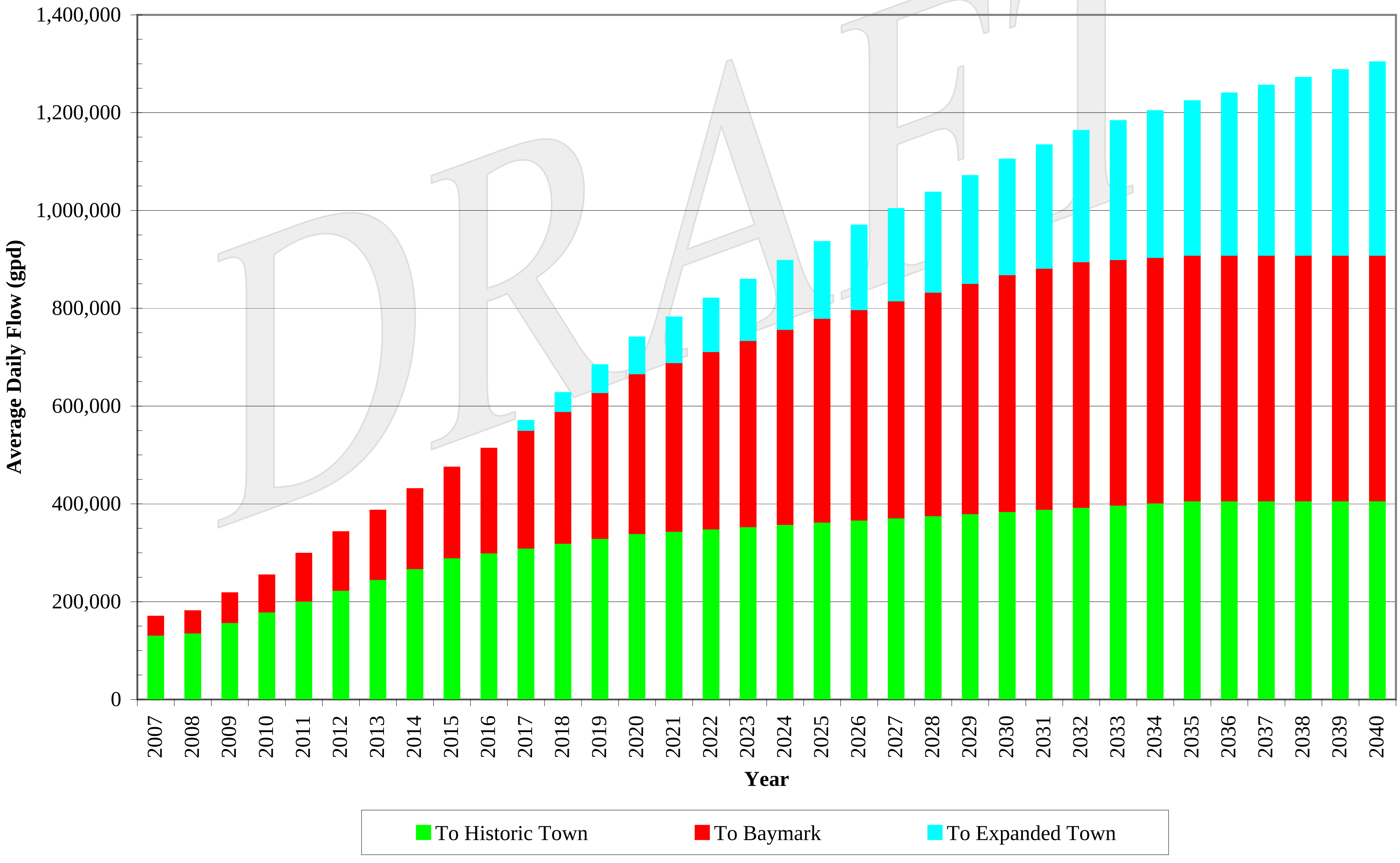

Figure 5
Distribution of Average Daily Flow between Historic Town and Baymark

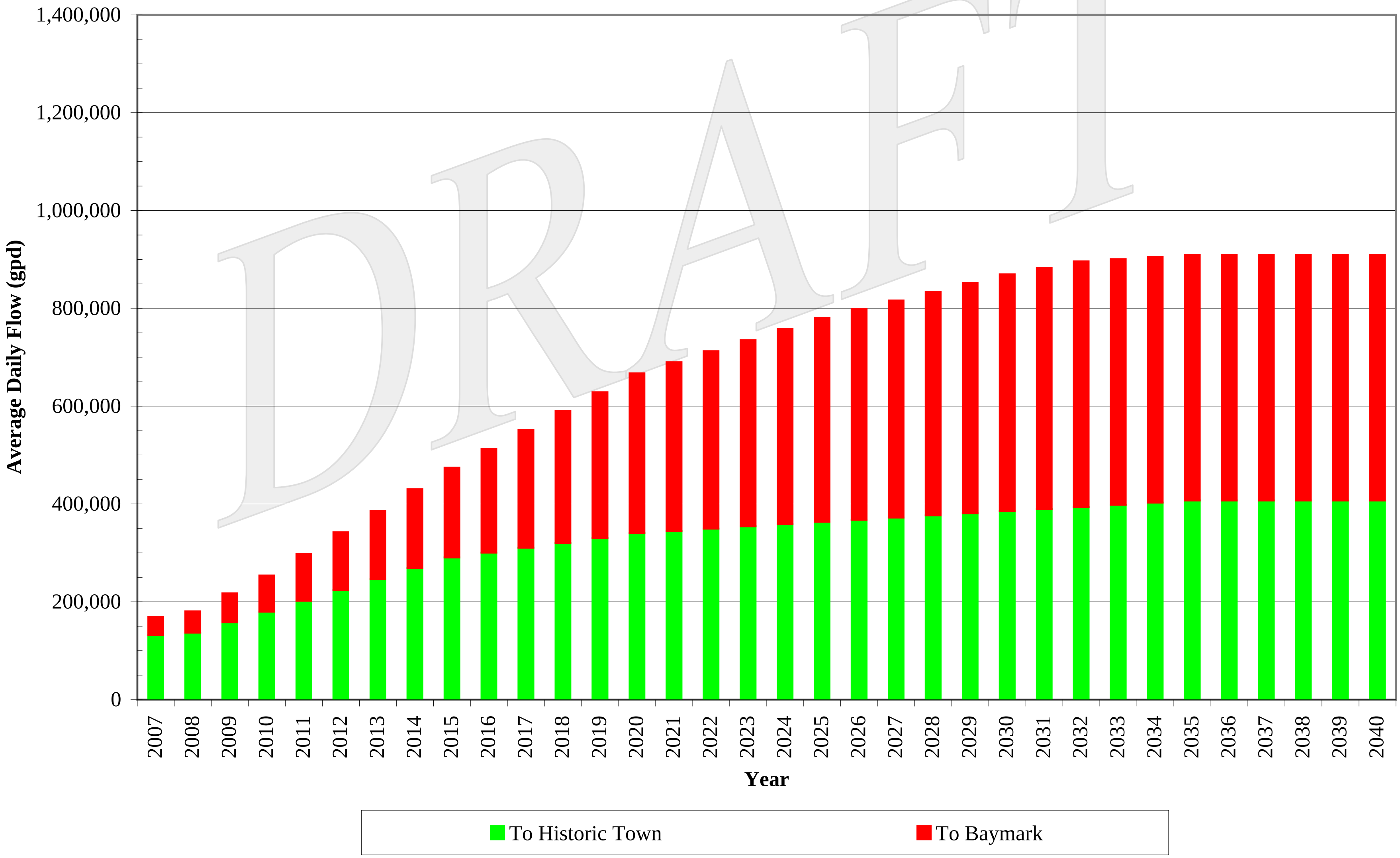

Figure 6
Comparison of Flow Estimates
(assumes expanded Town boundaries)

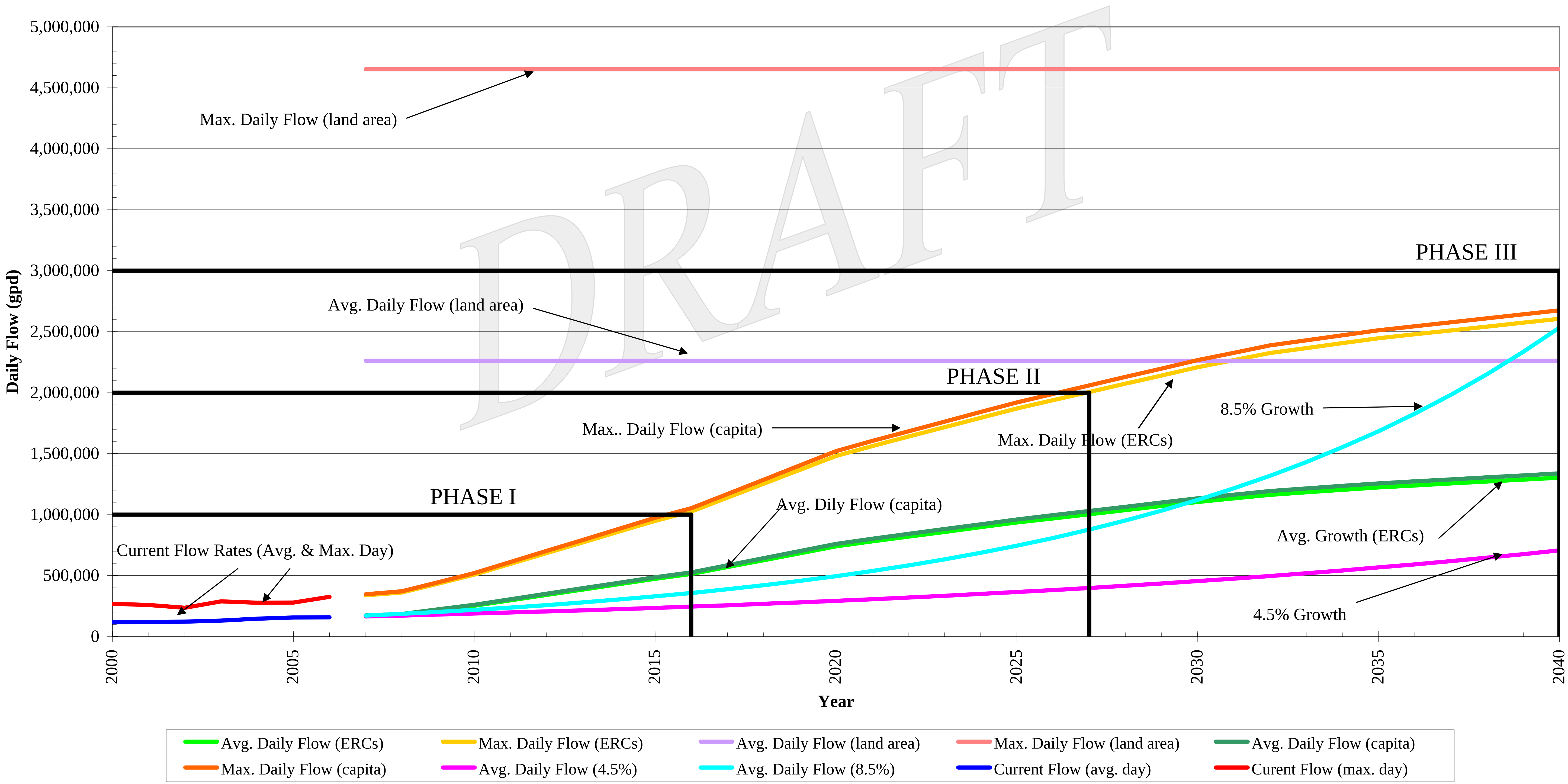

Figure 7
Comparison of Flow Estimates
(assumes no expansion of Town boundaries)