

## MEMORANDUM

---

**To:** Chandler Peter, U.S. Army Corps of Engineers  
Steve Dougherty, ERO Resources

**From:** Doug Jeavons

**Re:** Review of 2010-2011 NISP Demand Projections from Harvey Economics and  
Recommendations for NISP Supplemental EIS

**Date:** May 4, 2011

---

BBC Research & Consulting (BBC) was asked to review the report entitled *Water Supplies and Demands for Participants in the Northern Integrated Supply Project* (2011 HE Report). The report was produced by Harvey Economics (HE) for the Northern Colorado Water Conservancy District and the Northern Integrated Supply Project (NISP) Participants and provides updated projections of future water demands and updated estimates of the projected need for the proposed NISP project. BBC reviewed a draft version of the report (dated November 10, 2010) and a revised final version (dated January 21, 2011). This memorandum summarizes our review of these updated projections.

### Background and Overview

The 2011 HE Report is the fourth report summarizing projected demands for NISP participants. HE originally produced a report describing NISP participant demands in December 2004. That report was updated in July 2005 and again in December 2005, in part to reflect changes in the list of NISP participants. BBC reviewed each of these prior reports on behalf of the EIS team. In the interim between December 2005 and the 2011 HE Report, BBC also produced a memorandum for the EIS team that evaluated the recent population growth and water use trends of the NISP participants.

This evaluation begins with a brief discussion of the methodology used by HE to develop the latest demand projections. We then examine how the projections have changed since the December 2005 report. In the third portion of this memo, we provide our evaluation and assessment of the reasonableness of the latest projections.

### HE Methodology

The 2011 HE Report essentially incorporates the same methodology as the previous iterations in 2004-2005. The demand projections were developed on a participant by participant basis. In essence, HE gathered or developed projections of future demographic growth for each participant, then combined projected growth in population (or accounts) with assumptions regarding water use per resident (or per account) specific to each participant.

To conduct the 2011 demand update, HE gathered information from each of the NISP participants, including historical information on population (or account) growth and water use. HE also gathered the participants' demand projections, where available, or related information regarding anticipated future changes in their customer base and water requirements. As described in the 2011 HE report, participant projections were reviewed and then either accepted as is or modified for use in the HE study.

The 2011 HE Report consists of two volumes. The main volume largely aggregates information across all NISP participants and provides an analysis of historical growth and water use, projections of future water requirements and — through a comparison of future requirements to the firm yield from the participants' existing supplies — the projected need for supply from NISP. The main volume also provides a discussion of conservation efforts by the participants. The second volume consists of appendices for each participant which provide greater detail regarding historical water use and future demographic and water demand projections. Both report volumes were examined for this review.

### **Comparison with 2005 Projections**

When the Supplemental Draft EIS is completed and submitted for agency and public review, it is likely that reviewers will compare the updated demand projections with those used in the original Draft EIS. Comparison of two sets of projections, developed at different points in time, can neither confirm nor refute the future accuracy of either set of forecasts. Such comparison can, however, highlight potentially important changes in key assumptions underlying the forecasts. The following discussion provides a comparison of the most recent demand projections with the projections provided in December 2005 which were used in the Draft EIS.

**Changes in NISP participation.** Since the December 2005 projections, Berthoud has dropped out of the NISP participant group. The other 15 participants (including Dacono, Firestone and Frederick which are participating through the Central Weld County Water District) remain unchanged. The following comparisons between the December 2005 report and projections and the current report exclude Berthoud from the 2005 data to provide a more accurate comparison.

**Actual water use.** The 2005 HE projections provided historical data on the NISP participants' actual water use and total water requirements — including potable and non-potable deliveries and system losses — through 2003. The 2011 HE Report contains information on actual water use and total requirements through 2009. Figure 1, on the following page, depicts the annual total water requirements for the current NISP participants from 1999 through 2009.<sup>1</sup>

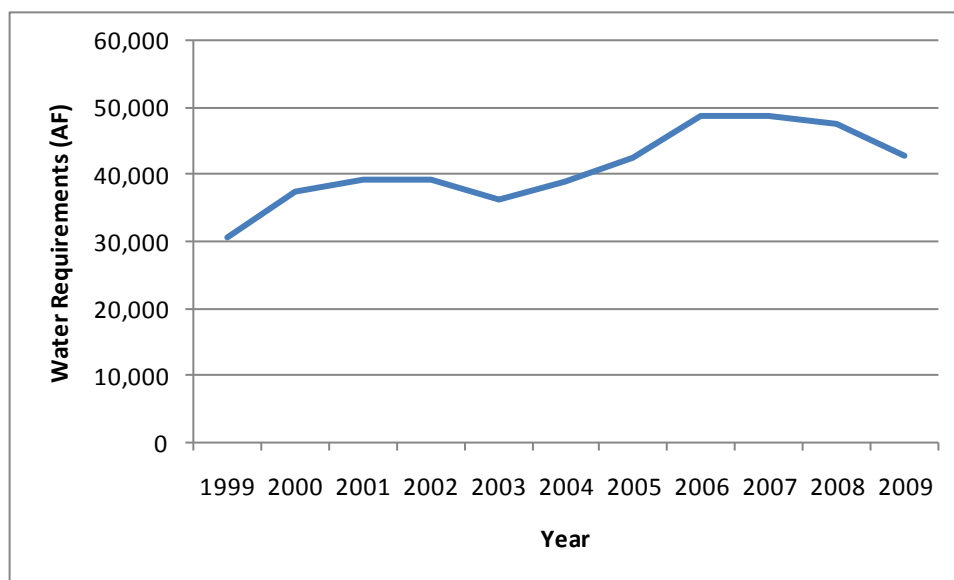
Figure 1 illustrates the general trend of increasing annual water requirements for the NISP participants over the past decade. Water requirements declined significantly in 2003 due to drought restrictions imposed by the participants. Beginning in 2007, economic and demographic growth in the NISP region (and elsewhere) has slowed dramatically due to the current recession, which is also reflected in the water use data. 2009 was a very unusual year due to extensive precipitation during the

---

<sup>1</sup> Although the 2011 HE Report contains data from earlier years for most of the NISP participants, data before 1999 were not available for CWCWD.

summer watering season along Colorado's Front Range. Total water requirements for the NISP participants in 2009 were about 10 percent less than in 2008. By way of comparison, Denver Water's demands in 2009 declined by more than 13 percent from the preceding year due to the unusually wet conditions.

**Figure 1.**  
**Historical Annual Water Requirements for the NISP Participants as a Group, 1999-2009**



Source: Harvey Economics January 2011 report.

**Population projections.** Fundamentally, the HE demand projections are based on assumptions regarding future growth in the service areas of the NISP participants. In most cases, these growth assumptions are expressed in terms of future population. In some cases, they are expressed in terms of growth in the number of connections (taps) served by the NISP participants. Future tap projections, however, can be converted into population equivalents based on either current population per tap ratios or explicit assumptions from the HE reports regarding the number of people per tap for those systems.

The 2011 HE Report projects that the population served by the NISP participants will increase from about 211,400 residents in 2010 to approximately 365,700 residents by 2030, over 496,000 residents by 2050 and about 575,700 residents by 2060. The 2005 HE projections (excluding Berthoud) anticipated higher population totals in 2010 (226,500 residents) and 2030 (388,300 residents) than are forecast in the current projections. However, the new projections anticipate more rapid population growth after 2030 than the previous projections, leading to a larger population in the NISP service areas in 2050 than previously forecast. The 2005 HE report did not make projections for 2060. Figure 2 compares the population projections from the 2011 HE Report with the 2005 HE projections.

**Figure 2.**  
**Comparison of NISP Population Projections from 2011 and 2005 HE Reports**

	Projected Population			
	2010	2030	2050	2060
<b>2010 HE Projections</b>	<b>211,424</b>	<b>365,698</b>	<b>496,340</b>	<b>575,683</b>
Average Annual Growth Rate				
- by period	NA	2.8%	1.5%	1.5%
- from 2010 forward	NA	2.8%	2.2%	2.0%
<b>2005 HE Projections*</b>	<b>226,524</b>	<b>388,320</b>	<b>470,826</b>	<b>NA</b>
Average Annual Growth Rate				
- by period	NA	2.7%	1.0%	NA
- from 2010 forward	NA	2.7%	1.8%	NA

Note: \*Summary of 2005 projections excludes Berthoud for comparability purposes.

Source: Harvey Economics December 2005 and January 2011 reports.

**Water demand projections.** Annual total water requirements of the NISP participants are projected to increase along with their growing populations. In the latest demand projections, annual total water requirements are projected to grow from about 52,000 acre-feet in 2010 to 99,000 acre-feet by 2030, about 127,000 acre-feet by 2050 and over 143,000 acre-feet by 2060. In the 2005 projections, annual water requirements were anticipated to be greater in 2010 (59,000 acre-feet), but lower in 2030 and 2050 (97,000 and 115,000 acre-feet, respectively).

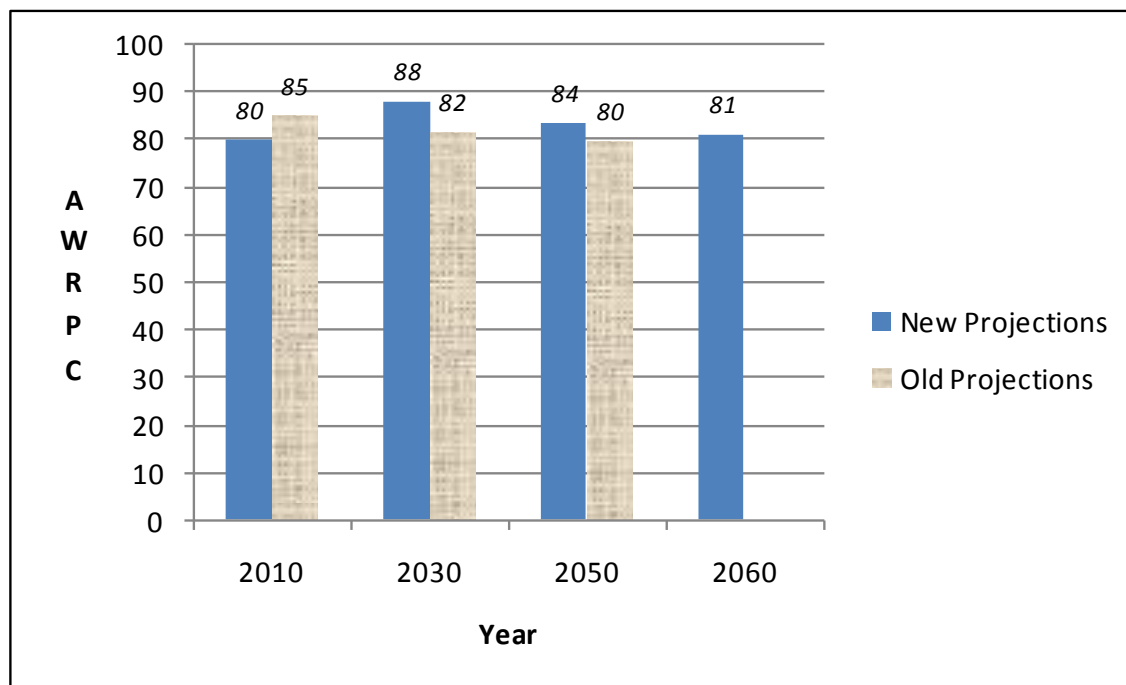
The higher water demand projections in 2050 (relative to the 2005 HE projections) are primarily attributable to the higher population projections described previously. However, the latest HE demand projections also indicate rising total water requirements per capita among the NISP participants — particularly in the 2030 through 2050 timeframe.

Dividing the overall water requirements projections for the NISP participants by the projected total population in the NISP service areas provides a metric that can be useful in evaluating changes in the intensity of water use over time — annual water requirements per capita (AWRPC). We have selected this metric to avoid confusion with a similar alternative metric, gallons per capita per day (GPCD). The HE report provides information on trends in GPCD among the NISP participants and a comparison of the GPCD of the NISP participants with other western communities, but focuses primarily on potable water deliveries. While the HE information on GPCD is useful, for our purposes in evaluating the purpose and need for NISP, total water requirements per capita (which also includes deliveries for non-potable use as well as system losses) is the most relevant metric in evaluating the need for the NISP alternatives. The other advantage of using AWRPC, and not using GPCD, is to reduce the temptation to draw comparisons across different water systems. Such comparisons are frequently made based on the GPCD metric, but are often misleading — due to

varying definitions (e.g. residential GPCD versus system-wide GPCD) and due the extraordinary difficulty in accurately comparing GPCD across different water systems.<sup>2</sup>

Based on the 2011 HE Report's projected annual water requirements for the NISP participants and their projected future populations, AWRPC will rise from about 80,000 gallons in 2010 to about 88,000 gallons by 2030, then decrease to about 83,600 gallons by 2050. By the end of the forecast period in 2060, the AWRPC for the NISP participants is projected to have decreased to about 81,000 gallons, nearly comparable to the 2010 AWRPC. In contrast, the previous 2005 projections reflected declining AWRPC over the forecast period. Figure 3 compares the annual water requirements per capita from the 2011 projections with the 2005 projections.

**Figure 3.**  
**Implicit Overall NISP Annual Water Requirements per Capita (AWRPC) in Thousands of Gallons**  
**(from 2011 and 2005 HE Reports)**



Note: \* 2005 projections exclude Berthoud for comparability purposes.

Source: BBC Research & Consulting based on Harvey Economics 2005 and 2011 reports.

**Existing supplies and need for NISP.** The 2011 HE Report, like the 2005 version, concludes with an evaluation of the existing supplies of the NISP participants and an evaluation of the need for NISP based on comparison of those supplies with projected future requirements.

<sup>2</sup> To draw meaningful inferences regarding the relative efficiency of water use between different water systems based on GPCD it is necessary to control for differences in weather, economic and demographic composition of the service areas, ages of the housing stock, lot sizes and numerous other factors influencing water use. Many analyses that compare GPCD between water systems fail to adequately consider these factors.

The supply evaluation in the 2011 HE report indicates that NISP participants currently have supplies totaling about 59,400 acre-feet in terms of firm yield. This figure suggests that participants have continued to add to their portfolios of water supplies since the 2005 report, when their collective firm yield was estimated at about 48,000 acre-feet.

The comparison of the future water requirements projections with existing supplies in the 2011 HE report indicates that NISP will be fully subscribed by approximately 2030 or 2031. The 2005 report had estimated that NISP would be fully subscribed between 2025 and 2030. The slightly longer timeframe for full use of NISP supplies primarily reflects the additional supplies that NISP participants have developed since the 2005 report.

### **Reasonableness Evaluation**

In our previous evaluation of the 2005 HE report and demand projections, we concluded that the methodology HE used was generally appropriate and made use of the best available data for each of the NISP participants. The 2011 HE Report incorporates the same general methodology and we continue to find the overall methodology to be reasonable.

The comparison of the 2011 and 2005 projections highlights some changes in key assumptions underlying the two forecasts. As noted earlier in this memorandum, the new projections assume faster population growth for the NISP participants than the earlier projections, particularly after 2030. The new projections also reflect an increase in annual water requirements per capita after 2010, and higher AWRPC in 2030 and 2050 than the previous projections, though the projected 2060 AWRPC are similar to 2010 AWRPC. To evaluate the reasonableness of the results of the latest HE projections, we have focused on these changes.

**Evaluation of population projections.** As noted in the 2011 HE Report, the NISP participants have experienced rapid population growth over the past 20 years. The average annual population growth for the NISP participant group was 5.3 percent over the 19 year period from 1990 through 2009. Even during the slower period of population growth in the Front Range from 2004 through 2009, the participants experienced average annual population growth of 3.7 percent per year.

The 2011 demand projections assume that the combined population in the NISP participants' service areas will increase by about 224,000 residents from 2010 through 2040 and by about 140,000 residents from 2040 to 2060. To further evaluate the population growth projections through 2040, BBC examined them in the context of historical and projected population growth for the northern Front Range region based on data from the Colorado State Demography Office (SDO).

From 1990 through 2010, the four counties that include the NISP participants (Boulder, Larimer, Morgan and Weld) added 332,000 residents. Over 40 percent of that growth occurred within the service areas of the NISP participants. Based on the latest population projections from the SDO, the four northern Front Range counties are expected to add almost 667,000 residents between 2010 and 2040. Comparing this figure to the NISP population projections from the 2011 HE Report indicates that the NISP participants would account for about 34 percent of 2010 through 2040 population growth in the counties. Figure 4 summarizes these data.

**Figure 4.**

**Comparison of NISP Historical and Projected Population Growth with Regional Projections from the State Demography Office**

County	1990	2010	2040	Change by Period	
				1990-2010	2010-40
Boulder	225,339	304,546	399,111	79,207	94,565
Larimer	186,136	302,600	500,713	116,464	198,113
Morgan	21,939	28,702	51,599	6,763	22,897
Weld	<u>131,821</u>	<u>261,719</u>	<u>612,852</u>	<u>129,898</u>	<u>351,133</u>
Total	565,235	897,567	1,564,275	332,332	666,708
NISP Group	76,000	211,424	435,603	135,424	224,179
NISP Share	13.4%	23.6%	27.8%	40.7%	33.6%

Source: Colorado State Demography Office and Harvey Economics January 2011 reports.

Based on comparison of these historical and projected “capture rates” of Front Range growth by the NISP participants, we conclude that the population projections assumed in the 2011 HE Report are reasonable and consistent with the official population projections for the region through 2040. Projections beyond 2040 are not available from the SDO.

**Evaluation of water use per capita.** Apart from the demographic growth assumptions, the second fundamental component of the HE demand projections is the projected intensity of water use among the participants, which we have defined in terms of AWRPC. As shown earlier in Figure 3, overall AWRPC among the NISP participants were estimated to be 80,000 gallons in 2010, to reach 88,000 gallons by 2030 and then to decline back to about 81,000 gallons by 2060.

The projected NISP AWRPC at the beginning of the forecast in 2010 (80,000 gallons) are based on data compiled by HE spanning the period of 1999 through 2009 and reflects the weighted average total water requirements per capita for the participants over that period. BBC evaluated the possibility that by using the 1999-2009 period — during which AWRPC generally trended down due to conservation and other factors — the HE projections may have overstated current “normalized” water use by giving too much weight to higher water use prior to the 2002-2004 drought.

To evaluate the projected average NISP water requirements per capita at the beginning of the forecast period (81,000 gallons) BBC examined the participants' actual water requirements per capita in 2007 from the HE data. We selected 2007 as a benchmark because our previous work for Denver Water had determined that year to be relatively "normal" from a water demand standpoint (e.g. in terms of weather during the irrigation season).<sup>3</sup> The overall water requirements per capita for the NISP participants in 2007 were 82,300 gallons. This result indicates that the HE starting point of 80,000 gallons per capita in 2010 reflects a reasonable estimate of current water requirements under "normal" climate conditions.<sup>4</sup>

The increase in AWRPC in future years that is implied by the HE projections is worthy of further scrutiny. In general, most municipal water providers (including the NISP participants) have experienced declines in water use per account (and AWRPC) over the past few decades. Detailed analysis conducted by BBC for Denver Water during 2007 through 2009 attributed the decline in that system's water use per account over the past decade to four primary factors:

- ongoing behavioral changes due to the 2002-2003 drought,
- increased conservation efforts,
- price (rate) increases, and
- natural replacement of aging plumbing fixtures (also referred to as "passive conservation").

The first of the factors listed above may well be transitory, as memories of the drought fade and new people move into the area. Many of the NISP participants primarily serve newer homes, so natural replacement is likely to have less influence in reducing future water demand. The other two factors (conservation efforts and rate increases), however, would appear likely to result in some reduction in future water requirements per capita among the NISP participants.

As noted previously, the HE demand projections were developed from the "bottom up", based on detailed analyses of each participant. The HE demand projections for some participants reflect increasing water requirements per capita, while the projections for others show decreases in AWRPC. In general, most (but not all) of the participants with substantial projected increases in AWRPC during the 2030-2050 time period were either projected to experience substantial increases in non-potable deliveries or (particularly in the case of CWCWD) to experience substantial increases in demand from large customers (e.g. dairies). In discussions with HE, they also noted that there are a number of factors that may tend to increase water requirements per capita in the NISP area over time. These include further development of commercial employment centers in the northern Front

---

<sup>3</sup> BBC developed a statistical model for Denver Water that is used to simulate variations in daily and annual water use over a 60 year period of historical climate conditions. Based on that model, demands during 2007 were estimated to be about 1.7 percent higher than average over the 61 year simulation period. Overall, Denver Water demands can vary by as much as 25 percent between the wettest and coolest years and the hottest and driest years. Obviously, Denver Water is a very different water system from those of the NISP participants. However, although weather patterns also differ to some extent between Denver and the NISP service areas approximately 50 miles to the north, we believe annual variations in Denver climate conditions are a reasonable proxy for annual variations throughout the northern Front Range of Colorado.

<sup>4</sup> While the HE approach might give too much weight to pre-drought water demands, that effect has likely been offset by the inclusion of the drought years in the HE sample (during which demands were artificially constrained by drought restrictions and other measures).



Range and the potential transition of at least some of the NISP participants away from being primarily “bedroom communities” with relatively little commercial water use.

Weighing the recent, general downward trend in water requirements per capita with the more specific information contained in the HE reports for each NISP participant, we believe it is certainly possible that water requirements per capita may increase for some participants. However, in our judgment, it is more likely that overall water requirements per capita for the NISP participants will decrease than increase in the future. With this conclusion in mind, we suggest the NISP Supplemental EIS also consider two modified future demand scenarios — as described in the following portion of this memorandum.

### **Conclusions and Recommendations for the EIS Team**

BBC has carefully reviewed the 2011 HE Report and demand projections for the NISP participants. Projecting future water demands for 15 relatively small and dynamic communities is a considerable challenge and it is clear that a great deal of effort was devoted to collecting and analyzing the best available information from each of the participants. In general, we find the HE methodology to be appropriate and consistent with industry standards for this type of analysis. We also find that the underlying growth assumptions for the NISP participants are consistent with the regional population growth projections prepared by the State Demography Office, if not slightly conservative (low) relative to those external projections.

As noted earlier in this memorandum, we are concerned about the HE projections’ implied increases in overall water requirements per capita for NISP participants, particularly in the 2030 through 2050 period. For the purposes of the Supplemental EIS, BBC recommends that two additional demand scenarios also be considered.

**Alternative demand scenarios.** The first alternative, which we have termed “Current AWRPC”, would reflect the continuation of recent (1999-2009) average annual water requirements per capita among the NISP participants. This scenario would multiply the population projections by 80,000 gallons per year to determine total annual water requirements for the NISP group in future years. Under this scenario, total annual NISP water requirements would be lower than the HE projections in 2030 through 2050, but similar in 2060.

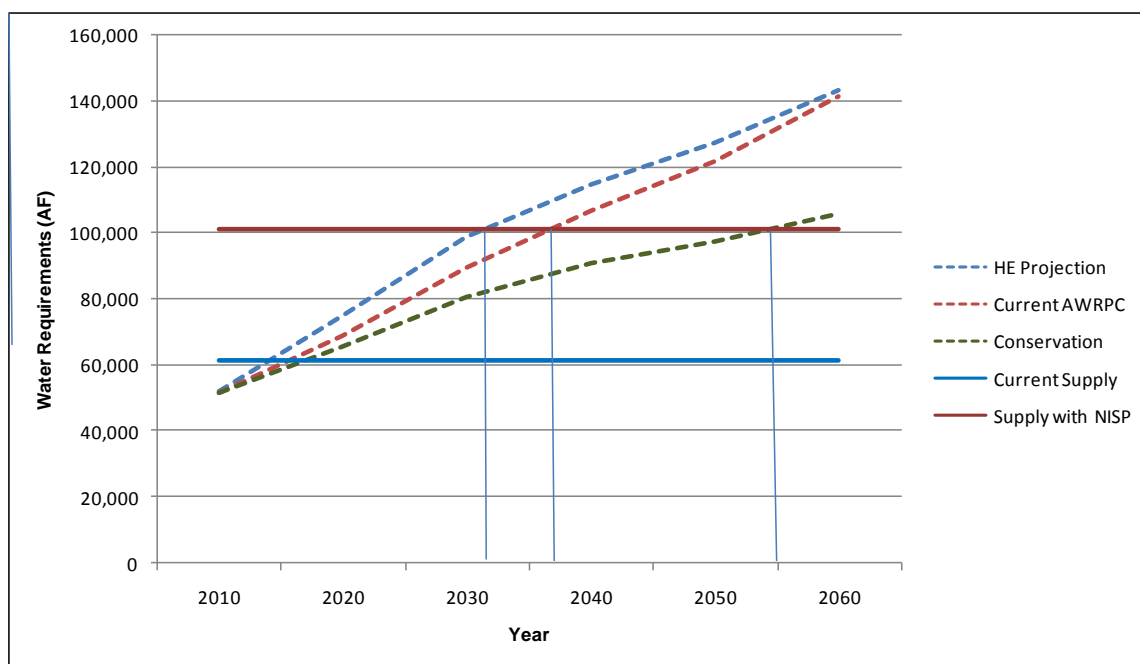
We also believe the EIS should consider the possibility that water requirements per capita among the NISP participants will continue to decline to at least some degree due to the participants’ ongoing conservation efforts, the likelihood of future rate increases to pay for new water supplies from the proposed NISP project and/or other sources, and some savings from natural replacement (passive conservation).

The extent of future declines in water requirements per capita is very difficult to predict and somewhat speculative in nature. We suggest the Supplemental EIS consider a conservation scenario in which overall NISP water requirements per capita decline by 5 percent — compared to 2010 AWRPC — during each future decade, leading to a total reduction of 25 percent by 2060. This scenario, which we have termed the “Conservation scenario”, would reflect future reductions in water requirements per capita of similar magnitude to those that the NISP participants have achieved

since the mid-1980s.<sup>5</sup> The magnitude of these assumed reductions in AWRPC is also generally comparable to preliminary assumptions regarding future municipal conservation being developed for the 2010 Statewide Water Supply Initiative Report (for passive conservation and medium level active conservation). Achieving such conservation would require additional conservation efforts by the NISP participants beyond their current programs, such as: landscape water budgets, irrigation efficiency evaluations, and targeted residential and non-residential audits for high use customers, among others.<sup>6</sup> While the NISP participants ability to achieve such savings is far from certain, the value of the Conservation scenario is in providing an assessment of the need for additional water supplies if such conservation savings were to be achieved in the future.

Figure 5 shows the resulting aggregate demand projections for the NISP participants under the 2011 HE Report projections, the Current AWRPC scenario and the Conservation scenario.

**Figure 5.**  
**Projected NISP Participant Demands under Alternative Demand Scenarios**



Source: BBC Research & Consulting based on analysis of 2011 HE Report.

<sup>5</sup> See Table III-3 in 2011 HE Report, page 26.

<sup>6</sup> See Draft 2010 SWSI Water Conservation Strategies, Office of Water Conservation and Drought Planning, CWCB. [http://www.colowc.com/SummerConference/Presentations/2010-08-25%20-%20Beorn%20Courtney%20-%20CWC\\_SWSI%20Strategies%20Presentatoin%20Aug%202010.pdf](http://www.colowc.com/SummerConference/Presentations/2010-08-25%20-%20Beorn%20Courtney%20-%20CWC_SWSI%20Strategies%20Presentatoin%20Aug%202010.pdf)

All three demand scenarios indicate the need for new supplies of the magnitude proposed for the NISP project — but the timing of full use of those supplies changes somewhat. As shown in Figure 5, under the Current AWRPC scenario, full utilization of the proposed NISP project (or a comparable alternative) might be delayed from about 2031 (under the HE projections) to perhaps 2036 or 2037. Under the scenario of substantial future reductions in water requirements per capita from passive and active conservation, full subscription of the proposed project might be delayed to as late as 2055. All three scenarios, however, suggest that a portion of the water supplies from a new project (or other sources) will be required as soon as 2020 or earlier.