SRP Transmission Line Asset Management
Revision 3, Dated March 10, 2023

Salt River Project (SRP)
Technical Provisions

General Construction Edition

Delivering water and power®

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Revision	Sections Revised	Description of Revisions	Changed By	Approved By	Approval Date
1	**1 & 3**		**P. Grant**	**D. Hays**	**March 2021**
2	**1, 3, & 5**		**P. Grant**	**D. Hays**	**June 2022**
3	**3, Appendix**		**P. Grant**	**D. Hays**	**March 2023**

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Definition: Customer in this document is defined to include a landowner, developer, contractor, consultant, applicant, interested parties and anyone requesting a review of design and/or construction drawings.

This document will be reviewed and agreed upon on an annual basis in order to cover changes that may occur to the SRP standards during that timeframe.

If you have any questions, please contact the department representative

The purpose of this document is to provide customers with general information and considerations that may be useful to them in the formulation of their construction projects or proposals pursuant to a Request for Proposal document ("RFP"). The requirements and information contained in this document are informational
only, are not intended to be complete, and not every requirement will apply in all situations. Similarly, time frames and possible cost estimates are general estimates only and may differ by project.

SRP Land: General Requirements and Considerations

IPR Process

SRP utilizes an Initial Plan Review (IPR) process which assists in the evaluation for compatibility of a proposed project, or a proposed land use change (such as recording or overlaying an easement), upon the operation and maintenance of SRP facilities. In order to accommodate the project needs in a responsible and effective manner, SRP Land Department's Land Rights Management Division will facilitate and coordinate a
Compatibility Review Process for the proposed improvements, or proposed land use change, with existing SRP Facilities and Land Rights through our IPR Process. Plans can be submitted to a portal site specifically created for you or your company. You can access instructions for establishing your Portal through our web site at the following location https://srpnet.com/about/land/secure/plansubmittal.aspx. Once you have established your portal you can upload plans for a Compatibility Review. You can also submit plans through other electronic means such as email, but we encourage you to use our portal system. It is easy and effective. The more detailed the submitted plans the greater the detail of our review but we will start working with you at any step in your process, even at the conceptual planning stages. Earlier is always better.

> Any improvements within Salt River Project's Water easements/ROW shall have written approval which is given by SRP in the form of a *License Agreement*. See section SRPW for additional information.
>
> Any improvements, construction activities or land use within Salt River Project's Transmission (SRP-P) easement/ROW shall have written approval which is given by SRP in the form of the *Consent to Use Agreement*. See section SRP-P Section A for additional information.

In addition, if new power service is required by the project, your plans will be submitted to our Customer Construction Services group to coordinate the Design and Construction of your new services. SRP has many planning, design, construction, operational and maintenance groups that require the opportunity to review proposed encroachments upon its existing facilities and the associated land rights protecting those facilities. Involving SRP early in the initial stages of your project planning and design will reduce overall conflicts, minimize changes and shorten response times helping the project to stay on track. A web portal will be created specifically for your company where New Project plans and information can be uploaded. This simple, quick, and paperless process to initiate your request allows the project to be accessible in a central location. Once the portal has been created, an email will be sent with instructions and a link to your company for access.

Please keep in mind that once we receive your submittal a Land Agent will be assigned to coordinate the review. SRP may need a full set of civil engineering plans to conduct a detailed review.

Corridor/Envelopes and Width Requirements

The following considerations affect the ability of SRP to relocate and/or impact the time needed for the relocation(s):

Water related Land rights:

It is helpful to understand that SRP is also the agent of the USA in the operation of the federal reclamation project (Project). Essentially, SRP manages the USA land rights with respect to the Project and coordinates these USA Land and Facilities relocations with the Bureau of Reclamation (BOR). If the job scope includes a USA Relocation, detailed Developer, Surveyor, Title and Landscape Guidelines will be provided, but please be aware of the following:

- A federal realty transaction generally takes up to 18 months to process depending upon the case load of the BOR.
- A nonrefundable, up-front fee of $7,500.00 to SRP is required to process the property relocation. This fee reimburses SRP for its administrative costs, as well as part of the cost of the environmental assessment.
- An initial deposit of $8,000.00 must be paid to the BOR before any relocation can occur. This money will be used for administrative costs incurred by the BOR in processing the relocation. If costs exceed $8,000.00, the BOR will bill the applicant and require the additional payment before they will proceed with the case. If the costs are less than
- $8,000.00, the BOR will refund the difference.
- The BOR will also require an executed Reimbursement Agreement to process this case.
- The existing and proposed USA properties cannot be disturbed until construction has been authorized by the BOR.
- Legal descriptions and tract maps for both the existing and proposed USA land rights are required.
- Title: Applicants must provide the following, together with official copies of all Schedule B documents: (i) a Commitment for Title Insurance for the new USA easement, in the Department of Justice approved form identified as ALTA US Policy 9/28/91 (Revised 12/3/12) and (ii) a Condition of Title or Special Report on the existing USA easement.
- Copies of all vesting deeds for the parcels involved in the facility relocation must be provided. If the owner is a corporation or partnership, you may be asked to provide documentation authorizing the signor for the Contract and Grant of Easement to the USA.
- PLEASE NOTE THAT ANY LAND SALES COULD DELAY THIS LAND EXCHANGE PROCESS. Any sales must be coordinated with an SRP land agent.
- Do not record a plat or otherwise encumber the proposed new USA easement. The BOR will not accept the easement subject to a recorded plat. Please wait to record the plat until the easement has been conveyed to the USA and that conveyance deed recorded.
- Environmental Assessment(s): The BOR will require a Phase I or II Environmental Site Assessment (ESA) that is funded, in part, by the $7,500.00 initial SRP fee. Both the existing and new USA easements will need to be staked for the environmental assessment field inspection. Prior to the site inspection, the ESA Owner Questionnaire

must be completed and sent to Environment Consultant. The environmental assessment report is generally completed within six (6) weeks from the date of the site inspection. The environmental assessment report is valid for 180 days. There will be an additional charge of $2,000.00 for any new reports required thereafter.

- Projects impacting over ½ mile or more of USA land rights may require more than one ESA, resulting in additional fees. SRP may charge additional fees for complex or multiple ESA reports (ex. projects involving multiple sections).
- The proposed USA property cannot be encumbered after receipt of the requirement letter.
- SRP requires a right of way license to be issued to the City for any improvements planned within the USA Fee property and Land will NOT be released for construction until City has executed such license. Applicants will need to contact City for processing fees. All improvements will need to be approved by Water Engineering prior to licensing.
- **No linear/parallel utilities shall be located within USA right of way (crossings only).**
- The Field Solicitor for the Department of the Interior will verify compliance. SRP will coordinate execution and recording of the Contract and Grant of Easement. Once the BOR has received the recorded document and final approved title policy, the BOR will notify SRP that the job can be released for construction.
- After the job has been constructed and SRP has approved the relocation of the facility, the BOR will execute the conveyance document and release the original USA easement to the underlying fee owner.
- Landscaping: If the new easement area is to be landscaped, SRP will need to review and approve the landscaping plans prior to installation. No trees or oleanders may be planted within the easement.

If SRP easement is required for any tie-ins, applicant is responsible to provide the vesting deed, legal description and to acquire the easement. SRP will prepare the easement document. A redesign may be required if the adjacent property owner does not agree to convey an easement.

Claimed Prior Rights, Land Rights, and status of customer acceptance

- SRP Land department will provide prior rights documentation.
- For any prior rights adjustments, all materials shall be subject to the requirements of the Buy America Act.
- Some of the laterals, if not all, may have USA land rights. A replacement easement will be necessary in which to relocate these facilities. It can take twelve to eighteen months to complete an exchange of USA easement land, and no ground disturbing activities may occur on the existing or proposed easement areas until the exchange is completed.
- Parallel utilities are not allowed inside the USA easement or SRP transmission easement corridors.
- Land rights will be needed from new developments for future work as well as temporary construction easements.
- Any proposed NEW easements within or impacting existing SRP land rights must be reviewed by SRP prior to recordation.

SRP Water (SRP-W): Technical Provisions

Design, Construction & General Requirements

- SRP-W forces, or SRP Water on-call firms, will design and construct all needed relocations or adjustments to the SRP-W system.
- SRP-W must have 24/7 access to water facilities. Customer shall provide safe access for SRP operation and maintenance for irrigation control structures. Customer to provide a minimum of 20 ft. industrial driveway for access to SRP gate structures, See Appendix for MAG Detail 250.
- Customer shall provide landscaping plans for review and comments to ensure the SRP Right-of-Way Guidelines are being followed.
- Thanksgiving to Feb 1st is the best time for shutdowns that may be required. Shutdowns may be possible on certain facilities at other times of the year. All shutdowns are at SRP- W's sole discretion dependent on water user or operational demands.
- All SRP-W agreements will be with customer, not with third parties.
- No SRP-W facilities will be deactivated.
- If a facility is abandoned in place, SRP will execute a transfer agreement with customer to transfer ownership of facility. Customer will be responsible for future blue staking of this facility. Customer shall be responsible for removing any portions of the abandoned facility in conflict with the proposed improvements in accordance with these Technical Provisions.
- Customer is responsible for removing the existing irrigation facilities once the new ones are operational.
- All new pipe installed will be class 5 RGRCP, unless otherwise noted by SRP-W.
- SRP-W will not accept collar extensions of the existing pipe crossings of the freeway and roadways. A new pipe crossing the freeway will need to be installed from ADOT (Arizona Department of Transportation) R/W to ADOT R/W following SRP and ADOT specifications on utilities in casing under the freeway.
- Any existing irrigation facility that runs parallel with the new roadway will not be allowed to stay under a traffic lane or installed under new traffic lanes.
- SRP-W has an existing master maintenance agreement for facilities within ADOT ROW. Any new or replaced siphons will need to be incorporated into the ADOT agreement.
- Siphons require a gate connection to the ADOT storm drain system for annual maintenance purposes. Customer will be responsible for tying the SRP drain into the ADOT storm drain system.
- For pipes 36" or less in diameter, manhole spacing cannot exceed 500'. For pipes greater than 36" in diameter there is no restriction but are generally placed at ¼ mile intervals or at changes in direction or grade.
- Customer will be responsible for setting final top elevations for all of SRP manholes. Once top elevations are set by customer and manhole is constructed, if adjustments are necessary customer will be responsible for cost. Customer must determine if manhole will be within concrete or asphalt roadway surface if manhole will be located within the roadway cross-section.
- SRP-W does not design or construct private irrigation facilities. Adjustments needed to the private systems that are beyond the SRP-W point of delivery will have to be done by the customer if necessary.
- During design, SRP-W will develop a list of potholes needed, and the customer will be responsible for performing those potholes, unless SRP-W decides to do them at the customer's cost.
- Within project construction limits, where SRP-W is currently in an open ditch, the ditch will need to be piped through the conflict area.

- The cost to repair any damage to an existing, new, or partially completed facility, including survey markers and staking, will be the responsibility of the customer. All repairs will be done by SRP forces.
- Customer will need to acquire an SRP license to go under and cross any of the SRP irrigation facilities.
- Any budget estimates provided to customer without accompanying an executed agreement are just that – budget only and SRP will not be held to performing work against those numbers.
- Buy America compliant material will be purchased once the plans have been reviewed and accepted by the customer. Some materials may have long lead times.
- SRP had design guidelines and specifications for bridge crossings of SRP canal available online at www.srpnet.com/water.
- See Appendix for SRP Right of Way guidelines and Utility Crossing or Parallel to SRP Irrigation Pipe.

SRP Power (SRP-P): Technical Provisions

SRP Power (SRP-P) is responsible for transmission and distribution line engineering design, construction, and maintenance of SRP's transmission and distribution assets. The five groups within SRP-P are Transmission Line Asset Management (TLAM), Transmission Line Design (TLD), Transmission Line Construction (TLC), Transmission Line Maintenance (TLM), and Distribution Design, Construction, & Maintenance (DIST).

Transmission Line Asset Management (TLAM)

SRP TLAM works with the SRP Land Department to provide conflict review for customer's construction projects. Plans for development or improvement that may impact SRP easements/ROW or any SRP asset should be submitted to the SRP Land Department via the Initial Plan Review (IPR) process. Please see Section A, Improvements within SRP's Transmission Easements/ROW, below in this document. Additionally, as needed SRP Safety Services may be reached at (602) 236-8117 or Safety@srpnet.com for more information.
Please contact SRP Transmission Line Support at (602) 236-3080 or TransmissionLineSup@srpnet.com for more information on the topics included in this section of the documentation.

Easements adjacent to Construction Projects

SRP must have 24/7 access to SRP electric facilities. Customer shall provide safe access for SRP operation and maintenance for all SRP electric facilities.
Customers and other responsible parties, at all times, shall permit SRP to access and maintain any SRP electric facilities. Customers and other responsible parties shall provide SRP all requested easements before beginning construction, including any easements required from third parties for SRP to access and maintain the electric facilities using SRP's standard form(s) of easement.

SRP General Design Guidelines for Construction Projects

A. Improvements within SRP's Transmission Easements/ ROW
B. Electrical Clearance Calculations
C. Tree and Ground Cover Restrictions
D. Storm Water Retention Basin
E. 69kV Setup Areas
F. Extra High Voltage (EHV) Setup Areas
G. Fiber Communication Installation Guidelines
H. Excavation near Transmission Structures
I. Blasting
J. Gates and Fence
K. Maintenance Practices
L. Construction Activities
M. Damage Claims

A. Improvements within SRP's Transmission Easements/ROW

Any improvements or proposed land use within Salt River Project's Transmission easement/ROW must have written approval which is given by SRP in the form of the *Consent to Use Agreement*. To obtain a *Consent to Use Agreement,* plans must be submitted to the SRP Land department where they will undergo a process of review, revision (if necessary), and approval. The review process should begin early in the design process to obtain approval of plans prior to construction. Upon approval of the final plans, a *Consent to Use Agreement* will be drafted by the SRP Land Department and sent to the Landowner for signature. The *Consent to Use Agreement* including an exhibit will be recorded at the County Recorder's Office. The approved plans are retained by SRP. *Consent to Use Agreements* are conditional and subject to future SRP expansion requirements within the SRP easements/ROW in the future.

General guidelines for the *Consent to Use Agreement* process are as follows:

1) All plans submitted to SRP must be drawn "to scale". Plans should be submitted to the SRP Land Department via the Initial Plan Review (IPR) process which may be started at https://www.srpnet.com/about/land/secure/plansubmittal.aspx , please contact (602) 236-3117 or Workflow@srpnet.com for more information.

2) All plans must show SRP easements/ROW boundaries. If any applicable SRP easement/ROW is not shown, the plans may be rejected by SRP and submittal of revised plans will be required.

3) All plans must show SRP facilities, including structures and overhead wire locations. Additionally, they must show compliance with structure/wire setup areas per *SRP Transmission ROW Maintenance Setup Areas* diagrams for appropriate voltages. If applicable SRP facilities are not shown the plans may be rejected by SRP and submittal of revised plans may be required.

4) All plans must include and call out all existing pole locations, conductor lines, and easement boundaries.

5) Plans must show all proposed improvements within SRP easements/ROW, including utilities, paving, grading, drainage, lighting, landscaping, etc.

Note: Plans may be rejected for review if they do not meet items 1-5 listed above.

6) Lighting structures must meet SRP electrical clearances with respect to the overhead conductors and towers/structures. In general, lighting structures 12 feet high or less should not violate SRP electrical clearances. Proposed lighting plans need to be reviewed and approved by SRP. SRP may require the customer to provide a Surveyed exhibit of SRP wires and structures as part of calculating clearances and approving lighting within SRP easements/ROW. SRP does not provide transmission outages for lighting maintenance.

7) In general, trees are prohibited within SRP easements/ROW. In special cases some landscaping, including low growing type trees, may be allowed provided it does not interfere with the maintenance of existing or future transmission lines. All proposed landscaping in SRP easements/ROW plans shall be reviewed and approved. A copy of the *SRP Approved Trees* and *SRP Approved Ground Cover* lists is included in the appendix.

8) In general, SRP does not allow parking, buildings (temporary or long term) or other structures such as storage sheds, fencing, site walls, signage, RV and/or vehicle storage, dumpsters, or drywells within SRP easements/ROW.

9) When a sidewalk and/or back of curb is needed within our easement, five feet is required between the closest back of curb to the face of the pole and two feet minimum from edge of sidewalk to the face of the pole.

10) In general, SRP does not allow drainage channels or any Regional Drainage within SRP easements/ROW. Retention basins will need to be designed by the customer to adhere to the *Storm Water Retention Basin Design Guidelines*. The *Storm Water Retention Basin Guidelines* provide general direction but each situation is unique and may include site-specific plans review comments from SRP. A copy of the *Storm Water Retention Basin Design Guidelines* is included in the appendix.

11) In general, SRP requires maintenance roads (with a maximum slope of 20:1) SRP requires maintenance roads (with a maximum slope of 20:1) along the length of the SRP easements/ROW, parallel to the transmission line. Multiple maintenance roads may be required to maintain multiple wires/circuits. The appropriate offset for the maintenance road with respect to each of the transmission line wires is determined by SRP. The roads are generally 20 feet wide, not including the width required for setup areas at towers/structures and at specific intervals along the wires. SRP maintenance roads shall be accessible from public ROW. Due to the complexity of issues involved, maintenance roads will need to be designed by the customer's consultants based upon input from SRP. To provide access to the maintenance roads, see the turning radius detail. A copy of the *SRP Transmission ROW Maintenance Setup Areas* diagrams is provided in the appendix. The *SRP Storm Water Retention Basin Design Guidelines* diagram also contains general design information for pole and wire setup areas.

12) Maintenance equipment/crane setup areas (with a maximum slope of 20:1) are required at towers/structures and at intervals parallel to the wires. The setup area at a tower/structure differs depending upon the voltage of the line. The Extra High Voltage (EHV) (*e.g*. 115kV, 230kV and 500kV) tower/structure setup area is generally defined as, a length of approximately 50 feet in each direction from the structure, by the width of the SRP easements/ROW. The 69kV structure setup area is generally defined as a length of approximately 30 feet in each direction from the structure, by the width of the SRP easements/ROW. Depending upon the transmission line voltage, the distance between setup areas along the wires and the size of the setup areas will vary. Due to the complexity of issues involved, tower/structure setup areas and wire setup areas will need to be designed by the customer's consultants based upon input from SRP. A copy of the *SRP Transmission ROW Maintenance Setup Areas* diagrams is provided in the appendix. The *SRP Storm Water Retention Basin Design Guidelines* diagram also contains general design information for pole and wire setup areas.

13) Parking may be acceptable use of SRP easements/ROW for EHV transmission lines upon SRP evaluation for compatibility and written notice. There are specific requirements for orientation with respect to traffic flow. Maintenance roads and crane setup areas will need to be incorporated into the parking design based upon input from SRP. Any vehicles parked within SRP easements/ROW must be able to be relocated, 24 hours a day and seven days a week, at the request of SRP.

Note: SRP easements/ROW for 69kV transmission lines does not allow for parking.

14) All pipes, manholes, or other proposed facilities to be located at or below grade in SRP easements ROW must be designed to withstand a minimum of 320 psi on a 27-inch diameter outrigger pad. Load calculations sealed by an Arizona licensed Civil Engineer must be provided along with plan and profile views for all underground installations for SRP review and approval. A copy of the *SRP Point Load General Analysis Guidelines* is provided in the appendix. No paralleling utilities or any trenching within the SRP easements/ROW will be allowed. Underground utilities may be allowed to perpendicularly cross/encroach upon SRP easements/ROW with SRP written approval.

> **Note:** If those crossings are allowed, any trenching needs to be backfilled with one and one-half (1½) sack slurry and plans will call out this requirement.

15) No grade changes/cut or fill is permitted within SRP easements/ROW without prior written approval. SRP has specific requirements for excavations near SRP towers, structures, and facilities.

16) Public Utility Easements (e.g. PUE, MUFE, PUFE, etc.) shall not be platted and approved in SRP easements/ROW. A city or municipality approval of a PUE does not supersede SRP land rights.

17) Transmission pole bracing, pole relocations, and/or transmission line conflict checks, plans shall be submitted to the SRP Land Department via the Initial Plan Review (IPR) process.

18) For third party companies that wish to install/bore within SRP easement or proximity to any SRP transmission poles, all borings must be a minimum of 6 feet from the face of any of those said transmission poles, pass review, and point load requirements.

19) Relocation of an SRP transmission line may be requested and discussed as an option by a customer for a proposed improvement. As part of any type of relocation agreement, the minimum easement required by the customer to SRP will be 30 feet wide for a 69kV Transmission line. If the request involves any of our extra high voltage transmission lines, the easement widths will be larger and provided at that time.

20) Proposed developments that are trying to build to zero lot line (*build up to SRP easement or SRP prescriptive rights*), the customer is required to submit a fully dimensioned work plan showing the equipment (scaffolding, scissor lift, crane, etc.) needed to complete the construction of the project. SRP will not allow any of the work to be done within our easement or prescriptive rights because of the concerns in terms of having qualified workers with proximity to the high voltage conductors and the corresponding OSHA requirements.

21) The use of cranes within or crossing the SRP easements will need to be reviewed on a case-by-case basis. Any information regarding the type of crane including loading from the outriggers, axels, and counterweights will be required. Include location, access/egress plans, any dimensions to the transmission facilities, and the need for use of cranes.

B. Electrical Clearance Calculations

Electrical clearance calculations are an additional submittal requirement that are not part of the Internal Plans Review (IPR) process that is separately submitted to SRP-P. Clearances are important for maintaining access where we give “like for like” unless NESC (National Electrical Safety Code) requires more clearance.

Any clearance calculations will need to be stamped and signed by an Arizona Professional Engineer. Any review of the proposed improvements will require survey data.

Survey Data

Using the same survey datum as SRP Transmission Line Design (TLD) (SRP TLD's survey datum is described later in this document in the TLD section under the Survey topic), please provide the following survey data:

1) The "point of attachment" elevations for the lowest wire on each transmission pole/tower for the spans that are affected by your improvements.

2) The elevation of grade at the base of the pole/tower for the spans that are affected by your improvements.

3) The elevation of the lowest wire at the belly of the span.

4) The horizontal distance (with no incline) between these attachment points.

Engineering Data

Develop two separate drawings as described below using the survey data above.

Plan Drawing

1) Dimension all horizontal distances from the nearest attachment point (surveyed above) to the proposed improvement(s) involved.

2) If applicable, dimension all horizontal offset distances (perpendicular from the wire) to the proposed improvement(s).

Profile Drawing

1) Dimension all elevations of the attachment points, midspan points (surveyed above) and the elevations of the proposed improvements.

2) Clearances based on NESC for both RS and FE need to be provided.

C. Tree and Ground Cover Restrictions

Approval or Disapproval of all trees/ground cover regardless of whether they are on the approved list is dependent upon electrical clearances to conductors based on voltage, as well as locations that do not hinder SRP maintenance crew access/setup. Any tree located under or near any electric lines is subject to trimming or removal by SRP. Trimming may result in the tree having an unnatural appearance. A copy of the *SRP Tree* and *SRP Ground Cover* lists is provided in the appendix. No trees allowed inside EHV easements or under EHV lines.

D. Storm Water Retention Basin

The following list of minimum criteria is required by anyone wishing to use SRP transmission easements for storm water retention basins. They must obtain specific written approval from the SRP Land Department before any construction may proceed within the easement property. A copy of the SRP *Storm Water Retention Basin Design Guidelines* diagram is provided in the appendix.

1) The property in question must be owned, in fee, by the customer or other requestor of multiple use in the easement.

2) The retention basin design must provide for continuous vehicular access and crane set-up areas along each edge of the easement (10:1 maximum longitudinal slope) above high water. Typically, this will require 35 feet wide access roads along each edge. An option is 20 feet wide access with 35 feet x 60 feet crane set-up pads centered at 110 feet.

3) As a crane set-up area and to protect the integrity of each pole or tower, a rectangular, level area of ground (above high water) must be provided measuring a minimum of 50 feet in each direction from the outside edge of any foundation. Typically, this cleared area will need to extend all the way across the easement (transverse) and tie to the access roads. Clean fill is acceptable, provided the grades remain 6 inches below the top of foundations.

> **Note:** Any proposed cuts or fills within the ROW are to be reviewed by SRP. This area must drain away from foundations, with 20:1 maximum slope.

4) The retention basin may have side slopes of 4:1 (maximum) but must provide 20-foot-wide access ramps (10:1 maximum slope) into basin from each structure location. All areas must be protected from soil erosion with erosion protection method approved by SRP.

5) If a water flow is required across the roadways or the 50-foot areas around structures, it must be constructed of pipe capable of withstanding a concentrated load from a crane outrigger with 320 psi on a 27-inch diameter pad. Calculations must be submitted to SRP showing the anticipated loading and strength analysis.

6) No drywells within the easement. If required, drywells must be located outside the SRP easement area with a catch basin inside the retention basin area. Design and location of catch basin, piping & drywell to be reviewed by SRP prior to any construction.

7) 20 feet wide openings or gates (in approved locations and perpendicular to access) must be provided in any fences or walls crossing the easement. Fences need to be grounded and must have shared lock access.

8) An engineered design of the proposed retention with the proposed time for it to drain must be submitted to SRP for review and approval.

E. 69kV Setup Areas

A copy of the *SRP Transmission ROW Maintenance Setup Areas* diagrams is provided in the appendix.

1) Structure setup areas for 69kV transmission lines are defined as a rectangular area 30 feet on each side of the face of structure by the width of the easement. Setup areas and wire setup areas must be clear of above grade improvements. SRP requires unobstructed "high and dry" maintenance roads that are 15 feet wide with a 20:1 maximum slope which run parallel to the conductor for the entire length of the easement on both sides of the towers/structures. Those maintenance roads require access 24 hours a day and 7 days a week.

2) Wire setup areas for 69kV transmission lines are defined as a rectangular area 35 feet long by the width of the easement, repeated every 50 feet between the structure setup areas.

   Note: Structure setup areas and wire set up areas for the 69kV transmission lines are reviewed during the SRP Initial Plan Review Process.

3) Below grade improvements within structure setup areas for 69kV transmission line are reviewed on a case-by-case basis. Prior written consent by SRP is required.

   Note: Improvements within SRP easements/ROW for 69kV transmission lines must meet 320 psi point load on 27-inch diameter pad.

4) Certain 69kV structures are required to meet Extra High Voltage (EHV) setup area requirements. In addition, any pole height for 69kV design that exceeds 80 feet above grade requires consultation with SRP Transmission Line Asset Management (TLAM) and agreement on the design. Highway crossings and other special cases may require taller poles. In these cases, larger setup areas, maintenance roads, and easements will be required.

5) Parking is not an acceptable use of SRP easements/ROW for 69kV transmission systems.

F. Extra High Voltage (EHV) Setup Areas

A copy of the *SRP Transmission ROW Maintenance Setup Areas* diagrams is provided in the appendix.

1) Tower/structure setup areas for Extra High Voltage (EHV) transmission lines (e.g. 115kV, 230kV and 500kV) are defined as a rectangular area 50 feet on each side of the outside tower legs or face of structure by the width of the easement. Setup areas and wire setup areas must be clear of above grade improvements. SRP requires unobstructed "high and dry" maintenance roads that are 20 feet wide with a 20:1 maximum slope which run parallel to the conductor for the entire length of the easement on both sides of the towers/structures. Those maintenance roads require access 24 hours a day and 7 days a week.

2) Wire setup areas for EHV transmission lines are defined as a rectangular area 60 feet long by the width of the easement, repeated every 100 feet between the tower/structure setup areas.

   Note: Tower/structure setup areas and wire set up areas for EHV transmission lines are reviewed during the SRP Initial Plan Review Process.

3) Below grade improvements within structure setup areas for EHV transmission line are reviewed on a case-by-case basis. Prior written consent by SRP is required.

   Note: Improvements within SRP easements/ROW for EHV transmission lines must meet 320 psi point load on 27-inch diameter pad.

4) Parking may be an acceptable use of SRP easement/ROW for EHV transmission lines. There are specific requirements for orientation with respect to traffic flow. Maintenance roads and crane setup areas will need to be incorporated into the parking design based upon input from SRP. Any vehicles parked within SRP easements/ROW must be able to be relocated, 24 hours a day and 7 days a week, at the request of SRP.

G. Fiber Communication Installation Guidelines

These are installation guidelines to help fiber companies understand how SRP requirements may impact their efforts near SRP easements/ROW and maintenance areas. Please refer to emphasized requirement below and reference the exhibits in the appendix.

> **Note**: Placing communication lines/equipment next to transmission poles could jeopardize the safety of maintenance crews and result in damage to fiber communication facilities if the transmission pole(s) need to be replaced or relocated in the future.

Plans may be rejected for review if they do not meet items 1-5 listed below.

1) All plans submitted to SRP must be drawn to "scale" (*i.e.*, 1 in. = 100 feet).

2) All plans must show SRP transmission facilities and structures. Please label SRP Transmission structures with the stationing that corresponds to the plans and provide dimensioning from closest proposed communication boring and/or trenching location.

3) Plans must show compliance with structure and wire set up areas per *SRP Transmission ROW Maintenance Setup Areas* diagrams for appropriate voltages (69kV and EHV). No improvements allowed inside maintenance setup areas. See Appendix.

4) For 69kV lines, the maintenance access drive path is 15 feet on each side of pole centerline parallel to conductor and should be added to plans. Typical width of a 69kV easements is 30 feet.

   Note: Most SRP transmission lines in the Valley are 69kV.

5) Plans must show all proposed improvements within SRP easement/ROW and maintenance areas.

6) All boring and/or trenching parallel to 69kV transmission conductors will be required to be outside the easement or a minimum of 15 feet from face of pole to edge of bore and/or trench (whichever is the greater distance) with the proposed trenching to be no more than 4-5 feet deep. If bore and/or trenching is closer than 15 feet, additional engineering review will be required and will delay response time.

7) For boring and/or trenching perpendicular to 69kV transmission conductors, they will be required to be a minimum of 30 feet from center of pole.

8) Pedestals or above ground equipment and structures shall not be placed inside pole setup areas or in a location where it blocks maintenance drive path.

9) No new joint use or underbuild attachments to transmission poles will be allowed. SRP only allows maintenance on existing communication facilities but no upgrades.

10) Any potholing required by a municipality or utility within the SRP pole setup areas for 69kV and EHV must be done at a minimum of 15 feet from the face of the pole by vacuum excavation (6 in. to 1 ft. diameter hole), with spoils removed and backfilled with one-half (1/2) sack slurry.

Extra High Voltage (EHV) Transmission Line (115kV, 230kV and 500kV) Guidelines

11) All above ground equipment and structures shall be placed outside Transmission EHV Easements.

12) All boring and/or trenching parallel to EHV transmission conductor must be outside the easement area.

13) All boring and/or trenching crossing under transmission lines shall be perpendicular to lines and cross at a minimum of 50 feet from closest leg of tower or face of pole for EHV transmission facilities.

14) Underground crossing may be required to meet SRP equipment load weight of 320psi on a 27-inch diameter outrigger pad and may also require a Consent to Use Agreement. SRP would require Civil Engineering load calcs for review and approval.

15) Add revision notes and clouds to all revised plans or provide written responses to comments to show comments are resolved.

H. Excavation near Transmission Structures

Drawing Submittal Guidelines Required for Review/Approval

Engineered drawings of proposed excavation must be submitted to SRP for review at the preliminary stages of the customer's design process. Excavation within 100 feet near SRP transmission structures or anywhere within the SRP ROW, whichever is greater, requires approval from SRP prior to construction.

The customer may employ consulting engineers to perform pole stability/excavation analysis and should contact SRP to obtain requirements. SRP reserves the right to accept or reject consultant methodology and conclusions based on the quality of the work and demonstrated knowledge of electric system structures/foundations.

Please provide the following information on your drawings:

1) An engineering scaled plan view with a cross section at each pole location, showing the existing grades and the proposed excavation. The plan should include general site location information such as adjacent streets or other geographic features.

2) The cross section should be perpendicular to the excavation through the center of the pole, showing all dimensions with respect to the edge of the pole foundation. Dimensions should at least include depth and width of excavation, and the horizontal distance from edge of excavation to nearest edge of pole foundation.

3) The cross section should also show the dimensions from the existing grade to the top of the pole foundation. Note the diameter of the pole foundation and indicate the SRP pole number.

4) The excavation cross section should show the side slope or bench planned

for construction that meets OSHA/ADOSH safety standards.

5) All work will need to be stamped and signed by a professional engineer.

6) Any additional information describing the construction process will aid in establishing reliable temporary structure safety factors for the analysis. This includes work items such as time period from start of excavation to end of backfill, time of year planned for work, and distance of cut to active traffic vibration. Also, submitting soils reports performed for the planned work may reduce the time required by SRP to evaluate this information.

General Analysis Guidelines for Excavations adjacent to SRP Electric Power Poles

1) The purpose of this analysis guideline is to provide general information for analyzing the stability of electric transmission power pole and tower foundations adjacent to temporary utility or construction excavations. The information contained herein covers data required for the analysis, the responsibility of entities both gathering data or performing analysis, load causes and criteria, models to be used for analysis and reporting for analysis results.

2) Analysis of the impact of excavations on adjacent foundations is a complex soil-structure interaction problem. Since there are no standard soils, excavation dimensions or power line configurations, there can be no standard distances or depths for safe excavations. The problem is also time dependent since a higher standard is required for long-term wind and weather conditions than would be for short-term situations.

Analysis Elements

1) Structures:

SRP Transmission Line Design and Maintenance departments are responsible for providing information on the structure elements. These structural elements include:

a) Pole material, length, dimensions, wall thickness (if steel).

b) Foundation embedded depth, type (direct embed or drilled pier concrete), backfill material and quality, dimensions.

c) Conductor configuration, type diameter, length to adjacent poles, quantity, location on pole, angles from tangent, tensions.

d) Other equipment on pole (transformers, streetlights, capacitors, comm. & cable).

2) Soils:

A registered professional geotechnical engineer must determine all soils elements. This may require a subsurface investigation, laboratory testing and soils analysis. Alternately, the geotechnical engineer may be able to rely on file data from other work performed in the area if it is of sufficient quality and quantity and representative of the pole and excavation location. These soil elements include:

a) Description of subsurface strata to full depth of trench or pole foundation (whichever is deeper).

b) Soil strength properties (friction angle, cohesion, unit weight).

c) Soil deformation properties.

d) Caving potential when excavated (based on soil and adjacent environmental conditions).

e) Reaction to water inundation (or protection from saturation).

3) Excavations:

The excavation contractor in conjunction with the designer of the new underground facility will determine the excavation elements. SRP requires excavation and conduit/pipe drawings show a cross-section of excavation geometry (width and depth of excavation) in relation to SRP pole or tower foundation/embedded pole (example attached). These excavation elements include:

a) Excavation geometry (depth, width, side slopes – final excavated condition).

b) Clear distance from edge of excavation to face of pole foundation.

c) Ground elevations between excavation and pole.

d) Personnel protection or shoring methods.

e) Backfill materials and methods.

f) Time excavation will remain open.

Loading and Structural Performance

The analysis on the impact of excavations to adjacent pole foundations must address the following concerns:

1) Wind forces on pole expected during the time that the excavation will remain open.

2) Acceptable short and long-term wind and tension load safety factors.

3) Acceptable structure movement (rotation and deflection) as a result of the open excavation.

4) Evaluate all modes of pole movement: over-rotation near surface, kick-out of pole foundation bottom, loss of ground for excavation below bottom of foundation.

Load and Performance Criteria

The following load and performance criteria have been used for previous evaluations. These may need to be adjusted by SRP depending upon the electric line location and importance. (Note: wind pressure is in psf is equal to 0.00256 x velocity^2, velocity in mph):

Case: "Long-Term"
Long-Term Wind: NESC Rule 250B (Combined Ice and Wind) using "Light" district (9 psf wind (60 mph), safety factor of 0.05 lb. /ft., no ice). Use 60 mph wind on the conductor and 60 mph wind on pole. The following overload condition factors are applied to the determined loads; wind load upon conductor, wire, and structures increased by 2.50, tension on conductor and wire increased by 1.65, vertical wire load and weight of structures increased by 1.50.

Long-Term Line Tension: NESC Rule 250C (Extreme Wind Loading). Based on ASCE 7-05 for 50-year return period, exposure category "C", not applicable to structures and facilities below 60 feet, load factors with change in grade of construction. Use 100 mph wind load on conductor, wire, and structures. Apply overload condition factor of 1.10 to conductor, wire, and structures for wind, 1.10 to conductor and wires for tension, 1.10 to vertical load and weight of conductor, wire, and structure load.

Structures supporting high voltage electric transmission lines (115kV and higher): Maximum top of foundation ground line deflection no greater than 4% of foundation diameter and rotation no greater than 1 degree at maximum loads,

Structures supporting electric sub-transmission and distribution lines (69kV and lower): Maximum top of foundation ground line deflection no greater than 5% of foundation diameter and rotation no greater than 2 degrees at maximum loads.

If the "Long Term" case does not work, then additional cases may be reviewed, or pole bracing may need to be provided by SRP at the cost of the applicant.

Soil-Structure Interaction Analysis

1) Engineering analysis must initially determine loads transferred to the top of the pole foundation or direct embedment pole at ground line for each load case. Typically, a static analysis is used to determine ground line moment and shear. Load cases to be evaluated include long-term, temporary, and short-term conditions.
2) Once ground line forces are determined, the analysis must evaluate each load case to ensure that structures perform within the defined performance criteria and the adjacent excavation wall will not fail from loads induced into the soil from the structure foundation. Soil-structure interaction modeling can include the following methods:

a) 3-dimensional finite element model.
b) For lateral load analysis, a combination of a model that can estimate pole movement and resulting soil pressures (LPILE, FAD, etc.) with a model that then takes those loads and applies them to the soils on the backside of the excavation from the loads.
c) For uplift or compression load analysis, a model that can estimate pole movement and the associated soil mass required to resist uplift/compression forces while superimposing the ground loss resulting from the open excavation.

Reports

An engineering report shall be prepared and sealed by a professional engineer registered in the State of Arizona who is qualified to perform both soil and structure analysis. The report must document the following items:

1) A description of the project, including the SRP power line and pole numbers involved.
2) All structure, soil and excavation data/configurations for each pole being analyzed.
3) All work required to obtain data and source of data.
4) The performance criteria for the analysis.
5) Analysis model and methodology.
6) Results of the analysis for each structure and each load case, with appropriate loads directed both toward the excavation and away from the excavation.
7) A summary of the impact for critical load conditions on each structure in relation to pole performance criteria and excavation slope stability.

8) Actions required (if any) to insure pole stability for each load case (trench shoring, structure bracing/guying, relocation of trench, modification of the trench dimensions, horizontal bore installation of the new underground facility).

9) Recommendations for new underground facility installation that will least impact the electric power structures (use of short-term or temporary excavation and backfill conditions, improved backfill materials, specialty shores to provide additional trench wall stability and resist pole forces).

10) Other trench construction recommendations in the vicinity of structures (trench backfill specifications, trench protection from storm water, shoring specifications, traffic/equipment/spoil restrictions between trench and structure.

11) Appendixes with all data, calculations, surveyed cross section at each pole location, site map, etc.

I. Blasting

Pre-Blast Survey

A pre-blast survey of all SRP facilities and structures within 500 feet of all blast events to be performed by an independent, qualified third party. Final, complete report to be submitted to SRP a minimum of 10-days prior to commencement of blasting. The purpose of the survey is to document any distress including existing cracks within SRP structures. The third party may exclude condition of conductor, attachments, and insulators of SRP structures as SRP will conduct own pre-blast survey of these items.

Blasting Plan

A Blasting Plan for **each** proposed event that is to occur within 500 feet of an SRP facility (includes, but not limited to, underground structures, above-ground structures, structures supporting overhead electric power, overhead conductor, overhead equipment and materials, substation equipment and walls, underground electric ducts, underground conduit, underground irrigation pipeline, manholes, and box culverts) must be submitted to SRP for approval.

Blasting Contractor shall fully comply with the requirements of the approved Blasting Plan. SRP approval is focused on the protection of nearby SRP facilities, and SRP approval of the Blasting Plan should not be interpreted as SRP dictating or approving safety and method used by the Blasting Contractor. The Blasting Contractor is solely responsible for ensuring that his method is safe, that all statutory and imposed requirements and limitations are followed, and to obtain approval from all relevant authorities and follow their requirements.

Submitted Blasting Plan is to provide details of the proposed event including, as a minimum, the following information:

1) Project name, shot/event identification, and submittal date.

2) Location (include map and show SRP facilities including horizontal distance from blast area to facilities and include location of drill holes in relation to SRP overhead conductor and provide elevations of top of drill rig and overhead conductor when inside SRP right-of-way).

3) Provide sketch showing where blast monitoring equipment for SRP

facilities will be placed and show distance from blast.

4) Scaled distance, anticipated PPV, and anticipated maximum air overpressure at nearest SRP facility.
5) Production diameter, spacing, total depth, total number, inclination, and map of location of holes.
6) Bench height, sub-drill height, stemming height, burden height, and loaded height.
7) Type and size of explosives used to include specific gravity.
8) Quantities of explosives used/hole and total quantity of explosive.
9) Sequence of blasting and planned time delays. Include holes/delay and maximum explosive pounds/delay. Sketch showing anticipated movement of shot relative to SRP facilities including anticipated direction of throw of blasted rock.
10) Comment on throw of rock blasted rock and its impact on SRP facilities (including overhead conductor) and any measures used to control fly rock, if required.
11) Detailed description of fly rock control method, where required (i.e., overburden thickness, overburden material type, overburden footprint, compactive effort used to place overburden, type of blasting mat/strip, size of blasting mat/strip, detail of blasting mat/strip placement including any anchoring, mat/strip weight, composition of mat, and any special blasting techniques used such as delays and development of free faces away from the structure provisions to control fly rock).

The Contractor's blasting event shall generally be considered satisfactory and in conformity with these specifications when the unstable rock mass is cleanly split from the stable rock mass in such a way that subsequent site activities do not shatter or loosen adjacent rock that is not to be removed. All drilling and blasting shall be done in such a manner as to bring the cliff face as close as possible to a stable profile and to disturb as little as possible the material to be left in place.

Event Report

Blasting Contractor shall provide the **SRP Designated Blasting Representative** an Event Report for each blasting event. Event Report must be submitted prior to performing any future blasting event that requires SRP approval, or within 24-hours from the most recent blast event, whichever is the shorter period. The time required to provide the Event Report may be adjusted by SRP should accurate verbal reporting regarding blasting event data be provided to SRP Blasting Representative soon after completion of the blasting event.

1) The Event Report shall contain all pertinent information of the blast event and shall use English units. Event reports shall provide, as a minimum, the following information:
2) Blast Date and Time.
3) Blast Identification.
4) Duration of Record Time.
5) Operator Name.
6) Set-Up Identification/Location.
7) Serial Number of Seismograph.
8) Seismograph Most Recent Calibration Date and by Source of Calibration.

9) File Name.
10) Maximum Pounds of Explosive per Delay.
11) Peak Velocity for Each Component (Transverse, Vertical, Longitudinal).
12) Zero Crossing (ZC) Frequency for Each Component
13) Time Relative to Trigger for Each Component.
14) Peak Acceleration for Each Component.
15) Peak Displacement for Each Component.
16) Peak Sound Pressure Level (PSPL).
17) Zero Crossing (ZC) Frequency for Air Overpressure.
18) Plot of Data with OSMRE and USBM RI8507 Limits.
19) Vibration and Microphone Data Time Histories (Plot, Tape, or Other Data Presentation Method).
20) Drawing, Map, and/or Scaled Image of Blast Location and Monitoring Locations, and Any Other Pertinent Information.

Monitoring Equipment and Set-Up

Each blast event shall be monitored for blast induced ground vibration and air overpressure by a qualified independent testing consultant or agency well experienced in that type of work.

SRP Blasting Requirements near SRP Facilities Including Overhead Conductor

Blast events must be planned and performed so as not to generate fly rock that may impact any SRP facility, this includes but is not limited to structures, structures supporting overhead electric power, insulators, conductor, hardware, attachments, and arms of structures.

SRP will not permit blasting events within 20 feet (horizontal distance) of any SRP structure supporting overhead electric power, and any other underground and above-grade structure. A special review process may be requested for blasting closer than 20 feet with the understanding that SRP review of this process may require several weeks, and it is likely that this review would not allow blasting at the closer distance. Blasting may be conducted directly beneath SRP overhead conductor upon approval by SRP.

SRP requires that any blasting within 50 feet (horizontal distance) of an SRP structure, structure supporting overhead electric power, or overhead conductor be designed to control fly rock. This design, as a minimum, must include covering of loaded holes using non-conductive blasting mats, non-conductive rubber strips, and/or overburden. Additionally, specialized blasting techniques such as use of delays and controlling development of free faces away from the conductor should be incorporated into the design.

Method proposed by Blasting Contractor to control fly rock must be proved to the satisfaction of SRP by at least one test blast or one production blast located outside the 50-foot distance. Success of the proof would dictate requirement for adjustment of method and further proof testing.

Metal blasting mats and any other conductive blasting mats are not permitted within 200 feet (horizontal distance) of overhead conductor. Blasting mats must be anchored to prevent the mat or other material from being thrown into the overhead conductor. Leading wires shall be placed at

right angles to the overhead conductor alignment and shall be securely anchored to prevent the blasting circuit conductor from being thrown into the overhead conductor.

Placement of overburden (including but not limited to thickness, compactive effort, material type, and area) is to be determined by the Blasting Contractor.

SRP Right to Delay or Cancel Blasting Work

SRP has the right to postpone or cancel a blast event due to operation concerns of the electric power system. These concerns would include items such as high load through conductor, or the in-ability to shed load rapidly in case of damage. The **SRP Designated Blasting Representative** would communicate any required cancellation or postponement to the Blasting Contractor as soon as possible.

SRP has the right to postpone or cancel future blast events should a preceding blast event not have performed as designed, or the event had the appearance of possibly damaging existing at-grade or underground structures, overhead conductor, or structures supporting overhead electric power. Items such as PPV or air overpressure values being above limits stated herein, fly rock encroaching structures or conductor, and the **SRP Designated Blasting Representative** observing any possible damage to structures and conductor would be considered a reasonable cause for shutdown.

The Blasting Work would be shut down until SRP has had the opportunity to observe and assess competency of structures and overhead conductor, and SRP has completed all necessary repairs (if required). Also, Blasting Work would be shut down until SRP approves submittal presenting reason(s) that blast event was not as anticipated, and corrective action(s) that will be taken to prevent such occurrence from repeating.

SRP has the right to modify the requirements of this Specification should damage occur to their facilities due to blasting events that meet all requirements stated within.

SRP Representatives and Submittal Confirmation

SRP will have two (2) to four (4) representatives to accept the submittal of a scheduled blasting event or Blasting Plan. These representatives are identified as “SRP Blasting Representatives.” Initial contact of the SRP Blasting Representative of a scheduled blasting event or submittal of a Blasting Plan by the Blasting Contractor must be by e-mail to the SRP address TransmissionLineSup@srpnet.com.

J. Gates and Fence

When gates and/or fencing are required the following outlines the minimum criteria required by anyone wishing to install them within or adjacent to SRP easements/ROW. They must obtain specific written approval from the SRP Land Department before any construction may proceed within the easement property.

Gates

1) Gates need to be self-closing and set parallel to the slope of road.
2) Where cattle guard is used, cattle guard shall be aligned with road.
3) Steel poles and braces shall be galvanized or painted with a baked-on asphalt base enamel.
4) Set fence posts and braces in concrete. The concrete shall be 2000 psi at 28 days.
5) The standard 20 feet gate shall be 42-inch-high minimum with 1 3/8-inch

O.D. galvanized iron tubular frame. All fittings shall be galvanized. The gate shall have a diagonal adjustable sag-rod or wire. The minimum weight of gate shall be 70lbs.

6) G. I. Mesh Fence filler to be 11-gauge farm fence filler or equivalent.

7) Install sign. Sign to read "Keep Gate Closed."

8) Install copper braided strap. Typically, 12 feet (BURNDY BD12 or equal) bonded for proper grounding.

Fence, Galvanized Chain-Link

1) Fences need to be grounded and must have shared lock access.

2) Install grounds at points not to exceed 500 feet apart in any fence that parallels the transmission line for more than 1000 feet as directed by the purchaser.

3) Install one ground at each edge of the right of way in fences that cross the transmission line (total of 2 rods).

4) Where a gate has been installed in the fence that crosses the transmission line, install a ground rod on each side of the gate opening.

5) Fill all clamps with conducting grease prior to crimping or bolting.

6) Deform the threads on the U-bolt grounding clamp with a chisel after installation to prevent removal of the nuts.

K. Maintenance Practices

Hardware and framing shall be designed to allow maintenance of each individual 69kV circuit in a double circuit configuration without affecting the operation of the adjacent circuit.

Conflict Reviews performed by SRP TLD and TLAM shall include NESC, maintenance access, and maintenance equipment setup areas. NESC clearances include but are not limited to: Streetlights, buildings, grading changes (cuts / fills at poles & at mid-spans).

L. Construction Activities

All construction activities (e.g. haul roads, laydown yards, etc.) that will impact SRP easements/ROW or any SRP asset must be reviewed and approved by SRP. Additionally, roadway construction project task work in the SRP easements/ROW that involves a crane and/or derrick must have oversight by SRP Safety Services. Please contact SRP Safety Services at (602) 236-8117 or Safety@srpnet.com for more information.

M. Damage Claims

Any damage to existing, new or partially completed SRP-P facilities, including survey markers and staking, by the customer's forces or equipment will be the responsibility of the customer. No excavation shall take place without Blue Stake.

Transmission Line Design (TLD)

Transmission Line Design (TLD) is responsible for the design and engineering of the transmission system, voltages 69kV and above. Some of the primary functions in TLD are to perform and evaluate electrical line clearance calculations, structural strength analysis, job scoping, estimating and detailed engineering and design. Transmission Line Design manages their projects from inception through construction, including route selection, public involvement, environmental/biological assessments, permitting, land rights acquisition and construction coordination, etc.

Design Information

Customers will provide TLD with their design files. All files need to be geo-referenced and aligned with TLD's survey requirements (described in the Survey section below).

1. 3D design models at 30%, 60% and 90% milestone deliverables. Models need to have existing and proposed grade elevations, as well as all facilities such as roadways, walls, bridges, curb, gutter, driveways, drainage channels etc. These files will need to be provided in either a .dxf or .dgn file format
2. Above ground obstructions such as lighting, signals, signs etc. that are not captured by 3D model at 30%, 60% and 90% milestone deliverables will also need to be provided in either a .dxf or .dgn file format.
3. Geotechnical reports.
4. Light Detection and Ranging (Lidar) topographic survey of existing SRP-P lines within the project area will be required to ensure accuracy of the wire sag information.
5. Other facilities that will be relocated due to this project such as COX Communications, CenturyLink, Southwest Gas, RWCD, Municipal water, sewer, storm drain, SRP-W and DIST will need to be coordinated with SRP-P and provide their design documents. Underground information for all existing facilities will need to be *CI/ASCE 38-02 utility quality level A, B, C, D.*

Survey

TLD survey requirements for design.

1) Horizontal Datum: North American Datum of 1983 (NAD83)
2) Zone: Arizona Central 202
3) Unit: International Foot
4) Vertical Datum: North American Vertical Datum of 1988 (NAVD88)
5) Coordinate Projection: Grid
6) LiDAR Point Load Cloud classification per SRP Feature Code (Feature Code can be provided upon request).
7) Typical recording of environmental data should include but not limited to date, time, temperature, and wind velocity.

Buy America Material

Buy America compliant material will be purchased after the SRP-P design plans have been reviewed and accepted by the customer. If the customer changes the design after the materials have been ordered, there is a potential for the construction schedule to adjust and/or the supplementary materials will be added to the variance list. Critical material items such as steel poles and wire typically have

a long lead delivery time, in some cases up to approximately 36 weeks.

Reimbursable Items

Pole braces, line clearance markers, line outages and shoo-flies of SRP-P facilities to aid customers during their construction will require a separate Reimbursable Contract with SRP-P. SRP-P Services will be based on the information provided by the customer. SRP reserves the right to request additional information from the customer during the course of the Service(s). If the customer modifies its request or the information provided therein is modified, the schedule to complete the Service(s) may be extended and the customer shall pay SRP for any additional Service costs that may be incurred as a result of such modification.

Project Changes - Any changes, amendments, or modifications to this Agreement must be in writing and signed by both parties.

Billing and Payment - SRP's delivery of this Agreement to the customer constitutes an offer to perform the Service(s) on the terms and conditions set forth in this Agreement. Customer may accept this offer by signing this Agreement (with no additions, deletions, or modifications) and returning it to SRP with the above Service(s) fee. SRP shall provide an invoice to the customer for the Service(s) with this Agreement.

Prior to the work being scheduled, the customer must return a signed contract and submit payment. Approximate turnaround time frames in the table below begin once payment has been received.

Install line guards (tattletale)	1-3 Business Day(s)
69kV line outage request	Minimum 30 business days notification
Pole brace w/ poles	4-5 Business Day(s)
Pole brace w/ truck	1-4 Business Day(s)

All outages are subject to loading conditions, weather, and critical customer load.

69kV Outages between May 1st and October1st are difficult to obtain.

Transmission Line Construction (TLC)

Transmission Line Construction is responsible for constructing new and existing 69kV, 115kV, 230kV, and 500kV lines throughout SRP's service territory. TLC also provides technical guidance to various departments throughout SRP.

Construction Schedule

1) SRP-P will schedule a construction crew after the following applicable steps are completed:
   a) All permits are approved
   b) Customer has returned the executed Agreement, approving all SRP costing documents
   c) Customer has provided SRP-P with the appropriate right-of-way or easements
   d) All the project material is in stock
2) All 230kV, 69kV and 12kV work is contingent on obtaining outages. All 230kV line outages must be requested at least 120 working days in advance of planned construction activities. All 69kV line outages must be requested at least 30 working days in advance of planned construction activities. All 12kV line outages must be requested at least 10 working days in advance of planned construction activities. All outages are subject to loading conditions, weather, and critical Customer load. The sooner an outage can be scheduled the better. 230kV and 69 kV OUTAGES BETWEEN MAY 1st AND OCTOBER 1st ARE EXTREMELY DIFFICULT TO OBTAIN. All outages are subject to availability.
3) All construction durations are subject to change depending upon final design approval, construction sequencing, final locations, access, permits, customer's right of way and archeological release for construction, etc.

Distribution Design, Construction, & Maintenance (DIST)

Distribution Design, Construction, & Maintenance (DIST) is responsible for the design and engineering of the distribution system voltages. Some of the primary functions in DIST are to perform and evaluate electrical line clearance calculations, structural strength analysis, job scoping, estimating and detailed engineering and design. DIST manages their projects from inception through construction, including route selection, public involvement, environmental/biological assessments, permitting, land rights acquisition and construction coordination, etc.

Design

Cost savings can be achieved if locations and electrical loading information for streetlights, traffic signals and landscaping associated with the project are provided prior to completion of relocation design work.

1) Joint Use
   Applications will be evaluated on a case-by-case basis by SRP to avoid conflicts and ensure that the design meets NESC and other required codes. In order to perform the evaluation, 3rd Party Design and customer's permit must be submitted simultaneously through SRP's IPR process for review and approval prior to construction or conduit installation.

2) Design Build Projects – Lock Down Sheets
   In order to keep the project on track, the use of Lock Down Sheets are encouraged whenever possible for all proposed improvements (i) in proximity to any SRP high voltage line or easement and/or (ii) in any area requiring an environmental site assessment.

Any design performed by others for, and on behalf of, DIST must be to DIST standards and specifications and reviewed and approved by DIST. All design and construction by others, including trench and conduit, must be done per DIST specifications (contact DIST for information).

Construction

All construction durations are subject to change depending upon final design approval, construction sequencing, final facility locations, access, permits, right of way and archeological release for construction, etc.

All sub-grades and final grades must be identified on design drawings at the locations of all SRP-P facilities such as trench line, pad mounted equipment, pole location, etc. Horizontal and vertical controls must be established by customer in the immediate vicinity of the work for all grades and survey ties. DIST will require that SRP's field survey for trench center line and elevation and pole locations be confirmed by the customer prior to start of work to insure correct survey data/datum. SRPP also requires a final legal description of customer's right of way in areas where the customer has not installed right of way monuments.

After existing facilities are relocated and energized DIST will: 1) remove overhead (OH) lines that are in conflict and for underground (UG) lines, DIST will: 2) remove the above ground equipment and cable from existing conduits. Others must remove abandoned direct buried cable, pads and conduit that may be in conflict.

DIST requires an executed service agreement contract before any electrical work will proceed.
DIST at its own discretion will determine if DIST will provide the customer(s) with paper copies or reproducible copies of any DIST drawings requested by the customer(s)

1) Right of Way
   DIST will not proceed with any work until all the customer's right of way in the work area has been acquired, the work area for DIST's construction is clear and level, prior

rights have been resolved, relocation alignments approved by the customer's design consultant, the necessary contract/agreements have been executed, all affected DIST easements and prior rights transferred to the new relocated locations, all long lead materials (Steel Poles etc.) are available and all the required permits approved by the various municipalities, the railroad and customer including any required State Land permits.

2) Access
   a) DIST requires drivable access to all poles and equipment located in customer's ROW for maintenance, operation, and construction of power lines.

   b) In order to operate and maintain its 12 kV equipment DIST requires a ten-foot-wide linear corridor to either side of the relocated facilities. Where ground level equipment is located a total of 12 feet of clearance is required in the front of the equipment.

3) Shoo-flies
   a) Customer must review and approve any proposed shoo-fly locations. Shoo-flies required for construction will be paid for by others. DIST will design the most cost-effective shoo-fly that meets NESC and other required codes. Any requests for modification or relocation of a shoo-fly after initial installation will be at the expense of others.

4) Streetlights, Signal Lights, & Other Customer Services
   a) If the conduits for streetlights, signal lights, or other customer service are not in an existing common trench with DIST, the designer will issue the job to customer and five copies to DIST's inspection group. Per DIST's Customer Policies and Procedures, the applicant and/or commercial customer is responsible for providing the trench and conduit. The customer is responsible for installation of trench and conduits, as well as the conduit and lead from the streetlight or the signal light control cabinet to SRP's point of delivery. When the customer has completed this work, DIST inspection must be contacted. Any inspection by DIST does not constitute acceptance of the trench and conduit until DIST has installed the cable and terminated and energized the service. DIST's inspector must be present to observe mandrelling of the conduit and pass the work as "Completed" before SRP-P will schedule the installation of cable to energize the lights or signals.

   b) No streetlight, signal light, or other customer service wire will be installed or connected until all required inspections have passed. A minimum of five days' notice is required to schedule a crew for installation or connection. If the crew shows up and if either the inspection was not scheduled or the inspection did not pass, a minimum of five additional days' notice must be given for a crew to return to the job site.

   c) If the streetlights are to be removed, DIST will only remove its cable from any conduit to the point of delivery and abandon the conduit and any direct buried cable. The customer should confirm ownership of lights before any removal and disposal. The party requesting the disconnect or reconnect will be responsible for the cost. Streetlights and the interconnections are not the property of DIST.

   d) For all bridge lighting, if any, DIST will provide service to J-boxes adjacent to, but off of, the bridge. All on-bridge conduits, wire fixtures, etc., shall be the responsibility of others.

Inspection

A DIST inspector must inspect any construction performed by others for, and on behalf of, DIST. Any conduit installation or other work that is performed by others for and on behalf of DIST including streetlights that is backfilled, covered, or closed before being inspected by DIST will be exposed

for inspection at the customer's expense. Also, after covering the conduit, final approval of any conduit installation requires the customer to "blow" a mandrel through the conduit in the presence of the DIST inspector to demonstrate there is no blockage or deformity. A pre-construction meeting shall take place prior to construction. Pre-scheduling of inspection may be available after construction starts. The present phone number for scheduling inspection is 602-236- 0436 (Distribution Improvements). This number may change and will be appropriately updated.

Excavation near Structure

Do not excavate within a 25-foot radius or fill within a 15' radius of any power pole without prior approval by DIST. Power poles have not been designed for adjacent excavation or fill. Customers must submit plans to DIST for approval at least ten (10) working days prior to start of work if construction requires any excavation within a 25-foot radius of a power pole.

Review by DIST does not relieve the customer of responsibility for protecting structures from impacts of adjacent excavations. Any bracing, guying or other special provision required to allow customers to excavate next to DIST structures will be prepaid by the customer.

Damage Claims

Any damage to existing, new or partially completed SRP-P facilities, including survey markers and staking, by the customer's forces or equipment will be the responsibility of the customer. No excavation shall take place without Blue Stake.

Buy America Material

Buy America compliant material will be purchased after the DIST design plans have been reviewed and accepted by the customer. If the customer changes the design after the materials have been ordered, there is a potential for the construction schedule to adjust and/or the supplementary materials will be added to the variance list. Critical material items such as steel poles and wire typically have a long lead delivery time, in some cases up to approximately 36 weeks.

Reimbursable Items

Line outages and shoo-flies of DIST facilities to aid the customer during their construction will require a separate Reimbursable Contract with SRP-P. SRP-P Services will be based on the information provided by the customer. SRP reserves the right to request additional information from the customer during the course of the Service(s). If the customer modifies its request or the information provided therein is modified, the schedule to complete the Service(s) may be extended and the customer shall pay SRP for any additional Service costs that may be incurred as a result of such modification.

Project Changes - Any changes, amendments, or modifications to this Agreement must be in writing and signed by both parties.

Billing and Payment - SRP's delivery of this Agreement to the customer constitutes an offer to perform the Service(s) on the terms and conditions set forth in this Agreement. Customer may accept this offer by signing this Agreement (with no additions, deletions, or modifications) and returning it to SRP with the above Service(s) fee. SRP shall provide an invoice to the customer for the Service(s) with this Agreement.

Prior to the work being scheduled, the customer must return a signed contract and submit payment. Approximate turnaround time frames in the table below begin once payment has been received.

A disconnect is only the removal of the meter. If total removal of electrical

equipment is required, a written request to remove or abandon equipment is required from the owner of the facilities. All removals are at the expense of the owner and/or applicant.

69kV line outage request	Minimum 30 business days notification
12kV line outage request	Minimum 10 business days notification
Street Light Inspection	Minimum 5 business days notification
Streetlight Disconnect Letter	Minimum 10 business days notification
Other Customer Requested Work	Minimum 20 business days notification

All outages are subject to loading conditions, weather, and critical customer load.

69kV Outages between May 1st and October1st are difficult to obtain.

SRP Safety Services Technical Provisions

We appreciate the opportunity to assist you with your construction project and would like to take this occasion to provide you with essential information about safety regulations which apply to all work performed near overhead or underground power lines.

Prior to the start of construction, you should be familiar with several clearance requirements regarding work performed near overhead and underground power lines. These include, but are not limited to, (i) Arizona law regarding high voltage overhead power lines and safety restrictions, (ii) Arizona law requiring underground facilities safe excavation practices, (iii) The National Electrical Safety Code, and (iv) regulations promulgated by the Occupational Safety and Health Administration (OSHA).

By taking a few moments now to review these safety requirements, you should be better able to complete your project in a safe and timely manner and reduce the possibility of accidents. Your compliance with these requirements in cooperation with SRP will not only help you maintain project safety but reduce the expense of project delays and damage claims.

Overhead Power Lines

Arizona law regarding "High Voltage Power Lines and Safety Restrictions" (A.R.S. §40-360.41 through 45) requires that a minimum clearance of ten (10) feet be maintained between an energized power line of up to 50 kV and a piece of mechanical equipment, its load, and any attachments such as "tag lines." Energized power lines with higher voltages require even greater distances. New OSHA regulations regarding the use of cranes may require even greater clearance distances.

The Arizona law states that, "A person or business entity shall not…operate any mechanical equipment or hoisting equipment or any load of such equipment, **any part of which is CAPABLE OF vertical, lateral, or swinging motion closer to any high voltage overhead lines than**" the minimum clearance distance, "unless prior arrangements have been made with the utility company to make sure that the work can be performed safely."

This means that before doing any work near overhead power lines, you must: (1) consult with SRP regarding the specific work you have planned near overhead power lines, and the specific date you plan to do the work; and (2) you must make specific arrangements with SRP so that the work can be done safely.

If you anticipate your project "work" will require activity closer to overhead power lines than these minimum standards allow, you must call SRP and ask for an SRP Representative to meet with you at the construction site to address your construction plans so that appropriate safety precautions can be made. **No work can be done until safe work arrangements have been made with SRP.** Failure to comply with this statute may not only be hazardous to your employees but could result in damage claims against you. Violations of this statute could also subject you to a five thousand dollar ($5,000) fine from the State as well as applicable fines from OSHA.

The National Electrical Safety Code "NESC" specifies clearances that must be maintained between power lines and buildings, signs, and other structures. These clearances vary with the voltage of the line, activity expected near the line and the structure that may be near the line. If you construct buildings, signs, or other structures nearer to existing power lines than the NESC authorizes, such construction activity may not only be hazardous to your employees (and a violation of OSHA and Arizona safety laws), but it may also subject you to the cost of correcting NESC code violations.

Underground Power Lines

Arizona law regarding "Underground Facilities" (A.R.S. §40-360.21 through 32) requires that you arrange for locating the position of underground facilities before beginning any excavation, and that you take necessary measures (including only hand digging within two feet of underground facilities) to ensure that the facilities are not cut or damaged. Failure to do so may not only be hazardous to your employees but could result in damage claims against you. Violation of this statute may also subject you to a five thousand dollar ($5,000.00) fine from the state. You may make arrangements for locating underground power lines free of charge by contacting Arizona 811 by calling (602) 263-1100 in Maricopa County, outside Maricopa County, call 811 (1-800-782-5348) or create a ticket online at least two (2) full working days excluding holidays prior to performing any excavation. Monday through Friday excluding holidays from 6:00 a.m. through 5:00 p.m.

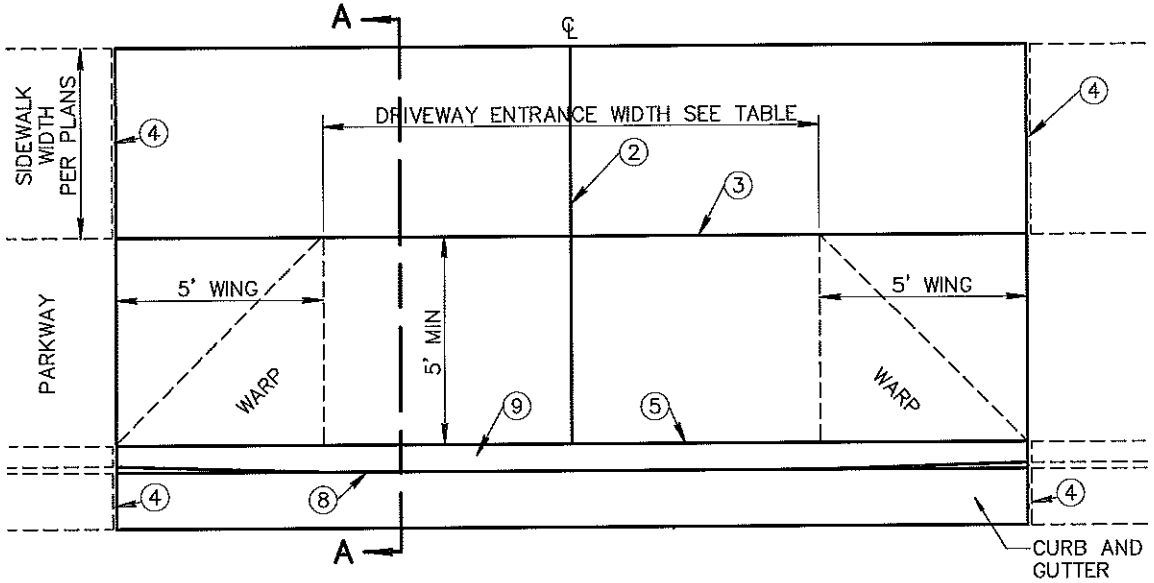
Please remember these safety standards and requirements along with applicable city ordinances when planning and constructing your project. For a more complete statement of the law, refer to the attached brochure and the referenced statutes. If your specific needs require assistance from SRP, please call the number listed below or email. Thank you for your interest in safety.

Safety Services: (602) 236-8117

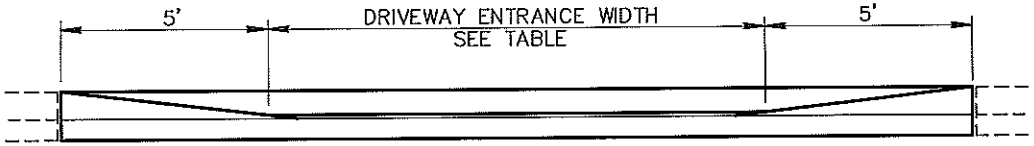
Email: publicsafety@srpnet.com
https://www.srpnet.com/safety/contractor.aspx

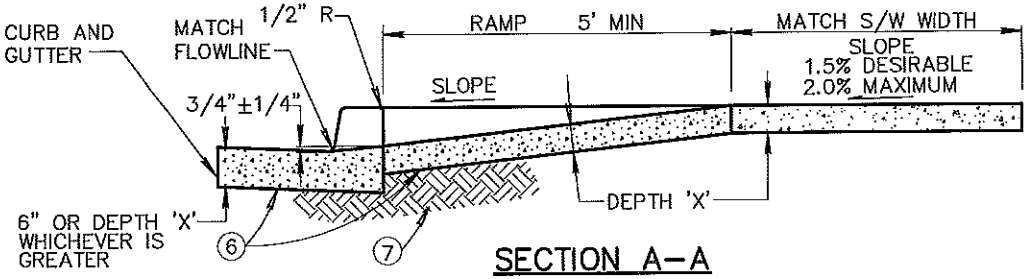
APPENDIX

- MAG Detail 250
- WES – ROWGUIDE. SRP Right-of-way Guidelines
- WES – 02604-001. Utilities Crossing of Parallel to SRP Irrigation Pipe
- Tree List
- Ground Cover List
- Storm Water Retention Basin
- 69kV Setup Areas
- Extra High Voltage (EHV) Setup Areas
- Fiber Communication Installation Guidelines – 69kV Setup Areas
- Fiber Communication Installation Guidelines – EHV Setup Areas
- Gate Detail
- Fence Detail
- SRP Reinforced Access Ramp
- Turning Radius Exhibit
- Applicant Safety Acknowledgement Form (Example)
- Occupation Safety and Health Administration General Industry Regulations (29 CFR 1910)
    - Subpart S – Electrical
- Occupation Safety and Health Administration Construction Industry Regulations (29 CFR 1926)
    - Subpart CC – Crane and Derricks in Construction
- SRP Point Load General Analysis Guidelines (25 pages)



DRIVEWAY WITH DETACHED SIDEWALK





SECTION A–A

NOTES:

1. DEPRESSED CURB SHALL BE PAID FOR AT THE CONTRACT UNIT PRICE FOR THE TYPE OF CURB USED AT THAT LOCATION.
2. CONTRACTION JOINT ON D/W CENTERLINE.
3. CONTRACTION JOINT.
4. 1/2–INCH EXPANSION JOINTS SHALL COMPLY WITH SECTION 340.
5. BACK OF CURB – CONSTRUCTION JOINT.
6. CONCRETE CLASS AS NOTED IN TABLE. CONCRETE PER SECTION 725.
7. SUBGRADE PREPARATION, SECT. 301.
8. FLOW LINE OF GUTTER.
9. DEPRESSED CURB.
10. SECT. A–A AND ELEVATION: D/W SHOWN WITH VERTICAL CURB AND GUTTER, ROLL TYPE CURB AND GUTTER TREATED SIMILARLY.
11. ROUGH BROOM FINISH FULL WIDTH OF RAMP AND WINGS.
12. TROWEL AND USE LIGHT HAIR BROOM FINISH FOR WALKWAY AREA.
13. 'DRIVEWAY ENTRANCE WIDTH' IS THE DRIVEWAY WIDTH PLUS ADDITIONAL WIDENING REQUIRED BY THE LOCAL JURISDICTION.
14. ELEVATION AT TOP OF DRIVEWAY RAMP SHALL BE EQUAL TO OR HIGHER THAN NORMAL CURB ELEVATION.

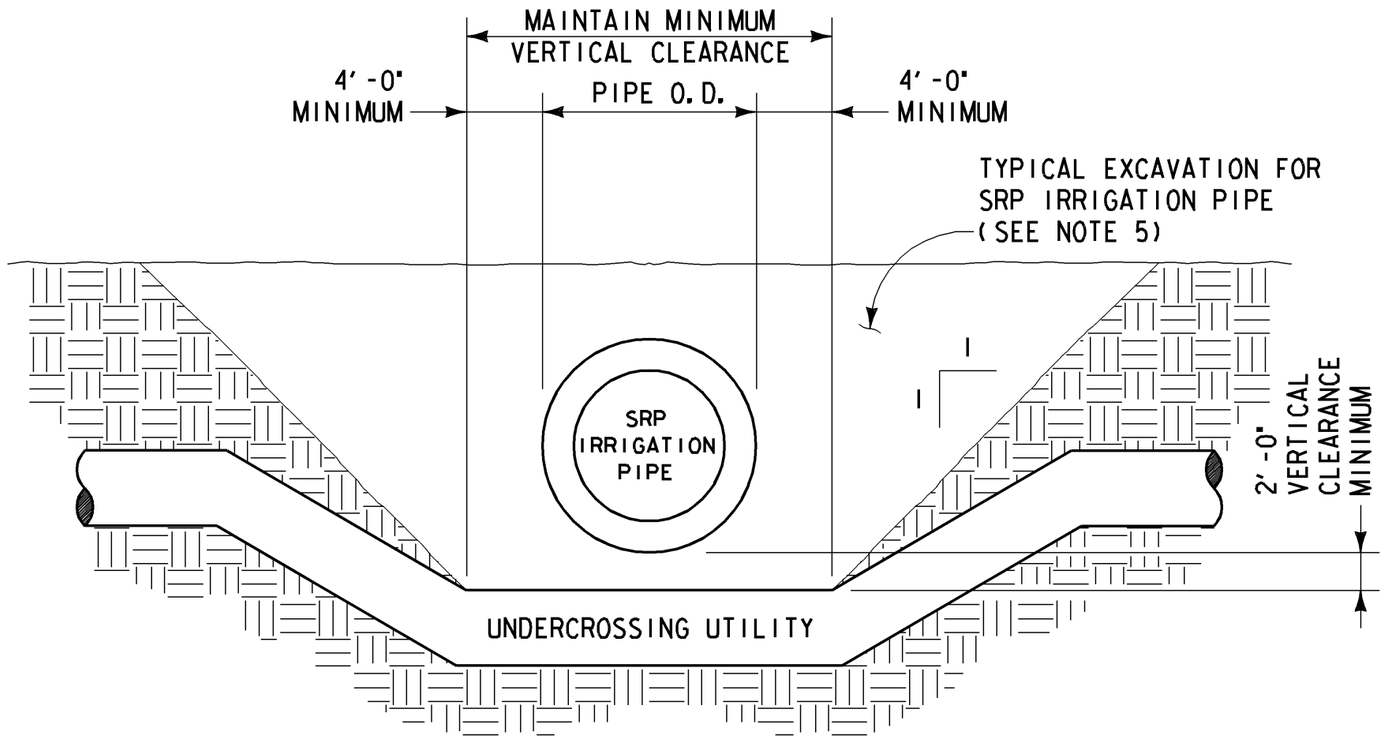
COMMERCIAL AND INDUSTRIAL

DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'
COMMERCIAL	✳ 16'	40'	A	9"
INDUSTRIAL	✳ 16'	40'	A	9"
✳24' MIN. FOR TWO WAY TRAFFIC				

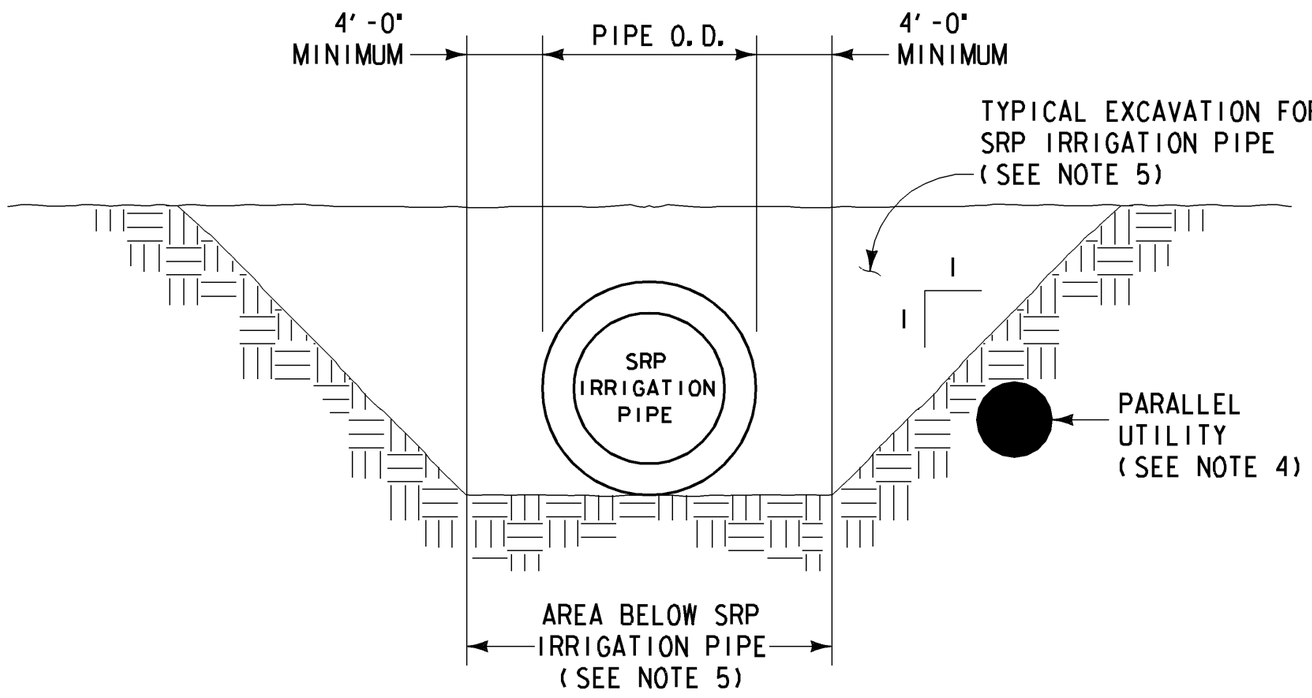
RESIDENTIAL

DRIVEWAY ENTRANCE WIDTH	MIN.	MAX.	CLASS	DEPTH 'X'
MAJOR STREET	16'	30'	B	5"
COLLECTOR STREET	✳ 12'	30'	B	5"
LOCAL STREET	12'	30'	B	5"
✳16' DESIRABLE				

DETAIL NO.			REVISED	DETAIL NO.
250–1	MARICOPA ASSOCIATION of GOVERNMENTS STANDARD DETAIL ENGLISH	DRIVEWAY ENTRANCES WITH DETACHED SIDEWALK	01–01–2014	250–1



PIPELINE - UNDERCROSSING

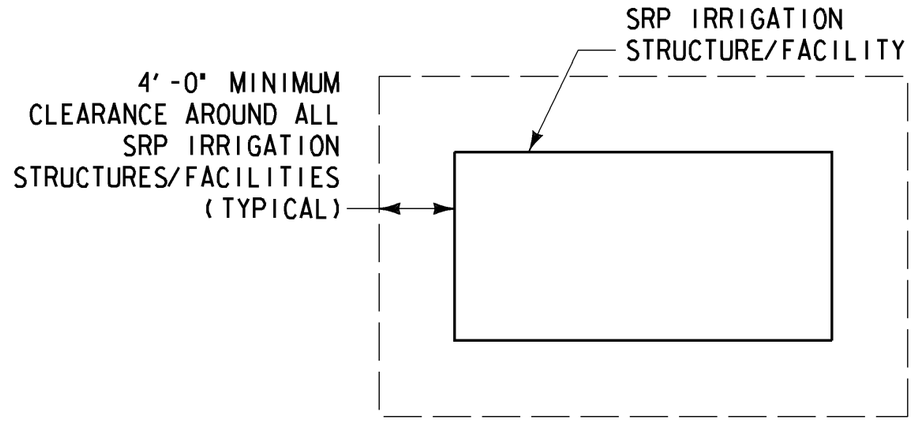


PIPELINE - PARALLEL UTILITY

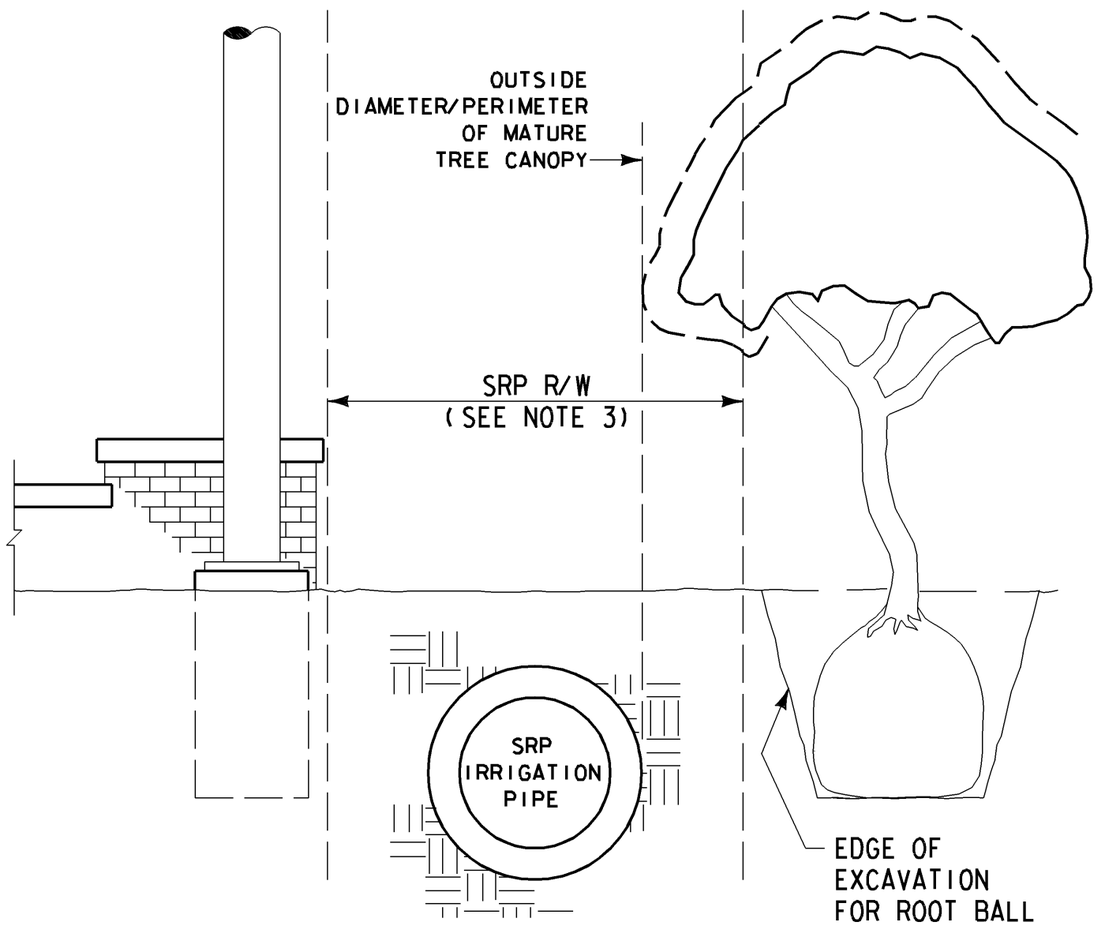
PIPELINES - RETENTION BASIN

NOTES

1. THESE GUIDELINES ARE PROVIDED AS A GENERAL AID TO PLANNING. ACTUAL SRP REQUIREMENTS MAY VARY BASED ON SITE-SPECIFIC CONDITIONS, OPERATIONAL CONSIDERATIONS, ETC.
2. AN SRP LICENSE IS REQUIRED FOR UTILITIES CROSSING/PARALLEL TO SRP IRRIGATION PIPE IN SRP RIGHT-OF-WAY. SRP REQUIRES ENGINEER DESIGNED UTILITY CROSSING/LOCATION AND EXCAVATION PLAN.
3. SRP MAY LICENSE LIMITED USES OF ITS RIGHT-OF-WAY SUCH AS PARKING, SIDEWALK, LAWN, ETC. POLES, STRUCTURES AND TREES ARE TYPICALLY NOT PERMITTED IN SRP RIGHT-OF-WAY. INCLUDE DESIGN DRAWINGS FOR PROPOSED USE WHEN SUBMITTING REQUEST TO SRP FOR LICENSE.
4. UTILITIES PARALLEL TO SRP IRRIGATION PIPE ARE REVIEWED ON A CASE-BY-CASE BASIS. LOCATE PARALLEL UTILITY OUTSIDE OF AREA SRP EXCAVATES WHEN MAINTAINING IRRIGATION PIPE, OR 4' -0" BEYOND THE SIDE OF THE OUTSIDE BELL DIAMETER OF THE SRP IRRIGATION PIPE, WHICHEVER IS GREATER. TYPICAL EXCAVATION INCLUDES AREA ABOVE AND TO EACH SIDE OF SRP IRRIGATION PIPE. SIDE EXCAVATION INCLUDES AREA ABOVE A LINE EXTENDING UPWARD AND OUTWARD AT A ONE-TO-ONE SLOPE FROM A POINT LEVEL WITH THE BOTTOM OF AND 4' -0" BEYOND THE SIDE OF THE OUTSIDE BELL DIAMETER OF THE SRP IRRIGATION PIPE.
5. OTHER UTILITIES ARE NOT PERMITTED IN THESE AREAS.



IRRIGATION STRUCTURE/FACILITY CLEARANCE



PIPELINES - LANDSCAPING

REFERENCES

UTILITIES CROSSING OR PARALLEL TO SRP IRRIGATION PIPE _____ WES-02604-001

REVISIONS

REV NO.	DFTR	DSGN	ENGR CHK	ISSUE AUTH	DATE
REVISED DETAIL CLEARANCES & RENUMBERED NOTES 3 TO 5, AND 4 TO 3. ADDED NOTE 4.					
6	JWS	-	-	REL	12/05/18
	JWS	-	-	REL	
INITIAL ISSUE.					
0	MOD	CWT	CWT	REL	04/07/98
	MOD	CWT	CWT	REL	

SALT RIVER PROJECT
WATER ENGINEERING STANDARD

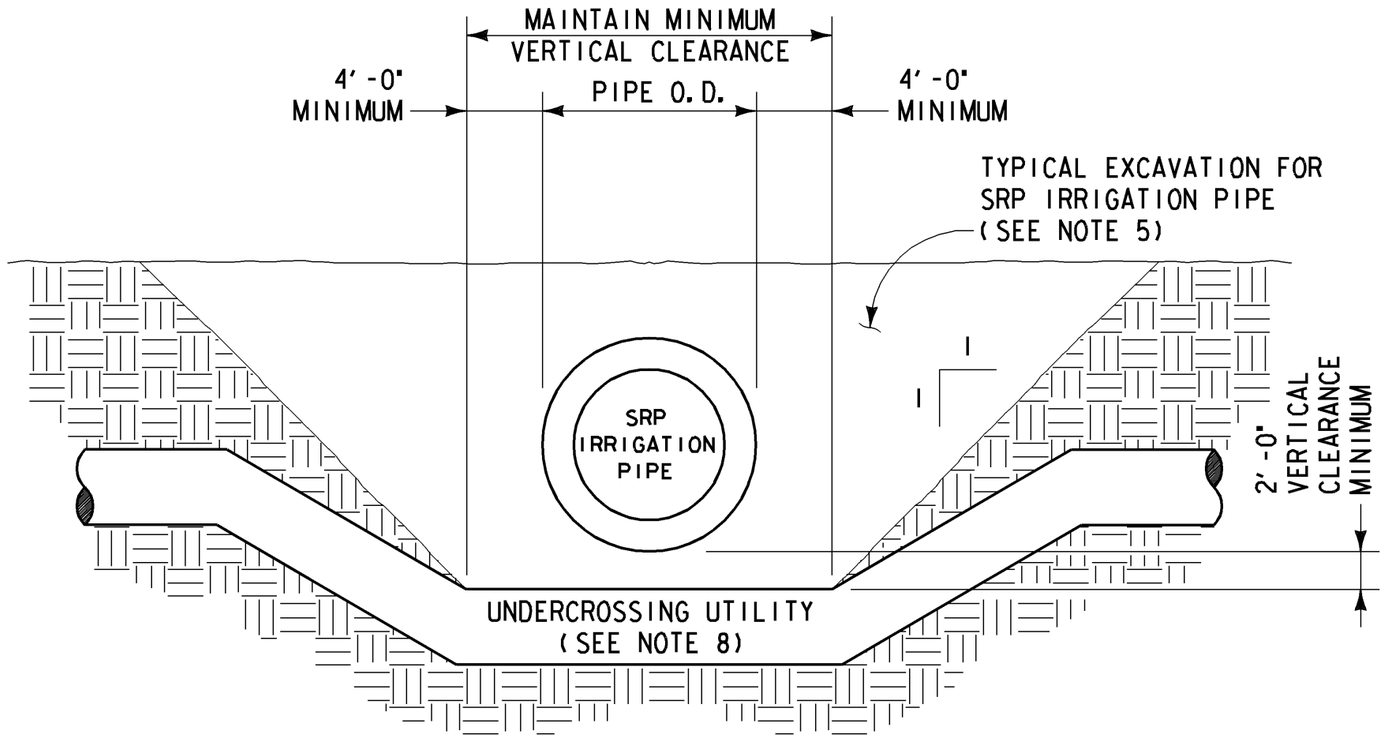
SALT RIVER PROJECT RIGHT-OF-WAY GUIDELINES

SCALE: NONE

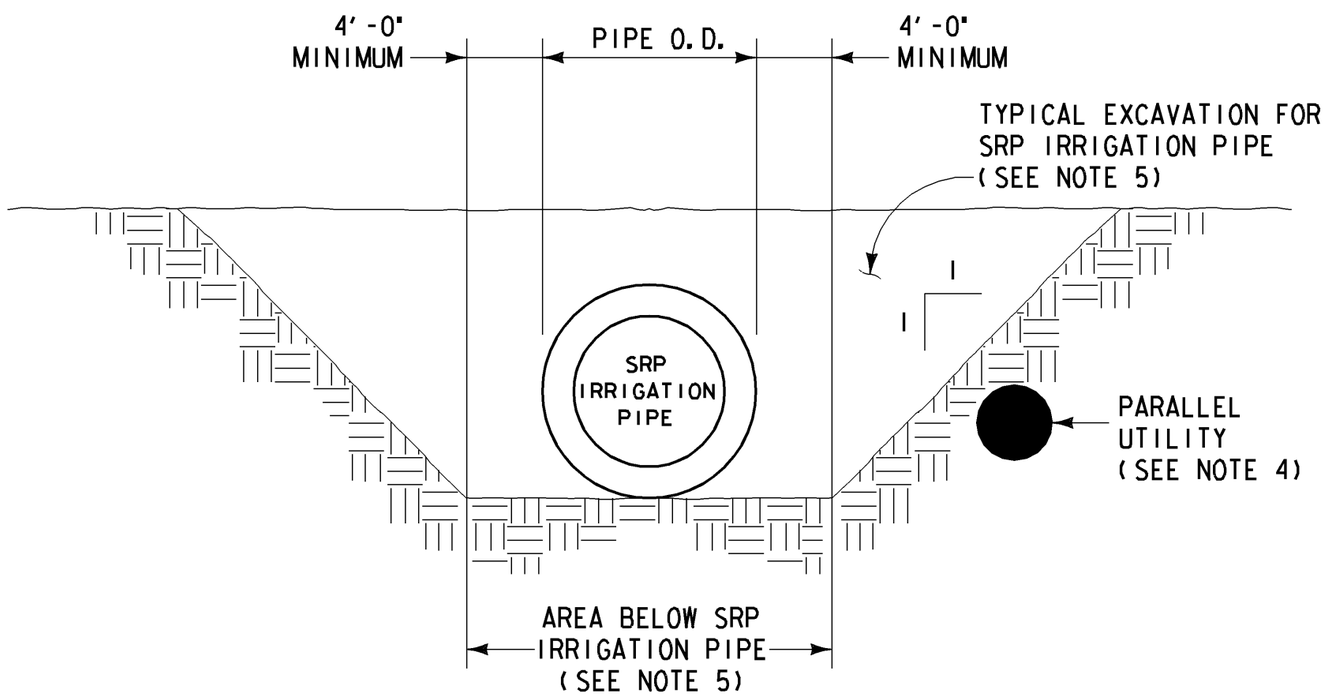
ROWGUIDE.WES

DWG SIZE
17X22

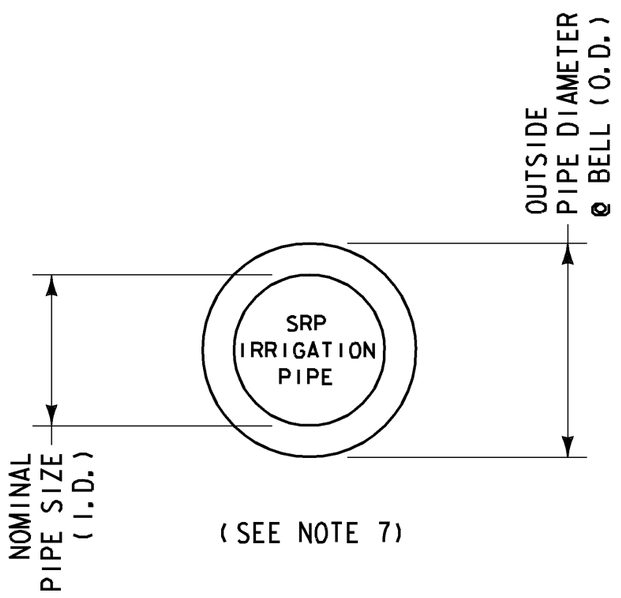
WES-ROWGUIDE



PIPELINE - UNDERCROSSING



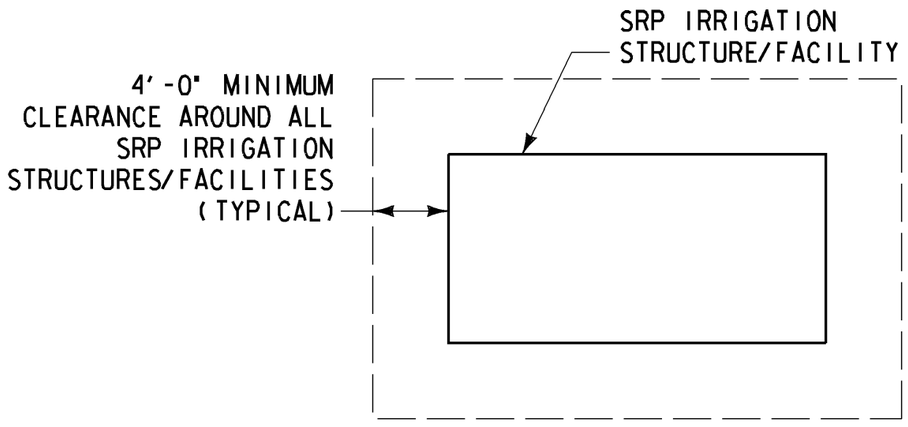
PIPELINE - PARALLEL UTILITY



(SEE NOTE 7)

NOMINAL PIPE SIZE (I.D.)	OUTSIDE PIPE DIAMETER AT BELL (O.D.)
24"	37"
30"	45"
36"	53"
42"	60"
48"	68"
54"	75"
60"	82"
66"	89"
72"	91"

OUTSIDE DIAMETER SRP IRRIGATION PIPE



IRRIGATION STRUCTURE/FACILITY CLEARANCE

NOTES

1. OVERCROSSINGS OF SRP IRRIGATION PIPE ARE REVIEWED ON A CASE-BY-CASE BASIS. EXCEPT FOR THOSE CASES SPECIFICALLY IDENTIFIED BELOW, OVERCROSSINGS ARE TYPICALLY NOT ALLOWED.
2. MAINTAIN MINIMUM 12" CLEARANCE BETWEEN SRP IRRIGATION PIPE AND OVERCROSSING ELECTRICAL CABLE/CONDUIT (1" DIA. OR LESS).
3. MAINTAIN MINIMUM 12" CLEARANCE BETWEEN SRP IRRIGATION PIPE AND CLOSEST POINT OF OVERCROSSING SCUPPER. SCUPPER SHALL CONFORM TO MAG STANDARD DETAIL 203 OR 206.
4. UTILITIES PARALLEL TO SRP IRRIGATION PIPE ARE REVIEWED ON A CASE-BY-CASE BASIS. LOCATE PARALLEL UTILITY OUTSIDE OF AREA SRP EXCAVATES WHEN MAINTAINING IRRIGATION PIPE, OR 4' -0" BEYOND THE SIDE OF THE OUTSIDE BELL DIAMETER OF THE SRP IRRIGATION PIPE, WHICHEVER IS GREATER. TYPICAL EXCAVATION INCLUDES AREA ABOVE AND TO EACH SIDE OF SRP IRRIGATION PIPE. SIDE EXCAVATION INCLUDES AREA ABOVE A LINE EXTENDING UPWARD AND OUTWARD AT A ONE-TO-ONE SLOPE FROM A POINT LEVEL WITH THE BOTTOM OF AND 4' -0" BEYOND THE SIDE OF THE OUTSIDE BELL DIAMETER OF THE SRP IRRIGATION PIPE.
5. OTHER UTILITIES NOT PERMITTED IN THESE AREAS.
6. CLEARANCE IS MEASURED FROM OUTSIDE BELL DIAMETER OF SRP IRRIGATION PIPE. OUTSIDE BELL DIAMETER IS SIGNIFICANTLY LARGER THAN NOMINAL PIPE SIZE (INSIDE DIAMETER) NOTED ON PLAN/PROFILE DRAWINGS. SEE TABLE FOR NOMINAL PIPE SIZES AND OUTSIDE BELL DIAMETERS.
7. SPECIFIED CLEARANCES ARE FOR USE WITH RUBBER GASKETED REINFORCED CONCRETE PIPE (RGRCP) UP TO AND INCLUDING 72" NOMINAL PIPE SIZE. GREATER CLEARANCE OR REPLACEMENT IS REQUIRED FOR LARGER DIAMETER RGRCP, CAST-IN-PLACE PIPE (CIPP) AND NON-REINFORCED CONCRETE PIPE.
8. ASSURE CONTINUOUS SUPPORT AND PROTECTION OF SRP IRRIGATION PIPE. DAMAGE TO SRP IRRIGATION PIPE/SYSTEM WILL BE REPAIRED BY SRP. ALL DIRECT AND INDIRECT COSTS SHALL BE BORNE BY OTHER UTILITY/LICENSEE.
9. TRENCH BACKFILL COMPACTION SHALL BE MARICOPA ASSOCIATION OF GOVERNMENTS (MAG) TYPE I OR TYPE III, EXCEPT THAT 95 % COMPACTION SHALL BE REQUIRED FROM 1' -0" ABOVE TOP OF PIPE TO BOTTOM OF TRENCH. WATER CONSOLIDATION IS NOT PERMITTED.
10. COMPLY WITH MAG UNIFORM STANDARD SPECIFICATIONS AND STANDARD DETAILS UNLESS OTHERWISE NOTED IN PROJECT SPECIFIC SRP DOCUMENTS. MOST STRINGENT REQUIREMENTS SHALL APPLY UNLESS SPECIFICALLY NOTED OTHERWISE IN SRP DOCUMENTS.
11. COMPLY WITH ALL APPLICABLE STATUTES, ORDINANCES AND REGULATIONS INCLUDING BLUE STAKE LAW (A.R.S. SEC. 40-360-21 ET SEQ.).
12. THESE GUIDELINES ARE PROVIDED AS A GENERAL AID TO PLANNING. ACTUAL SRP REQUIREMENTS MAY VARY BASED ON SITE-SPECIFIC CONDITIONS, OPERATIONAL CONSIDERATIONS, ETC.
13. AN SRP LICENSE IS REQUIRED FOR UTILITIES CROSSING/PARALLEL TO SRP IRRIGATION PIPE IN SRP RIGHT-OF-WAY. SRP REQUIRES ENGINEER DESIGNED UTILITY CROSSING/LOCATION AND EXCAVATION PLAN.
14. NOTIFY SRP INSPECTOR A MINIMUM OF 72 HOURS BEFORE STARTING CONSTRUCTION IN OR AROUND SRP IRRIGATION FACILITIES. AN IRRIGATION OUTAGE AGREEMENT MUST BE COMPLETED BY THE CONTRACTOR IF A DRY-UP OF ANY PART OF THE IRRIGATION SYSTEM WILL BE NECESSARY DURING CONSTRUCTION. ISSUANCE OF A LICENSE DOES NOT PROVIDE FOR A CONSTRUCTION DRY-UP.

REFERENCES

SALT RIVER PROJECT
RIGHT-OF-WAY GUIDELINES____WES-ROWGUIDE

REVISIONS

REV NO.	DFTR	DSGN	ENGR CHK	ISSUE AUTH	DATE
REVISED DETAIL CLEARANCES AND NOTE 4. ADDED IRRIGATION CLEARANCE DETAIL.					
6	JWS	-	-	REL	12/05/18
	JWS	-	-	REL	
INITIAL ISSUE.					
0	MOD	CWT	CWT	REL	04/06/98
	MOD	CWT	CWT	REL	

SALT RIVER PROJECT
WATER ENGINEERING STANDARD

UTILITIES CROSSING OR PARALLEL TO SRP IRRIGATION PIPE

SCALE: NONE | 02604001.WES
DWG SIZE: 17X22

WES-02604-001

Tree List*

Common Name	Scientific Name	Mature Height x Width (feet)
Mulga***	*Acacia aneura ****	20 x 20
Guajillo	*Acacia berlandieri*	15 x 15
White Thorn, Mescat Acacia	*Acacia constricta*	20 x 20
Leather Leaf Acacia	*Acacia craspedocarpa*	20 x 10
Knife Acacia	*Acacia cultriformis*	20 x 20
Weeping Myall	*Acacia pendula*	20 x 15
Twisted Acacia	*Acacia schaffneri*	20 x 20
Paurotis Palm	*Acoelorrhaphne wrightii*	25 x 15
Anacacho Orchid Tree	*Bauhinia lunariodes*	12 x 12
Chihuahuan Orchid Tree	*Bauhinia macranthera*	20 x 15
Pindo Palm	*Butia capitata*	25 x 15
Cascalote	*Caesalpinia cacalaco*	20 x 20
Bird of Paradise	*Caesalpinia gilliesi*	10 x 10
Mexican Bird of Paradise	*Caesalpinia mexicana*	20 x 20
Red Bird of Paradise	*Caesalpinia pulcherrima*	10 x 12
Pink Powder Puff	*Calliandra haematocephala*	15 x 15
Trinidad or Brazilian Flame Bush	*Calliandra tweedii*	10 x 10
Bottlebrush Slim	*Callistemon vimalis*	10 x 10
Desert Hackberry	*Celtis ehrenbergiana*	20 x 10
Foothills Palo Verde ***	*Cercidium microphyllum ****	25 x 25
Mexican Redbud	*Cercis mexicana*	20 x 20
Texas (Western) Redbud	*Cercis occidentalis*	25 x 25
Costa Rican Parlor Palm	*Chamaerops costaricana*	10 x 6
Mediterranean Fan Palm	*Chamaerops humilis*	25 x 20
Desert Willow ***	*Chilopsis linearis ****	30 x 25
Bouquet Orange	*Citrus aurantium "Bergamia"*	20 x 15
Tangerine/Mandarin Orange	*Citrus reticulata*	20 x 15
Tangelo	*Citrus paradisi X C. reticulata*	20 x 15
Robertson Orange	*Citrus sinensis*	20 x 15
Texas Olive, Anacahuita	*Cordia boissieri*	15 x 15
Sago Palm	*Cycas revoluta*	10 x 5
Dioon	*Dioon edule*	10 x 5
Hopseed Bush	*Dodonaea viscosa*	20 x 10
Bookleaf Malee	*Eucalyptus krueseana*	10 x 10
Roundleaf Malee	*Eucalyptus orbifolia*	10 x 10
Swamp Malee	*Eucalyptus spathulata*	25 x 25
Square-Fruited Malee	*Eucalyptus tetraptera*	25 x 20
Kidneywood	*Eysenhardtia orthocarpa*	20 x 10
Pineapple Guava	*Feijoa sellowiana*	15 x 15
Littleleaf Ash	*Fraxinus gregii*	20 x 15
Texas Lignumvitae	*Guaiacum angustifolium*	20 x 15
Lignumvitae	*Guaiacum sanctum*	15 x 15
Peregrina, Firecracker	*Jatropha integerrima*	15 x 15
Juniper	*Juniperis chinensis*	25 x 10

Tree List*

Common Name	*Scientific Name*	Mature Height x Width (feet)
Crepe myrtle	*Lagerstromia spp.*	25 x 20
Japanese Privet	*Ligustrum juponicum texanum*	25 x 10
Desert Fern	*Lysiloma thornberi*	25 x 25
Orange Jasmine	*Murraya paniculata*	20 x 15
Mock Orange	*Philadelphus lewisii*	15 x 10
Pygmy Date Palm	*Phoenix roebelenii*	10 x 5
Fraser's Photinia	*Photinia fraseri*	20 x 20
Mastic	*Pistacia lentiscus*	20 x 15
Willow Pittosporum	*Pittosporum phillyraeoides*	25 x 20
Frangipani	*Plumeria rubra*	25 x 25
American Plum	*Prunus americana*	25 x 20
Bird Cherry	*Prunus americana*	15 x 10
Flowering Peach	*Prunus persica*	20 x 15
Flowering Almond	*Prunus triloba var. multiplex*	20 x 15
Strawberry Guava, Cattley Guava	*Psidium littorale*	25 x 20
Pomegranate 'Wonderful'	*Punica granatum*	20 x 20
Mexican Elderberry	*Sambucus mexicana*	20 x 20
Texas Mountain Laurel, Mescal Bean	*Sophora secundiflora*	25 X 15
Silver Texas Mountain Laurel	*Sophora secundiflora 'Sierra Silver'*	25 x 15
Arizona Yellow Bells	*Tecoma stans var stans*	25 x 15
Yellow Tree Oleander	*Thevetia peruviana*	20 x 15
Mexican Buckeye	*Ungnadia speciosa*	25 x 15
Monk's Pepper Tree	*Vitex agnus-castus*	25 x 25
Cut-Leaf Chaste Tree	*Vitex negundo 'Heterophylla'*	20 x 20
Arabian Lilac	*Vitex trifolia*	15 x 15
Xylosma	*Xylosma congestum*	20 x 15

* Although trees on this list are approved, approval or disapproval of all trees for a project are dependent upon electrical clearances to conductors based on voltage, as well as locations that do not hinder SRP maintenance crew access/setup.

*** Species are not to be planted near "mid-span" between transmission poles or directly under the power lines

Groundcover List*

Common Name	Scientific Name	Ht x W (ft) Comments
Desert Ageratrum	*Ageratum corybosum*	1x3; perennial with light blue flowers, dormant in the winter
Bursage	*Ambrosia deltoidea*	1-2x1-3; also called Triangle leaf bursage & Rabbit bush
Purple Threeawn	*A, Purpurea var. arizonica*	2-3x1-2; perennial bunch grass; purple summer & fall flowers
Arizona Threeawn	*A, Purpurea var. fendleriana*	2-3x1-2; perennial bunch grass; purple summer & fall flowers
Fendler's Threeawn	*A, Purpurea var. logiseta*	2-3x1-2; perennial bunch grass; purple summer & fall flowers
Blue Threeawn	*A, Purpurea var. nealleyi*	2-3x1-2; perennial bunch grass; purple summer & fall flowers
Parish's Threeawn	*A, Purpurea var. parishii*	2-3x1-2; perennial bunch grass; purple summer & fall flowers
Purple Threeawn	*A, Purpurea var. purplexa* or *A, Purpurea var. purpurea*	2-3x1-2; perennial bunch grass; purple summer & fall flowers
Wright's Threeawn	*A, Purpurea var.wrightii*	2-3x1-2; perennial bunch grass; purple summer & fall flowers
Prostrate Dutchman's Pipe	*Aristolochia fibriata*	1x3-4; heart shaped leaves & inconspicuous flowers. Moderate to rapid spring growth but dormant in summer. A preferred host plant for swallowtail butterfly larvae. Drought tolerant
Mediterranean Beach Daisy	*Asteriscus maritimus*	1x1.5; low-mounding perennial herb with dense green, hairy leaves. Has bright yellow flowers late winter-spring. Declines in health with extreme sun, heat and cold.
Desert Marigold	*Baileya multiradiata*	1+x1+; evergreen perennial bears bright yellow flowers all year with adequate moisture. Short-lived but reseeds easily so there are always new plants to replace dead ones. Native to AZ
Needle Grama Grass	*Bouteloua aristidoides*	1.5-2.5x1.5x2.5; perennial bunchgrass; foliage browns in fall
Bulbine	*Bulbine frutescens*	1.5x1.5; tough clumping evergreen succulent with bright green leaves & yellow flowers. Orange flower variety called 'Hallmark' is more compact. Both bloom over long periods of the year.

Groundcover List*

Common Name	Scientific Name	Ht x W (ft) Comments
Daminiata Daisy	*Chrysactinia mexicana*	1-2x3; mounding evergreen shrub with aromatic leaves. Vibrant yellow daisy like flowers spring-fall.
African Daisy	*Dimorphotheca sinuate*	1x1: also called Cape Marigold. Annual with bright orange to yellow daisy flowers in winter and spring. Plant goes to seed & dies after flowering. New flowers arise from seed next winter
Rosea Ice Plant	*Drosanthemum floribundum*	.5-1.5' evergreen groundcover forms a low dense mat with light pink flowers late spring to summer
Golden Dyssodia	*Dyssodia pentachaeta*	1x1; low growing perennial with bright yellow small daisy like flowers. Re-seeds annually
Brittle Bush	*Encelia farinose*	3x3; woody perennial mounding shrub with bright yellow daisies in spring. **Native to AZ**
Outback Sunrise Emu Bush	*Eremphila prostrate 'Outback Sunrise'*	6"x8-9"; evergreen shrub with show tubular flowers spring/summer
California Poppy	*Eschscholzia californica*	2x2; orange yellow flowers late winter to early spring
Mexican Poppy	*Eshscholzia mexicana*	1x1; similar to California poppy. **Native to AZ**
Gopher Plant	*Euphorbia rigida*	2x3; mounding perennial shrub; easily driven over
Pink Guara	*Guara lindheimeri*	1x1; perennial with white flowers that fade to pink but some varieties have flowers that open pink from bud. Summer blooms
Clumping Gazania	*Gazania rigens hybrids*	1x1; forms non-spreading mound of foliage with daisy like flowers in brilliant colors with decorative markings spring to fall
Trailing Gazania	*Gazania rigens leucolaena*	1x1.5; perennial prostrate groundcover with daisy like orange, yellow, white or bronze flowers spring to fall
Sonoran Hechtia, Mesclito	*Hechtia montana*	1x3; ground hugging plants with succulent leaves in rosettes
Texas Hechtia	*Hechita texana*	1.5x3; similar to Sonoran Hechtia; also called False Agave
Hertia Daisy	*Hertia chirifolia*	1.5x4; gray-green mound of foliage has yellow daisy like flowers. Bloom late winter to spring

Groundcover List*

Common Name	*Scientific Name*	Ht x W (ft) Comments
Angelita Daisy	*Hymenoxys acaulis*	1x1; resembles Desert Marigold (Baileya multiradita) but has green instead of gray foliage & deeper yellow flowers
Trailing Ice Plant	*Lampranthus spectabilis*	1x2; succulent groundcover with trailing habit. Vibrant red, pink, purple spring flowers
Purple Trailing	*Lantana montevidenis*	1x6; woody trailing shrub
White Trailing	*Lantana montevidenis var. alba*	1x6; woody trailing shrub
Yellow Trailing	*Lantana montevidenis*	1x6; woody trailing shrub
Arizona Lupine	*Luminus arizonicus*	To 16" tall; pinkish purple flowers
Mojave Lupine; Coulter's Lupine	*Lupinus sparsiflorus*	To 16" tall; violet blue flowers
Gray Ice Plant	*Malephora crocea*	1x6; evergreen perennial succulent with trailing growth habit. Forms dense mat with reddish-yellow to orange daisy like flowers mostly in spring
Yellow Malephora	*Malephora luteola*	1x6; trailing succulent has bright yellow spring flowers
Blackfoot Daisy	*Melampodium leucanthum*	2x2; low mounding perennial has white daisies with yellow centers spring-fall. **Native to AZ**
Nashville Mulley Grass	*Muhlenbergia rigida 'Nashville'*	2x2; small, low growing clumps of grass
Trailing Myoporum	*Myoporum parvifolium*	0.5x9; mat-forming evergreen spreads by trailing stems that root as fast as they grow. White spring flowers then purple berries
Mexican Evening Primrose	*Oenothera berlandieri*	1x3; spreads to form low open cover. Has bell-shaped white to rosy pink spring flowers
White or Evening Primrose	*Oenthera caespitosa*	1x2; perennial forms a low-mounding clump with fragrant white flowers abundant in spring that open in evening & turn pink by mid-morning the next day. **Native to AZ**
Chihuahuan Primrose	*Oenthera stubbei*	0.5x4; herbaceous perennial with heavy bloom yellow flowers in spring that open in evening
Trailing African Daisy	*Osteopermum fruticosum*	1x2-4; low spreading evergreen perennial with light purple daisy like flowers late winter-spring
Rock Penstemon	*Penstemon baccarifolius*	1-2x1; shrub with beautiful flowers on flower stalks
Parry's Penstemon	*Penstemon parryi*	1-3x1-3; shrub with vibrant pink flowers on flower stalks

Groundcover List*

Common Name	Scientific Name	Ht x W (ft) Comments
Superb Penstemon, Coral Penstemon	*Penstemon superbus*	4-6x4; Coral red spring flowers; low-water use plant; susceptible to root rot
Karoo Bush	*Pentzie incana*	1x3; forms compact evergreen shrub with yellow button flowers in spring
Indian Wheat	*Plantago insularis*	12-20”; similar to Plantago ovata
Dessert Indian Wheat	*Plantago ovate*	Also known as Read Threeawn or Purple Threeawn; can be weedy
Paper Flower, Yellow Paper Daisy	*Psilostrophe cooperi*	1.5x1.5; clump forming perennial with bright yellow flowers that turn papery & hold color as they dry
Katie Trailing Ruellia	*Ruellia brittoniana ‘Katie’*	1x2; mounding evergreen form with purple flowers spring to fall
Desert Chia	*Salvia columariae*	0.5x1.5; fall bloom
Sonoran Ice Plant	*Sesuvium verrucosum*	0.5x3; prostrate succulent forms dense network or trailing branching stems & leaves; small pink flowers spring - fall
Setcreasea, Purple Heart Plant	*Setcreassea pallida*	1.5x4; sprawling perennial with succulent leaves bearing small pink, lavender or purple flowers throughout summer; leaf color varies from green to rich purple such as in variety ‘Purple Heart’
**Arizona Yellow Bell	***Tecoma stans var. agustata*	15x10; shrub has relatively small flowers & lacy foliage made of narrow deeply toothed leaves ****This plant may be used depending on location due to concern for line trucks**
Gooding Verbena	*Verbena gooddingii*	1.5 x3; perennial short-lived ground covering yields short spikes of tiny pink-lavender flowers in spring/summer. **Native to AZ**
Peruvia Verbena	*Verbena peruviana & Preuvia Hybrids*	0.5x3; perennial ground hugging mat of dark green leaves bearing small brick red flowers during warm season. Hybrids exist in white, pink, red or purple
Moss Verbena	*Verbena pulchalla gradillor*	1x5; evergreen flat growing perennial with dark green leaves & small blue-purple flower clusters (sometimes violet, pink or white) blooming late in winter to fall

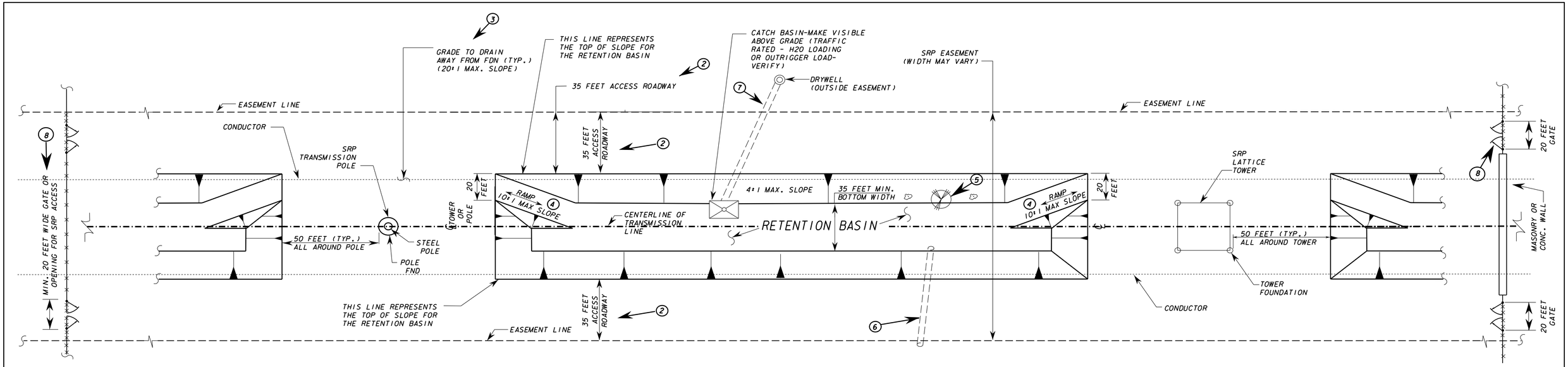
Groundcover List*

Common Name	Scientific Name	Ht x W (ft) Comments
Sandpaper Verbena	*Verbena rigida*	2x4; evergreen perennial has dark green leaves & clusters of deep purple flowers summer/fall
Creeping Daisy; Yellow Dot; Rabbit's Paw	*Wedelia trilobata*	1x spreading; daisy like flowers
Twisted Leaf Yucca	*Yucca ripicola*	2x2-3 with 5' tall flower stalk
California Fuchsia	*Zauschneria californica lotifolia*	0.5x3; similar to Hummingbird Trumpet bush but California Fuchsia has wider leaves & clearly visible lateral veins opposing arranged; similar flowers
Fairy Lily	*Zephyranthes candida*	1x1
Desert Zinnia	*Zinnia acerosa*	1x1; small herbaceous perennial bears clusters of white to pale yellow flowers marked with green veins below petals; flowers intermittently spring/fall with moisture. **Native to AZ**
Rocky Mountain Zinnia, Plains Zinnia	*Zinnia grandiflora*	1x1; low spreading evergreen shrub with bright green foliage & bears clusters of small zinnia like yellow daisies summer/fall

*Although groundcovers on this list are approved, approval or disapproval of all plantings for a project are based on voltage, as well as locations that do not hinder SRP maintenance crew access/setup. Plants may damage SRP equipment in certain locations.

This plant may be used depending on location due to concern for Condor & Line Trucks.

Bibliography Referenced
Jones, Warren & Sacamanto, Charles. Landscape Plants for Dry Regions. Fisher Books. Tucson, AZ c2000
Editors of Sunset Books & Sunset Magazine. Sunset Western Garden Book. Sunset Publishing Corporation. Menlo Park, CA c1995
Desert Landscaping 2.0 CD-ROM C 1996-2005, AZ Board of Regents for the University of Arizona
Various internet sites

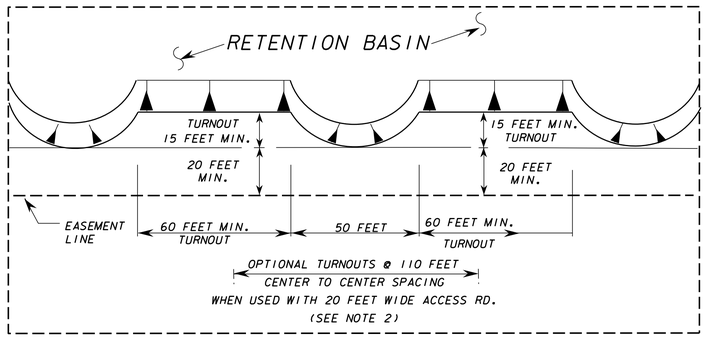


PLAN VIEW OF STORM WATER RETENTION BASIN WITHIN SRP TRANSMISSION LINE RIGHT OF WAY N.T.S.

STORM WATER RETENTION BASIN GUIDELINES:

THE FOLLOWING LIST OF MINIMUM CRITERIA IS REQUIRED BY ANYONE WISHING TO USE SRP TRANSMISSION LINE EASEMENTS FOR STORM WATER RETENTION BASINS.
THEY MUST OBTAIN SPECIFIC WRITTEN APPROVAL FROM THE SRP LAND DEPARTMENT BEFORE ANY CONSTRUCTION MAY PROCEED WITHIN THE EASEMENT PROPERTY.
PLANS SHOULD BE SUBMITTED TO THE SRP LAND DEPARTMENT VIA THE INITIAL PLAN REVIEW (IPR) PROCESS WHICH MAY BE STARTED AT https://www.srpnet.com/about/land/secure/plansubmittal.aspx ,
PLEASE CONTACT (602) 236-3117 OR workflow@srpnet.com FOR MORE INFORMATION.

1. THE PROPERTY IN QUESTION MUST BE OWNED, IN FEE, BY THE DEVELOPER OR OTHER REQUESTOR OF MULTIPLE USE IN THE EASEMENT.
2. THE RETENTION BASIN DESIGN MUST PROVIDE FOR CONTINUOUS VEHICULAR ACCESS AND CRANE SET-UP AREAS ALONG EACH EDGE OF THE EASEMENT (10:1 MAXIMUM LONGITUDINAL SLOPE) ABOVE HIGH WATER. TYPICALLY, THIS WILL REQUIRE 35 FEET WIDE ACCESS ROADS ALONG EACH EDGE. AN OPTION IS 20 FEET WIDE ACCESS WITH 35 FEET x 60 FEET CRANE SET-UP PADS CENTERED AT 110'.
3. AS A CRANE SET-UP AREA AND TO PROTECT THE INTEGRITY OF EACH POLE OR TOWER, A RECTANGULAR, LEVEL AREA OF GROUND (ABOVE HIGH WATER) MUST BE PROVIDED MEASURING A MINIMUM OF 50 FEET IN EACH DIRECTION FROM THE OUTSIDE EDGE OF ANY FOUNDATION. TYPICALLY, THIS CLEARED AREA WILL NEED TO EXTEND ALL THE WAY ACROSS THE EASEMENT (TRANSVERSE) AND TIE TO THE ACCESS ROADS. CLEAN FILL IS ACCEPTABLE, PROIVDED THE GRADES REMAIN 6 INCHES BELOW THE TOP OF FOUNDATIONS. NOTE: ANY PROPOSED CUTS OR FILLS WITHIN THE ROW TO BE REVIEWED BY SRP. THIS AREA MUST DRAIN AWAY FROM FOUNDATIONS, WITH 20:1 MAXIMUM SLOPE.
4. THE RETENTION BASIN MAY HAVE SIDE SLOPES OF 4:1 (MAXIMUM), BUT MUST PROVIDE 20-FOOT WIDE ACCESS RAMPS (10:1 MAXIMUM SLOPE) INTO BASIN FROM EACH STRUCTURE LOCATION. ALL AREAS MUST BE PROTECTED FROM SOIL EROSION WITH EROSION PROTECTION METHOD APPROVED BY SRP.
5. APPROVAL OR DISAPPROVAL OF ALL TREES/GROUND COVER REGARDLESS OF WHETHER THEY ARE ON THE APPROVED LIST IS DEPENDENT UPON ELECTRICAL CLEARANCES TO CONDUCTORS BASED ON VOLTAGE, AS WELL AS LOCATIONS THAT DO NOT HINDER SRP MAINTENANCE CREW ACCESS/SETUP. ANY TREE LOCATED UNDER OR NEARANY ELECTRIC LINES IS SUBJECT TO TRIMMIMNG OR REMOVAL BY SRP. TRIMMING MAY RESULT IN THE TREE HAVING UNNATURAL APPEARANCE
6. IF A WATER FLOW IS REQUIRED ACROSS THE ROADWAYS OR THE 50-FOOT AREAS AROUND STRUCTURES, IT MUST BE CONSTRUCTED OF PIPE CAPABLE OF WITHSTANDING A CONCENTRATED LOAD FROM A CRANE OUTRIGGER WITH 320 PSI ON A 27 INCH DIAMETER PAD. CALCULATIONS MUST BE SUBMITTED TO SRP SHOWING THE ANTICIPATED LOADING AND STRENGTH ANALYSIS.
7. NO DRYWELLS WITHIN EASEMENT. IF REQUIRED, DRYWELLS MUST BE LOCATED OUTSIDE THE SRP EASEMENT AREA WITH A CATCH BASIN INSIDE THE RETENTION BASIN AREA. DESIGN AND LOCATION OF CATCH BASIN, PIPING & DRYWELL TO BE REVIEWED BY SRP PRIOR TO ANY CONSTRUCTION.
8. 20 FEET WIDE OPENINGS OR GATES (IN APPROVED LOCATIONS AND PERPENDICULAR TO ACCESS) MUST BE PROVIDED IN ANY FENCES OR WALLS CROSSING THE EASEMENT. FENCES NEED TO BE GROUNDED AND MUST HAVE SHARED LOCK ACCESS.

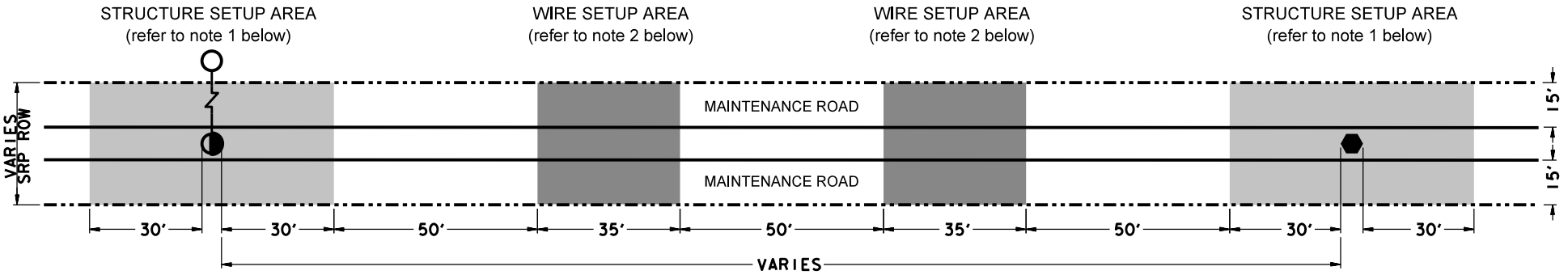


PLAN VIEW OF OPTIONAL TURNOUT @ 110' CENTERS

REVISIONS						
REV NO	DATE	DFTR	CHKR	ENGR CHK	SUPV APPD	ISSUE AUTH
PRELIMINARY ISSUE						
0	04/05	DMG	---	WRS	WRS	WRS

SRP®
TRANSMISSION LINE DESIGN STANDARDS
TRANSMISSION LINE (500kV, 230kV, 115kV) DESIGN STANDARD
STORM WATER RETENTION BASIN DESIGN GUIDELINES
DWG SIZE 30X42
TE-52030

SRP TRANSMISSION ROW MAINTENANCE SETUP AREAS APPLICABLE TO 69kV TRANSMISSION LINES



LEGEND

STRUCTURE

STUB POLE

ROW BOUNDARY

CONDUCTOR

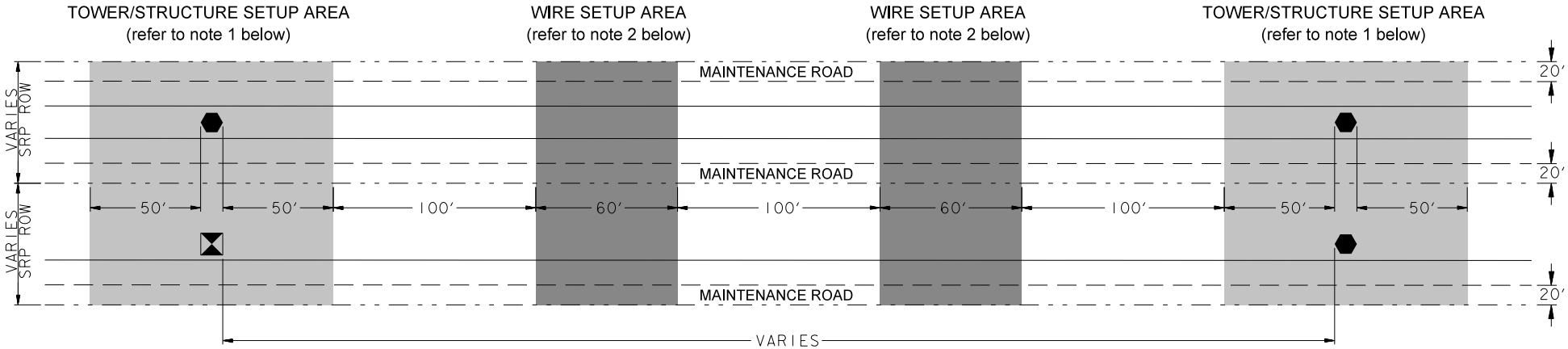
NOTES:

1. STRUCTURE SETUP AREAS FOR 69kV TRANSMISSION LINES ARE DEFINED AS A RECTANGULAR AREA 30 FEET ON EACH SIDE OF THE FACE OF STRUCTURE BY THE WIDTH OF THE EASEMENT. SETUP AREAS AND WIRE SETUP AREAS MUST BE CLEAR OF ABOVE GRADE IMPROVEMENTS. SRP REQUIRES UNOBSTRUCTED "HIGH AND DRY" MAINTENANCE ROADS THAT ARE 15 FEET WIDE WITH A 20:1 MAXIMUM SLOPE WHICH RUNS PARALLEL TO THE CONDUCTOR FOR THE ENTIRE LENGTH OF THE EASEMENT ON BOTH SIDES OF THE TOWERS/STRUCTURES. THOSE MAINTENANCE ROADS REQUIRE ACCESS 24 HOURS A DAY AND 7 DAYS A WEEK.
2. WIRE SETUP AREAS FOR 69kV TRANSMISSION LINES ARE DEFINED AS A RECTANGULAR AREA 35 FEET LONG BY THE WIDTH OF EASEMENT, REPEATED EVERY 50 FEET BETWEEN THE STRUCTURE SETUP AREAS. *NOTE: STRUCTURE SETUP AREAS AND WIRE SETUP AREAS FOR 69kV TRANSMISSION LINES ARE REVIEWED DURING THE SRP INITIAL PLAN REVIEW PROCESS.
3. BELOW GRADE IMPROVEMENTS WITHIN STRUCTURE SETUP AREAS FOR 69kV TRANSMISSION LINES ARE REVIEWED ON A CASE BY CASE BASIS. PRIOR WRITTEN CONSENT BY SRP IS REQUIRED. *NOTE: IMPROVEMENTS WITHIN SRP EASEMENTS/ROW FOR 69kV TRANSMISSION LINES MUST MEET 320 PSI POINT LOAD ON 27 INCH DIAMETER PAD.
4. CERTAIN 69kV STRUCTURES ARE REQUIRED TO MEET EXTRA HIGH VOLTAGE (EHV) SETUP AREA REQUIREMENTS. IN ADDITION, ANY POLE HEIGHT FOR 69kV DESIGN THAT EXCEEDS 80 FEET ABOVE GRADE REQUIRES CONSULTATION WITH SRP TRANSMISSION LINE ASSET MANAGEMENT (TLAM) AND AGREEMENT ON THE DESIGN. HIGHWAY CROSSINGS AND OTHER SPECIAL CASES MAY REQUIRE TALLER POLES. IN THESE CASES, LARGER SETUP AREAS, MAINTENANCE ROADS, AND EASEMENTS WILL BE REQUIRED. PLANS SHOULD BE SUBMITTED TO THE SRP LAND DEPARTMENT VIA THE INITIAL PLAN REVIEW (IPR) PROCESS WHICH MAY BE STARTED AT https://www.srpnet.com/about/land/secure/plansubmittal.aspx, PLEASE CONTACT (602) 236-3117 FOR MORE INFORMATION.
5. PARKING IS NOT ACCEPTABLE USE OF SRP EASEMENTS/ROW FOR 69kV TRANSMISSION SYSTEMS.

PLANS SHOULD BE SUBMITTED TO THE SRP LAND DEPARTMENT VIA THE INITIAL PLAN REVIEW (IPR) PROCESS WHICH MAY BE STARTED AT https://www.srpnet.com/about/land/secure/plansubmittal.aspx , PLEASE CONTACT (602) 236-3117 OR Workflow@srpnet.com FOR MORE INFORMATION.

REV: 1	10/4/2019

SRP TRANSMISSION ROW MAINTENANCE SETUP AREAS
APPLICABLE TO 115kV, 230kV, & 500kV TRANSMISSION LINES



LEGEND

TOWER OR STRUCTURE — ROW BOUNDARY — CONDUCTOR

NOTES:

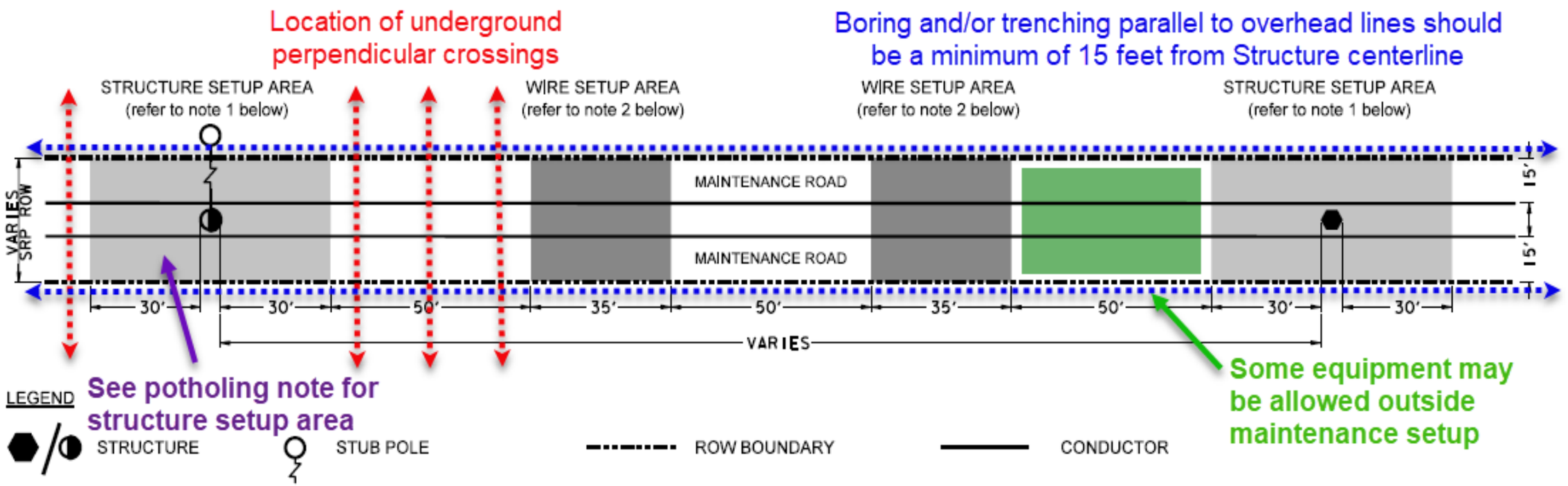
1. TOWER/STRUCTURE SETUP AREAS FOR EXTRA HIGH VOLTAGE (EHV) TRANSMISSION LINES (*e. g.* 115kV, 230kV, AND 500kV) ARE DEFINED AS A RECTANGULAR AREA 50 FEET ON EACH SIDE OF THE OUTSIDE TOWER LEGS OR FACE OF STRUCTURE BY THE WIDTH OF THE EASEMENT. SETUP AREAS AND WIRE SETUP AREAS MUST BE CLEAR OF ABOVE GRADE IMPROVEMENTS. SRP REQUIRES UNOBSTRUCTED "HIGH AND DRY" MAINTENANCE ROADS THAT ARE 20 FEET WIDE WITH A 20:1 MAXIMUM SLOPE WHICH RUNS PARALLEL TO THE CONDUCTOR FOR THE ENTIRE LENGTH OF THE EASEMENT ON BOTH SIDES OF THE TOWERS/STRUCTURES. THOSE MAINTENANCE ROADS REQUIRE ACCESS 24 HOURS A DAY AND 7 DAYS A WEEK.
2. WIRE SETUP AREAS FOR EHV TRANSMISSION LINES ARE DEFINED AS RECTANGULAR AREA 60 FEET LONG BY THE WIDTH OF EASEMENT, REPEATED EVERY 100 FEET BETWEEN THE TOWER/STRUCTURE SETUP AREAS. *NOTE: TOWER/STRUCTURE SETUP AREAS AND WIRE SETUP AREAS FOR EHV TRANSMISSION LINES ARE REVIEWED DURING THE SRP INITIAL PLAN REVIEW PROCESS.
3. BELOW GRADE IMPROVEMENTS WITHIN TOWER/STRUCTURE SETUP ARES FOR EHV TRANSMISSION LINES ARE REVIEWED ON A CASE BY CASE BASIS. PRIOR WRITTEN CONSENT BY SRP IS REQUIRED. *NOTE: IMPROVEMENTS WITHIN SRP EASEMENTS/ROW FOR EHV TRANSMISSION LINES MUST MEET 320 PSI POINT LOAD ON 27 INCH DIAMETER PAD.
4. PARKING MAY BE ACCEPTABLE USE OF SRP EASEMENT/ROW FOR EHV TRANSMISSION LINES. THERE ARE SPECIFIC REQUIREMENTS FOR ORIENTATION WITH RESPECT TO TRAFFIC FLOW. MAINTENANCE ROADS AND CRANE SETUP AREAS WILL NEED TO BE INCORPORATED INTO THE PARKING DESIGN BASED UPON INPUT FROM SRP. ANY VEHICLES PARKED WITHIN SRP EASEMENT/ROW MUST BE ABLE TO BE RELOCATED, 24 HOURS A DAY AND SEVEN DAYS A WEEK, AT THE REQUEST OF SRP.

PLANS SHOULD BE SUBMITTED TO THE SRP LAND DEPARTMENT VIA THE INITIAL PLAN REVIEW (IPR) PROCESS WHICH MAY BE STARTED AT https://www.srpnet.com/about/land/secure/plansubmittal.aspx, PLEASE CONTACT (602) 236-3117 OR WorkFlow@srpnet.com FOR MORE INFORMATION.

REV: 1	10/4/2019

FIBER COMMUNICATION INSTALLATION GUIDELINES
SRP TRANSMISSION ROW MAINTENANCE SETUP AREAS
APPLICABLE TO 69kV TRANSMISSION LINES

No improvements inside 69kV easement except for Underground crossings



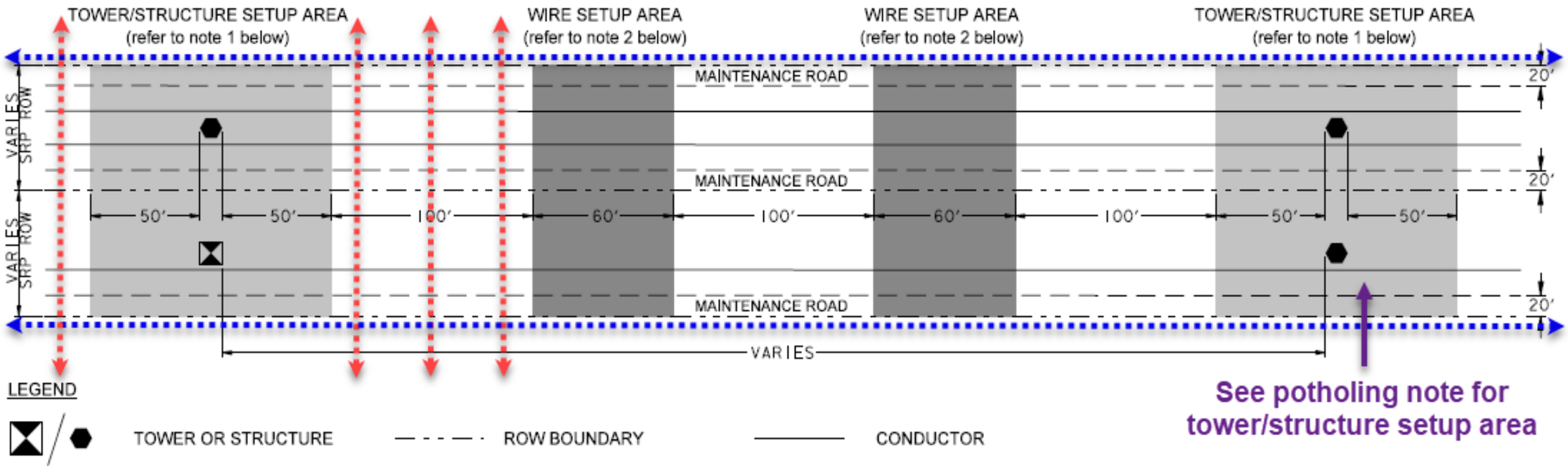
- No improvements allowed inside 69kV easements except for underground perpendicular crossings located outside of Structure and Wire setup areas. (Civil Engineering load calculations may be required).
- Boring and/or trenching parallel to overhead lines should be a minimum of 15 feet from Structure centerline.
- Perpendicular underground crossings shall be outside Structure and Wire setup areas.
- Any potholing required must be done at a minimum of 15 feet from the face of the Structure by vacuum excavation. (See Section G)

FIBER COMMUNICATION INSTALLATION GUIDELINES
SRP TRANSMISSION ROW MAINTENANCE SETUP AREAS
APPLICABLE TO 115kV, 230kV, & 500kV TRANSMISSION LINES

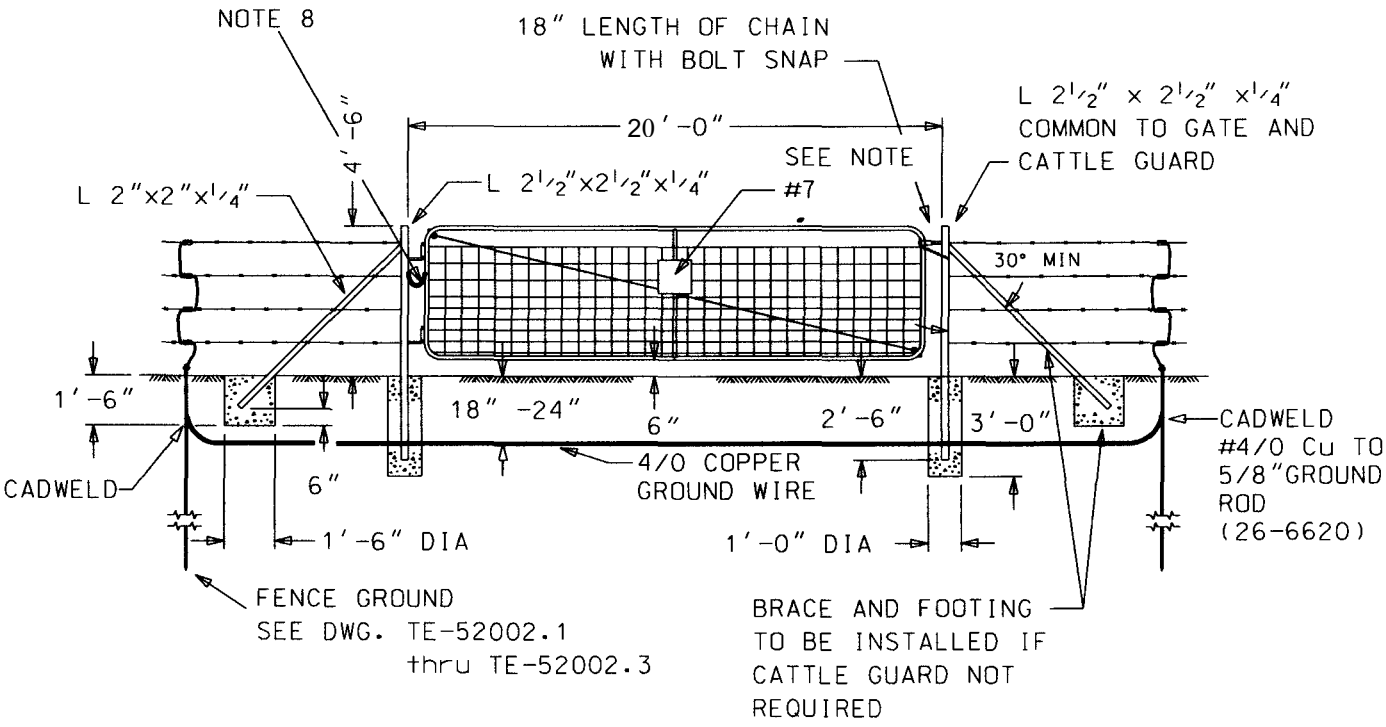
No improvements inside EHV easement except for Underground crossings

Location of underground perpendicular crossings

Boring and/or trenching parallel to overhead lines must be outside EHV easement



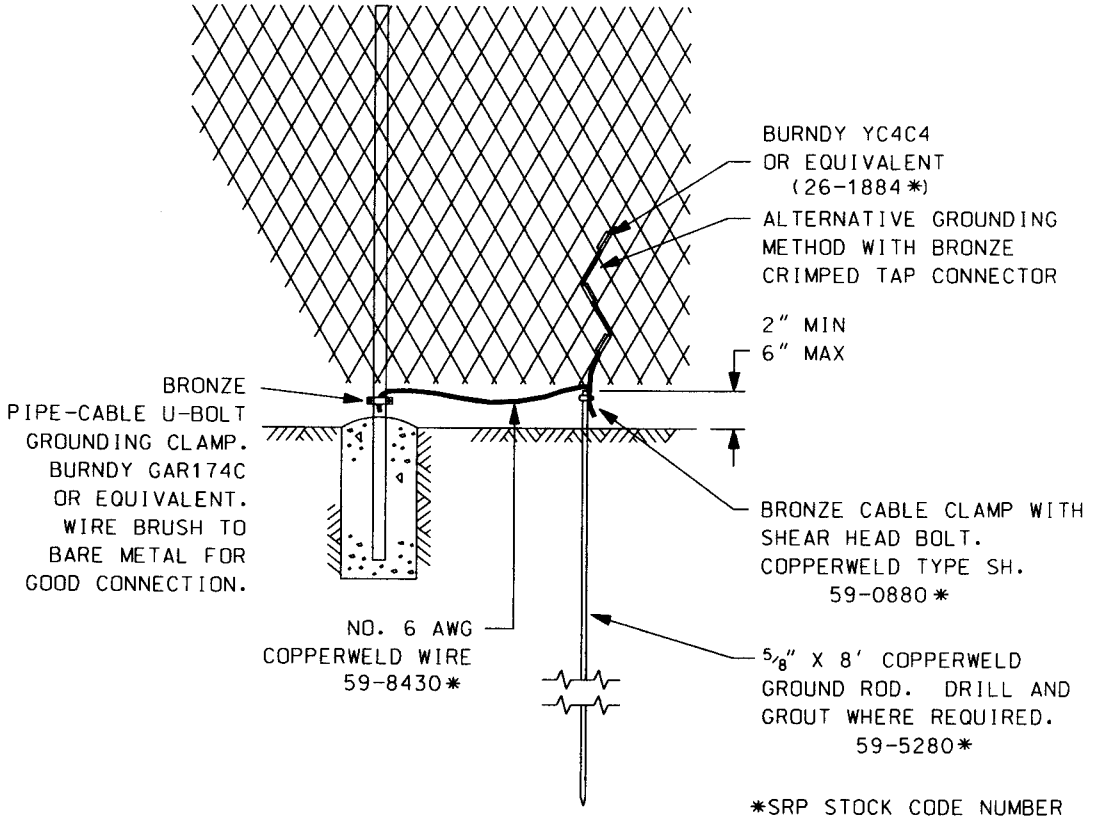
- No improvements allowed inside EHV easements except for underground perpendicular crossings located outside of Tower/Structure and Wire setup areas. (Civil Engineering load calculations may be required).
- Boring and/or trenching parallel to overhead lines must be outside EHV easement boundaries.
- Perpendicular underground crossings shall be outside Tower/Structure and Wire setup areas.
- Any potholing required must be done at a minimum of 15 feet from the face of the Tower/Structure by vacuum excavation. (See Section G)



NOTES:

1. GATE TO BE SELF-CLOSING AND SET PARALLEL TO SLOPE OF ROAD.
2. WHERE CATTLE GUARD IS USED, CATTLE GUARD SHALL BE ALIGNED WITH ROAD.
3. STEEL POLES AND BRACES SHALL BE GALVANIZED OR PAINTED WITH A BAKED-ON ASPHALT BASE ENAMEL.
4. SET FENCE POSTS AND BRACES IN CONCRETE. CONCRETE SHALL BE 2000 PSI AT 28 DAYS.
5. STANDARD 16' GATE SHALL BE 42" HIGH MINIMUM WITH $1\frac{3}{8}$" O.D. GALVANIZED IRON TUBULAR FRAME. ALL FITTINGS SHALL BE GALVANIZED. GATE SHALL HAVE A DIAGONAL ADJUSTABLE SAG-ROD OR WIRE. MINIMUM WEIGHT OF GATE SHALL BE 70 POUNDS.
6. G.I. MESH FENCE FILLER TO BE 11 GAUGE FARM FENCE FILLER, OR EQUIVALENT.
7. INSTALL SIGN. SIGN TO READ "KEEP GATE CLOSED."
8. INSTALL COPPER BRAIDED STRAP, TYPICAL 12" (BURNDY BD12 OR EQUAL) SRP STOCK NO. 26-2280.

OVERHEAD TRANSMISSION CONSTRUCTION STANDARDS SRP® *PROPRIETARY MATERIAL*	REV. FORMAT	8515E383.DGN
	METAL FRAME FENCE GATE	DATE: 07/11/00 REV. NO: 1 REV. DATE: 11/17/03 APPROVAL: AJK
		TE-52004

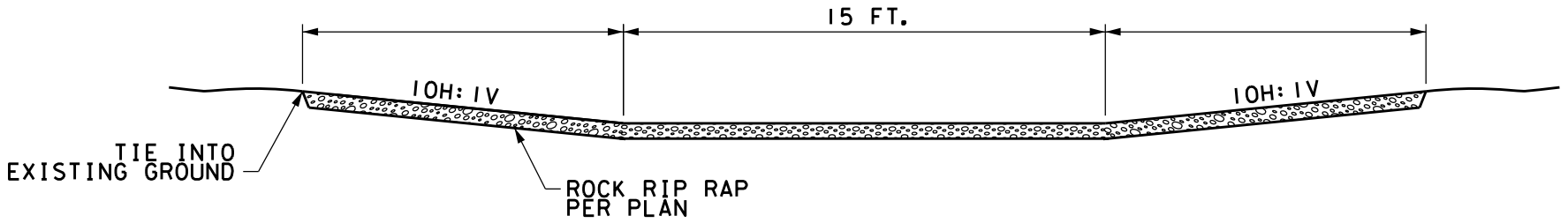


NOTES:

1. INSTALL GROUNDS AT POINTS NOT TO EXCEED 500 FEET APART IN ANY FENCE THAT PARALLELS THE TRANSMISSION LINE FOR MORE THAN 1000 FEET AS DIRECTED BY THE PURCHASER.
2. INSTALL ONE GROUND AT EACH EDGE OF THE RIGHT OF WAY IN FENCES THAT CROSS THE TRANSMISSION LINE. (TOTAL OF 2 RODS.)
3. WHERE A GATE HAS BEEN INSTALLED IN THE FENCE THAT CROSSES THE TRANSMISSION LINE, INSTALL A GROUND ROD ON EACH SIDE OF THE GATE OPENING.
4. FILL ALL CLAMPS WITH CONDUCTING GREASE PRIOR TO CRIMPING OR BOLTING.
5. DEFORM THE THREADS ON THE U-BOLT GROUNDING CLAMP WITH A CHISEL AFTER INSTALLATION TO PREVENT REMOVAL OF THE NUTS.

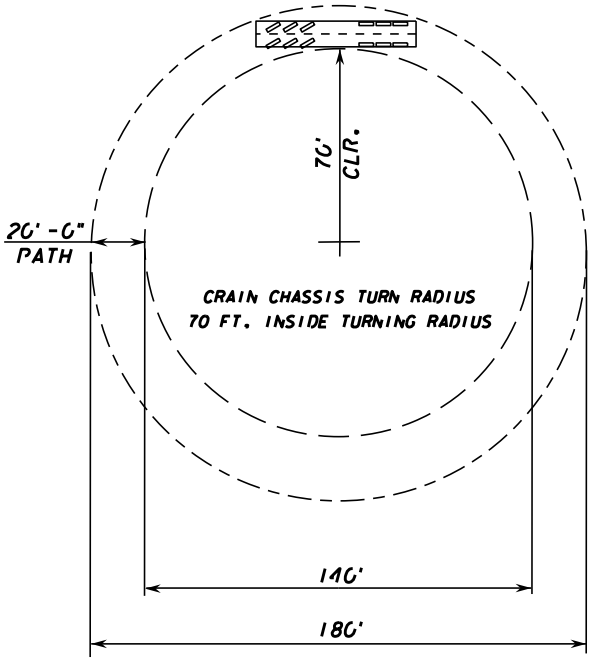
OVERHEAD TRANSMISSION CONSTRUCTION STANDARDS SRP® PROPRIETARY MATERIAL	REV. FORMAT	8515E386.DGN
	TRANSMISSION LINE FENCE GROUND, GALVANIZED CHAIN LINK	DATE: 04/00/93 REV. NO: 1 REV. DATE: 11/18/03 APPROVAL: AJK
		TE-52002.2

SRP REINFORCED ACCESS RAMP

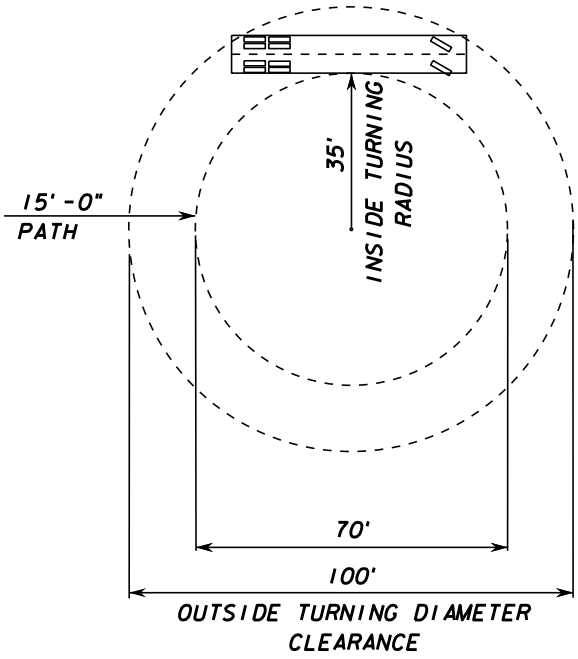


DETAIL NOTES:

1. RAMP DESIGNED TO PROVIDE HS20-44 TRUCK TRAFFIC RATING PER SRP REQUIREMENTS.
2. REMOVE RIP RAP BEFORE PLACING CONCRETE IN NOTE 3.
3. PLACE CONCRETE: OVERALL THICKNESS TO BE MINIMUM OF 1'-3" WITH LOWER 8" CONSISTING OF SOLID 3000 PSI CONCRETE PER MAG 220-5.
4. REPLACE EXISTING RIP RAP WITH SMOOTH/ROUNDED RIVER ROCK.
5. TOP PORTION CONSISTING OF RIP RAP SHALL BE GROUTED WITH THE SAME CONCRETE MIX AS STATED IN NOTE 3.



TURNING RADIUS PLAN FOR
SRP EHV MAINTENANCE
TRUCK & CRANE



TURNING RADIUS PLAN FOR
SRP 69kV MAINTANCE TRUCK

NOTES:
1. TURNING RADIUS FOR TRANSMISSION EQUIPMENT, PLEASE CONTACT SRP FOR ADDITIONAL INFORMATION.
2. CRANES WILL BE USED FOR BOTH 69kV AND EHV TO SET TRANSMISSION POLES.
3. MAINTENANCE EQUIPMENT AND CRANES SET UP USES OUTRIGGERS THAT CREATE A 320 PSI POINT LOAD ON THE 27 INCH DIAMETER PAD.
4. WHEN CREATING PLANS FOR THIS EQUIPMENT, PLEASE UNDERSTAND THAT IT WILL ALWAYS NEED TO BE GROUNDED WHEN WORKING ON SRP TRANSMISSION LINES.

Transmission Line Design Standards PROPRIETARY MATERIAL	**TURNING RADIUS AND SET-UP DIMENSIONS FOR SRP TRANSMISSION EQUIPMENT**	ISSUE DATE: 05/05/20 REV. DATE: APPROVAL:

Delivering water and power™

Applicant Safety Acknowledgement Form

(To Acknowledge Receipt of Safety Letter and Safety Brochure)

This is to acknowledge that I have received from the SRP Representative a copy of SRP's Safety Letter and associated Safety Brochure which outline my responsibilities before and during any excavation, and inform me of minimum approach distances that must be maintained, when working near overhead power lines.

_____

Project Identifying Information

_____

Project Address

_____

Printed Name (Applicant or Applicant's Representative)

_____

Company Name (if applicable)

_____

Signature (Applicant or Applicant's Representative)

Date of Acknowledgement: _____/_____/_____

Delivering water and power™

29 CFR 1910 Occupation Safety and Health Administration General Industry Regulations Subpart S - Electrical

Part Number:
1910
Part Number Title:
Occupational Safety and Health Standards
Subpart:
1910 Subpart S
Subpart Title:
Electrical
Standard Number:
1910.333
Title:
Selection and use of work practices
GPO Source:
e-CFR

1910.333(c)(3)(i)
"Unqualified persons."

1910.333(c)(3)(i)(A)
When an unqualified person is working in an elevated position near overhead lines, the location shall be such that the person and the longest conductive object he or she may contact cannot come closer to any unguarded, energized overhead line than the following distances:

1910.333(c)(3)(i)(A)(1)
For voltages to ground 50kV or below - 10 feet (305 cm);

1910.333(c)(3)(i)(A)(2)
For voltages to ground over 50kV - 10 feet (305 cm) plus 4 inches (10 cm) for every 10kV over 50kV.

1910.333(c)(3)(i)(B)
When an unqualified person is working on the ground in the vicinity of overhead lines, the person may not bring any conductive object closer to unguarded, energized overhead lines than the distances given in paragraph (c)(3)(i)(A) of this section.

https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.333

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29 CFR 1926 Occupation Safety and Health Administration Construction Industry Regulations Subpart CC – Crane and Derricks in Construction

Part Number:
1926
Part Number Title:
Safety and Health Regulations for Construction
Subpart:
1926 Subpart CC
Subpart Title:
Crane and Derrick in Construction
Standard Number:
1926.1408
Title:
Power line safety (up to 350 kV) –equipment operations.
GPO Source:
e-CFR

1926.1408(a)(2)(i)
Option (1)--Deenergize and ground. Confirm from the utility owner/operator that the power line has been deenergized and visibly grounded at the worksite

1926.1408(a)(2)(ii)
Option (2)--20 foot clearance. Ensure that no part of the equipment, load line, or load (including rigging and lifting accessories), gets closer than 20 feet to the power line by implementing the measures specified in paragraph (b) of this section.

1926.1408(a)(2)(iii)
Option (3)--Table A clearance.

The requirements of § 1926.1407 and § 1926.1408 apply to power lines over 350 kV except:

1926.1409(a)
For power lines at or below 1000 kV, wherever the distance \"20 feet\" is specified, the distance "50 feet" must be substituted; and

1926.1409(b)
For power lines over 1000 kV, the minimum clearance distance must be established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution.

https://www.osha.gov/laws-regs/regulations/standardnumber/1926/1926.1408
https://www.osha.gov/laws-regs/regulations/standardnumber/1926/1926.1409
For more information visit: https://www.srpnet.com/safety/contractor.aspx

August 7, 2019

Delivering water and power™

Author:	Paul Grant	**Origination Date:**	October 16, 2020
Revised By:	(none)	**Revision Date:**	(none)
Approved By:	Chris Francoeur	**Approval Date:**	November 30, 2020
Document Type:	Point Load General Analysis Guideline		

Effective Date: November 30, 2020 **Version:** 0

Version	Sections Revised	Description of Revisions	Changed By	Approved By	Approval Date

Contents

The purpose of this guideline is to help customers that have submitted plans through the Salt River Project (SRP) Internal Plan Review (IPR) portal and are currently working with the Transmission Line Asset Management (TLAM) agent performing the plan review. During the review it may be determined that point load calculations are required and will need to be provided by the customer/engineer which will be reviewed by the SRP Civil Engineering Services group. The following guidelines will assist in preparing point load calculations and analysis consistent with SRP Civil Engineering Services group requirements.

1.0 GENERAL

1.1. The purpose of this analysis guideline is to provide general information required for assessing the impact of outrigger loads on any underground facilities existing or proposed to be installed within SRP easements and right-of-way. The information contained herein covers information required for the analysis, load and performance criteria, suggested models recommended for analysis, and the reporting format along with the responsibilities for the engineer of record performing the analysis.

1.2. Analysis of the impact of surface loads on pipes, conduits, vaults, manholes, structures, and similar infrastructure installed at or below grade shall be based on well accepted engineering practices and principles and the use of site-specific soil or backfill data with the actual dimensions of the planned installation.

1.3. A separate set of calculations may be required for multiple installations where there is a change in the size or type of material used for the underground installation, change in embedment depth, or change in soil conditions. It is the responsibility of the engineer of record to determine the extent of additional calculations required to properly communicate changes in condition.

1.4. Analysis shall be performed for all facility installations at or below grade within SRP transmission line easements and right-of-way. Unless pre-approved by SRP, all new underground installations shall be at or below the existing grade and not protrude above the surface. These underground facilities include, but are not limited to:

- Water and irrigation pipes,
- Sewer and drainage pipes,
- Electric and communications conduits or conduit banks,
- Natural gas pipes,
- Utility structures, including manholes, catch basins, grated drainage inlets, and pull vaults (including concrete aprons at grade), and
- Other structures, including bridge decks and retaining walls (including lateral load assessment).

SRP will only consider crossing that are perpendicular to SRP easement or right-of-way. Any angle or parallel crossing will not be considered.

2.0 ANALYSIS INFORMATION

2.1. Plan and Profile

The point load calculation submittal shall include plan and profile drawings highlighting the location of the underground installation within the SRP transmission line easement or right-of-way. The length and limits of the easement must be clearly marked. Additionally, plan and profile drawings shall note the following information:

- Existing and proposed elevations should be clearly indicated. Cross sections showing continuous ground surface and the top of existing or proposed underground facility elevations should be provided. The cross section should denote the location where the least coverage occurs and include the calculated depth of least coverage.
- Underground facility should be described by diameter, type and material (*e.g.* 8-inch diameter Class V RGRCP for concrete pipe).
- Structures should be described by the base foundation elevation and dimensions.
- Backfill material and degree of compaction used in the analysis should be referenced.
- All plan views should have a north arrow and directional reference to cross sections.

2.2. Excavation Backfill

Data describing the backfill from excavation is required to perform analysis of the transfer of live load and earth pressure to the underground facility. If imported engineered fill is to be used as backfill, identify the material type specified on the construction plans and relevant engineering properties for the backfill. If native soil is used as the trench backfill, provide laboratory testing and soils analyses. This may require performing a subsurface investigation. Alternately, existing data from other work performed at the site can be used if representative of the soil to be used as backfill.

Bedding/Backfill for pipes/conduits and backfill above the underground facility shall be defined and include the specified degree of compaction required for the installation. This information is needed by the engineer to select engineering properties for outrigger load analysis.

Excavation backfill properties typically required for the analysis include:

- Backfill classification/description (USCS or AASHTO designations)
- Backfill total unit weight
- Modulus of soil reaction for backfill
- Strength properties for structural analyses, such as retaining walls

As noted in the previous section, the backfill material and degree of compaction used in the analysis should be directly referenced on the construction plans submitted for review.

SRP requires that the customer and/or contractor performing installation work provide third party installation documentation, inspection, and testing reports. SRP may also require on-site inspection during construction to validate design assumptions.

2.3. Design Live Load Pressure

Overhead transmission line maintenance equipment requires firm and stable subgrades to allow safe operation activities within SRP easements and right-of-way. Transmission line construction and maintenance equipment utilize outriggers to keep equipment stable during extensions and lifts. The lifting loads imparted to the ground through outrigger ground pads can be substantial and result in high vertical stresses to underground installations.

For the purpose of the analysis, the maximum design outrigger pad shall be assumed as a 27-inch diameter rigid disk imparting a 320 pounds per square inch (psi) vertical pressure on the ground surface. This pressure shall be applied vertically, directly over the underground facility to be analyzed. See Section 3.1 for live load analysis.

3.0 LOADS AND PERFORMANCE

3.1. Outrigger (Live) Load

Elastic soil theory is often used to determine the effect of equipment, foundation or other loads at the ground surface on a point at some depth below grade. The solution typically assumes that the soil is a linear elastic, homogeneous, isotropic medium with semi-infinite depth. One of the most well accepted approaches is based on Boussinesq's theory of elasticity pertaining to vertical stress distribution as illustrated in Figure 1.

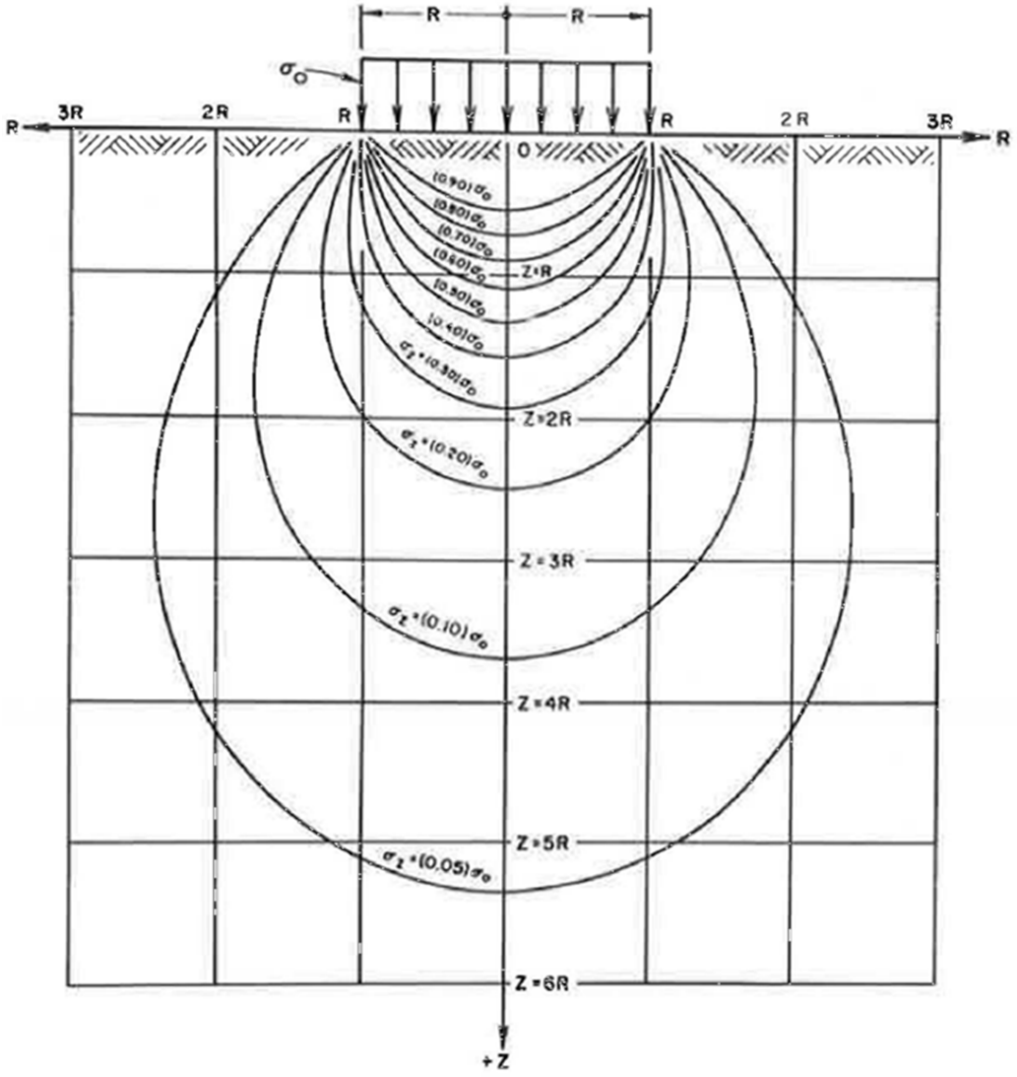


Figure 1. Isobars from a uniformly loaded circular bearing area (Jumikis, 1971)

Boussinesq's general equation can be obtained in most foundation engineering textbooks (*e.g.* Bowles, J.E. *Foundation Analysis and Design*. 5th Ed. McGraw-Hill. 1988.), where the circular outrigger pressure is converted to a single point load and the resulting vertical pressure is directly calculated at the top of the underground facility. The method using influence value graphs for circular bearing areas is presented by Alfreds Jumikis in his 1971 paper for the 41st Annual Meeting of the Highway Research Board.

Another variation in this approach for use with rigid (concrete) pipe is presented in the American Concrete Pipe Association (ACPA) Concrete Pipe Design Manual, where the circular outrigger load area is converted to a rectangular area and stress is projected as a four-sided polyhedron with

a truncated apex to the top of the underground pipe. The live load for this approach typically is assumed as a wheel pressure that must be modified to adjust for the outrigger pressure intensity. The resulting output is given in terms of force per unit length of pipe.

3.2. Earth Load

Earth load is considered as a constant (dead) load that does not vary over time. For flexible conduit, this load results in a pressure from the prism of soil directly over the pipe with dimensions of the conduit diameter, the height of cover over the conduit and a unit length of the conduit. With rigid pipe, the effect of pipe stiffness should also be examined to determine if the load is greater due to arching effects. The resulting output is given in terms of force per area squared (for pipe or conduit, this may also be given as force per width of pipe per unit length of pipe).

3.3. Performance Criteria

Underground facilities shall be designed so that they do not excessively deflect or are not crushed by the surface outrigger loads in combination with all other expected dead loads such as overburden earth pressure.

Various flexible pipe/conduit vendors provide minimum performance limits for their products in terms of maximum allowable deflection. The engineer of record shall present the pipe/conduit limits within the calculation set and provide documentation verifying the limits as typical for the industry, denoting the reference.

Rigid pipe calculations shall show that the combined applied live loads plus earth loads do not exceed the specified D-load strength shown in Section 4.2, Table 1 for the concrete pipe to be used within the SRP electric transmission line easement or right-of-way.

Structure performance is dependent on the appropriate design methodology proposed by the engineer of record and shall be provided by the engineer of record as part of the calculations.

If insufficient performance is found for the underground facility, the engineer of record shall provide recommendations for modifying the installation, which may include improved installation methods, conduit or pipe with greater strength or stiffness, deeper embedment, or thicker structural member cross sections.

4.0 ANALYSIS METHODS

4.1. Flexible Conduit or Pipe

Flexible conduit or pipe rely on deformation of the conduit or pipe from loads imposed to mobilize support of the bedding backfill on both sides of the pipe to distribute imposed vertical loads into the surrounding soil. These types of pipes commonly include:

- Steel pipe
- Ductile iron pipe
- Corrugated metal pipe
- Plastic pipe (PVC, corrugated polyethylene, HDPE, fiberglass)

Bending stress on pipe or conduit and vertical deflection are determined from the applied vertical live and earth pressures. The magnitude of stress and deflection are dependent on pipe properties, soil properties, soil weight and surface loads. The resistance to external loading is a function of the pipe stiffness and the passive soil resistance under and adjacent to the pipe. Deflection (sometimes referenced as “ring deflection”) is typically interpreted as the percentage change in diameter versus the original pipe diameter (ovalizing). Stress is typically assessed in terms of

pipe wall buckling potential and bending stress/strain. The most common approaches are based on relationships derived by M.G. Spangler of Iowa State University, which is often referred to as the "Iowa Formula". The pipe and conduit industries have developed several variations on this relationship based on field and laboratory testing of the different pipe materials. Some of these general industry approaches can be found in the following documents:

- American Water Works Association. M11 Steel Pipe: A Guide for Design and Installation. 5th Ed. AWWA. 1989 (see Chapter 5, "External Loads on Buried Pipe").
- Ductile Iron Pipe Research Association. Design of Ductile Iron Pipe. DIPRA. May 2016.
- American Lifelines Alliance. Guidelines for the Design of Buried Steel Pipe. ASCE. July 2001 (addenda through February 2005).
- Carleo, J. Handbook of PVC: Pipe Design and Construction. 5th Ed. Uni-Bell PVC Pipe Association. Industrial Press, Inc. 2013.
- Plastic Pipe Institute. Handbook of Polyethylene Pipe. 2nd Ed. PPI. 2008 (see Chapter 6, "Design of PE Piping Systems", Section 3, "Buried PE Pipe Design").

These various industry approaches incorporate different means to account for factors such as time and traffic. The engineer of record is responsible for performing the required calculations is not required to use these specific references, and shall provide justification for any analysis approach selected, demonstrating that it is based on well accepted engineering practices and principles.

In addition to live and earth loads, calculations typically consider the following properties:

- Pipe or conduit diameter or radius,
- Pipe or conduit wall stiffness,
- Backfill total unit weight, bedding factor and stiffness (modulus of soil reaction), and
- Deflection lag factor (time dependent)

Calculations must describe the analysis method to be used and present the complete analysis approach as presented in the method.

4.2. Rigid Pipe

Rigid pipes shall be sufficiently strong to withstand anticipated live and earth loads. Pipe strength is affected by the embedment condition, which must be factored into resistance capacity calculations. Rubber gasketed reinforced concrete pipe (RGRCP) is the most common rigid pipe used locally, but non-reinforced vitrified clay pipe (VCP) is still used for some sewer pipe projects. Rigid pipe load resistance is determined by a three-edge bearing test (sometimes referenced as "D-load") multiplied by a bedding factor that applies to standard loading conditions (trench, positive projecting embankment, negative projecting embankment or jacked and tunneled installation). Pipe may also be encased within controlled low strength material (CLSM) or concrete that requires additional assessment. The most common design approach for rigid pipe is a variation on Marston's method. Some general industry design approaches for rigid pipe can be found in the following documents:

- American Concrete Pipe Association. Concrete Pipe Design Manual. ACPA. 2011.
- National Clay Pipe Institute. Vitrified Clay Pipe Engineering Manual. NCPI. 2015.

Concrete pipes are identified by classes related to specific minimum D-load results, defined as the minimum load required to cause a 0.01-inch crack in the pipe. D-load is expressed in terms of force per linear length of pipe. Table 1 presents the pipe classes and corresponding D-loads as designated in ASTM (American Society for Testing and Materials) C76.

Table 1. Concrete pipe classes

Class	D-load (lbs./ft./ft.)
I	800
II	1000
III	1350
IV	2000
V	3000

Source: ASTM C76-20 "Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, 2020 revision.

CLSM or low strength concrete may be used as flowable fill to encase rigid pipe. Some studies suggest that hardened flowable fills transfer loads from the pipe to the insitu soil; therefore, the native soil must be able to provide the necessary support for the pipe. The hardened flowable fill should not be considered as providing any side support for the pipe (Howard, A.K. "Flowable fill solves pipe backfilling problems." Proceedings; 14th International Conference on Soil Mechanics and Foundation Engineering. Hamburg, GE. Vol. 3. September 1997. pp. 1609-1612.).

Three-edge bearing strength standards for vitrified clay pipe are provided in ASTM C700 (Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated, latest revision in 2018).

As with flexible pipe approaches, the engineer of record is responsible for performing the required calculations, is not required to use these specific references and shall provide justification for any analysis approach selected to demonstrate that it is based on well accepted engineering practices and principles.

4.3. Duct Banks

Analysis of loading on electric and communication duct banks is comprised of one or more plastic conduits that encase a conductor or cable. As such, these installations are less sensitive to loading since greater deflection is permissible. Also, the external loading capacity of duct banks is largely dependent upon the type of embedment material chosen and the quality of the installation of the material in the embedment zone. This material may range from compacted aggregate backfill to cementitious slurry products such as CLSM and low strength concrete that produce a rigid backfill. Unless otherwise justified by the engineer of record, flexible pipe analysis should be used where native or aggregate compacted materials are used as backfill. Rigid backfill encasing a conduit bank should be analyzed in bending as an unreinforced structural beam element, with the backfill compressive strength equal to or greater than the applied earth and live load stress. The engineer of record should include analysis on how conduits within rigid backfill may reduce bending and bearing strength.

4.4. Other installations

Other installations often include underground or at grade vaults, bridges and manholes or retaining walls (lateral support of an embankment) that are structural elements primarily comprised of reinforced concrete. PVC, HDPE (high density polyethylene) and fiberglass also comprise some utility structures. The engineer of record shall provide structural analysis consistent with the original structure design approach and must show that the structure can resist the applied outrigger loading in addition to normal design loads within standard industry performance or strength requirements. No standard method(s) is(are) given for reference. The engineer of record is responsible for performing the required calculations must provide a description of the methodology and justification for any analysis approach selected to demonstrate that it is based on well accepted engineering practices and principles.

Vaults, manholes, and other non-linear facilities are not acceptable in SRP easement or right-of-way.

5.0 REPORTS

5.1. Sealed Calculations

Engineering calculations shall be prepared and sealed by professional engineer registered in the State of Arizona who is qualified to perform the analysis. The calculation set shall document the following items in a logical order for review:

- The SRP Land Job number (LJ######) for tracking the project information.
- A description of the project (with site address), including a scaled plan and profile drawing for each underground installation showing the SRP power line, pole or tower structures (if in the installation area) and dimensioning of the transmission line easement or right-of-way. The plan and profile shall also show the location, dimensions and elevations of the proposed underground facility.
- The key assumptions, given information and references for methods and data. Any safety factors or other constants/factors used in the analysis should be noted.
- The Soil and/or trench backfill properties along with associated data/information used to develop the properties.
- A description of the analysis method along with rational for selecting the approach.
- The performance criteria for the analysis.
- The new underground facility geometry (e.g. pipe size/diameter, wall thickness, minimum embedment depth).
- The detailed calculations of live and earth loads at the top of the new underground facility. These include detailed calculations on how outrigger pressure at the ground surface translates to stresses at the top of the existing or proposed underground facility.
- All tables, graphs, charts and diagrams referred to in the calculations from industry design guides that are incorporated within the analysis method.
- The Strength and/or deflection calculations that use the live and earth loads to assess the adequacy of underground facility resistance and/or stiffness.
- And when referencing equations from an industry design guide, include the equation number and/or page from the original source.

5.2. Traceable Calculations

Hand calculations are acceptable**;** however, calculations may be rejected if insufficient detail is provided. Engineering calculations that use commercial software, in-house spreadsheets and similar computer methods must provide sufficient detail so that approaches and results are traceable and can be reviewed. Although not required, calculations utilizing Mathcad® or similar software that show the work typically demonstrates the level of detail required for review.

6.0 GLOSSARY

- USCS – Unified Soil Classification System
- AASHTO – American Association of State Highway and Transportation Officials.
- ASTM – American Society of Testing and Materials

7.0 Point Load Calculation Appendices

APPENDIX A: Analysis of Crane Outrigger Pad Loads on Buried Concrete Pipe
APPENDIX B: Analysis of Crane Outrigger Pad Loads on Buried Ductile Iron Pipe
APPENDIX C: Analysis of Crane Outrigger Pad Loads on Buried Concrete Duct Bank

APPENDIX A

Example 1: Analysis of Crane Outrigger Pad Loads on Buried Concrete Pipe

1. Problem Description

The purpose of the following calculations is to evaluate the required strength of a nominal 12-inch diameter rubber-gasket reinforced concrete pipe (RGRCP) buried below the ground and subjected to a live load ground applied pressure of 320 psi by a 27-inch diameter SRP crane outrigger. The pipe is to be installed for a new storm drain and retention basin located at the northwest corner of Main Street and State Street in Anytown, Arizona. See the attached plan view that shows the location of the SRP overhead power line with easement. The pipe will be buried with a minimum of 4 feet of cover (top of pipe to finished grade), as shown in the attached cross section (profile) drawing.

2. Analysis Methodology

The analysis method determines the combined earth and live loads imposed onto the system, compared against the strength capacity of the pipe. This type of pile should be assessed using a rigid pipe method. The load determination follows the procedure outlined in American Concrete Pipe Association's Concrete Pipe Design Manual (ACPA, 2011), modified so that the outrigger is modeled as a single dual wheel load. ASTM C76 Class V RGRCP is to be analyzed per the installation plan. Subsurface soil data from the project geotechnical report dated May 13, 2020 are used to assess the soil conditions (relevant pages from the report are attached).

3. Assumptions

- Dynamic load allowance, IM, is zero (no traffic, the outrigger is a static load)
- Safety Factor, SF = 1.0 (very short-term load, only during period SRP maintenance work)
- An earth load bedding factor (based on ACPA, 2011 Illustration 4.25) is used in the following calculations to modify the load from the outrigger pad instead of the larger factor recommended for trench condition in the ACPA document (Illustration 4.22). Since these factors are used in the denominator of design equations, larger numbers create a lower factor of safety. A conservative approach is used herein using a smaller bedding factor.
- Standard Installation Type 3 condition (ACPA, 2011, Illustration 4.23), implying that the higher strength pipe is necessary since the Type 3 was developed for conditions of little control over materials or compaction, thus producing conservative results. Additionally, narrow trench installation is recommended in order to improve bedding conditions.
- Per the site geotechnical report, backfill of trenches above bedding zones and bedding must comply with the requirements of Type B or better per MAG Standard Detail 200-1 for compacted select granular fill.
- The cover depth for the pipe is considered to be the earth cover depth.

4. Given Information

Pipe Geometry & Properties:

- Pipe inner diameter, d_i = 12 inches = 1 foot
- Pipe thickness, t = 2 inches
- Pipe outer diameter, $d_o = d_i + 2t$ = 16 inches = 1.33 feet
- Pipe cover depth (top of pipe to finished grade), H = 4 feet
- Allowable D-load for Class V RGRCP, D_{allow} = 3000 lbs/ft/ft, ASTM C76, table as follows:

Class	D-load (lbs/ft/ft)
I	800
II	1000
III	1350
IV	2000
V	3000

Loads:

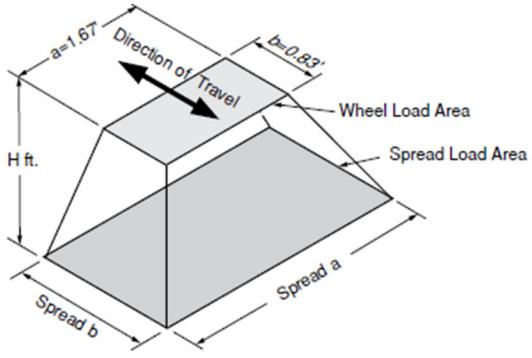
- Pressure applied by the outrigger pad, w_{crane} = 320 psi
- Outrigger pad diameter, d_{pad} = 27 inches or 2.25 feet
- Outrigger pad area, $A_{pad} = \pi (d_{pad} / 2)^2$ = 572.6 inches^2
- LRFD lane load requirement for pipe at depth less than 8 feet (ACPA pg. 45), L_L = 64 psf
- Earth load soil density, γ_s = 135 pcf (see site geotechnical report, pg. XX)

5. Analysis

Determine Outrigger Live Load on Pipe. Use method in ACPA, pp. 38 - 45

- Calculate area of pressure distribution at top of pipe (spread load area)

Illustration 4.13 Spread Load Area - Single Dual Wheel



Area dimensions a and b are obtained from equations in Illustration 4.12 "LRFD Critical Wheel Loads and Spread Dimensions at the Top of Pipe," for a live load distribution for select granular fill with load travelling perpendicular to the pipe (worst case). Selecting the appropriate spread equation is done by assessing the solution to the following equation from Illustration 4.12,

$H + 1.15\ d_o = 5.53$ feet

Based on this value, an equation that uses a wide spread is recommended in the design guide. But due to the lack of guidance for non-traffic type loading in the guide (such as an outrigger), the most conservative (thus smaller) spread area equation is to be used, where:

Spread a = Spread b = $d_{pad} + 1.15\ H = 6.85$ feet = $L_{12''}$

The spread area at the top of the pipe is circular due to the pad geometry, therefore the projected area is based on the dimension of the load area parallel and perpendicular to the pipe longitudinal axis. Thus, the spread area at the top of the pipe is interpreted as:

$A_{spread} = \pi\ (L_{12''}/2)^2 = 36.85\ feet^2$

Use Equation 4.12 from the ACPA reference to determine the average pressure intensity, $w_{12''}$:

$w_{12''} = w_{crane} \times A_{pad} / A_{spread} = (320\ psi \times 572.6\ in^2) / 36.85\ ft^2 = 4972\ psf$

Use Bousinesqu's theory for point load on the surface directly above an object below ground to assess if this approach provides a reasonable measure of pressure with depth (Bowles, 1997; pg. 287, eqn. 5-3), where:

$P_p = 3\ (w_{crane} \times A_{pad}) / (2\pi\ H^2) = 3(320\ psi \times 572.6\ in^2) / (2 \times \pi \times 4^2\ ft^2) = 3645\ psf$

Therefore, the ACPA approach provides a conservative estimate of average pressure intensity.

Use Equation 4.13 from the ACPA reference guide to determine total live load acting on the pipe, W_T:

$W_T = (w_{12''} + L_L)\ L_{12''} \times S_L = (4972\ psf + 64\ psf) \times 6.85\ ft \times 1.33\ ft = 45{,}880$ lbs

Note that a conservative estimate of S_L is provided by setting this value equal to the pipe outside width, or $S_L = d_o$

Use Equation 4.13 from the ACPA reference guide to determine the total live load acting on the pipe in pounds per linear foot, or W_L:

$W_L = W_T / L_e$, where:

$L_e = L_{12''} + 1.75\ (0.75 \times d_o) = 6.85\ ft + 1.75\ (0.75 \times 1.33\ ft) = 8.6\ ft$, and

$W_L = 45{,}880\ lbs / 8.6\ ft = \underline{5335\ lbs/lf}$

<u>Determine Earth Load on Pipe</u>

Determine the weight per linear foot of a soil prism over the pipe, P_L (ACPA Equation 4.2), where

$P_L = VAF \times \gamma_s\ (H + d_o\ (4 - \pi) / 8)\ d_o$

VAF, or vertical arching factor, is equal to 1.4 from ACPA Illustration 4.7 for a Type 3 trench condition (See Assumptions). Therefore:

P_L = 1.4 x 135 pcf x (4 ft + 1.33 ft (4 – π) / 8) 1.33 ft = <u>1044 lbs/lf</u>

<u>Load Calculation Verification</u>

Determine the D-load induced on the pipe, $D_{12''}$, per ACPA Equation 4.24. Assuming no fluid load, the equation simplifies to:

$D_{12''} = FS (W_L + P_L) / (B_{fLL} \times d_i)$

In accordance with the assumptions, a conservative live load bedding factor, $B_{fLL,}$ can be estimated from ACPA Illustration 4.22 for a fill height of 4 feet and a nominal pipe diameter of 12 inches. The value for B_{fLL} = 2.2 is selected for this analysis (see below):

Illustration 4.25 Bedding Factors, $B_{f.L.L}$, for HS20 Live Loadings

Fill Height, Ft.	Pipe Diameter, Inches										
	12	24	36	48	60	72	84	96	108	120	144
0.5	2.2	1.7	1.4	1.3	1.3	1.1	1.1	1.1	1.1	1.1	1.1
1.0	2.2	2.2	1.7	1.5	1.4	1.3	1.3	1.3	1.1	1.1	1.1
1.5	2.2	2.2	2.1	1.8	1.5	1.4	1.4	1.3	1.3	1.3	1.1
2.0	2.2	2.2	2.2	2.0	1.8	1.5	1.5	1.4	1.4	1.3	1.3
2.5	2.2	2.2	2.2	2.2	2.0	1.8	1.7	1.5	1.4	1.4	1.3
3.0	2.2	2.2	2.2	2.2	2.2	2.2	1.8	1.7	1.5	1.5	1.4
3.5	2.2	2.2	2.2	2.2	2.2	2.2	1.9	1.8	1.7	1.5	1.4
4.0	2.2	2.2	2.2	2.2	2.2	2.2	2.1	1.9	1.8	1.7	1.5
4.5	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.0	1.9	1.8	1.7
5.0	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.0	1.9	1.8

Therefore, the applied D-load from the outrigger with 4 feet of cover on a 12-inch nominal diameter RGRCP, $D_{12''}$ is:

$D_{12''}$ = 1.0 (5335 lbs/lf + 1044 lbs/lf) / (2.2 x 1 ft) = <u>2900 lbs/ft/ft</u>

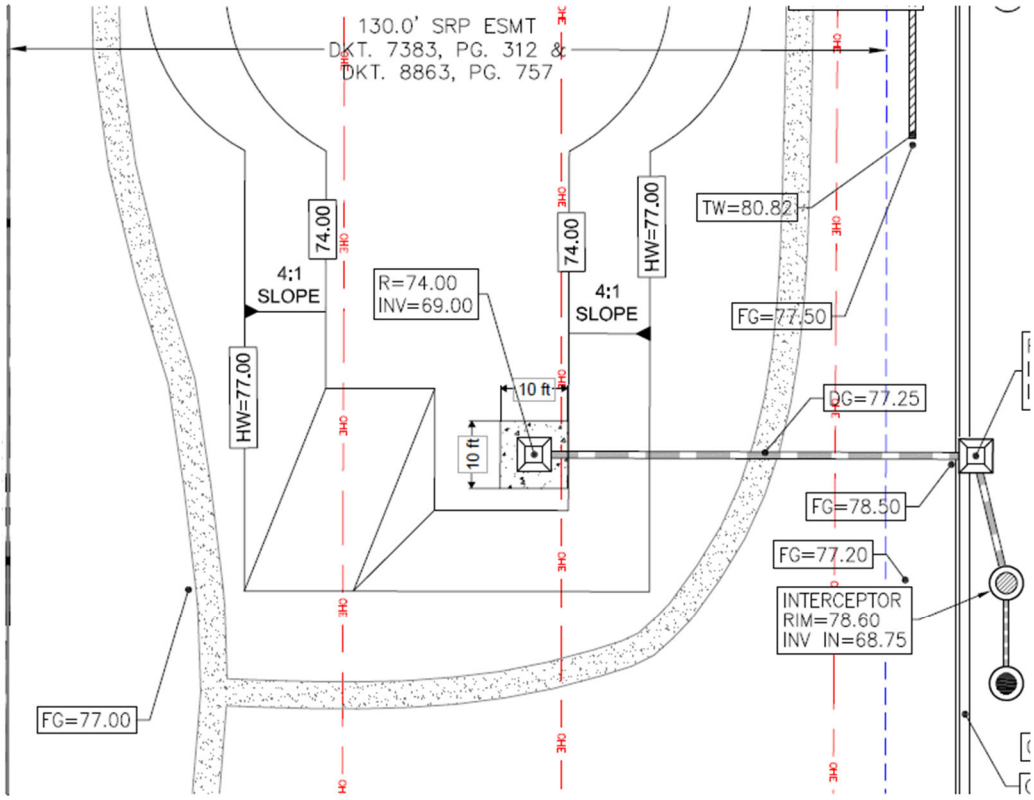
From the given information, the allowable D-load for Class V RGRCP (D_{allow}) is 3000 lbs/ft/ft, therefore

<u>$D_{allow} > D_{12''}$, therefore the installation is acceptable.</u>

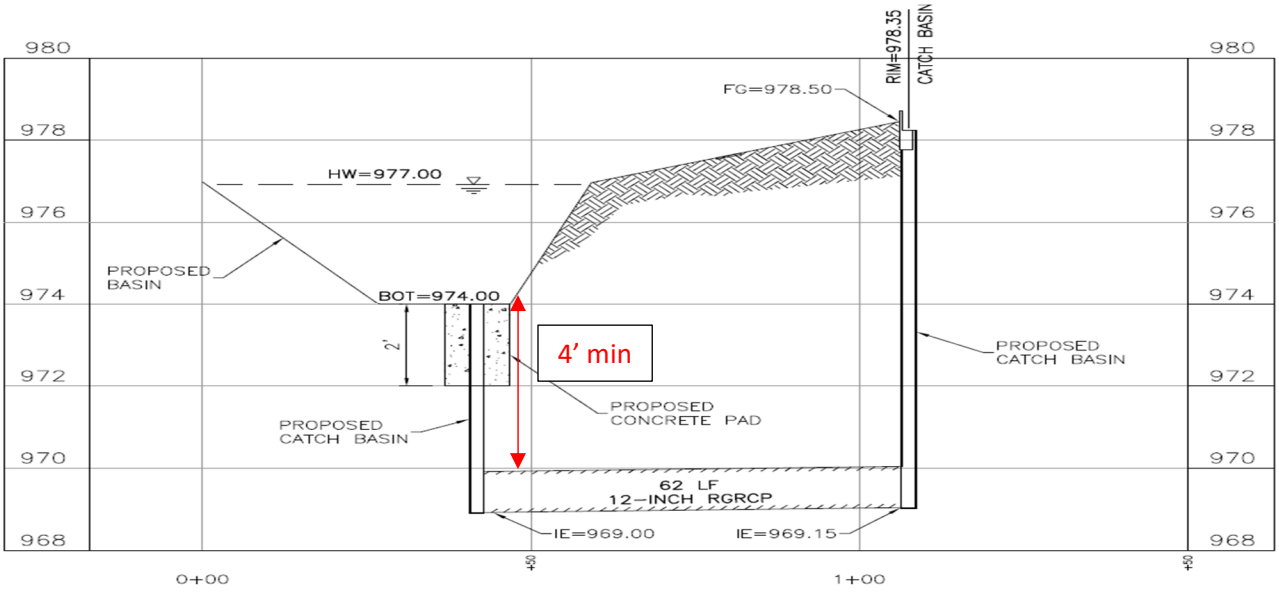
6. References

American Concrete Pipe Association (ACPA) 2011. *Concrete Pipe Design Manual.*

Bowles, J.E. 1996. *Foundation Analysis and Design*, 5th Ed. McGraw-Hill, NY.



STORM DRAIN PLAN VIEW
12-INCH PIPE
N.T.S.



STORM DRAIN PROFILE
12-INCH PIPE

APPENDIX B

Example 2: Analysis of Crane Outrigger Pad Loads on Buried Ductile Iron Pipe

1. Problem Description

The purpose of the following calculation is to evaluate the required strength of a nominal 6-inch diameter ductile iron pipe (DIP) buried below the ground and subjected to a live load surface pressure of 320 psi by a 27-inch diameter SRP crane outrigger. The pipe is to be installed for a new water line connection ¼-mile east of Walnut Street and within the southbound lanes of Main Street in Anytown, Arizona. See the attached plan view that shows the location of the SRP overhead power line with easement. The pipe will be buried with a minimum of 4 feet of cover (top of pipe to finished grade), as shown in the attached cross section (profile) drawing.

2. Analysis Methodology

The analysis method determines bending stress with pipe wall buckling potential of the DIP and vertical deflection from the applied combined earth and live loads imposed onto the system, compared against the bending strength and deformation capacity (interpreted as the percentage change in diameter versus the original pipe diameter) of the pipe. The resistance to external loading is assumed as a function of the pipe stiffness and the passive soil resistance under and adjacent to the pipe using a flexible pipe analysis method. The load determination follows procedures outlined in the Ductile Iron Pipe Research Association's Design of Ductile Iron Pipe manual (DIPRA, 2016). Analysis requires knowledge of the pipe properties, soil properties, soil weight and surface loads. Subsurface soil data from the project geotechnical report dated May 13, 2020 are used to assess the soil conditions.

3. Assumptions

- Live load pressure at the top of the pipe is based upon Boussinesq's theory.
- External load design includes calculation of both ring bending stress and deflection. Ring bending stress is limited to 48,000 psi, providing a safety of at least 2 based upon ultimate bending stress (DIPRA 2016, pg. 1).
- Deflection of the pipe ring is limited to a maximum of 3 percent for cement-mortar lined pipe, providing a safety factor of at least 2 against applicable performance limits of the lining (unlined pipe and pipe with flexible linings are capable of withstanding greater deflections) (DIPRA 2016, pg. 1).
- Standard laying condition Type 5 (DIPRA 2016, figure 1), implies the pipe is bedded to its center line in compacted granular material. Per the project geotechnical report, compacted granular or select material shall be placed to top of pipe (Approximately 90% standard proctor). Backfill of trenches above bedding zones and bedding must comply with the requirements of Type B or better per MAG Standard Detail 200-1 for compacted select granular fill.
- The cover depth for the pipe is considered to the earth cover depth.

4. Given Information

Pipe Geometry and Properties:

- Cover, H = 4 feet (see profile)
- DIP properties & size (per Table 3 (DIPRA, 2016) and the attached pipe vendor manufacturer cut sheet):
  - Pipe pressure class rating, 350 psi
  - Nominal Pipe size, 6 inches
  - Nominal Pipe thickness, t = 0.25 inch
  - Pipe outside diameter, d_O = 6.90 inches

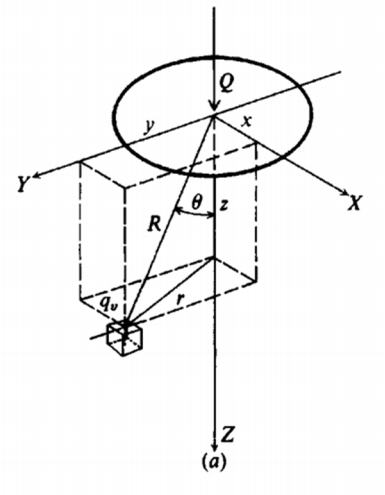
Loads:

- Pressure applied by the outrigger pad, w_{crane} = 320 psi
- Outrigger pad diameter, d_{pad} = 27 inches
- Outrigger pad area, $A_{pad} = \pi (d_{pad}/2)^2$ = 572.6 inches^2
- Outrigger point load, $P = w_{crane} * A_{pad}$ = 183,218 lbs
- Earth load soil density, γ_S = 130 pcf (see soils report)

5. Analysis

Determine outrigger live load pressure on pipe, P_L

Use Boussinesqu's theory for stress below grade due to a concentrated load on the surface (see figure below, Bowles, 1996, pg. 287). Point load is applied directly above pipe, where r = 0:



$$P_L = \frac{3P}{2\pi H^2} \frac{1}{\left(1 + \left({}^{r}/_{H}\right)^2\right)^{2.5}}$$

(Bowles, 1996. Eqn. 5-5)

therefore,

P_L= (3 * 183,218 lbs) / (2 * π * (4 ft)^2 * ((1 + (0 ft/4 ft)^2)$^{2.5}$)) = 5,468 psf

Determine earth pressure on pipe, P_E

$P_E = \gamma_S * H$ = (130 pcf) * (4 ft) = 520 psf (Terzaghi et al., 1996. Eqn. 15.4)

Total combined pressure on pipe, $P_{V\ applied}$

$P_{V\ applied} = P_L + P_E$ = 5,478 psf + 520 psf = 5,988 psf, or 41.6 psi

Determine the maximum allowable load (bending stress limit)

The following equation is used to calculate the maximum allowable load (pressure, in psi) applied at the top of the pipe to develop a bending stress of 48,000 psi at the pipe invert (DIPRA 2016, pg. 2):

$$P_{v\ allow} = \frac{f}{3\left(\frac{d_o}{t}\right)\left(\frac{d_o}{t}-1\right)\left(K_b - \frac{K_x}{\frac{8E}{E'\left(\frac{d_o}{t}-1\right)^3}+0.732}\right)}$$

where,

f = design maximum bending stress, 48,000 psi

K_b = bending moment coefficient, 0.128 (DIPRA 2016, Table 1)

K_x = deflection coefficient, 0.085 (DIPRA 2016, Table 1)

E = modulus of elasticity of DIP, $24x10^6$ psi

E' = modulus of soil reaction, 700 psi (DIPRA 2016, Table 1)

t = nominal pipe thickness, 0.25 inch

d_O = pipe outside diameter, 6.90 inches

The design bending stress of 48,000 psi provides safety factors under total loading of at least 1.5 based on ring yield strength and at least 2.0 based on ultimate ring strength. Therefore,

$P_{V\ allow}$ = (48,000 lbs/in^2)/ (3 * (6.9 in / 0.25 in) * ((6.9 in / 0.25 in) - 1) * (0.128 - 0.085 / (8 * $24x10^6$ lbs/in^2 / (700 lbs/in^2 * ((6.9 in / 0.25 in) - 1)^3) + 0.732))) = 178 psi

Compare applied to allowable load:

$P_{V\ allow}$ = 178 psi

$P_{V\ applied}$ = 41.6 psi

Therefore, the applied load is less than the allowable load and the 6-inch DIP should withstand the outrigger load at a 4-foot depth below grade.

Determine the deflection of the pipe

The DIPRA guide document (2016, pg. 3) notes the maximum allowable ring deflection for cement mortar lined DIP is 3 percent of the outside diameter. Tests have shown that 3 percent deflection will provide a safety factor of at least 2.0 regarding failure of the cement-mortar lining. The following equation is adapted from this guide document to calculate the ring deflection based on the applied load, $P_{v\ applied}$:

$$Ring\ deflection, \frac{\Delta_x}{d_o} = P_{v\ applied} \left(\frac{12K_x}{\frac{8E}{\left(\frac{d_o}{t_1} - 1\right)^3} + 0.732E'} \right)$$

where,

K_x = deflection coefficient, 0.085 (DIPRA 2016, Table 1)

E = modulus of elasticity of DIP, $24x10^6$ psi

E' = modulus of soil reaction, 700 psi (DIPRA 2016, Table 1)

t = minimum pipe thickness, t + 0.08 = 0.33 inch (see note on vendor cut sheet for tolerance)

d_O = pipe outside diameter, 6.90 inches

Therefore, the ring deflection due to the applied loads is:

$\Delta x/d_o$ = (41.6 lbs/in^2 * 12 * 0.085) / ((8 * ($24x10^6$ lbs/in^2) / (((6.9 in / 0.33 in) - 1)^3)) + 0.732 * 700 lbs/in^2) = 0.2%

Therefore, the applied load results in a deflection well below the allowable 3% deflection, so the 6-inch DIP provides satisfactory performance with the outrigger load at a 4-foot depth below grade.

6. Refences

Ductile Iron Pipe Research Association (DIPRA) 2016. *Design of Ductile Iron Pipe*.

Bowles, J.E. 1996. *Foundation Analysis and Design*, 5th Ed. McGraw Hill, NY.

Terzaghi, K., Peck, R. B., & Mesri, G. 1996. *Soil mechanics in engineering practice*, 3rd Ed. John Wiley & Sons.

NOMINAL THICKNESS FOR STANDARD PRESSURE CLASSES OF DUCTILE IRON PIPE

For Generations

Size In.	Outside Diameter In.	Pressure Class*				
		150	200	250	300	350
		Normal Thickness — in.				
3	3.96	—	—	—	—	0.25**
4	4.80	—	—	—	—	0.25**
6	6.90	—	—	—	—	0.25**
8	9.05	—	—	—	—	0.25**
10	11.10	—	—	—	—	0.26
12	13.20	—	—	—	—	0.28
14	15.30	—	—	0.28	0.30	0.31
16	17.40	—	—	0.30	0.32	0.34
18	19.5	—	—	0.31	0.34	0.36
20	21.60	—	—	0.33	0.36	0.38
24	25.80	—	0.33	0.37	0.40	0.43
30	32.00	0.34	0.38	0.42	0.45	0.49
36	38.30	0.38	0.42	0.47	0.51	0.56

* Pressure Classes are defined as the rated water pressure of the pipe in psi. The thicknesses shown are adequate for the rated water working pressure plus a surge allowance of 100 psi. Calculations are based on a minimum yield strength of 42,000 and a 2.0 safety factor times the sum of the working pressure and 100 psi surge allowance.

**Calculated thicknesses for these sizes and pressure ratings are less than those shown above. Presently, these are the lowest nominal thicknesses available in these sizes.

NOTE: Per ANSI/AWWA C150/A21.50 the thicknesses above include the 0.08 in. service allowance and the casting tolerance listed below by size ranges:

SIZE (Inches)	CASTING TOLERANCES (Inches)
3–8	-0.05
10–12	-0.06
14–36	-0.07

McWANE DUCTILE | IRON STRONG

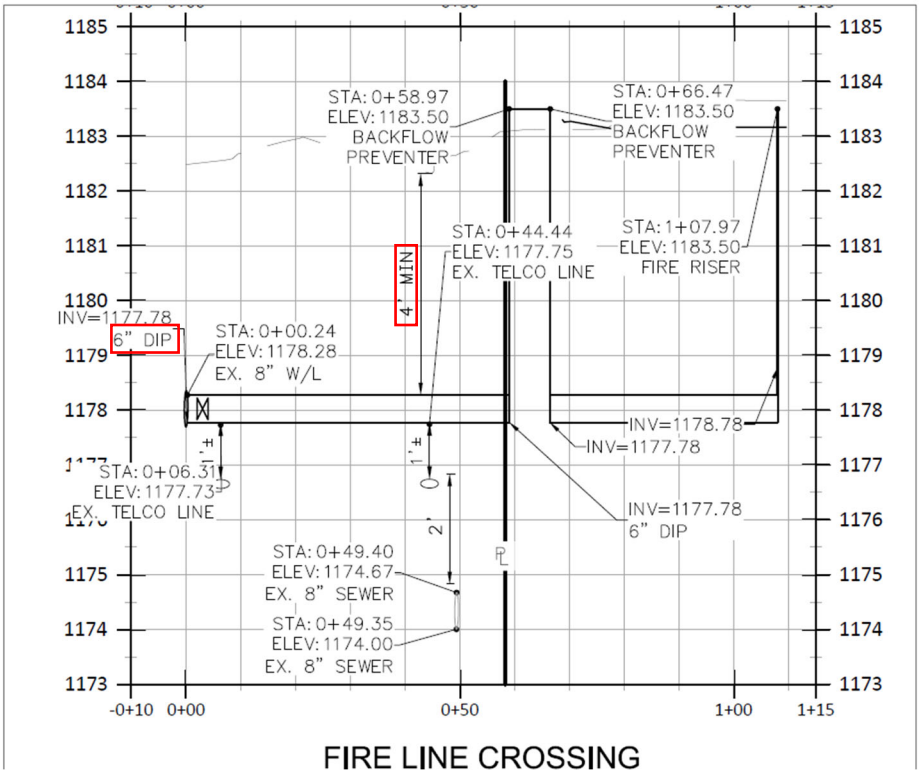
Canada Pipe Company ULC

NEW JERSEY
183 Sitgreaves St.
Phillipsburg, NJ 08865
908-454-1161
mcwaneductile.com

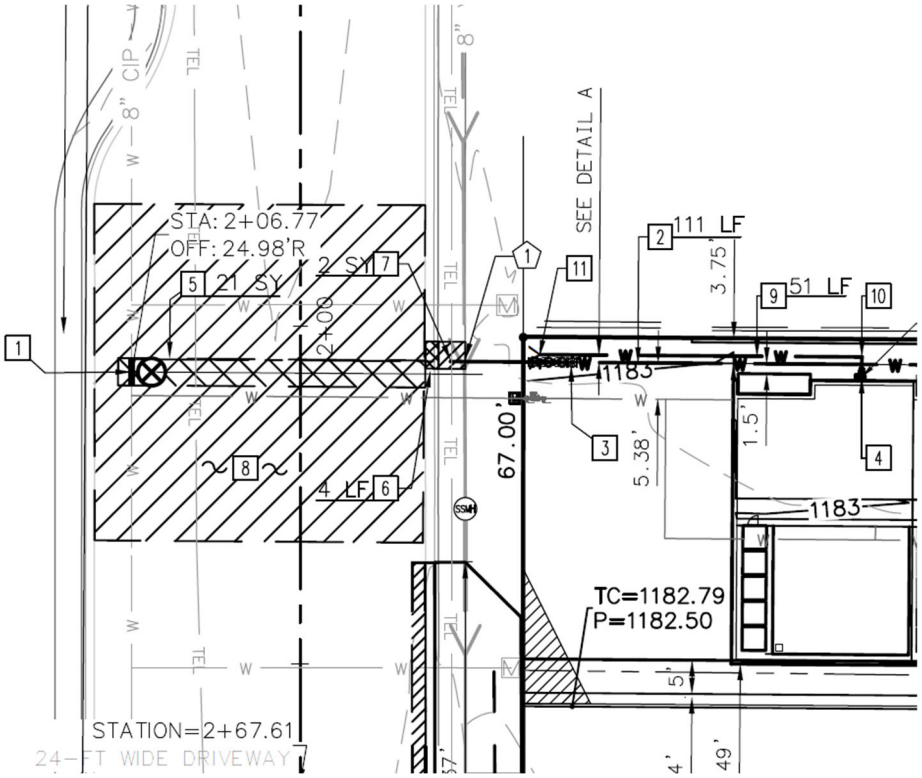
OHIO
2266 S. 6th St.
Coshocton, OH 43812
740-622-6651
mcwaneductile.com

UTAH
1401 E 2000 S.
Provo, UT 84503
801-373-6910
mcwaneductile.com

CANADA
1757 Burlington St. E
Hamilton, ON L8N-3R5
905-547-3251
canadapipe.com



FIRE LINE CROSSING



APPENDIX C

Example 3: Analysis of Crane Outrigger Pad Loads on Buried Concrete Duct Bank

1. Problem Description

The purpose of the following calculation is to evaluate the required strength of 6-inch diameter concrete encased PVC conduits (two rows of 3) buried below the ground and subjected to a live load surface pressure of 320 psi by a 27-inch diameter SRP crane outrigger. The duct bank is to be installed for a street lighting connection ¼-mile east of Walnut Street and within the southbound lanes of Main Street in Anytown, Arizona. The duct bank will be buried with a minimum of 4 feet of cover (top of concrete), as shown in the attached cross section (profile) drawing (**Figure 1**).

2. Analysis Methodology

Vertical stress is based upon Boussinesq's stress distribution theory in a homogenous linear elastic half space soil under normal loads. Resisting capacity is based on the concept that the area directly above the PVC conduit within the conduit bank does not carry any of the vertical load (conservative assumption), and resistance is derived from columns of concrete on the sides of the conduits (assuming a vertical plane), with two columns of 6-inch wide concrete and two columns of 3-inch wide (18-inch equivalent column) concrete (**Figure 2**). Pressure at the top of concrete encasement is across the 36-inch wide conduit bank. Load analysis assumes a 12-inch unit length

Analysis requires knowledge of the encasing concrete strength, soil properties, soil weight and surface loads. Subsurface soil data from the project geotechnical report dated January 13, 2021 are used to assess the soil conditions.

3. Given Information

<u>Duct Bank Geometry and Properties:</u>

- Cover, H = 4 feet (see profile)
- 36" x 24" Duct Bank
- 3000 psi Concrete

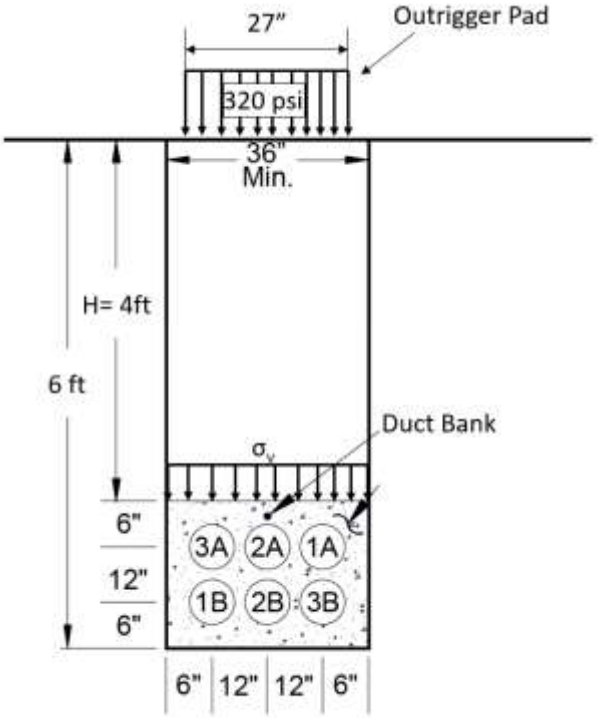
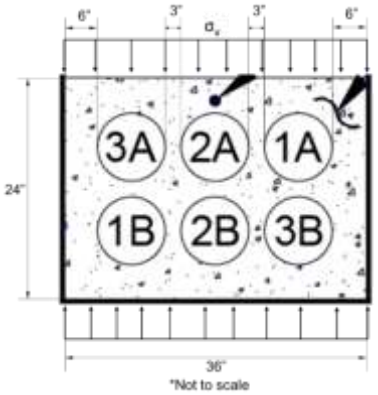


Figure 1. Trench Profile



6 in + 3 in +3 in +6 in = 18 in

Figure 2. Free body diagram of conduit bank showing concrete area

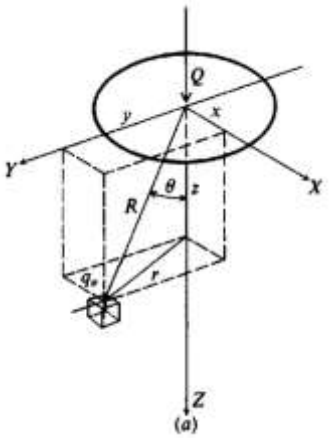
Loads:

- Pressure applied by the outrigger pad, w_{crane} = 320 psi
- Outrigger pad diameter, d_{pad} = 27 inches
- Outrigger pad area, $A_{pad} = \pi (d_{pad}/2)^2$ = 572.6 inches^2
- Outrigger point load, $P = w_{crane} * A_{pad}$ = 183,218 lbs
- Earth load soil density, γ_S = 130 pcf (see soils report)

4. Analysis

Determine outrigger live load pressure on pipe, P_L

Use Boussinesqu's theory for stress below grade due to a concentrated load on the surface (see figure below, Bowles, 1996, pg. 287). Point load is applied directly above pipe, where r = 0:



$$P_L = \frac{3P}{2\pi H^2} \frac{1}{\left(1 + \left(r/H\right)^2\right)^{2.5}}$$

(Bowles, 1996. Eqn. 5-5)

therefore,

P_L= (3 * 183,218 lbs) / (2 * π * (4 ft)^2 * ((1 + (0 ft/4 ft)^2)$^{2.5}$)) = 5,468 psf

Determine earth pressure on pipe, P_E

$P_E = \gamma_S * H = (130\ pcf) * (4\ ft) = 520\ psf$ (Terzaghi et al., 1996. Eqn. 15.4)

Total combined pressure on pipe, $P_{V\ applied}$

$P_{V\ applied} = P_L + P_E = 5{,}478\ psf + 520\ psf = 5{,}988\ psf$, or 41.6 psi

Total load at the top of the duct bank, $Q_{V\ applied}$ (per linear foot)

$Q_{V\ applied} = (P_{V\ applied} * 36\ in * 12in) = (41.6\ psi * 36\ in * 12\ in)/1000 = 17.97\ kips$

Resisting compressive capacity from remaining concrete columns with dimensions, R_u (per linear foot)

$R_u = (3000\ psi * 18\ in * 12\ in) / 1000 = 648\ kips$

Load at the top of the grade from the outrigger pad forces must be less than the resisting compressive capacity from the remaining concrete columns (per linear foot) and must provide a minimum safety factor of 1.0.

Therefore, the capacity safety factor is,

Safety Factor = $R_u / Q_v = 648\ kips / 17.97\ kips = 36 >> 1.0$ **OK**

5. Refences

Bowles, J.E. 1996. *Foundation Analysis and Design*, 5th Ed. McGraw Hill, NY.

Terzaghi, K., Peck, R. B., & Mesri, G. 1996. *Soil mechanics in engineering practice*, 3rd Ed. John Wiley & Sons.