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Arizona Society of Professional Engineers  
1992  
Outstanding Engineering Project of the Year

For

Facilities Modifications at Squaw Peak  
Water Treatment Plant  
Due to Arizona Canal Diversion Channel  
Construction

A118.973



# Arizona Society of Professional Engineers

A state society of the National Society of Professional Engineers

24 W. Camelback Road  
Suite M  
Phoenix, Arizona 85013-2530  
Phone: (602) 264-4871

## 1992 ASPE "OUTSTANDING ENGINEERING PROJECT OF THE YEAR" AWARD

Firm Name: JOHN CAROLLO ENGINEERS  
(If a joint venture between two or more engineering firms, list for award and recognition purposes.)

Name of Individual Contact within Firm: George E. Shirley, P.E., Partner  
3877 North 7th Street, Suite 400; Phoenix, AZ 85014 (602) 263-9500  
(Address) (City, State, Zip) (Phone)

Name of Project: Facilities Modifications at Squaw Peak Water Treatment Plant Due  
To Arizona Canal Diversion Channel Construction  
Address: 6202 North 24th Street; Phoenix, AZ 85016

Owner's Name: Flood Control District of Maricopa County \*\*\*  
Address: 2801 West Durango Street; Phoenix, AZ 85009

\*\*\*Squaw Peak WTP Owned by the City of Phoenix, Water Services Dept. 455 N. 5th St.  
Client's Name (If different from Owner): Same Phoenix, AZ 85004

Names & Locations of other Consultants/Architects: Thomas-Hartig; 7031 W. Oakland St;  
Chandler, AZ; 85224 DNA; 340 E. Willetta Street; Phoenix, AZ 85004

### ALL ENTRY MATERIAL MUST INCLUDE THE FOLLOWING:

1. Role of the firm in the project.
2. Role of other consultants.
3. Brief project description (300 words or less) - including type of project, project size and total cost as related to original and/or proposed alternate solution.
4. Client requirements (limit to 10 major considerations).
5. Description of unique or unusual design features and solutions which indicate engineering excellence, as distinguished from normally high standards of engineering competence (list by heading using outline form and limit descriptions to 10 words per heading).
6. How well the project is meeting the needs of the client and the conditions of design (performance evaluation and significance to client and profession).
7. A description of the scope of the project (up to two pages double spaced). This description should reflect those factors requested in the above and should clarify intent as well as unique or original aspects of the particular project (this will be used for press release information).
8. A minimum of four different and original 8" x 10" photographs, or 35 mm slides (either color or black and white) to be used for publicity purposes, if project wins.

**RETURN completed form to: David Anderson, P.E., Awards Chairman, 2541 E. Blackledge, Tucson, AZ 85716 NO LATER THAN MAY 15TH to be considered for the Award.**

The Awards Committee will meet to select the winners, which will be announced just prior to the Annual Meeting in Anaheim, California. (June 17 - 21, 1992).

**Arizona Society of Professional Engineers**  
**1992 Outstanding Engineering Project of the Year Award**  
**Name of Project: Facilities Modifications at Squaw Peak Water**  
**Treatment Plant Due to Arizona Canal Diversion Channel Construction**

1. **Role of Firm** - John Carollo Engineers (JCE) was retained by the Flood Control District of Maricopa County (FCDMC) to evaluate the impacts of construction of the ACDC on the Squaw Peak WTP and to design the relocation of impacted utilities and facilities. The key role of the firm in this project was to work in close coordination with the FCDMC, the City of Phoenix (COP), the Salt River Project, and the Corps of Engineers. JCE provided study, design and construction services for the utilities relocation, the presedimentation basin bypass, and finally the new preliminary treatment facilities for the Squaw Peak WTP. The project was required by the construction of the ACDC which is now being completed to intercept storm water runoff from north of the Arizona Canal and to prevent flooding.

2. **Role of Other Consultants** - JCE hired, as subconsultants, Thomas-Hartig for geotechnical investigation and DNA, Inc. for site survey. To design the pretreatment facilities, JCE has worked in concert with Malcolm-Pirnie Consulting Engineers, designers of the raw water pump station and other treatment plant upgrades, Brown and Caldwell Consulting Engineers, who designed the solids treatment system, and the Corps of Engineers, in charge of design and construction of the ACDC. In addition, Bollinger and Associates Architects are designing the new City of Phoenix Water Services Building adjacent to the site.

3. **Brief Project Description** - The Flood Control District of Maricopa County developed a project to construct a channel (Arizona Canal Diversion Channel) to intercept flood waters on the north side of the Arizona Canal across the northern part of Phoenix. The project parallels the Arizona Canal and extends from near 48th Street west to the New River. One of the major constraints to this project was the City of Phoenix Squaw Peak Water Treatment Plant (WTP), situated on the north side of the Arizona Canal between 24th Street and the Squaw Peak Freeway Corridor.

Facilities of the WTP located within the proposed corridor for the ACDC included the water intake facilities, a presedimentation basin, and six major pipelines sized 36-inch to 66-inch diameters. Preliminary planning had indicated relocation of a portion of the Arizona Canal might be required to minimize impacts to the WTP.

The City of Phoenix had recently completed a study which had recommended a major rehabilitation of the 40-year old WTP, to include a new intake facility, upgrades to the presedimentation basin and raw water pump stations, as well as new solids handling facilities. This rehabilitation project was planned for construction a few years after the ACDC was completed.

The FCDMC selected John Carollo Engineers to evaluate alternative locations for the ACDC through the WTP site, identify utility and facility relocations required, design the utility relocations, and assist in coordination, or perform design, of WTP facility relocations.

The overall project and key features are shown on the following site plan.

The project consists of three phases:

- Phase I - Study of Utilities Relocations for ACDC at Squaw Peak WTP
- Phase II - Design and Construction of Utilities Relocation (May 1990 to February 1991) with a construction cost of \$1,754,961
- Phase IIA - Design and construction of the Presedimentation Bypass (October 1990 to April 1991), with a construction cost of \$677,272
- Phase III - Design and construction services of Pretreatment Facilities (scheduled for completion by December 1994) for approximately \$6,900,000 in construction costs.

Scheduling elements are shown on the following Master Schedule.

#### **4. Client Considerations**

##### Overall Considerations:

- a. Identify the best location for the ACDC through the WTP site, along with associated utility relocations and requirements for new or modified WTP facilities.
- b. Develop designs and schedule construction in consideration of ACDC project and to minimize impact on WTP operation.

## MASTER SCHEDULE

	1989	1990	1991	1992	
<b>PHASE I</b>					
STUDY UTILITY RELOCATIONS	▬				
<b>PHASE II</b>					
DESIGN UTILITY RELOCATIONS		▬			
CONSTRUCT UTILITY RELOCATIONS		▬			
DESIGN BYPASS		▬			
CONSTRUCT BYPASS			▬		
<b>PHASE III</b>					
DESIGN PRETREATMENT FACILITIES			▬		
CONSTRUCT PRETREATMENT FACILITIES				▬	ONGOING
DESIGN ACDC (Corps of Engineers)	▬				
CONSTRUCT ACDC (Corps of Engineers)		▬			
CONSTRUCT ACDC (THRU PLANT SITE) (Corps of Engineers)			▬		

- c. Manage project activities within a highly restricted and congested site, adjacent to an upscale residential neighborhood.

Utilities Relocations:

- d. Develop a design to consider excavation in hard rock for conventional crossings under drainage channel vs. exposed crossings bridging above the future ACDC channel.
- e. Construction must be readily accomplished within limited WTP outages during canal dry-ups or during low water demand periods.
- f. Design and construct two vehicular bridges for access to existing and proposed WTP facilities on the south side of the ACDC.

Bypass Channel:

- g. Design and construct a bypass channel system that will allow operation of the WTP without the presedimentation basin when canal water quality is acceptable. Bypass channel will allow demolition of the existing presedimentation basin during construction of the ACDC. Bypass channel must be designed to allow operation with existing canal intake and raw water pump stations, and also become a component of the new pretreatment facilities of the WTP.

WTP Pretreatment Facilities:

- h. Include in design all features required by the City of Phoenix for preliminary treatment: canal intake, mechanically cleaned bar screens, gate structures, flow metering, chemical feed and premixing facilities, sedimentation basin with sludge collection system, and solids pumping station.
- i. Coordinate design with planned improvements to WTP being designed by other consultants, with intent to package all WTP improvements in a single construction contract.

5. **Description of Unique or Unusual Design Features and Solutions Which Indicate Engineering Excellence:**

- Intergovernmental Agency Cooperation Was Key to Success. During all phases of the project, intergovernmental agency cooperation was highly important. The consulting

engineer was a major facilitator in achieving the requisite communications necessary for multiple agency cooperation regarding cost sharing, scheduling of work and identification of design and construction responsibilities. The two major participants, FCDMC and the City of Phoenix, negotiated a formal agreement regarding such issues as right-of-way for the ACDC and sharing of costs for engineering and construction. Other agencies, such as the Salt River Project and the Corps of Engineers, also were involved, as well as various departments within the City of Phoenix.

- Sequential Project Relationships Were Involved. The requirements of the project, as developed in the Phase I - Study of Utilities Relocation for the ACDC at Squaw Peak WTP, were quite broad and enabled the consulting engineer to look at all aspects of the proposed ACDC, as well as the proposed WTP improvements. It became clear that there was a series of project activities to be developed that ranged from the immediate issue of limited utility relocations to the broader locating of the ACDC itself, as well as designing major WTP modifications. The consulting engineer was able to identify these activities, achieve agreement with the involved agencies, and get the recommendations implemented in a timely manner, through both design and construction phases of the series of related projects.
- Designed to Satisfy Requirements of Multiple Agencies. The consulting engineer performed design work which addressed requirements from the FCDMC, City of Phoenix, Salt River Project and the Corps of Engineers. These requirements involved the immediate features of concern of operation of the WTP and the relocated utilities (COP), site access to the WTP (COP), operation and maintenance of the ACDC floodway (FCDMC), canal operation (SRP), electric power system (SRP), recreational use of canal corridor by the public (COP), and construction adjacent to ACDC construction (COE).

- Site is Highly Confined and Congested. Design considerations for the project had to address the tight constraints of a small site which contained major operating WTP systems, an SRP canal and a proposed drainage way (ACDC). The site is surrounded by an upscale Phoenix residential neighborhood. The site has difficult geotechnical conditions of bedrock close to grade. Multiple construction projects and activities by separate contractors were planned to occur within the same general time period.
- Utilities Relocations Were Constructed Above Grade. Because of anticipated difficulty and expense to excavate in bedrock conditions to relocate pipelines under the proposed ACDC, the concept of above grade bridging of the ACDC was implemented. The ACDC contractor was able, with heavy equipment, to readily remove the rock materials for his project and was able to work beneath the relocated pipelines. Access bridges were also constructed on grade, with the ACDC contractor excavating underneath for his project.

6. **Performance Evaluation**

- Major floodway construction is nearing completion per planned schedule.
- WTP operation has been virtually unaffected by relocations of pipelines or temporary elimination of presedimentation treatment and operation using bypass system.
- Construction of utilities relocations and bypass facilities occurred on schedule and with minimal change orders.
- Operation of SRP canal and electric facilities have been unaffected by these projects.
- The City of Phoenix has completed design of major modifications and upgrades to the Squaw Peak WTP as scheduled and construction will commence shortly.
- Projects constructed to date were completed without controversy or detrimental impact on surrounding residential communities.
- This project clearly demonstrates how multiple agencies can join forces with a consulting engineer to accomplish goals in the best interest of all parties while remaining a good neighbor to the surrounding community.

7. Scope of Project - The Flood Control District of Maricopa County developed a project to construct a channel (Arizona Canal Diversion Channel) to intercept flood waters on the north side of the Arizona Canal across the northern part of Phoenix. The project parallels the Arizona Canal and extends from near 48th Street west to the New River. One of the major constraints to this project was the City of Phoenix Squaw Peak Water Treatment Plant (WTP), situated on the north side of the Arizona Canal between 24th Street and the Squaw Peak Freeway Corridor.

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The City of Phoenix had recently completed a study which had recommended a major rehabilitation of the 40-year old WTP, to include a new intake facility, upgrades to the presedimentation basin and raw water pump stations, as well as new solids handling facilities. This rehabilitation project was planned for construction a few years after the ACDC was completed.

In March 1989, the Flood Control District of Maricopa County (District) contracted with John Carollo Engineers (Engineer) to perform a preliminary study (Phase I Services) of utility relocations required for construction of the Arizona Canal Diversion Channel (ACDC) at the City of Phoenix (City) Squaw Peak Water Treatment Plant (WTP) site. In the June 1989 Predesign Services Report, the recommended alternative was the "North Location of the ACDC". This recommendation, accepted by both the District and the City, required construction of the new ACDC through the existing WTP preliminary sedimentation basin.

Phase II services commenced in September 1989 to develop engineering design of utilities to be relocated from the alignment of the ACDC within the WTP site. Six major pipelines - ranging in size from 36 inches to 66 inches in diameter - were affected. These lines include two raw water force mains, two gravity drain lines, and two finished water pipelines. The design services also included the relocation of electrical duct banks and miscellaneous plant piping and the design of two vehicular access bridges. As part of this service, final design criteria and locations for new preliminary treatment facilities were prepared.

Due to the presence of hard rock, JCE designed the pipelines to span the channel. This approach had the added advantage of avoiding the use of an inverted siphon for the gravity drain lines. The pipe crossings vary from 70 to 80 feet. Each steel pipe is supported by reinforced concrete caissons drilled in bedrock at each end. The pipes rest on a concrete pad

and saddle on the top of each caisson and allowed to move horizontally for pipe expansion and contraction.

JCE designed two types of access bridges for the project. One is a cast-in-place post-tensioned bridge; the second utilized existing precast box girders, which the FCDMC had previously used on past ACDC construction segments.

To provide continuous water service to businesses and residents served by the 140 mgd Squaw Peak Plant, close coordination between the JCE team, the City of Phoenix, the FCDMC, and the Salt River Project was essential. Actual relocation of the pipelines took place during the short winter dry-up period when the canal is shut down for routine maintenance and the water demand is lower.

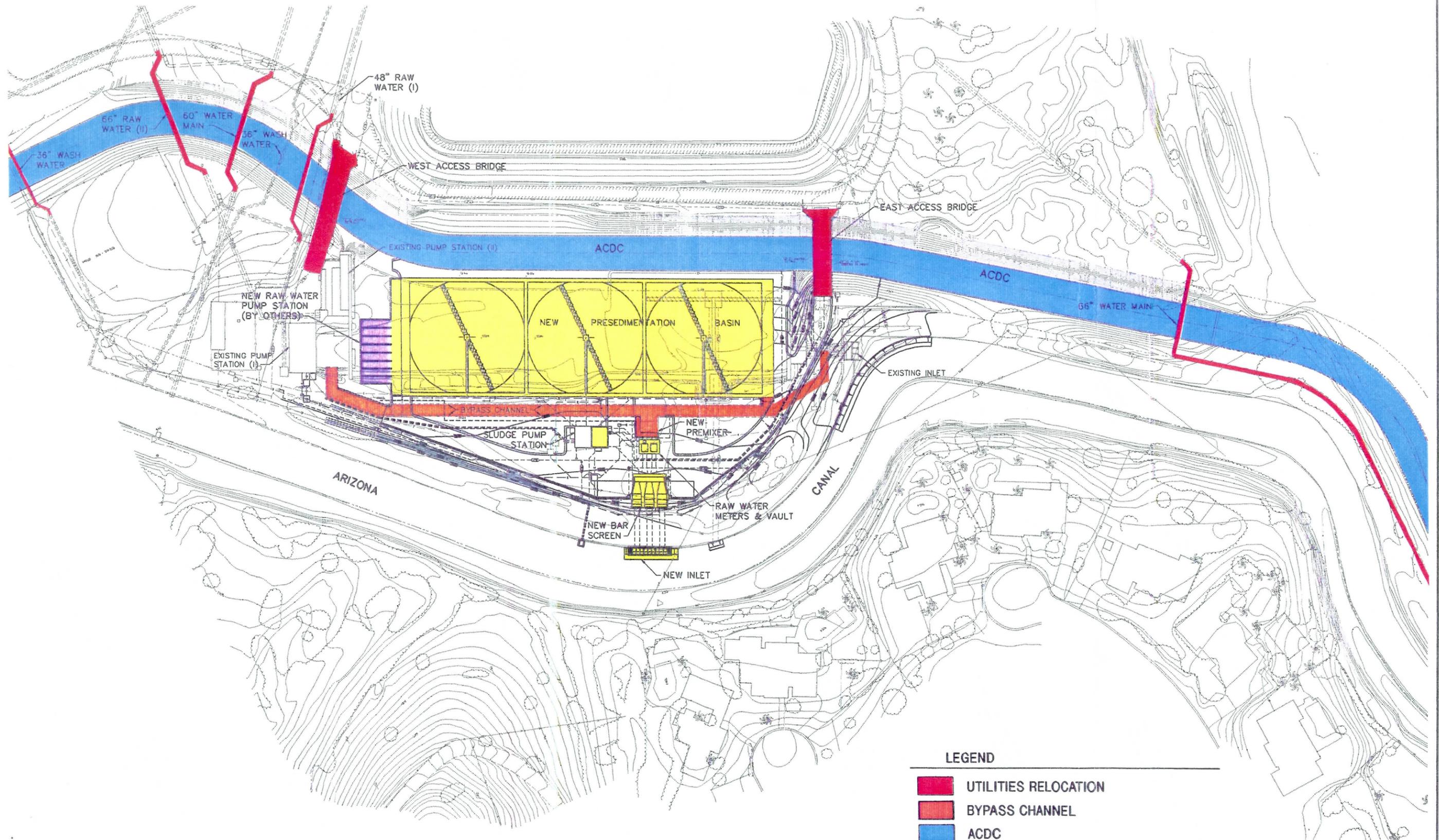
The major component of the Phase IIA services included the design of a bypass channel to connect the existing plant inlet with the existing raw water pump station. This bypass was necessary so that construction of the ACDC could proceed through the existing presedimentation basin.

The bypass was designed as a 12-foot by 12-foot box channel. Provisions were made so that the bypass could serve as both an interim and ultimate bypass after construction of the new preliminary treatment facilities are completed. JCE performed a hydraulic analysis as part of the design in order to match the existing hydraulic profile with the new pretreatment facilities and new raw water pump station. The bypass has been in service since April 1991, and will continue to be utilized until after construction of the new presedimentation basin is completed in December 1994.

Phase III design services were recently completed. This phase involved the design of the new preliminary treatment facilities. Included within the design are the following new structures: canal inlet structure, bar screens, raw water metering, premixing, presedimentation basin, and sludge pump station.

Close coordination was required during the phase with two other consulting firms performing major design improvements concurrently at the plant. At the onset of design, the City expressed the desire to package all three designs together when the designs were completed so that a single construction contract could be awarded. Construction will begin shortly on these features. The construction will be completed in December 1994.

**The significance of this engineering effort is the team's success in overcoming numerous constraints inherent in the nature of this project. These were: Involvement of and agreement among multiple agencies; outside scheduling constraints, highly urbanized setting, and physical constraints of the site.**



**LEGEND**

- UTILITIES RELOCATION
- BYPASS CHANNEL
- ACDC
- PRELIMINARY TREATMENT FACILITIES
- RAW WATER PUMP STATION (BY OTHERS)

**SITE PLAN**  
**SQUAW PEAK WATER TREATMENT PLANT - PRELIMINARY TREATMENT FACILITIES**



66" Finished Water Pipeline Crossing ACDC



New Precast Bridge Over ACDC with Existing Plant Intake Facilities in Background



66" Finished Water Pipeline Crossing ACDC



New Post-tensioned Bridge Over ACDC & Relocated Pipelines