APPENDIX A: State Agency Memoranda on Arizona-specific Water-related Needs

1. Arizona Department of Water Resources

Date: May 13, 2005

To: Lisa Danka, Department of Commerce

From: Karen Smith, ADWR

Subject: Arizona Water Institute (AWI) and ADWR Needs Assessment

The AWI has issued a draft proposal to assist the State in managing its water resources with their expertise in various areas of the water arena. The broad areas of assistance the AWI is concentrating on are to:

- Support the development of sound water management and conservation practices in Arizona;
- Evaluate new legal, economic and policy options to expand water supply availability;
- Reduce vulnerability of water supplies in arid and semi-arid environments;
- Encourage development of water sustainability industries and jobs.

The Department has identified and listed below the general areas in which assistance is desired. Specific AWI responses in each area would be better identified if a "Get Acquainted Conference" were held at a future date. This conference would be a very useful start that allows the universities, ADWR and other agencies to present current research and resource limitations and to identify needs and programs for AWI support. This would allow the agencies to present their programs, challenges, and needs in more detail and identify individuals and programs to further develop AWI assistance.

The general areas in which ADWR desires AWI assistance and opportunities for collaboration are as follows:

Water Resources Education

Public education is a vital part of making sound water management decisions, yet the public is not well aware of basic hydrologic and water management concepts, nor is the public well aware of the education resources available. The universities are well situated to provide this service to all of Arizona. The following forms of assistance would be of use:

- Statewide Public Education Forums
    - Hydrologic Education Workshops – physical concepts, data availability, surface and groundwater supply sources and volumes, water budgets, sources of data and additional water information.
    - Planning and Management Concepts such as sustainability and safe yield; agency responsibilities and roles; role of conservation and drought management; and Arizona's water rights framework. Education in basic hydrology concepts and distribution of knowledge of state-of-the-art conservation techniques and equipment is needed in many parts of the state.

- Water Resource Management Plan Development – education, training, and guidance. Small communities that experience dramatic growth will be in need of assistance to properly plan for their future. Most small communities have limited resources to prepare for such a challenge. Proactive rather than reactive activities are much preferred. Perhaps an electronic blueprint or menu of choices available through a website could be offered. Such diverse towns as Buckeye, Queen Creek, and Prescott Valley, are examples of communities that could benefit from this product.

- A Work Study or Internship Program. This would allow university students to rotate through the ADWR or other agencies to gain an array of practical experience. Interns have provided very good service to ADWR over the years and many of our new hires come from the interns we have employed. Formalizing such a program may be of benefit.

Water Resource Management and Planning

- Augmentation of Water Resources. Identification of the next water resource available is important for Arizona's future. Sources such as the Redwall Aquifer, basin imports, de-salinization, weather modification readily come to mind, but AWI expertise could add other solutions to this problem. Identification and exploration of sources, volumes available, impacts of utilization, costs and other constraints are needed as well.

- Managing Water Resources and Climate Change. A guidance document on incorporating climate change data into water resources planning and identifying flexible long-term planning tools to deal with global climate change would be of value.

Economic Studies

- Guidelines for the economic evaluation of water supply development options would be useful in obtaining consistent and reliable information on capital and OMR costs of developing alternative water supply sources.

- Studies of the costs of treating water quality problem parameters such as nitrate, arsenic, salinity, and brine disposal would be useful for regional and local water resources planning and management.

- Study of treatment options and costs related to recharge and reuse with respect to emerging contaminants would be useful, especially with regard to effluent recharge. The effects of these contaminants on the utility of this increasingly important water resource is little understood, and application of AWI expertise would be very useful in managing these water resources and in managing the health-based implications of these types of contaminants.

Data Management and Dissemination

- Development of a spatial database center for Arizona, coupled with ArcIMS would be useful. This might include ADWR data (groundwater, ROGR, well registration, surface water, gravimetric, remote sensing, and other data) as well as data from many other agencies.

- Website development or mirror sites for hosting the Drought Monitoring and Management Program, the Statewide Conservation Program, as well as to offer hydrologic and other data to the public may be feasible.

- A statewide data library offering ADWR and other agency data catalog to the public would be useful. Offering "one stop shopping" would simplify access to information by both the public and the

agencies. Such data could include groundwater, pumping and recharge information, well registrations, surface water registrations, gravimetric, remote sensing, and other types of information.

Water Resources Evaluation and Analysis

- Develop localized applications of ADWR groundwater models for rural water resources support. As an example, the Department developed a very successful groundwater model of the Prescott Active Management Area (AMA), and local interest has been expressed in using the model to explore the effects of various growth scenarios on the future groundwater and surface water systems of the AMA. Such models can be used to explore alternative future development.
- Analytical tools to deal with hardrock and fractured rock aquifers are needed by the Department for use in many rural areas of the state. The Department's experience and expertise is in the area of regional basin fill aquifers, yet in many rural areas of the state the aquifers available consist of localized fracture systems, or localized sandstones or limestones. Because of both a lack of data from these systems and a lack of analytical tools we do not have a good method to evaluate water adequacy applications and often deny the applicant. It is worth noting that in many cases these fractured systems are very small, shallow, sensitive to drought, and sensitive to contamination from septic tank systems. Nonetheless it would be worthwhile to have a better tool available to evaluate these types of aquifers, especially as rural Arizona continues to grow.
- Regional Water Resource Evaluations. Such studies would be done from the point of view of the Water Adequacy Program, to include identification of aquifer properties, development of a water budget, estimates of water in storage, water quality information, and water demand estimates for all uses. The Department's current program no longer develops such studies and does not track regional uses as effectively as it should. Studies should be done by basin or sub-basin, and include an evaluation of available supply and current and committed subdivision demands.
- Geologic mapping for aquifer identification and study of subflow issues is of great value, and is not currently one of the Department's strengths. Prior work by the US Geological Survey and the Arizona Geological Survey has been vital in adjudication efforts and should be expanded in those areas subject to the Adjudication effort.
- Collaboration between ADWR and university geology and geophysics departments to utilize remote sensing, gravity studies, resistivity studies, and seismic studies to define aquifer limits and characteristics.
- Research on groundwater quality changes with depth. As groundwater becomes more limited in supply, it will be important to know about water quality limitations on direct use and to plan for management of such waters. We have limited knowledge of the vertical changes in groundwater quality in much of the state, including the AMAs.

We appreciate the opportunity to share the Department's assessment of Arizona's water resource management needs and look forward to the continuing conversation.

Cc: Herb Guenther, ADWR

2. Arizona Department of Environmental Quality

Date: June 2, 2005

To: Arizona Water Institute (AWI) Core Group

From: Chuck Graf, Water Quality Division Deputy Director

Subject: Research, Education, and Outreach Priorities

For your consideration, the following list identifies areas of research by the AWI that would assist the Department in improving programs managed by its Water Quality, Waste Programs, and Tanks Divisions. Education and outreach activities are not specifically singled out, but would be a component of many of the listed research areas.

1. Emerging contaminants: Identification; quantification; occurrence in the environment; health and ecosystem effects; properties, fate, and transport; prevention, treatment, and remediation measures
    a. Specific contaminants
        1) Excreted pharmaceuticals and endocrine disruptors
        2) Nanoparticles
        3) Flame retardents (polybrominated diphenyl ethers and others)
        4) Microbial and viral agents
        5) Algae (deleterious impacts on fisheries)
        6) Mercury—background levels, sources, and source identification
    b. Methodologies for forecasting contaminants that will pose future problems
2. Better assessment methodologies
    a. Analytical technologies
        1) Faster—up to and including real-time detection and quantification
        2) More accurate; lower detection levels
        3) More appropriate or diagnostic methods (better surrogates, better bulk toxicity methods)
    b. Fate and transport, including natural attenuation
    c. Statistical approaches
    d. Data management, GIS, integration of environmental databases
    e. Environmental performance measures
        1) Identification of measures that accurately assess the state of the environment
        2) Development of simple, cost-effective methods of measurement
    f. Effectiveness of non-point source controls
    g. Inexpensive, simple, and more accurate methods of assessing soil permeability for design of disposal fields for on-site wastewater treatment facilities (septic tank/leach field systems primarily)
3. Treatment technologies – more effective, lower cost drinking water, wastewater, and remedial treatment measures

a. Nitrogen/nitrate
b. Arsenic
c. Perchlorate
d. MTBE
e. Pathogens
f. Salinity
g. Sulfate
h. VOCs
i. Disinfection byproducts
j. Lower maintenance, lower cost, denitrifying on-site wastewater treatment facilities

4. Analysis and development of improved institutional approaches
   a. Riparian protection—sustainability; maintaining the physical, chemical, and biological integrity of riparian areas
   b. Reclaimed water/gray water use
   c. Green chemicals
   d. Saline/brackish water
   e. Homeland security
      1) Best approaches to hardening water/wastewater treatment plants
      2) Measures to identify, mitigate, respond to releases of chemical, biological, and radiochemical agents
   f. Sewage treatment—tools to analyze cost effectiveness and environmental protection associated with sewering with centralized or distributed treatment facilities versus use of onsite wastewater treatment facilities
   g. Water quality protection in the arid west, where ephemeral and effluent-dependent watercourses are common
      1) Effluent quality
      2) Stormwater
      3) Other non-point sources
   h. Rehabilitation of deteriorating sewer and water infrastructure
      1) Methods of prioritization
      2) More cost-effective rehab approaches and methods

cc: Joan Card

3. Arizona Department of Commerce

Date: June 8, 2005

To: Participants of the Arizona Water Institute (AWI) Agencies/Universities Work Session

From: Lisa Danka

Subject: Water needs assessment for Community and Economic Development

Attached please find the water-related excerpts of three recent reports commissioned by the Arizona Department of Commerce as part of the Statewide Economic Study. This body of work provides the foundation on which a long-range economic plan is being developed for the state, scheduled for release in August 2005.

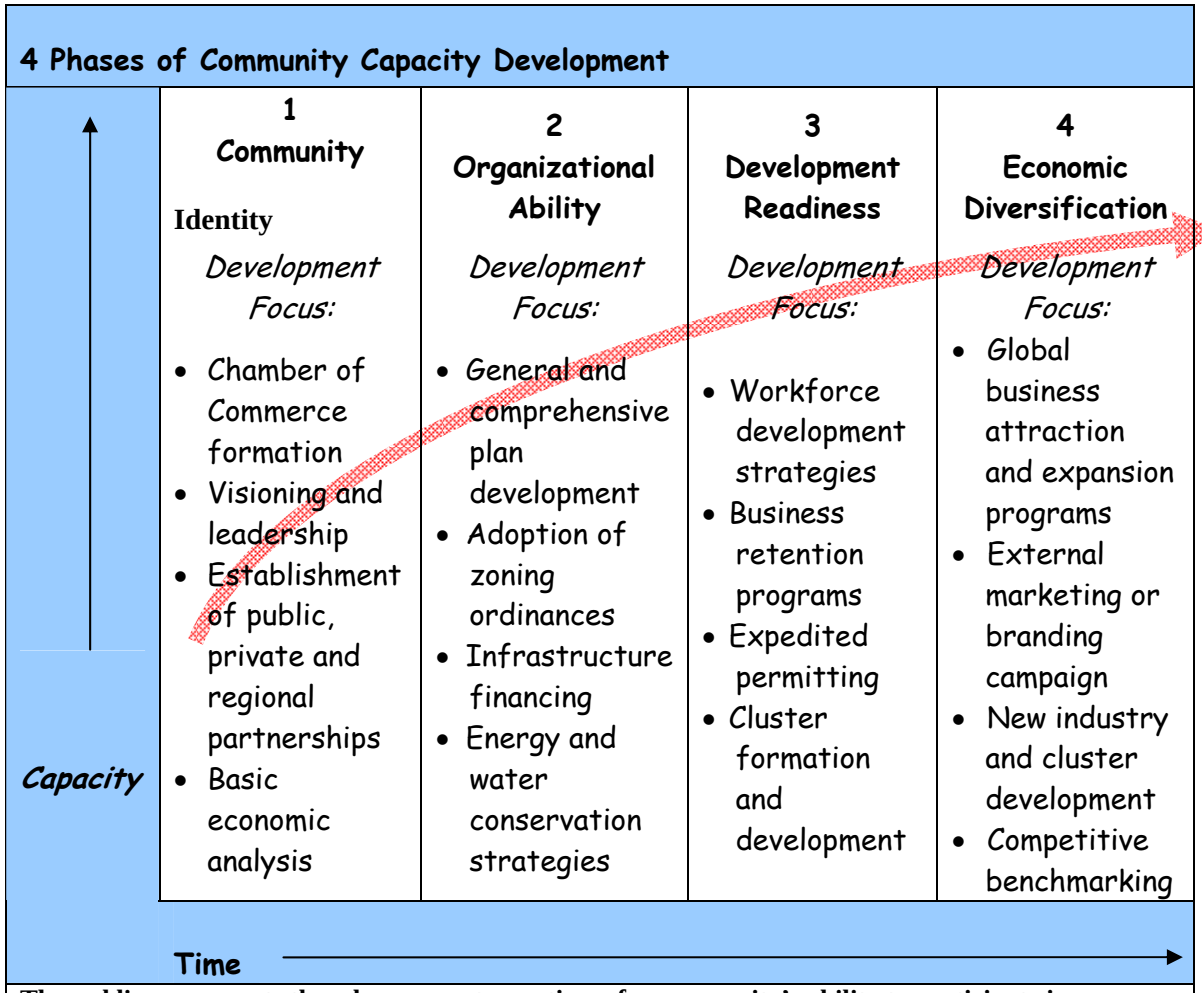
Background

In the early 1990s, Arizona pioneered the "vital cycle" concept of economic development, used throughout the world today. Under this model, economic development efforts are targeted to "clusters" and "foundations." As defined by Harvard economist Michael Porter, "Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, and associated institutions in a particular field that are present in a nation or region. Clusters arise because they increase the productivity with which companies can compete." Arizona's clusters include electronics manufacturing (semiconductors), aerospace/defense, agriculture, biosciences, and tourism, among others.

Foundations are those "building blocks" of a community that support the competitiveness of all companies, regardless of the industry. Foundations include physical infrastructure, access to capital, tax and regulatory structure, human resources (workforce), quality of life, technology, and communications and information infrastructure. Figure 1 demonstrates the correlation between a community's "capacity" and the ability to grow and diversify its economy. "Capacity" refers to the degree to which the foundations are present in an economy. Generally speaking, as a community builds capacity, it has greater potential to diversify its economic base, attract higher skilled jobs and employees, and increase per capita income.

The water-related needs of Arizona's businesses and communities parallel the vital cycle concept.

Figure 1.



The red line represents the advancement over time of a community's ability to participate in increasingly sophisticated economic activity as its human, physical and business infrastructure develops.

Business [Economic] Development

Assured water quality and quantity - Arizona's economic development strategy includes a focus on "basic" or export-oriented industries. These industries bring new money into an economy, tend to pay higher wages and create a greater number of jobs throughout the economy. Several of Arizona's basic industries are heavily dependent upon water quality and quantity: semi-conductors, agriculture, forestry and biosciences. This issue impacts communities in all phases of capacity development.

- New industry development – This represents both a need and an opportunity. In terms of need, Arizona's economy is heavily concentrated in a few narrow economic sectors that are highly cyclical. As a result, we often feel the impacts of economic cycles more intensely than more diversified and older economies. To even out the cyclical impacts and spread the risk across more sectors, community and economic developers often pursue diversification strategies.

In terms of opportunity, the more diversified economies of Phoenix, Flagstaff and Tucson have the capacity to develop a new water industry cluster due to the research and development capacity in the research universities located in these communities. A 1999 survey by the Association of University Technology Managers indicated that 82% of the new businesses created around university technology remained in the region served by the university that developed the technology.[1]

Because Arizona's universities are considered to be world-class in the conduct of R&D in water, this presents a unique innovation opportunity for creation of new markets, products and services, and – ultimately – new companies and jobs for Arizona residents. The following industry growth trends (2002 data) indicate the magnitude of this opportunity:

- Water and wastewater treatment demand - $122 billion, 40% of world environmental market
- Irrigation - $30 billion annually; demand for micro-irrigation and low-pressure sprinkler technologies growing at 10% annually
- Desalination of seawater and wastewater - currently worth approximately $2 billion; forecast to be $70 billion by 2020
- Water treatment and disinfection technologies – 10-15% annual growth; current market value $5 billion a year each.

Community Development

- Planning, research and policy development – communities at all stages of capacity development need better information and tools to plan and manage growth.
- Physical water infrastructure needs to be built in many areas of the state (water, sewer, waster water treatment facilities). This is a particular challenge for tribal lands, communities in phases 1 and 2 of capacity development, and the fast-growing phase 3 communities that have finally reached a "critical mass" that enables them to potentially diversify their economies. These communities all need options for cheaper, more efficient and effective infrastructure technologies, and building techniques.
- Financing for this infrastructure is also a critical need. The two primary sources of funding include the Water Infrastructure Financing Authority (WIFA) and the Greater Arizona Development Authority (GADA). WIFA is a state-administered program of the federal government. It is a revolving loan fund, and all WIFA loans must have voter approval. GADA is a state program that issues bonds and assists communities with cost of issuance coverage. GADA loans do not need voter approval (unless the local charter requires it).

[1] Kalis, Nanette. Technology Commercialization Through New Company Formation, NBIA Publications, 2001, pg 8.