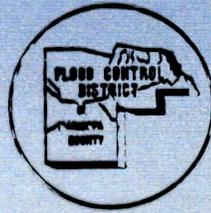
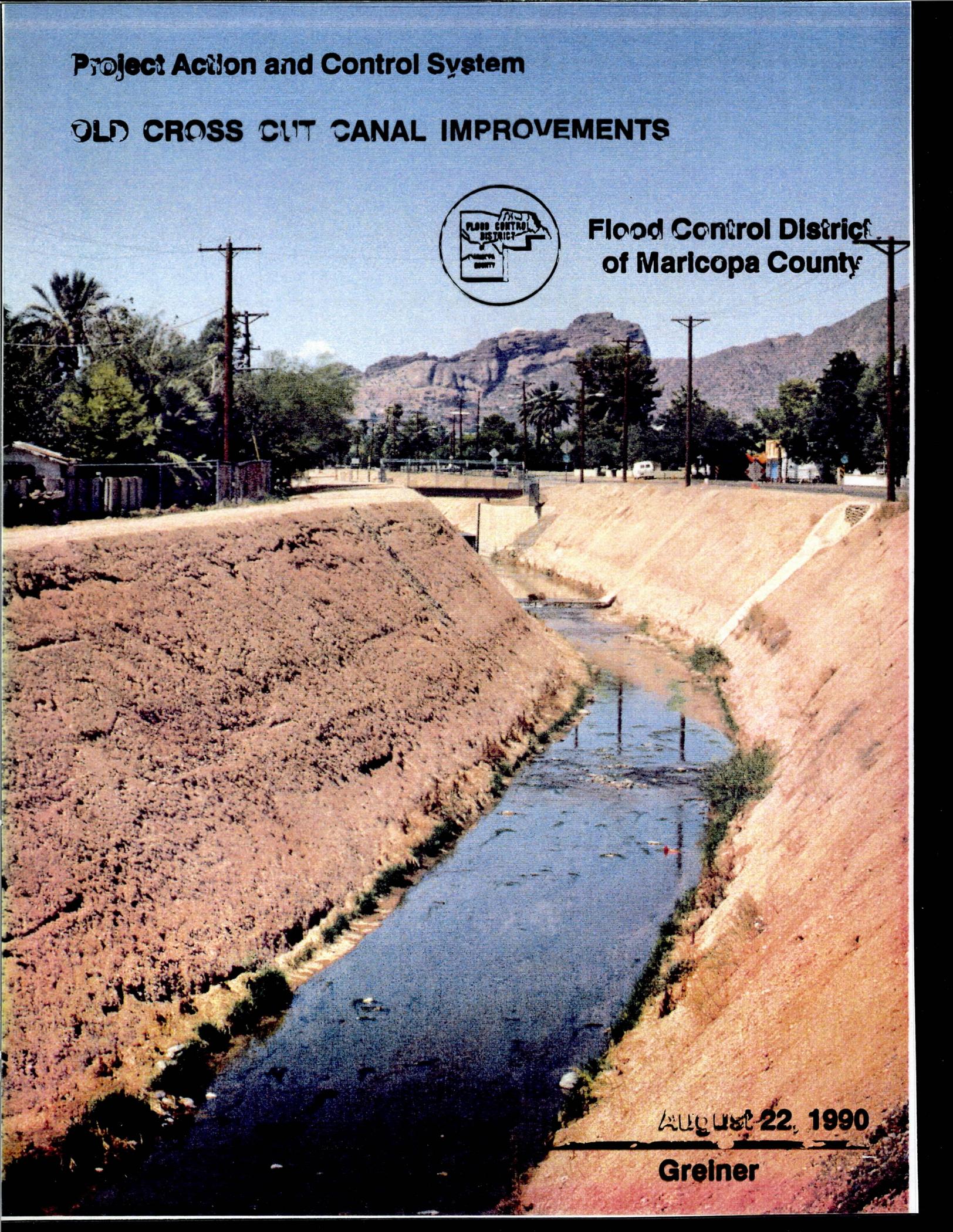


Project Action and Control System

OLD CROSS CUT CANAL IMPROVEMENTS

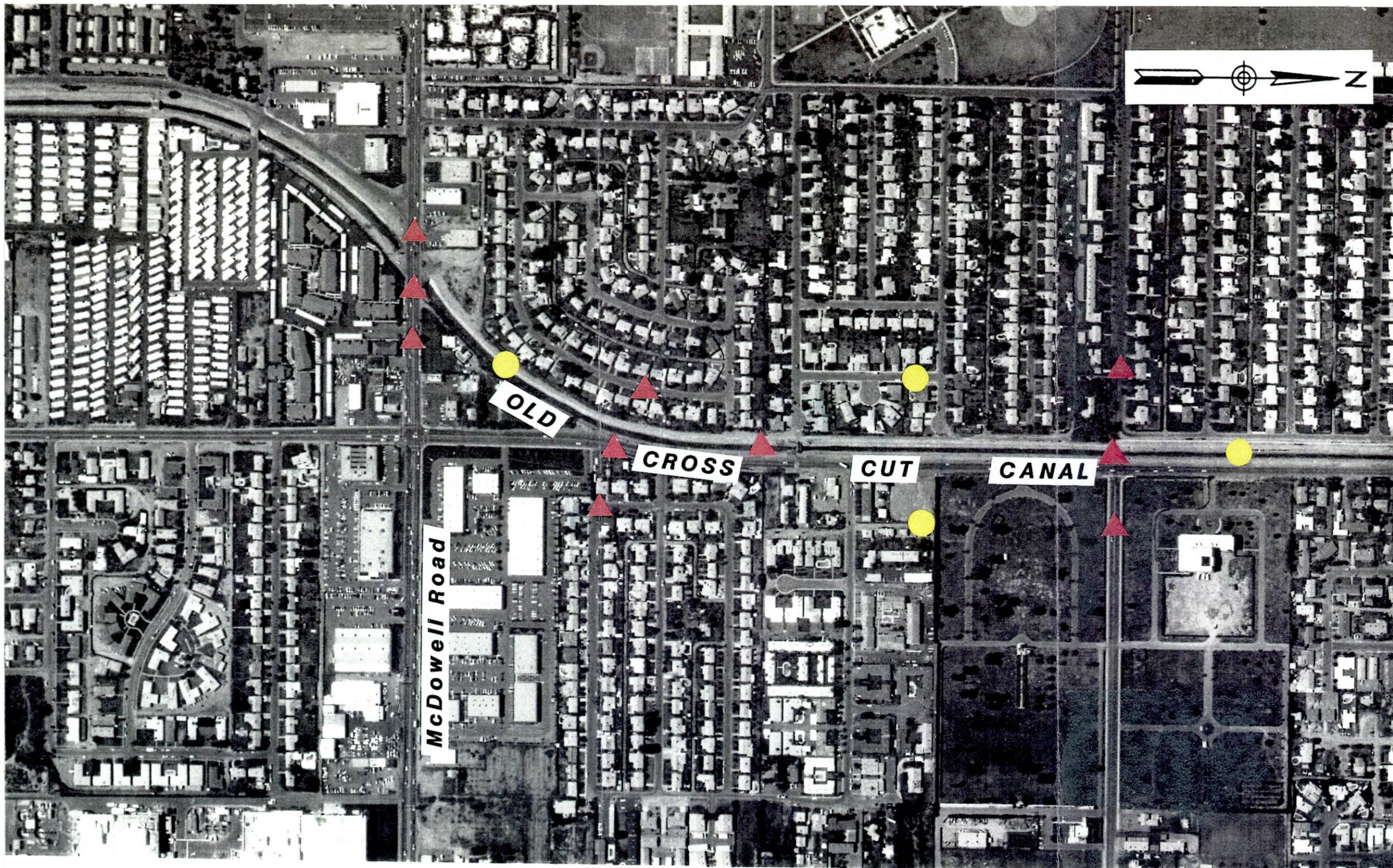


**Flood Control District
of Maricopa County**



AUGUST 22, 1990

Greiner



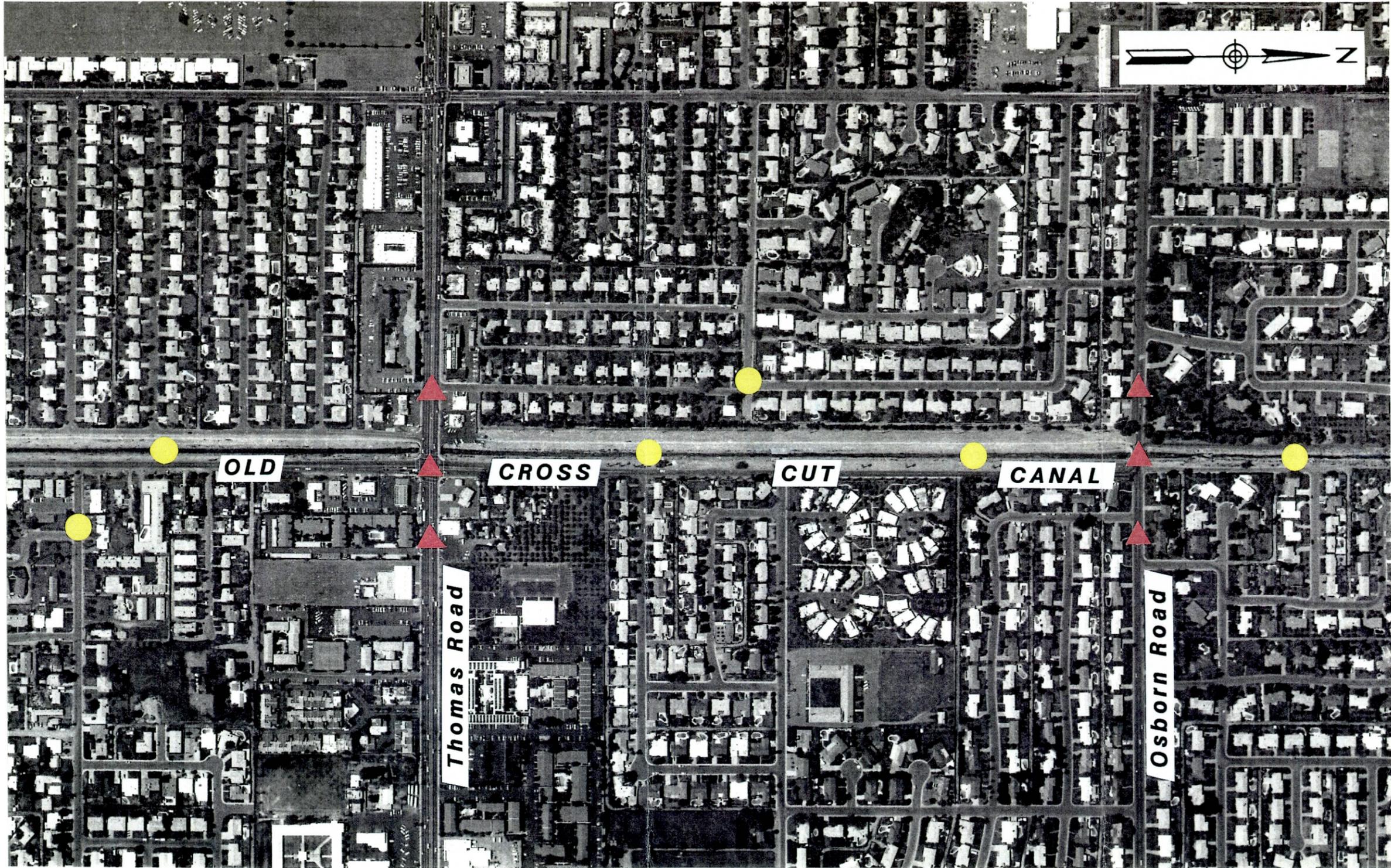
LEGEND

▲ *Horizontal & Vertical*

● *Vertical only*

AERIAL PHOTO CONTROL DIAGRAM

OLD CROSS CUT CANAL



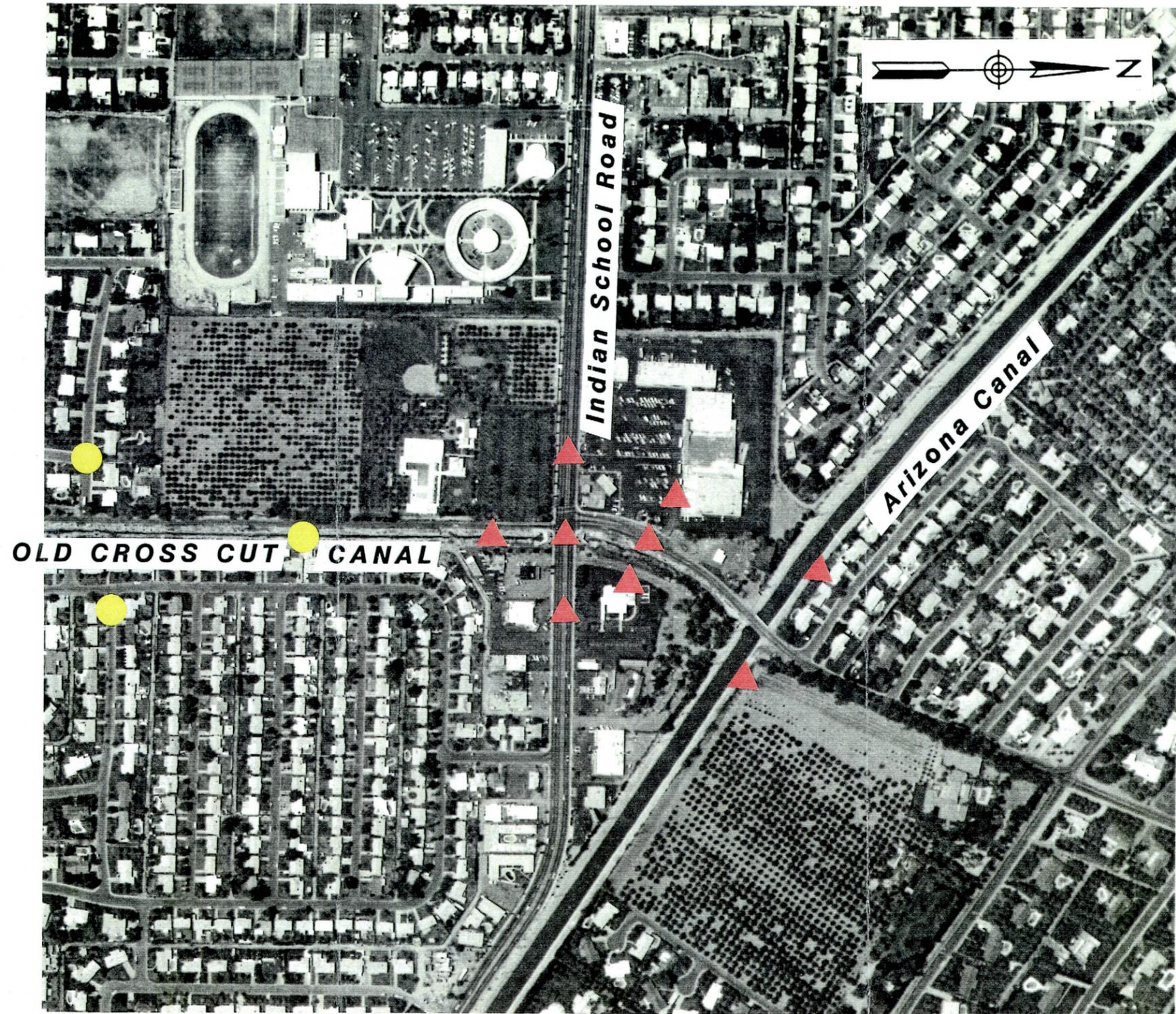
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AERIAL PHOTO CONTROL DIAGRAM

OLD CROSS CUT CANAL

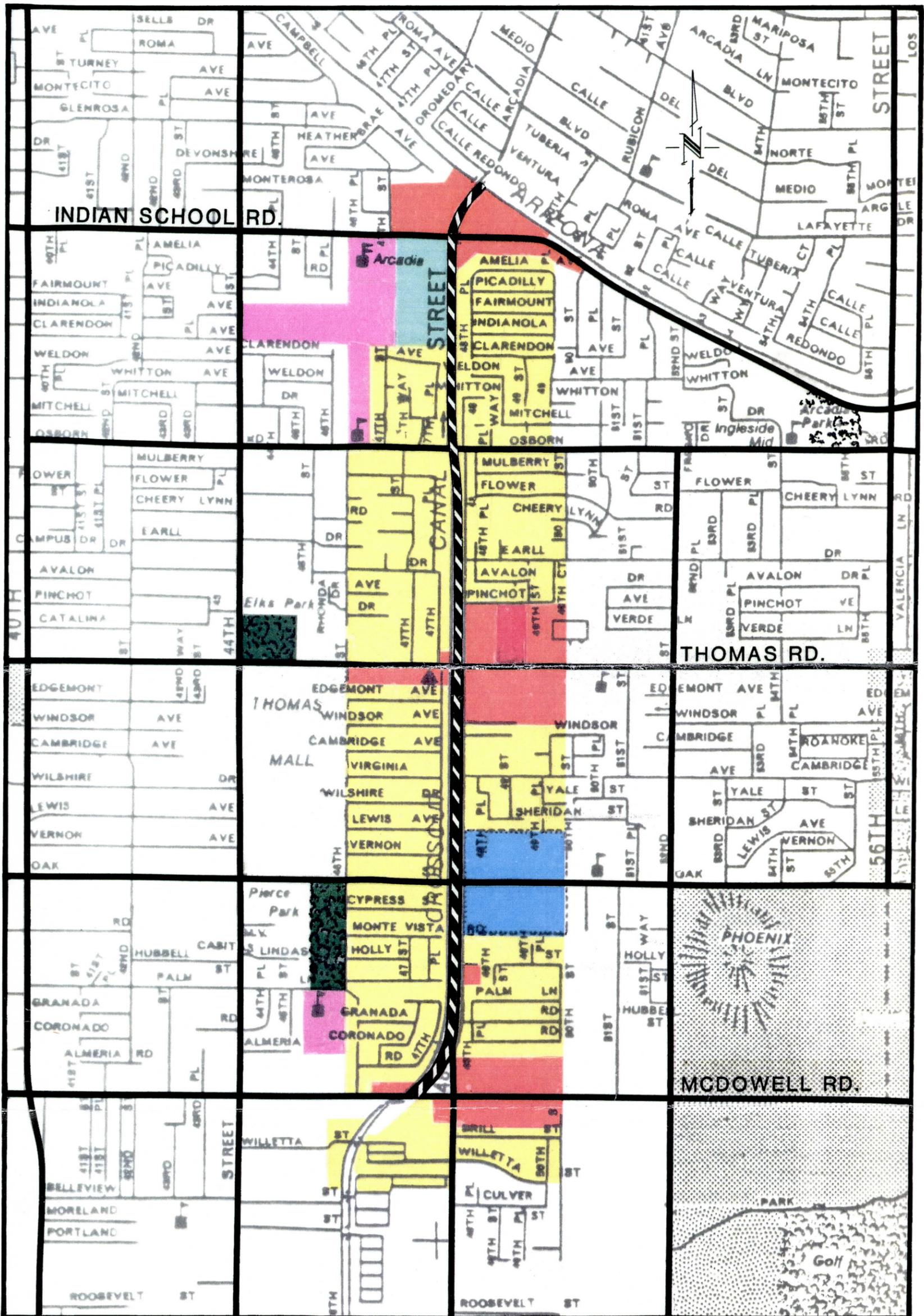


LEGEND

- ▲ *Horizontal & Vertical*
- *Vertical only*

AERIAL PHOTO CONTROL DIAGRAM

OLD CROSS CUT CANAL



LEGEND

- OLD CROSS CUT CANAL**
- RESIDENTIAL**
- COMMERCIAL**
- RECREATIONAL**
- SCHOOL & LIBRARY**
- CHURCH**
- PARK**
- CEMETERY**

**OLD CROSS CUT
CANAL ALIGNMENT
CITY OF PHOENIX**

EXISTING LAND USES



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Draft Scope of Work

Old Cross Cut Canal Flood Control Improvements
(North of McDowell Road to North of Indian School Road)

FCD 90-23

I. Purpose and General Description

The purpose of this project is to prepare plans and specifications for construction of improvements to the existing Old Cross Cut Canal, from just south of the Arizona Canal (north of Indian School Road) to McDowell Road.

The improvements consist of replacement of the existing open channel with a covered section. The covered section shall be designed to accept existing inflows without causing diversion of drainage, and to convey flows from a 25 year storm using hydrology results from a study prepared by the Corps of Engineers. The design shall accommodate 3000 cfs north of Indian School Road and allow for the connection of a future drainage structure to convey 2000 cfs under the Arizona Canal from the watershed north of the canal. The design shall accommodate 4100 cfs at the connection to the existing culverts at McDowell Road. The new section is to be designed to stay within existing Salt River Project (Bureau of Reclamation) rights of way. The project also includes preparation of plans and specifications for relocations of conflicting water and sewer lines, traffic control provisions and coordination of the relocation of conflicting utilities.

II. Project Tasks

- Task 1. Acquire and review existing engineering studies, planning studies, drainage reports, drainage improvement plans, street improvement plans, topographic maps, right of way drawings, soils reports and utility drawings within the Old Cross Cut Canal corridor.
- Task 2. Provide field survey services within the Old Cross Cut corridor to prepare topographic base maps at 1"=20' scale with one foot contour intervals. Horizontal and vertical control shall be on Phoenix datum, but shall include multiple ties to Salt River Project datum. The base maps shall be prepared on Version 10 of AutoCad and the files provided to the District on floppy disks. If the topographic drawings are prepared from aerial survey, ground survey shall be performed to provide ties to existing utilities, structures and landscaping features to within 1/10th of a foot accuracy horizontally and vertically.

- Task 3. Prepare and submit a report for review and approval to the District, City of Phoenix and Salt River Project that includes:
- a. Tabular summary of all reference data collected and reviewed in Task I.
 - b. Summary of hydrology review and drainage considerations.
 - c. Horizontal and vertical alignment considerations.
 - d. Drainage inlet locations and sizes.
 - e. Hydraulic design considerations.
 - f. Size and type of structural section(s) recommended.
 - g. Utility conflicts and resolutions.
 - h. Traffic considerations at Indian School Road, Thomas Road and any other traffic conflicts.
 - i. Constructibility concerns.
 - j. Right of way considerations.
 - k. Impacts of proposed future improvements (park improvements, street improvements, storm drain improvements) on concentration points of flows, inlet sizes and locations.
 - l. Preliminary construction cost estimates, and cost estimates for comparison of alternatives as required.
 - m. Operation and maintenance considerations.
 - n. Recommendations.

Task 4. Incorporate comments from the review agencies into the report.

Task 5. Provide soils investigations and a soils report.

Task 6. Prepare and submit 30% plans for the approved alternative. The consultant will coordinate the relocation of all affected utilities. Details of items to incorporate in the 30% submittal follow.

Task 7. Prepare 90% plans and specifications. A detailed description of this submittal follows.

Task 8. Incorporate comments and submit all documents ready for advertisement.

During the entire design process, close continual coordination will be required with the District, the City, Salt River Project and any other affected parties. The drainage design must be closely coordinated with the City's consultant developing the park and the improved street transportation features.

III. Specifications and Standards

1. Structural design will be in accordance with current AASHTO Specifications as interpreted by the Flood Control District. Street crossings shall be designed to accommodate HS20-44 loading. Calculations will be based on service loads and the working stress method.
2. Construction specifications shall be in accordance with MAG Specifications as supplemented by the City of Phoenix.
3. Construction Special Provisions prepared by the Consultant shall be numbered, named and sequenced in the same order as MAG Specifications. Each Construction Special Provision Item referenced by the Consultant shall state whether it replaces all or part, or is added to the corresponding MAG Section.
4. The Items in the Engineer's estimate shall conform exactly to the Bidding Schedule Items. Item numbers in the Bidding Schedule shall reference MAG Specification Section Numbers.
5. The Consultant shall provide the Construction Special Provisions section of the bidding documents, the Engineer's Estimate, and reproducible drawings. The District shall provide all other bidding documents (Invitation, Bid Form, Certificate of Insurance, Bonds, etc.) and the District shall assemble the documents into a booklet, ready for reproduction.
6. Drawing sheet sizes shall be 24" by 36".
7. All lettering on drawings shall be plain, simple and legible. "Architectural" style lettering on drawings will not be accepted. Mechanical lettering (LeRoy or equivalent) shall be used when preparing cover sheets. Freehand lettering, with non-reproducible guidelines, may be used for all other purposes. AMES lettering guide, size number 4 or larger shall be used for all dimensions and notes, number 5 or larger for subtitles such as Plan, Elevation, Section, etc.; and number 7 or larger for main titles. Vertical lettering shall be used for main titles and title block data. No lettering shall be smaller than number 4.
8. Signature blocks required on the plans by other agencies shall be included on the plans by the Consultant as approved by the District. The Consultant shall be responsible for obtaining approval signatures.

9. Cover sheets shall be provided to the Consultant by the District. The Consultant shall fill in the Project Title, Project Number, add approval blocks as required and shall provide a table of contents listing each of the enclosed sheets. The District will provide the Consultant with a copy of a standard title block, to be reproduced and placed on the bottom right hand corner of each sheet. The Consultant shall initial and date all of the appropriate blanks on each title block (design, check, etc.). Title block information required on the plans by other agencies shall be provided as approved by the District.
10. The plans shall include a summary table of concrete quantities for each concrete item. The quantities in the table shall add up to the bid item quantities for the appropriate class and strength of concrete (i.e. Class "A", Class "AA").
11. Street section design criteria shall be as required by the City of Phoenix.
12. All aspects of traffic control design will be in accordance with City of Phoenix standards and will be subject to approval by the City.
13. Design of the relocation of utilities will be in accordance with the standards of the appropriate utility owner and will be subject to the approval of the utility owner and the District. In particular, sewer and water drawings shall conform to City of Phoenix requirements.
14. In-situ soils testing will be in accordance with NAVFAC DM-7.1, Soil Mechanics Design Manual 7.1, May 1982. In addition, standard penetration testing will be performed with the borehole maintained full with water during the driving of the sampler. All test borings for the project should extend beyond the significant zone for proposed foundations. If the auger meets refusal at a lesser depth, then at least one hole should be extended through the significant zone by any means unless bedrock is hit.
15. Allowable soil bearing values and lateral load capacities will be determined in accordance with NAVFAC DM-7.2, Foundations and Earth Structure Design Manual 7.2, May 1982, and in accordance with current AASHTO Specifications as interpreted by the District. In case of conflict between AASHTO and NAVFAC specifications, AASHTO specifications will govern. The effect of future

elevated moisture content or saturated condition of the soil due to potential future seepage from the drainage structure should be considered and included in the soils report. The maximum allowable soil bearing values and recommended in sections 1.4.2 and 1.4.4 of AASHTO will not be exceeded without prior consultation with the District.

16. Plans shall be based on the City of Phoenix datum, however, equations for Salt River Project datum shall be shown on the plans.
17. The work of any sub-consultants utilized by the prime Consultant for this contract (i.e. soils reports, survey data, civil design, structural design) should be reviewed by the prime Consultant for compliance with this scope of work and these specifications prior to submittal for review by the District. In particular, all calculations sheets shall be initialed and dated by both a designer and a checker.

IV. Additional Work Item Descriptions

- A. The consultant shall appoint a Project Manager who shall be familiar with the entire design project and be aware of the progress of each phase of the project. The Project Manager will be the point of contact for the District. The Project Manager shall submit to the District a project status update on the 1st of each month. A "Project Update Form" is attached.
- B. Development of Project Criteria
 1. Locate and review existing street, utility and right-of-way plans.
 2. Contact appropriate City departments and utility owners to establish design criteria and scheduling of relocations.
 3. Perform soils investigations and prepare a geotechnical report for foundation and pavement design. The layout of the proposed soils borings should be submitted to the District for approval prior to the commencement of the field work. Calculations contained in the soils report shall be initialed and dated by both the designer and a checker.

4. Establish requirements for public and private access within the project limits and review traffic control requirements for the construction phase.
5. Identify any additional rights-of-way necessary for the construction of the project and report them immediately to the District. The District will prepare written legal descriptions and will acquire necessary rights of way based on drawings outlining the required right of way, provided by the Consultant.
6. The Consultant shall submit two copies of the field survey plans and notes and two copies of the geotechnical report to the District. The geotechnical report will be reviewed by the District.
7. The Consultant shall not proceed with the final design and preparation of plans until after receipt of approval of the recommended alternatives from the District, the City of Phoenix and Salt River Project.

C. First Draft Engineering Plans (30% plans)

1. Prepare preliminary full size plans, which show the plan, profile, cross-section, foundation layout and approximate size of structural members; the roadway plan, profile and cross-section; the utility rerouting; and the detour(s). Drawings shall be on sheet size 24 by 36 inch. Submit copies of the preliminary plans to the District and other affected agencies for review. The Consultant will solicit and document comments from other affected agencies and submit them to the District.
2. Submit two copies of a preliminary construction cost estimate to the District.
3. The Consultant will assist the District in the review of the preliminary design and cost estimate and will send review plans to and attend meetings and conferences with other affected agencies as necessary. Changes requested by reviewing agencies and approved by the District will be incorporated into the final design. The Consultant will forward copies of all correspondence sent to or received from other affected agencies to the District.

D. Final Draft of Engineering Design, Plans and Construction
Special Provisions (90% plans)

1. Upon approval of the preliminary plans by the District, incorporate review comments and perform final civil and structural calculations necessary and prepare plans, construction special provisions and cost estimates for the 90% completion submittal.
2. Final drawings will be on sheet size 24 by 36 inch. Structural details will be in accordance with ADOT Highway Division, Bridge Section Procedures. Standard details may be incorporated by reference number and shall be the most currently available.
3. All design drawings and calculations will be independently checked in the Consultant's office and each drawing and calculation sheet initialed and dated by both the designer and checker. All engineering assumptions made during the design other than standard engineering judgements will be documented with appropriate references on the calculation sheets.
4. All design calculations submitted to the District shall be complete in detail.
5. The 90% complete submittal shall include two copies of the checked structural design calculations, six copies of the plans, four copies of the construction special provisions and bidding schedule and two copies of the Engineer's cost estimate (the cost estimate submittal shall include complete quantity calculations, with each sheet initialed by the originator and checker) including any alternate bid items.
6. The Consultant will forward plans and specs to and will coordinate the review and approval of the plans and specifications with other affected agencies (utility owners, cities etc.) as required for coordination and approvals. The Consultant will solicit and document comments from other affected agencies and will copy the District on all correspondence sent to or received from other affected agencies.

E. Final Project Plans and Construction Special Provisions

1. Incorporate final review comments and submit final contract documents ready for advertising and bidding. Two copies of reproducible of all drawings and the construction special provisions shall be provided to the Flood Control District within ten days of receipt of final review comments. All original typewritten materials, drawings and charts will be submitted unbound at this time in reproducible form. If "Kroy" type, sticky-back notes are applied to the original plans, the Consultant shall make and submit an additional set of high quality mylar reproducible to the District. If the plans are the product of computer aided drafting (cad), the Consultant shall provide copies of the resulting data on floppy disks.

V. Schedule

1. Data collection, field investigations and report preparation shall commence immediately upon notice to proceed with the contract. The report and survey information shall be submitted to the District within 10 weeks of the notice to proceed.
2. The Soils report shall be submitted within 15 weeks of the notice to proceed.
3. The preliminary plans shall be submitted within 6 weeks of receipt of written notice to proceed with the preliminary plans.
4. The 90% plans (90% plans are completed plans, special provisions, cost estimates and calculations subject to final review) shall be submitted within 8 weeks of receipt of written notice to proceed with the 90% plans.
5. The final plans, special provisions, cost estimate, bid tabulation and corrected calculations shall be submitted ready for advertisement within 4 weeks of receipt of written notice to proceed to the final plans and specs.

VI. Meetings

Meetings shall generally be held at the Flood Control District office.

Meetings with outside review agencies will be held as required and shall generally be held at their office.

The following "Milestone" meetings shall be held:

1. Within one week of the notice to proceed:
The Consultant shall submit a schedule, including dates of all proposed review meetings, and shall discuss the schedule and the tasks necessary to accomplish it.
2. Two weeks after submittal of the report, the Consultant shall meet to discuss the results. The Consultant shall submit a written progress report, not to exceed two pages in length, summarizing the work accomplished, including contacts with other agencies, and an update of the schedule and future meeting dates.
3. Within three weeks after submittal of the preliminary (30%) plans, the Consultant shall meet at the District to receive and discuss review comments. The Consultant shall submit a written progress report, not to exceed two pages in length, summarizing the work accomplished since the last meeting, including contacts with other agencies, and an update of the schedule and future meeting dates.
4. Within three weeks after submittal of the 90% plans the Consultant shall meet at the District to receive and discuss review comments. The Consultant shall submit a written progress report, not to exceed two pages in length, summarizing the work accomplished since the last meeting, including contacts with other agencies.

both the DISTRICT and the CONSULTANT, be made in accordance with the Consumer Price Index for Urban Consumers, Western Division published by the U.S. Department of Labor, Bureau of Labor Statistics, using the published edition coinciding with the initial contract expiration date. Any such fee adjustment shall only apply to the extended contract time period.

SECTION III - PAYMENTS TO THE CONSULTANT

The CONSULTANT shall be paid for work under this Contract a lump sum/not to exceed fee of \$_____ plus any adjustments that have been approved in writing in accordance with the Maricopa County Procurement Code. For "not to exceed" fee contracts, payments will be made for the actual hours worked and/or other costs incurred or provided for in this contract.

The DISTRICT shall pay the CONSULTANT upon completion of the work as accepted by the DISTRICT, except that progress payments may be made as billed by the CONSULTANT based on approved monthly progress reports subject to the limitations set forth in Exhibit "A", Scope of Work. Ten percent of all contract payments made on an interim basis shall be retained by the DISTRICT as insurance of proper performance of the contract or, at the option of the CONSULTANT, a substitute security may be provided by the CONSULTANT in an authorized form pursuant to procedures established by the DISTRICT. The CONSULTANT is entitled to all interest from any such substitute security.

If the CONSULTANT desires a partial payment in accordance with the provisions above, the CONSULTANT will complete and forward, a DISTRICT provided form, indicating payment distribution to MBE/WBE firms.

Any retention shall be paid or substitute security returned or released, as applicable, to the CONSULTANT within forty-five (45) calendar days after: (1) final completion of all work per Exhibit A, (2) acceptance of work under the contract, (3) receipt of a completed "Certificate of Performance" form, (4) the CONSULTANT'S statement that no project disputes exist, (5) invoicing for any retained monies has been received by the DISTRICT, and (6) a document stating the total payments received by the prime as well as total payments the prime has made to MBE and WBE subcontractors, vendors, and suppliers.

SECTION IV - THE DISTRICT'S RESPONSIBILITIES

The DISTRICT shall furnish the CONSULTANT, at no cost to the CONSULTANT, the following information or services for this PROJECT:

A. One copy of on-hand maps, records, survey ties, bench marks or other data pertinent to the PROJECT. This does not, however, relieve the CONSULTANT of the responsibility of searching records for additional information, for requesting specific information or for verification of that information provided. The DISTRICT does not warrant the accuracy or comprehensiveness of any such information.

B. All available information and data relative to policies, standards, criteria, and studies, etc. impacting the PROJECT as identified by the CONSULTANT.

C. Availability of staff for consultation with the CONSULTANT during the performance of studies and plan development in order to identify the problems, needs, and other functional aspects of the PROJECT.

D. Examination of documents submitted by the CONSULTANT and rendering of decisions pertaining thereto promptly, to avoid unreasonable delay in the progress of the work by the CONSULTANT. The DISTRICT will keep the CONSULTANT advised concerning the progress of the DISTRICT's review of work.

SECTION V - ALTERATION IN SCOPE OF WORK

Any alteration in the scope of work that will result in a substantial change in the nature of the PROJECT so as to materially increase or decrease the contract fee will require negotiation of an amendment to the contract to be executed by the DISTRICT and the CONSULTANT. No work shall commence on the change until the contract amendment has been approved by the DISTRICT and the CONSULTANT has been notified to proceed by the AGENT. It is distinctly understood and agreed that no claim for extra work done or materials furnished by the CONSULTANT will be allowed by the DISTRICT except as provided herein, nor shall the CONSULTANT do any work or furnish any materials not covered by this agreement unless such work is first authorized in writing in accordance with the Maricopa County Procurement Code. Any such work or materials furnished by the CONSULTANT without such written authorization first being given shall be at his own risk, cost, and expense, and he hereby agrees that without such written authorization he will make no claim for compensation for such work or materials furnished.

SECTION VI - RECORDS

Records of the CONSULTANT's payroll expense pertaining to this PROJECT and records of accounts between the DISTRICT and the CONSULTANT shall be kept on a generally recognized accounting basis and shall be available upon request to the DISTRICT or its authorized representative for audit during normal business hours. The records shall be subject to audit by appropriate grantor agency if the PROJECT is funded all or in part by a grant.

SECTION VII - PROJECT COMPLETION

If during the course of this contract situations arise which prevent completion within the allotted time, an extension may be granted by the AGENT.

SECTION VIII - TERMINATION

The DISTRICT may terminate this contract at any time upon reimbursement to the CONSULTANT of expenses which include reasonable charges for time and material for the percentage of work satisfactorily completed and turned over to the DISTRICT.

The DISTRICT reserves the right to postpone, terminate or abandon this PROJECT for the CONSULTANT's failure to complete the PROJECT on time, or failure to comply with the provisions of the contract. The DISTRICT also reserves the right to terminate any or all parts of this contract for its own convenience as the DISTRICT may determine at its sole discretion.

The DISTRICT hereby gives notice that pursuant to A.R.S. Section 38-511 "A" this contract may be cancelled without penalty or further obligation within three years after execution if any person significantly involved in initiation, negotiation, securing, drafting, or creating a contract on behalf of the DISTRICT is, at anytime while the contract or any extension of the contract is in effect, an employer, agent, or any other party to the contract in any capacity or a consultant to any other party of the contract with respect to the subject matter of the contract. Cancellation under this section shall be effective when written notice from the Chief Engineer and General Manager of the District is received by all of the parties of the contract. In addition, the DISTRICT may recoup any fee for commission paid or due to any person significantly involved in initiation, negotiation, securing, drafting, or creating the contract on behalf of the DISTRICT from any other party to the contract arising as a result of the contract.

The CONSULTANT may terminate this contract in the event of nonpayment of fees as specified in Section III, PAYMENTS TO THE CONSULTANT.

SECTION IX - OWNERSHIP OF DOCUMENTS

All original documents including, but not limited to studies, reports, tracings, drawings, physical and computer models, estimates, field notes, investigations, design analyses, calculations, computer software, and specifications, prepared in the performance of this Contract are to be and remain the property of the DISTRICT and are to be delivered to the AGENT before final payment is made to the CONSULTANT. The DISTRICT reserves the right to reuse the documents as it sees fit. However, the DISTRICT will not reuse, alter, or modify these documents without noting such alterations, modifications, or intent of their reuse, and will hold the CONSULTANT harmless from any claims arising from the reuse, alteration, or modification of the documents.

SECTION X - COMPLIANCE WITH LAWS

The CONSULTANT is required to comply with all Federal, State and local laws, local ordinances and regulations. The CONSULTANT's signature on this contract certifies compliance with the provisions of the I-9 requirements of the Immigration Reform and Control Act of 1986 for all personnel that the CONSULTANT and any subconsultants employ to complete this PROJECT. It is understood that the DISTRICT shall conduct itself in accordance with the provisions of the Maricopa County Procurement Code.

SECTION XI - GENERAL CONSIDERATIONS

A. Prior to beginning the work, the CONSULTANT shall furnish the DISTRICT for approval the names of its key employees, and of its sub-consultants and their key employees to be used on this PROJECT. Any subsequent changes are subject to the written approval of the DISTRICT.

The CONSULTANT in replacing a MBE/WBE subcontractor should attempt to contract with another MBE/WBE.

B. The failure of either party to enforce any of the provisions of this Contract or to require performance of the other party of any of the provisions hereof shall not be construed to be a waiver of such provisions, nor shall it affect the validity of this Contract or any part thereof, or the right of either party to thereafter enforce each and every provision.

C. The CONSULTANT shall be responsible for the cost of any additional design, field layout, testing, construction and supervision necessary to correct those errors or omissions attributable to the CONSULTANT and for any damage incurred by the DISTRICT as a result of additional construction costs caused by such CONSULTANT errors or omissions.

D. The fact that the DISTRICT has accepted or approved the CONSULTANT's work shall in no way relieve the CONSULTANT's responsibility.

E. It is mutually understood and agreed that this Contract shall be governed by the laws of the State of Arizona, both as to interpretation and performance. Any action at law, suit in equity, or judicial proceeding for the enforcement of this Contract, or any provision thereof, shall be instituted only in the courts of the State of Arizona.

SECTION XII - SUCCESSORS AND ASSIGNS

This Contract shall not be assigned by either party without prior written approval of the other except that the CONSULTANT may use in the performance of this Contract without prior approval of the DISTRICT, personnel or services of its related entities and affiliated companies as if they were

an integral part of the CONSULTANT; and it shall extend to and be binding upon the heirs, executors, administrators, successors and assigns of the parties hereto.

SECTION XIII - NO KICK-BACK CERTIFICATION

The CONSULTANT warrants that no person has been employed or retained to solicit or secure this Contract upon any agreement or understanding for a commission, percentage, brokerage, or contingent fee; and that no member of the Board of Directors/Supervisors or any employee of the DISTRICT has any interest, financially or otherwise, in the CONSULTANT firm.

For breach or violation of this warranty, the DISTRICT shall have the right to annul this Contract without liability, or at its discretion to deduct from the Contract price or consideration, the full amount of such commission, percentage, brokerage, or contingent fee.

SECTION XIV - ANTI-DISCRIMINATION PROVISION

The Flood Control District of Maricopa County will endeavor to ensure in every way possible that minority and women-owned business enterprises shall have every opportunity to participate in providing professional services, purchased goods, and contractual services to the Flood Control District of Maricopa County without being discriminated against on the grounds of race, religion, sex, age, or national origin.

The CONSULTANT agrees not to discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, or handicap and further agrees not to engage in any unlawful employment practices. The CONSULTANT further agrees to insert the foregoing provisions in all subcontracts hereunder.

SECTION XV - AMENDMENTS

This Contract may be amended by mutual written agreement of the DISTRICT and the CONSULTANT.

SECTION XVI - INDEMNIFICATION AND INSURANCE

A. The CONSULTANT shall provide and maintain the following minimum insurance requirements:

1. Professional Liability. The CONSULTANT shall show evidence of maintaining continuous insurance for the past five (5) years with a minimum coverage limit of \$500,000.00 each claim and/or in the aggregate.

The CONSULTANT shall provide and maintain Professional Liability Insurance with a minimum single limit of \$1,000,000.00 for each claim made and an aggregate limit of \$1,000,000.00 for all claims made through this contract's completion date or the policy's life, whichever is longer.

2. Commercial General Liability. Commercial general liability insurance with a minimum single limit of \$1,000,000.00 for each coverage/occurrence. The policy shall include coverage for bodily injury and personal injury, broad form property damage and blanket contractual coverage.

3. Automobile Liability. Automobile liability insurance, with an individual single limit for bodily injury and property damage of no less than \$1,000,000.00, each occurrence, with respects to CONSULTANT's vehicles (whether owned, hired, non-owned), assigned to or used in the performance of this contract.

4. Workers' Compensation Insurance. This insurance shall be maintained during the life of the contract.

5. Additional Insured. The policies, except professional liability and workers' compensation, required by this section shall name the DISTRICT as Additional Insured, and shall specify that insurance afforded the CONSULTANT shall be primary insurance, and that any insurance coverage carried by the DISTRICT or its employees shall be excess coverage, and not contributory coverage to that provided by the CONSULTANT. No policy issued under this contract shall lapse, be cancelled, allowed to expire, or be materially changed to affect the coverage available to the DISTRICT without thirty (30) days written notice to the DISTRICT.

6. DISTRICT approved documentation outlining the coverages specified in this section shall be filed with the DISTRICT prior to issuance of the Notice to Proceed.

B. The CONSULTANT agrees to indemnify and save harmless the DISTRICT, any of its departments, agencies, officers, or employees from all suits, including attorney's fees and costs of litigation, actions, loss, damage, expense, cost or claims, of any character or any nature arising out of the CONSULTANT's wanton, willful or negligent acts, errors or omissions in the performance of work under this Contract, and any wanton, willful or negligent acts, errors or omissions by any subconsultant or other agent used by the CONSULTANT in the performance of work under this Contract.

IN WITNESS WHEREOF, the parties herein have executed this Contract.

CONSULTANT

Principal

Title

Printed Name

Date: _____

Tax Identification Number

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY:

ACCEPTED AND APPROVED:

D. E. Sagramoso, P.E.
Chief Engineer and General Manager

Chairman, Board of Directors

Date: _____

Date: _____

ATTEST:

Clerk of the Board

LEGAL REVIEW

Approved as to form and within the powers and authority granted under the laws of the State of Arizona to the Flood Control District of Maricopa County.

General Counsel, District

Date: _____



**OLD CROSS CUT CANAL IMPROVEMENTS
PROJECT TEAM ORGANIZATION CHART**

**FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY**

Ed Raleigh, P.E.
Project Manager

PROJECT PRINCIPAL

James E. Attebery, P.E.

PROJECT MANAGER

Shi-En Shiao, P.E.

PUBLIC RELATIONS

PSM2
Julia E. Ellegood, M.A., A.P.A.

QUALITY CONTROL

A. Claude Griffin, P.E.

**PROJECT ENGINEER -
CIVIL ENGINEERING**

Randall D. Beck, P.E.

Joseph A. Ayala, P.E.
Hydrology / Hydraulics

Ronald H. Ferguson, E.T.
Plan Production

Michael E. Mathieu, P.E.
Utility Coordination

James Rautmann, P.E., R.L.S.
Traffic / Roadway Coordination

**CONSTRUCTIBILITY
REVIEW / COST ESTIMATING**

C. Phillip Turner, P.E., R.L.S.

SURVEY

James R. Cristea, R.L.S.

**GEOTECHNICAL
ENGINEERING**

Thomas-Hartig & Associates

**PROJECT ENGINEER -
STRUCTURAL
ENGINEERING**

Entranco Engineers
William Kantor, P.E.

James Milne, P.E.

GREINER



ACTION PLAN

OVERVIEW

A highly qualified technical team has been assembled, and a comprehensive project approach and action plan have been developed to meet the project objectives. Greiner will work as an extension of the staff of the Flood Control District to implement the study and design of the Old Cross Cut Canal. Throughout this project, the following items will be integrated into all of our work tasks:

- o **Open and continuous communication** with the Project Manager of the Flood Control District, which will include weekly progress reports and a full-time, local Project Manager
- o **Public information distribution** as requested and approved by the Flood Control District, in coordination with the City of Phoenix
- o **Coordination with other agencies**, such as the City of Phoenix, Salt River Project and other federal, state and local agencies, for assurance of agreement
- o **Accuracy, common sense and sound professional judgement**
- o **Responsiveness and flexibility** in serving the Flood Control District's needs -- **we listen and act accordingly**
- o **Environmental sensitivity and acceptance** by integrating aesthetic considerations and working solutions
- o **Value engineering and the potential for cost savings**
- o **Complete project activity documentation** through the use of technical memoranda, telephone record forms and meeting minutes
- o **Constructible, cost-effective solutions** -- our job is not done until the project is complete and functioning as designed

Project Flow Charts were developed utilizing the Critical Path Management Program. These Project Flow Charts illustrate our approach in completing the project and are included on the following pages. The charts are based upon the three major design phases -- Initial, Preliminary and Final -- and upon the key items listed above. A Schedule, Manhour Estimate and Preliminary Sheet Count are included at the end of this section.

INITIAL PHASE

Task 1 -- Mobilization / Planning / End Product

Mobilization

The initial tasks of the design process are very important in that they set the tone and operating parameters for the balance of the work. If the work falls behind schedule during the early stages of the process, it can be extremely difficult to catch up. If details are overlooked or data is incomplete, serious delays or problems can occur during later phases. To guard against these occurrences, Greiner will thoroughly analyze the work to be accomplished, the schedule of tasks and critical information before the Notice-To-Proceed is

ACTION PLAN

issued. A written list of information that the Greiner team will need to initiate the project tasks will be submitted to the Flood Control District Project Manager so that this data is obtained as early as possible.

The kick-off meeting will be used to review the information required, the project schedule and the lines of communication to be followed throughout the project. The project objectives and key issues will also be discussed at this meeting so that everyone has an understanding of the methods to be used in dealing with constraints. Coordination and consultation with other agencies will be initiated.

Planning

To complete the design process in a smooth and timely manner, a work plan will be prepared. A successful project is based on an understanding of the relationship between the following key items:

- o The end result of product
- o The tasks to be accomplished to achieve the end product
- o The issues to be addressed within
- o The time and manpower required to accomplish the tasks and to deal with the specific issues
- o The logical sequence of each of these events and the interdependency of tasks

End Product

The Flood Control District of Maricopa County requires construction documents for this portion of the Old Cross Cut Canal improvements. The plans and specifications must meet the standards and criteria established by the District, and must clearly convey the extent of work items required of the contractor. **The project's constructibility will have a direct impact on the construction cost.**

In addition to the final plans and specifications, there are several necessary intermediate submittals and reviews. The purpose of the reviews are to assist in evaluating the project work to-date and ensure that the design objectives are met. Greiner will keep the project on track through the formal submittals and frequent informal conversations with the Flood Control District Project Manager. These meetings and conversations will be documented and distributed to appropriate team members.

Task 2 -- Date Search / Field Visit / Brainstorming Workshop

Greiner will acquire and review existing engineering studies, planning studies, environmental evaluations, drainage reports, environmental reports, drainage improvement plans, street improvements plans, topographic maps, right-of-way drawings, soils reports and utility drawings within the Old Cross Cut Canal corridor.

A meeting and field reconnaissance trip will be conducted with key project personnel from the Flood Control District, their invitees and the Greiner team. Improvement concepts, constraints and ideas will be discussed and documented, as well as critical elements that may

ACTION PLAN

impact the study. A **brainstorming workshop** will be conducted to fine-tune the study plan. The purpose of the workshop is to identify the critical path and depth required for each task so that unnecessary studies, surveys or field investigations are avoided. An **environmental evaluation** of potential environmental deficiencies which may presently exist on this site will be conducted.

Task 3 -- Preliminary Study and Report

In the Project Understanding, several items of key concern were listed. These items were identified during our initial review of the project and will be evaluated in more detail when further information is available. The preliminary study will consist of analyzing each project area, identifying potential conflicts or issues, and compiling a list of these issues. After all the points of concern are listed, they will be prioritized and each issue will be investigated in more detail and possible solutions identified. After the issues, impacts and possible solutions have been identified and compiled, Greiner will review this with Flood Control District staff.

A report will be prepared and submitted to the Flood Control District, City of Phoenix and Salt River Project for review and approval, and will include:

- o Tabular summary of all reference data collected and reviewed
- o Summary of hydrology review and drainage considerations
- o Alternative formulation and selection
- o Horizontal and vertical alignment considerations
- o Size and type of structural sections(s) recommended
- o Drainage impact (with project/without project) for 25- and 100-year storms
- o Drainage inlet locations and sizes
- o Hydraulic design considerations
- o Utility conflicts and resolutions
- o Traffic considerations at Indian School Road, Osborn Road and Thomas Road, and any other traffic conflicts
- o Constructibility concerns
- o Right-of-way considerations
- o Impacts of proposed future improvements (park, street and storm drain improvements) on concentration points of flows, inlet sizes and locations
- o Preliminary construction cost estimates and cost estimates for comparison of alternatives, as required

ACTION PLAN

- o Operation and maintenance considerations
- o Recommendations

Task 4 -- Survey and Mapping

Research and Review

Greiner intends to gather and review the adjacent subdivision plats, SRP right-of-way plans, City of Phoenix quarter section maps and any recorded results of survey prior to commencing the ground survey work. The establishment of a common datum plane for design is a major concern; Greiner will also obtain SRP construction control (i.e., stationing for the Old Cross Cut Canal and SRP benchmarks) in order to integrate their datum into our survey work. The intent is to establish equations between SRP control and City of Phoenix datum.

Verify Horizontal and Vertical Control

The centerline of existing 48th Street will be traversed to verify alignments as shown by the public record. Bench loops will be run, based on City of Phoenix datum, through SRP benchmarks and temporary benchmarks for pre-design surveys. Traverse coordinate values will be expressed in Arizona State Plan Coordinates NAD 1983, and will integrate the survey control for this project into adjacent major construction (Papago Freeway, Squaw Peak Parkway, etc.). Existing control points just south of the Old Cross Cut Canal alignment are close by and will be used as the basis for the control survey.

Aerial Mapping Control

Based on the primary control noted in the paragraph above, targets will be laid out for control of the aerial mapping. Appropriate utility valve locations will be painted so that they can be compiled in the planimetric features of the mapping. The aerial mapping will extend 150 feet to the right and left of the centerline of the Old Cross Cut Canal, and will extend 250 feet right and left at bridged intersections.

The mapping will be flown at such an elevation and C factor to enable the aerial mapping firm to digitize cross-sections of the Canal on 50-foot stations for hydrologic computations and earthwork quantities. The mapping will be at 1" = 20', 1-foot contour intervals per the Scope of Work. AutoCAD Version 10 floppy disks will be prepared for the County and for Greiner to plot the aerial mapping and contours, and input the digitized cross-sections.

Check Cross-Sections

Cross-sections and miscellaneous utility locations and elevations will be surveyed. Greiner will perform 10 cross-section checks at various locations on the project to verify the aerial mapping and assure the quality control of the base mapping. Additional survey checks of the existing utility locations and grades using ground survey procedures will complete the base mapping for engineering design.

Final Benchmarks

Three permanent monuments will be set at Indian School, Thomas and McDowell Roads. These monuments will be placed in locations away from future Old Cross Cut Canal

ACTION PLAN

construction, and will serve as project construction benchmarks. Elevations will be expressed in City of Phoenix datum.

Task 5 -- Provide Soils Investigations and a Soils Report

Details of these services include:

- o **Review of any subsurface data available along the project alignment.** Data may be available from previous improvements to the Canal, and where street crossings have been improved.
- o **Test drilling and sampling to determine the subsurface stratification.** Nine test borings are proposed and will be located on approximately 0.25-mile intervals. Additional test borings will be designated at areas where particular structure types will need investigations. Each boring location will be Blue Stake approved, and traffic control will be provided during the field exploration. Test borings will be drilled to a depth of 20 to 25 feet with Standard Penetration Test (SPT) drive samples obtained on 5-foot vertical increments. The SPT sampling will be performed with the boreholes maintained full of water during sampling. Driven ring samples may also be obtained for soil mechanics testing.
- o **Piezometers will be installed in selected, and possibly all, boreholes for monitoring of any groundwater levels.** A perched groundwater zone is known to underlie this general area at depths of 15 to 25 feet below the ground surface which may be within the depth of construction. The top of the piezometers will be in a lock vault with a water-tight cap. Any boreholes not fitted with piezometers will be grouted per State requirements.
- o **Field Resistivity Testing will also be performed** at all test drilling locations for an indication of the corrosivity potential of the native soils.
- o **Laboratory testing of representative samples is anticipated as follows:**
 - Moisture Content -- all driven SPT and ring samples
 - Dry Density -- all driven ring samples
 - Gradation and Plasticity Index -- one selected sample from each boring
 - Consolidation -- five selected samples
 - Direct Shear -- five selected samples
 - Maximum Density (Proctor) -- five selected samples
 - Soluble Salts, Sulfates, Chlorides and pH -- five selected samples
 - R-Value Testing -- assume four tests (four locations where the project may require reconstruction of existing City of Phoenix street pavements)
- o **Geotechnical Report.** The report will present the results of the field and laboratory tests, and will provide the basis for the following:
 - Constructibility concerns relative to the subsoil stratification encountered including the presence and elevation of any groundwater
 - Excavation conditions and slope stability considerations
 - Bearing capacity offered to and lateral earth pressures expected against buried structures
 - Bedding and backfilling recommendations

ACTION PLAN

PRELIMINARY PHASE

Task 6 -- Preliminary Plans, Preliminary Design Report and Preliminary Cost Estimate

Thirty percent plans will be prepared and submitted for the approved alternative. At this time, Greiner will also coordinate the relocation of all affected utilities.

The preliminary design plans will include the basic design layout, including the horizontal and vertical alignments of the major drain, catch basins and laterals, right-of-way limits and initial utility conflicts. Limits of construction will be clearly indicated on the plans for the laterals with stubs that will be installed by this project, and will call attention to the fact that the catch basins will be installed in the future Roadway Improvement Project.

The improvement plans will be in ink on plan and profile mylar tracings to a scale of 1" = 20' for the plan and profile sheets, with special details at a larger scale, as may be required. All plans will indicate horizontal and vertical locations of all recorded and proposed underground utilities and physical terrain features that may affect design. The design documents to be submitted will include the preliminary design plans, a preliminary cost estimate and a preliminary design report.

A field review will be conducted by Flood Control District staff, utility representatives and Greiner engineers to verify data shown on the preliminary plans with actual conditions existing in the field.

FINAL PHASE

Task 7 -- Final Plans, Specifications, Cost Estimate, Maintenance of Traffic and Final Design Report

Final plans, specifications, cost estimate and final design report will include the 90 Percent Submittal and a Final Submittal. All work performed will meet design and drawing specifications and standards outlined in the Request for Proposal and Scope of Work provided by the Flood Control District.

The final design process consists of two primary activities which include 1) adding the necessary details to all aspects of the construction items, and 2) checking all plan sheets and special provisions for constructibility.

Adding Necessary Detail

The first activity will be broken down into detailed individual tasks on the Project Flow Chart and Schedule. Particular items identified are:

- o Drainage structures (culverts, transition structures, flow equalizing chamber energy dissipators, drop inlets special connections)
- o Intersections
- o Retaining walls/bridges (if cost justified)

ACTION PLAN

- o Construction phasing
- o Maintenance of traffic

Other items which will also be involved include project special provisions and cost estimates.

Checking Plan Sheets / Constructibility

All of these items will be finalized with the necessary details. Each item will be checked individually, but the key to the checking process is the second primary task mentioned earlier -- the constructibility review. Complete sets of documents are checked by our in-house team for conformance with Flood Control District requirements, for completeness of the documents to ensure each item of work to be performed is covered with regard to installation, measurement and payment, and to make sure all items of work are compatible and coordinated with the other items. The clarity and consistency of the plans are checked so that the contractors involved in the work understand the end product desired and how the end product is to be built.

For peer review, we have found it to be beneficial to involve other Greiner personnel with many years of experience in either designing similar projects or in managing the construction of similar projects for the Flood Control District, and in dealing with the major contractors and construction problems which are in this area. In order to check inconsistencies or incompleteness relative to the measurement and payment of an item or how a particular aspect of the work is to be accomplished, we propose using an experienced design manager and a senior construction manager as two members of the constructibility review team.

Documents will be marked-up and corrected before they are submitted for review by the Flood Control District. A written sequence of construction to maintain a specified minimum number of traffic lanes on a paved surface at all times during construction will be prepared. This document will include construction phasing plans showing restriping, signing and detour as needed to facilitate traffic movement, and to maximize traffic flow and safety through the project limits during construction; and will allow access to all local businesses and neighborhoods during construction.

After all documents have been finalized, they will be submitted as the 90 Percent Final 1 Review Plans. Following Flood Control District review and comments. A field visit will be conducted to verify all design elements, modifications will be addressed, corrections made and the 100 Percent Final 2 documents submitted. If there are any other items to be addressed, those will be covered and everything checked before submitting the documents for bidding purposes. Greiner will address all review comments, redesign any portion of the work which does not meet Flood Control District, utility and government standards, and resubmit all work for review to the Project Manager until such work is approved by each respective agency. This last submittal completes the design phase of the project so that the construction phase may begin.

The final submittal will include original documents, field notes and calculations. Disks of the final design and plans will be supplied to the Flood Control District in AutoCAD format. The technical specifications (special provisions) and project bid schedule will be provided to the District (hard copy and 5-1/4-inch diskette, IBM compatible format) for final printing and binding into contract documents.

ACTION PLAN

CONSTRUCTION PHASE SERVICES

Bid Advertising

We will provide the necessary design and administrative services to support the bid letting process by responding to questions relative to the PS&E, revise the documents as may be required for clarity, prepare required addenda, and attend and participate in the prebid conference.

Post Design Services

We recognize the importance of timely response to post design requests. Our proximity to the project and our familiarity with the process will ensure that these requests are expedited.

PROJECT CONTROL

A project procedures manual for this project will be prepared under the guidelines of Greiner's QA/QC procedures. This manual will consist of the schedule, proposed administrative and project control procedures, and the agreed upon Scope of Work.

Quality Control

Throughout the project development process, Greiner's Quality Assurance/Quality Control Program of checking and backchecking will be utilized.

We recognize the importance of prompt turn-around time in the Flood Control District review process. This can occur if design submittals, which are required throughout the development process, are accurate and complete. Accuracy can be assured by our formalized checking procedure. To ensure that this process has occurred, certification signed by the Project Engineer and Project Manager will accompany each submittal.

To ensure that each submittal is complete and contains those elements of the project required by the Scope of Work, we propose that prior to each review submittal, the Flood Control District Project Manager, Greiner Project Manager and Project Principal, as well as appropriate subconsultant personnel, review this submittal for completeness in accordance with the agreed upon Scope of Work. This review will also include the necessary QA certification of checking and backchecking.

By conducting this joint review prior to submittals, we hope to reduce the scheduled four-week period, thus permitting the plans to proceed ahead of the proposed schedule and also allow for the unexpected without sacrificing the schedule.

Greiner will conduct independent reviews to ensure the constructibility of the documents; to ensure that all AASHTO, MAG and Flood Control District standards have been met; and to ensure that the presentation is in accordance with specified standard procedures.

Schedule Control

A defined process for communication between Flood Control District staff, subconsultants, affected governmental agencies and the public must exist. To effectively and formally

ACTION PLAN

communicate within the project team, we will hold weekly project meetings to discuss progress, schedule and problems. To ensure that identified problems can be readily resolved, we will invite the Flood Control District Project Manager attend these weekly meetings, as well as others who may be needed to resolve a particular issue. To keep other agencies informed of project development, we propose formal monthly progress meetings with a liaison group identified by the Flood Control District Project Manager.

Value Engineering

Greiner has a detailed Value Engineering Program that is quality product oriented. Adherence to this program will enable identification and recommendation of alternatives to be developed, through the phases of Investigation/Analysis, Creative Speculation, Evaluation, Development and Recommendation.

In the development of the specific Value Engineering Program for the Old Cross Cut Canal Improvements, Greiner will plan the necessary tasks within each phase to ensure that the activities performed satisfy the goals of each phase. The results of the program will be summarized in a Value Engineering Report which will identify results of each study aspect. A flow chart of the Value Engineering Process is included at the end of this Section.

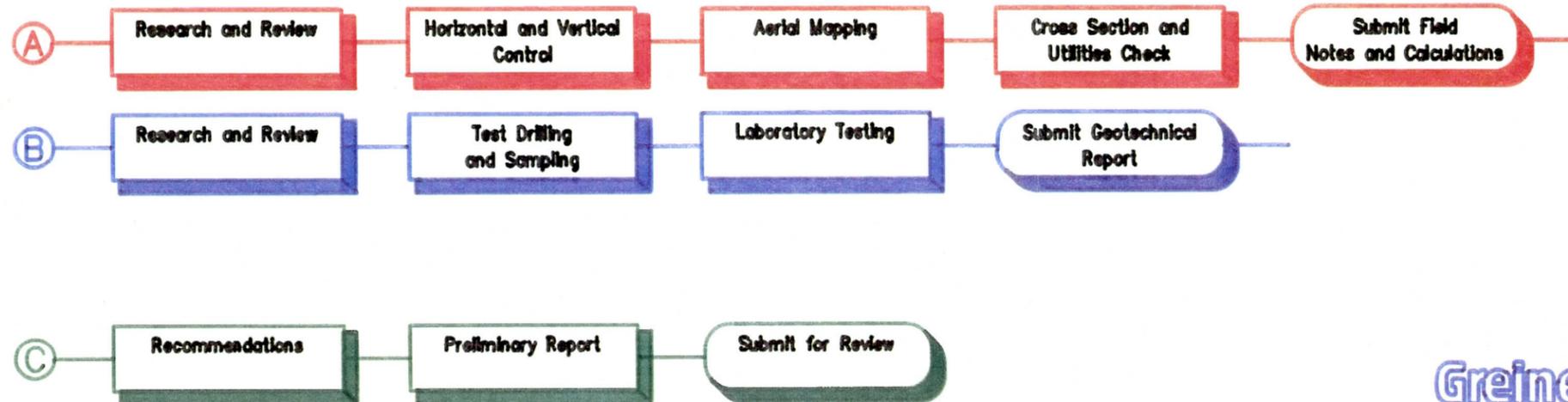
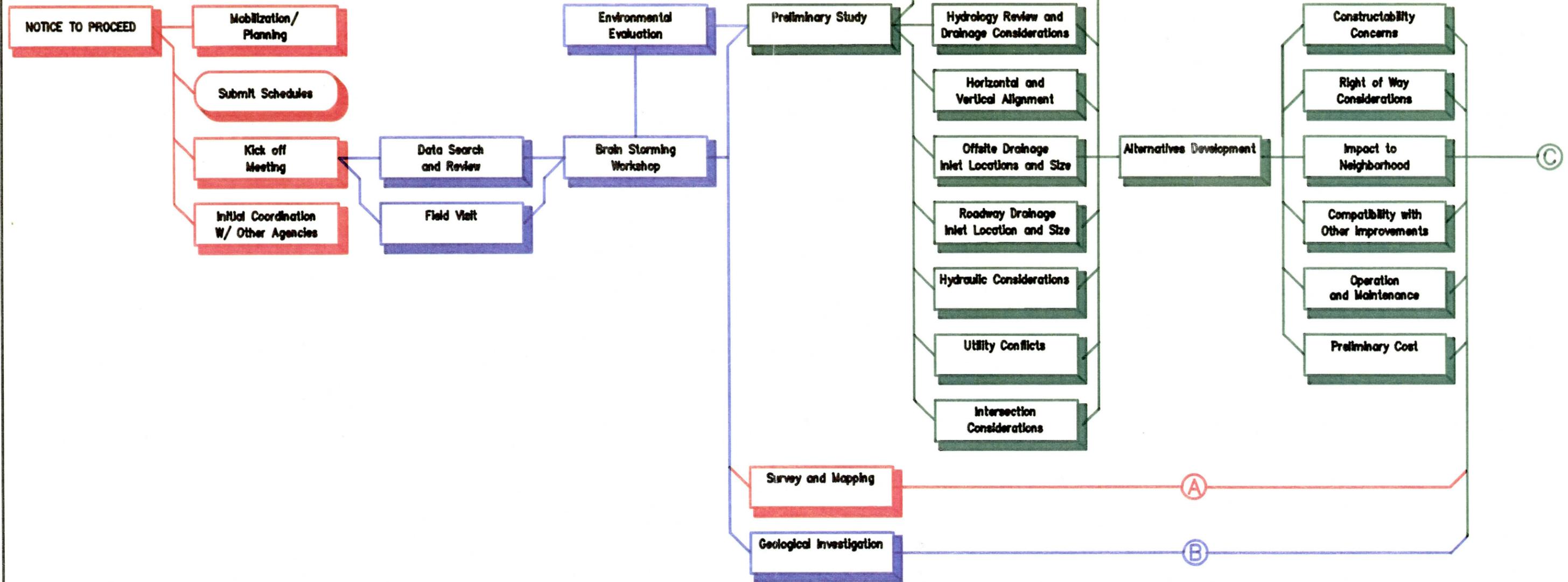
Construction Cost Control

Our approach will include a comprehensive evaluation of alternative structural sections to meet the project requirements for cost, constructibility and low maintenance in the long term. In addition to these requirements, special attention will be given to specific challenges such as groundwater in the area, geotechnical requirements, and special measures required by constructing the new conduit along the alignment of the existing ditch section.

We appreciate that cost control will be a key element of the project. From initial development of design concepts through preparation of the final construction package, Greiner will ensure that the Flood Control District is provided with updated cost information for structural sections, earthwork and special structures at major street and utility crossings. Our objective is to keep accurate and current cost information in the hands of the Flood Control District Project Manager to ensure that timely decisions can be made and that there are "no surprises" later in the project. This will be particularly important given the complexities associated with construction of a major conduit in the urban environment and limited funding for the project.

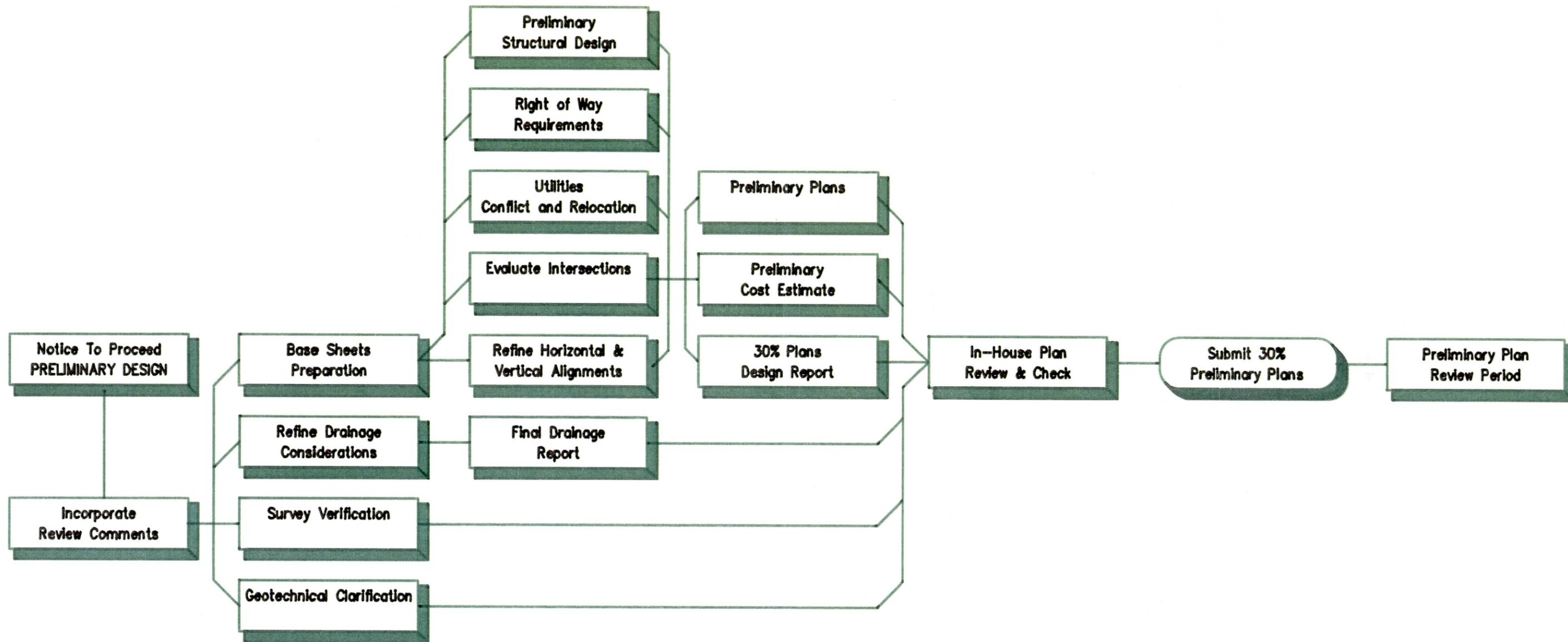
Public Meetings

Greiner recognizes the importance of public support to an improvement project and is experienced in conducting and/or assisting in public meetings. The meetings, if requested by the Flood Control District, will be either a presentation, an open-house workshop or combined formal presentation/workshop style. If required, Greiner will prepare exhibits and attend meetings to answer questions.



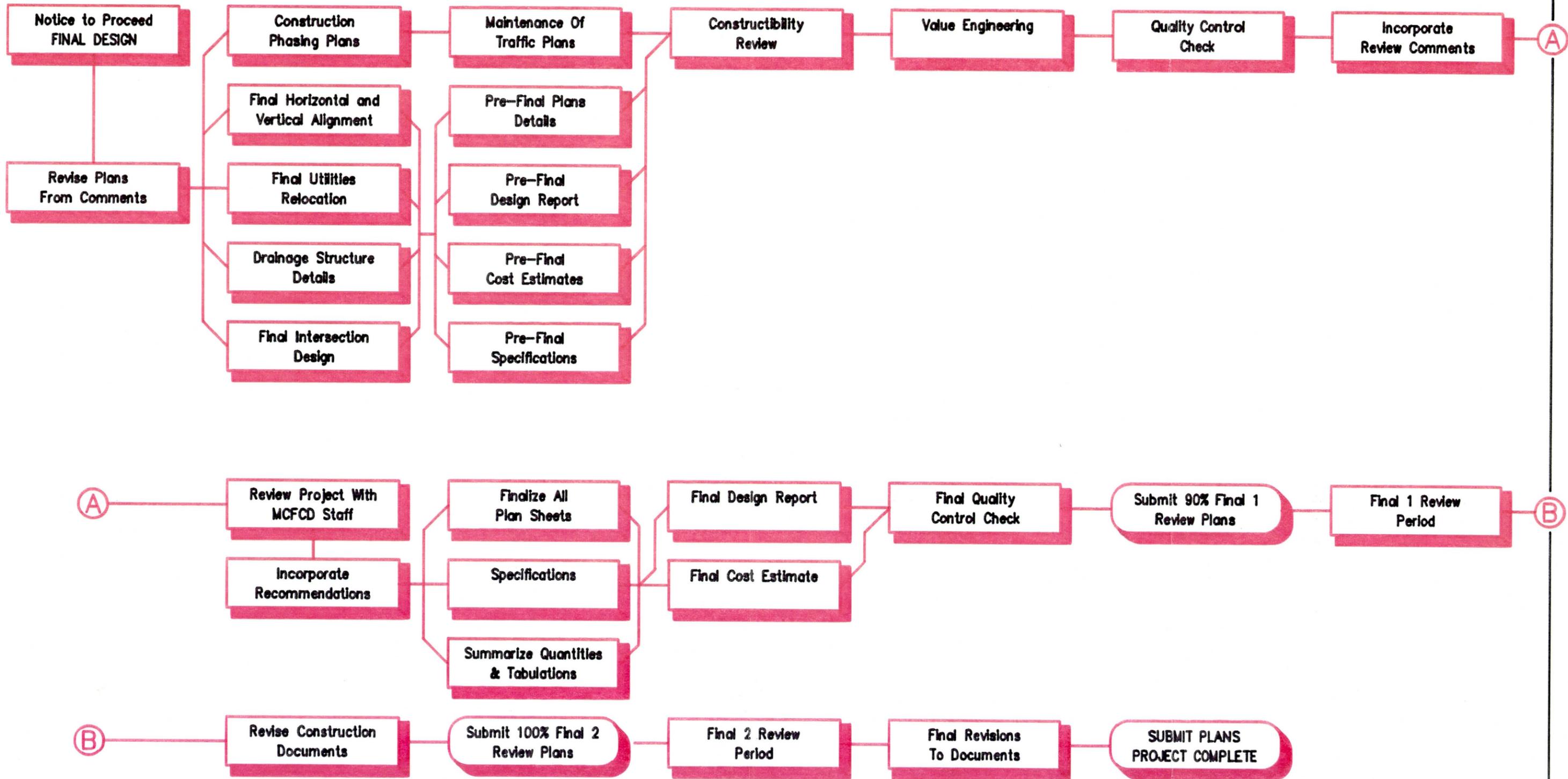
Greiner, Inc.

OLD CROSS CUT CANAL
DRAINAGE IMPROVEMENTS
PROJECT FLOW CHART
INITIAL PHASE



Greiner, Inc.

OLD CROSS CUT CANAL
DRAINAGE IMPROVEMENTS
PROJECT FLOW CHART
PRELIMINARY DESIGN PHASE





OLD CROSS CUT CANAL IMPROVEMENTS PROJECT REPORT

The Project Report form is for the purpose of reporting progress to the client, the Flood Control District of Maricopa County. These tables will be periodically updated by the Project Manager and distributed with the Project Schedule. Following is a sample of a Project Report utilized previously.

Distribution of this Report is as follows:

Additional copies may be distributed within the Flood Control District of Maricopa County as requested by the Project Manager.

Job No. E-126-011

**WEEKLY PROGRESS REPORT
LYNX CREEK/CLIPPER WASH
WEEK ENDING AUGUST 27, 1987**

- o Greiner received the remaining blueprints of topographic maps for Lynx Creek on July 23, 1987.
- o The water surface profiles of the 10-, 50-, 100- and 500-year floods were completed. The floodway limits for the 100-year peak flow were also determined.
- o We are finalizing the conceptual channel scheme options for floodplain management at Lynx Creek.
- o We are in the process of writing the drainage report and preparing figures and tables.
- o Greiner is waiting for the original mylars of topographic maps for Lynx Creek.

BGS/jsa

cc: E. Collett
J. Cooper
S. Shiau
K. Spedding
G. Sun

SAMPLE

TUCSON STORMWATER MANAGEMENT STUDY

PROJECT # : _____
 PHASE I : _____
 CONSULTANT : _____

For the Period: _____ to _____

TASK NO.	TASK DESCRIPTION	% COMPLETE	CUMULATIVE % COMPLETE	ESTIMATED COMPLETION DATE	DATE COMPLETE	COMMENTS/REMARKS
100	Initial Coordination					
110	Collect & Review Data					
120	Collect Hydro/Hydra Data					
130	Prepare Base Maps					
140	Inventory Existing Facility					
150	Coordinate & Evaluate Info					
200	Existing Hydrologic Studies					
300	Existing Drainage Patterns					
310	Hydrologic Modeling					
320	Hydraulic Modeling					
330	Review Results					
340	Capital Improvement Program					
350	Exhibits					
360	Presentation					
370	Public Participation					
380	Economic & Financial Plan					

SAMPLE

Total % Complete

Approved: _____
 Project Manager

TUCSON STORMWATER MANAGEMENT STUDY

PROJECT # : _____
 PHASES I & II: _____
 CONSULTANT: _____

TASK NO.	TASK DESCRIPTION	% COMPLETE	CUMULATIVE % COMPLETE	ESTIMATED COMPLETION DATE	DATE COMPLETE	COMMENTS/REMARKS
400	Goals, Policies & Reg. Const.					
410	Review Current Drainage Stand.					
420	Prepare Drainage Criteria & Object.					
430	Prepare Task 4 Deliverables					
440	COI Review - Phase I					
500	Hydro. Model Future Cond.					
510	Alternative Improvement Prog.					
520	Hydro/Hydra Model of Altern.					
530	Sizing Drainage Facilities					
600	Cost Estimates					
610	Value Engineering					
620	Environ. Impact/GW Recharge					
630	Construction Scheduling					
640	Alternative Sel.					
650	Prep. Deliver for Task 5 & 6					

SAMPLE

Total % Complete

Approved: _____
 Project Manager

SPECIAL PROBLEM REPORTS

PROBLEM AREA

- Technical Coordination
- Unresolved Discrepancies
- Unrealistic Schedule
- Other

DISTRIBUTION

DETAILED EXPLANATION:

PROPOSED SOLUTION

SAMPLE

Prepared By: _____

Reviewed By: _____



CORRESPONDENCE

- o All correspondence sent out of the office should be addressed and signed per the attached. The Project Manager's signature is the minimum.
- o If information and clarification are needed to transmit something, don't wait for the Project Manager to write the letter. Write the letter for the Project Manager's signature or review. This will assure uniform appearance, as well as keep the Project Manager informed as to project progress.
- o It is not necessary to type all in-house memos; this includes communications to subconsultants.
- o All outgoing correspondence will be typed.
- o All incoming correspondence will be delivered to the Project Manager. Copies to the appropriate key person and subconsultants will be distributed. For outgoing correspondence format, see the attached.
- o A brief memo of telephone conversations with the client, agencies or the public will be written and delivered to the Project Manager.
- o All project files will be kept adjacent to the Project Manager's office in Phoenix.
- o Significant correspondence will be distributed to the following people:

MEETINGS WITH THE CLIENT, AGENCIES AND THE PUBLIC

Key persons shown on the Organization Chart, including subconsultants, will be responsible for taking minutes of their respective meetings.

Copies of minutes will be given to the Project Manager for his review and initials, after which copies will be forwarded to the client's Project Manager for his records.

A separate copy will be placed in the files.

Job No. E-111122

June 30, 1988

**MEETING MEMORANDUM #40
S.R. 87
CONTRACT NO. 86-82**

A meeting was held on June 30, 1988 at Greiner's office prior to the final plan review meeting with ADOT to discuss the requests from the Bar-T-Bar Ranch owner regarding the Deer Creek levee construction. The attendees were:

Pamela Lowe	- ADOT
George Lopez-Cepero	- ADOT
Marvin Sheldon	- ADOT
Jerry Love	- Greiner, Inc.
Gary Sun	- Greiner, Inc.

Mr. Sun briefly described the discussion with the Bar-T-Bar owner, Mr. Brooks, on June 23, 1988 at the Ranch (see Memo #39). Mr. Sun explained the owner's requests on the 50-scale aerial map with the selected levee alignment.

Ms. Lowe instructed Greiner to meet the owner's requests for the construction of the dirt road over the levee and scour protection where the road crosses Deer Creek. Greiner will extend the new dirt road to provide the access to the Deer Creek channel bottom.

For the fence along the levee toe, Ms. Lowe said this will require an agreement between ADOT's maintenance group and the owner. Ms. Lowe said that she would check into it.

Mr. Sun said that he will get back to ADOT with the design of the new dirt road as soon as possible.

GS/cb

cc: Project File
Attendees
Shi-En Shiau, Greiner, Inc.

SAMPLE

GREINER, INC.
RECORD OF TELEPHONE CONVERSATION

DATE: November 11, 1987 TIME: 8:00 a.m. JOB NO.: E1711.12

PERSON CALLED: Randall Beck ADDRESS: 7310 N. 16th St.--Phoenix

REPRESENTING: Greiner, Inc. PHONE NUMBER: 275-5400

NAME OF CALLER: Mike Gutierrez PHONE NUMBER: 262-4967

ADDRESS: 125 E. Washington -- Phoenix REPRESENTING: City of Phoenix

DETAILS OF CONVERSATION:

Mike returned my call from 11/9/87. I requested a status update of the review of the 39th Avenue Storm Drain. Mike indicated that the review was still in progress and that he thought he would be through by the end of next week. I asked him if it would be possible to adjust the project schedule to allow for the additional review time. He said that he had spoken to Ross Blakley about it and that there was no problem with adjusting the schedule.

I Asked Mike if he had any concerns about the project based on his review at this point. He said the only comments he had at this time was to look at relocating some of the manholes to eliminate some catch basin laterals, and to use the stub-out at Maryland to drain the catch basin on the east side of 39th to eliminate another catch basin lateral.

He said that the plans looked very good and he did not have any other comments at this time.

I asked Mike about the prefab detail that the other consultant was working on. He said that it would not be ready until the consultant had made preliminary plan corrections. He still would like to incorporate this detail into Greiner's plan set for the Bethany Home intersection.

I told Mike to call me if he had any questions.

REPLIES:

SAMPLE

Distribution: Shi-En Shiau
Mike Gutierrez
Phone File

Randall Beck
Randall Beck, Project Engineer

2:PHONE

Letter of Transmittal

555 East River Road, Suite 100
Tucson, Arizona 85704
602 887-1800

7310 N. 16th Street, Suite 160
Phoenix, Arizona 85020
602 275-5400

To Ms. Teresa Dominguez
Project Manager
Flood Control District of Maricopa County
3335 West Durango Street
Phoenix, Arizona 85008

Date October 20, 1987

Subject Bell Road Project Drainage Study Executive Summary

Reference # ECD 86-20 E1230.61 Please refer to this number in all correspondence.

Attached please find:

100 Copies of Executive Summary

- Review and approval comment
- Signature and return
- Appropriate action
- As requested
- For your information

Remarks The selected Plan Report will be submitted on October 26, 1987.

We are happy to be of service.

Sincerely yours,

Greiner, Inc.

By


Mustafa Chudnoff

Copy

Jerry Love

Shi-En Shiau

SAMPLE



QUALITY ASSURANCE PLAN

Definition and Objective

Quality Assurance (QA) may be defined as a methodical procedure to establish and maintain performance in accordance with prevailing standards. From this definition, it can be seen that quality assurance does not simply apply to plans and specifications alone, but extends to all of the elements as follows:

- Project Procedures Manual
- Roadway Design Plans (Initial, Preliminary, Final Design I and II)
- Drainage Reports (Initial, Preliminary and Final)
- Right-of-Way Plans (Initial, Preliminary and Final)
- Right-of-Way Descriptions
- Survey Data
- Cost Estimates
- Special Provisions
- Subconsultant Data
- Final Project Submittals (Design Computations)

Quality assurance then is an attitude as well as a procedure.

General Quality Assurance/Quality Control Requirements

Effective Communication and Documentation

This is one of the major, yet the most often disregarded areas of the quality control requirements. The failure of the Project Manager to employ effective verbal and written communication can seriously affect quality control. A Project Manager's failure to transmit a critical instruction effectively and clearly at the onset of the project can seriously inhibit effective quality control and efficient design. Likewise, failure of the drafter to communicate the existence of a problem to the engineer prior to release of the plans can result in faulty design. All communications, whether written or verbal, that concern the scope of work, contract conditions, regulatory agency information, etc., must be thoroughly documented. Documentation should include written verification of verbal conversations, parties to the communication, when it was received, who conveyed it and who received it. Specifically, communication will be handled in the following ways:

- o All communication will be written, including telephone logs
- o All written information leaving our office will be typed
- o Standard distribution lists will be developed to be used for all communication.
- o Periodic review meetings will be held to update Management Consultant and the Arizona Department of Transportation as to our status
- o Weekly status reports and schedule updates will be prepared by the project manager
- o Use of a project administration control and communications system will enhance our communication efforts to all team members

The five C's of effective communication are key aspects of our QA Program and should be remembered: correctness, conciseness, clarity, courteousness and confidence. Failure to exercise any one of these can result in lack of understanding of what is meant to be conveyed.

QUALITY ASSURANCE PLAN

Adequate Project Review

This includes not only observation of work spaces, but also review of in-house design and production. In the same manner, as the field representative witnesses construction in the field, the Project Manager should critically observe the parameters of the design, the manner in which the project is accomplished and the details which play a part in the decision process. The person responsible for a project must continually review the project. He or she must be aware of the status of the project, problems that exist or existed and solutions that have been implemented and/or may be required. This continuous critical scrutiny of the project will ensure implementation of quality control measures in the project design. Reports and special studies must be scrutinized for format, accuracy, proper grammar and completeness.

Implementation and Maintenance of a Consistent Standard of Quality Assurance

Quality assurance and control procedures are to be reviewed and emphasized as significant and important elements of the project at periodic staff meetings during the course of a project. Minimum intervals for these conferences are: project kick-off, interim reviews depending on job scope, the Project Manager's establishment of needs and final review.

The interim reviews should be scheduled at the kick-off conference. An active quality assurance program during the design phase of a project is critical to minimizing errors and omissions in the plans and other documents. Most of the errors in plans and specifications can be avoided simply by disciplining the project team to think through the project as it is being designed and subjecting it to periodic review. The routine of detailed specification checks, system checks, existing condition and conflict checks, etc., not only will improve the detailed technical design, but will allow major technical problems to be exposed and solved routinely.

Quality Assurance and Quality Control Requirements for a Specific Project

Each employee on a project is, in his own way, responsible for a portion of the Quality Assurance as part of that project. The Project Manager, though, is responsible for insuring that adequate checks and reviews are incorporated into each project prepared under his direction. In order to assist in the QA program, the Project Manager is directed to address the following categories whenever appropriate.

1. Contracts
2. Schedules
3. Site Visit
4. Project Reviews
5. Survey Coordination
6. Design Reviews
7. Project Files

Within each of these categories, the following items, as a minimum, must be considered:

Schedules

1. Written schedule projecting both estimated and actual dates
2. Submitted to client (where appropriate), project team and officer in charge
3. Kept up to date

QUALITY ASSURANCE PLAN

4. Include (where appropriate):
 - a. Start date
 - b. Review meetings
 - c. Plan review time
 - d. Submittal dates
 - e. Key task completion dates
 - f. Client decision dates
 - g. Meetings (City Council, County Commissioners, etc.)

Site Visits (Prior to Proposal in many cases)

1. By Project Manager/Project Engineer/Design Engineer, as appropriate
2. Prior to substantial effort on design
3. With client if possible
4. Review Key design parameters
5. Prepare site visit memo
6. Pre-construction meeting with Party Chief prior to construction

Project Reviews

1. To be included in schedule
2. Held at appropriate intervals
3. Attended by all those involved in design
4. Survey department to be invited where appropriate
5. Cost of these reviews to be a part of contract fee

Survey Coordination

1. The Project Manager will keep survey department up to date on appropriate projects.
2. Design surveys will be coordinated to schedule work as a unit.
3. The Survey Department will review plans prior to submittal to agency.
4. Prior to construction, the Party Chief, Project Manager and Project Engineer will meet to review the project.
5. During significant survey activity, the Project Manager and Project Engineer will review project status with the Party Chief.

Design Reviews

1. All plans, specifications, reports, etc., will be reviewed as appropriate by the Project Engineer, Project Manager, Survey Department and Project Director.

QUALITY ASSURANCE PLAN

2. The Project Manager will make sure that all plans are reviewed for constructibility by the appropriate individual.
3. The "Checked by," "Approved by," "Designed by" and "Drafted by" initial blocks on the title sheets shall be initialed by the persons performing the work, not leroyed in by the drafter.
4. The cost of these reviews will be budgeted by the Project Manager as part of the job fee.

Engineering Design Calculations

In order to fully document our design work, all calculations will be performed on engineering calculation paper and will be initialed and dated by the individual preparing the calculations and the checker. Job numbers and project names will also be shown on the calculation sheet. Scratch pad calculations are not acceptable in project files.

In general, all calculations must:

1. Be neat and legible
2. List all design assumptions
3. List all formulas and define symbols
4. Group calculations for various portions of project
5. Number all pages in proper order
6. Provide indices for quick reference
7. Be filed for future reference when complete
8. Footnote all references

Numerical computations should be neat. They should define the criteria and assumptions used in the calculations. Any deviations from recognized codes and procedures should be defined in detail. Remember that computations are part of the design file and that it may be necessary to rely on them in the future. The fact that this situation may occur at some time following their completion points up the need for thoroughness, documentation and neatness. The checker should verify reasoning and formula and should always use a different approach to checking values. For example, if the Manning Equation is used to design a channel, published nomographs can be used to verify the resulting values. Beware of "booby trap" calculations. For example, in the calculation of a beam deflection, some very large values are used in a formula to yield a very small number.

The following detailed procedures have been established for checking, backchecking and final review of all engineering design calculations.

1. Checking
 - a. The checker (someone other than the originator and with equal or greater technical ability) shall examine the original calculations as prepared by the originator for:

QUALITY ASSURANCE PLAN

- o Project design criteria
 - o Recognized codes and procedures
 - o Compatibility with other associated project documents
- b. The checker shall determine if the document is suitable and adequate to accomplish the required function.
 - c. The checker shall mark in red on the original calculation each formula, procedure, assumption, calculation, etc., that has been checked and is correct.
 - d. The checker shall line out in red (but not to the extent that the original calculation or formula cannot be easily read) any incorrect calculations and mark in red immediately above (or adjacent to) the correct calculation.
 - e. The checker shall add in red any additional comments, formulas, references or calculations as required to further clarify the design calculations.
 - f. If any calculation is checked by the checker using independent means (computer programs, nomographs, etc.), these calculations shall immediately follow the original and the original marked "see independent check following."
 - g. Any calculations that are jointly determined by the originator and checker not to be applicable to the calculations shall be marked in red N/A or "not applicable" and initialed and dated by the originator and checker. The calculation shall remain with the calculation documents. A short remark as to the reason for the action should be included on the original.
 - h. Any calculation that is deemed void or has been revised shall be stamped "VOID" or "REVISED" respectively, dated and initialed and a short remark made as to the reason for the action.
 - i. The checker shall sign and date the original calculation and forward the calculation to the backchecker.
2. Backchecking
 - a. The originator shall review the checkers marks on the calculations.
 - b. The originator shall place a check mark in green near each of the checkers red-marked corrections and comments if he agrees with the correction or comment.
 - c. The originator shall consult with the checker if he does not agree with the red-marked changes. If both the checker and the originator agree that the document original should not be changed, the originator shall mark "OK" in green and initial each of the checker's red-marked corrections.
 - d. The backchecker shall sign and date the original and forward the calculations to the reviewer.
 3. Reviewing
 - a. The reviewer shall be appointed by the manager and shall not be the originator or the checker.

QUALITY ASSURANCE PLAN

- b. The reviewer shall review the checked documents for compatibility with the project requirements and for technical adequacy.
 - c. The reviewer shall review the calculations for compliance with the established Quality Control Procedures.
 - d. The reviewer shall resolve all review notations and comments with the originator.
 - e. If necessary, the reviewer shall have the document originals updated and checked as necessary to include the reviewer's comments.
 - f. The reviewer shall review the document originals to see that all of the agreed-to changes have been accurately made.
 - g. The reviewer shall sign and date the cover page of the calculations.
4. Document Package
- a. The Project Manager shall review the package of documents for professional quality, job requirements and client requirements.
 - b. The designated company officer or engineer will sign and impress or stamp their seal on the original documents that require this action.
 - c. The Project Manager shall submit the package of documents to the client for review, acceptance and approval.

Plan Review Procedures

The value to the client of a construction plan set, technical design, report, investigation or other professional service lies in its adequacy and dependability. The adequacy depends upon the integrity, attitude and thoroughness in which the professional has performed the task. To be dependable, the work must be grammatically correct and contain no mistakes, material errors or omissions. This aspect involves a thorough check of the design, plans, specifications and engineering estimates. Following are some procedures to be used in the checking process:

Use a standard checklist of items to review and work through the plans, verifying only a few items on the list at a time. Attempting to check too many items at once creates confusion and failure to check all items. In checking plans and specifications, two questions must be answered:

- a. Is the information shown in a clear, correct and concise manner? If not, what information must be added?
- b. Can the construction staking be completed and the project built from the information shown? If not, what information must be added?

In composing and reviewing notes on plans, employ precision and clarity. Ask what the notes need to say. Then ask if the note says it clearly. Bear in mind the people who will read and follow the instructions being covered. Be sure to use short, direct, grammatically correct sentences in the simplest possible language. Avoid using abbreviations unless they are widely accepted and well known. Be very careful in the proper selection of a word that may have more than one meaning and use. For example, the word "set" is given 25 meanings as a transitive verb, 18 as an intransitive verb and 18 as a noun.

QUALITY ASSURANCE PLAN

Specifications often include, by simple reference, standards from professional or trade associations. For the most part, inclusion of these standards by reference is an acceptable and word-saving practice. However, the design professional must be aware of the content of these standard specifications - some of them frequently allow alternative choices of materials and construction methods not acceptable to the project being designed. The job specification is not completed unless these alternatives are clearly accepted or modified to meet the particular circumstances of the design.

Do not duplicate data shown on plans and specifications. One reference within the contract documents is sufficient. Often a requirement is placed in both plans and specification documents for emphasis. Should a revision be necessary, confusion results when, all too often, one of the documents is changed, but not the other. Avoid specifying in schedules or tabular format the quantity of particular items shown in the plans. Proposal forms in specification documents should also state clearly that quantities shown are approximate and payment will be made for actual quantities furnished as verified by construction survey notes and field observation.

Plan Checking Procedures

In order to establish uniformity between the draftsmen and engineers, the following drawing checking procedure shall be followed:

1. Checking
 - a. Yellow
 - o Item has been checked.
 - o Item is correct.
 - b. Green
 - o Item shall be removed from the drawing.
 - c. Red
 - o Item has been checked.
 - o Item is in some manner incorrect. Draftsman shall correct or add to the drawing as indicated.
 - d. Blue
 - o Item has been corrected.
 - o Item has been backchecked.
 - e. Pencil
 - o Notes to draftsman.
 - o Additional information required.
2. Backchecking

QUALITY ASSURANCE PLAN

- a. Checker compares tracing with check print to verify that all corrections or additions have been made.
 - b. After verification, item is checked with blue on check print. DO NOT color to the extent that original drawing or additions made by checker cannot be easily read.
 - c. Items indicated in orange from above should be thoroughly checked.
3. Correcting
- a. Original draftsman should correct drawing whenever possible.
 - b. All items in red and green, either corrections, additions or removals should be checked for accuracy before the change is made on the drawing.
 - o Items in red or green that the draftsman does not agree with, should be discussed with the checker before any alterations are made.
 - c. DO NOT eliminate or change any item colored yellow from the drawing without approval by the checker and note any required change on check print.
 - d. After each red or green item is entered on the drawing, it should then be colored yellow on check print. DO NOT color to the extent that original drawing or additions made by checker cannot be easily read.
 - e. If it is necessary to erase or eradicate a section of the drawing, a note indicating the extent of this removal and replacement should be made in orange on the check prints.

Summary Statement

Quality Assurance is not only a methodical procedure to establish and maintain performance for all engineering work but, even more importantly, it is an attitude or philosophy that must be accepted by all members of the engineering team. Quality Assurance is an integral part of all of our day-to-day engineering activities. The Greiner team is fully committed to this concept as a key element of our major goal of engineering excellence.

QUALITY CONTROL FORM

Project Name _____

Greiner Job Number _____

Work Code _____

Item _____
Description _____

Submittal _____
Phase _____

Instructions

Plans. Both boxes are to be filled out and this sheet is to be attached to check prints/worksheets.

Calculation Sheets. The top box is to be filled out and attached to the package of calculations (i.e., drainage calculations, geometric calculations, quantity calculations, etc.).

When completed, this form is to be filed in the project Quality Assurance File.

	Name	Date
*Designed By		
Checked By		
*Backchecked By		

*Same Person

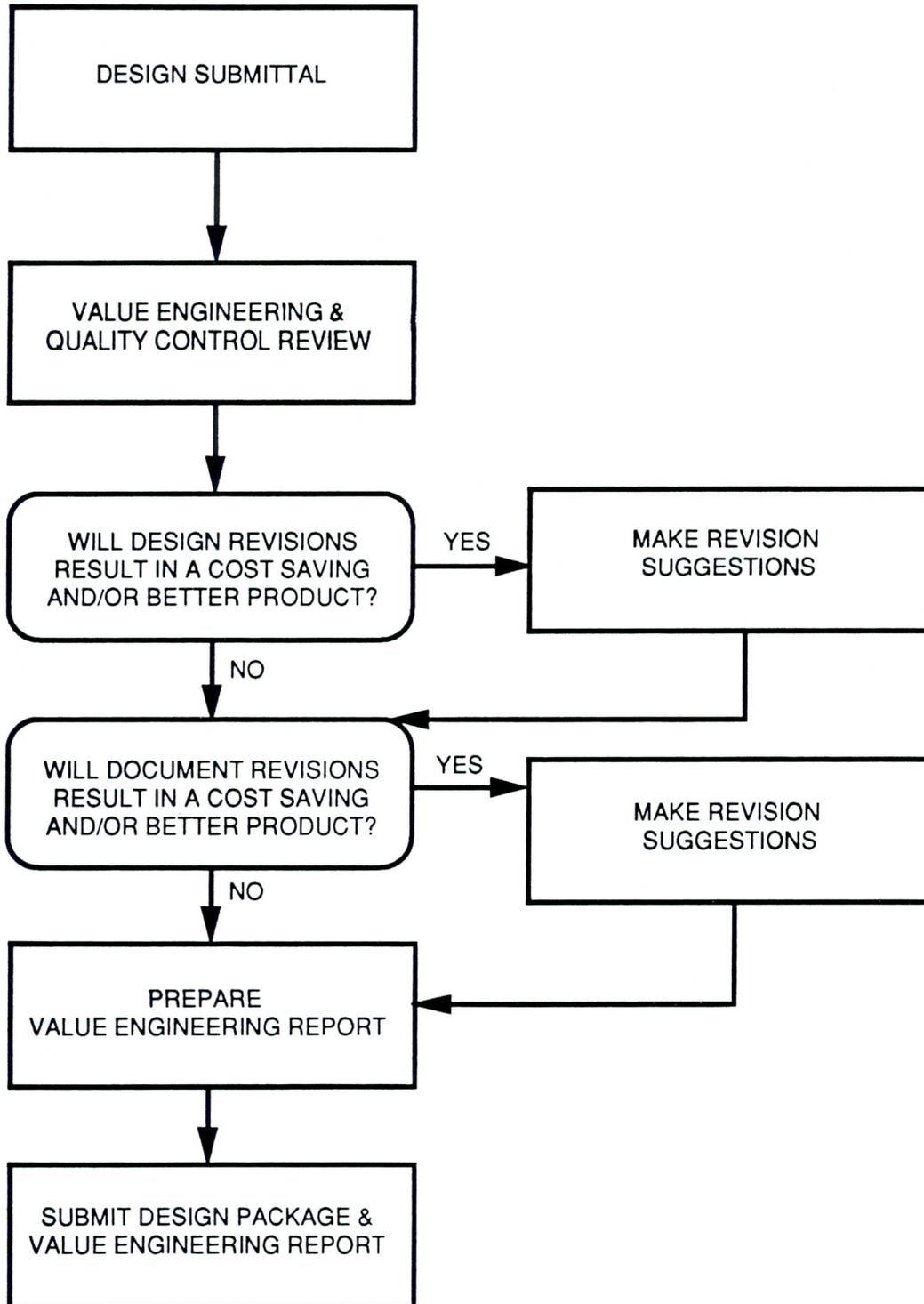
	Name	Date	Drafting Color Codes	
Drafted By			Yellow	Correct
**Checked By			Red	Needs Correction
**Backchecked By			Green	Delete
			Blue	Item Corrected
			Pencil	Notes to Drafter

**Same Person

Review Box is to be filled out by the project Quality Control Manager.

	Name	Date
Reviewed By		

VALUE ENGINEERING PROCESS





**PROJECT BUDGET BY TASKS, MANHOURS
AND BUDGET AMOUNT**

To be completed by the Project Manager
after Notice-To-Proceed

PRELIMINARY MANHOUR ESTIMATE

TASK	HOURS
Task 1 -- Mobilization and Planning	40
Task 2 -- Data Search	
o Data Search and Review	160
o Field Trip	40
o Brainstorming Workshop	40
o Environmental Evaluation	<u>120</u>
Total Task 2	360
Task 3 -- Preliminary Study and Report	
o Hydrology	120
o Drainage Impact Study	320
o Alignment Study and Right-of-Way	300
o Off-site Drainage Connection	120
o Hydraulic Analysis and Design	400
o Development of Alternatives and Structural Investigation	300
o Utilities Relocation	100
o Intersection Investigation	60
o Quantities and Cost Estimate	80
o Report	<u>200</u>
Total Task 3	2,000
Task 4 -- Survey and Mapping	
o Ground Control, Cross-Section and Culture Survey	620
o General Mapping	<u>380</u>
Total Task 4	1,000
Task 5 -- Geotechnical and Soils Report	300
Task 6 -- 30 Percent Plans	1,800
Task 7 -- Final Plans	4,200
Total Project Manhours	9,700

PRELIMINARY SHEET COUNT

ITEM	NUMBER OF SHEETS
<p>Cover Sheet The Flood Control District will provide the base map with the District's logo. Greiner will provide the project title and number, the location map and approvals check-off box.</p>	1
<p>General Notes General Notes, Construction Notes, Legend, Index of Sheets, Survey - Monumentation.</p>	1
<p>Key Map and Master Profile The key map will provide the sheet location and alignment of the storm drain in plan view. The master profile (1" = 200') will include the hydraulic profile of the design flow in the system. The location of soil borings will also be shown.</p>	4
<p>Detail Sheet Off-site drainage connection (6) Utility relocations as necessary (9) Pavement reconstruction (3) Connection to the Arizona Canal Diversion Channel and provision for upstream improvements (1) Construction phasing and traffic control (6)</p>	25
<p>Plan Profile Sheet -- 22 Sheets Sheets will be prepared at 1" = 20' horizontal scale for the full project length of approximately 11,000 linear feet.</p> <p>Construction features in plan view will be shown with number references. A summary of all pay items will be on the right side of each sheet.</p> <p>Profile will show storm drain, all cross-utilities and existing grade at the monument line.</p> <p>TBM data is to be shown every 1,000 feet.</p> <p>A typical cross section at 1" = 10' vertical, and 1" = 10' horizontal will be provided on each sheet.</p>	22

PRELIMINARY SHEET COUNT

ITEM	NUMBER OF SHEETS
Structural Sheet Box culvert; dimensions and details (2 sizes) (4) Box culvert; details (standard pipe penetrations) (2) Transition structures (2) Flow equalizing chambers (2) Box culvert closure (temporary bulkhead) (1) Energy dissipator (if required) (2) Special connection to SRP gates (3) Drop inlet (2) Catch basin connector pipe/box connection (1) Manhole connection to box top slab (1) Bridges (if required) through analyses	20
Quantity Summary Sheet	2
Concrete Summary Sheet	1
Soil Boring Sheets 1 boring every 1,000 feet, 3 borings per sheet	4



CALCULATIONS / DESIGN / TECHNICAL MEMOS

- o All calculations will be placed on Greiner calculations sheets. Follow Quality Assurance Plan for checking procedures.
- o Bind all calculations (check Greiner practice).
- o Quantity determinations are considered "calculations" and, therefore, must conform to the above.
- o All calculations must clearly show (see sample next page):
 - Subject
 - Statement of Problem
 - Sources of Data
 - Assumptions
 - References
 - Sources of Formulas
 - Initials/Date of Calculator
 - Initials/Date of Checker

Greiner

Greiner, Inc.

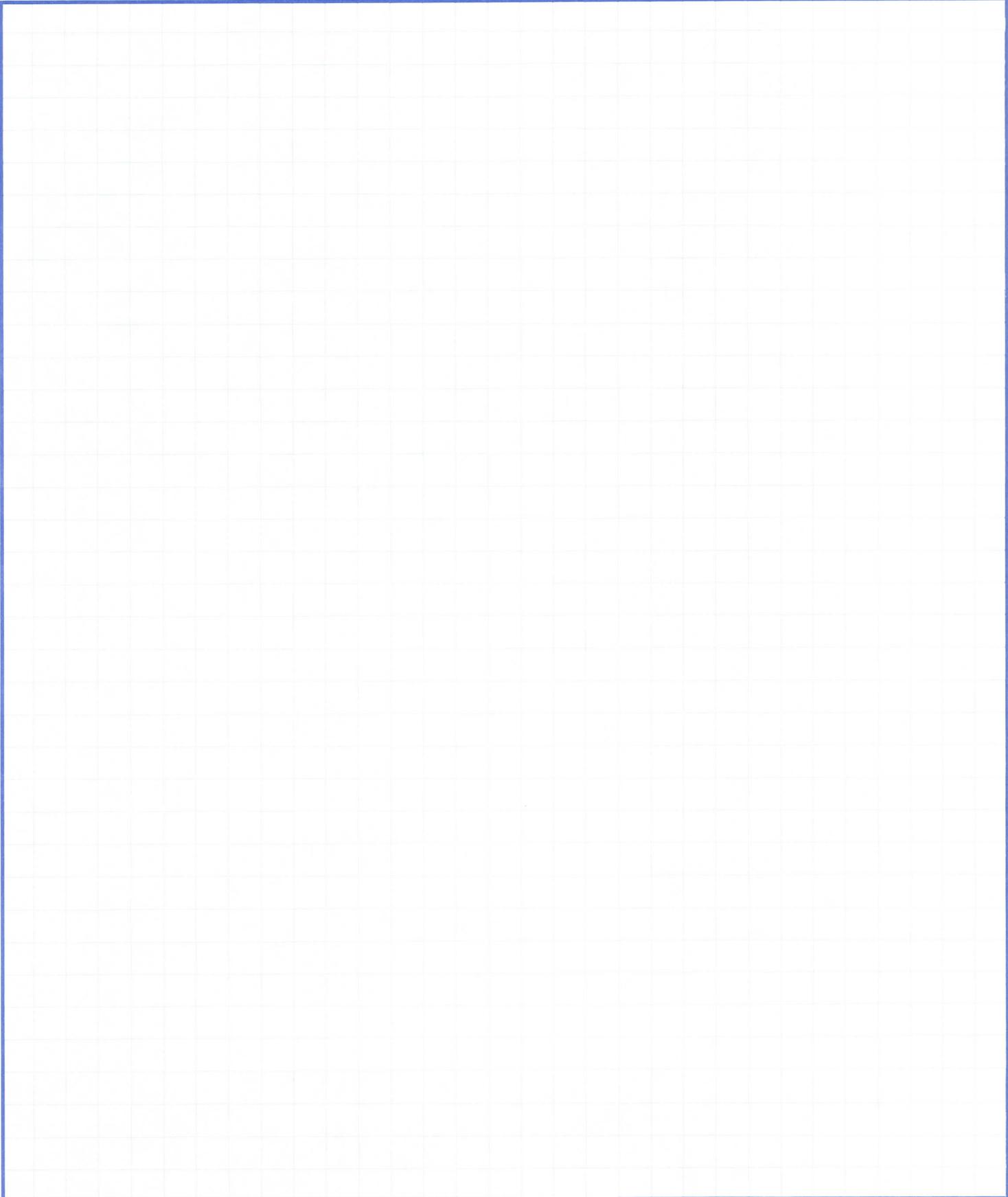
Tucson 602 887-1800
Phoenix 602 275-5400

Job _____

Description _____

Calculated by _____ Date _____ Sheet No. _____

Checked by _____ Date _____ of _____



Job No. E113014

August 10, 1988

DESIGN MEMORANDUM #11

Tonto Hatchery Renovation Hydraulic Correction Design Phase II

SUBJECT: HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

Source: Maskell Co. - John Stockton
Ralph Maskell (Tuscon) 294-7666

To eliminate the head loss due to the butt-fused joints in the High Density Polyethylene Pipe (HDPE) and fittings (90°, 45° and Tee), either molded polyethylene fittings or fabricated fittings (w/bead removal) can be used to replace the existing fittings. The removal of beads from existing fittings is not recommended because existing piping may be easily broken or damaged during the process.

To connect a polyethylene fitting (90°, 45° or Tee) to a polyethylene pipe, a Victaulic Hugger Connector with mechanical joint can be used for any diameter up to 12 inches. For pipe sizes larger than a 12 inches, a dresser coupling should be used. When a pipe needs to be extended for a short length to connect a fitting such as a 90° elbow, a cut length of HDPE can be used to fit in by installing clamps and coupling at the ends, if a butt-fused connection is not considered. Cost for using a coupling instead of a butt-fused joint is considered to be much more expensive.

The SDR piping pressure rating for fabricated fittings will be reduced to 60% (for example: HDPE SDR11 can withstand a pressure of 160 psi, a fabricated fitting made from SDR11 can only withstand a pressure of $160 \text{ psi} \times 0.6 = 96 \text{ psi}$). The fabricated 90° elbow will be a long radius elbow.

The minimum SDR used for molded polyethylene fittings is SDR11 because the machine which molds the fittings can not make any wall thickness less than SDR11. The 90° molded elbow will be a short radius elbow.

Prices for different size Connectors and Couplings are:

Connector	8"	\$124.25
(Steel, Style 995)	10"	\$142.89
	12"	\$164.68
Dresser	14"	\$169.20
coupling (Steel	16"	\$183.10
Style 38)	18"	\$201.78

SAMPLE

Greiner

Prices for different sizes of molded and fabricated fittings are quoted below:

<u>Fittings</u>	<u>Size (in.)</u>	<u>Molded Fittings (SDR11)</u>	<u>Fabricated Fitting w/bead removal (SDR11)</u>
90°	8	\$ 109.09	\$ 262.31
	10	\$ 295.03	\$ 366.93
	12	\$ 337.67	\$ 484.93 (compare to \$284.23 w/o bead removal)
	14	--	\$ 601.47
	16	--	\$ 763.11
	18	--	\$1042.28
45°	8	\$ 109.09	\$ 135.86
	10	\$ 301.48	\$ 193.38
	12	\$ 344.62	\$ 281.15
	14	--	\$ 342.63
	16	--	\$ 422.46
	18	--	\$ 594.03
Tee	8	\$ 142.81	\$ 180.49
	10	\$ 326.77	\$ 242.41
	12	\$ 407.09	\$ 329.24
	14	\$ --	\$ 402.13
	16	\$ --	\$ 496.84
	18	\$ --	\$ 789.39

Dimensions of different sizes of molded and fabricated fittings are:

<u>Fittings</u>	<u>Size (in.)</u>	<u>Molded Fittings (in.)</u>					<u>Fabricated Fittings (in.)</u>				
		<u>R</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>R</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
90°	8	6	12				12	17			
	10	7 1/4	13 1/4				14	18			
	12	8 1/4	15 3/4				18	30			
	14	--	--				21	33			
	16	--	--				24	36			
	18	--	--				27	39			
45°	8	9 5/8		10			12	9 7/8			
	10	17 1/2		13 1/4			14	9 3/4			
	12	20		15 3/4			18	19 3/8			
	14	--		--			21	20 3/8			
	16	--		--			24	20 3/4			
	18	--		--			27	23 1/16			
Tee	8				24	12			28	14	
	10				26 1/2	13 1/4			28	14	
	12				31	15 1/2			30	15	
	14				--	--			32	16	
	16				--	--			32	16	
	18				--	--			38	19	

Greiner

HDPE SDR information:

<u>SDR</u>	<u>Pressure at Ambient Temperature</u>	<u>I.D.</u> (in.)	<u>12" Size</u> <u>Wall Thickness</u> (in.)	<u>Weight</u> (lb./ft.)
31.5	52 psi			
26	65			
21	80			
17	100	11.250	0.750	12.0
15.5	110	11.104	0.823	13.12
11	160			
7	255			

Material for Polyethylene Pipe:

Driscopipe 1000 - Good only for clear solution, no high stress condition such as pump piping

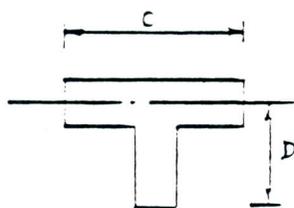
Driscopipe 8600 - Good for abrasive and high stress condition.

Driscopipe 100 should be the type of material used for this project and is supplied by Phillips Petroleum.

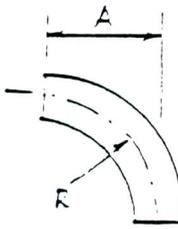
Price for different sizes of HDPE

<u>SDR</u> (100 psi)	<u>Size (in.)</u>	<u>*Price (Per ft.)</u>
17	8	4.85
	10	7.54
	12	10.60
	16	12.18
	14	16.70
	18	21.14

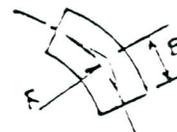
* Price is subject to change



TEE



90°

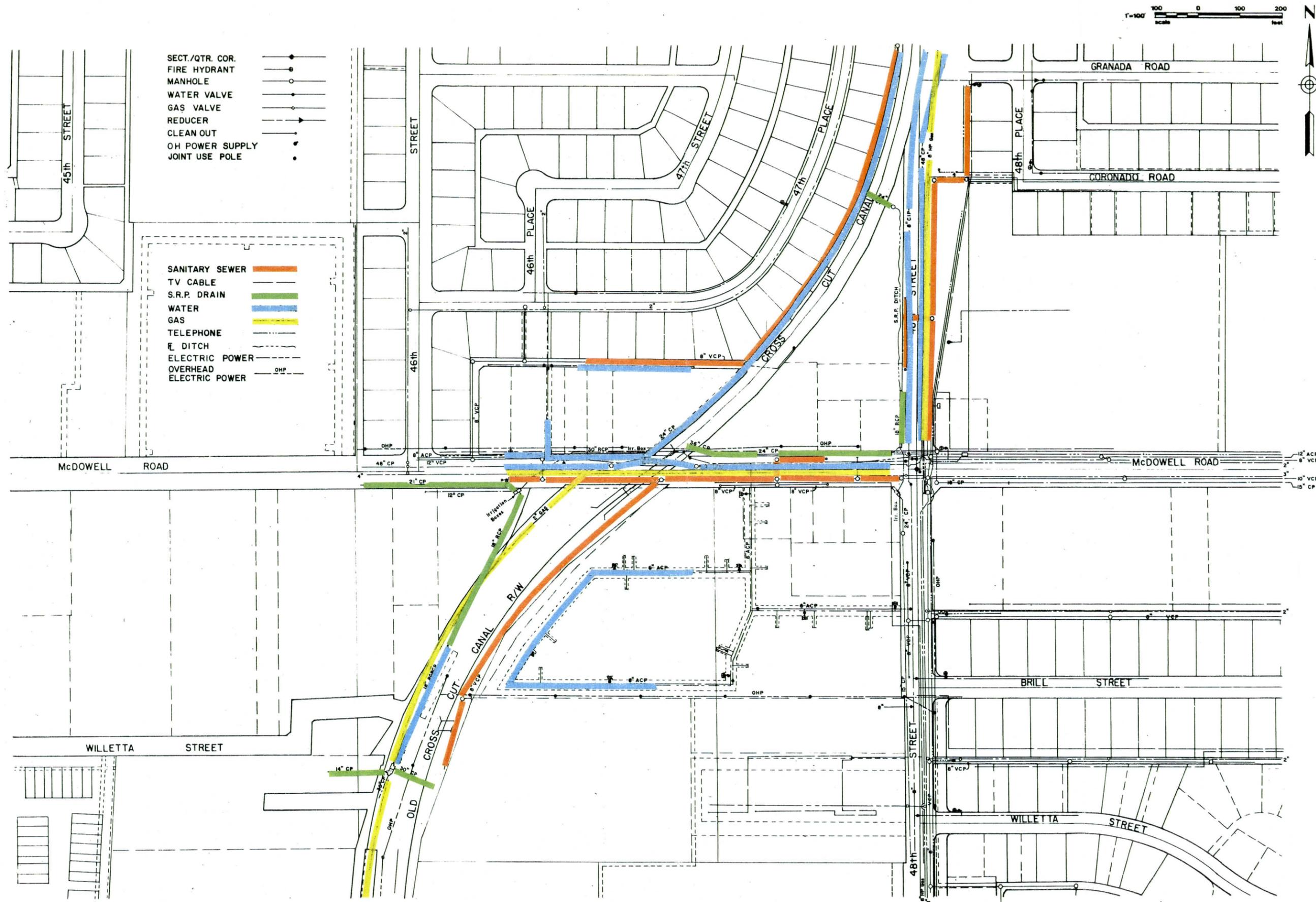


45°

cc: Project File
 Larry Goddard - Arizona Game and Fish
 Roger Sorenson - Arizona Game and Fish

2:TONTD





- SECT./QTR. COR.
- FIRE HYDRANT
- MANHOLE
- WATER VALVE
- GAS VALVE
- REDUCER
- CLEAN OUT
- OH POWER SUPPLY
- JOINT USE POLE

- SANITARY SEWER
- TV CABLE
- S.R.P. DRAIN
- WATER
- GAS
- TELEPHONE
- DITCH
- ELECTRIC POWER
- OVERHEAD
- ELECTRIC POWER

**OLD CROSS CUT CANAL
FLOOD CONTROL
IMPROVEMENTS**

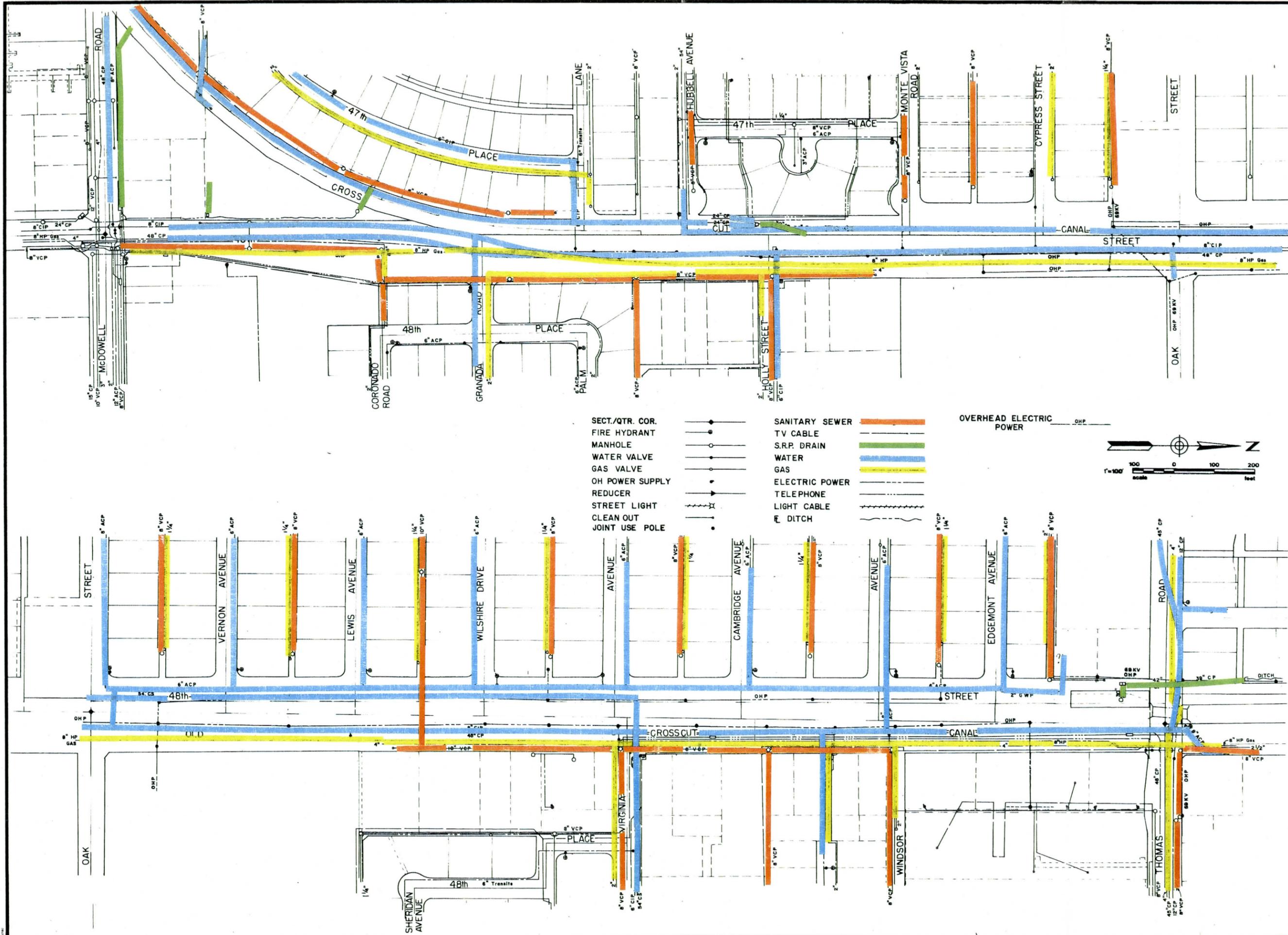
**FLOOD CONTROL
DISTRICT OF
MARICOPA COUNTY**

Greiner Engineering
Greiner Engineering Sciences, Inc.
Greiner Engineering Sciences, Inc.
1700 N. 19th Street, Suite 100, Phoenix, Arizona 85006, 602-275-5400
555 East River Road, Suite 100, Tucson, Arizona 85704, 520-687-1800

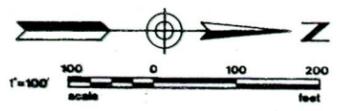
Design
Drawn **K.R.S.**
Check **SS.**
Scale **N.T.S.**
(Reduced)

UTILITY INVENTORY

Date **AUG., 1990**
Job No.
Sheet **1** of **3**



- | | | | | | |
|-----------------|---|----------------|---|-------------------------|-----|
| SECT./QTR. COR. | ● | SANITARY SEWER | — | OVERHEAD ELECTRIC POWER | OHP |
| FIRE HYDRANT | ⊙ | TV CABLE | — | | |
| MANHOLE | ○ | S.R.P. DRAIN | — | | |
| WATER VALVE | ⊙ | WATER | — | | |
| GAS VALVE | ⊙ | GAS | — | | |
| OH POWER SUPPLY | ⊙ | ELECTRIC POWER | — | | |
| REDUCER | ⊙ | TELEPHONE | — | | |
| STREET LIGHT | ⊙ | LIGHT CABLE | — | | |
| CLEAN OUT | ⊙ | DITCH | — | | |
| JOINT USE POLE | ⊙ | | | | |



**OLD CROSS CUT CANAL
FLOOD CONTROL
IMPROVEMENTS**

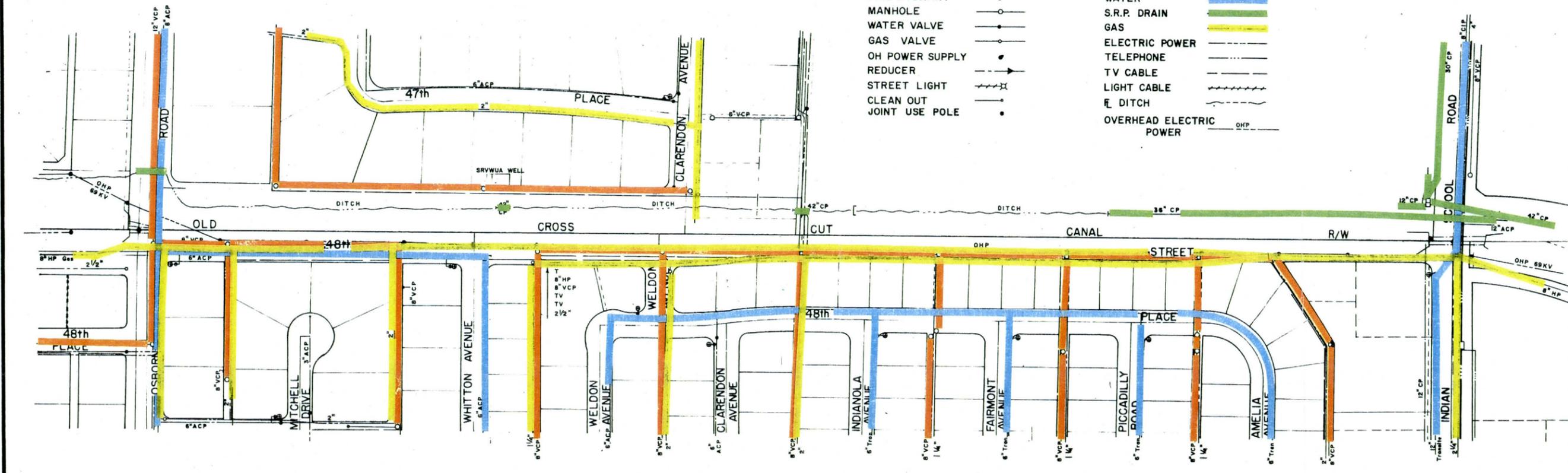
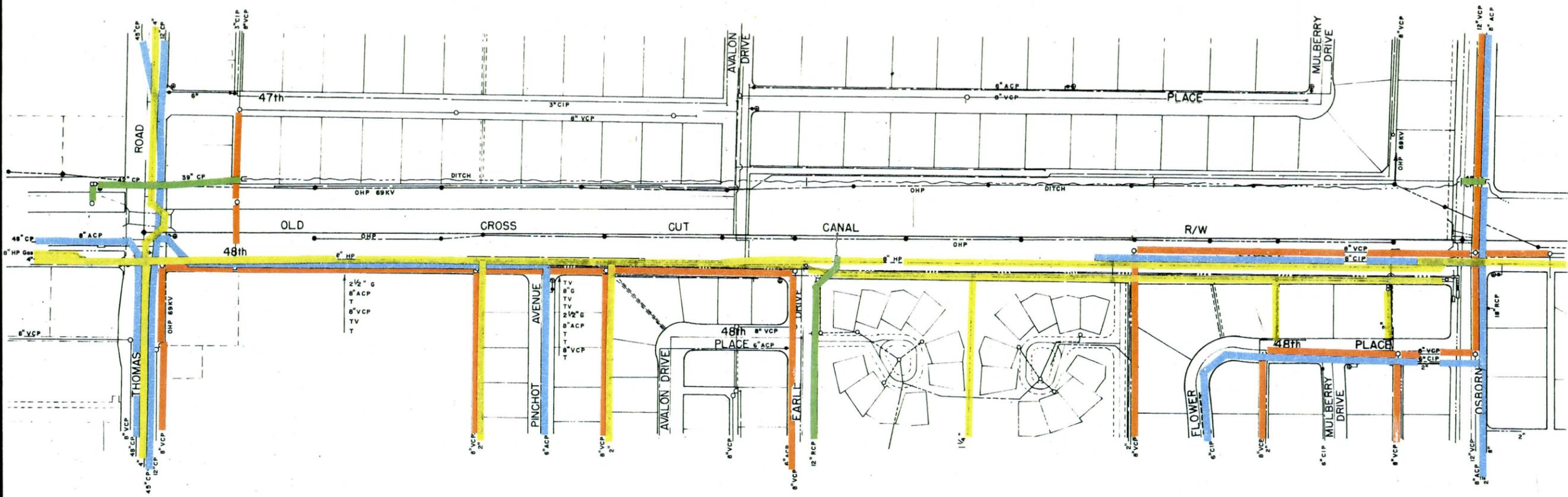
**FLOOD CONTROL
DISTRICT OF
MARICOPA COUNTY**

Greiner Engineering
 Greiner Engineering Sciences, Inc.
 1000 West Camelback Road, Suite 100, Phoenix, Arizona 85015
 Phone: (602) 998-1100

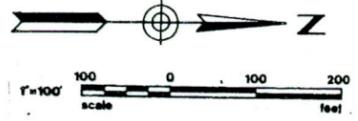
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Checked	SS
Scale	N.T.S.
(Reduced)	

UTILITY INVENTORY

Date	AUG., 1990
Job No.	
Sheet	2 of 3



- | | | | |
|-----------------|-----|-------------------------|-----|
| SECT./QTR. COR. | —●— | SANITARY SEWER | — |
| FIRE HYDRANT | —●— | WATER | — |
| MANHOLE | —○— | S.R.P. DRAIN | — |
| WATER VALVE | —○— | GAS | — |
| GAS VALVE | —○— | ELECTRIC POWER | — |
| OH POWER SUPPLY | —●— | TELEPHONE | — |
| REDUCER | —○— | TV CABLE | — |
| STREET LIGHT | —○— | LIGHT CABLE | — |
| CLEAN OUT | —○— | DITCH | — |
| JOINT USE POLE | —●— | OVERHEAD ELECTRIC POWER | OHP |



**OLD CROSS CUT CANAL
FLOOD CONTROL
IMPROVEMENTS**

**FLOOD CONTROL
DISTRICT OF
MARICOPA COUNTY**

Greiner Engineering
Greiner Engineering Sciences, Inc. • Greiner Engineering, Inc. • Greiner Engineering, Inc. • Greiner Engineering, Inc.
Greiner Engineering Sciences, Inc. • Greiner Engineering Sciences, Inc. • Greiner Engineering Sciences, Inc. • Greiner Engineering Sciences, Inc.
555 East River Road • Suite 100 • Tucson, Arizona 85704 • 802-887-1800

Design	
Drawn	K.R.S.
Check	S.S.
Scale	N.T.S. (Reduced)

UTILITY INVENTORY

Date	AUG. 1990
Job No.	
Sheet	3
of	3



11-Sep-86

SUN VALLEY PARKWAY
COST ESTIMATE
by Greiner Engineering Sciences, Inc.

Item No.	Description	Unit	Quantity	Rate	Total Amount
1.0	Clear & Grub R.O.W.	ACRES	540	\$300.00	\$162,000.00
2.0	Removal & Replanting Cactus/Shrubs	ACRES	540	500.00	270,000.00
3.0	Scarify/Preparation of Subgrade or Prewet and Compact	SY	1,800,000	0.25	450,000.00
4.0	Excavate/Place In Embankment	CY	215,335	1.50	323,002.50
5.0	Borrow Material	CY	1,164,360	2.50	2,910,900.00
5.1	Within 1500 ft Haul	CY	0	2.50	0.00
5.2	Extra for 2 Mile Haul	CY/MILE	835,535	0.50	417,767.50
5.3	Extra for 6 Mile Haul	CY/MILE	430,425	1.50	645,637.50
6.0	Structural Excavation	CY	133,384	10.00	1,333,840.00
7.0	Structural Backfill	CY	21,754	15.00	326,310.00
8.0	Concrete Box Culverts (Incl Headwalls)	CY	60,732	200.00	12,146,400.00
8.1	Concrete/Formwork	TONS	5,074	800.00	4,059,200.00
8.2	Rebar - Supply/Place	TONS	5,074	800.00	4,059,200.00
9.0	Corrugated Metal Pipe Culverts				
9.1	50 x 31 CMP	LIN FT	6,077	65.00	395,005.00
9.2	43 x 27 CMP	LIN FT	8,832	45.00	397,440.00
9.3	36 x 22 CMP	LIN FT	4,521	35.00	158,235.00
9.4	29 x 18 CMP	LIN FT	4,740	30.00	142,200.00
9.5	72" Dia CMP	LIN FT	857	70.00	59,990.00
9.6	48" Dia CMP	LIN FT	771	55.00	42,405.00
9.7	36" Dia CMP	LIN FT	0	45.00	0.00
10.0	Concrete Headwalls @ CMP				
10.1	Concrete	CY	3,489	500.00	1,744,500.00
10.2	Rebar	TONS	116	800.00	92,800.00
11.0	Grouted Riprap	SY	36,420	25.00	910,500.00
12.0	Concrete Curbs				
12.1	Detail 'A'	LIN FT	318,000	6.00	1,908,000.00
12.2	Detail 'B'	LIN FT	318,000	3.50	1,113,000.00
13.0	AC Paving (4")	TONS	298,000	25.00	7,450,000.00
14.0	Aggregate Base/Select (Avg 16 Mile Haul)				
14.1	4" AB	TONS	286,690	7.00	2,006,830.00
14.2	4" Select	TONS	270,000	5.50	1,485,000.00
15.0	Traffic Control				
15.1	Striping	LIN FT	633,600	0.12	76,032.00
15.2	Misc Equip/Devices	MILE	30	2,500.00	75,000.00
16.0	Drainage Channelization				
16.1	Excavation/Shaping	CY	105,979	5.00	529,895.00
16.2	Relief Piping - 12"	LIN FT	1,200	12.00	14,400.00
17.0	Parkway Grading				
17.1	Median	SY	282,000	0.50	141,000.00
17.2	Shoulders	SY	1,056,000	0.15	158,400.00
17.3	Catch Basins/Pipe	EA	39	1,750.00	68,250.00
18.0	Landscape Medians	SY	282,000	1.00	282,000.00
19.0	Fencing (4-Wire)	MILE	10	5,000.00	50,000.00
20.0	Handrailing (H-2-1)	LIN FT	13,500	60.00	810,000.00
21.0	Intersection Work (1 Mile Apart)				
21.1	Curb & Gutter	LIN FT	6,000	7.00	42,000.00
21.2	Concrete Valley Gutter & Apron	SF	21,990	2.75	60,472.50
21.3	Barricades	LIN FT	4,200	35.00	147,000.00
21.4	Conduit (3")	LIN FT	12,000	6.00	72,000.00
21.5	Pull Boxes	EA	360	200.00	72,000.00
21.6	Paving (4/8)	SY	5,000	9.50	47,500.00
22.0	Dam Over Trilby Wash Levee				
22.1	Excavation/Fill	CY	140,000	2.50	350,000.00
22.2	CMP's Under Dam	LIN FT	1,500	100.00	150,000.00
23.0	Wagner Wash/CBC's	EA	2	250,000.00	500,000.00
24.0	Beardsley Canal CBC	EA	1	150,000.00	150,000.00
					=====
* * TOTAL ESTIMATED PROJECT COST * *					\$44,746,912.00

Job No. E113044

August 17, 1990

CANYON CREEK HATCHERY
General Improvements

Description	Quantity	Unit	Unit Cost	Total Cost
SPRINGWATER INTAKE				
Remove and install 20'-18" CMP for Box A:				
Remove existing 18" CMP		LS	\$200.00	\$200.00
Excavate existing rock	6	HR	100.00	600.00
Install concrete cradle	3	HR	25.00	75.00
18" CMP installed	20	LF	44.00	880.00
Concrete	2	YD ³	250.00	500.00
Repair leak at west bottom of Springbox A:				
Clean area (wirebrush)	4	HR	17.00	68.00
Hydraulic cement	1	60 LB BKT	44.00	44.00
Labor for application	4	HR	25.00	100.00
Refinish collection boxes:				
Sandblast	4	HR	75.00	300.00
Concrete patch	33	GAL	33.33	1,100.00
Labor for application	4	HR	23.00	92.00
Repair concrete pipe cap:				
Remove old concrete and install ten No. 4 dowels	8	HR	20.00	160.00
High-strength grout for dowels	4	GAL	40.00	160.00
Concrete	1	YD ³	300.00	300.00
Dewater area		LS	700.00	700.00
Labor to place concrete	2	HR	23.00	46.00
Remove wood cover on Springbox "B" overflow pipe and install Armco flap gate on "A" and "B" overflow pipes:				
Armco flap gate	2	EA	600.00	1,200.00

Description	Quantity	Unit	Unit Cost	Total Cost
Labor to remove wooden board and install flap gate	2	HR	17.00	34.00
CONCRETE JUNCTION STRUCTURE				
Refinish				
Sandblast	2	HR	75.00	150.00
Patch compound	8	GAL	40.00	320.00
Labor for patch application and forming	2	HR	23.00	46.00
Replace screen cage:				
Remove existing screen support and drill/grout support bolts	3	HR	17.00	51.00
Remove old screen from support and discard screen; retain support	5	HR	17.00	85.00
New screen (2 yards; old support)		LS	150.00	150.00
Install new screen	3	HR	17.00	51.00
High-strength grout	1	GAL	40.00	40.00
SETTLING TANKS				
Repair leaking concrete discharge structure:				
Clean area	2	HR	17.00	34.00
Sandblast	2	HR	75.00	150.00
Labor for application	2	HR	23.00	46.00
Hydraulic cement	1	60 LB BKT	44.00	44.00
Clean plates and paint return structure, diversion structure and manhole access covers:				
Sandblast	8	HR	75.00	600.00
Primer application	8	HR	23.00	184.00
Paint application	8	HR	23.00	184.00
Primer	1	GAL	20.00	20.00
Paint	1	GAL	20.00	20.00
Replace broken pipe downstream of the return structure:				
Replace 16" ACP		LS	44.00	44.00

Description	Quantity	Unit	Unit Cost	Total Cost
Excavate and backfill	3	HR	100.00	300.00
RETENTION STRUCTURE				
Reshape retention basin:				
Remove existing excess sediment (reshape floor)	2	HR	100.00	200.00
LOW FLOW CROSSING				
Replace existing concrete:				
Remove existing eroded concrete	4	HR	100.00	400.00
Dewater area		LS	700.00	700.00
Labor for forming and concrete placement	6	HR	23.00	138.00
Concrete	23	YD ³	300.00	6,900.00
DIVERSION VALVES				
Refinish metal covers:				
Sandblast	2	HR	75.00	150.00
Labor to prime and paint	3	HR	28.00	84.00
Primer	1	GAL	20.00	20.00
Paint	1	GAL	20.00	20.00
SURGE TANK				
Renovate surge tank:				
Renovate		LS	9,100.00	9,100.00
REARING POND				
Repair pipe collapse between Pond Nos. 5 and 6:				
Excavate pipe	2	HR	100.00	200.00
Remove and replace broken 12" pipe	1	HR	150.00	150.00
Install flexible coupling	2	HR	150.00	300.00
Backfill and compact	3	HR	17.00	51.00
Repair cracks at inlet and outlet structures:				
Sandblast	8	HR	75.00	600.00

Description	Quantity	Unit	Unit Cost	Total Cost
Install flexible sealant		LS	300.00	300.00
Remove existing broken concrete at Pond No. 3 and repair:				
Remove broken concrete	3	HR	17.00	51.00
Excavate to depth required to repair break	2	HR	100.00	200.00
Sandblast	1	HR	75.00	75.00
Drill four dowel holes and grout	2	HR	23.00	46.00
Backfill and compact and form for concrete replacement, pour concrete	3	HR	150.00	450.00
Concrete	1	YD ³	300.00	300.00
Repair broken waste grates:				
New grates with frames	6	EA	100.00	600.00
ELECTRIC POWER				
Turbine reconditioning:				
Representative from Leffel to come to site and disassemble, pack-up and ship back to Ohio	24	HR	80.00	1,920.00
Leffel to inspect and repair turbine		LS	2,000.00	2,000.00
Leffel to reassemble and ship back to Hatchery with one worker to install and calibrate	35	HR	80.00	2,800.00
Kato to inspect, renovate and calibrate hydroelectric generator	60	HR	80.00	4,800.00
Woodward to inspect, renovate and calibrate governor and hydraulic amplifier	60	HR	80.00	4,800.00
Kohler to inspect, renovate and recalibrate generator	60	HR	80.00	4,800.00
SEWAGE COLLECTION AND TREATMENT				
Provide mechanical action:				
Remove existing 1/3 h.p. pump which is non-operational	1	HR	17.00	17.00
Install new 1/3 h.p., 1,725 rpm, Phase I pumps	8	HR	20.00	160.00

Description	Quantity	Unit	Unit Cost	Total Cost
New 1/3 h.p., 1,725 rpm, Phase I pumps	2	EA	135.00	270.00
Install new treatment facility:				
Excavate for facility	4	HR	100.00	400.00
Install new facility	2	HR	140.00	280.00
New facility (includes \$1,500 shipping)	1	EA	8,950.00	8,950.00
Backfill new tanks	3	HR	140.00	420.00
Excavate for new diversion structure	1	HR	140.00	140.00
Form work and steel work	3	HR	28.00	84.00
Structural concrete	2	YD ³	250.00	500.00
Backfill around diversion structure	2	HR	140.00	280.00
Install new leach field:				
Dig 700' of trench	8	HR	100.00	800.00
Install crushed rock	56	YD ³	45.00	2,520.00
Lay 190' of 4" VCP	2	HR	140.00	280.00
4" perforated PVC or bituminous pipe	7	HR	140.00	980.00
SETTLING PONDS				
Clean:				
Drain ponds	8	HR	17.00	136.00
Remove sediment	6	HR	17.00	102.00
Install handles on drain boards (two handles/board, one on each side):				
Labor to attach handles	4	HR	17.00	68.00
Handles	32	EA	5.00	160.00
Refinish and repair cracks and chipped edges:				
Sandblast	4	HR	75.00	300.00
Patch (eleven 3-gallon kits)	33	GAL	36.00	1,188.00
Application	3	HR	23.00	69.00
Install walkway grate for draining ponds at weir:				
Drill and grout bolts	2	HR	23.00	46.00

Description	Quantity	Unit	Unit Cost	Total Cost
Install grate	2	HR	17.00	34.00
Grate	144	FT ³	16.25	2,340.00
Repair leaks in central wall:				
Sandblast	2	HR	75.00	150.00
Concrete	1	YD ³	250.00	250.00
Labor for placement	3	HR	23.00	69.00
DISCHARGE STRUCTURE				
Refinish structure:				
Sandblast	2	HR	75.00	150.00
Apply patch	2	HR	23.00	46.00
Patching compound (three 3-gallon kits)	9	GAL	41.00	369.00
Trash rack:				
Labor	2	HR	23.00	46.00
Trash rack		LS	250.00	250.00
DOMESTIC CHLORINATOR				
Labor to install system	6	HR	23.00	138.00
System		LS	3,500.00	3,500.00
EXISTING DRAINAGE CHANNEL				
Renovate channel:				
Remove debris from previous storms	3	HR	100.00	300.00
Dumped rock	24	YD ³	45.00	1,080.00
Install 60'-18" CMP	60	LF	44.00	2,640.00
Encased concrete	19	YD ³	250.00	4,750.00
SITE IMPROVEMENTS				
Roadway and Drainage		LS	200,000.00	200,000.00

Description	Quantity	Unit	Unit Cost	Total Cost
OUTDOOR LARGE RACEWAY (RECOMMENDED ALTERNATIVE)				
Mobilization		LS	5,000.00	5,000.00
Demolition:				
Pipeline removal	810	LF	6.00	4,860.00
Pipe plug	9	EA	400.00	3,600.00
Earthwork:				
Cut	4,500	YD ³	3.50	15,750.00
Fill	7,000	YD ³	5/15.00	60,000.00
Inflow line:				
18" PVC	540	LF	25.00	13,500.00
18" tee	8	EA	1,120.00	8,960.00
18"-90 degree elbow	9	EA	750.00	6,750.00
18"-45 degree elbow	10	EA	590.00	5,900.00
18" valve with actuator	9	EA	1,800.00	16,200.00
2" drain valve	8	EA	175.00	1,400.00
Installation	140	HR	150.00	21,000.00
Reuse line:				
18" PVC	1,100	LF	25.00	27,500.00
18" tee	11	EA	1,120.00	12,320.00
18"-90 degree elbow	18	EA	750.00	13,500.00
18" valve with actuator	15	EA	1,800.00	27,000.00
2" drain valve	6	EA	175.00	1,050.00
Installation	220	HR	150.00	33,000.00
Waste line:				
18" PVC	510	LF	25.00	12,750.00
18" tee	7	EA	1,120.00	7,840.00
18"-90 degree elbow	8	EA	750.00	6,000.00
Installation	70	HR	150.00	10,500.00

Description	Quantity	Unit	Unit Cost	Total Cost
Raceway:				
Rearing tanks (125' x 10' x 3')	8	EA	20,000.00	160,000.00
Baffles	85	EA	300.00	25,500.00
Screen	8	EA	300.00	2,400.00
Pack column (5' x 36")	8	EA	3,500.00	28,000.00
18" riser	8	EA	1,000.00	8,000.00
Stand pipes	8	EA	250.00	2,000.00
Mud valves	8	EA	250.00	2,000.00
Grate	8	EA	100.00	800.00
Weather port (127' x 25') (120 mph wind)		LS	94,951.00	94,951.00
Demand feeder with stand	32	EA	300.00	9,600.00
Cat walk (12' x 2')	24	EA	200.00	4,800.00
Electrical wiring		LS	10,000.00	10,000.00
Installation	200	HR	150.00	30,000.00



PROJECT UNDERSTANDING

PROJECT OVERVIEW

The Flood Control District of Maricopa County has been responsible for the planning, design and construction of flood control projects since 1959. The District is a municipal corporation and political subdivision of the State of Arizona and is governed by a Board of Directors, which is also the Board of Supervisors of Maricopa County. The activities of the District are funded by a Flood Control Tax Levy assessed on all real property within Maricopa County, and a variety of cost sharing arrangements with other agencies.

The Flood Control District plans to contract for engineering services for the Old Cross Cut Canal Flood Control Improvements. The work under this contract consists of preparing plans and specifications for construction of improvements to the existing Old Cross Cut Canal, from just south of the Arizona Canal (north of Indian School Road) to McDowell Road.

The Arcadia area drainage was studied a few years ago in conjunction with the City of Phoenix, Corps of Engineers and the Flood Control District. At that time, there was some hope that this drainage project would qualify for Corps of Engineers funding. This participation did not materialize, but the City of Phoenix and the Flood Control District are developing an intergovernmental agreement for cost sharing of this conduit.

The Old Cross Cut Canal Improvement Project will require development of a hydraulic conduit structure that will accommodate large design flows of stormwater, minimize construction and maintenance costs, and be constructible in a developed urban environment. Construction of the structure along this urban corridor will require resolution of conflicts with major sanitary sewer trunks and water mains, special structures at street crossings and connections to major storm laterals, and efforts to minimize the profile depth and structural section requirements. Constructibility will also be a key challenge given the need to minimize the time required for construction and the potential for storm flows in the existing channel during construction.

KEY ISSUES

Greiner is intimately familiar with this section of the Old Cross Cut Canal. Greiner studied and prepared a report for the City of Phoenix that provides preliminary engineering for an enclosed conduit to carry flows in the Old Cross Cut Canal. The report also provides, in some detail, a roadway that will traverse the Old Cross Cut Canal alignment, running from the north terminus of the Hohokam Expressway to Indian School Road. We have augmented our background knowledge with additional information provided in the Request for Proposal, discussions with Flood Control staff and field visits. We have identified several key issues which must be addressed during the development of this project. These key issues include:

o Compatibility with Other Improvements

Compatibility among the Old Cross Cut Canal improvements, proposed City of Phoenix roadway improvements and area-wide off-site drainage.

o Construction Planning During the Course of the Design and Construction Plan Development

This includes provision for controlled drainage during construction, construction methods, construction material, easements and material storage that may have an impact on the neighborhood, and maintenance of traffic through existing intersections.

PROJECT UNDERSTANDING

o **Contaminated Groundwater in the Vicinity of McDowell Road and the Old Cross Cut Canal**

The area has been declared a Superfund site by the Environmental Protection Agency. Remedial action is currently under evaluation by Motorola, the alleged originator of the contaminants. The presence of trichlorethylene in the project site will require compliance with OSHA regulations providing for health and safety planning for field personnel working on-site.

o **Agency / Public Coordination**

While Greiner's work on this project is directed by the Flood Control District, we recognize that this is a multi-faceted/multi-agency project with substantial interest from neighborhoods, City Council representatives, City Parks Department, Arts Commission, City Streets and Transportation Department, and the Engineering Department, and will require interfacing with the Salt River Project and the Arizona Department of Transportation.

o **Drainage**

Drainage analysis and design for the project will address four points of concern. The first concern is to provide a cost-effective, functional control conduit that will accommodate approximately 3,000 cfs north of Indian School Road and allow for the connection of a future drainage structure to convey 2,000 cfs under the Arizona Canal from the Arcadia watershed. The design will accommodate 4,100 cfs at the connection to the existing culverts at McDowell Road. The second concern is to provide drainage connections for the area-wide off-site drainage. The third area of concern is to provide a drainage connection for the proposed City of Phoenix roadway improvements. The fourth concern is to minimize or maintain the same level of flooding impact from the 100-year storm, while providing a 25-year improvement.

o **Alternative Conduit Selection**

The range of design flows to be accommodated in the new conduit vary up to 4,100 cfs. Given the available slope along the proposed alignment, we will look closely at using a concrete box culvert as one of our proposed alternatives. Design flows will likely require box culvert sections to be double-barrel boxes, ranging from a double 10-foot by 8-foot section up to a double 12-foot by 12-foot section. Although the development of reinforced concrete box alternatives will be evaluated, it is possible that large diameter pipe may be an economical alternative in the upstream areas, if sufficient cover and utility conflicts can be accommodated. In our evaluation of pipe alternatives, we will review manufacturer submittals for strength and site appropriateness.

o **Hydraulic Calculations and Design**

The end product of this project is to have a functional flood control system as designed and anticipated. The hydraulic design for this project, by simple culvert or storm drain analysis, cannot provide adequate hydraulic information for final design and construction. Widely used computer programs, such as STORM, WSPG and HEC-2, are not programmed for these types of facilities, as the proposed flood control system is restricted by the boundary conditions at:

- The existing 10-foot by 14-foot and 10-foot by 10-foot box culverts at McDowell Road
- The 54-inch water line and drop structure upstream of McDowell Road
- Crossings at Thomas, Osborn and Indian School Roads
- Various utility constraints
- Connection to the Arizona Canal relief gates

PROJECT UNDERSTANDING

- Provision of a connection to the future flood relief channel for the area north of the Arizona Canal
- Connections to the off-site drainage
- Provision of connections for the future roadway drainage

Some of these boundary conditions may create situations of "hydraulic discontinuity" and a change in "hydraulic control," and may induce cross waves, choking flows, and result in a non-functioning system.

The hydraulic design of this system will be based on a clear understanding of:

- Energy equations
- Continuity equations
- Momentum equations
- Location of hydraulic control
- Sedimentation

If computer programs are to be used, clear program constraints and hydraulic boundary conditions will be employed. Hand calculations will be used to enhance the accuracy of the computer model in reflecting actual boundary conditions. Well documented procedures will be used for the calculations. A listing of reference materials available to Greiner's hydraulic designers is listed in Section 9 of this Technical Proposal.

o Utilities

- Sanitary Sewers. City of Phoenix sanitary sewers cross under the canal at McDowell Road and Osborn Road. These are both 12-inch gravity flow sewers. A 10-inch sewer crosses between Lewis Avenue and Wilshire Drive. Just north of Thomas Road, an 8-inch sewer crosses the canal above the existing flow line. This sewer, which is inside a steel casing supported by concrete piers, will require either siphoning under the proposed enclosed canal or reconstruction to some point downstream where it can flow by gravity. As the proposed flow line of the enclosed canal may be lower than the existing flow line, all of the former 10-inch and 12-inch sewer lines may have to be reconstructed, as mentioned above.
- Storm Drains. Reinforced concrete pipe storm drain relocation will be required at 12 different locations. These pipes vary in size from 8-inch-diameter to 42-inch-diameter.
- Water Lines. City of Phoenix water lines crossing under the canal at McDowell Road include an 8-inch main and a 48-inch transmission line. The 48-inch line turns and continues north from McDowell Road to Thomas Road along the east side of 48th Street and then east on Thomas Road. A 54-inch transmission line crosses under the canal at Virginia, turns south and parallels the west bank of the canal to Hubbell Avenue, where it turns and continues west. A 45-inch transmission line crosses under the canal at Thomas Road. This is an old line and may be fragile. These major transmission lines may require relocation and/or adjustments in grade due to the potential lowering of the flow line of the enclosed canal. Additional water lines cross under the canal at other locations. These lines, ranging in size from 6 inches through 12 inches, are shown on the Utility Inventory Map in this section, and may also have to be lowered.
- Gas Mains. An 8-inch high-pressure gas line owned by Southwest Gas Company runs the entire length of the corridor along the east side of 48th Street. This gas line will probably not need to be relocated; however, extreme care will have to be exercised when

PROJECT UNDERSTANDING

working in the immediate vicinity. Potholing during the field data collection phase will be accomplished to determine the exact elevation of this line so that a decision can be made on whether or not to lower the line. Four-inch gas lines cross the canal at McDowell Road, Thomas Road and Indian School Road. These lines must be relocated to areas under the enclosed canal.

- Electrical Transmission Lines. Overhead electrical power lines located on wooden poles are owned by Salt River Project and run the length of the corridor. For the majority of the corridor these power lines are located on both sides of the canal and are 12 kv primary feeder lines to the residential areas on both sides. A 69 kv transmission line crosses the canal on the north side at Thomas Road, where it turns and continues north along the far west side to Osborn Road. Here it splits, one part turning west and another portion crossing the canal north of Osborn Road and continuing north along the east bank of the canal to north of Indian School Road. This northern segment carries a 12 kv line, in addition to the 69 kv line. At Oak Street, an additional 69 kv line crosses the corridor at right angles. All 69 kv transmission lines are carried on 60- to 70-foot wooden poles.

With the possible exception of the transmission line between Thomas Road and Osborn Road, it may be desirable to relocate or bury all 12 kv overhead lines for the following reasons:

- o Safety during construction
- o To eliminate the pole line so that the Hohokam Expressway and linear park can be constructed in the future

Some of these poles are joint-use poles with U.S. West and cable TV facilities, in addition to electrical power and street lighting. Any relocations must be coordinated with Salt River Project and other joint users.

- o **Geotechnical Investigation**

Inspection of the Old Cross Cut Canal revealed that, at the Indian School Road/Old Cross Cut intersection, the channel embankment and foundation is composed of Recent Alluvium consisting of light brown, gravelly sandy silts and silty sands. Soil appeared to be coarse-grained with higher percentages of gravel with some cobbles in the downstream direction, and is moderately to well cemented by caliche at depths of approximately 5 to 10 feet below the ground surface. At the uncemented layer of the channel, between the Arizona Canal and Osborn Road, the slopes are eroded to approximately 1V:1/2H. The deeper cemented material has been eroded to vertical slopes. A caliche-cemented boulder deposit is exposed in the canal banks upstream of Indian School Road. The boulders are rounded, up to approximately one foot in diameter, and are embedded in a light brown, hard, dense, calcareous silty sand matrix.

Previous subsurface soil investigations have been conducted by the City of Phoenix in this urban area. The materials are classified and described as silty clayey sands to sandy clays with a moderate calcareous cementation of the soil in the form of caliche below five feet.

Bedrock is exposed at two locations on the Old Cross Cut Canal alignment. Sandstone of the Red Unit is exposed in the banks of the Arizona Canal east of 56th Street in an outcrop

PROJECT UNDERSTANDING

extending about 100 feet downstream from the Arizona Falls. Precambrian quartzite is exposed along the banks of the Old Cross Cut Canal, from about 500 feet north of Washington Boulevard to about 200 feet south of Van Buren Street. The quartzite is grayish pink, highly fractured, moderately weathered, hard and dense. It occurs in the lower 4 to 8 feet of the canal and is overlain with as much as 10 feet of soft to moderately hard caliche.

Consideration must be given to the strength parameters of the sandy clay. Bearing capacities could be limited to 2,400 psf based on previous design reports done for the Arizona Canal Diversion Channel.

The following are considerations during construction:

- Diversion and Control of Water. Groundwater is at or near the proposed invert elevations throughout the Old Cross Cut reach. Dewatering will be required to remove groundwater during excavation and construction of structures, such as drop structures, and the entrenched channel that extends below the existing canal invert. In addition, diversion and control of varying amounts of surface flow will be required for construction during any season.
- Excavation. Excavation can be accomplished with conventional heavy construction equipment. Dozers with ripper blades or heavy-duty hammering equipment may be required to loosen bedrock and calcareous cemented soils (i.e., caliche) where encountered in the collector system excavation or channel excavation. Blasting may not be allowed due to the surrounding urban area.
- Fill/Backfill. For the conduits in the collection system north of the Arizona Canal, suitable backfill material can be obtained from the required excavation. For conduit south of the Arizona Canal, backfill material may have to be imported. Coarse-grained soils obtained from suitable sources will be used as fill and backfill material behind channel walls and other subsurface structures subjected to high groundwater or expansive soils.
- Channel/Box Conduits. If a concrete box culvert is used, a subdrain system may be required to relieve hydrostatic pressure under the invert and behind the channel walls. The subdrain system would consist of a slotted 6-inch-diameter collector pipe behind the heel of the channel walls, a gravel drain layer beneath the invert to transport groundwater to the pipes, and a sand filter layer under the gravel to prevent clogging with fine-grained foundation soils. Subdrain outlets would be provided at intervals not exceeding 1,000 feet. Bedrock or caliche would be over-excavated to a depth of one foot below the bottom of the concrete lining and a subdrain system and a bedding layer of pervious material would be provided.

o Survey

Field survey services will be provided within the Old Cross Cut corridor to prepare topographic base maps at 1" = 20' scale with 1-foot contour intervals. Horizontal and vertical control shall be on Phoenix datum, and will include multiple ties to Salt River Project datum. The base maps will be prepared on Version 10 of AutoCAD and the files provided to the Flood Control District on floppy disks. If the topographic drawings are prepared from aerial survey, ground survey will be performed to provide ties to existing utilities, structures and landscaping features to within 0.1-foot accuracy horizontally and vertically.

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One of the critical issues is consultant coordination with the City of Phoenix in terms of road closures and safety signage. Strict adherence to the City of Phoenix specifications as to working hours and signage layout is essential. Planning the field work around these constraints is included in this proposal. Many times, this aspect of the survey work is overlooked and causes serious problems. Greiner understands the City of Phoenix policy for safety and signage, and has the proper signage already at hand to ensure a safe project with minimum traffic impact.

o **Right-of-Way**

From a brief project visit and review of the City of Phoenix quarter section maps, it appears that irregular parcels adjoining the Old Cross Cut Canal could pose some right-of-way constraints. Whether these constraints are major or minor will be determined after the research and review phase of the project. In the best interests of the adjoining landowners and the Flood Control District, a right-of-way base map will be marked in red by Greiner showing any right-of-way and easements for drainage, irrigation, construction, etc. Area calculations for the new right-of-way and necessary easements for each parcel will be included. Greiner will note items on the plans and in the estimate as items of work to be done by the contractor in accordance with the Flood Control District's standard specifications and bid item list.

The following items will also be included as items of work to be done by the contractor:

- Water services renewals
- Sanitary sewer lines
- Drain and waste lines
- Water main realignments
- Irrigation lines and ditches
- Water meter relocations
- Fire hydrant relocations

Greiner will research and make every effort to determine all water service pipe sizes and types for determination of correct water service renewals required.

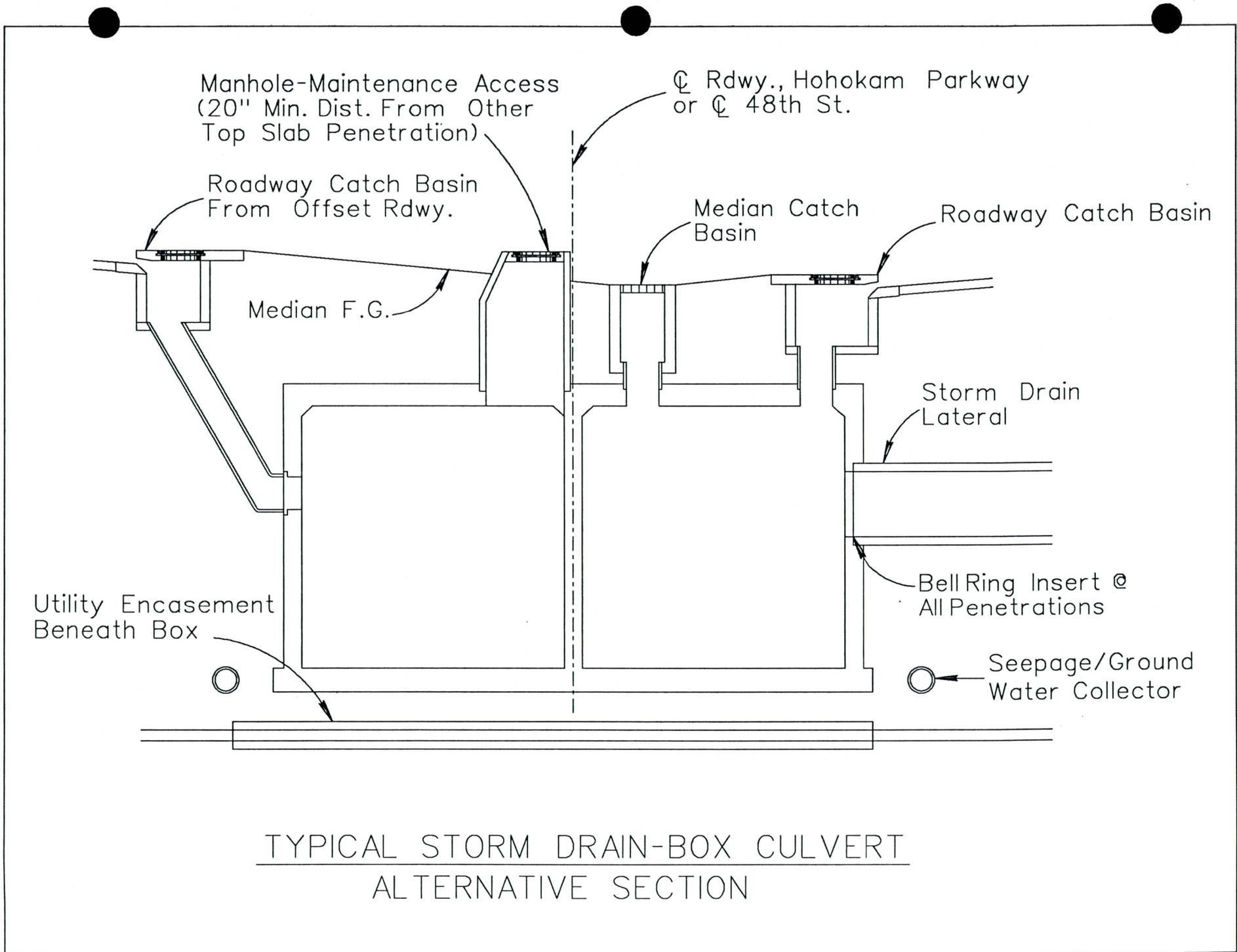
o **Structural Design**

All structural design will be in accordance with the current AASHTO specifications, as interpreted by the District. We will coordinate the development of structural designs closely with Flood Control District staff to ensure an ongoing awareness of the development of project designs. Calculations will be based on service loads and the working stress method.

All rigid frames, such as box culvert barrels, vaults, junction structures, etc. which are buried will be designed for the "at-rest" (restrained) lateral soil pressures. Active lateral pressures will be used when the element can translate or rotate slightly, about 0.001 times the element's height.

Concrete strength for buried structures will be $f'c=4,000$ psi, or greater, to reduce member sizes and provide economy. Reinforcing steel will be in conformance with ASTM A-615 and the yield strength (f_y) will equal 60,000 psi. If saturated conditions are encountered, anti-corrosive measures (epoxy coated rebar and concrete admixtures) should be employed.

If required, the design of an external drainage system parallel to the storm drain conduit will be provided to collect seepage from landscape water, ponded storm runoff and groundwater. Historic geotechnical information in the project area suggests that some



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areas have zones of perched groundwater. This will affect buoyancy and corrosion requirements, and will be included as part of the design and planning process.

Road crossings will be designed for HS-20 live loads. Other controlling designs will be based on the more severe of conditions of the live load applied longitudinally or transversely in the case of box culverts.

Soil bearing values and lateral load capacities will be developed from the field data performed in accordance with NAVFAC DM-7.1, Soil Mechanics Design Manual 7.1, May 1982. Bearing values and lateral loads will be determined in accordance with NAVFAC DM-7.2, Foundations and Earth Structure Design Manual 7.2, May 1982, and per AASHTO Specifications. AASHTO Specifications will control if there is a conflict between the above methods. Any effects of future elevated moisture or saturation of the site will be addressed in the report. AASHTO Sections 1.4.2 and 1.4.4 will not be exceeded for maximum bearing values, unless the District is consulted and approves.

Since the proposed hydraulic conduit will serve as a storm drain, there will be a range of structural elements and details to design. Assuming that the selected structure is a reinforced concrete box culvert, we have developed a concept sketch for this hydraulic conduit and included it on the following page. We anticipate the need for the following structural design and detailing for a concrete box culvert alternative:

- Between two and four different double-barrelled concrete box culvert sections; as a starting point, we will evaluate double 10-foot by 8-foot and double 12-foot by 12-foot sections
- Transition structures to connect different concrete box culvert sections or pipes with concrete box culverts
- Flow equalizing structures
- Barrel closure details (temporary bulkhead)
- Future extension details
- Energy dissipating structures
- A special gate connection at the SRP spillway
- A drop inlet structure
- Storm drain and catch basin connector pipe connections
- Manhole connections to top slab of box
- Bridges or other structures at major street and utility crossings, as required

o Construction Cost

The Old Cross Cut Canal Improvement Project is estimated at a construction cost of between \$9- and \$10-million. In addition to our track record of delivering projects at or below budget by following construction control procedures, utilizing construction cost estimate programs and value engineering, we constantly look for design features that can save the owner money and deliver a quality product. Some of the key design features which will impact the cost include:

- Connection to the Arizona Canal relief gates and the future upstream flood control facility to be tied into at 48th Street and the Arizona Canal
- Feasibility of utilizing the existing drainage crossings at Indian School, Osborn and Thomas Roads, or augmentation with supplemental facilities
- The 54-inch and 45-inch water line crossing and the existing drop structure upstream of McDowell Road

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- Connection to the existing McDowell Road culverts, which feature 10-foot by 14-foot and 10-foot by 10-foot double boxes
- Construction method selection -- such as rolling box culvert forms

A potential cost saving measure would involve scheduling roadway improvements in conjunction with this conduit construction. By depressing the roadway, the earthwork can be balanced, eliminating the need for borrow. The depressed roadway could also serve as a flood relief facility during a higher frequency storm.