Final Project Report: AWI-07-46
Drought Indicator and Trigger Tool (DITT) for Community Water Systems
15-Aug-08

PROFILE

- **Project Name**: “Drought Indicator & Trigger Tool for Community Water Systems” (DITT)
- **Lead Principal Investigator**: Dr. Michael Crimmins, University of Arizona, (UofA)
- **Project Manager for AWI**: Placido dos Santos, AWI’s Associate Director at ADWR
- **Project Manager for ADWR**: Arizona Department of Water Resources (ADWR)
- **Other Actors**: Office of Climatology at Arizona State University (ASU), UofA Programmers and Research Assistant

**Part A: General Progress**

This final report documents general project progress and evaluation criteria (Part A) of the subject project. In Part B, the specific progress *vis a vis* the contractual deliverables will be presented.

The DITT Project prepared an on-line tool for small Community Water Systems (CWS) that assists them in the preparation of the required Drought Preparedness Plan. The Drought Preparedness Plan online tool was and can be accessed at [http://droughtplan.arid.arizona.edu](http://droughtplan.arid.arizona.edu). Over 75 CWS accessed the tool. A copy of the home page of the tool is featured in Figure 1.

On February 20th, each was sent an email inviting the CWS to answer three quick questions to rate the DITT and its components (using Survey Monkey, please click here to access the link: [http://www.surveymonkey.com/s.aspx?sm=vAmXRTSQkMx3a5ipDO42zQ_3d_3d](http://www.surveymonkey.com/s.aspx?sm=vAmXRTSQkMx3a5ipDO42zQ_3d_3d)) about the tool and providing them their Fact-Sheet link in case they should desire to print out the information concerning their watershed. Unfortunately, only one CWS completed the on-line survey. This respondent’s highest rating (Excellent) was given to ‘DITT usefulness’ and the ‘Drought Sensitivity Questionnaire’; the lowest score was for its timeliness (Average). The respondent stated that there was nothing in the DITT that was missing or that required changing.
One of the most important results of the project was an improved understanding of CWS level of knowledge, needs and drought perceptions. Most CWS have limited knowledge of their immediate environments, such as the name of their watershed. To improve this knowledge base, a series of Fact Sheets were created for each watershed (see Figure 2), that could be downloaded and printed in color by all on-line users. This set of maps, although not a direct deliverable, proved to be useful to other efforts as well.

Based on the case study exercise (described below), 9 out of 10 CWS interviewed do not perceive drought or the climate in general to be major limiting factors in the management of their water system. Often, they consider the daily struggle to manage the service (many as non-salaried managers working full-time elsewhere) as a more pressing concern for them. Others clearly considered that a signed 100-year ‘promise’ of water supply (signed when the wells were drilled) was a sound commitment from Mother Nature –despite any level of recent capricious behavior on her part or unprecedented growth in Arizona. These and other key insights helped to prepare a set of tools that would best meet the needs of the CWS.

Part B: Details on Key Deliverables

Key deliverables within the DITT contract award included:
1. Selection of Community Water Systems for Case Studies
2. Gather Hydro-Climatological and Water Supply Information for Case Studies
3. Complete Case Studies
4. Mid-term Meeting Among Project Collaborators
5. Self-Assessment Tool for Vulnerability Analyses by Community Water Systems
6. Web-based Tool for Drought Indicator and Trigger Determinations

Details on progress for each of these will be briefly described here below.

Task 1: Selection of Community Water Systems for Case Studies

Fifteen of Arizona’s 654 community water systems was the suggested number of case studies to be evaluated to anticipate performance of the web-based tools that were later developed in this project. ADWR provided the necessary maps and data layers to help identify appropriate case studies, as well as the previous studies compiled on the CWS and their contact information. After dividing the CWS by watershed (n=14) and number of people served, a UofA research assistant canvassed them by telephone starting at the top and continuing down the list until at least two...
verbally agreed to serve as a Case Study. The sample of case studies is therefore stratified by watershed and purposive, with an inherent bias towards the inclusion of those who answered the phone and expressed interest (most often prior sensitivity or exposure to drought) in participating.

**Task 2: Gather Hydro-Climatological and Water Supply Information for Case Studies**

Hydro-climatological information and other information were collected both to explore the links of these variables to others such as ground water levels, and to indicate trends to CWS managers so that they might be better informed about the evolution of conditions in their watershed. Total annual precipitation, annual average temperature and population were explored at the lowest possible levels since the early 1970s. After preliminary analysis, despite interesting associations between SPI at the watershed level and hydrographs for the CIM wells, the team agreed to use the hydro-climatological information simply to portray relative trends in a user-friendly manner to CWS, with no direct link to the representativity of the case studies.

**Task 3: Complete Case Studies**

The Case Study questionnaire was developed by University of Arizona with review by ADWR prior to launching it. It was prepared both as an on-line questionnaire (using SurveyMonkey software, see Figure 3)) and as a paper conversation guide for telephone interviews. The DITT team made a total of 78 phone calls between May 14 and 29th, 2007; 31 of these were machines (to which complete messages were recorded) and 7 of them returned the call. A total of 28 CWS verbally agreed to be one of our Case Studies:

- 15 requested links (sent immediately, and a reminder was sent out Thursday announcing a deadline of noon Tuesday 29 May) and 7 completed the survey on line.
- another 4 were completed over the telephone (most that agreed to speak were over 60 years of age and had been managing the water system for 20 odd years).

A total of 13 Case Studies were finalized, representing 11 of the 14 watersheds. Eight of the 13 were private ACC and 5 were domestic water improvement districts.

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[Image: Drought Indicator & Trigger Tool for Community Water Systems (CWS)]

**Drought Indicator & Trigger Tool for Community Water Systems (CWS)**

**4. Population Served**

Please tell us about the population you serve.

- **11. Total resident population served in 2007**
- **12. Estimate of the importance of each type of clientele in 2006 (if 0-100%, sum of all four must equal 100) for your CWS**
  - Commercial/industrial
  - Domestic
  - Turf facilities (schools, parks, campests, golf)
  - Agricultural
- **13. Number of domestic connections (usually households):**
  - 2007
  - 2006
  - 2005
- **14. Please estimate potential new connections in the future (beyond the current number):**
  - In 5 Years
  - Next

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Each CWS has between one and three wells, and only one of the 13 respondents depends entirely on surface water (this CWS had one active well, two backup wells and has had to truck water three times since 1998).

In addition to an analysis of vulnerability, the case studies meant to explore whether drought indicators, based on Watershed-level hydro-climatological conditions alone, are an effective means of triggering actions that can prolong or sustain water deliveries by the community water systems. It was decided that the indicators are insufficient to trigger action on the part of typical CWS agents.

**Task 4: Mid-term Meeting Among Project Collaborators**
On Monday, June 18, 2007 in Phoenix, the Principal Investigator met with the other project collaborators to discuss the research findings of Tasks 1 through 3 above and determined if the project direction or tasks should be adjusted for optimal benefit to ADWR and Arizona’s Community Water Systems. The strategic discussion was focused on identifying an approach that would generate awareness and interest among Community Water System representatives so they will use the tools for benefit of their water systems. It was decided that ADWR would publicize the DITT tool via their mailings informing CWS about the upcoming drought plan deadlines.

**Task 5: Self Assessment Tool for Vulnerability Analyses by Community Water Systems**
As a component of the on-line DITT tool, the research team developed a Self-Assessment drought ‘Sensitivity’ analysis allowing Community Water Systems to auto-evaluate their vulnerability to drought by answering a series of questions about their personal system, past exposure to drought and knowledge of local conditions. A draft “beta-version” of the tool was provided to ADWR for review and comment. In a post-evaluation, respondents appreciated this component.

**Task 6: Web-based Tool for Drought Indicator and Trigger Determinations**
A draft “beta-version” of this web-based tool was provided to ADWR for review and comment and changes were made according to ADWR concerns and wishes. See Figure 1.

According to the internet analytics set up to monitor use, the DITT
tool was visited 410 times between Jan 1 and May 12, 2008, all but 5 of these visits originating in USA and Alaska (two visitors from South Korea and Australia spent roughly 20 and 7 minutes on the site, respectively). Thirty–seven percent (37%) of the 410 visits represent direct traffic while 50% come from referring sites (166 came from azwater.gov) and the remaining 13% from search engines. Out of the 410 visits, only 266 were unique visitors and 230 continued through the site as far as submitting their registration information. Only 203 (close to 50% of the visitors) completed and submitted the questionnaire. The visitors averaged 8.25 minutes per visit on the DITT site.