

**ASSOCIATION OF GROUND WATER AGENCIES
NOMINAL GROUP TECHNIQUE**

CONJUNCTIVE USE ISSUE PAPER

Prepared by the
AGWA NGT Conjunctive Use Workshop Committee¹

BACKGROUND

In December 1995, the Association of Ground Water Agencies (AGWA) and Metropolitan Water District of Southern California (Metropolitan) published a jointly sponsored study on conjunctive use opportunities which would integrate Metropolitan's imported water system with Southern California's groundwater basins². In support of Metropolitan's Integrated Resources Plan, the study³ quantified up to 1.5 million acre-feet (AF) of groundwater basin storage capacity of imported surface waters, as shown below in Table 1. Also shown in the table is the estimated potential for reduction in imported water demands on Metropolitan in dry years, through production of pre-stored imported waters. This is viewed as a significant benefit of conjunctive use.

Table 1
Summary of Conjunctive Use Storage Capacities
Comparison of Normal and Dry Year Demands on Metropolitan

Groundwater Basin	Capacity (AF)	Normal Year (AF)	Dry Year (AF)	Percent Reduction
Orange County Basin	350,000	182,100	44,300	76%
Raymond Basin	100,000	29,800	6,200	79%
San Fernando Basin	200,000	257,800	132,800	48%
Main San Gabriel Basin	300,000	82,400	17,300	79%
Central/West Basins	150,000	390,400	236,400	39%
North Las Posas Basin	100,000	113,500	37,600	67%
Chino Basin	300,000	73,300	14,500	80%
Total	1,500,000	1,129,300	489,100	57%

In response to the study, Metropolitan's Intergrated Water Resources Plan⁴ (IRP) presented a *Preferred Resource Mix* which called for implementation of 800,000 AF of groundwater storage. Upon approval of the IRP by Metropolitan's Board of Directors, staff began discussions with groundwater basin managers in Southern California with the intent of negotiating storage agreements. Metropolitan has established groundwater storage agreements with Calleguas Municipal Water District and Semi-Tropic Water

¹ Edwin James, Chairman (Jurupa Community Services District), JoAnn Auerswald (Mojave Water Agency), Mel Blevins (Upper Los Angeles River Watermaster), Burnie Cavendar (San Bernardino Valley Water Conservation District), Fred Fudacz (Nossman, Gunther, Knox & Elliott), Nina Jazmadarian (Metropolitan Water District of Southern California), Darryl Miller (Psomas and Associates), William R. Mills (Orange County Water District), Harold Glaser, Contact Person (Montgomery Watson).

Storage District (although this storage is clearly outside of Southern California). Only the Calleguas agreement contributes toward achievement of the 800,000 AF IRP storage target. No significant progress has been made toward construction of facilities required to implement conjunctive use between Metropolitan and Southern California's groundwater basin managers.

For this reason, the Association of Ground Water Agencies and Metropolitan proposed to conduct the Nominal Group Technique (NGT) approach to problem-solving in an effort to set negotiations back on track. The purpose of this paper is to identify issues and barriers to implementation of conjunctive use in order to provide a common basis of discussion at the NGT session.

DEFINITION OF CONJUNCTIVE USE

Definitions of conjunctive use abound. Professor and Consultant David Keith Todd's textbook⁵ definition captures the approach to water resources management and key benefits. In short, the whole is greater than the sum of the parts:

The coordinated and planned operation of both surface water and groundwater resources to meet water requirements in a manner whereby water is conserved. The basic difference between the usual surface water development with its associated groundwater development and a conjunctive operation of surface water and groundwater resources is that the separate firm yields of the former can be replaced by the larger and more economic joint yields of the latter.

A recent issue of Western Water⁶ focused on conjunctive use principles and practices in California. The article also presents an excellent overview of the benefits of conjunctive use, regulatory and institutional issues, and identifies obstacles which must be overcome to implement additional programs. The definition presented in this article is as follows:

Conjunctive use is the operation of a groundwater basin in coordination with a surface water system to increase total supplies and enhance water supply reliability. The basin is recharged artificially and/or naturally in years of above average precipitation, so there is more groundwater to extract in years of below-normal surface water supplies.

AGWA adopted its own definition⁷ of conjunctive use at a recent strategic planning workshop:

The integration of surface water and groundwater resources resulting in the optimal use of those resources.

CONJUNCTIVE USE OBJECTIVES

Water Import Agencies

Metropolitan's stated objective is to increase conjunctive use in the service area to increase supply reliability and help meet the region's reliability goal.

Groundwater Basin Agencies

AGWA members recognize the value of storage capacities within their basins as a resource for providing storage of water supplies to meet local needs. The members of AGWA also realize that conjunctive use would be valuable to Metropolitan and to themselves.

Other Water Agencies with Groundwater Supplies

Other water agencies may derive collateral benefits from conjunctive use operations. Examples which have been cited in the past include improved basin management, increased water supply reliability, groundwater cleanup.

Other Water Agencies with Little or No Groundwater Supplies

Water agencies who may have little or no access to groundwater supplies may still benefit from regional implementation of conjunctive use. For example, during dry years an agency with access to groundwater would be able to defer surface water deliveries by pumping pre-stored imported groundwater. This would permit available surface water to be delivered to agencies with little or no access to groundwater. Overall, this results in an improvement to dry year reliability on a regional and local basis.

Benefits to Potential Participants

There are numerous benefits to participants in conjunctive use programs. These include:

- Additional water conservation
- Increased yield of combined surface and groundwater systems
- Reduced need for costly surface water storage
- Reduced need for surface water conveyance and distribution capacity
- Local emergency storage of imported supplies
- Reduced evapotranspiration storage losses
- Reduced pumping lifts due to higher groundwater levels
- Potential for groundwater cleanup

Public Benefits

From a public perspective, two benefits which are cited with the most frequency include reduced life-cycle cost of water, and increased water supply reliability.

CONJUNCTIVE USE ALTERNATIVES

Examples

David Keith Todd⁸ and Iris Priestaf categorized conjunctive use into three conceptual types:

The simplest is the passive system in which the individual user alternates between groundwater and surface water based upon available supplies and costs. A second is the limited system; here recharge is increased from locally intercepted rainfall and incidental recharge from leaking canals. Most important is the comprehensive system where surface water is actively developed for deliberate recharge and groundwater extractions are controlled. Such a system requires facilities for diversion, storage, treatment, extraction, and delivery. Increasingly, conjunctive use strategies are not only comprehensive, combining groundwater with local, imported, and recycled surface water systems, but also integrated. An integrated management system takes into account not only water supply objectives, but also related goals such as water quality management or maintenance of streamflow and riparian habitats.

Alternative Methodologies

It should be made clear that acceptable approaches to conjunctive use vary widely from groundwater basin to basin. Several variables inevitably influence the framework of implemented programs. Major factors include:

- Groundwater Basin Hydrogeology. This is the single greatest factor influencing available storage capacity, recharge methods and rates, movement of groundwater, and production rates. In general, Southern California's alluvial groundwater basins provide enormous capacity to store and transport imported surface waters to purveyors and ultimate users. For the most part, the hydrogeology of AGWA members' groundwater basins is well-known to the point that elaborate physical solutions to adjudications have been established, and mathematical models of flow and solute transport abound. From a conjunctive use perspective, significant existing recharge and production capacity make storage in Southern California's basins an attractive, cost-effective proposition.
- Redundancy of Capacity. By definition, implementation of conjunctive use requires redundant capacity for recharge and/or production of surface and groundwater. Historically, purveyors and groundwater basin managers have invested in dual facilities

to manage and store local waters. As a result, excess capacity could be made available for management and storage of imported waters. In certain cases, new facilities may be required to achieve desired imported water capacities, including dual-purpose wells.

- Hydraulic Grade Line/Access to Conveyance Facilities. The available pressure of imported water supplies has emerged as an important site-specific issue determining economically viable recharge methods because many of Metropolitan's conveyance facilities operate at high pressures. As an example, certain purveyors view surface water deliveries as an inexpensive alternative to groundwater pumping, and therefore prefer in-lieu recharge methods. Limitations to surface water access may require new conveyance facilities or inter-connections in order for all purveyors to participate in in-lieu imported water storage.
- Water Quality Considerations. Historical land use practices have often led to groundwater contamination with total dissolved solids, nitrates, metals, and synthetic organic compounds, among others. Careful management of a conjunctive use program in concert with a thoughtful cleanup program incorporating well-head treatment can enhance groundwater basin cleanup activities.
- Basin Management Practices/Adjudication. The specific details of groundwater pumping, accounting, and payment for storage and over-pumping have a profound impact on the economics of alternative conjunctive use schemes. Historical incentives (or disincentives) for ground and surface water management may place a hidden impact on program implementation.

PARTICIPANTS IN CONJUNCTIVE USE

Participants Necessary for Success in Southern California

Efforts to date indicate that necessary participants within Metropolitan's service area include the Metropolitan Water District of Southern California, as well as a Member Agency of Metropolitan. The Member Agency is required because imported water sales are made only to Member Agencies. It also appears that Member Agencies must become parties to conjunctive use agreements.

From the perspective of AGWA members, the groundwater basin manager is clearly the other major party to the agreement. The nature of this entity varies from basin to basin, but will typically be a court-appointed watermaster or groundwater special district. Also included, by default, will be the sub-entities which compose or govern the groundwater basin manager. These include overlying groundwater basin pumpers who hold production water rights, as well as appropriators. As a result, pumpers can include regulated water utilities, individual or corporate private parties, agricultural interests, Board of Directors of special districts, and local city councils. Appropriate judicial authorities may be participants if modifications to court-ordered adjudications are required.

A fascinating observation of recent attempts to conclude groundwater storage agreements is that it seems that all participants must agree to the storage agreement terms and

conditions. Recent experience suggests that any one party is capable of blocking agreements from being signed and implemented.

IDENTIFICATION AND OVERCOMING BARRIERS

As a result of the recent efforts of Metropolitan to negotiate conjunctive use agreements, staff summarized Barriers to Conjunctive Use from the perspective of the Metropolitan in a recent informal memorandum⁹. Metropolitan and the Raymond Basin Management Board also co-developed Principles for an Agreement¹⁰ to conjunctive use. Also recently, AGWA members published a Statement of Principles¹¹ for developing contractual agreements with Metropolitan. All of these documents are helpful in identification of barriers to be overcome in implementing conjunctive use agreements. Table 2 compares the stated positions of Metropolitan and the Association of Ground Water Agencies on several issues related to implementation of conjunctive use.

SUMMARY

If Metropolitan and AGWA are to implement conjunctive use agreements to the levels targeted in Metropolitan's IRP and together enjoy the benefits such programs offer, more work remains in identification of common ground, and resolution of differences.

² Montgomery Watson, *Defining Conjunctive Use Programs for Southern California's Groundwater Basins and Metropolitan's Imported Supplies*, Association of Ground Water Agencies and The Metropolitan Water District of Southern California, December 1995.

³ H.T. Glaser, D.E. Evenson, and M.J. Wildermuth, "Conjunctive Use of Groundwater and Imported Surface Waters in Southern California," *Proceedings of the American Water Resources Association Conference, Symposium on Conjunctive Use of Water Resources: Aquifer Storage and Recovery*, Long Beach, California (October 1997).

⁴ Metropolitan Water District of Southern California, *Integrated Resource Plan*, October 1995.

⁵ Todd, David Keith, pp 371-381, *Groundwater Hydrology*, Second Edition, John Wiley & Sons, 1980.

⁶ McClurg, Sue, Maximizing Groundwater Supplies, *Western Water*, May/June 1996.

⁷ Tonya Beilstein, *Personal Communication*, Association of Ground Water Agencies, Strategic Planning Workshop, October 1997.

⁸ Todd, David Keith and Priestaf, Iris, "Role of Conjunctive Use in Groundwater Management", *Proceedings of the American Water Resources Association Conference, Symposium on Conjunctive Use of Water Resources: Aquifer Storage and Recovery*, Long Beach, California (October 1997).

⁹ The Metropolitan Water District of Southern California, *Barriers to Implementation of Conjunctive Use Programs*, Draft Internal Memorandum, April 14, 1997.

¹⁰ Metropolitan Water District of Southern California, and the Raymond Basin Management Board, *Principles for an Agreement*, September 1997.

¹¹ Association of Ground Water Agencies, *Statement of Principles for Terms of Conjunctive Use Agreements with the Metropolitan Water District of Southern California*, Undated.

Table 2
Conjunctive Use Issues
Comparison of Metropolitan and AGWA Positions

Issue	Metropolitan Requirements/Position	AGWA Requirements/Position	Comments
Economic Benefits	<ul style="list-style-type: none"> • Investments in conjunctive use projects may not exceed savings from deferral of substitute capital projects. • Credit for benefits to overlying agencies. 	<ul style="list-style-type: none"> • Benefits justify management and administrative costs, and reward for current and historic investment in basin management facilities and policies. • Entitled to consideration in the form of water, water quality improvements, reduction in water price, or cash. 	<ul style="list-style-type: none"> • It could be argued that Metropolitan and AGWA place highly different values on access to local groundwater storage capacity. This single issue may be the most significant barrier (or lack of incentive) to implementation of conjunctive use.
Program Costs	<ul style="list-style-type: none"> • Metropolitan to fund construction and pay operations and maintenance costs. 	All borne by Metropolitan.	
Water Rates	Water delivered from storage to be sold at the appropriate Metropolitan rate at the time of withdrawal.		
Storage Losses	Equivalent to losses incurred by other basin rights holders for similar activities.	Metropolitan to bear, on a basis which recognizes priority of local interests to storage capacity.	
Water Rights	<ul style="list-style-type: none"> • Makes no claim to presently decreed water rights. 	<ul style="list-style-type: none"> • AGWA member and local basin interests have priority to storage space. Capacity determined by AGWA member. Local basin interests must be recognized, as well as needs for meeting regulatory requirements, and those needed to maintain basin safe yield. • Some pumpers appear unwilling to allow Metropolitan to become party to 	<ul style="list-style-type: none"> • A measure of distrust appears to persist in enjoining Metropolitan to basin judgments.

Table 2
Conjunctive Use Issues
Comparison of Metropolitan and AGWA Positions

Issue	Metropolitan Requirements/Position	AGWA Requirements/Position	Comments
Facilities Control	<ul style="list-style-type: none"> • Assurance that water can be stored in wet or normal years, and withdrawn in dry years or emergency conditions. • Metropolitan may own or lease facilities from local entities. 	<p>Managed to ensure maximum protection of the basin water supply. If demands exceed storage, then AGWA member has discretion with whom to contract. Operations subject to control of AGWA member.</p>	<ul style="list-style-type: none"> • Basin managers have expressed a desire to make use of conjunctive use facilities for collateral purposes such as additional basin management, or for groundwater cleanup activities. However, use in this manner may limit extractions.
Storage Management	<ul style="list-style-type: none"> • Established on a case-by-case basis and defined in storage contract. • Total amount to meet IRP requirements. • Storage or payback by (1) Direct spreading, (2) Direct injection, (3) In-lieu, (4) Transfer of previously stored water. • Water delivered from storage account deemed equivalent to surface water deliveries. • Requires mechanism for proof that water withdrawn exceeds what normally would have been produced. 	<ul style="list-style-type: none"> • Established on a case-by-case basis and defined in storage contract. • Metropolitan to maintain a positive balance. Negative balance permitted by AGWA member agreement and assurance of timely replacement. 	<ul style="list-style-type: none"> • Verification of dry year production is an important issue to Metropolitan, and is integral to the Seasonal Storage Service program.
Overall Basin Management/Operations	<ul style="list-style-type: none"> • Modification of management or operations to ensure program benefits to producers and Metropolitan. • Overall plan of operation subject to approval by basin manager. 	<ul style="list-style-type: none"> • Responsibility of AGWA members. • Consistency with applicable judgment(s), statutory and/or regulatory requirements. 	

C-015442

Table 2
Conjunctive Use Issues
Comparison of Metropolitan and AGWA Positions

Issue	Metropolitan Requirements/Position	AGWA Requirements/Position	Comments
Water Quality	Groundwater produced and input to Metropolitan's system meets EPA, DHS, and Metropolitan standards. Acceptable to downstream users.	a basin judgment. Imported water quality not to degrade basin supplies, and meet or exceed Basin Plan requirements and objectives.	<ul style="list-style-type: none"> • A major problem may be developing as groundwater contamination may reduce storage availability.
Groundwater Basin Export	Ability to export pumped groundwater supplies outside of basin boundaries so as not to limit use to overlying demand.	<ul style="list-style-type: none"> • Established on a case-by-case basis. • Some basins require export under groundwater cleanup production. 	
Indemnity/Disputes	<ul style="list-style-type: none"> • Liability to be clearly defined. Willing to take responsibility for its own actions. 	<ul style="list-style-type: none"> • Metropolitan responsible for own actions. Indemnity for all claims, with hold harmless provisions. • No adverse impacts from Metropolitan operations. • Ready, efficient means for producers to assert claims. • Efficient procedure to address disputes between AGWA member and Metropolitan. • Mechanism for Metropolitan to react to harm. For example, alternative water supply be made available. 	<ul style="list-style-type: none"> • Risk allocation, especially for consequential or unforeseen damages, remains a significant barrier to implementation of conjunctive use.

Table 2
Conjunctive Use Issues
Comparison of Metropolitan and AGWA Positions

Issue	Metropolitan Requirements/Position	AGWA Requirements/Position	Comments
Early Termination	<ul style="list-style-type: none"> • If no transactions for 5 year period, and no water in storage account, basin manager may request early termination of agreement. Basin manager must pay depreciated costs of facilities. • Basin manager may choose to terminate agreement at any time. Basin manager must repay escalated capital costs of facilities plus 20 percent penalty, and firm water rate for any water remaining in storage. • Metropolitan may terminate at any time. Facilities shall be turned over to basin manager or dismantled. Payment terms for water in storage subject to negotiation. • Agreement terminated if basin manager or Metropolitan is prevented from performance of any material obligation under agreement. Basin manager will pay Metropolitan firm water rate for water in storage, and fair market value of facilities. 	<ul style="list-style-type: none"> • No stated position, although these points seem to be generally agreed to. 	<ul style="list-style-type: none"> • Metropolitan has asserted that capital investments must provide regional benefits to all member agencies. Early termination clauses not only protect parties to the agreement, but Metropolitan's other member agencies, as well.
CEQA Compliance	Appropriate lead agency to be determined.	At option of AGWA member, Metropolitan's responsibility including permits and mitigation.	
Accounting and Record Keeping	Basin manager responsibility.		