

## NRR-PMDAPEm Resource

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**From:** Mary Lampert [mary.lampert@comcast.net]  
**Sent:** Tuesday, August 12, 2014 9:50 AM  
**To:** NRCExec@nrc.gov  
**Cc:** Morgan, Nadiyah  
**Subject:** Pilgrim Watch Supplement to its KLD Petition 08.11.14; Attachment, KLD PNPS Memo Population Update 2014; Attachment-KLD Pilgrim Population Update Report 2013.  
**Attachments:** PILGRIM WATCH SUPPLEMENT TO ITS KLD PETITION 08 11 14.pdf; KLD\_PNPS\_Memo\_Population\_Update\_2014.pdf; KLD\_Pilgrim\_Population\_Update\_Report\_2013\_Rev0.pdf

Hello:

Please find Pilgrim Watch Supplement to its KLD Petition 08.11.14; Attachment, KLD PNPS Memo Population Update 2014; Attachment-KLD Pilgrim Population Update Report 2013.

If you have any difficulty opening the documents, please call Mary Lampert at 781-934-0389.

Courtesy of receipt by return email appreciated.

On August 11, 2014, we tried to email these documents and had difficulty. We understand only some went through and the rest remained stuck in the outbox. We discovered the reason was that the KLD PNPS Memo Population Update 2014 was in Rich Txt that was more than 23,000 KBs. Once we turned it into a Pdf file, the problem we hope is resolved.

Apologies for any additional work on your part and certainly confusion.

Thank you,

Mary

**Hearing Identifier:** NRR\_PMDA  
**Email Number:** 1491

**Mail Envelope Properties** (107b01cfb634\$439cae10\$cad60a30\$)

**Subject:** Pilgrim Watch Supplement to its KLD Petition 08.11.14; Attachment, KLD PNPS Memo Population Update 2014; Attachment-KLD Pilgrim Population Update Report 2013.

**Sent Date:** 8/12/2014 9:49:40 AM

**Received Date:** 8/12/2014 9:55:22 AM

**From:** Mary Lampert

**Created By:** mary.lampert@comcast.net

**Recipients:**

"Morgan, Nadiyah" <Nadiyah.Morgan@nrc.gov>

Tracking Status: None

"NRCExec@nrc.gov" <NRCExec@nrc.gov>

Tracking Status: None

**Post Office:** lampert@comcast.net

Files	Size	Date & Time	
MESSAGE	819	8/12/2014 9:55:22 AM	
PILGRIM WATCH SUPPLEMENT TO ITS KLD PETITION 08 11 14.pdf			359791
KLD_PNPS_Memo_Population_Update_2014.pdf	868077		
KLD_Pilgrim_Population_Update_Report_2013_Rev0.pdf			1239957

**Options**

**Priority:** Standard

**Return Notification:** No

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**Sensitivity:** Normal

**Expiration Date:**

**Recipients Received:**

August 11, 2014

Executive Director for Operations  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001  
By Mail & Email: [NrcExecSec@nrc.gov](mailto:NrcExecSec@nrc.gov)

**PILGRIM WATCH'S AUGUST 8, 2014 SUPPLEMENT TO ITS AUGUST 30, 2013 2.206 PETITION TO MODIFY, SUSPEND, OR TAKE ANY OTHER ACTION TO THE OPERATING LICENSE OF PILGRIM STATION UNTIL THE NRC CAN ASSURE EMERGENCY PREPAREDNESS PLANS ARE IN PLACE TO PROVIDE REASONABLE ASSURANCE PUBLIC HEALTH & SAFETY ARE PROTECTED IN THE EVENT OF A RADIOLOGICAL EMERGENCY**

**PILGRIM NUCLEAR POWER STATIONS ANNUAL POPULATION UPDATE – 2014**

**I. INTRODUCTION**

Pursuant to §2.206 of Title 10 in the Code of Federal Regulations, Pilgrim Watch (Hereinafter “PW”) on behalf of its members and members of the Town of Duxbury Nuclear Advisory Committee, Pilgrim Coalition, Project for Entergy Accountability, Cape Cod Bay Watch, EcoLaw, Beyond Nuclear, Greenpeace, and others submits this supplement to its request that the Nuclear Regulatory Commission (NRC) institutes a proceeding to modify, suspend or take any other action<sup>1</sup> as may be proper to the operating license of Pilgrim Station in order that the NRC can assure Pilgrim’s Radiological Emergency Plan and Standard Operating Procedures/Guidelines are based on accurate and credible Evacuation Time Estimates (ETEs).

The new and significant information petitioners add to the KLD petition is based on the July 31, 2014 *MEMO from KLD, Kevin Weinisch, Regarding Pilgrim Nuclear Power Station*

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<sup>1</sup> NRC Enforcement actions include: notices of violation, civil penalties, orders, notice of nonconformance, confirmatory action letters, letters of reprimand, and demand for action.

*Annual Update-2014.* (Attached) The MEMO simply shows updated population figures that indicate a small increase in population. The updated 2014 report is not completed. But the numbers in it make clear that the final 2014 Update will follow the same flawed format, methodology and assumptions that were used in the *KLD Pilgrim Evacuation Estimate December 12, 2012 Final Report KLD-TR-510* and its 2013 *Pilgrim Nuclear Power Station Annual Population Update, 2013*

**What's wrong with KLD's update analyses?** The 2013 update failed to learn two fundamental lessons from KLD's Cape Cod Telephone Survey; and unless the NRC orders otherwise, the 2014 update will fail also.

First, the 2013 update used KLD's ridiculously low assumption that only 20% of the shadow evacuation would evacuate. The Cape Cod Telephone Survey shows that the actual number who would choose to evacuate is between 50% and 70%, at the 95% confidence level<sup>2</sup>. Second, the Cape Telephone Survey also showed that the shadow evacuation extends to 25 miles not 15 miles, as assumed by KLD.

Section IV of Appendix E to 10 CFR part 50 and Section 5.4, "Reviews and Updates" of NUREG/CR-7002 says that:

If at any time during the decennial period, the EPZ permanent resident population increases such that it causes the longest ETE value for the 2-mile zone or 5-mile zone, including all affected Emergency Response Planning Areas, or for the entire 10-mile EPZ to increase by 25 percent or 30 minutes, whichever is less, from the nuclear power reactor licensee's currently NRC approved or updated ETE, the

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<sup>2</sup> Pilgrim Watch August 30, 2013 filing in this proceeding fully discussed the KLD Cape Telephone Survey and the KLD telephone survey in the EPZ and its 15 mile shadow. It showed that if telephone survey respondents were told that the questions regarded a radiological incident, and not simply an unspecified incident like the Sandia's and the EPZ survey, far more respondents said they would evacuate. This is expected because the public fears radiation the most, especially so since Fukushima.

licensee shall update the ETE analysis to reflect the impact of that population increase. The licensee shall submit the updated ETE analysis to the NRC under § 50.4 no later than 365 days after the licensee's determination that the criteria for updating the ETE have been met and at least 180 days before using it to form protective action recommendations and providing it to State and local governmental authorities for use in developing offsite protective action strategies.

If the shadow evacuation estimate were correctly to assume either (i) that 50% to 70% of the shadow population would try to evacuate, or (ii) that the actual shadow evacuation zone would extend to 25 miles **then the increase in the number of evacuees will increase KLDs base line ETE analysis by more than 30 minutes and an updated ETE for Pilgrim Station will be required.**

## II. DOCUMENTS PETITIONERS RELY UPON

- *MEMO from KLD, Kevin Weinisch, Regarding Pilgrim Nuclear Power Station Annual Update-2014, July 31, 2014*
- *KLD Pilgrim Nuclear Power Station Annual Population Update – 2013, September 25, 2013*
- *KLD Pilgrim Evacuation Estimate December 12, 2012, Final Report KLD-TR-510014*
- U.S. Census Bureau QuickFacts
- Pilgrim Watch's 2.206 Petition To Modify, Suspend, Or Take Any Other Action To The Operating License Of Pilgrim Station Until The NRC Can Assure Emergency Preparedness Plans Are In Place To Provide Reasonable Assurance Public Health And Safety Are Protected In The Event Of A Radiological Emergency, August 30, 2013
- Amendment And Supplement To Pilgrim Watch's 2.206 Petition To Modify, Suspend, Or Take Any Other Action To The Operating License Of Pilgrim Station Until The NRC Can Assure Emergency Preparedness Plans Are In Place To Provide Reasonable Assurance Public Health & Safety Are Protected In The Event Of A Radiological Emergency, November 22, 2013

### III. FACTUAL BASIS

The following analysis is based on *KLD Pilgrim Nuclear Power Station Annual Population Update – 2013, September 25, 2013*, and is the model that KLD will follow for the 2014 update unless NRC steps in and requires a reliable and honest analysis.

1. The ETE is the time required to evacuate the zone in question. The ETE depends on the number of evacuees, assumes that the entire zone is evacuated, and also assumes a 20% shadow evacuation of those in the 10-15 mile zone.
2. Table 6 from KLD's 2013 update shows that an updated ETE will be required if the number of evacuees increases by 25,258 from KLD's base assumption of 109,891 to 135,077. KLD determined that an increase in slightly more than 25,000 evacuees would increase the full EPZ 90<sup>th</sup> Percentile ETE by 30 minutes. Obviously, a larger increase in the number of evacuees would result in even longer ETEs.

**Table 6. ETE Variation with Population Change**

Resident Population + 20% Shadow Population	Base	Population Change		
	109,819	10%	20%	23%
		120,801	131,783	135,077
ETE for 90 <sup>th</sup> Percentile				
Region	Base	Population Change		
		10%	20%	23%
2-MILE	2:55	2:55	3:00	3:00
5-MILE	2:35	2:45	2:50	2:55
FULL EPZ	3:30	3:40	3:55	4:00
ETE for 100 <sup>th</sup> Percentile				
Region	Base	Population Change		
		10%	20%	26%
2-MILE	6:00	6:00	6:00	6:00
5-MILE	6:05	6:05	6:05	6:05
FULL EPZ	6:10	6:10	6:10	6:10

2013 Update, pg., 11

3. In the 2013 Population Update Analysis, the only increases in the number of evacuees that KLD considered were those resulting from increases in the populations of the EPZ and the 10-15 mile shadow region. The ETE is critically dependent on the percentage of those in the shadow region that will choose to evacuate.

4. Table 4 shows KLD's estimate of the population of the shadow region, within 15 miles of Pilgrim. Its ETE estimate assumed that only 20% (16,077) of the 2013 Extrapolated Population (80,387) would choose to evacuate. It also unrealistically assumed that no one more than 15 miles from Pilgrim would evacuate.

**Table 4. Shadow Population by Sector**

<b>Sector</b>	<b>2010 Census Population</b>	<b>2013 Extrapolated Population</b>
N	0	0
NNE	0	0
NE	0	0
ENE	0	0
E	0	0
ESE	0	0
SE	0	0
SSE	6,756	6,760
S	9,469	9,494
SSW	12,363	12,790
SW	3,968	4,069
WSW	4,928	4,965
W	4,741	4,794
WNW	12,639	12,729
NW	10,158	10,288
NNW	14,255	14,498
<b>Total</b>	<b>79,277</b>	<b>80,387</b>

2013 Update, pg., 7

5. The recent KLD Cape Cod Telephone Survey (discussed at length in Pilgrim Watch's August 30, 2013 2.206 Petition pending before the NRC, pages 5-13) showed that the 20%

assumption is ridiculously low, and that the actual **number who would choose to evacuate** at the 95% confidence level is between **50% and 70%.** Seventy (70) percent of those within 25 miles said they would evacuate if they were told that there was an incident at the Pilgrim Nuclear Power Station; and fifty (50) percent of those within 25 miles of Pilgrim would evacuate, even if they were told that they were not in Pilgrim's Emergency Planning Zone. KLD's Cape Telephone Survey unequivocally showed that ETE's shadow evacuation assumption is fatally wrong. Far more than 20% of those not instructed to evacuate will voluntarily evacuate anyway.

6. The recent Cape Cod Telephone Survey showed that actual number of evacuees from the 10-15 mile shadow zone would be far more than the 16,077 estimated by KLD.

- 70% (56,217) of the 2013 Extrapolated 50% Population (80,387) that said they would evacuate if there was an incident at Pilgrim is 40,194 more evacuees than KLD assumed.
- 50% (40,194) of the 2013 Extrapolated Population that that said they would evacuate even if told they were not in the EPZ is 24,117 more evacuees than KLD assumed.

Taking only the more conservative 50%, the increased number of evacuees is very, very close to the 25,258 additional evacuees that KLD admitted would require an updated ETE. If the actual number of shadow region evacuees was only 51.42% of the shadow region population, an updated ETE would be required.

Splitting the difference between the 50% and 70% in the Cape Telephone Survey responses, if 60% of those in the 10-15 mile zone chose to evacuate, the additional number of evacuees would be well over KLD's 25,258 number requiring an update, If 70% choose to evacuate, the number of evacuees would clearly require an update.



<b>% of estimated 2013 Shadow Population, (80,387)</b>	<b>Added Evacuees</b>	<b>Updated ETE Required If population exceeds 25,258</b>
<b>20% = 16,077.4</b>	<b>0</b>	<b>No</b>
<b>50% = 40,193.5</b>	<b>24,117</b>	<b>Close</b>
<b>60% = 48,232.2</b>	<b>32,155</b>	<b>Yes</b>
<b>70% = 56,270.89</b>	<b>40,194</b>	<b>Yes</b>

Sources:

Table 4 Estimated 2013 shadow population = 80,387

Table 6: updated ETE required if evacuees increases by 25,258

**7. Shadow Region out to 25 miles:** KLD's Cape Cod Telephone Survey also showed that the ETE's assumption that there would be "shadow evacuation" only from the 10-15 mile region is incorrect. The Cape survey showed that 50% to 70% of the respondents throughout the Cape, out to 25 miles, would choose to evacuate. The number of evacuees from outside the official 15 mile shadow region would also be well over the 25,258 more required for an ETE.

Any realistic ETE must take into account a shadow region that extends out to at least 25 miles. If as little as 20% of the population of either, or only 4% of both, chose to evacuate, the total number of evacuees would increase by more than the 22,258 that KLD admits requires a new ETE analysis.

**Barnstable County's** 2010 permanent population<sup>3</sup> is 215,888; and the 2013 estimated permanent population is 214,990. (U.S. Census QuickFacts) The KLD Population Estimate included two towns in Barnstable County Bourne and Sandwich (Table 1) with a total population of 40,468, in its 10-15 mile Shadow Region. Subtracting the population of those already counted

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<sup>3</sup> The census provides permanent population numbers; the summer population approximately doubles the Cape population. If NRC were to insist on a conservative estimate, it would base the population on the largest population, summer.

two towns, the ignored population of what should be the Barnstable County Shadow Region is 174,522.

If only 20% of this added Barnstable County population decided to evacuate, there would be 34,904 more evacuees. If 50%, 60%, or 70% decided to evacuate the number of additional evacuees would be respectively 87,261, 104,713 and 122,165. In each case the number of evacuees would far exceed the 25,248 that KLD 2013 admits would require an updated ETE.

**Plymouth County's** 2010 population was 494,919 and the 2013 estimate is 501,915. (U.S. Census QuickFacts) The KLD Population Estimate included 10 towns in its 10-15 mile Shadow Region with a total population of 109,819 (Table 6). Subtracting the population of those ten already counted towns, the ignored population of what should be the 25-mile Plymouth County Shadow Region is 392,096. There are two ignored Norfolk County towns within the 25 mile radius, Cohasset (pop., 7,483) and Weymouth (pop., 54,565), bringing the total ignored shadow evacuation population to 454,144.

If only 20% of this nearly half-million Plymouth County and two Norfolk County town populations, (all within 25 miles) decided to evacuate, there would be 90,828 more evacuees. If 50%, 60%, or 70% decided to evacuate the number of additional evacuees would be respectively 227,072, 272,486, and 317,901. In each case the number of evacuees would far exceed the 25,248 that KLD 2013 admits would require an updated ETE. Indeed, an updated ETE would be required if less than 6% decided to do so.

**Barnstable and Plymouth Shadow Evacuation Regions to 25 Miles:** The total population of the 25-mile Barnstable County 2013 Shadow Region on one side of Pilgrim is

214,990; the total population of the 25-mile Plymouth County and two Norfolk County towns 2013 Shadow Region is 501,915. The total shadow population would be 669,134 – over eight times the 80,387 estimated by KLD (Table 4).

If only 4% of the shadow population out to 25 miles chose to evacuate, there would be 26,765 more evacuees than KLD estimated, exceeding the 25,258 number that KLD admits requires an ETE update; if only 20% (KLD's assumed percentage) were to evacuate, there would be almost 134,000 more evacuees, five times what KLD admits requires an update.

The overall picture emphasizes the total inadequacy of KLD's estimates. In an effort to produce ETE's that the NRC might find acceptable, KLD chose to deal with a population of less than 175,000, the 2010 EPZ population plus the 2010 10-15 mile shadow region population, and to ignore 80% of the latter. The total number of people now in the EPZ and within 25 miles of Pilgrim is 764,908.

What are the almost 600,000 that KLD says will not even try to evacuate supposed to do?

8. **Incorrect Methodology & Assumptions:** The KLD Population Update further underestimates the population demand, the total number of people evacuating, by using the incorrect methodology and making the same inaccurate assumptions that were made in *KLD Pilgrim Evacuation Estimate December 12, 2012 Final Report KLD-TR-510014*, discussed in Pilgrim Watch's August 30, 2013 petition.

**a. Methodology: Population Update 2013 and 2014 Only Looked At Undifferentiated Permanent Population Data**

The Update should have looked at increases in population sub-groups. The *KLD Pilgrim Evacuation Estimate December 12, 2012 Final Report KLD-TR-510* looked at summer

population, transient population, worker population, and the transportation dependent-school children and residents of nursing/ group homes. By doing so, KLD acknowledged that these sub groups are important to consider in estimating evacuation times<sup>4</sup>.

**b. KLD's Population Update 2013, Like the ETE, Incorrectly Assumes That The Longest 90 Percentile is Scenario 8: Winter, Mid-Day, Mid-Week, Snow**

Regulations require that an updated ETE must be conducted if population growth is large enough to cause the 90 percentile ETE to increase by 25% or 30 minutes. In order for the Population Update to be valid it must correctly assess the longest scenario. It did not do so. Pilgrim Watch and DNAC showed in the on-going 2.206 Enforcement Petition that the ETE underestimated traffic flow. It failed to account for chronically heavy traffic over summer weekends that significantly increases travel times; and it underestimated traffic flow during inclement weather. The impact of snow is greatest during peak commuting hours that KLD never studied. Peak Traffic Scenarios must be recalculated to satisfy the requirement.

**c. KLD's Population Update 2013 models the 2-mile zone or 5-mile zone, including all affected Emergency Response Planning area and the entire EPZ.**

This conforms to Section IV of Appendix E to 10 CFR part 50 and Section 5.4, "Reviews and Updates" of NUREG/CR-7002 but it does not conform to reality. The Cape Telephone Survey showed that 50% of the respondents said that they would evacuate anyway even if told that they were not in the EPZ. Therefore it shows that the segmented evacuation will never be followed inside the EPZ, far more than 20% will choose to voluntarily evacuate outside the 2-mile or 5-mile area. Additionally at the Alert Stage of the accident beaches, parks, forests are closed and boaters are told to get off the water. The word of trouble at Pilgrim will rapidly

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<sup>4</sup> Note that Pilgrim Watch's August 2013 filing showed that KLD's ETE did not properly estimate the numbers and times required to evacuate different sub-groups.

spread due to today's rapid communication capability and an unplanned evacuation will begin. Unplanned evacuations mean an increase in vehicle accidents that will clog the routes when the actual evacuation is called, increasing evacuation times.

#### IV. CONCLUSION

Faulty assumptions and methodology in the *KLD Pilgrim Evacuation Estimate December 12, 2012 Final Report KLD-TR-510014* were carried forward in *KLD Pilgrim Nuclear Power Station Annual Population Update – 2013* and likewise will infect the 2014 Update. The result is KLD documents that are not credible. There will be much higher levels of congestion, and much longer evacuation times, as our filings in this proceeding showed. Absent an honest and credible ETE, the population does not have reasonable assurance of adequate protection in the event of an accident. It is time to do better.

Pilgrim should not be operating until a new Population Update and ETE is done. Indeed an updated ETE analysis must be prepared if the EPZ resident population increases such that it causes the 90<sup>th</sup> percentile ETE for either the 2-mile zone, the 5-mile zone or the entire 10-mile EPZ to increase by 25% or 30 minutes, whichever is less. (Section IV of Appendix E to 10 CFR part 50 and Section 5.4, "Reviews and Updates" of NUREG/CR-7002). Pilgrim Watch has shown that based on KLD's own Cape Telephone Survey that the EPZ resident population and shadow evacuation exceeds the population number requiring a new study. Properly adding the summer population would further escalate the population figures.

As we concluded in our original August 2013 KLD petition, Judge Rosenthal of the ASLB accurately said that, with one possible exception, the NRC had not granted a section 2.206

petitioner the substantive relief it sought for at least 37 years. Judge Rosenthal concluded that, “where truly substantive relief is being sought (i.e., some affirmative administrative action taken with respect to the licensee or license), there should be no room for a belief on the requester’s part that the pursuit of such a course is either being encouraged by Commission officialdom or has a fair chance of success.”<sup>5</sup>

We truly hope that Judge Rosenthal will be proven wrong and this petition will be granted.

Respectfully submitted on behalf of the Petitioners,

Mary Lampert  
Pilgrim Watch, Director  
148 Washington Street  
Duxbury, MA 02332  
Tel 781-934-0389  
Email: mary.lampert@comcast.net  
August 11, 2014

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<sup>5</sup> Memorandum And Order (Denying Petitions For Hearing), LBP-12-14, July 10, 2012, Additional Comments of Judge Rosenthal ( See NRC’s EHD Docket EA-12-05-/12-51)



# Memo

To: Donna Calabrese  
From: Kevin Weinisch  
CC: Karen Larson-Sullivan, Kara O'Neill (KLD), Christina Hoffman (KLD), Lorena Moschetta (KLD)  
Date: July 31, 2014  
Re: Pilgrim Nuclear Power Station Annual Population Update - 2014

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## Introduction

Section IV of Appendix E to 10 CFR part 50 and Section 5.4, "Reviews and Updates" of NUREG/CR-7002 stipulate:

Licensees shall estimate EPZ [Emergency Planning Zone] permanent resident population changes at least annually during the years between decennial censuses using U. S. Census Bureau data. These estimates shall occur no more than 365 days apart. State/local government population data may also be used, if available. Licensees shall maintain these estimates available for NRC inspection during the period between censuses and shall submit these estimates to the NRC with any updated ETEs [Evacuation Time Estimates].

If at any time during the decennial period, the EPZ permanent resident population increases such that it causes the longest ETE value for the 2-mile zone or 5-mile zone, including all affected Emergency Response Planning Areas, or for the entire 10-mile EPZ to increase by 25 percent or 30 minutes, whichever is less, from the nuclear power reactor licensee's currently NRC approved or updated ETE, the licensee shall update the ETE analysis to reflect the impact of that population increase. The licensee shall submit the updated ETE analysis to the NRC under § 50.4 no later than 365 days after the licensee's determination that the criteria for updating the ETE have been met and at least 180 days before using it to form protective action recommendations and providing it to State and local governmental authorities for use in developing offsite protective action strategies.

Entergy has contracted KLD Engineering, P.C. to estimate annual population changes between the decennial censuses for the Pilgrim Nuclear Power Station (PNPS) in accordance with the aforementioned federal regulations. KLD requests that Entergy and the Offsite Response Organizations (OROs) – the Massachusetts Emergency Management Agency (MEMA), and the Towns of Carver, Duxbury, Kingston, Marshfield and Plymouth – review the methodology and Census growth rates provided below and provide feedback/comments by close of business on August 15, 2014. If no comments are generated during your review, please indicate via e-mail that there are no comments and you approve the methodology and growth rates as documented in this memo. Once approval is received, KLD will proceed with the population estimates.

### **US Census Growth Rates**

The population analysis for the 2012 PNPS Evacuation Time Estimates (KLD TR-510, dated December 2012), was performed using 2010 Census population data provided on the U.S. Census Bureau website<sup>1</sup>. The Census Bureau QuickFacts<sup>2</sup> website provides annual population updates for each state, county, minor civil division (town)<sup>3</sup> and municipality in the United States. The most recent update for town growth rates available on the QuickFacts website is for the time period from April 1, 2010 to July 1, 2013. The growth rates for each town within the study area (Emergency Planning Zone – EPZ – plus Shadow Region) provided by QuickFacts are summarized in Table 1. The Census does not provide annual population estimates for the Census Designated Places (CDPs – i.e., North Plymouth) within the study area. The Census boundaries for all towns are shown in Figure 1.

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<sup>1</sup> [www.census.gov](http://www.census.gov)

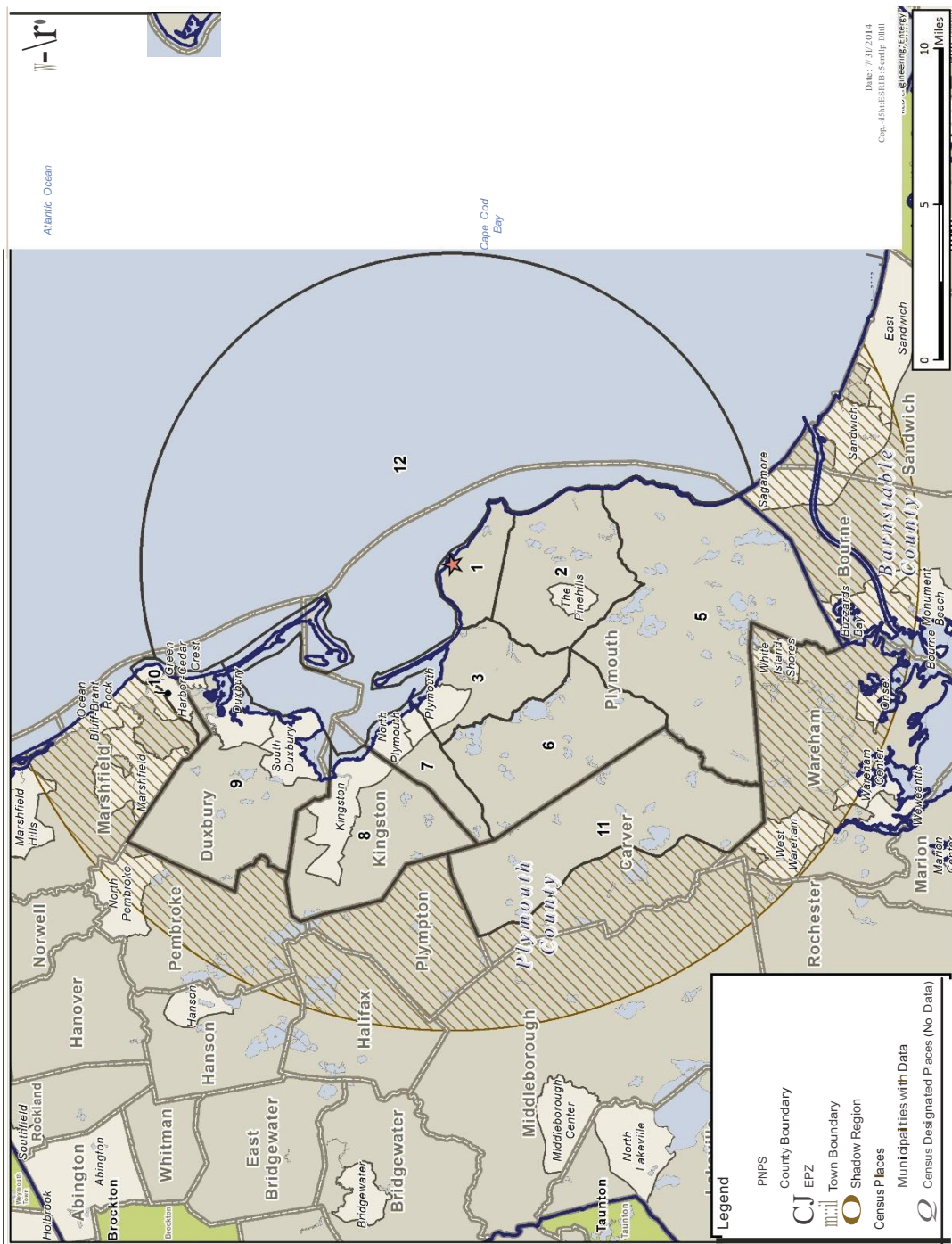
<sup>2</sup> <http://quickfacts.census.gov/qfd/index.html>

<sup>3</sup> <http://www.census.gov/popest/data/cities/totals/2013/SUB-EST2013.html>



Table 1. Town Growth Rates from April 1, 2010 to July 1, 2013

Town	2010 Population	2013 Population	Percent Change
<b>Barnstable County, MA</b>			
<i>Shadow Region</i>			
<b>Bourne</b>	19,754	19,733	-0.11%
<b>Sandwich</b>	20,675	20,589	-0.42%
<b>Plymouth County, MA</b>			
<i>EPZ</i>			
<b>Carver</b>	11,509	11,494	-0.13%
<b>Duxbury</b>	15,059	15,288	1.52%
<b>Kingston</b>	12,629	12,819	1.50%
<b>Marshfield</b>	25,132	25,509	1.50%
<b>Plymouth</b>	56,468	57,826	2.40%
<i>Shadow Region</i>			
<b>Halifax</b>	7,518	7,606	1.17%
<b>Hanson</b>	10,209	10,324	1.13%
<b>Middleborough</b>	23,116	23,601	2.10%
<b>Pembroke</b>	17,837	18,097	1.46%
<b>Plympton</b>	2,820	2,859	1.38%
<b>Rochester</b>	5,232	5,381	2.85%
<b>Wareham</b>	21,822	22,384	2.58%



## Methodology

The compound growth formula (Equation 1) will be used for all population projections, where  $g$  is the annual growth rate and  $X$  is the number of years projected forward from Year 2010. The compound growth formula can be solved for  $g$  as shown in Equation 2. The data provided in Table 1 was used in Equation 2 to compute the annual growth rate for each town in the study area using  $X = 3.25$  (3 years and 3 months from April 1, 2010 to July 1, 2013). The computed annual growth rates for town are summarized in Table 2.

### Equation 1

$$P_{2010+X} = P_{2010} (1 + g)^X$$

### Equation 2

$$g = \left( \frac{P_{2010+X}}{P_{2010}} \right)^{\frac{1}{X}} - 1$$

Table 2. Annual Growth Rate by Town

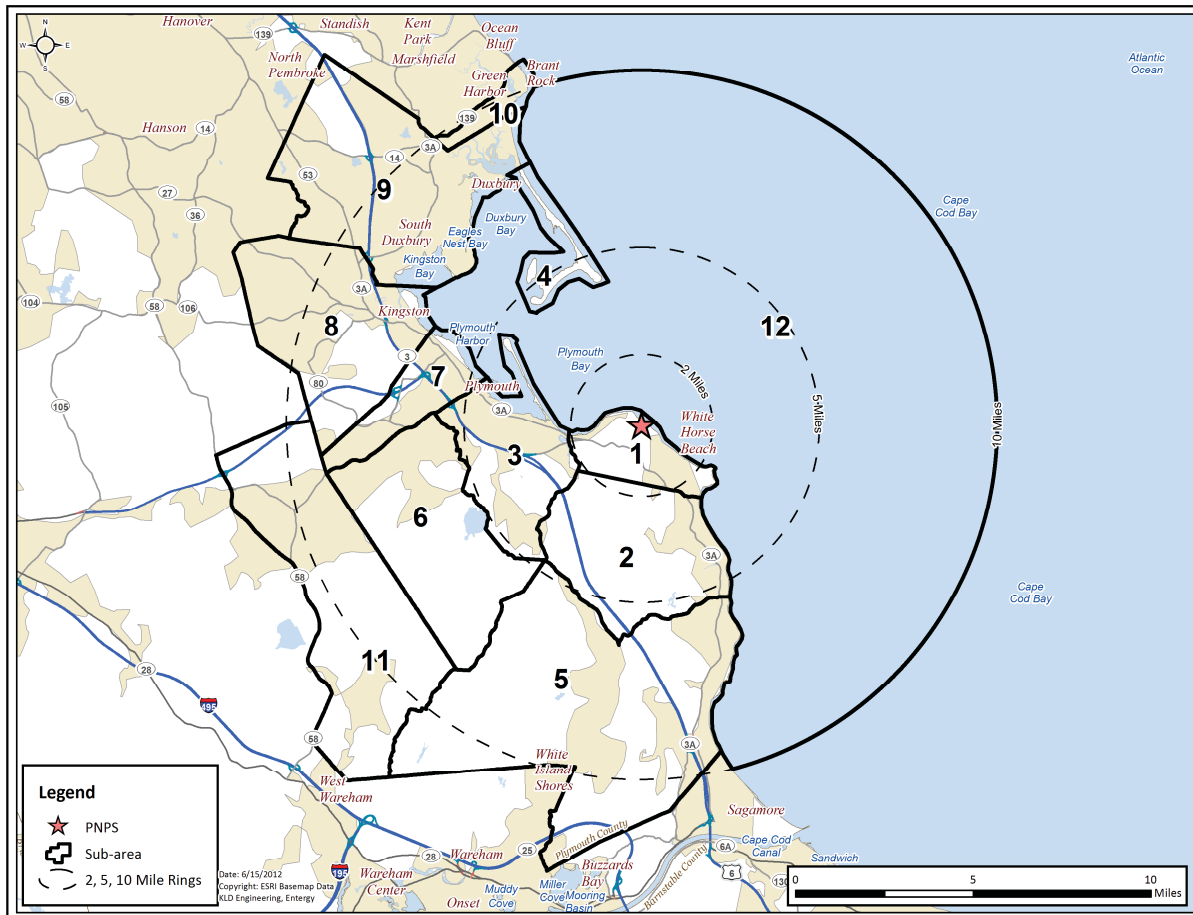
Town	Annual Growth Rate
<b>Barnstable County, MA</b>	
<i>Shadow Region</i>	
<b>Bourne</b>	-0.03%
<b>Sandwich</b>	-0.13%
<b>Plymouth County, MA</b>	
<i>EPZ</i>	
<b>Carver</b>	-0.04%
<b>Duxbury</b>	0.47%
<b>Kingston</b>	0.46%
<b>Marshfield</b>	0.46%
<b>Plymouth</b>	0.73%
<i>Shadow Region</i>	
<b>Halifax</b>	0.36%
<b>Hanson</b>	0.35%
<b>Middleborough</b>	0.64%
<b>Pembroke</b>	0.45%
<b>Plympton</b>	0.42%
<b>Rochester</b>	0.87%
<b>Wareham</b>	0.79%

The most detailed data should always be used when forecasting population. In terms of detailed data, municipal data is the finest level of detail, then town data, county data, and state data. As shown in Figure 1, there are no incorporated municipalities within the study area. Town growth rates are available for the entire study area and were used as they are the finest level of detail available. Thus, county and state data need not be used.

The appropriate annual growth rate will be applied to each Census block in the study area depending on which town the block is located within. The population will then be projected to the desired month and year – September 2014 for this update – using Equation 1. The estimated population for 2014 will be provided for each sub-area, for the EPZ as a whole, the 2 and 5 mile regions, the Shadow Region, and the entire study area. In accordance with federal guidance, the computed percent change in population will be compared with Table M-3 from the 2012 ETE report to check if a full ETE update has been triggered. A report documenting this methodology and the results of the analysis will be provided to Entergy and the OROs upon completion.

**Pilgrim Nuclear Power Station**

**2013 Population Update Analysis**



**Work performed for Entergy, by:**

**KLD Engineering, P.C.**  
**43 Corporate Drive**  
**Hauppauge, NY 11788**  
<mailto:kweinisch@kldcompanies.com>

## Introduction

Section IV of Appendix E to 10 CFR part 50 and Section 5.4, “Reviews and Updates” of NUREG/CR-7002 stipulate:

Licensees shall estimate EPZ permanent resident population changes at least annually during the years between decennial censuses using U. S. Census Bureau data. These estimates shall occur no more than 365 days apart. State/local government population data may also be used, if available. Licensees shall maintain these estimates available for NRC inspection during the period between censuses and shall submit these estimates to the NRC with any updated ETEs.

If at any time during the decennial period, the EPZ permanent resident population increases such that it causes the longest ETE value for the 2-mile zone or 5-mile zone, including all affected Emergency Response Planning Areas, or for the entire 10-mile EPZ to increase by 25 percent or 30 minutes, whichever is less, from the nuclear power reactor licensee's currently NRC approved or updated ETE, the licensee shall update the ETE analysis to reflect the impact of that population increase. The licensee shall submit the updated ETE analysis to the NRC under § 50.4 no later than 365 days after the licensee's determination that the criteria for updating the ETE have been met and at least 180 days before using it to form protective action recommendations and providing it to State and local governmental authorities for use in developing offsite protective action strategies.

Entergy has contracted KLD Engineering, P.C. to estimate annual population changes between the decennial censuses for the Pilgrim Nuclear Power Station (PNPS) in accordance with the aforementioned federal regulations. Entergy and the offsite response organizations (OROs) – the Massachusetts Emergency Management Agency, and the Towns of Carver, Duxbury, Kingston, Marshfield and Plymouth – have reviewed the methodology and Census growth rates provided below.

## US Census Growth Rates

The population analysis for the 2012 PNPS Evacuation Time Estimate (ETE) was performed using 2010 Census population data provided on the U.S. Census Bureau website<sup>1</sup>. The Census Bureau QuickFacts<sup>2</sup> website provides annual updates of population data for each state, county, minor civil division (town)<sup>3</sup> and municipality in the United States. The most recent update for town growth rates available on the QuickFacts website is for the time period from April 1, 2010 to July 1, 2012. The growth rates for each town within the study area (Emergency Planning Zone – EPZ – plus the Shadow Region) provided by QuickFacts are summarized in Table 1. The Census does not provide annual population estimates for the Census Designated Places (CDPs – i.e., North Plymouth) within the study area. The Census boundaries for all towns within the study area are shown in Figure 1.

**Table 1. Town Growth Rates from April 1, 2010 to July 1, 2012**

Town	2010 Population	2012 Population	Percent Change
<b>EPZ</b>			
<b>Carver</b>	11,509	11,521	0.10%
<b>Duxbury</b>	15,059	15,172	0.75%
<b>Kingston</b>	12,629	12,727	0.78%
<b>Marshfield</b>	25,132	25,436	1.21%
<b>Plymouth</b>	56,468	57,463	1.76%
<b>Shadow Region</b>			
<b>Bourne</b>	19,754	19,806	0.26%
<b>Halifax</b>	7,518	7,546	0.37%
<b>Hanson</b>	10,209	10,292	0.81%
<b>Middleborough</b>	23,116	23,395	1.21%
<b>Pembroke</b>	17,837	17,959	0.68%
<b>Plympton</b>	2,820	2,840	0.71%
<b>Rochester</b>	5,232	5,325	1.78%
<b>Sandwich</b>	20,675	20,662	-0.06%
<b>Wareham</b>	21,822	22,339	2.37%

<sup>1</sup> [www.census.gov](http://www.census.gov)

<sup>2</sup> <http://quickfacts.census.gov/qfd/index.html>

<sup>3</sup> <http://www.census.gov/popest/data/cities/totals/2012/index.html>



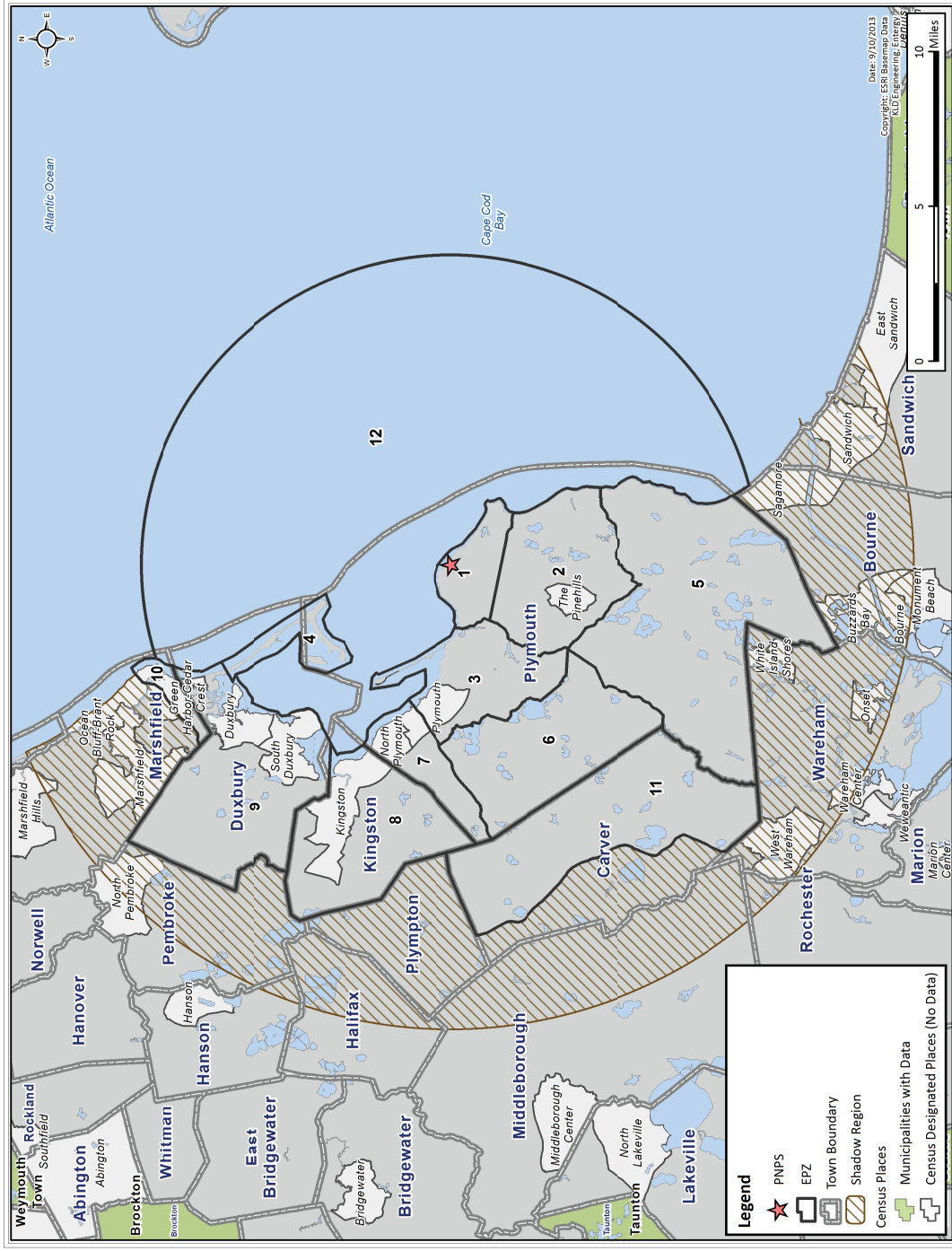


Figure 1. Census Boundaries within the PNPS Study Area



## Methodology

The compound growth formula (Equation 1) was used for all population projections, where  $g$  is the annual growth rate and  $X$  is the number of years projected forward from Year 2010. The compound growth formula can be solved for  $g$  as shown in Equation 2. The data provided in Table 1 was used in Equation 2 to compute the annual growth rate for each town in the study area using  $X = 2.25$  (2 years and 3 months from April 1, 2010 to July 1, 2012). The computed annual growth rates for each town are summarized in Table 2.

### Equation 1. Compound Growth Rate

$$(\text{Compound Growth for } X \text{ years}): \text{Population 201X} = \text{Population 2010} \times (1 + g)^X$$

### Equation 2. Annual Growth Rate

$$(\text{Solving for the annual growth rate}): g = (\text{Population 201X} \div \text{Population 2010})^{1/X} - 1$$

Table 2. Annual Growth Rate by Town

Town	Annual Growth Rate
EPZ	
Carver	0.05%
Duxbury	0.33%
Kingston	0.34%
Marshfield	0.54%
Plymouth	0.78%
Shadow Region	
Bourne	0.12%
Halifax	0.17%
Hanson	0.36%
Middleborough	0.53%
Pembroke	0.30%
Plympton	0.31%
Rochester	0.79%
Sandwich	-0.03%
Wareham	1.05%

The most detailed data should always be used when forecasting population. In terms of detailed data, municipal data is the finest level of detail, then town data, county data, and state data. As shown in Figure 1, there are no incorporated municipalities within the study area. Town growth rates are available for the entire study area and were used as they are the finest level of detail available. Thus, county and state data were not used.

Using Geographical Information Systems (GIS) mapping software, the appropriate annual growth rate was applied to each Census block in the study area depending on which town the block is located within. The population was projected to September 1, 2013 for this update using Equation 1 with  $X = 3.42$  (3 years and 5 months from the April 1, 2010 Census date to September 1, 2013).

## Results

The sub-areas which comprise the approximate 10-mile EPZ for the PNPS are shown in Figure 2. Table 3 presents the 2010 population and estimated population for 2013 for each sub-area, for the EPZ as a whole, and also for the 2 and 5 mile regions. Table 4 presents the estimated population for 2013 for the PNPS Shadow Region, which extends 15 miles radially from the PNPS. Figure 3 and Figure 4 present the estimated 2013 EPZ and Shadow Region population, respectively, by sector and distance from the PNPS site. These “population roses” were constructed using GIS software.

Note that the 2-Mile Region and 5-Mile Region do not conform exactly to the 2-mile and 5-mile radii due to the irregular shape of the Sub-areas; see Figure 2. Thus, the 2-mile and 5-mile populations shown in Figure 3 do not exactly match the 2-Mile Region and 5-Mile Region totals in Table 3.

Equation 3 was used to compute the percent change in population from 2010 to 2013. The percent change in population for the various regions of interest is summarized in Table 5.

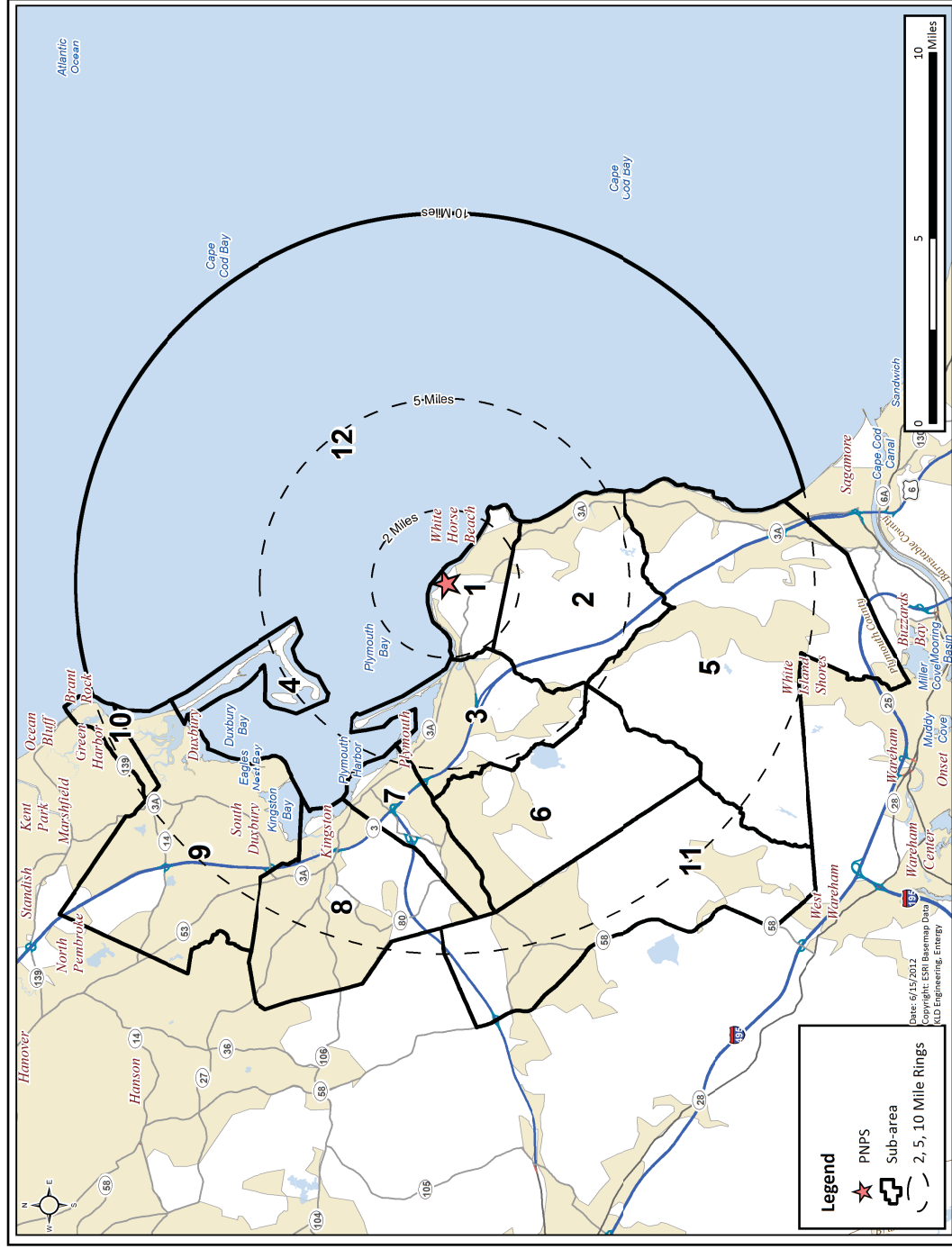


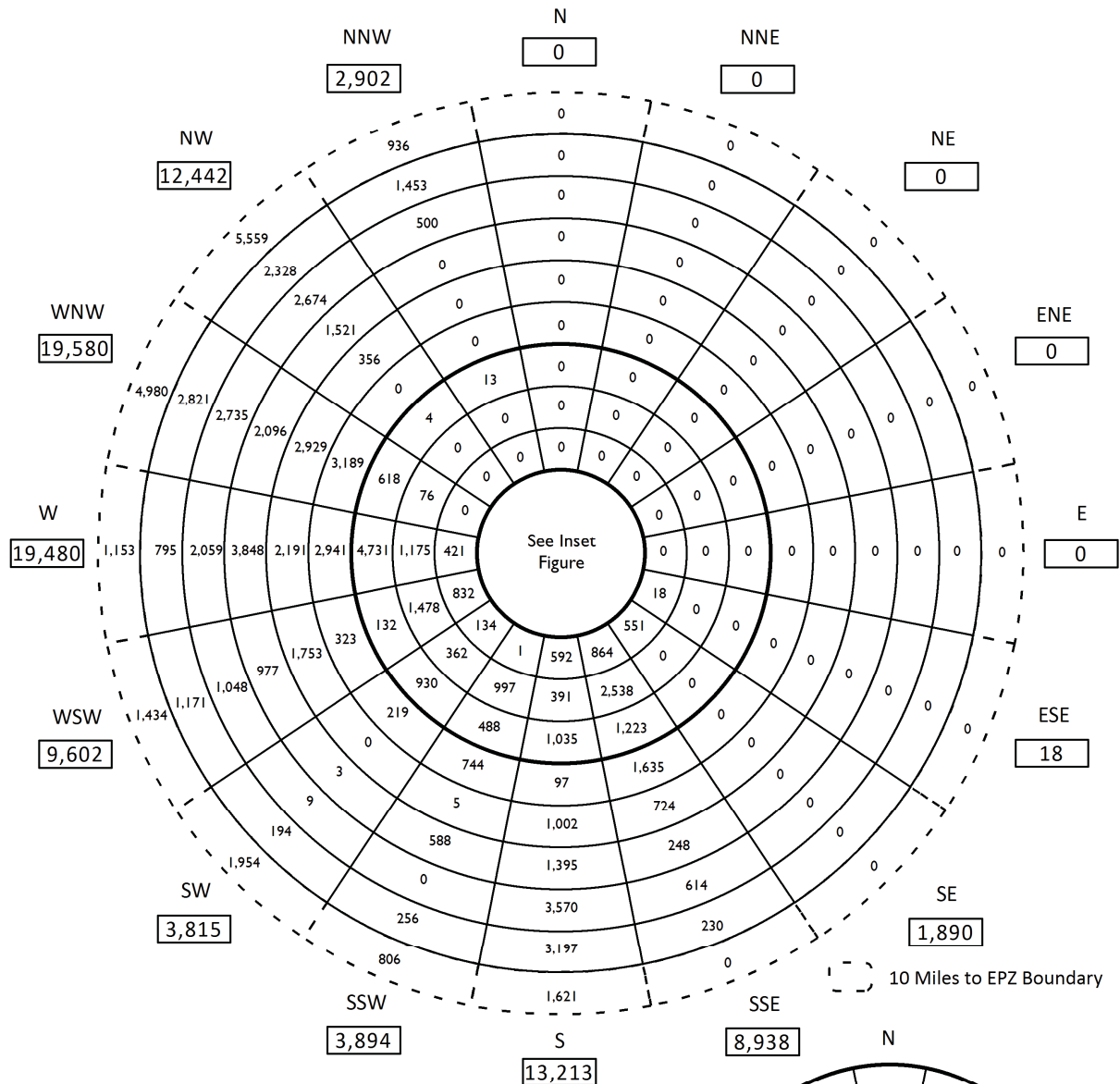
Figure 2. Sub-areas Comprising the PNPS EPZ

Table 3. EPZ Population

Sub-area	2010 Census Population	2013 Extrapolated Population
1	3,710	3,805
12	-	-
<b>2-Mile Region Total:</b>	<b>3,710</b>	<b>3,805</b>
2	8,985	9,221
3	10,946	11,236
4	17	17
<b>5-Mile Region Total:</b>	<b>23,658</b>	<b>24,279</b>
5	15,546	15,953
6	8,305	8,524
7	8,959	9,196
8	12,629	12,760
9	15,059	15,206
10	2,329	2,372
11	7,479	7,484
<b>EPZ Total:</b>	<b>93,964</b>	<b>95,774</b>

Table 4. Shadow Population by Sector

Sector	2010 Census Population	2013 Extrapolated Population
N	0	0
NNE	0	0
NE	0	0
ENE	0	0
E	0	0
ESE	0	0
SE	0	0
SSE	6,756	6,760
S	9,469	9,494
SSW	12,363	12,790
SW	3,968	4,069
WSW	4,928	4,965
W	4,741	4,794
WNW	12,639	12,729
NW	10,158	10,288
NNW	14,255	14,498
<b>Total</b>	<b>79,277</b>	<b>80,387</b>



### 2013 Resident Population

Miles	Subtotal by Ring	Cumulative Total
0 - 1	726	726
1 - 2	2,563	3,289
2 - 3	3,413	6,702
3 - 4	7,017	13,719
4 - 5	9,174	22,893
5 - 6	9,148	32,041
6 - 7	8,960	41,001
7 - 8	10,676	51,677
8 - 9	13,209	64,886
9 - 10	12,445	77,331
10 - EPZ	18,443	95,774
Total:		95,774

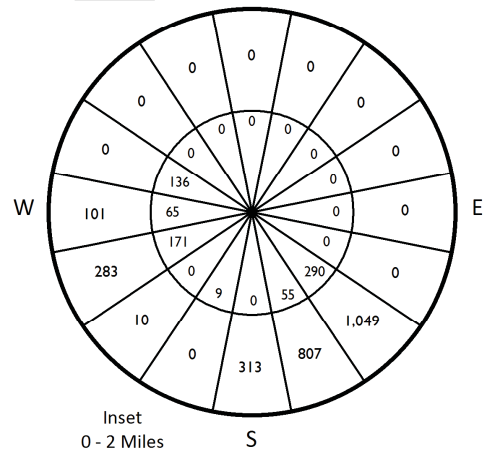
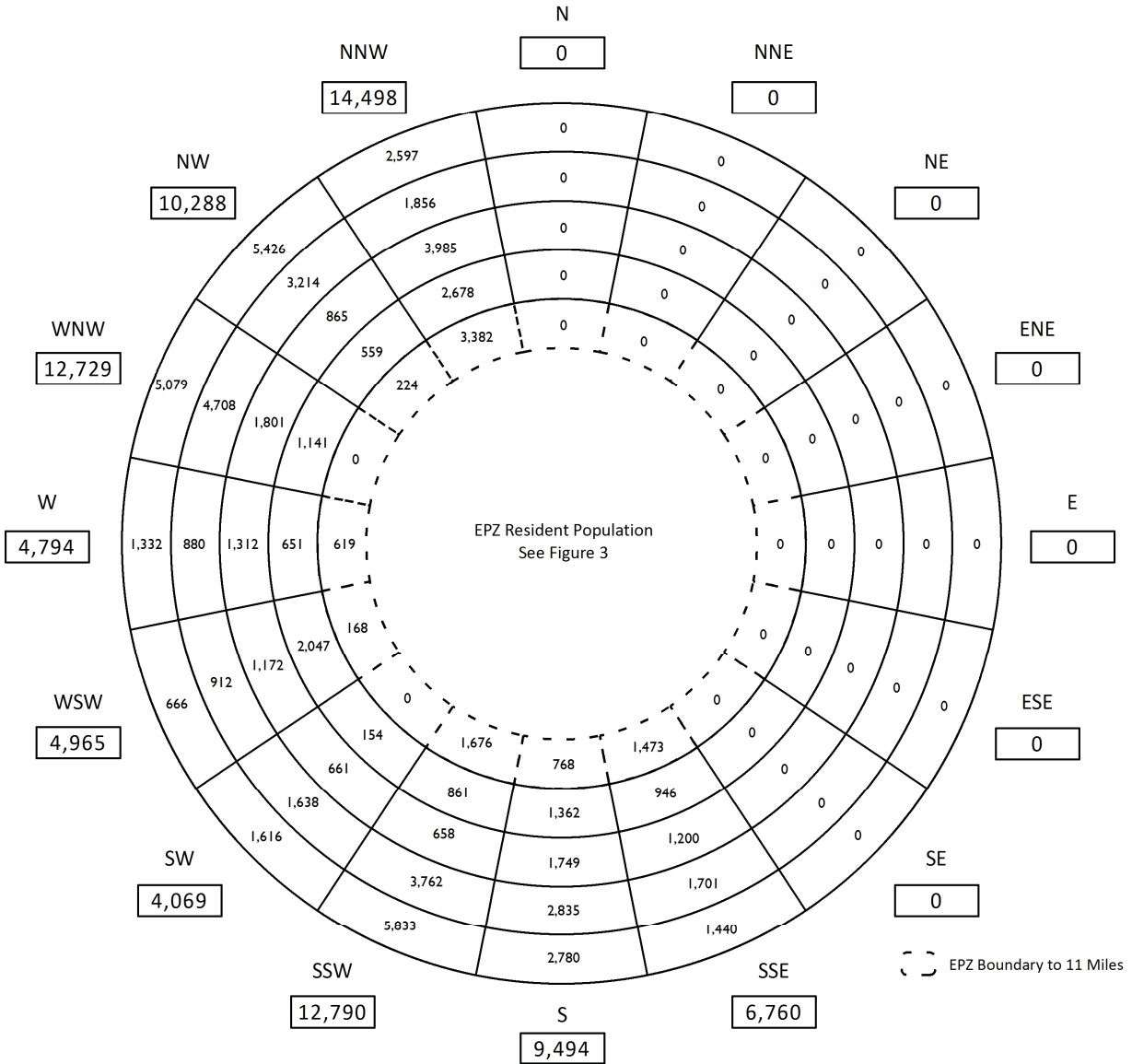


Figure 3. Permanent EPZ Resident Population by Sector



### 2013 Shadow Population

Miles	Subtotal by Ring	Cumulative Total
EPZ - 11	8,310	8,310
11 - 12	10,399	18,709
12 - 13	13,403	32,112
13 - 14	21,506	53,618
14 - 15	26,769	80,387
Total:		80,387

Figure 4. Shadow Population by Sector

**Equation 3. Percent Population Change**

$$\% \text{ population change} = \frac{2013 \text{ Population} - 2010 \text{ Population}}{2010 \text{ Population}} \times 100\%$$

**Table 5. Summary of Percent Population Changes**

Region	Percent Population Change (2010-2013)
2-Mile Region	2.6%
5-Mile Region	2.6%
EPZ	1.9%
Shadow Region	1.4%
EPZ + Shadow Region	1.7%

As documented in the NRC’s response to the Emergency Planning Frequently Asked Question (EPFAQ) 2013-001, the licensee should consider the impact of a population increase on the longest 90<sup>th</sup> percentile ETE for the scenarios identified in Table 1-3 of NUREG/CR-7002, with two possible exceptions:

1. The roadway impact scenario need not be considered because the only purpose of this scenario is to support the development of traffic control planning.
2. The need to include the special event scenario depends on the frequency of the special event analyzed. Licensees should consider using this scenario if the special event chosen is repetitive during the year, such as multiple home football or baseball games, and not a one-time event such as a seasonal parade.

As documented in Table 7-1, “Time to Clear the Indicated Area of 90 Percent of the Affected Population” in the PNPS ETE Report (KLD TR-510, dated December 2012), the scenario with the longest 90<sup>th</sup> percentile ETE is Scenario 8 – a winter, midweek, midday scenario with snow – a non-special event.

Table 6 is adapted from Table M-3 in Appendix M of the PNPS ETE Report and documents the population sensitivity study conducted for an evacuation under Scenario 8 conditions. As discussed in the introduction, federal regulations stipulate that an updated ETE must be conducted if population growth

is large enough to cause the 90<sup>th</sup> percentile ETE to increase by 25 percent or 30 minutes, whichever is less.

Comparing the percent population changes presented in Table 5 with those in Table 6 indicates that **population has not grown enough to trigger an ETE update**. As discussed in the introduction, annual population estimates shall be maintained by licensees and made available for NRC inspection between censuses. This report should be kept on file for NRC inspectors to indicate that the annual population analysis for 2013 has been completed and that an updated ETE analysis is not warranted at this time. This report need not be submitted to the NRC as an updated ETE analysis has not been triggered by population growth.

**Table 6. ETE Variation with Population Change**

Resident Population + 20% Shadow Population	Base	Population Change		
		10%	20%	23%
	109,819	120,801	131,783	135,077
ETE for 90 <sup>th</sup> Percentile				
Region	Base	Population Change		
		10%	20%	23%
2-MILE	2:55	2:55	3:00	3:00
5-MILE	2:35	2:45	2:50	2:55
FULL EPZ	3:30	3:40	3:55	4:00
ETE for 100 <sup>th</sup> Percentile				
Region	Base	Population Change		
		10%	20%	26%
2-MILE	6:00	6:00	6:00	6:00
5-MILE	6:05	6:05	6:05	6:05
FULL EPZ	6:10	6:10	6:10	6:10