

June 12, 2023

Jarrold Cabral, Director
Truro Department of Public Works
17 Town Hall Road
Truro, MA 02666

Cody Salisbury, Superintendent
Provincetown Water Department
2 Mayflower Street
Provincetown, MA 02657

**RE: Provincetown and Truro Combined Water System Demands Assessment
Town of Truro, MA
Town of Provincetown, MA**

Dear Mr. Cabral and Mr. Salisbury:

Environmental Partners (EP) has prepared this draft letter report to assess and provide conclusions and recommendations on future long-term demands on the Town's water system. The goal of this assessment is to include addition Town of Truro projected demands to the Provincetown Water System Demands Assessment completed April 6, 2023 and provide recommendations for the Town to ensure that adequate water supplies are available with the future build-out of the Town through 2040. EP focused this assessment on summer season demands, because this season places the greatest stress on the system.

Project Background

The Town of Provincetown and Town of Truro is preparing for future buildout and the expected impacts on the water system. New affordable housing projects and future expansion of the Provincetown's sewer system are driving the need for the re-assessment of the water system to provide an adequate supply. An internal Provincetown growth assessment document titled *"Managed Growth with S.O.L.C. & Growth Management and Forecast Increased Water Needs"* prepared by John Goodrich (December 1, 2022) and a separate draft revised table provided by John Goodrich in January 2023 provided data on the Town's forecasted growth. Both documents discuss the projected increase in water demand through 2040 through a growth assessment. These assessments are provided in Attachment 1.

The revised January 2023 Growth Forecast states that Provincetown growth will be limited by the available water supply. New planned housing properties, and sewer system build-out are estimated to increase annual average day demand (ADD). An annual maximum day demand (MDD) of 2.5 times the annual ADD was previously calculated during the 2018 Water Management Study Update.

Assessment Goals

In the assessment below, EP has completed the following analysis:

1. Compared the Town's growth forecast and historical water demand trends. The comparison was used to determine whether the Town's growth forecast is reasonable.
2. Compared future demands (growth forecast) and permitted available pumping. EP used summer season ADD and MDD as the basis for this analysis. The analysis used various pumping scenarios that are discussed in detail.
3. Compared useable tank volumes, pumping, and summer ADD and MDD. The comparison was used to analyze how useable tank volumes (water stored above a level that provides all users with at least a static water pressure of 35-psi) and pumping can be used to help provide water during MDD days.
4. Compared annual ADD to the current Provincetown Water Management Act (WMA) withdrawal limit of 850,000-gpd.
5. Provide conclusions and recommendations based on this assessment, the Town's growth forecast, the need for a new source, the need for an additional water storage tank, and plans to reduce unaccounted for water.

Available Water System Information

This section discusses data used in EP's analysis, including the summer season average day demand (ADD), the maximum day demand (MDD), available water sources, and storage tank volumes.

Historical pumping data was based on monthly pumping information provided by the Water Department from 2014 to 2022. EP focused the information collection on summer season demands, including the months of June through September.

Historical Summer Season Average Day Demand (ADD)

Summer season ADD in this assessment is defined as the average daily volume of water supplied by Town sources from June through September. Demands during the summer season are consistently high due to the return of summer residents and tourists to the Town. The summer ADD will provide a basis for determining the adequacy of the water supply sources by allowing for a comparison of available supply and customer demand. Table 1 lists the end user metered Summer ADD from 2014 to 2022, which does not include water losses from water treatment waste, flushing, or unaccounted-for-water (UAW) from system leaks, water main breaks, and other uses that are not metered.

Table 1. Summer Season ADD and MDD from 2014 to 2022

Year	Summer ADD (gpd)
2014	853,631
2015	871,762
2016	877,648
2017	834,992
2018	854,770
2019	895,018
2020	787,342
2021	808,589
2022	815,737

Historical Maximum Day Demand (MDD)

The MDD is defined as the largest 24-hour demand during the year. If the available pumping from the water supply sources is less than the MDD, the water system will begin to draw stored water from its two water storage tanks.

In the Provincetown's 2017 Water Management Study Update, EP calculated an average MDD demand ratio of 2.56 based on annual ADD and MDD for each historical year. However, because this assessment focuses on the summer season demands, a separate ratio of 1.7 was used to determine the relationship between summer season ADD and the MDD. This ratio was based on historical daily meter flows and analysis of summer demands that was performed in the 2017 Water Management Study Update.

Approved Safe Yield at Available Sources

The Town operates four active wellfields:

- South Hollow Wellfield (SH),
- Knowles Crossing (KC) Wellfield, and
- North Union Field (NUF) Wellfield.
- North Truro Airforce Base (NTAFB) Wellfield (Emergency Use Only)

Table 2 shows the approved safe yield at each of the wellfields and the Town's Water Management Act (WMA) permitted annual average day limit. The maximum annual average withdrawal volume limit for the Town's water supply wells is 850,000-gpd. Permitted withdrawal volumes cannot be exceeded by 100,000-gpd without a violation of the Water Management Act. Based on the annual historical data, the Town's annual average withdrawal from 2018-2021 is 660,000-gpd.

Table 2. Approved Safe Yield and Annual WMA Withdrawal

Source	GPD
South Hollow Wellfield (SH)	864,000
KC Wellfield (KC)	216,000
North Union Field Wellfield (NUF)	734,000
North Truro Airforce Base Wellfield (NTAFB) (Emergency Use Only)	334,000
Water Management Act (WMA) Permit	850,000 Annual Average

Water Storage Tanks

The Town operates two water storage tanks. The tanks provide consistent pressure within the water system and supplement supply from usable storage when the demand exceeds the capacity of the wellfield pumps. Usable storage is the volume of storage a tank has above the elevation that provides all users with a static pressure of 35 psi. The Mt. Gilboa water storage tank is a 2,700,000-gal steel standpipe with a usable storage of 700,000 gal. The Winslow II water storage tank is a 3,800,000-gal standpipe with a usable storage of 390,000 gal. The total usable storage in the Town's water system is 1,097,000 gal.

Projected Future Water System Demands

Historical Trends

EP assessed the historical summer season ADDs presented in Table 1 to develop a trendline to project long term future demands. Four alternative trendlines were developed. However, the final trendline, provided in Figure 1 below, used a linear relationship of summer season ADD from 2014 to 2019. Year 2020 through 2022 were discarded due to abnormally low ADD most likely because of the Covid-19 pandemic. The trendline shown in Figure 1 provides a line slope of 3,237-gpd/year. In this assessment, water demand is projected to increase by 3,237-gpd every year.

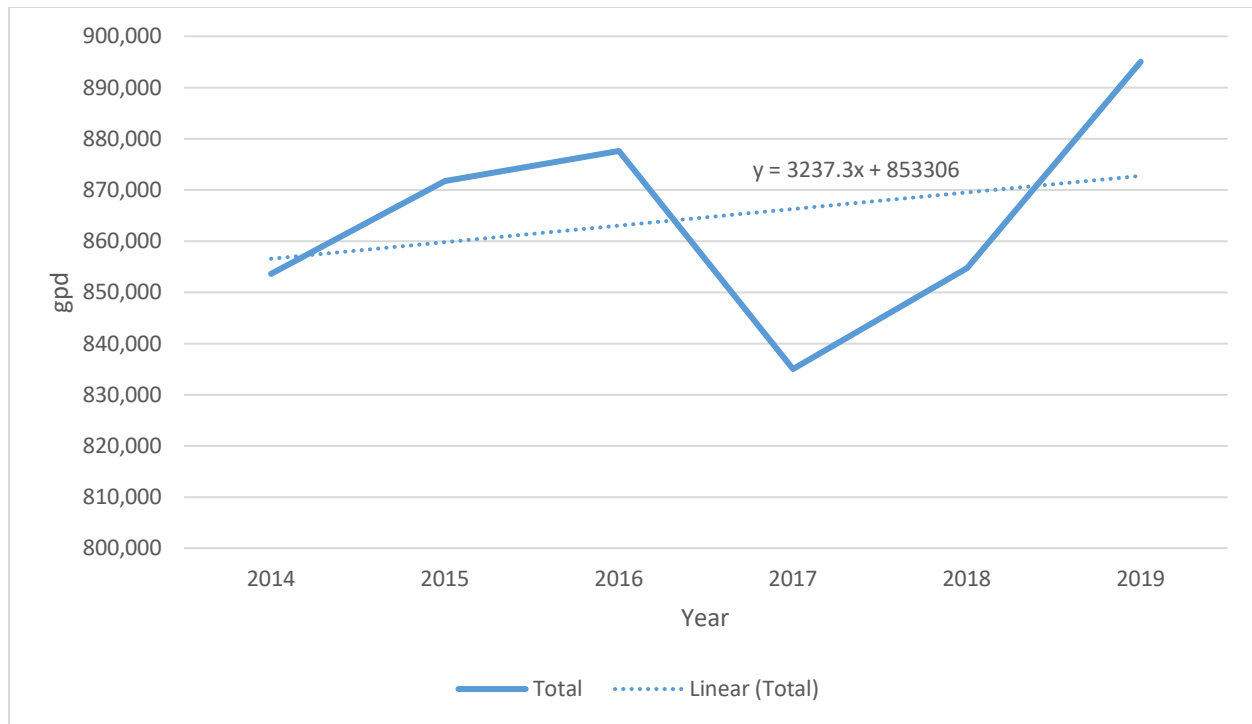


Figure 1. EP Growth Forecast

Historical Trends and Town Growth Water Forecasts

EP compared forecasted demands based on historical water demand trends and the Town's growth forecast. We converted the growth forecast from total increase to annual water use to a yearly increase as ADD.

The growth forecasts from the January 2023 updated table predicted an increase in demand of 13,000,000-gal from 2023 to 2030 and 8,000,000-gal from 2031 to 2040. In addition, Truro has forecasted that 260 housing units will require water from the water system. An average of 220-gpd was used per housing unit. Truro's forecasted demand was calculated as an increase of 9,279,760-gal from 2023 to 2030 and 11,599,700-gal from 2031 to 2040. The total increase (Provincetown and Truro combined) is the equivalent of an ADD increase of 7,630-gpd from 2023 to 2030 and an ADD increase of 5,370-gpd from 2031 to 2040. Table 3 summarizes these flow forecasts.

Table 3. Summary of Data Presented in Town Growth Forecast

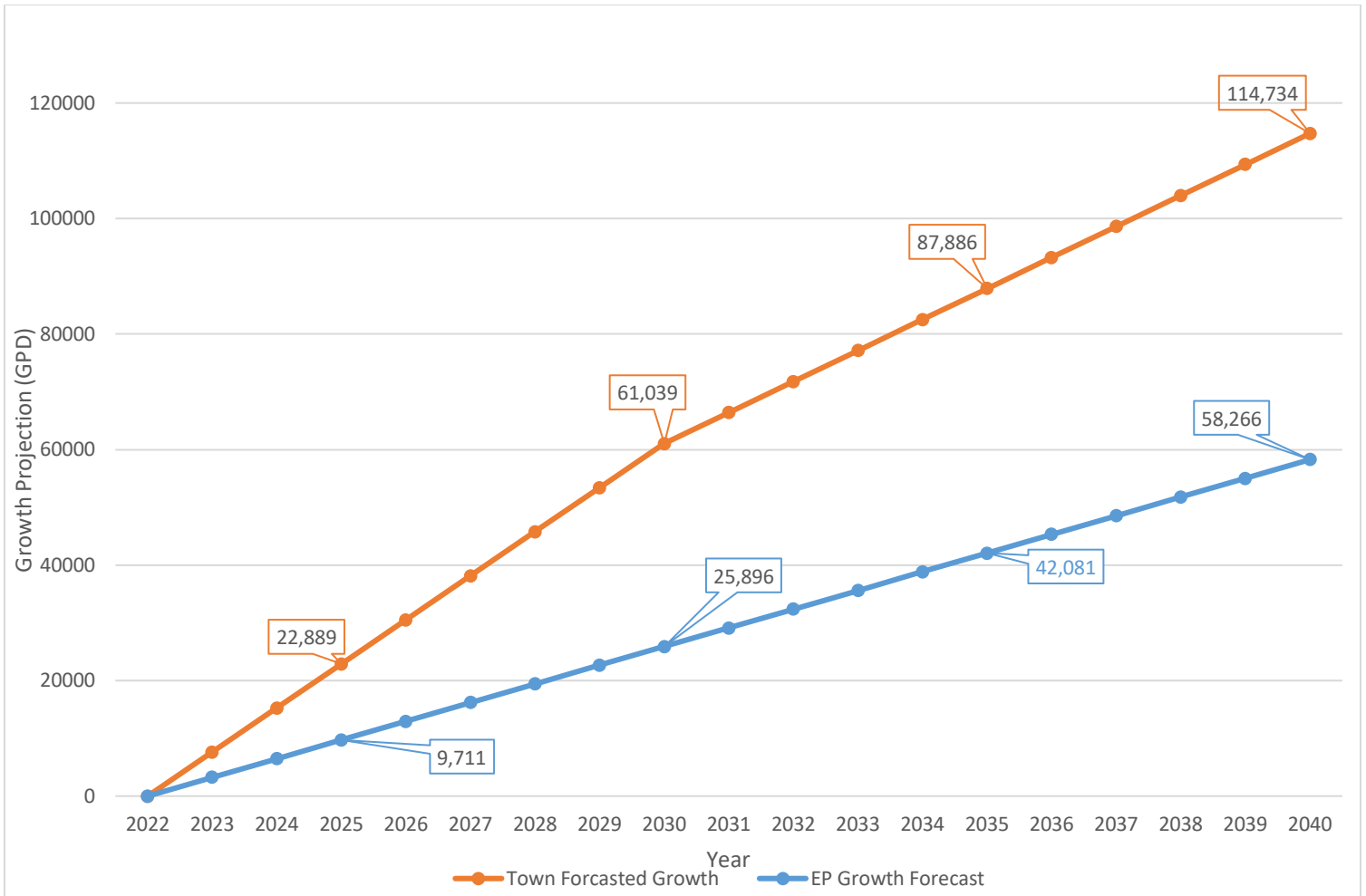
Source	Time Period	Provincetown Annual Water Use (MG)	Truro Annual Water Use (MG)	Years	Annual ADD Increase (GPD)
Town Growth Forecast	2023 to 2030	13.0	9.3	8	7,630
	2031 to 2040	8.0	11.6	10	5,370

EP compared the historical demand trends shown in Figure 1 to the Town's growth forecast shown in Table 3. This comparison is provided in Table 4 and Figure 2.

Table 4. Forecasted Growth Comparisons

Year	Provincetown and Truro Forecasted Growth (gpd)	EP Growth Forecast (Historical Demand Trends) (gpd)
2022	0	0
2025	15,260	9,711
2030	61,039	25,896
2035	87,886	42,081
2040	114,734	58,266

1. Growth forecast comparisons are based on projected metered demands.



1. Growth forecast comparisons are based on projected end user demands.

Figure 2. Forecasted Growth Comparisons

The combined growth forecast from Provincetown and Truro was calculated to be 56,468-gpd above EP's forecasted historical trend projections by year 2040, which is almost twice the expected demand based on linear projections. Therefore, in the next 18-years demands are expected to increase at approximately twice the rate of the systems historical growth pattern.

Summer Season Pumping Demands

The growth forecast projected above is based on billing meter end user demands and does not include water lost between the wellfields and the end user's. An allowance for water losses in the system and water needed for backwash at the KCWTP were added. To compare the Town's forecasted demands shown in Table 4 and Figure 2 in orange directly to the Town's available water sources safe yield, EP adjusted the growth forecast demands into a *forecasted summer season ADD* and a *forecasted MDD*. This was accomplished by:

1. Multiplying the growth forecast demands by a water loss factor of 1.274 and adding the calculated pumped summer season ADD from 2022 from the months of June through September of 1,111,936 to the growth forecast demands that results in the *Forecasted Summer Season ADD*. The loss factor accounts for water losses due to waste from water system operations, such as Knowles Crossing Water Treatment Plant waste water and hydrant flushing, of 12.4% (0.124), and unaccounted for water (UAW) of 15.0% (0.15).
2. Multiplying the new *Forecasted Summer Season ADD* by a factor of 1.7 to obtain the *forecasted MDD*, which was determined previously as the relationship between summer season ADD and the MDD.

Table 5 shows the forecasted growth, adjusted forecasted growth, forecasted pumped summer season ADD, and calculated forecasted pumped MDD that were used in our analysis.

Table 5. Summer Season Town Forecasted Growth and Pumping Demands

Year	Forecasted Growth ¹ (gpd)	Adjusted Forecasted Growth ² (gpd)	Forecasted Summer Season ADD ³ (gpd)	Forecasted MDD ⁴ (gpd)
2022	0	0	1,111,936	1,890,292
2025	15,260	29,161	1,141,098	1,939,866
2030	61,039	77,763	1,189,700	2,022,490
2035	87,886	111,967	1,223,904	2,080,636
2040	114,734	146,171	1,258,108	2,138,783

1. Based on the forecasted growth in Table 4 and Figure 2.
2. Forecasted growth multiplied by a loss factor of 1.274.
3. 2022 summer season ADD plus the adjusted forecasted growth.
4. Summer season ADD multiplied by the 1.7 MDD factor.

Future Water System Conditions

EP compared the forecasted pumped summer season demands provided in Table 5 to the existing water supplies approved safe yield and useable water storage to determine whether the system is capable of providing forecasted water demands.

Summer Season Pumping Demands and Available Sources

To assess the ability to meet future demands, three (3) scenarios of available sources (Table 2) were compared to the summer season pumped ADD and MDD (Table 5) through year 2040. These scenarios are graphed below in Figure 3.

1. Approved Safe Yield – NTAFB OFF: This is the condition currently being operated normally by the Water Department. All regular wellfields (KC, SH, and NUF) are operable, with a total approved safe yield is 1,814,000-gal.
2. Approved Safe Yield – NUF OFF: This condition provides total pumping with NUF Offline and NTAFB online as an emergency supply. The total approved safe yield is 1,414,000-gal.
3. Approved Safe Yield – NTAFB OFF and NUF OFF: This condition provides total pumping with NUF offline and NTAFB offline. The total approved safe yield is 1,080,000-gal.

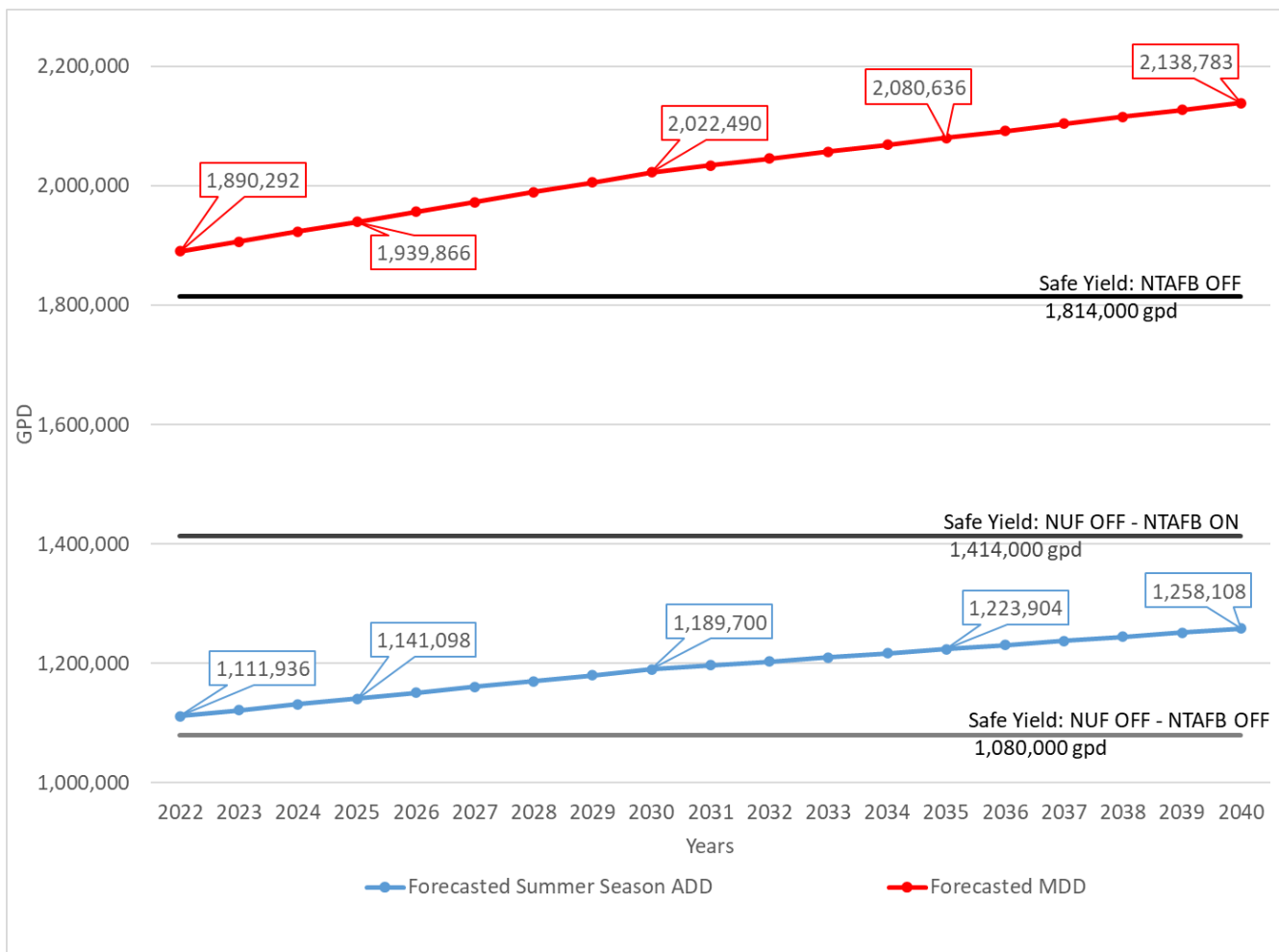


Figure 3. Forecasted Summer Season Demands and Safe Yield

From this analysis and the trends in Figure 3, EP observed the following:

1. Approved Safe Yield – NTAFB OFF: The Town can provide summer season ADD to its users through year 2040. However, the assumption that there will never be a loss of a source to emergencies or maintenance may be unrealistic over a long time. The Town should plan for at least one source out of service at any time.
2. Approved Safe Yield – NUF OFF: Like Scenario 1, the Town can provide summer season ADD to its users through year 2040. With NUF OFF, available yield drops by approximately 400,000-gpd compared to Scenario 1. However, the use of the NATFB was meant to be an emergency source and should not be considered part of the Town's normal operations. Therefore, EP recommends that long-term plans should account for the assumption that there will never be a loss of a source to emergencies or maintenance may be unrealistic over a long period.
3. Approved Safe Yield – NTAFB OFF and NUF OFF: This scenario is the most conservative. Without the use of NUF and emergency water from NTAFB, the Town currently cannot meet summer season ADD.
4. MDD Analysis: In all scenarios the Town will not be capable of providing sufficient water to meet the MDD using an available daily safe yield. However, well pumps are capable of pumping above safe yield limits if necessary for short periods of time. For long term planning, the Town should not rely on pumping above safe yield limits. If NUF was offline, the deficit or gap between the safe yield and MDD increases. In addition, the Town is capable of supplementing water needs from its water storage tanks for a short period of time. However, useable water storage is limited.

Future Water Demands and Useable Water

Figure 3 shows that currently the Town's normally operated sources at SH, KC, and NUF may not be capable of providing sufficient water to meet the MDD. Available safe yield based on the three (3) scenarios presented in the previous section were subtracted from the MDD to give the volume of water required from the Town's water storage to meet MDD. This difference between MDD and available safe yield can be provided in the short term from the Town's water storage tanks.

EP then used the amount of useable storage of 1.097-MG (water stored above a level that provides all users with at least a static water pressure of 35-psi) for comparison to needed water storage. Figure 4 below shows the analysis to determine how much water is required from water storage during a MDD condition.

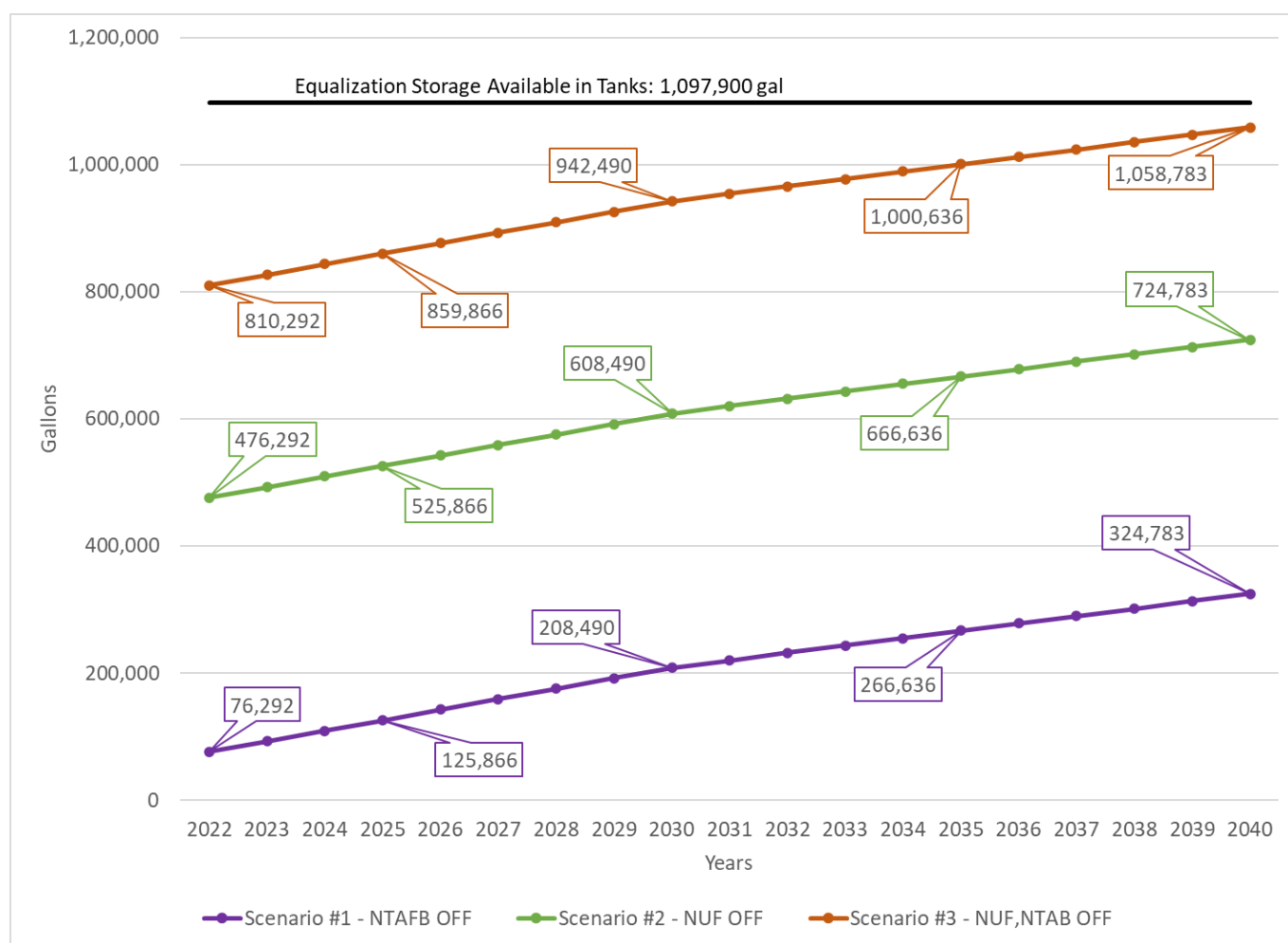


Figure 4. Useable Water Storage and MDD

Based on this analysis, the Town's storage tanks are capable of providing water needed to meet MDD. However, in a scenario with two back-to-back MDD days and NUF offline and the emergency NTAFB activated, the tanks may not be capable of meeting demands by year 2027.

UAW Reduction

EP reviewed a separate scenario that reduces UAW from 15% to 10% (a reduction of 5% total) through leak and meter management to reduce pumping needs. EP was provided with a UAW with removed estimated flows due to flushing and other operational needs. Figure 5 below shows the Town's future growth projections when UAW was reduced to 10%, which is a common goal for water systems operation.

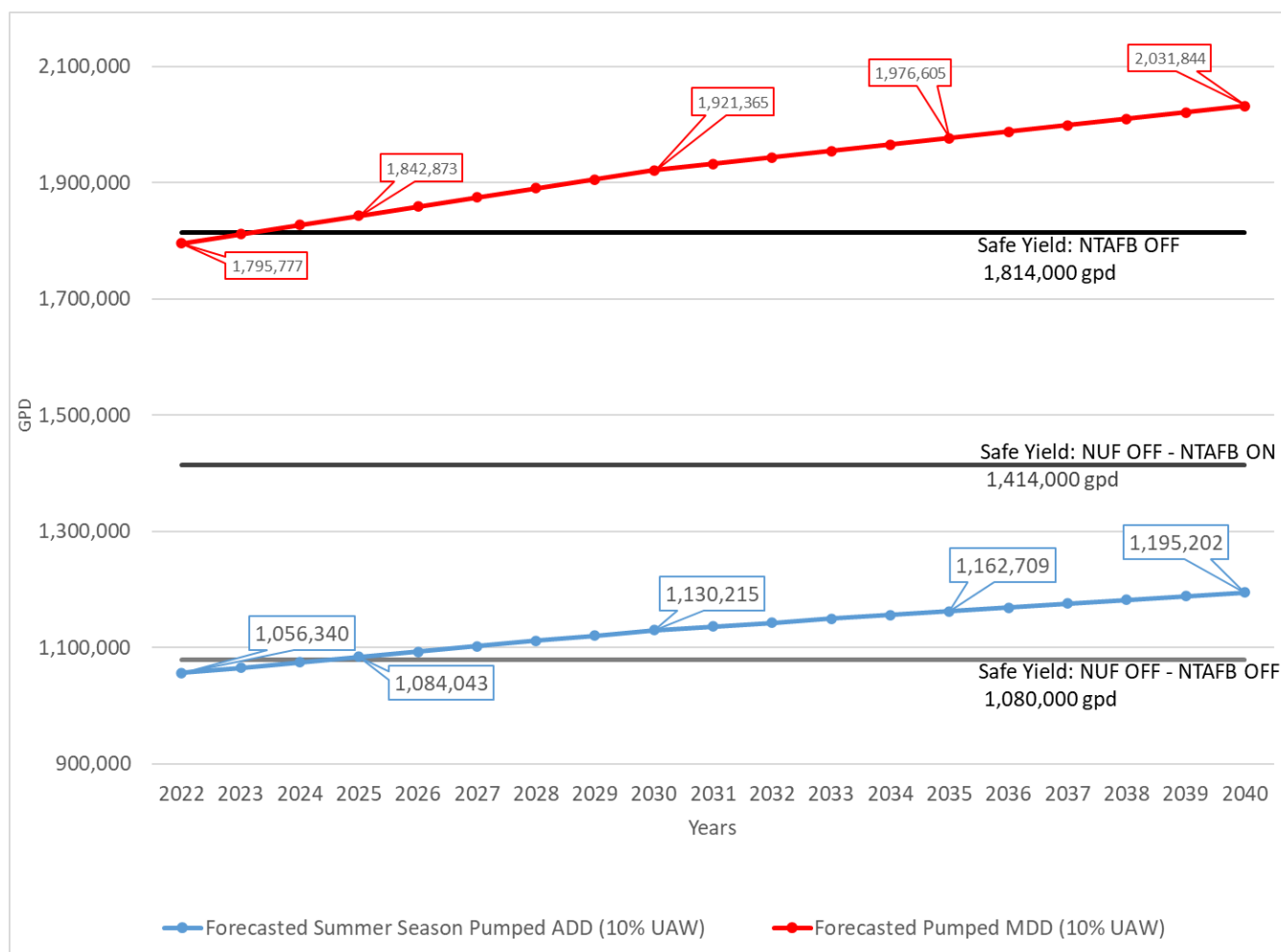


Figure 5. Projected Summer Season Pumped Demands and in UAW from 15% to 10%

Water Management Act (WMA) Permitted Limits

The Town's WMA limit is 850,000-gpd on an average annual basis. EP calculated from 2018-2021 that the Town's annual average withdrawal is 660,000-gpd. Therefore, approximately 190,000-gpd of annual average withdrawal is approximately available. According to the forecasted growth through year 2040, the Town has anticipated the addition of 146,171-gpd in annual average withdrawal from Provincetown and Truro (Table 5), resulting in a total of 806,171-gpd annual average withdrawal.

Conclusions and Recommendations

Growth forecasted water demands projected by Provincetown (Attachment 1) and Truro show a steep rate of forecasted demand compared to historical trends. The system's growth forecast to year 2040 is approximately twice as much as the estimate that EP calculated from historical trends based on the Town's Water Department information.

With the KC, SH, and NUF pumping sources in operation, the system can provide forecasted summer season ADD. However, the Town should consider the NUF as a redundant source and the NTAFB for emergency use only. NUF provides 734,000-gpd to the water system. When NUF is removed from the pumping totals, the data shows a current need for an additional source to meet forecasted summer season ADD. The system currently shows a summer season ADD deficit of approximately 32,000-gpd and a 178,100-gpd summer season ADD deficit by 2040 with the NUF out of service and no use of its emergency wellfield at NTAFB.

Scenario 2, with NUF out of service and NTAFB online to provide short term emergency water, was used to determine pumping needs during a MDD. Using only the sources safe yield, the system is currently in need of an additional source with a capacity of approximately 477,000-gpd. In 2040, that forecasted need increases to approximately 725,000-gpd to meet MDD.

Using Scenario 2, EP compared maximum day demands (MDD) to both available pumping and useable water storage (water stored above a level that provides all users with at least a static water pressure of 35-psi). The system is capable of handling up to two back-to-back MDD days by supplementing well pumping with useable tank water storage. However, if there are two MDD consecutive days with NUF offline and NTAFB in service as an emergency source, the system will not be capable of providing adequate pressures to users by approximately 2030. Useable water from the Mt. Gilboa and Winslow II storage tanks totals 1,097,900-gallons. To meet MDD demands with NUF out of service the system needs approximately 352,000-gal of additional useable storage by year 2040.

EP compared the forecasted pumped growth to the WMA permitted annual average daily limit of 850,000-gpd. The system's 2040 forecasted pumped growth demand is not expected to exceed the WMA permit. The Town is expected to have approximately 43,800-gpd annual average remaining at year 2040.

Recommendations from EP's assessment and findings are as follows:

1. Provincetown should continue to work on UAW. The reduction of UAW from 15% to 10%, will further reduce summer season ADD through year 2040 and provides additional available capacity to the system for use for future build-out.

We understand that Provincetown has been diligently working to reduce their UAW by replacing aging pipes and services, conducting leak testing, and the future institution of a zoned meter program. The Town should continue these efforts.

2. Provincetown should review options for a new redundant water source to provide at least an additional 725,000-gpd to the system on a long-term basis to fully meet MDD if the NUF supply is out of service. NUF was once considered a redundant source to SH. However, during the summer season, NUF must now be considered a primary source, which leaves the Town without a true redundant source. In addition, the Town should not count on the reduction of UAW as its ultimate solution. Significant efforts have been made to reduce UAW; however, UAW trends show that this will be a continuing hurdle.
3. Provincetown and Truro should review options for additional useable water storage. Short term back-to-back MDD days are a likely scenario in the summer season. EP calculates that an additional 352,000-gal of useable storage will be required by year 2040 with the assumption that no new water sources are available. In addition, an elevated water storage tank located in North Truro will provide reliable pressures to meet fire flow requirements, and provide some additional useable water storage volume.

We appreciate the opportunity to work on this important project with the Town of Provincetown. Please call or email me if you have any questions regarding this assessment.

Sincerely,

Environmental Partners Group, LLC



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Senior Project Manager
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Attachments:

1. Provincetown Growth Assessments for Water Demands (December 2022 and January 2023)

Attachment 1 - Town Forecasted Demands

When properties with existing wastewater flows that are served by onsite septic systems connect to the sewer, they do not require any additional water use, but for the managed growth flows that are added to the sewer, there is also an additional water use demand. As a preliminary estimate of the additional water use demand, wastewater data from 2015 thru 2021 was used to calculate the ratio of the average and peak day flows at the Treatment Plant to the connected Title 5 flow. Then, the ratio of the average daily water withdrawal and the average daily Treatment flow was calculated to come up ratios of daily and peak water use needs for additional wastewater managed growth allocations. This is only a rough estimate, and the numbers can be refined as a part of the Demand Study that is being undertaken for the Water Dept.

From this preliminary analysis the average daily water use is about 25% of the Title 5 design flow, and the peak water use is about 2.5 times the average, as shown in the table below. **The forecasts for additional water use also need to include large users that did not have flows for all or part of 2022 but should have flows by 2026: the Surf Club which reopened on July 13th and the former Old Reliable property at 227R Commercial Street. With a combined additional Title 5 flow of about 12,000 GPD, they are estimated to have total annual water use of about 1,000,000 gallons as shown below.**

	Est. Growth Annual Total Water Use	Total Annual Total Water Use	Est. Growth Peak Day Water Use	Total Peak Day Water Use
Water Use from Properties with large additional flow	N/A	1,000,000	N/A	7,000
Growth Management thru 2026	8,750,000	9,750,000	60,000	67,000
Growth Management thru 2030	12,000,000	13,000,000	82,500	90,000
Growth Management thru 2040	20,000,000	21,000,000	135,000	142,000
State of Limited Capacity Max. thru 2026	6,750,000	7,750,000	45,000	52,000
State of Limited Capacity Forecast thru 2026	5,000,000	6,000,000	35,000	42,000

The average daily water withdrawal for 2022 was 746,802 GPD or 88% of the MassDEP Water Management Permit. Through 2026, the above estimate based on using **ALL** of the Growth Management allocations plus the water use from the properties with large additional flow would add about 26,750 gallons to the daily water withdrawal, increasing the draw to **almost 92%** of the permitted amount, and **closer to 96%** taking into account the preliminary forecast of needs from Truro. The growth would also add to the peak day water use which may be even more of a limiting factor going forward.

The State of Limited Capacity limits this managed growth increase to 21,250 gallons for the daily water withdrawal and about 52,000 for the peak day. A more likely State of Limited Capacity forecast for 2026 would add about 16,500 gallons to the daily water withdrawal (6,000,000 gallons to the annual total water use) and 42,000 to the peak day, as shown in the last row of the table.

Summary of Forecasts for Additional Water Demand from Managed Growth

Calculation steps that were used using data from 2015 thru 2021:

STEP1: Ratio average Plant flow to connected Title 5 flow Ratio peak day Plant flow to connected Title 5 flow	STEP 2: Ratio average daily water withdrawal to average daily Plant flow
STEP 3: Ratio average day water use demand for managed growth thru 2030 Ratio peak day water use demand for managed growth thru 2030	Average daily water use ~25% of the Title 5 design flow Peak water use ~2.5 times average water use based on this analysis

	Allowed by Growth Mgmt Thru 2030 incl. balances	Allowed by S.O.L.C. Thru 2027 per Board	Forecast additional water demand thru 2027	No. of bedrooms for known/planned housing w/ add'l water demand	Notes
HOUSING Cat. 1 & 2 GM	60,000	50,000	22,000	85 Jerome Smith 30 Maushope new 35 Old police station 50 Inclusionary	46 existing on water Existing use on water Est 28 on septic
EDPs Cat. 4A GM	54,000	17,000	17,000		Trend is c. 4,000/year
Other Cat. 3 & 4	17,000	5,000	5,000		Not until Repeal Special Act – 2024?
Municipal New Police Station	N/A	1,300	1,300		
SUM OF ABOVE	c. 131,000	c. 73,300	c. 45,300		
	***	***	9,500	Barracks project	Already approved by Growth Mgmnt & SOLC
Add for Water Use Calculations	12,000	12,000	12,000	Surf Club < 07-13-2022 227R Commercial	Already approved by Growth Mgmnt & SOLC
Forecast Additional Annual Water Use Demand	13,000,000	7,700,000	6,000,000		

*** Probably should include the Barracks in additional demand for 2030 – would increase total additional annual water use demand to 13,800,000 gallon & 8,500,000 for 2027