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Appendix J. OTR Operations Plans

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Appendix J. OTR Operations Plans

The following appendices contain all OTR Operations Plans, as of April 2007, which describe the technical components of OTR.

These plans consist of:

- the Installation, Removal, and Restoration Planning Documents (Appendix J1)
- the Event Management Planning Documents (Appendix J2).

These plans explain the specific procedures for installing OTR, operating during the viewing period, removing OTR, and restoring the lands. These plans include the traffic management and emergency response plans during all project phases. All plans will continue to evolve based on input and guidance from the OTR team, skilled specialists, BLM, Colorado Department of Transportation (CDOT), and other agencies.

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J1. Installation, Removal, and Restoration Planning Documents

J1. Installation, Removal, and Restoration Planning Documents

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Appendix J1. Installation, Removal, and Restoration Planning Documents

The plans for OTR installation, removal, and restoration are divided into two sections:

- The engineering plans (Appendix J1.1) explain the technical details concerning the engineering for OTR installation, removal, and restoration.
- The operations plans (Appendix J1.2) include the traffic management, emergency management, and sanitation protocols for the installation and removal periods.

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J1.1 Installation, Removal, and Restoration Engineering Plan

J1.1 Installation, Removal, and Restoration Engineering Plan

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ANCHOR AND ANCHOR TRANSITION FRAME (ATF) INSTALLATION AND REMOVAL PLAN

PROPOSED FOR

CHRISTO AND JEANNE-CLAUDE

OVER THE RIVER
A TEMPORARY WORK OF ART

PREPARED BY:
Hayward Baker Inc.
(HBI)
11575 Wadsworth Blvd.
Broomfield Colorado 80020
November 15, 2006

The technical approach to ground anchor installation for the OTR Project is based on industry standard practices, Hayward Baker Inc. (HBI) experience in conducting hundreds of similar projects, visual assessment of the overburden and bedrock conditions and physical constraints at the jobsite, as well as site visits to observe each of the proposed anchor locations. The approach addresses all design features as detailed in the Golder Associates report dated November 15, 2006. We believe the approach outlined in this plan is executable, and any changes dictated by actual site conditions are solvable through adaptation of specific drilling equipment, techniques, and staging/ sequence of construction.

The work described in this Section consists of drilling and installing temporary ground anchors to support and secure the Anchor Transition Frames (ATF's) at each cable end location, testing the anchorages, assembling the ATF at each location, as well as the eventual removal and reclamation of the ATF and ground anchors after the project is over.

Anchor Installation Procedures

Prepare Plans and Submittals

The Project Team prepares all final equipment, procedural, and materials certification submittals prior to commencement of construction. Key personnel attend the pre-construction meetings with all involved agencies and parties. Plans include the Health and Safety Plan, Traffic Control Schedule, Erosion Control Plan, Storm Water Control Plan,

Installation Quality Control Plan, and material certifications. The Team works in close consultation with the CDOT, BLM, Colorado Department of Parks and Recreation, the Colorado State Patrol, and the project designers during this phase, to ensure all environmental concerns, technical issues, and potential problems identified by the group are addressed.

Mobilization

The Project Team intends to source its rental equipment and incidental supplies and materials needed from local firms in Fremont and Chaffee Counties. Most rental support equipment is mobilized from Canon City or Salida. Table 1 lists the equipment we anticipate mobilizing for this project.

Crews will be hired locally from the canyon communities, Canon City, or Salida. Our team members are familiar with the level of craft labor for operators and construction workers from this area. Our staff has experience on geotechnical projects in this area using the available local labor and sub-contracting sources.

HBI sets up a small site office in a single axle pup-trailer with a complete workshop at the Railroad Siding (centrally located Construction Staging Area at Texas Creek) (CSA) designated for support of the overall project. Locking Sea containers are used to store all equipment, tools, and supplies.

TABLE 1- BASIC EQUIPMENT LIST

Description	No. Units	Source	Tasks/Comments
6000lb telescoping rubber-tired forklift/ loader	2	Local Rental	Handling palleted cement, super-sacks, equipment, anchor bars, loading/ unloading; support units at the PSA.
375 cfm high pressure Compressor	3	Local Rental	For flushing cuttings inside drill casing; mounted on support unit w/ grouting equipment.
375 cfm compressor	2	Local Rental	For hand drills and smaller machine drills
Job Johns	3-4	Local Service Rental	Weekly Service
Trash Dumpster, bear-proof.	3	Local Service	Construction trash
Water Truck	3	Local Service Rental	For supplying water to support units
Chemgrout model CG-500 Grout mixer and	3-4	HBI Equipment	Self contained portable batching, mixing, and pumping unit for

pumping unit mounted on trailer or rail car with compressors noted above.			producing slurry grout for anchors. Support Unit has water tank, compressor/ genset and all support equipment for the drills.
Tractor and semi-trailer mounted support unit	3	HBI Equipment	For supporting grouting and compressed air service to the drilling operations on the Hwy side
Flat-car mounted support unit	1	HBI Equipment	For supporting grouting and compressed air service to the drilling operations on the rail side
Klemm KR 2510 Hydraulic excavator-mounted drill with all drilling tools	2	HBI Equipment	Drilling and setting cased and uncased rock anchors within 25 feet of lane centerline. Cat 325 Units equipped with rubber-track plates on tracks to prevent scuffing pavement
Klemm 2510 drilling mast set up for operating suspended from crane leads.	1	HBI Equipment	Drilling and setting cased and uncased rock anchors on slopes greater than 25 feet from lane centerline.
Bob-cat mounted TEI drill all	1	HBI Equipment	Small mobile machine drill for setting ground anchors off Hwy/ RR
Berretta rubber-track mounted small mobile drill	1	HBI Equipment	Small mobile machine drill for setting anchors off Hwy/RR
Hydraulic-powered hand rock drills	3	HBI Equipment	Hand held drills for drilling holes into solid rock, complete with portable hydraulic power-pack units.
Drill Transport Trailer	2	Local Rental	Tractor and trailer for moving crawler-mounted drilling equipment between work areas, and drill mast to crane work locations.
Hydraulic drill power unit	1	HBI Equipment	Truck mounted for supplying power to crane-supported drill mast
Truck-Mounted Hydraulic Crane (e.g. Grove TMS875c)	1	Rental with operator	For crane-supported drill mast
Boom truck	2	Local rental	For distributing ATF units and collecting ATF's after project is over.
Crew Pickup Trucks	10		For personnel transport. Some equipped for high-railing on railroad tracks
Fueling/ Service truck	2	Hired Outfit	To provide fuel and maintenance of heavy equipment

Shop Trailer	2	HBI Equipment	Self contained shop and office trailer for equipment support
Shipping/sea container,	5	HBI Equipment	For secure storage of tools equipment, and supplies at Staging area.
Fisher-Porter electromagnetic flow meter, with totalizer	3	HBI Equipment	Digital electronic slurry-grout flow measurement and control unit, with back-up unit.
Digital flow and pressure meter	3	HBI Equipment	Water and permeability testing

TABLE 1- EQUIPMENT LIST-continued

Prepare Site and Project Environmental Controls

The OTR Construction Team maintains an organized, clean, and professional work site at all times. Waste and pollution control are an important part of our operations. The main concerns for pollution control associated with the drilling and grouting operations are control and disposal of drill cuttings, waste grout, and washout water. We anticipate using cyclone collectors (vacuum collection) to control drill cuttings at the collar of the hole, as well as air-mist injection to control dust from rock drilling with the smaller machine drills. Cuttings are directed into a hopper that collects drill cuttings for daily transport and disposal at the sediment pit in the central CSA. Once operations are concluded, the sediment pit is cleaned out, backfilled, compacted and the area cleaned, restored, and re-seeded.

Any waste grout and wash water are circulated back into waste tanks mounted on the support trailer. The tanks are emptied each shift at the designated, CSA disposal pit. An orange construction fence is attached to a five-strand barbed wire enclosure around the sediment pit, to prevent cattle and people from entering the disposal area. A gate is closed when the sediment basin site is not attended. Each week, the hardened cement waste is excavated and disposed of at a landfill where construction debris is permitted.

Each anchor installation crew is equipped with a complete set of drums, spill kits, absorbent pads, and containers for handling any hydraulic fluid or oil leakage. An approved secure waste fluids enclosure is established at the CSA for handling waste lubricants and fluids from equipment maintenance. Equipment maintenance is only carried out at the CSA, not in the field locations. All waste fluids are periodically transported in sealed containers by approved equipment maintenance providers to the proper recycling locations off-site.

Construction debris and trash is contained in a closed bin on each support trailer. A roll-off container at the CSA periodically receives trash and debris from the bins, and is serviced by approved contracted waste management firms to an approved landfill.

Set up Support Systems and Drilling and Grouting Operations.

Water Supply

A heavy HDPE plastic water storage tank is mounted on each drill support unit. The tank is filled as needed by a water truck from designated private sources dedicated to the construction project. The tanks hold water for grout mixing, and drilling operations. A waste-water tank is also included on each support unit trailer

Water pumps include moyno-type progressive cavity pumps for air-mist injection during rock drilling. These are the same type of pumps used to pump grout.

Cement Storage

Permanent materials for this job include Portland cement. Palleted, bagged cement is used for ease of handling and storage. Cement is stored in plastic wrapped pallets to protect cement from moisture. The pallets are loaded onto the support unit trailer each day to service the grout mixing operations.

Additives

Additives for mixing various grouts are stored on-site. We anticipate having a superplasticizer and retarder on site for use as needed, dictated by actual grouting response. The plasticizer is Kao Corp. “Mighty 150” superplasticizer. It is mixed according to the manufacturer’s recommendations to reduce water and provide better flowability as dictated by grouting response. Kao Mighty 150 is certified by the Portland Cement Association as meeting the requirements for a type A (water-reducing) and type F (water reducing, High Range), chemical admixture in ASTM C494-80.

Kelco-crete: A seaweed-derived material mixed into grout to close off and seal large leaking fissures and piping cavities. A handful in a hopper of grout results in a flash-setting grout that begins hardening as soon as it stops flowing. It is useful for sealing off large piping cavities in drill holes.

Bentonite: Wyo-Ben or Baroid brand bagged, powdered bentonite clay

Equipment Descriptions

Drilling Equipment

Three large drilling units are planned for the project, as well as several smaller machine drills and hand-held equipment. A drilling crew will be assembled around each of the three large drills, and a fourth around the smaller machines and hand drills as follows:

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Drill-1 <u>Klemm KR 2510 Hydraulic drill mounted on tracked Cat-325 excavator</u>
This is a powerful machine, specifically designed for geotechnical foundation and rock drilling. These machines are routinely used for drilling both overburden, and bedrock. Drill-1 is configured for cased duplex-rotary percussive drilling and self-drilling anchors. The machine is configured to reach anchor locations within 25 feet from the centerline the riverside lane or the railroad tracks. It is equipped with rubber-pads on the tracks to avoid scuffing or marking the highway pavement. This machine has a full crew and support trailer that contains compressed air service, water, grouting equipment, and a supply of ground anchors.

Drill-2 <u>Klemm KR 2510 Hydraulic drill mounted on tracked Cat-325 excavator</u>
Same machine as Drill-1, except it is configured only for percussion drilling self drilling anchors from a rotary carousel drill rod holder. It is equipped with rubber-cleats on the tracks to avoid scuffing or marking the highway pavement. This machine also has a full crew and support trailer that contains compressed air service, water, grouting equipment, and a supply of ground anchors.

Drill-3 <u>Klemm KR 2510 Hydraulic drill mast set up for crane-supported drilling</u>
This is the same drilling mast as Drills 1 and 2 above, but is configured to be suspended from a crane. The diesel-electric hydraulic power unit is separately mounted on a truck and the hydraulic hoses and controls are connected to the mast via a suspended cable bundle. The mast is configured for percussion drilling self drilling anchors from a rotary carousel drill rod holder, or for cased hole duplex-drilling as conditions warrant. The unit can be suspended from motor-cranes of different sizes to get the reach needed to access the ATF locations farther down the bank than can be reached by Drills 1 &2. This drill mast can also be suspended from a rail-mounted crane for use on the railroad side of the project. This machine also has a full crew and support trailer that has compressed air service, water, grouting equipment, and a supply of ground anchors.

Crew-4 Rubber-tired and rubber tracked small-size drills, hand drills, anchor testing.

The fourth crew will use a variety of small bob-cat mounted or rubber-tracked mini-excavator mounted rock drills to install anchors at locations well away from the highway or railroad. Specifications for a few of these machines are included. This crew will also be assigned to install anchors in limited access locations that use hand-held drilling equipment. The drills are transported to the work areas on small trailers behind the crew pick-up trucks. A separate support unit that contains the compressor, grouting equipment, and supply of anchor materials is mounted on a flatbed truck that is equipped with a crane arm. Longer air and grout hoses are supplied with this support unit so that it can be stationed on the existing nearby access roads and serve several ATF locations from the same spot. This same support equipment is used with the hand held rock drills used at some locations.

Grouting Equipment

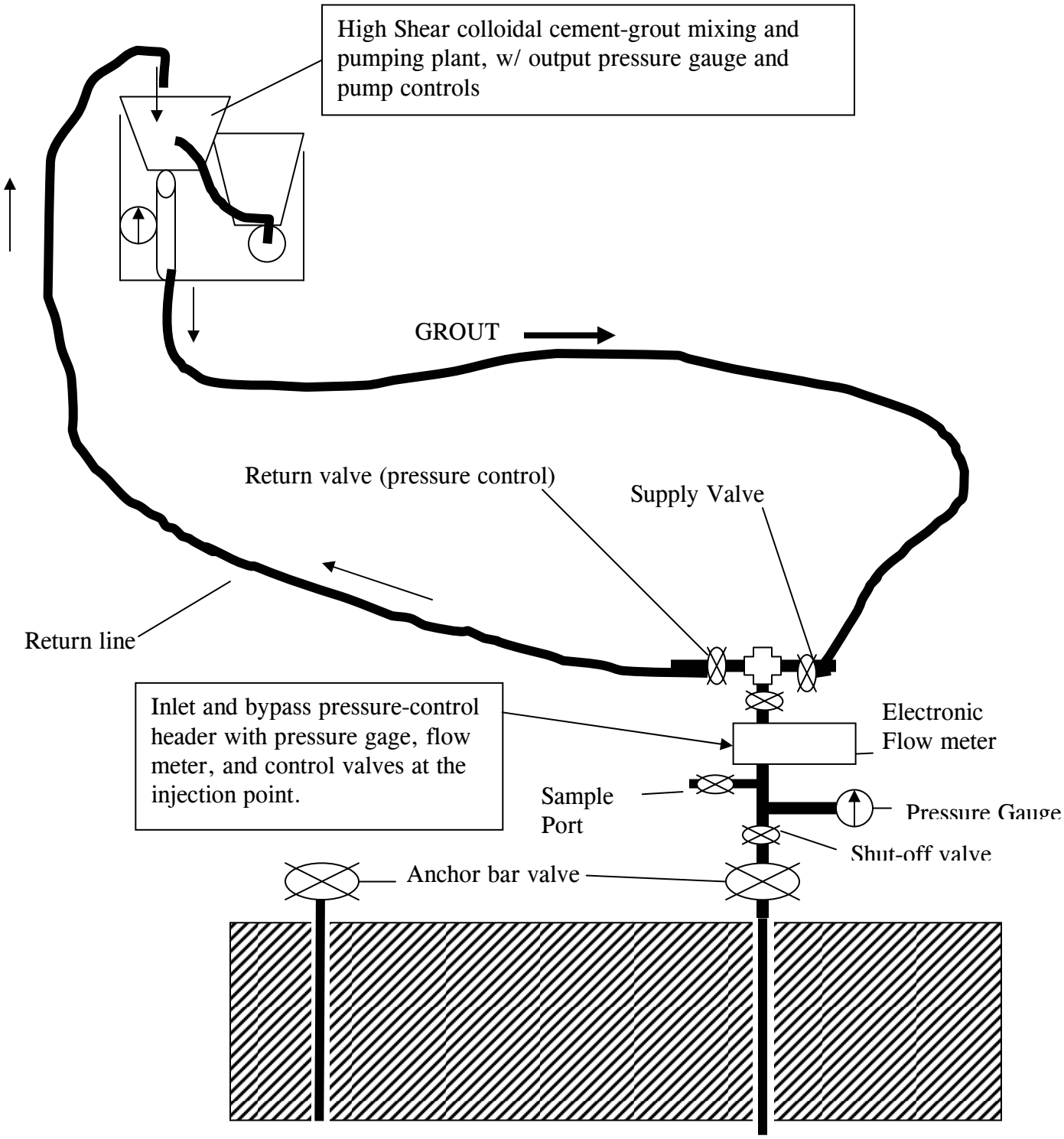
Slurry Grout

The slurry grouting system is capable of supplying grout at variable pressures, measured at the pump, up to 300 psi and at rates of 2cf to15cf per minute, as required to suit the application. The units are Chem Grout CG-500 high-shear colloidal mixing and pumping plants, specifically designed to mix and pump neat cement grouts. These are double-drum mixers with built-in holding tanks, eliminating the need for a separate holdover tank. The pumps on these units are progressive-cavity “moyno-type”. The units are air-powered from the compressor.

A return-circulation grouting system is used. A saunders-type valve controls flow and pressure by regulating bypass return to the grout pump. Injection is controlled with valves at the injection header at the anchor location by the grouting technician. Valves allow grout flow to be shut off while maintaining flow and spillage is minimized while moving between anchors.

Grout-flow metering equipment consists of a Fisher-Porter electro-magnetic flow meter with a totalizer for digital readout of flow rate, pressure, and cumulative take in gallons. A header and calibrated valve system controls grout flow to each injection point. Digital, calibrated water meters are used to precisely batch and mix any range of grout mixes that might be needed to address the actual grouting conditions. HBI’s grout plant can mix grout down to 0.2 water-cement ratio if required.

All required mixing charts, thinning charts, thickening charts, mix yield data, and compiled daily grouting data are available in chart and print form, as well as electronically via the on-site lap-top supported grouting management program.



Schematic diagram of re-circulating slurry-grout injection delivery system. Injection pressure is maintained with return valve.

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Drilling, Setting, and Removal of Ground Anchors

General Construction Sequence

Based on the developed and agreed upon overall project schedule, each crew and drill is assigned a series of anchor locations to install for each Section of a given Area. Anchor installation on the railroad side can be accomplished year round, depending on time frames governing any environmentally sensitive areas and weather conditions. Anchor installation on the highway side is only prosecuted during the non-summer months. It is envisioned that during the summer months, all four crews will be working on the railroad side. During the fall, early winter, and spring, all the crews are working on the highway side, but not in the same areas at any given time.

At this time the schedule is constructed around the equipment packages envisioned to complete the work in the allotted time frame, and summarized on the attached spread sheet down to the sections of each area, with a total number of days estimated for anchor installation. It is important to realize that three or four crews are each working on different sections on a given day, and that the total of days (anchor installations) for each section will occur in multiple visits at different times with different equipment set-ups.

The work is sequenced so that one crew based in Salida begins working from the west side with Drill-1, and the second crew based in Canon City begins working from the east side using Drill-2. The crane-drill (crew-3) would work on the railroad side or in the middle areas. Each crew installs only the anchors associated with the configuration of their drilling equipment, skipping those locations where a different type of drilling is necessary. This means that each section is visited at different times by the different equipment needed to install the anchors. There could be weeks or even months between visits to an individual section.

Crew 4 has the fewest anchors to install, and is mostly independent of the other crews. Following completion of the foot-access and off-highway anchors, Crew 4 will begin systematically proof-testing 5% of all anchors, and torque-testing at least one anchor at every ATF location.

When the Drill-1 and Drill-2 crews meet in the middle, they exchange equipment, and begin to work back the way they came, completing the skipped-over anchors with the alternate drilling equipment. This staging is carefully controlled by the master schedule and project scheduler. All section-timing and environmental constraints are factored into the schedule. Each crew works on their assigned locations only when and as directed by the project scheduler.

General Equipment Layouts

This section describes the general layout and construction sequence for the different drilling equipment packages described above. Each Drill has its own crew and support equipment that move with it along the route to install the ground anchors. The drills are supplied with fuel, each night by a fueling truck. Anchor materials, water, and grout are transported to the drills by the support units that return to the CSA each day for restocking of supplies and materials.

Highway Side Construction

<u>Drill 1 and 2 Klemm KR 2510 Hydraulic drill mounted on Cat 325 excavator chassis.</u>

The equipment packages for Drills 1 and 2 consist of the drill, a tractor and semi-trailer to transport the drill to the work area, and a tractor and trailer-mounted support unit. The support unit stays adjacent to the KR 2510 drill in the river-side highway lane in front of or just behind it.

The support units are custom built and include the following equipment mounted on a semi-trailer:

- Small hydraulic crane-arm
- Air compressor
- Cyclone cuttings collector
- Grout Plant
- Water Tank and Pump
- Waste water Collection Tank
- Rack/ bins for Anchor Bar Supply
- Bagged grout storage
- Small electric generator
- Trash bin
- Holding bin for drill cuttings
- Porta-John

<u>Daily Construction Operations</u>

The following is a general overview of typical daily operations for crews using the KR-2510 track-mounted drills on US Hwy 50:

- The crew and project scheduler coordinate flagging and traffic control operations for the project section scheduled for work.

- Once traffic control is set up, the traffic control crew radios such to the anchor crew, and the semi trailer arrives to deliver the KR 2510 drill. These machines are equipped with special un-cleated flat-rubber growsers (“parade tracks”) so that they will not scuff or scratch the pavement. They are unloaded directly onto the pavement and the drill transport tractor and trailer leaves the site.

- The support unit trailer arrives from the PSA and is positioned behind the drill. Compressed air lines and the vacuum line to the cyclone cuttings collector are connected to the drill. The anchor-rod carousel on the drill is loaded with anchor rods using the small hydraulic crane arm on the support unit.

- The KR 2510 operator begins drilling anchors at the ATF locations assigned to the crew. A technician on foot assists with accurate collaring of the holes at the surveyed locations.

- The cyclone cuttings collector (vacuum) sucks up drill cuttings as they rise to the collar of the hole. Cuttings are discharged into an enclosed bin.

- Once the hole is drilled to proper depth the anchor is grouted or set and expanded into position. Grout is batched on board the support unit by the equipment and methods described above. Any waste grout is re-circulated to the waste tank/tub on the support unit.

- After completing all four anchors at the ATF location, the drill moves down the highway to the next assigned location. The support unit follows it closely, and the anchor setting process is repeated.

- A water truck may arrive during the shift to re-supply the water tank on the support unit. It is positioned in the lane on the opposite side from the support unit, so that only one traffic lane is occupied.

- At the end of the work shift, the drill is either trammed up or down the highway to a safe location well off the highway where it is parked overnight, or the transport trailer is summoned and the drill is moved to a designated safe parking area.

- The support unit returns to the PSA where it is fueled, serviced, and re-stocked with supplies for the next shift. Waste water and drill cuttings are emptied into the disposal areas at the PSA.

- The drill is fueled and serviced by the fueling truck during the night so that it is ready for the next days work.

This sequence is repeated daily for those locations in a given section that are assigned by the project scheduler.

Drill 3_ Klemm KR 2510 Hydraulic drill set up for crane-supported operations.

The equipment package for Drill 3 is similar to those for Drills 1 & 2. It consists of the KR 2510 drill mast and cable leads. A tractor and semi-trailer transports the drill mast to the work area. A truck-mounted hydraulic crane, similar to the Grove TMS 875c described in the equipment specifications section is positioned at the work area each day. The trailer-mounted support unit is the same as for drills 1&2. The package also includes the drill hydraulic power unit mounted on a short flatbed truck. The support unit and power unit stay adjacent to the crane in the river-side highway lane in front of and just behind it.

Daily Construction Operations

The following is a general overview of typical daily operations for crews using the KR-2510 crane-supported drill on US Hwy 50:

- The crew and project scheduler coordinate flagging and traffic control operations for the project section scheduled for work.

- Once traffic control is set up, the traffic control crew radios such to the anchor crew, and the semi trailer arrives to deliver the KR 2510 drill mast. The motor crane rolls in to the work site and sets up at the designated ATF location.

- The drill mast is hooked to the crane and hoisted off the transport trailer. The transport trailer leaves the work site.

- The truck-mounted drill hydraulic power unit arrives and is positioned next to the crane. The hydraulic power lines and control lines are connected by quick-disconnect couplings to the drill mast lines.

- The support unit trailer arrives from the PSA and is positioned behind the drill. Compressed air lines and the vacuum line to the cyclone cuttings collector are connected to the drill mast. The anchor-rod carousel on the drill is loaded with anchor rods using the small hydraulic crane arm on the support unit.

- The crane operator positions the drill mast at the correct angle and location for each anchor, as directed by the driller, who operates the drill on the mast by remote control.

- For angled holes, reaction cables are connected to the crane body.

- The drill operator begins drilling anchors at the ATF locations. A technician on foot assists with accurate collaring of the holes at the surveyed locations.

- The cyclone cuttings collector (vacuum) sucks up drill cuttings as they rise to the collar of the hole. Cuttings are discharged into an enclosed bin.

- Once the hole is drilled to proper depth the anchor is grouted or set and expanded into position. Grout is batched on board the support unit by the equipment and methods described above. Any waste grout is re-circulated to the waste tank/tub on the support unit.

- After completing all four anchors at the ATF location, the drill mast is lifted clear, and if the next ATF location is adjacent, the crane moves down the highway to the next assigned location. If the next location is not adjacent, the mast transport trailer returns and the drill mast is placed on the trailer but not disconnected from the crane. The crane then trams down the highway to the next location. The support unit and power unit follow it closely, and the anchor setting process is repeated.

- A water truck may arrive during the shift to re-supply the water tank on the support unit. It is positioned in the lane on the opposite side from the support unit, so that only one traffic lane is occupied.

- At the end of the work shift, the drill mast is returned to the transport trailer, and the equipment is moved away to a safe location well off the highway where it is parked overnight.

- The support unit returns to the PSA where it is fueled, serviced, and re-stocked with supplies for the next shift. Waste water and drill cuttings are emptied into the disposal areas at the PSA.

- The crane and power supply units are fueled and serviced by the fueling truck during the night so that they are ready for the next days work.

This sequence is repeated daily for those locations in a given section that are assigned to the crane-supported unit by the project scheduler.

Crew-4 Rubber-tired and rubber tracked small-size drills, hand drills, anchor testing.

These machines are small in size and are transported on conventional tandem axel trailers behind pick-up trucks. Drilling work is conducted well off the Highway and railroad.

<u>Daily Construction Operations</u>

The following is a general overview of typical daily operations for crews using the small bob-cat and mini-excavator-mounted drills, staged from US Hwy 50:

- The crew and project scheduler coordinate flagging and traffic control operations for the project section scheduled for work. Generally traffic control will consist only of warning signs for shoulder work, and alerts for possible trucks entering or leaving the highway. Lane closures are not required.

- Once traffic control is set up, the traffic control crew radios such to the anchor crew, and the drill trailer and crew truck arrive and get into the designated off-highway staging area. The low-bearing pressure machines are unloaded directly onto the ground.
- The small drill is trammed to the ATF location along a pre-flagged specified access route that avoids steep slopes, trees, and sensitive vegetation,

- The support unit trailer arrives from the PSA and is positioned in a staging area on an existing access road or trail near the ATF locations. Compressed air lines are run out to the drill. The anchor-rods are carried to the ATF location by hand.

- The drill operator begins drilling anchors at the ATF locations assigned to the crew. A technician on foot assists with accurate collaring of the holes at the surveyed locations.

- An air-mist injection or cyclone collector is used to control dust and collect cuttings at the collar of the hole. Cuttings are placed in buckets and returned to the bin on the support

unit

- Once the hole is drilled to proper depth the anchor is grouted or set and expanded into position. Grout is batched on board the support unit by the equipment and methods described above, and pumped down to the ATF locations though long re-circulating hoses. Any waste grout is re-circulated to the waste tank/tub on the support unit.

- After completing all four anchors at the ATF location, the drill moves to the next assigned location nearby. The support unit is repositioned as needed, and the anchor setting process is repeated.

- A water truck may arrive during the shift to re-supply the water tank on the support unit.

- At the end of the work shift, the drill is moved to a safe location well off the highway where it is parked overnight, or the transport trailer is summoned and the drill is moved to a designated safe parking area elsewhere.

- The support unit returns to the PSA where it is fueled, serviced, and re-stocked with supplies for the next shift. Waste water and drill cuttings are emptied into the disposal areas at the PSA.

- The drill is fueled and serviced by the fueling service truck during the night so that it is ready for the next days work.

This sequence is repeated daily for those locations in a given section that are assigned by the project scheduler.

Railway Side Construction

Construction procedures for anchor installation on the rail road side of the project are similar in most respects to those for the highway side. The same equipment packages described above will all be used on the railroad side during the course of construction.

Major differences include**:**

- All construction operations are staged from the railroad yard designated as the Construction Support Area (CSA). Railroad operations including equipment and personnel transport are coordinated by the project railroad traffic control manager.

- Two small yard-locomotives and high-rail-mounted trucks are used to tram equipment and personnel to the work areas.

- The drill support units are mounted on custom built railroad flat cars or high-rail trucks.

- Track Drills are mounted on flat cars and moved into position for anchor installation.
- Track drills can be dismounted from the flat cars using ramps so that they can access ATF locations farther away from the track centerline.
- A special rail-mounted sectional crane is used for crane-supported drilling operations.
- Highway Traffic control is not required.

Anchors

Anchors consist of either hollow self-drilling steel bars, threaded expansion-shell "point anchors", or extendable Swellex friction anchors, depending on the actual geologic conditions at each ATF location (refer to the Golder Associate report of November 15, 2006 for a description of anticipated ground conditions and each anchor type). Drilling procedures for each condition are described below.

Open Hole in Solid Rock

For holes in solid rock without any unconsolidated overburden, the hole is advanced with a hydraulic top-hammer drill or hand-held hydraulic rock drill to design depth. Air or water is used to flush the cuttings. The drill steel is withdrawn and a spin-lock friction "point anchor" is set in the open hole and torqued to specifications. Cuttings are sucked from the collar of the hole by the cyclone collector, or wet cuttings are shoveled into buckets. Some cuttings are saved in a labeled container for later reclamation of the holes at each ATF location. There is no grouting involved in setting the spin-lock anchors. The anchorage is provided by the mechanical expansion shell tightened in the rock hole.

Reclamation

After the anchor is no longer needed, the threaded rod is loosened and the anchor is withdrawn from the hole. The hole is patched with non-shrink mortar and the original cuttings are placed into the mortar mix to blend in with the surrounding rock face.

Overburden or Loose Rock-Fill over Shallow Bedrock, Boulder Fill

Threaded, hollow self-drilling steel anchor bars are advanced down through loose rock fill and overburden by a hydraulic top-hammer drill. The rods use a disposable rock bit that stays in the hole. Drilling parameters such as rate of advance, bit pressure, and circulation loss/return are carefully recorded so that the condition of the materials along the hole is determined.
Once a solid section of boulder or bedrock is intercepted that meets minimum anchorage depth requirement, cement grout is pumped through the bar in a precise volume to fill the "rock socket". The grout cures in the rock socket and provides the anchorage for the bar. Any cuttings

that return are sucked from the collar of the hole by the cyclone collector.

Reclamation

After the anchor is no longer needed, the upper part of the threaded rod is loosened and removed from the top of the hole. The lower part of the rod is left in the ground 12 inches below surface. The loose fill or rock debris around the collar of the hole is allowed to settle in and fill the upper part of the hole. The fill is tamped into place in the hole and raked- and re-graded to match the surrounding slope. If the collar of the hole is in solid rock or a boulder, the hole is reclaimed as for solid rock above. The hole is patched with mortar and the original cuttings are mixed into the mortar mix to blend in with the surrounding rock face.

Deeper Overburden or Loose Soils and Fill, No Bedrock

Steel surface casing is set into the soils using a duplex (double-rod) top-hammer drilling system, with an air-mist flush. Drilling parameters such as rate of advance, bit pressure, and circulation loss/return are carefully recorded so that the condition of the materials along the hole is determined. Any cuttings that return are sucked from the collar of the hole by the cyclone collector. Once casing is set through the overburden and soils to the anchor design depth, the inner string of drill rods is tripped out and a threaded steel bar with PVC centralizers is inserted into the casing until it is standing on bottom. The casing is filled with grout through a tremmy tube from bottom to top and the casing is withdrawn incrementally from the ground, allowing the grout to bond the thread bar to the formation soils. A short upper piece of bar above a coupler is provided with a PVC plastic bond-breaker coating to prevent the grout from bonding to the short top section of the thread bar. Anchorage is provided by the grout-soil bound strength along the bar.

Reclamation

After the anchor is no longer needed, the upper part of the threaded rod is loosened from the coupler and removed from the top of the hole. The bar is provided with a PVC plastic bond-breaker to prevent the grout from bonding to the upper removable section. The upper 12 inches of grout are broken out of the hole and removed, and the hole is covered with soil or loose fill and tamped or compacted and seeded. Broken grout pieces are collected and removed from the site.

Deeper Overburden or Loose Soils Over Broken, Fractured Bedrock

Steel surface casing is set to the top of bedrock using a duplex top-hammer drilling system as described above. An air flush is used. Drilling parameters such as rate of advance, bit pressure, and circulation loss/return are carefully recorded so that the condition of the materials along the hole is determined. Any cuttings that return are sucked from the collar of the hole by the cyclone collector. Once casing is set through the overburden down to bedrock, the inner drill string and bit is unlatched from the casing shoe, and drilling continues downward through the bedrock without the casing, forming the “rock socket”. Once the rock socket is deep enough, the inner string of rods is tripped out of the hole and an extendable Swellex friction rock bolt is

inserted down into the rock socket. The soft steel Swellex element is expanded using water-pressure according to the manufacturer's instructions until the friction element is fully expanded in the rock socket, providing the anchorage. The steel casing in overburden is then removed from the hole and the overburden settles around the upper part of the bolt. No grouting is required for this type of anchor.

Reclamation

After the anchor is no longer needed, the upper part of the Swellex rod is uncoupled and removed from the top of the hole. The lower part of the rod is left in the ground 12 inches below surface. The loose fill or rock debris around the collar of the hole is allowed to settle in and fill the upper part of the hole. The fill is tamped into place in the hole and raked- and re-graded to match the surrounding slope. If the collar of the hole is in solid rock or a boulder, the hole is reclaimed as for solid rock above. The hole is patched with mortar and the original cuttings are placed into the mortar mix to blend in with the surrounding rock face.

Project Management

QA/QC and Documentation

The OTR team uses a lap-top supported project management software system to document and analyze all aspects of the drilling and grouting program. A technician inputs drilling logs, and grout pumping data into the software program on a daily basis. Graphic and descriptive logs are printed off for submission to the engineer. A snapshot of each production quantity for the project, and cumulative footage of drilling is always available to the engineer.

HBI's lap-top supported QA/QC system is down-loaded via the inter-net to the main server in Denver each day. The data can then be e-mailed via the inter-net to any interested party.

Back-up for the software system is provided by the hard-copy paper field forms and logs completed in the field on a daily basis. A complete paper grouting log is kept for every stage of every hole. Field drill logs, water testing logs, and grout logs are copied and provided to the engineer. The paper-trail of field data creates a redundant base-record of the work performed. All these logs are filed in the office on-site, as well as copied to the main office in Denver, and provided to the site engineer/inspector.

Grout samples are pulled from each different batch and tested in accordance with:

STANDARDS AND REFERENCES

A. The most recent version of the following testing methods or standards:

1. ASTM C150 Compliance Standard for Portland Cement

2. ASTM C143 Test Method for Slump of Portland Cement Concrete

Test Cylinders are cast as directed by the engineer for compressive strength testing by others.

Anchor Testing Procedures

Standard Practice requires that 5% of the ground anchors be proof tested. This requires that approximately 450 random anchors be tested by applying assigned test loads with a hydraulic jack apparatus. Additionally, due to the highly variable nature of the ground conditions in which the anchors are installed, it is anticipated that one of the four anchors at each ATF location will be test-loaded by a measured torque applied to the anchor bar nut and plate.

Proof Testing

A random list of anchors is computer generated for proof testing. The testing crew is assigned the locations on a daily basis by the project scheduler. No traffic control measures are needed.

The two man crew has a pick-up truck with tool boxes that contain the testing equipment. Proof testing equipment includes:

- A small hydraulic jack with a hollow center piston.
- A hand pump with calibrated pressure gauge that connects via a hydraulic hose to the jack.
- Several steel plates, extension bar section, coupler, and nuts to fit the anchor bars
- A tripod, magnetic stand and dial indicator.
- Steel jack stool.
- Two backpacks for transporting the equipment.
- Pre-printed test forms

The Proof-Testing Procedure is generally as follows:

- The crew parks the pick up truck or the (high-rail truck) in a safe location off the highway and walks to the anchor locations with the equipment.
- A coupler and extension section of thread bar is attached to the anchor bar.
- The jack stool and hollow stem jack is set over the bar extension and connected to the hand pump.
- The plate and nut are installed such that the jack will push outward (pull) on the anchor bar.
- The tripod, magnetic stand, and dial indicator are positioned to measure any movement or elongation of the anchor bar.
- The jack is pressured-up in specified increments with the hand pump. Gauge pressure and dial indicator movement measurements are recorded on the test forms.
- The equipment is disassembled and the crew heads to the next test location.

Torque Load Testing

Torque load testing is accomplished in similar fashion as above. One of the four anchors at each location is loaded by applying a specified maximum torque with a calibrated torque wrench. Results are recorded on the forms. The testing is done by a two man crew moving between the locations on foot.

Anchor Transition Frame Installation

After the ground anchors are installed at each cable end location, an Anchor Transition Frame (ATF) is assembled and attached to the anchors in preparation for cable installation. ATF units consist of square-section steel tubes, a steel tube frame, cables, pins, nuts and other attaching hardware. They are easily assembled and adjusted with simple hand tools (wrenches, pliers, hammer, alignment pins, etc.). ATF's are pre-manufactured and bundled into a package or "kit" for field assembly.

The conceptual procedure for distributing and assembling the ATF's is as follows:

- Packaged ATF assemblies are loaded onto a flat-bed boom truck a day before they are needed in a given section.
- The project scheduler coordinates traffic control for the area and section where the ATF's are to be distributed.
- The boom truck crew coordinates with traffic control and moves slowly down the highway, placing the ATF kits near the cable end locations. (this could be done at night)
- Two-man assembly teams travel to the work area by pickup truck and move on foot between the cable end locations.
- The crews assemble the ATF's onto the ground anchors and perform preliminary adjustment using hand tools.
- ATF assembly is staged and sequenced to accomplish the task in the scheduled window for each area, ahead of the cable installation work.

Anchor Transition Frame Removal

The ATF units are disassembled in reverse order of construction. The parts are bundled together with tie-wire and marked with florescent flagging for collection by the flat-bed boom truck. The ATFs are collected by the boom truck moving along the highway or railroad. The steel ATF parts are eventually taken to the steel mill in nearby Pueblo, Colorado, or other similar outlet for recycling.

Following disassembly of the ATF, the crew performs anchor removal and reclamation as described above for the various anchor types.

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
COUNTY LINE Section 1	1	2,872,591.22	1,244,185.80	6,930.43	FOOT	0.5			0.25
	1	2,872,759.03	1,244,274.12	6,928.07	RUBBER TRACK		0.5		0.25
	2	2,872,619.29	1,244,161.03	6,928.74	CB3	0.6668			0.25
	2	2,872,774.95	1,244,242.95	6,927.32	RUBBER TRACK		0.5		0.25
	3	2,872,646.74	1,244,130.39	6,927.44	CB	0.5			0.25
	3	2,872,789.86	1,244,227.45	6,927.22	RUBBER TRACK		0.5		0.25
	4	2,872,668.39	1,244,102.78	6,926.71	CB	0.5			0.25
	4	2,872,845.05	1,244,222.59	6,928.24	RUBBER TRACK		0.5		0.25
	5	2,872,705.38	1,244,073.43	6,925.69	CB3	0.6668			0.25
	5	2,872,839.77	1,244,235.40	6,929.45	RUBBER TRACK		0.5		0.25
	6	2,872,737.85	1,244,057.74	6,924.79	CB3	0.6668			0.25
	6	2,872,852.24	1,244,195.62	6,926.13	RUBBER TRACK		0.5		0.25
	7	2,872,779.17	1,244,042.32	6,923.66	CB3	0.6668			0.25
	7	2,872,848.62	1,244,202.01	6,926.57	RUBBER TRACK		0.5		0.25
	8	2,872,813.09	1,244,032.57	6,922.92	CB3	0.6668			0.25
	8	2,872,871.68	1,244,167.28	6,923.89	RUBBER TRACK		0.5		0.25
	9	2,872,847.75	1,244,024.50	6,922.40	CB3	0.6668			0.25
	9	2,872,902.25	1,244,149.79	6,922.85	RUBBER TRACK		0.5		0.25
	10	2,872,887.95	1,244,015.01	6,922.27	CB3	0.6668			0.25
	10	2,872,906.10	1,244,148.27	6,922.80	RUBBER TRACK		0.5		0.25
	11	2,872,922.95	1,244,012.69	6,922.13	CB3	0.6668			0.25
	11	2,872,940.55	1,244,141.90	6,922.72	RUBBER TRACK		0.5		0.25
	12	2,872,957.57	1,244,007.58	6,922.15	CB3	0.6668			0.25
	12	2,872,975.03	1,244,135.73	6,922.59	RUBBER TRACK		0.5		0.25
	13	2,872,992.10	1,244,001.75	6,922.26	TH	0.4			0.25
	13	2,873,010.22	1,244,134.81	6,922.68	RUBBER TRACK		0.5		0.25
	14	2,873,026.74	1,243,996.78	6,922.33	TH	0.4			0.25
	14	2,873,044.74	1,244,128.90	6,922.52	RUBBER TRACK		0.5		0.25
	15	2,873,061.93	1,243,995.81	6,922.26	TH	0.4			0.25
	15	2,873,079.58	1,244,125.34	6,922.39	RUBBER TRACK		0.5		0.25
	16	2,873,101.99	1,243,997.41	6,922.23	TH	0.4			0.25
	16	2,873,092.26	1,244,127.73	6,922.44	RUBBER TRACK		0.5		0.25
	17	2,873,136.87	1,244,000.31	6,922.29	TH	0.4			0.25
	17	2,873,126.12	1,244,144.27	6,923.01	RUBBER TRACK		0.5		0.25
	18	2,873,175.68	1,244,003.77	6,922.46	TH	0.4			0.25
	18	2,873,142.36	1,244,147.58	6,923.01	RUBBER TRACK		0.5		0.25

CB = Crane Basket
TH = Track Hoe mounted drill
TH* = Track Hoe assembled off train car
FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
COUNTY LINE Section 1 (continued)	19	2,873,211.74	1,244,003.19	6,922.89	TH	0.4			0.25
	19	2,873,176.00	1,244,157.46	6,923.11	RUBBER TRACK		0.5		0.25
	20	2,873,220.71	1,244,003.02	6,922.96	TH	0.4			0.25
	20	2,873,222.12	1,244,160.27	6,923.01	RUBBER TRACK		0.5		0.25
	21	2,873,255.72	1,244,003.92	6,922.73	TH	0.4			0.25
	21	2,873,257.22	1,244,170.71	6,923.71	RUBBER TRACK		0.5		0.25
	22	2,873,260.66	1,244,003.93	6,922.68	TH	0.4			0.25
	22	2,873,314.52	1,244,182.89	6,925.20	RUBBER TRACK		0.5		0.25
	23	2,873,296.57	1,244,004.90	6,922.24	TH	0.4			0.25
	23	2,873,356.50	1,244,198.51	6,927.29	RUBBER TRACK		0.5		0.25
	G1	2,872,734.79	1,244,323.83	6,927.51	RUBBER TRACK		0.5		0.25
	G2	2,873,529.33	1,244,184.64	6,919.52	CB		0.5		0.25
	G3	2,873,326.09	1,244,005.81	6,921.19	CB3	0.6668			0.25
	G4	2,872,562.14	1,244,264.04	6,927.83	FOOT	0.5			0.25
Total						**13.068**	**12.5**	**25.568**	**12.5**

COUNTY LINE Section 5	1	2,874,642.82	1,244,057.53	6,918.15	TH	0.4			0.25
	1	2,874,594.40	1,244,269.50	6,919.50	RUBBER TRACK		0.5		0.25
	2	2,874,677.51	1,244,062.85	6,918.32	CB	0.5			0.25
	2	2,874,628.84	1,244,275.91	6,919.36	RUBBER TRACK		0.5		0.25
	3	2,874,714.37	1,244,058.63	6,919.24	TH	0.4			0.25
	3	2,874,663.61	1,244,280.88	6,919.10	RUBBER TRACK		0.5		0.25
	4	2,874,750.91	1,244,055.83	6,920.15	CB3	0.6668			0.25
	4	2,874,697.85	1,244,288.12	6,919.04	RUBBER TRACK		0.5		0.25
	5	2,874,786.94	1,244,055.26	6,920.92	TH	0.4			0.25
	5	2,874,732.74	1,244,292.57	6,918.74	RUBBER TRACK		0.5		0.25
	6	2,874,822.58	1,244,056.44	6,921.56	TH	0.4			0.25
	6	2,874,767.27	1,244,298.57	6,918.58	RUBBER TRACK		0.5		0.25
	7	2,874,831.90	1,244,057.24	6,921.69	TH	0.4			0.25
	7	2,874,807.58	1,244,302.70	6,918.23	RUBBER TRACK		0.5		0.25
	8	2,874,867.34	1,244,054.51	6,922.14	TH	0.4			0.25
	8	2,874,842.47	1,244,305.47	6,918.12	RUBBER TRACK		0.5		0.25
	9	2,874,880.18	1,244,055.94	6,921.72	TH	0.4			0.25
	9	2,874,881.62	1,244,306.17	6,917.84	RUBBER TRACK		0.5		0.25
	10	2,874,915.20	1,244,059.02	6,920.95	TH	0.4			0.25
	10	2,874,916.64	1,244,309.45	6,917.79	RUBBER TRACK		0.5		0.25
	11	2,874,950.22	1,244,062.96	6,920.23	TH	0.4			0.25

CB = Crane Basket
TH = Track Hoe mounted drill
TH* = Track Hoe assembled off train car
FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
COUNTY LINE Section 5 (continued)	11	2,874,951.69	1,244,317.81	6,918.16	RUBBER TRACK		0.5		0.25
	12	2,874,985.24	1,244,067.12	6,919.49	TH	0.4			0.25
	12	2,874,986.74	1,244,327.61	6,918.71	RUBBER TRACK		0.5		0.25
	13	2,875,020.27	1,244,071.98	6,918.71	TH	0.4			0.25
	13	2,875,021.80	1,244,338.05	6,919.40	CB		0.5		0.25
	14	2,875,055.32	1,244,081.81	6,917.51	FOOT	0.5			0.25
	14	2,875,056.82	1,244,341.21	6,919.42	CB		0.5		0.25
	15	2,875,090.32	1,244,080.55	6,917.29	RUBBER TRACK	1			0.25
	15	2,875,091.52	1,244,290.37	6,914.98	RUBBER TIRE		0.5		0.25
	16	2,875,125.35	1,244,086.64	6,916.46	RUBBER TRACK	1			0.25
	16	2,875,126.54	1,244,292.76	6,914.84	RUBBER TIRE		0.5		0.25
	17	2,875,160.41	1,244,097.16	6,915.32	RUBBER TRACK	1			0.25
	17	2,875,161.51	1,244,288.88	6,914.29	RUBBER TIRE		0.5		0.25
	18	2,875,195.59	1,244,127.76	6,913.08	FOOT	0.5			0.25
	18	2,875,196.54	1,244,293.49	6,914.29	RUBBER TIRE		0.5		0.25
	G1	2,874,518.15	1,244,246.59	6,915.88	RUBBER TRACK		0.5		0.25
	G2	2,875,276.26	1,244,309.50	6,916.48	FOOT		0.5		0.25
	G3	2,875,234.16	1,244,130.33	6,911.59	FOOT	0.5			0.25
	G4	2,874,581.89	1,244,054.37	6,915.46	TH	0.4			0.25
Total						**10.4668**	**10**	**20.4668**	**10**

COUNTY LINE Section 6	1	2,875,362.82	1,244,139.72	6,914.43	FOOT	0.5			0.25
	1	2,875,339.41	1,244,336.19	6,915.43	FOOT		0.5		0.25
	2	2,875,396.98	1,244,148.88	6,913.76	FOOT	0.5			0.25
	2	2,875,373.27	1,244,347.79	6,915.67	FOOT		0.5		0.25
	3	2,875,432.86	1,244,143.57	6,914.03	FOOT	0.5			0.25
	3	2,875,407.68	1,244,354.86	6,915.56	FOOT		0.5		0.25
	4	2,875,468.77	1,244,137.96	6,914.39	FOOT	0.5			0.25
	4	2,875,442.58	1,244,357.75	6,915.11	FOOT		0.5		0.25
	5	2,875,505.39	1,244,126.45	6,915.32	FOOT	0.5			0.25
	5	2,875,477.44	1,244,360.98	6,914.69	FOOT		0.5		0.25
	6	2,875,540.57	1,244,127.04	6,915.29	FOOT	0.5			0.25
	6	2,875,514.86	1,244,342.69	6,912.68	FOOT		0.5		0.25
	7	2,875,575.62	1,244,128.63	6,915.18	FOOT	0.5			0.25
	7	2,875,547.76	1,244,362.43	6,913.45	FOOT		0.5		0.25
	8	2,875,610.27	1,244,133.66	6,914.75	FOOT	0.5			0.25
	8	2,875,581.14	1,244,378.11	6,914.04	FOOT		0.5		0.25
	9	2,875,643.94	1,244,146.89	6,913.60	FOOT	0.5			0.25
	9	2,875,613.60	1,244,401.41	6,915.46	TH		0.4		0.25
	10	2,875,675.79	1,244,175.36	6,911.41	FOOT	0.5			0.25
	10	2,875,648.56	1,244,403.81	6,914.94	TH		0.4		0.25

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RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
	G1	2,875,276.26	1,244,309.50	6,916.48	FOOT		0.5		0.25
	G2	2,875,732.80	1,244,390.79	6,908.66	TH		0.4		0.25
	G3	2,875,747.84	1,244,175.99	6,908.53	FOOT	0.5			0.25
	G4	2,875,312.20	1,244,146.55	6,912.66	FOOT	0.5			0.25
Total						**6**	**5.7**	**11.7**	**6**
TUNNEL Section 1	1	2,891,325.12	1,233,448.28	6,797.54	CB3	0.6668			0.25
	1	2,891,494.75	1,233,530.15	6,790.16	RUBBER TIRE		0.5		0.25
	2	2,891,340.95	1,233,417.06	6,797.31	CB3	0.6668			0.25
	2	2,891,509.95	1,233,498.62	6,790.00	RUBBER TIRE		0.5		0.25
	3	2,891,362.78	1,233,378.85	6,797.54	CB3	0.6668			0.25
	3	2,891,515.06	1,233,492.75	6,790.02	RUBBER TIRE		0.5		0.25
	4	2,891,383.75	1,233,350.83	6,797.55	CB3	0.6668			0.25
	4	2,891,537.50	1,233,465.82	6,789.89	RUBBER TIRE		0.5		0.25
	5	2,891,412.12	1,233,322.10	6,797.21	TH	0.4			0.25
	5	2,891,550.72	1,233,451.76	6,789.85	RUBBER TIRE		0.5		0.25
	6	2,891,437.19	1,233,297.63	6,796.98	TH	0.4			0.25
	6	2,891,575.52	1,233,427.03	6,789.83	RUBBER TIRE		0.5		0.25
	7	2,891,462.56	1,233,273.44	6,796.70	TH	0.4			0.25
	7	2,891,601.28	1,233,403.20	6,789.84	RUBBER TIRE		0.5		0.25
	8	2,891,490.86	1,233,246.35	6,796.64	TH	0.4			0.25
	8	2,891,618.71	1,233,390.40	6,789.92	RUBBER TIRE		0.5		0.25
	9	2,891,516.41	1,233,222.40	6,796.68	TH	0.4			0.25
	9	2,891,647.03	1,233,369.58	6,790.03	RUBBER TIRE		0.5		0.25
	10	2,891,542.02	1,233,198.54	6,796.77	TH	0.4			0.25
	10	2,891,677.05	1,233,350.68	6,790.25	RUBBER TIRE		0.5		0.25
	11	2,891,567.74	1,233,174.79	6,796.90	TH	0.4			0.25
	11	2,891,713.39	1,233,338.90	6,790.97	RUBBER TIRE		0.5		0.25
	12	2,891,602.38	1,233,150.50	6,796.56	CB3	0.6668			0.25
	12	2,891,722.75	1,233,340.20	6,791.37	RUBBER TIRE		0.5		0.25
	13	2,891,638.41	1,233,141.96	6,795.27	CB3	0.6668			0.25
	13	2,891,751.13	1,233,319.61	6,791.14	RUBBER TIRE		0.5		0.25
	14	2,891,658.92	1,233,108.95	6,796.85	CB3	0.6668			0.25
	14	2,891,779.02	1,233,298.24	6,790.87	RUBBER TIRE		0.5		0.25
	15	2,891,686.30	1,233,086.77	6,797.19	CB3	0.6668			0.25
	15	2,891,808.43	1,233,279.25	6,790.75	RUBBER TIRE		0.5		0.25
	16	2,891,712.73	1,233,063.10	6,797.73	TH	0.4			0.25
	16	2,891,837.76	1,233,260.16	6,790.62	RUBBER TIRE		0.5		0.25

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RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
TUNNEL Section 1 (continued)	17	2,891,741.50	1,233,043.12	6,797.79	TH	0.4			0.25
	17	2,891,868.58	1,233,243.41	6,790.64	RUBBER TIRE		0.5		0.25
	G1	2,891,461.15	1,233,607.97	6,787.04	RUBBER TIRE		0.5		0.25
	G2	2,891,923.26	1,233,172.66	6,785.51	RUBBER TIRE		0.5		0.25
	G3	2,891,809.77	1,233,003.24	6,794.02	CB3	0.6668			0.25
	G4	2,891,300.39	1,233,508.57	6,795.11	CB3	0.6668			0.25
Total						**10.268**	**9.5**	**19.768**	**9.5**
TUNNEL Section 2	1	2,892,061.25	1,232,899.09	6,784.01	CB3	0.6668			0.25
	1	2,892,152.74	1,233,053.39	6,783.49	RUBBER TRACK		0.5		0.25
	2	2,892,091.63	1,232,881.71	6,783.82	CB3	0.6668			0.25
	2	2,892,185.05	1,233,039.24	6,783.61	RUBBER TRACK		0.5		0.25
	3	2,892,123.16	1,232,866.26	6,783.47	CB3	0.6668			0.25
	3	2,892,207.19	1,233,007.96	6,782.54	RUBBER TRACK		0.5		0.25
	4	2,892,156.67	1,232,854.14	6,782.90	CB3	0.6668			0.25
	4	2,892,245.73	1,233,004.34	6,783.36	RUBBER TRACK		0.5		0.25
	5	2,892,190.79	1,232,843.06	6,782.36	CB3	0.6668			0.25
	5	2,892,276.69	1,232,987.93	6,783.20	RUBBER TRACK		0.5		0.25
	6	2,892,231.19	1,232,832.81	6,781.84	CB3	0.6668			0.25
	6	2,892,289.80	1,232,981.54	6,783.03	RUBBER TRACK		0.5		0.25
	7	2,892,265.38	1,232,824.11	6,781.50	CB3	0.6668			0.25
	7	2,892,328.21	1,232,983.55	6,783.84	RUBBER TRACK		0.5		0.25
	8	2,892,306.82	1,232,814.59	6,781.47	CB3	0.6668			0.25
	8	2,892,328.21	1,232,983.55	6,783.84	RUBBER TRACK		0.5		0.25
	9	2,892,341.40	1,232,809.12	6,781.46	TH	0.4			0.25
	9	2,892,363.41	1,232,982.87	6,783.42	RUBBER TRACK		0.5		0.25
	10	2,892,382.83	1,232,807.22	6,781.27	TH	0.4			0.25
	10	2,892,370.67	1,232,983.57	6,783.36	RUBBER TRACK		0.5		0.25
	11	2,892,417.74	1,232,809.81	6,780.83	TH	0.4			0.25
	11	2,892,405.47	1,232,987.64	6,782.60	RUBBER TRACK		0.5		0.25
	12	2,892,454.24	1,232,820.39	6,780.04	CB3	0.6668			0.25
	12	2,892,421.60	1,232,987.21	6,782.14	RUBBER TRACK		0.5		0.25
	13	2,892,486.74	1,232,836.58	6,779.33	CB3	0.6668			0.25
	13	2,892,457.04	1,232,988.34	6,781.28	RUBBER TRACK		0.5		0.25
	14	2,892,520.48	1,232,851.31	6,778.91	CB3	0.6668			0.25
	14	2,892,476.14	1,232,990.35	6,780.90	RUBBER TRACK		0.5		0.25
	15	2,892,553.89	1,232,861.73	6,778.74	CB3	0.6668			0.25

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RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
TUNNEL Section 2 (continued)	15	2,892,509.69	1,233,000.35	6,780.54	RUBBER TRACK		0.5		0.25
	16	2,892,588.63	1,232,872.77	6,778.67	TH	0.4			0.25
	16	2,892,528.69	1,233,005.25	6,780.20	RUBBER TRACK		0.5		0.25
	17	2,892,621.15	1,232,885.80	6,778.54	TH	0.4			0.25
	17	2,892,558.12	1,233,025.12	6,780.29	RUBBER TRACK		0.5		0.25
	18	2,892,655.42	1,232,900.93	6,778.53	TH	0.4			0.25
	18	2,892,570.64	1,233,037.21	6,780.36	RUBBER TRACK		0.5		0.25
	19	2,892,686.86	1,232,916.65	6,778.46	TH	0.4			0.25
	19	2,892,594.81	1,233,064.62	6,780.90	RUBBER TRACK		0.5		0.25
	20	2,892,716.92	1,232,934.59	6,778.27	CB3	0.6668			0.25
	20	2,892,617.01	1,233,095.18	6,781.83	RUBBER TRACK		0.5		0.25
	21	2,892,747.25	1,232,952.10	6,778.11	CB3	0.6668			0.25
	21	2,892,650.91	1,233,106.96	6,780.95	CB3		0.6668		0.25
	22	2,892,776.19	1,232,971.83	6,777.82	CB3	0.6668			0.25
	22	2,892,682.64	1,233,122.21	6,780.43	CB3		0.6668		0.25
	G1	2,892,101.63	1,233,069.11	6,781.41	RUBBER TRACK		0.5		0.25
	G2	2,892,751.11	1,233,135.43	6,775.98	FOOT		0.5		0.25
	G3	2,892,828.89	1,232,997.82	6,775.79	CB3	0.6668			0.25
	G4	2,892,006.40	1,232,941.40	6,781.25	FOOT	0.5			0.25
Total						**13.9688**	**12.3336**	**26.3024**	**12**
TUNNEL Section 3	1	2,892,857.22	1,232,997.97	6,780.04	TH	0.4			0.25
	1	2,892,811.41	1,233,194.81	6,781.36	CB3		0.6668		0.25
	2	2,892,896.71	1,233,004.79	6,780.17	TH	0.4			0.25
	2	2,892,849.27	1,233,208.58	6,781.73	CB3		0.6668		0.25
	3	2,892,937.75	1,233,004.92	6,780.80	TH	0.4			0.25
	3	2,892,893.57	1,233,194.71	6,779.98	CB3		0.6668		0.25
	G1	2,892,792.99	1,233,160.27	6,778.77	CB2		0.5		0.25
	G2	2,892,937.81	1,233,216.99	6,779.26	TH		0.4		0.25
	G3	2,892,950.19	1,233,090.69	6,767.79	FOOT	0.5			0.25
	G4	2,892,806.32	1,233,049.41	6,765.85	FOOT	0.5			0.25
Total						**2.2**	**2.9004**	**5.1004**	**2.5**
TUNNEL Section 4	1	2,893,129.42	1,233,067.68	6,774.06	RUBBER TRACK	0.5			0.25
	1	2,893,119.95	1,233,233.55	6,772.13	CB		0.5		0.25
	2	2,893,149.56	1,233,065.82	6,774.07	RUBBER TRACK	0.5			0.25
	2	2,893,140.05	1,233,232.43	6,772.07	CB		0.5		0.25
	3	2,893,143.82	1,233,065.16	6,774.17	RUBBER TRACK	0.5			0.25
	3	2,893,160.86	1,233,228.65	6,771.96	CB		0.5		0.25
	4	2,893,164.62	1,233,071.79	6,773.39	RUBBER TRACK	0.5			0.25
	4	2,893,180.50	1,233,224.10	6,771.85	CB		0.5		0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
TUNNEL Section 4 (continued)	5	2,893,159.99	1,233,070.34	6,773.57	RUBBER TRACK	0.5			0.25
	5	2,893,200.54	1,233,219.87	6,771.88	CB		0.5		0.25
	6	2,893,181.30	1,233,072.54	6,772.91	RUBBER TRACK	0.5			0.25
	6	2,893,220.16	1,233,215.78	6,771.92	CB		0.5		0.25
	7	2,893,178.62	1,233,073.74	6,772.92	RUBBER TRACK	0.5			0.25
	7	2,893,241.26	1,233,211.84	6,772.12	CB3		0.6668		0.25
	8	2,893,197.71	1,233,067.40	6,772.50	CB	0.5			0.25
	8	2,893,261.95	1,233,209.04	6,772.40	RUBBER TRACK		0.5		0.25
	9	2,893,195.46	1,233,068.15	6,772.56	RUBBER TRACK	0.5			0.25
	9	2,893,284.07	1,233,201.42	6,772.71	CB		0.5		0.25
	10	2,893,216.42	1,233,063.56	6,771.97	RUBBER TRACK	0.5			0.25
	10	2,893,299.40	1,233,188.36	6,772.56	CB		0.5		0.25
	11	2,893,215.60	1,233,063.89	6,771.98	RUBBER TRACK	0.5			0.25
	11	2,893,315.36	1,233,171.45	6,772.25	CB		0.5		0.25
	12	2,893,231.41	1,233,051.53	6,771.71	RUBBER TRACK	0.5			0.25
	12	2,893,328.73	1,233,156.46	6,772.16	CB		0.5		0.25
	13	2,893,231.21	1,233,051.77	6,771.71	RUBBER TRACK	0.5			0.25
	13	2,893,346.08	1,233,141.31	6,772.25	CB		0.5		0.25
	14	2,893,244.60	1,233,036.86	6,771.43	RUBBER TRACK	0.5			0.25
	14	2,893,356.08	1,233,123.75	6,772.10	CB3		0.6668		0.25
	15	2,893,244.72	1,233,036.71	6,771.43	RUBBER TRACK	0.5			0.25
	15	2,893,367.76	1,233,104.11	6,772.00	CB3		0.6668		0.25
	16	2,893,253.75	1,233,018.85	6,771.26	RUBBER TRACK	0.5			0.25
	16	2,893,377.00	1,233,086.37	6,772.00	CB3		0.6668		0.25
	17	2,893,254.83	1,233,016.59	6,771.24	RUBBER TRACK	0.5			0.25
	17	2,893,385.03	1,233,065.27	6,771.87	CB3		0.6668		0.25
	18	2,893,263.85	1,232,998.62	6,771.02	RUBBER TRACK	0.5			0.25
	18	2,893,390.71	1,233,046.04	6,771.73	CB3		0.6668		0.25
	19	2,893,269.58	1,232,986.78	6,770.89	RUBBER TRACK	0.5			0.25
	19	2,893,396.14	1,233,025.77	6,771.59	CB3		0.6668		0.25
	20	2,893,276.22	1,232,967.90	6,770.77	RUBBER TRACK	0.5			0.25
	20	2,893,399.84	1,233,005.98	6,771.38	CB3		0.6668		0.25
	21	2,893,280.49	1,232,955.37	6,770.70	RUBBER TRACK	0.5			0.25
	21	2,893,404.19	1,232,985.64	6,771.20	CB3		0.6668		0.25
	22	2,893,298.79	1,232,930.02	6,770.19	RUBBER TRACK	0.5			0.25
	22	2,893,412.55	1,232,950.86	6,770.99	CB3		0.6668		0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
TUNNEL Section 4 (continued)	23	2,893,304.14	1,232,900.64	6,770.17	RUBBER TRACK	0.5			0.25
	23	2,893,419.19	1,232,915.76	6,770.71	RUBBER TIRE		0.5		0.25
	24	2,893,302.50	1,232,870.55	6,770.31	RUBBER TRACK	0.5			0.25
	24	2,893,427.56	1,232,880.60	6,770.66	RUBBER TIRE		0.5		0.25
	25	2,893,300.96	1,232,835.31	6,770.44	RUBBER TRACK	0.5			0.25
	25	2,893,437.87	1,232,846.31	6,770.73	RUBBER TIRE		0.5		0.25
	26	2,893,299.35	1,232,812.37	6,770.58	RUBBER TRACK	0.5			0.25
	26	2,893,426.55	1,232,808.66	6,769.80	RUBBER TIRE		0.5		0.25
	27	2,893,295.16	1,232,777.48	6,770.91	RUBBER TRACK	0.5			0.25
	27	2,893,436.88	1,232,773.34	6,769.87	RUBBER TIRE		0.5		0.25
	28	2,893,290.01	1,232,754.41	6,771.32	RUBBER TRACK	0.5			0.25
	28	2,893,420.76	1,232,737.31	6,768.96	RUBBER TIRE		0.5		0.25
	29	2,893,283.29	1,232,719.99	6,771.88	RUBBER TRACK	0.5			0.25
	29	2,893,415.43	1,232,702.70	6,768.60	RUBBER TIRE		0.5		0.25
	30	2,893,276.58	1,232,682.68	6,772.15	FOOT	0.5			0.25
	30	2,893,413.77	1,232,680.02	6,768.45	RUBBER TIRE		0.5		0.25
	31	2,893,279.12	1,232,647.62	6,771.72	FOOT	0.5			0.25
	31	2,893,422.43	1,232,644.84	6,768.49	RUBBER TIRE		0.5		0.25
	32	2,893,283.55	1,232,612.53	6,771.09	FOOT	0.5			0.25
	32	2,893,421.44	1,232,609.86	6,768.22	RUBBER TIRE		0.5		0.25
	33	2,893,281.87	1,232,577.55	6,770.83	FOOT	0.5			0.25
	33	2,893,422.23	1,232,574.84	6,767.93	RUBBER TIRE		0.5		0.25
	34	2,893,278.22	1,232,542.62	6,770.86	FOOT	0.5			0.25
	34	2,893,436.03	1,232,539.56	6,768.23	RUBBER TIRE		0.5		0.25
	35	2,893,282.80	1,232,506.81	6,770.35	FOOT	0.5			0.25
	35	2,893,434.90	1,232,509.46	6,768.01	RUBBER TIRE		0.5		0.25
	36	2,893,282.76	1,232,471.80	6,770.24	FOOT	0.5			0.25
	36	2,893,434.53	1,232,474.45	6,767.81	RUBBER TIRE		0.5		0.25
	37	2,893,285.55	1,232,435.68	6,769.96	FOOT	0.5			0.25
	37	2,893,434.99	1,232,447.28	6,767.77	RUBBER TIRE		0.5		0.25
	38	2,893,281.46	1,232,400.26	6,770.17	FOOT	0.5			0.25
	38	2,893,438.21	1,232,412.43	6,767.83	RUBBER TIRE		0.5		0.25
	39	2,893,299.90	1,232,365.82	6,768.92	FOOT	0.5			0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
TUNNEL Section 4 (continued)	39	2,893,438.70	1,232,385.03	6,767.80	RUBBER TIRE		0.5		0.25
	40	2,893,299.96	1,232,330.50	6,768.84	FOOT	0.5			0.25
	40	2,893,442.90	1,232,350.28	6,767.93	RUBBER TIRE		0.5		0.25
	41	2,893,294.21	1,232,292.53	6,769.29	FOOT	0.5			0.25
	41	2,893,445.22	1,232,322.75	6,767.92	RUBBER TIRE		0.5		0.25
	42	2,893,300.87	1,232,258.17	6,769.24	FOOT	0.5			0.25
	42	2,893,449.20	1,232,287.85	6,767.69	RUBBER TIRE		0.5		0.25
	43	2,893,307.07	1,232,221.64	6,769.35	FOOT	0.5			0.25
	43	2,893,458.33	1,232,261.48	6,767.74	RUBBER TIRE		0.5		0.25
	44	2,893,319.93	1,232,188.83	6,769.06	FOOT	0.5			0.25
	44	2,893,460.14	1,232,225.77	6,767.32	RUBBER TIRE		0.5		0.25
	45	2,893,332.50	1,232,154.17	6,768.88	FOOT	0.5			0.25
	45	2,893,463.38	1,232,197.19	6,767.05	RUBBER TIRE		0.5		0.25
	46	2,893,336.69	1,232,118.70	6,769.24	CB	0.5			0.25
	46	2,893,491.82	1,232,169.70	6,767.75	RUBBER TIRE		0.5		0.25
	G1	2,893,073.00	1,233,235.80	6,771.28	CB3		0.6668		0.25
	G2	2,893,487.80	1,232,127.66	6,756.19	CB3		0.6668		0.25
	G3	2,893,362.04	1,232,065.81	6,766.68	CB3	0.6668			0.25
	G4	2,893,105.60	1,233,131.15	6,770.69	FOOT	0.5			0.25
Total						**24.1668**	**26.0016**	**50.1684**	**24**
VALLIE BRIDGE Section 1	1	2,917,120.73	1,210,565.03	6,588.96	TH	0.4			0.25
	1	2,917,280.20	1,210,784.93	6,581.21	RUBBER TRACK		0.5		0.25
	2	2,917,147.19	1,210,541.90	6,590.34	TH	0.4			0.25
	2	2,917,273.05	1,210,715.45	6,579.36	RUBBER TRACK		0.5		0.25
	3	2,917,174.82	1,210,520.39	6,591.01	TH	0.4			0.25
	3	2,917,292.84	1,210,683.13	6,579.60	RUBBER TRACK		0.5		0.25
	4	2,917,204.08	1,210,501.12	6,589.90	TH	0.4			0.25
	4	2,917,365.47	1,210,723.65	6,581.81	RUBBER TRACK		0.5		0.25
	5	2,917,233.22	1,210,481.68	6,589.37	TH	0.4			0.25
	5	2,917,386.93	1,210,693.63	6,580.70	RUBBER TRACK		0.5		0.25
	6	2,917,262.89	1,210,462.98	6,588.73	TH	0.4			0.25
	6	2,917,412.26	1,210,668.93	6,580.05	RUBBER TRACK		0.5		0.25
	7	2,917,294.48	1,210,446.92	6,586.86	CB3	0.6668			0.25
	7	2,917,429.52	1,210,633.11	6,577.92	RUBBER TRACK		0.5		0.25
	8	2,917,325.83	1,210,430.53	6,584.53	CB3	0.6668			0.25
	8	2,917,434.65	1,210,580.58	6,575.06	RUBBER TRACK		0.5		0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
VALLIE BRIDGE Section 1 (continued)	9	2,917,354.01	1,210,409.77	6,582.85	CB3	0.6668			0.25
	9	2,917,464.47	1,210,562.08	6,573.39	RUBBER TRACK		0.5		0.25
	G1	2,917,180.80	1,210,751.06	6,574.25	RUBBER TRACK		0.5		0.25
	G2	2,917,490.24	1,210,519.42	6,557.92	RUBBER TRACK		0.5		0.25
	G3	2,917,403.50	1,210,394.41	6,567.89	CB3	0.6668			0.25
	G4	2,917,064.27	1,210,617.85	6,582.62	CB3	0.6668			0.25
Total						**5.734**	**5.5**	**11.234**	**5.5**

VALLIE BRIDGE Section 2	1	2,917,381.83	1,210,363.16	6,590.80	CB3	0.6668			0.25
	1	2,917,572.33	1,210,532.34	6,578.75	RUBBER TRACK		0.5		0.25
	2	2,917,406.24	1,210,338.03	6,589.63	CB3	0.6668			0.25
	2	2,917,594.43	1,210,505.16	6,577.72	RUBBER TRACK		0.5		0.25
	3	2,917,431.03	1,210,313.23	6,588.38	CB3	0.6668			0.25
	3	2,917,616.05	1,210,477.55	6,576.67	RUBBER TRACK		0.5		0.25
	4	2,917,455.72	1,210,288.35	6,587.16	CB3	0.6668			0.25
	4	2,917,642.13	1,210,453.90	6,575.87	RUBBER TRACK		0.5		0.25
	5	2,917,479.31	1,210,262.49	6,586.14	CB3	0.6668			0.25
	5	2,917,666.97	1,210,429.16	6,575.00	RUBBER TRACK		0.5		0.25
	6	2,917,503.86	1,210,237.49	6,584.08	CB3	0.6668			0.25
	6	2,917,688.08	1,210,401.09	6,574.18	RUBBER TRACK		0.5		0.25
	7	2,917,526.96	1,210,211.19	6,582.56	CB3	0.6668			0.25
	7	2,917,698.87	1,210,363.87	6,573.19	RUBBER TRACK		0.5		0.25
	8	2,917,549.40	1,210,184.31	6,580.90	CB3	0.6668			0.25
	8	2,917,724.94	1,210,340.21	6,573.33	RUBBER TRACK		0.5		0.25
	9	2,917,570.95	1,210,156.64	6,579.42	CB3	0.6668			0.25
	9	2,917,754.05	1,210,319.25	6,573.82	RUBBER TRACK		0.5		0.25
	10	2,917,593.56	1,210,129.91	6,577.86	CB3	0.6668			0.25
	10	2,917,776.20	1,210,292.11	6,574.03	RUBBER TRACK		0.5		0.25
	11	2,917,616.27	1,210,103.27	6,576.43	CB3	0.6668			0.25
	11	2,917,801.74	1,210,267.99	6,574.67	RUBBER TRACK		0.5		0.25
	12	2,917,639.41	1,210,077.01	6,575.10	CB3	0.6668			0.25
	12	2,917,826.33	1,210,243.01	6,575.39	RUBBER TRACK		0.5		0.25
	13	2,917,662.48	1,210,050.69	6,573.90	TH	0.4			0.25
	13	2,917,854.49	1,210,221.22	6,576.67	RUBBER TRACK		0.5		0.25
	14	2,917,685.40	1,210,024.23	6,572.84	TH	0.4			0.25
	14	2,917,881.79	1,210,198.65	6,577.97	RUBBER TRACK		0.5		0.25
	15	2,917,708.22	1,209,997.69	6,571.85	TH	0.4			0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
VALLIE BRIDGE Section 2 (cont)	15	2,917,858.77	1,210,131.40	6,573.10	FOOT		0.5		0.25
	G1	2,917,500.22	1,210,537.55	6,566.81	RUBBER TRACK		0.5		0.25
	G2	2,917,888.81	1,210,094.09	6,560.07	FOOT		0.5		0.25
	G3	2,917,782.81	1,209,962.69	6,551.99	CB3	0.6668			0.25
	G4	2,917,376.52	1,210,425.64	6,565.23	CB3	0.6668			0.25
Total						**10.5352**	**8.5**	**19.0352**	**8.5**
VALLIE BRIDGE Section 3	1	2,917,784.54	1,209,911.81	6,567.61	TH	0.4			0.25
	1	2,917,937.49	1,210,050.32	6,568.66	FOOT		0.5		0.25
	2	2,917,813.69	1,209,890.99	6,567.06	TH	0.4			0.25
	2	2,917,969.62	1,210,032.19	6,569.57	FOOT		0.5		0.25
	3	2,917,838.93	1,209,866.63	6,566.86	TH	0.4			0.25
	3	2,917,988.13	1,210,001.74	6,568.95	FOOT		0.5		0.25
	4	2,917,865.77	1,209,843.72	6,566.54	TH	0.4			0.25
	4	2,918,002.49	1,209,967.52	6,567.95	FOOT		0.5		0.25
	5	2,917,892.56	1,209,820.76	6,566.23	TH	0.4			0.25
	5	2,918,013.63	1,209,930.39	6,566.77	FOOT		0.5		0.25
	6	2,917,918.81	1,209,797.31	6,565.98	TH	0.4			0.25
	6	2,918,035.13	1,209,902.65	6,566.56	FOOT		0.5		0.25
	7	2,917,943.85	1,209,772.77	6,565.82	TH	0.4			0.25
	7	2,918,064.35	1,209,881.89	6,566.98	FOOT		0.5		0.25
	8	2,917,968.10	1,209,747.51	6,565.72	TH	0.4			0.25
	8	2,918,148.87	1,209,911.20	6,574.69	TH		0.4		0.25
	9	2,917,992.23	1,209,722.15	6,565.62	TH	0.4			0.25
	9	2,918,170.71	1,209,883.76	6,574.36	TH		0.4		0.25
	10	2,918,016.75	1,209,697.13	6,565.50	TH	0.4			0.25
	10	2,918,155.43	1,209,822.71	6,568.90	FOOT		0.5		0.25
	11	2,918,041.28	1,209,672.13	6,565.38	TH	0.4			0.25
	11	2,918,181.30	1,209,798.92	6,569.13	FOOT		0.5		0.25
	12	2,918,065.70	1,209,647.03	6,565.27	TH	0.4			0.25
	12	2,918,203.60	1,209,771.89	6,568.93	FOOT		0.5		0.25
	13	2,918,090.18	1,209,621.97	6,565.16	TH	0.4			0.25
	13	2,918,228.07	1,209,746.84	6,569.00	FOOT		0.5		0.25
	14	2,918,114.57	1,209,596.84	6,565.05	TH	0.4			0.25
	14	2,918,239.31	1,209,709.80	6,567.60	FOOT		0.5		0.25
	G1	2,917,888.81	1,210,094.09	6,560.07	FOOT		0		0
	G2	2,918,336.38	1,209,655.31	6,565.25	TH		0.4		0.25
	G3	2,918,151.83	1,209,561.18	6,563.23	CB2	0.5			0.25
	G4	2,917,762.28	1,209,983.20	6,551.80	CB3	0.6668			0.25
Total						**6.7668**	**7.2**	**13.9668**	**7.75**
VALLIE BRIDGE Section 4	1	2,918,206.57	1,209,487.66	6,568.35	TH	0.4			0.25
	1	2,918,353.97	1,209,637.34	6,564.59	TH		0.4		0.25
	2	2,918,230.39	1,209,461.97	6,568.53	TH	0.4			0.25
	2	2,918,383.04	1,209,616.97	6,564.96	TH		0.4		0.25
	3	2,918,255.38	1,209,437.47	6,568.55	TH	0.4			0.25
	3	2,918,405.77	1,209,590.17	6,564.79	TH		0.4		0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
VALLIE BRIDGE Section 4 (continued)	4	2,918,280.39	1,209,412.98	6,568.57	TH	0.4			0.25
	4	2,918,429.13	1,209,564.01	6,564.69	TH		0.4		0.25
	5	2,918,304.46	1,209,387.54	6,568.72	TH	0.4			0.25
	5	2,918,452.38	1,209,537.74	6,564.58	TH		0.4		0.25
	6	2,918,328.47	1,209,362.04	6,568.88	TH	0.4			0.25
	6	2,918,474.81	1,209,510.63	6,564.41	TH		0.4		0.25
	7	2,918,352.64	1,209,336.70	6,569.01	TH	0.4			0.25
	7	2,918,497.63	1,209,483.93	6,564.28	TH		0.4		0.25
	8	2,918,376.91	1,209,311.47	6,569.14	TH	0.4			0.25
	8	2,918,520.40	1,209,457.17	6,564.15	TH		0.4		0.25
	9	2,918,401.39	1,209,286.44	6,569.23	CB3	0.6668			0.25
	9	2,918,543.43	1,209,430.68	6,564.04	TH		0.4		0.25
	10	2,918,426.55	1,209,262.11	6,569.23	CB3	0.6668			0.25
	10	2,918,566.32	1,209,404.04	6,563.94	TH		0.4		0.25
	11	2,918,451.70	1,209,237.76	6,569.23	CB3	0.6668			0.25
	11	2,918,588.79	1,209,376.97	6,563.81	TH		0.4		0.25
	12	2,918,477.03	1,209,213.61	6,569.21	CB3	0.6668			0.25
	12	2,918,612.06	1,209,350.72	6,563.74	TH		0.4		0.25
	13	2,918,501.67	1,209,188.75	6,569.28	CB3	0.6668			0.25
	13	2,918,635.17	1,209,324.30	6,563.66	TH		0.4		0.25
	14	2,918,524.65	1,209,162.20	6,569.59	CB3	0.6668			0.25
	14	2,918,658.13	1,209,297.74	6,563.58	TH		0.4		0.25
	15	2,918,547.94	1,209,135.97	6,569.85	CB3	0.6668			0.25
	15	2,918,680.85	1,209,270.93	6,563.50	TH		0.4		0.25
	16	2,918,571.45	1,209,109.97	6,570.09	CB3	0.6668			0.25
	16	2,918,703.61	1,209,244.16	6,563.42	TH		0.4		0.25
	17	2,918,594.98	1,209,083.98	6,570.33	CB3	0.6668			0.25
	17	2,918,726.89	1,209,217.92	6,563.37	TH		0.4		0.25
	G1	2,918,285.77	1,209,687.94	6,560.34	CB3		0.6668		0.25
	G2	2,918,756.46	1,209,177.15	6,561.69	TH		0.4		0.25
	G3	2,918,650.20	1,209,029.45	6,567.30	CB3	0.6668			0.25
	G4	2,918,172.41	1,209,531.00	6,565.93	CB3	0.6668			0.25
Total						**10.5348**	**7.8668**	**18.4016**	**9.5**

TEXAS CREEK Section 1	1	2,978,573.97	1,212,839.55	6,163.04	CB2	0.5			0.25
	1	2,978,360.18	1,212,900.86	6,172.18	FOOT		0.5		0.25
	2	2,978,587.82	1,212,871.99	6,162.96	CB2	0.5			0.25
	2	2,978,363.62	1,212,936.29	6,172.71	CB3		0.6668		0.25
	3	2,978,593.82	1,212,906.68	6,162.55	CB2	0.5			0.25
	3	2,978,363.84	1,212,972.63	6,173.71	CB3		0.6668		0.25
	4	2,978,612.37	1,212,937.77	6,162.69	CB	0.5			0.25
	4	2,978,375.29	1,213,005.76	6,173.21	CB3		0.6668		0.25
	5	2,978,621.64	1,212,971.52	6,162.42	CB	0.5			0.25
	5	2,978,388.75	1,213,038.31	6,172.44	CB3		0.6668		0.25
	6	2,978,627.71	1,213,006.19	6,162.00	CB	0.5			0.25
	6	2,978,407.05	1,213,069.47	6,171.06	CB3		0.6668		0.25
	7	2,978,637.27	1,213,039.86	6,161.74	CB	0.5			0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
TEXAS CREEK Section 1 (continued)	7	2,978,416.47	1,213,103.18	6,170.84	CB3		0.6668		0.25
	8	2,978,647.66	1,213,073.29	6,161.52	CB3	0.6668			0.25
	8	2,978,424.70	1,213,137.23	6,170.76	CB3		0.6668		0.25
	9	2,978,655.98	1,213,107.31	6,161.21	CB3	0.6668			0.25
	9	2,978,442.69	1,213,168.48	6,169.47	CB3		0.6668		0.25
	10	2,978,663.74	1,213,141.50	6,160.87	CB3	0.6668			0.25
	10	2,978,456.37	1,213,200.97	6,168.73	CB3		0.6668		0.25
	11	2,978,669.31	1,213,176.31	6,160.45	CB3	0.6668			0.25
	11	2,978,466.92	1,213,234.35	6,168.37	CB3		0.6668		0.25
	12	2,978,678.83	1,213,209.99	6,160.19	CB3	0.6668			0.25
	12	2,978,473.61	1,213,268.85	6,168.46	CB3		0.6668		0.25
	13	2,978,690.26	1,213,243.12	6,160.01	CB3	0.6668			0.25
	13	2,978,470.05	1,213,306.28	6,169.84	CB3		0.6668		0.25
	14	2,978,702.09	1,213,276.14	6,159.84	TH	0.4			0.25
	14	2,978,462.01	1,213,344.99	6,172.00	CB3		0.6668		0.25
	15	2,978,708.37	1,213,310.75	6,159.45	TH	0.4			0.25
	15	2,978,467.78	1,213,379.75	6,172.30	CB3		0.6668		0.25
	16	2,978,710.52	1,213,346.54	6,158.93	TH	0.4			0.25
	16	2,978,476.12	1,213,413.77	6,172.23	CB3		0.6668		0.25
	17	2,978,714.47	1,213,381.82	6,158.49	TH	0.4			0.25
	17	2,978,484.49	1,213,447.78	6,172.16	CB3		0.6668		0.25
	18	2,978,718.86	1,213,416.97	6,158.10	CB2	0.5			0.25
	18	2,978,494.11	1,213,481.43	6,171.91	TH		0.4		0.25
	19	2,978,724.64	1,213,451.73	6,157.75	CB2	0.5			0.25
	19	2,978,503.74	1,213,515.08	6,171.66	TH		0.4		0.25
	20	2,978,730.60	1,213,486.43	6,157.42	CB2	0.5			0.25
	20	2,978,516.80	1,213,547.74	6,170.90	TH		0.4		0.25
	G1	2,978,346.26	1,212,831.67	6,169.39	FOOT		0.5		0.25
	G2	2,978,538.25	1,213,635.42	6,176.34	TH		0.4		0.25
	G3	2,978,736.20	1,213,535.59	6,155.48	CB3	0.6668			0.25
	G4	2,978,542.44	1,212,773.33	6,160.40	CB3	0.6668			0.25
Total						**11.9344**	**13.2688**	**25.2032**	**11**
TEXAS CREEK Section 2	1	2,978,749.20	1,213,579.01	6,156.90	TH	0.4			0.25
	1	2,978,584.45	1,213,677.10	6,163.50	CB3		0.6668		0.25
	2	2,978,756.81	1,213,615.22	6,156.05	TH	0.4			0.25
	2	2,978,599.20	1,213,709.05	6,163.39	CB3		0.6668		0.25
	3	2,978,766.19	1,213,650.37	6,155.35	TH	0.4			0.25
	3	2,978,616.21	1,213,739.66	6,163.01	CB3		0.6668		0.25
	4	2,978,781.13	1,213,682.21	6,154.81	TH	0.4			0.25
	4	2,978,634.34	1,213,769.60	6,162.49	CB3		0.6668		0.25
	5	2,978,796.88	1,213,713.56	6,154.28	TH	0.4			0.25
	5	2,978,651.99	1,213,799.83	6,162.02	CB3		0.6668		0.25
	6	2,978,812.99	1,213,744.70	6,153.77	TH	0.4			0.25
	6	2,978,671.54	1,213,828.92	6,161.33	CB3		0.6668		0.25
	7	2,978,827.84	1,213,776.60	6,153.24	TH	0.4			0.25
	7	2,978,691.88	1,213,857.54	6,160.54	CB3		0.6668		0.25

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RUBBER TRACK = Rubber track drill
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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
TEXAS CREEK Section 2 (cont)	8	2,978,846.29	1,213,806.34	6,152.76	TH	0.4			0.25
	8	2,978,712.35	1,213,886.09	6,159.74	CB3		0.6668		0.25
	G1	2,978,538.25	1,213,635.42	6,176.34	TH		0		0
	G2	2,978,738.55	1,213,922.75	6,157.47	CB3		0.6668		0.25
	G3	2,978,884.19	1,213,856.30	6,151.65	TH	0.4			0.25
	G4	2,978,688.68	1,213,557.80	6,143.08	FOOT	0.5			0.25
Total						**4.1**	**6.0012**	**10.1012**	**4.75**
TEXAS CREEK Section 3	1	2,978,869.92	1,213,844.60	6,150.94	TH	0.4			0.25
	1	2,978,744.28	1,213,933.46	6,158.33	CB3		0.6668		0.25
	2	2,978,890.79	1,213,872.71	6,150.52	TH	0.4			0.25
	2	2,978,765.74	1,213,961.15	6,157.74	CB3		0.6668		0.25
	3	2,978,914.38	1,213,898.89	6,150.12	TH	0.4			0.25
	3	2,978,787.83	1,213,988.40	6,157.07	CB3		0.6668		0.25
	4	2,978,936.87	1,213,925.86	6,149.73	TH	0.4			0.25
	4	2,978,807.71	1,214,017.20	6,156.67	CB3		0.6668		0.25
	5	2,978,957.96	1,213,953.81	6,149.31	TH	0.4			0.25
	5	2,978,828.55	1,214,045.34	6,156.16	CB3		0.6668		0.25
	6	2,978,978.47	1,213,982.17	6,148.88	TH	0.4			0.25
	6	2,978,849.46	1,214,073.42	6,155.64	CB3		0.6668		0.25
	7	2,978,998.92	1,214,010.58	6,148.45	TH	0.4			0.25
	7	2,978,869.17	1,214,102.35	6,155.26	CB3		0.6668		0.25
	8	2,979,019.17	1,214,039.12	6,148.02	TH	0.4			0.25
	8	2,978,888.78	1,214,131.35	6,154.90	CB3		0.6668		0.25
	9	2,979,039.60	1,214,067.54	6,147.60	CB3	0.6668			0.25
	9	2,978,908.51	1,214,160.26	6,154.52	CB3		0.6668		0.25
	10	2,979,060.05	1,214,095.95	6,147.17	TH	0.4			0.25
	10	2,978,927.96	1,214,189.38	6,154.18	CB3		0.6668		0.25
	11	2,979,079.87	1,214,124.80	6,146.73	TH	0.4			0.25
	11	2,978,947.31	1,214,218.56	6,153.85	CB3		0.6668		0.25
	12	2,979,097.97	1,214,154.87	6,146.27	TH	0.4			0.25
	12	2,978,966.64	1,214,247.75	6,153.52	CB3		0.6668		0.25
	13	2,979,115.22	1,214,185.53	6,145.80	TH	0.4			0.25
	13	2,978,985.77	1,214,277.10	6,153.22	CB3		0.6668		0.25
	14	2,979,132.92	1,214,215.89	6,145.34	TH	0.4			0.25
	14	2,979,004.95	1,214,306.40	6,152.92	CB3		0.6668		0.25
	15	2,979,150.45	1,214,246.36	6,144.89	TH	0.4			0.25
	15	2,979,025.68	1,214,334.60	6,152.41	CB3		0.6668		0.25
	G1	2,978,712.35	1,213,886.09	6,159.74	CB3		0		0
	G2	2,979,060.69	1,214,375.16	6,149.01	CB3		0.6668		0.25
	G3	2,979,166.89	1,214,278.52	6,143.53	TH	0.4			0.25
	G4	2,978,846.29	1,213,806.34	6,152.76	TH	0			0
Total						**6.6668**	**10.6688**	**17.3356**	**8**

CB = Crane Basket
TH = Track Hoe mounted drill
TH* = Track Hoe assembled off train car
FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
TEXAS CREEK Section 4	1	2,979,181.95	1,214,301.02	6,143.95	CB3	0.6668			0.25
	1	2,979,060.69	1,214,375.16	6,149.01	CB3		0.6668		0.25
	2	2,979,199.72	1,214,331.17	6,143.78	CB3	0.6668			0.25
	2	2,979,080.46	1,214,404.10	6,148.70	CB3		0.6668		0.25
	3	2,979,217.01	1,214,361.62	6,143.60	CB3	0.6668			0.25
	3	2,979,097.18	1,214,434.90	6,148.69	CB3		0.6668		0.25
	4	2,979,233.74	1,214,392.42	6,143.42	CB3	0.6668			0.25
	4	2,979,116.40	1,214,464.17	6,148.44	CB3		0.6668		0.25
	5	2,979,250.98	1,214,422.89	6,143.25	CB3	0.6668			0.25
	5	2,979,135.98	1,214,493.22	6,148.14	CB3		0.6668		0.25
	6	2,979,268.09	1,214,453.45	6,143.07	CB3	0.6668			0.25
	6	2,979,156.06	1,214,521.96	6,147.80	CB3		0.6668		0.25
	7	2,979,286.47	1,214,483.24	6,142.91	CB3	0.6668			0.25
	7	2,979,175.45	1,214,551.13	6,147.53	CB3		0.6668		0.25
	G1	2,979,025.68	1,214,334.60	6,152.41	CB3		0		0
	G2	2,979,199.29	1,214,599.86	6,151.69	CB3		0.6668		0.25
	G3	2,979,303.26	1,214,515.33	6,141.81	TH	0.4			0.25
	G4	2,979,157.97	1,214,266.48	6,142.96	TH	0.4			0.25
Total						**5.4676**	**5.3344**	**10.802**	**4.25**

TEXAS CREEK Section 5	1	2,979,320.52	1,214,526.67	6,146.04	TH	0.4			0.25
	1	2,979,199.29	1,214,599.86	6,151.69	CB3		0		0
	2	2,979,339.59	1,214,556.04	6,145.99	TH	0.4			0.25
	2	2,979,219.41	1,214,628.60	6,151.41	CB3		0.6668		0.25
	3	2,979,358.74	1,214,585.37	6,145.94	TH	0.4			0.25
	3	2,979,240.06	1,214,657.01	6,151.08	CB3		0.6668		0.25
	4	2,979,376.80	1,214,615.35	6,145.87	TH	0.4			0.25
	4	2,979,261.04	1,214,685.23	6,150.73	CB3		0.6668		0.25
	5	2,979,394.59	1,214,645.49	6,145.80	TH	0.4			0.25
	5	2,979,281.70	1,214,713.65	6,150.41	CB3		0.6668		0.25
	6	2,979,412.03	1,214,675.84	6,145.73	TH	0.4			0.25
	6	2,979,302.09	1,214,742.22	6,150.13	CB3		0.6668		0.25
	7	2,979,430.53	1,214,705.56	6,145.67	TH	0.4			0.25
	7	2,979,320.52	1,214,771.97	6,150.03	CB3		0.6668		0.25
	8	2,979,445.95	1,214,737.13	6,145.57	TH	0.4			0.25
	8	2,979,339.44	1,214,801.44	6,149.89	CB3		0.6668		0.25
	9	2,979,465.19	1,214,766.40	6,145.52	TH	0.4			0.25
	9	2,979,359.82	1,214,830.02	6,149.62	CB3		0.6668		0.25
	10	2,979,485.04	1,214,795.30	6,145.48	TH	0.4			0.25
	10	2,979,380.08	1,214,858.67	6,149.36	CB3		0.6668		0.25
	11	2,979,492.96	1,214,808.29	6,145.08	TH	0.4			0.25
	11	2,979,402.77	1,214,889.72	6,149.03	CB3		0.6668		0.25
	12	2,979,513.08	1,214,837.29	6,144.26	CB3	0.6668			0.25
	12	2,979,424.75	1,214,917.03	6,148.50	CB3		0.6668		0.25
	13	2,979,534.01	1,214,865.54	6,143.49	CB2	0.5			0.25
	13	2,979,447.83	1,214,943.35	6,147.78	CB3		0.6668		0.25
	14	2,979,556.00	1,214,892.84	6,142.73	CB2	0.5			0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
TEXAS CREEK Section 5 (continued)	14	2,979,471.13	1,214,969.47	6,147.04	CB3		0.6668		0.25
	15	2,979,579.56	1,214,918.73	6,141.97	TH	0.4			0.25
	15	2,979,494.14	1,214,995.84	6,146.33	CB3		0.6668		0.25
	G1	2,979,175.45	1,214,551.13	6,147.53	CB3		0		0
	G2	2,979,523.52	1,215,022.10	6,144.12	CB2		0.5		0.25
	G3	2,979,606.22	1,214,945.40	6,143.17	TH	0.4			0.25
	G4	2,979,296.11	1,214,495.74	6,145.04	TH	0.4			0.25
Total						**7.2668**	**9.8352**	**17.102**	**8**
TEXAS CREEK Section 6	1	2,979,638.07	1,214,970.08	6,145.51	TH	0.4			0.25
	1	2,979,537.43	1,215,051.24	6,149.64	CB3		0.6668		0.25
	2	2,979,659.50	1,214,997.76	6,145.17	TH	0.4			0.25
	2	2,979,565.89	1,215,073.25	6,148.68	CB		0.5		0.25
	3	2,979,681.53	1,215,024.95	6,144.83	TH	0.4			0.25
	3	2,979,581.92	1,215,105.29	6,148.91	CB3		0.6668		0.25
	4	2,979,704.89	1,215,051.08	6,144.51	TH	0.4			0.25
	4	2,979,601.48	1,215,134.48	6,148.81	CB		0.5		0.25
	5	2,979,727.72	1,215,077.63	6,144.19	TH	0.4			0.25
	5	2,979,624.00	1,215,161.28	6,148.41	CB3		0.6668		0.25
	6	2,979,750.42	1,215,104.29	6,143.87	CB2	0.5			0.25
	6	2,979,647.37	1,215,187.39	6,147.92	CB3		0.6668		0.25
	7	2,979,773.74	1,215,130.44	6,143.56	CB2	0.5			0.25
	7	2,979,670.94	1,215,213.35	6,147.43	CB3		0.6668		0.25
	8	2,979,796.91	1,215,156.72	6,143.25	CB2	0.5			0.25
	8	2,979,694.06	1,215,239.67	6,146.97	CB3		0.6668		0.25
	9	2,979,820.27	1,215,182.85	6,142.94	CB2	0.5			0.25
	9	2,979,717.10	1,215,266.05	6,146.53	CB3		0.6668		0.25
	G1	2,979,503.61	1,215,013.35	6,148.79	CB3		0.6668		0.25
	G2	2,979,744.63	1,215,294.07	6,144.84	CB3		0.6668		0.25
	G3	2,979,854.64	1,215,219.86	6,143.34	CB2	0.5			0.25
	G4	2,979,606.22	1,214,945.40	6,143.17	TH	0			0
Total						**4.5**	**7.0012**	**11.5012**	**5.25**
TEXAS CREEK Section 7	1	2,979,890.74	1,215,253.85	6,145.47	CB	0.5			0.25
	1	2,979,784.02	1,215,356.06	6,149.93	TH		0.4		0.25
	2	2,979,912.60	1,215,281.38	6,144.98	CB	0.5			0.25
	2	2,979,807.16	1,215,382.37	6,149.64	TH		0.4		0.25
	3	2,979,935.35	1,215,308.05	6,144.52	CB	0.5			0.25
	3	2,979,830.25	1,215,408.72	6,149.35	TH		0.4		0.25
	4	2,979,958.98	1,215,333.89	6,144.09	CB	0.5			0.25
	4	2,979,854.27	1,215,434.17	6,148.95	TH		0.4		0.25
	5	2,979,982.70	1,215,359.63	6,143.66	CB	0.5			0.25
	5	2,979,878.44	1,215,459.49	6,148.53	TH		0.4		0.25
	6	2,980,006.58	1,215,385.22	6,143.23	CB	0.5			0.25
	6	2,979,897.44	1,215,489.76	6,148.75	TH		0.4		0.25
	7	2,980,030.52	1,215,410.76	6,142.81	CB	0.5			0.25
	7	2,979,918.57	1,215,517.98	6,148.72	TH		0.4		0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
TEXAS CREEK Section 7 (continued)	8	2,980,054.51	1,215,436.25	6,142.38	CB	0.5			0.25
	8	2,979,940.57	1,215,545.37	6,148.58	TH		0.4		0.25
	9	2,980,078.41	1,215,461.82	6,141.96	CB	0.5			0.25
	9	2,979,962.78	1,215,572.57	6,148.43	TH		0.4		0.25
	10	2,980,102.20	1,215,487.50	6,141.53	CB	0.5			0.25
	10	2,979,985.20	1,215,599.55	6,148.25	TH		0.4		0.25
	11	2,980,126.25	1,215,512.93	6,141.11	CB	0.5			0.25
	11	2,980,007.64	1,215,626.53	6,148.08	TH		0.4		0.25
	12	2,980,151.60	1,215,537.11	6,140.71	CB	0.5			0.25
	12	2,980,029.85	1,215,653.72	6,147.94	TH		0.4		0.25
	13	2,980,177.04	1,215,561.21	6,140.32	CB3	0.6668			0.25
	13	2,980,052.85	1,215,680.16	6,147.70	TH		0.4		0.25
	14	2,980,202.86	1,215,584.94	6,139.95	CB3	0.6668			0.25
	14	2,980,078.45	1,215,704.10	6,147.08	CB		0.5		0.25
	15	2,980,227.16	1,215,610.13	6,139.53	CB3	0.6668			0.25
	15	2,980,102.72	1,215,729.31	6,146.65	CB		0.5		0.25
	16	2,980,247.31	1,215,639.29	6,139.01	CB3	0.6668			0.25
	16	2,980,134.65	1,215,747.20	6,145.17	CB		0.5		0.25
	17	2,980,270.33	1,215,665.71	6,138.57	RUBBER TIRE	0.5			0.25
	17	2,980,158.06	1,215,773.24	6,144.86	CB		0.5		0.25
	G1	2,979,754.34	1,215,316.77	6,148.59	CB3		0.6668		0.25
	G2	2,980,208.47	1,215,822.69	6,141.15	CB2		0.5		0.25
	G3	2,980,289.74	1,215,692.29	6,137.34	CB3	0.6668			0.25
	G4	2,979,854.64	1,215,219.86	6,143.34	CB2	0			0
Total						**9.834**	**8.3668**	**18.2008**	**9.25**

TEXAS CREEK Section 8	1	2,980,346.15	1,215,742.31	6,142.27	TH	0.4			0.25
	1	2,980,225.98	1,215,845.04	6,142.67	TH		0.4		0.25
	2	2,980,372.95	1,215,765.44	6,142.56	TH	0.4			0.25
	2	2,980,255.05	1,215,866.24	6,142.20	TH		0.4		0.25
	3	2,980,399.68	1,215,788.63	6,142.87	TH	0.4			0.25
	3	2,980,285.63	1,215,886.14	6,141.69	TH		0.4		0.25
	4	2,980,409.40	1,215,803.21	6,142.74	TH	0.4			0.25
	4	2,980,320.12	1,215,905.71	6,141.13	TH		0.4		0.25
	5	2,980,432.69	1,215,829.75	6,142.17	CB3	0.6668			0.25
	5	2,980,351.15	1,215,923.38	6,141.06	TH		0.4		0.25
	6	2,980,439.89	1,215,836.64	6,141.82	CB3	0.6668			0.25
	6	2,980,384.78	1,215,941.34	6,141.05	TH		0.4		0.25
	7	2,980,469.19	1,215,856.13	6,141.56	CB3	0.6668			0.25
	7	2,980,417.22	1,215,954.85	6,140.94	TH		0.4		0.25
	8	2,980,490.19	1,215,870.69	6,141.30	CB3	0.6668			0.25
	8	2,980,450.97	1,215,968.08	6,140.86	TH		0.4		0.25
	9	2,980,521.46	1,215,886.75	6,141.08	CB3	0.6668			0.25
	9	2,980,483.96	1,215,979.86	6,140.81	TH		0.4		0.25
	10	2,980,547.00	1,215,891.61	6,141.17	CB3	0.6668			0.25
	10	2,980,518.49	1,215,990.32	6,140.76	TH		0.4		0.25

CB = Crane Basket
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FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
TEXAS CREEK Section 8 (continued)	11	2,980,581.68	1,215,897.67	6,141.24	CB3	0.6668			0.25
	11	2,980,552.85	1,215,997.51	6,140.67	TH		0.4		0.25
	12	2,980,606.23	1,215,904.18	6,141.15	CB3	0.6668			0.25
	12	2,980,588.01	1,216,004.65	6,140.63	TH		0.4		0.25
	13	2,980,639.69	1,215,915.83	6,140.85	CB3	0.6668			0.25
	13	2,980,622.56	1,216,010.31	6,140.60	TH		0.4		0.25
	14	2,980,666.14	1,215,912.91	6,141.04	CB3	0.6668			0.25
	14	2,980,658.30	1,216,013.63	6,140.55	TH		0.4		0.25
	15	2,980,701.29	1,215,912.32	6,141.09	CB3	0.6668			0.25
	15	2,980,693.40	1,216,013.69	6,140.46	TH		0.4		0.25
	16	2,980,726.65	1,215,912.82	6,141.04	CB3	0.6668			0.25
	16	2,980,729.06	1,216,013.17	6,140.40	TH		0.4		0.25
	17	2,980,761.76	1,215,917.06	6,140.76	CB3	0.6668			0.25
	17	2,980,764.05	1,216,012.61	6,140.40	TH		0.4		0.25
	18	2,980,787.81	1,215,915.77	6,140.68	CB3	0.6668			0.25
	18	2,980,799.77	1,216,010.43	6,140.40	TH		0.4		0.25
	19	2,980,820.41	1,215,894.63	6,141.31	CB3	0.6668			0.25
	19	2,980,834.54	1,216,006.38	6,140.40	TH		0.4		0.25
	20	2,980,841.09	1,215,875.25	6,142.08	CB3	0.6668			0.25
	20	2,980,870.40	1,216,001.85	6,140.45	TH		0.4		0.25
	G1	2,980,178.16	1,215,784.16	6,139.43	CB3		0.6668		0.25
	G2	2,980,907.30	1,215,990.03	6,139.39	TH		0.4		0.25
	G3	2,980,880.90	1,215,891.57	6,139.95	RUBBER TRACK	0.5			0.25
	G4	2,980,315.04	1,215,711.73	6,140.87	CB3	0.6668			0.25
Total						**13.4356**	**9.0668**	**22.5024**	**11**
MAYTAG Section 1	1	2,983,428.23	1,215,877.42	6,144.23	TH	0.4			0.25
	1	2,983,371.34	1,216,037.91	6,125.89	TH		0.4		0.25
	2	2,983,457.71	1,215,898.96	6,144.52	TH	0.4			0.25
	2	2,983,403.25	1,216,052.60	6,126.29	TH		0.4		0.25
	3	2,983,471.75	1,215,964.06	6,137.82	CB3	0.6668			0.25
	3	2,983,435.73	1,216,065.67	6,126.38	TH		0.4		0.25
	4	2,983,503.29	1,215,979.78	6,137.38	CB3	0.6668			0.25
	4	2,983,468.34	1,216,078.37	6,126.28	TH		0.4		0.25
	5	2,983,532.10	1,215,990.98	6,137.04	CB3	0.6668			0.25
	5	2,983,502.70	1,216,089.45	6,126.14	TH		0.4		0.25
	6	2,983,566.01	1,215,999.74	6,136.76	CB3	0.6668			0.25
	6	2,983,536.50	1,216,098.59	6,125.90	TH		0.4		0.25
	7	2,983,595.46	1,216,004.18	6,136.93	CB3	0.6668			0.25
	7	2,983,572.30	1,216,105.38	6,125.81	TH		0.4		0.25
	8	2,983,631.12	1,216,005.26	6,137.55	CB3	0.6668			0.25
	8	2,983,606.99	1,216,110.69	6,125.75	TH		0.4		0.25
	9	2,983,652.88	1,216,001.15	6,138.35	CB3	0.6668			0.25
	9	2,983,644.57	1,216,115.97	6,125.46	TH		0.4		0.25
	10	2,983,687.76	1,216,004.08	6,138.10	CB3	0.6668			0.25
	10	2,983,679.29	1,216,121.08	6,125.10	TH		0.4		0.25
	11	2,983,722.73	1,216,005.80	6,138.01	CB3	0.6668			0.25

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FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
MAYTAG Section 1 (continued)	11	2,983,713.95	1,216,127.12	6,124.65	TH		0.4		0.25
	12	2,983,757.97	1,216,003.68	6,138.43	CB3	0.6668			0.25
	12	2,983,748.44	1,216,135.42	6,123.98	TH		0.4		0.25
	13	2,983,795.19	1,215,999.11	6,138.81	RUBBER TRACK	0.5			0.25
	13	2,983,779.63	1,216,140.00	6,123.44	TH		0.4		0.25
	14	2,983,829.24	1,216,009.59	6,136.70	RUBBER TRACK	0.5			0.25
	14	2,983,814.60	1,216,142.21	6,122.93	TH		0.4		0.25
	15	2,983,872.21	1,215,990.34	6,137.15	RUBBER TRACK	0.5			0.25
	15	2,983,841.95	1,216,145.16	6,122.33	TH		0.4		0.25
	16	2,983,916.01	1,215,948.73	6,140.35	RUBBER TRACK	0.5			0.25
	16	2,983,876.71	1,216,149.78	6,121.34	TH		0.4		0.25
	17	2,983,953.14	1,215,941.21	6,138.96	RUBBER TRACK	0.5			0.25
	17	2,983,911.68	1,216,153.32	6,120.50	TH		0.4		0.25
	18	2,983,989.36	1,215,938.36	6,136.94	RUBBER TRACK	0.5			0.25
	18	2,983,946.46	1,216,157.81	6,119.63	TH		0.4		0.25
	19	2,984,025.06	1,215,938.16	6,134.65	RUBBER TRACK	0.5			0.25
	19	2,983,980.91	1,216,164.04	6,118.92	TH		0.4		0.25
	G1	2,983,349.34	1,216,023.57	6,124.91	TH		0.4		0.25
	G2	2,984,014.60	1,216,167.76	6,116.88	TH		0.4		0.25
	G3	2,984,104.08	1,216,010.53	6,117.37	RUBBER TRACK	1			0.25
	G4	2,983,358.36	1,215,891.22	6,120.67	FOOT	0.5			0.25
Total						**12.468**	**8.4**	**20.868**	**10.5**

MAYTAG Section 2	1	2,984,672.15	1,216,531.46	6,137.13	TH	0.4			0.25
	1	2,984,519.00	1,216,602.24	6,118.74	TH		0.4		0.25
	2	2,984,684.31	1,216,564.39	6,136.48	TH	0.4			0.25
	2	2,984,534.30	1,216,633.72	6,118.60	TH		0.4		0.25
	3	2,984,697.20	1,216,596.99	6,135.98	TH	0.4			0.25
	3	2,984,548.67	1,216,665.63	6,118.41	TH		0.4		0.25
	4	2,984,680.00	1,216,643.50	6,130.34	FOOT	0.5			0.25
	4	2,984,564.06	1,216,697.08	6,118.18	TH		0.4		0.25
	5	2,984,702.92	1,216,671.46	6,131.37	FOOT	0.5			0.25
	5	2,984,579.33	1,216,728.58	6,117.94	TH		0.4		0.25
	6	2,984,703.55	1,216,709.73	6,128.98	FOOT	0.5			0.25
	6	2,984,593.42	1,216,760.62	6,117.70	TH		0.4		0.25
	7	2,984,720.76	1,216,740.33	6,129.27	FOOT	0.5			0.25
	7	2,984,607.08	1,216,792.86	6,117.56	TH		0.4		0.25
	8	2,984,747.14	1,216,766.69	6,131.04	FOOT	0.5			0.25
	8	2,984,621.83	1,216,824.61	6,117.49	TH		0.4		0.25
	9	2,984,772.11	1,216,793.71	6,132.68	CB3	0.6668			0.25
	9	2,984,636.50	1,216,856.38	6,117.42	TH		0.4		0.25
	10	2,984,786.66	1,216,825.54	6,132.58	CB3	0.6668			0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
MAYTAG Section 2 (continued)	10	2,984,650.19	1,216,888.61	6,117.30	TH		0.4		0.25
	11	2,984,798.14	1,216,844.35	6,132.90	CB3	0.6668			0.25
	11	2,984,667.18	1,216,927.23	6,117.16	TH		0.4		0.25
	12	2,984,812.37	1,216,876.77	6,132.69	CB3	0.6668			0.25
	12	2,984,682.29	1,216,959.09	6,117.09	TH		0.4		0.25
	13	2,984,814.34	1,216,916.17	6,130.37	CB3	0.6668			0.25
	13	2,984,699.00	1,216,990.59	6,117.11	TH		0.4		0.25
	14	2,984,841.30	1,216,940.43	6,132.44	CB3	0.6668			0.25
	14	2,984,715.92	1,217,021.33	6,117.15	TH		0.4		0.25
	G1	2,984,507.82	1,216,571.83	6,118.26	TH		0.4		0.25
	G2	2,984,742.53	1,217,048.39	6,115.32	TH		0.4		0.25
	G3	2,984,823.24	1,216,984.44	6,114.99	CB3	1			0.25
	G4	2,984,631.77	1,216,456.67	6,131.20	TH	0.4			0.25
Total						**9.1008**	**6.4**	**15.5008**	**8**
MAYTAG Section 3	1	2,984,870.40	1,216,973.26	6,134.06	CB3	0.6668			0.25
	1	2,984,757.55	1,217,077.54	6,116.04	TH		0.4		0.25
	2	2,984,891.61	1,217,001.31	6,133.45	CB3	0.6668			0.25
	2	2,984,779.36	1,217,105.04	6,115.85	TH		0.4		0.25
	3	2,984,914.06	1,217,028.23	6,133.12	CB3	0.6668			0.25
	3	2,984,802.13	1,217,131.66	6,115.75	TH		0.4		0.25
	4	2,984,937.92	1,217,053.83	6,133.12	CB3	0.6668			0.25
	4	2,984,825.43	1,217,157.78	6,115.68	TH		0.4		0.25
	5	2,984,962.03	1,217,079.21	6,133.17	CB3	0.6668			0.25
	5	2,984,848.96	1,217,183.69	6,115.64	TH		0.4		0.25
	6	2,984,972.56	1,217,088.24	6,133.37	CB3	0.6668			0.25
	6	2,984,877.60	1,217,211.37	6,115.58	TH		0.4		0.25
	7	2,985,000.30	1,217,109.57	6,133.41	CB3	0.6668			0.25
	7	2,984,904.85	1,217,233.35	6,115.43	TH		0.4		0.25
	8	2,985,027.34	1,217,131.82	6,132.94	CB3	0.6668			0.25
	8	2,984,933.47	1,217,253.54	6,115.24	TH		0.4		0.25
	9	2,985,056.28	1,217,151.60	6,132.88	CB3	0.6668			0.25
	9	2,984,962.83	1,217,272.78	6,115.01	TH		0.4		0.25
	10	2,985,087.30	1,217,168.70	6,133.34	CB3	0.6668			0.25
	10	2,984,992.57	1,217,291.52	6,114.75	TH		0.4		0.25
	G1	2,984,742.53	1,217,048.39	6,115.32	TH		0		0
	G2	2,985,023.42	1,217,298.33	6,114.24	TH		0.4		0.25
	G3	2,985,148.47	1,217,212.17	6,126.42	CB3	0.6668			0.25
	G4	2,984,823.24	1,216,984.44	6,114.99	CB3	0			0.25
Total						**7.3348**	**4.4**	**11.7348**	**5.75**
THREE ROCKS Section 1	1	2,995,516.19	1,226,276.91	6,023.28	CB2	0.5			0.25
	1	2,995,436.78	1,226,346.38	6,021.65	TH		0.4		0.25
	2	2,995,535.00	1,226,306.96	6,022.81	CB	0.5			0.25
	2	2,995,460.88	1,226,371.81	6,021.43	TH		0.4		0.25
	3	2,995,554.75	1,226,336.18	6,022.42	CB3	0.6668			0.25
	3	2,995,486.13	1,226,396.21	6,021.19	TH		0.4		0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
THREE ROCKS Section 1 (continued)	4	2,995,578.94	1,226,361.52	6,022.30	CB	0.5			0.25
	4	2,995,512.57	1,226,419.59	6,020.93	TH		0.4		0.25
	5	2,995,610.22	1,226,380.66	6,022.67	TH	0.4			0.25
	5	2,995,539.01	1,226,442.96	6,020.68	TH		0.4		0.25
	G1	2,995,414.80	1,226,317.34	6,020.86	TH		0.4		0.25
	G2	2,995,556.29	1,226,455.27	6,020.11	TH		0.4		0.25
	G3	2,995,643.29	1,226,406.24	6,021.21	TH	0.4			0.25
	G4	2,995,490.83	1,226,239.69	6,022.54	TH	0.4			0.25
Total						**3.3668**	**2.8**	**6.1668**	**3.5**
THREE ROCKS Section 2	1	2,995,643.29	1,226,406.24	6,021.21	TH	0.4			0.25
	1	2,995,588.29	1,226,491.16	6,021.09	TH		0.4		0.25
	2	2,995,672.45	1,226,425.60	6,020.99	TH	0.4			0.25
	2	2,995,614.16	1,226,515.59	6,021.13	TH		0.4		0.25
	3	2,995,703.35	1,226,442.29	6,020.88	TH	0.4			0.25
	3	2,995,639.83	1,226,540.34	6,021.21	TH		0.4		0.25
	4	2,995,735.40	1,226,457.18	6,020.88	TH	0.4			0.25
	4	2,995,668.21	1,226,560.90	6,021.08	TH		0.4		0.25
	5	2,995,767.93	1,226,471.34	6,020.93	TH	0.4			0.25
	5	2,995,695.82	1,226,582.66	6,021.03	TH		0.4		0.25
	6	2,995,795.51	1,226,484.27	6,020.61	TH	0.4			0.25
	6	2,995,726.23	1,226,602.91	6,020.41	TH		0.4		0.25
	7	2,995,803.36	1,226,488.01	6,020.47	TH	0.4			0.25
	7	2,995,764.43	1,226,624.12	6,018.92	TH		0.4		0.25
	8	2,995,834.93	1,226,504.90	6,019.52	TH	0.4			0.25
	8	2,995,796.74	1,226,638.41	6,017.60	TH*		0.5		0.25
	9	2,995,866.74	1,226,520.94	6,018.63	TH	0.4			0.25
	9	2,995,833.63	1,226,636.71	6,015.93	TH*		0.5		0.25
	10	2,995,898.68	1,226,536.53	6,017.79	TH	0.4			0.25
	10	2,995,870.55	1,226,634.88	6,014.59	TH*		0.5		0.25
	11	2,995,930.24	1,226,553.45	6,016.86	TH	0.4			0.25
	11	2,995,904.73	1,226,642.63	6,013.49	TH*		0.5		0.25
	G1	2,995,572.02	1,226,472.09	6,020.50	TH		0.4		0.25
	G2	2,995,937.83	1,226,657.45	6,011.45	TH*		0.5		0.25
	G3	2,995,959.80	1,226,556.37	6,020.48	TH	0.4			0.25
	G4	2,995,610.22	1,226,380.66	6,022.67	TH	0.4			0.25
Total						**5.2**	**5.7**	**10.9**	**6.5**
THREE ROCKS Section 3	1	2,996,022.72	1,226,602.93	6,020.62	TH	0.4			0.25
	1	2,995,963.64	1,226,666.71	6,015.42	TH*		0.5		0.25
	2	2,996,048.46	1,226,626.64	6,020.29	TH	0.4			0.25
	2	2,995,993.44	1,226,686.04	6,015.27	TH*		0.5		0.25
	3	2,996,071.85	1,226,652.89	6,019.65	TH	0.4			0.25
	3	2,996,012.88	1,226,716.55	6,014.66	TH*		0.5		0.25
	4	2,996,099.27	1,226,674.79	6,019.54	TH	0.4			0.25
	4	2,996,038.89	1,226,739.98	6,014.34	TH*		0.5		0.25
	5	2,996,127.92	1,226,695.37	6,019.60	TH	0.4			0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
THREE ROCKS Section 3 (continued)	5	2,996,064.46	1,226,763.88	6,013.99	TH*		0.5		0.25
	6	2,996,154.85	1,226,717.79	6,019.53	TH	0.4			0.25
	6	2,996,092.42	1,226,785.19	6,013.84	TH*		0.5		0.25
	7	2,996,179.98	1,226,742.16	6,019.33	TH	0.4			0.25
	7	2,996,119.36	1,226,807.61	6,013.77	TH*		0.5		0.25
	8	2,996,205.56	1,226,766.04	6,019.20	TH	0.4			0.25
	8	2,996,117.58	1,226,861.03	6,013.00	TH		0.4		0.25
	9	2,996,231.16	1,226,789.90	6,019.02	TH	0.4			0.25
	9	2,996,150.12	1,226,877.40	6,012.88	TH		0.4		0.25
	10	2,996,256.32	1,226,814.25	6,018.62	TH	0.4			0.25
	10	2,996,179.62	1,226,897.05	6,012.63	TH		0.4		0.25
	11	2,996,281.73	1,226,838.32	6,018.16	TH	0.4			0.25
	11	2,996,206.95	1,226,919.05	6,012.23	TH		0.4		0.25
	12	2,996,307.08	1,226,862.45	6,017.69	TH	0.4			0.25
	12	2,996,235.30	1,226,939.94	6,011.87	TH		0.4		0.25
	13	2,996,332.92	1,226,886.05	6,017.29	TH	0.4			0.25
	13	2,996,264.09	1,226,960.37	6,011.53	TH		0.4		0.25
	14	2,996,357.99	1,226,910.49	6,016.78	TH	0.4			0.25
	14	2,996,293.78	1,226,979.81	6,011.24	TH		0.4		0.25
	15	2,996,384.02	1,226,933.89	6,016.40	TH	0.4			0.25
	15	2,996,322.97	1,226,999.80	6,010.95	TH		0.4		0.25
	16	2,996,411.44	1,226,955.78	6,016.22	CB	0.5			0.25
	16	2,996,351.88	1,227,020.09	6,010.67	TH		0.4		0.25
	G1	2,995,904.73	1,226,642.63	6,013.49	TH*		0.5		0.25
	G2	2,996,362.78	1,227,027.03	6,010.48	TH		0.4		0.25
	G3	2,996,460.23	1,226,976.40	6,024.72	CB2	0.5			0.25
	G4	2,996,001.41	1,226,585.54	6,020.58	TH	0.4			0.25
Total						**7.4**	**8**	**15.4**	**9**

THREE ROCKS Section 4	1	2,996,430.80	1,226,957.38	6,024.65	CB	0.5			0.25
	1	2,996,382.43	1,227,040.55	6,012.16	TH		0.4		0.25
	2	2,996,460.23	1,226,976.40	6,024.72	CB	0.5			0.25
	2	2,996,411.91	1,227,059.46	6,013.53	TH		0.4		0.25
	3	2,996,491.23	1,226,992.72	6,024.42	CB	0.5			0.25
	3	2,996,442.80	1,227,075.97	6,013.41	TH		0.4		0.25
	4	2,996,509.03	1,227,003.02	6,024.09	CB	0.5			0.25
	4	2,996,476.60	1,227,092.48	6,013.29	TH		0.4		0.25
	5	2,996,541.39	1,227,016.46	6,023.94	CB	0.5			0.25
	5	2,996,508.58	1,227,106.95	6,013.09	TH		0.4		0.25
	6	2,996,574.00	1,227,029.19	6,023.76	CB	0.5			0.25
	6	2,996,540.46	1,227,121.71	6,012.81	TH		0.4		0.25
	7	2,996,607.27	1,227,040.11	6,023.67	CB	0.5			0.25
	7	2,996,572.69	1,227,135.49	6,012.50	TH		0.4		0.25
	8	2,996,633.75	1,227,045.49	6,023.58	CB	0.5			0.25
	8	2,996,608.17	1,227,147.00	6,012.04	TH		0.4		0.25
	9	2,996,668.27	1,227,051.76	6,023.65	CB	0.5			0.25
	9	2,996,641.61	1,227,157.55	6,011.61	TH		0.4		0.25

CB = Crane Basket
TH = Track Hoe mounted drill
TH* = Track Hoe assembled off train car
FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
	G1	2,996,362.78	1,227,027.03	6,010.48	TH		0.4		0.25
	G2	2,996,671.41	1,227,155.39	6,009.58	TH		0.4		0.25
	G3	2,996,692.37	1,227,072.97	6,011.17	CB	0.5			0.25
	G4	2,996,384.02	1,226,933.89	6,016.40	TH	0.4			0.25
Total						**5.4**	**4.4**	**9.8**	**5.5**
THREE ROCKS Section 5	1	2,996,786.43	1,227,073.68	6,016.16	CB	0.5			0.25
	1	2,996,791.97	1,227,180.21	6,009.39	TH		0.4		0.25
	2	2,996,821.45	1,227,073.29	6,015.67	CB	0.5			0.25
	2	2,996,827.13	1,227,182.45	6,008.95	TH		0.4		0.25
	3	2,996,856.32	1,227,069.79	6,015.50	CB	0.5			0.25
	3	2,996,862.19	1,227,182.69	6,008.56	TH		0.4		0.25
	4	2,996,891.08	1,227,064.33	6,015.53	CB	0.5			0.25
	4	2,996,897.25	1,227,182.91	6,008.17	TH		0.4		0.25
	5	2,996,925.83	1,227,058.59	6,015.59	CB	0.5			0.25
	5	2,996,932.31	1,227,183.28	6,007.78	TH		0.4		0.25
	6	2,996,960.53	1,227,051.83	6,015.54	TH	0.4			0.25
	6	2,996,967.16	1,227,179.48	6,007.22	TH		0.4		0.25
	7	2,996,995.25	1,227,045.60	6,015.44	TH	0.4			0.25
	7	2,997,001.92	1,227,173.83	6,006.71	TH		0.4		0.25
	8	2,997,029.94	1,227,038.75	6,015.42	TH	0.4			0.25
	8	2,997,036.64	1,227,167.64	6,006.22	TH		0.4		0.25
	G1	2,996,765.16	1,227,175.39	6,009.24	TH		0.4		0.25
	G2	2,997,064.64	1,227,161.45	6,005.23	TH		0.4		0.25
	G3	2,997,104.14	1,227,027.71	6,009.80	CB	0.5			0.25
	G4	2,996,742.77	1,227,072.48	6,015.72	CB	0.5			0.25
Total						**4.7**	**4**	**8.7**	**5**
THREE ROCKS Section 6	1	2,997,104.14	1,227,027.71	6,009.80	CB	0			0
	1	2,997,129.48	1,227,153.46	6,005.18	TH		0.4		0.25
	2	2,997,138.50	1,227,021.07	6,009.53	TH	0.4			0.25
	2	2,997,163.61	1,227,145.68	6,004.92	TH		0.4		0.25
	3	2,997,172.93	1,227,014.74	6,009.23	TH	0.4			0.25
	3	2,997,197.54	1,227,136.87	6,004.65	TH		0.4		0.25
	4	2,997,207.20	1,227,007.65	6,008.99	TH	0.4			0.25
	4	2,997,231.66	1,227,129.02	6,004.39	TH		0.4		0.25
	5	2,997,241.52	1,227,000.75	6,008.74	TH	0.4			0.25
	5	2,997,266.13	1,227,122.92	6,004.15	TH		0.4		0.25
	6	2,997,275.84	1,226,993.93	6,008.48	TH	0.4			0.25
	6	2,997,300.03	1,227,113.96	6,003.89	TH		0.4		0.25
	7	2,997,310.26	1,226,987.53	6,008.19	TH	0.4			0.25
	7	2,997,334.10	1,227,105.89	6,003.63	TH		0.4		0.25
	8	2,997,344.63	1,226,980.92	6,007.92	TH	0.4			0.25
	8	2,997,368.27	1,227,098.28	6,003.38	TH		0.4		0.25
	9	2,997,378.99	1,226,974.28	6,007.64	TH	0.4			0.25
	9	2,997,402.52	1,227,091.06	6,003.12	TH		0.4		0.25
	10	2,997,413.60	1,226,968.83	6,007.27	TH	0.4			0.25

CB = Crane Basket
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FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
THREE ROCKS Section 6 (continued)	10	2,997,436.68	1,227,083.37	6,002.87	TH		0.4		0.25
	11	2,997,448.32	1,226,963.97	6,006.86	TH	0.4			0.25
	11	2,997,470.64	1,227,074.76	6,002.62	TH		0.4		0.25
	12	2,997,482.90	1,226,958.39	6,006.50	TH	0.4			0.25
	12	2,997,504.72	1,227,066.67	6,002.37	TH		0.4		0.25
	13	2,997,517.46	1,226,952.75	6,006.15	TH	0.4			0.25
	13	2,997,538.93	1,227,059.29	6,002.12	TH		0.4		0.25
	14	2,997,551.93	1,226,946.61	6,005.84	TH	0.4			0.25
	14	2,997,573.07	1,227,051.54	6,001.87	TH		0.4		0.25
	15	2,997,586.30	1,226,940.00	6,005.57	TH	0.4			0.25
	15	2,997,607.09	1,227,043.20	6,001.62	TH		0.4		0.25
	16	2,997,620.98	1,226,934.94	6,005.22	TH	0.4			0.25
	16	2,997,641.33	1,227,035.94	6,001.40	TH		0.4		0.25
	17	2,997,655.95	1,226,931.29	6,004.83	TH	0.4			0.25
	17	2,997,676.03	1,227,030.93	6,001.26	TH		0.4		0.25
	18	2,997,690.64	1,226,926.26	6,004.55	TH	0.4			0.25
	18	2,997,709.67	1,227,020.69	6,001.12	TH		0.4		0.25
	19	2,997,724.84	1,226,918.82	6,004.40	TH	0.4			0.25
	19	2,997,743.57	1,227,011.77	6,000.92	TH		0.4		0.25
	20	2,997,758.79	1,226,910.07	6,004.34	TH	0.4			0.25
	20	2,997,777.54	1,227,003.16	6,000.73	TH		0.4		0.25
	21	2,997,792.31	1,226,899.27	6,004.41	TH	0.4			0.25
	21	2,997,811.64	1,226,995.19	6,000.54	TH		0.4		0.25
	22	2,997,818.06	1,226,889.80	6,004.46	TH	0.4			0.25
	22	2,997,846.42	1,226,987.24	6,000.34	TH		0.4		0.25
	23	2,997,852.81	1,226,883.96	6,003.86	TH	0.4			0.25
	23	2,997,880.61	1,226,979.47	6,000.14	TH		0.4		0.25
	24	2,997,884.77	1,226,879.88	6,003.25	TH	0.4			0.25
	24	2,997,915.35	1,226,971.68	5,999.94	TH		0.4		0.25
	25	2,997,917.69	1,226,867.96	6,003.12	TH	0.4			0.25
	25	2,997,949.36	1,226,963.02	5,999.75	TH		0.4		0.25
	26	2,997,945.61	1,226,847.99	6,003.62	TH	0.4			0.25
	26	2,997,983.71	1,226,953.88	5,999.55	TH		0.4		0.25
	27	2,997,964.19	1,226,829.82	6,004.16	TH	0.4			0.25
	27	2,998,021.51	1,226,946.60	5,999.40	TH		0.4		0.25
	28	2,997,990.80	1,226,804.61	6,004.55	TH	0.4			0.25
	28	2,998,056.21	1,226,937.86	5,999.38	TH		0.4		0.25
	29	2,997,996.48	1,226,800.32	6,004.52	TH	0.4			0.25
	29	2,998,097.73	1,226,918.17	5,999.48	TH*		0.5		0.25
	30	2,998,025.41	1,226,780.28	6,003.96	TH	0.4			0.25
	30	2,998,111.20	1,226,880.14	5,999.18	TH*		0.5		0.25
	31	2,998,040.26	1,226,770.47	6,003.62	TH	0.4			0.25
	31	2,998,135.79	1,226,849.31	5,999.15	TH*		0.5		0.25
	32	2,998,074.39	1,226,753.26	6,002.73	TH	0.4			0.25
	32	2,998,159.84	1,226,823.77	5,999.13	TH*		0.5		0.25
	33	2,998,106.60	1,226,732.87	6,002.36	TH	0.4			0.25
	33	2,998,169.70	1,226,813.09	5,999.12	TH*		0.5		0.25

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RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
THREE ROCKS Section 6 (continued)	34	2,998,135.39	1,226,712.86	6,002.28	TH	0.4			0.25
	34	2,998,193.70	1,226,787.00	5,999.11	TH*		0.5		0.25
	35	2,998,162.64	1,226,689.90	6,002.52	TH	0.4			0.25
	35	2,998,219.71	1,226,771.43	5,999.11	TH*		0.5		0.25
	36	2,998,192.27	1,226,671.02	6,002.42	TH	0.4			0.25
	36	2,998,258.59	1,226,767.61	5,999.26	TH*		0.5		0.25
	37	2,998,223.87	1,226,652.82	6,002.42	TH	0.4			0.25
	37	2,998,276.54	1,226,756.80	5,999.25	TH*		0.5		0.25
	38	2,998,255.44	1,226,637.70	6,002.40	TH	0.4			0.25
	38	2,998,310.85	1,226,747.08	5,999.35	TH*		0.5		0.25
	G1	2,997,081.86	1,227,157.41	6,004.08	TH		0.4		0.25
	G2	2,998,310.73	1,226,702.55	5,993.88	TH*		0.5		0.25
	G3	2,998,281.96	1,226,628.25	6,001.54	TH	0.4			0.25
	G4	2,997,062.67	1,227,040.49	6,008.56	TH	0.4			0.25
Total						**15.6**	**17.1**	**32.7**	**19.75**
SPIKE BUCK-00 Section 1	1	3,005,612.52	1,227,630.57	5,924.35	TH	0.4			0.25
	1	3,005,624.34	1,227,511.33	5,928.46	TH		0.4		0.25
	2	3,005,647.55	1,227,632.00	5,924.11	TH	0.4			0.25
	2	3,005,658.97	1,227,516.78	5,928.08	TH		0.4		0.25
	3	3,005,682.51	1,227,634.11	5,923.89	TH	0.4			0.25
	3	3,005,693.84	1,227,519.77	5,927.90	TH		0.4		0.25
	4	3,005,717.42	1,227,636.75	5,923.66	TH	0.4			0.25
	4	3,005,728.51	1,227,524.82	5,927.55	TH		0.4		0.25
	5	3,005,752.16	1,227,641.09	5,923.44	TH	0.4			0.25
	5	3,005,763.22	1,227,529.46	5,927.24	TH		0.4		0.25
	6	3,005,786.96	1,227,644.88	5,923.22	TH	0.4			0.25
	6	3,005,798.04	1,227,533.00	5,927.01	TH		0.4		0.25
	7	3,005,821.85	1,227,647.71	5,922.98	TH	0.4			0.25
	7	3,005,832.78	1,227,537.41	5,926.70	TH		0.4		0.25
	8	3,005,856.76	1,227,650.28	5,922.65	TH	0.4			0.25
	8	3,005,867.41	1,227,542.87	5,926.24	TH		0.4		0.25
	9	3,005,891.49	1,227,654.78	5,922.29	TH	0.4			0.25
	9	3,005,902.12	1,227,547.45	5,925.86	TH		0.4		0.25
	10	3,005,919.69	1,227,656.70	5,921.99	TH	0.4			0.25
	10	3,005,938.19	1,227,553.37	5,925.55	TH		0.4		0.25
	11	3,005,954.83	1,227,659.00	5,921.65	TH	0.4			0.25
	11	3,005,972.65	1,227,559.49	5,925.22	TH		0.4		0.25
	12	3,005,990.11	1,227,660.53	5,921.32	TH	0.4			0.25
	12	3,006,007.45	1,227,563.70	5,925.03	TH		0.4		0.25
	13	3,006,024.95	1,227,664.52	5,920.99	TH	0.4			0.25
	13	3,006,042.17	1,227,568.35	5,924.80	TH		0.4		0.25
	G1	3,005,570.25	1,227,622.47	5,923.41	TH		0.4		0.25
	G2	3,006,049.24	1,227,663.09	5,920.30	TH		0.4		0.25
	G3	3,006,078.61	1,227,576.22	5,922.08	CB2	0.5			0.25
	G4	3,005,583.82	1,227,510.00	5,927.42	TH	0.4			0.25
Total						**6.1**	**6**	**12.1**	**7.5**

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RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
SPIKE BUCK-00 Section 2	1	3,006,118.58	1,227,674.61	5,921.07	TH		0.4		0.25
	1	3,006,120.14	1,227,572.74	5,927.31	TH	0.4			0.25
	2	3,006,153.48	1,227,681.13	5,920.74	TH		0.4		0.25
	2	3,006,155.10	1,227,575.92	5,926.85	TH	0.4			0.25
	3	3,006,188.48	1,227,681.67	5,920.55	TH		0.4		0.25
	3	3,006,190.05	1,227,579.29	5,926.38	TH	0.4			0.25
	4	3,006,223.47	1,227,682.36	5,920.36	TH		0.4		0.25
	4	3,006,225.03	1,227,580.68	5,926.10	TH	0.4			0.25
	5	3,006,258.48	1,227,682.06	5,920.18	TH		0.4		0.25
	5	3,006,260.00	1,227,582.86	5,925.75	TH	0.4			0.25
	6	3,006,293.49	1,227,681.89	5,920.00	TH		0.4		0.25
	6	3,006,294.98	1,227,584.92	5,925.41	TH	0.4			0.25
	7	3,006,328.35	1,227,691.49	5,919.65	TH		0.4		0.25
	7	3,006,329.97	1,227,585.89	5,925.25	TH	0.4			0.25
	8	3,006,361.54	1,227,695.00	5,919.45	TH		0.4		0.25
	8	3,006,369.41	1,227,587.38	5,925.14	TH	0.4			0.25
	9	3,006,396.36	1,227,698.66	5,919.25	TH		0.4		0.25
	9	3,006,404.53	1,227,587.06	5,925.22	TH	0.4			0.25
	10	3,006,431.15	1,227,702.87	5,919.04	TH		0.4		0.25
	10	3,006,439.64	1,227,586.79	5,925.30	TH	0.4			0.25
	11	3,006,466.03	1,227,705.77	5,918.85	TH		0.4		0.25
	11	3,006,474.77	1,227,586.33	5,925.40	TH	0.4			0.25
	12	3,006,500.98	1,227,707.71	5,918.66	TH		0.4		0.25
	12	3,006,509.84	1,227,586.62	5,925.43	TH	0.4			0.25
	13	3,006,535.83	1,227,711.05	5,918.46	TH		0.4		0.25
	13	3,006,544.99	1,227,585.86	5,925.57	TH	0.4			0.25
	14	3,006,570.82	1,227,712.48	5,918.29	TH		0.4		0.25
	14	3,006,580.23	1,227,583.87	5,925.86	CB3	0.6668			0.25
	15	3,006,605.90	1,227,712.63	5,918.13	TH		0.4		0.25
	15	3,006,615.49	1,227,581.67	5,926.17	CB3	0.6668			0.25
	16	3,006,640.69	1,227,716.76	5,917.92	TH		0.4		0.25
	16	3,006,650.84	1,227,578.17	5,926.61	CB3	0.6668			0.25
	17	3,006,684.28	1,227,720.97	5,917.64	TH		0.4		0.25
	17	3,006,661.88	1,227,577.14	5,926.61	CB3	0.6668			0.25
	18	3,006,719.55	1,227,719.95	5,917.44	TH		0.4		0.25
	18	3,006,696.73	1,227,573.41	5,925.90	CB3	0.6668			0.25
	19	3,006,707.29	1,227,572.61	5,925.46	TH*		0.5		0.25
	19	3,006,766.49	1,227,712.63	5,917.20	CB3	0.6668			0.25
	20	3,006,744.01	1,227,569.58	5,924.21	TH*		0.5		0.25
	20	3,006,792.75	1,227,684.86	5,917.08	CB3	0.6668			0.25
	21	3,006,787.07	1,227,566.07	5,923.18	TH*		0.5		0.25
	21	3,006,804.45	1,227,680.08	5,917.01	CB3	0.6668			0.25
	22	3,006,821.91	1,227,562.36	5,923.04	TH*		0.5		0.25
	22	3,006,837.96	1,227,667.66	5,916.93	CB3	0.6668			0.25
	23	3,006,860.98	1,227,560.65	5,922.83	TH*		0.5		0.25
	23	3,006,858.74	1,227,664.43	5,916.87	CB3	0.6668			0.25
	24	3,006,896.03	1,227,558.63	5,923.14	TH*		0.5		0.25

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FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
SPIKE BUCK-00 Section 2 (continued)	24	3,006,893.65	1,227,669.14	5,916.65	CB3	0.6668			0.25
	25	3,006,948.30	1,227,553.90	5,924.58	TH*		0.5		0.25
	25	3,006,896.00	1,227,669.73	5,916.64	CB3	0.6668			0.25
	26	3,006,988.09	1,227,550.84	5,926.27	TH		0.4		0.25
	26	3,006,902.41	1,227,740.57	5,916.75	CB3	0.6668			0.25
	27	3,006,985.09	1,227,551.33	5,926.07	TH*		0.5		0.25
	27	3,006,971.36	1,227,698.93	5,916.12	CB3	0.6668			0.25
	28	3,007,021.00	1,227,543.10	5,928.64	TH*		0.5		0.25
	28	3,007,006.09	1,227,703.52	5,915.69	CB2	0.5			0.25
	29	3,007,053.02	1,227,547.16	5,927.48	TH*		0.5		0.25
	29	3,007,039.72	1,227,729.15	5,914.85	CB2	0.5			0.25
	30	3,007,088.31	1,227,544.42	5,927.67	TH*		0.5		0.25
	30	3,007,075.06	1,227,725.71	5,914.36	CB3	0.6668			0.25
	31	3,007,123.45	1,227,543.73	5,927.59	TH*		0.5		0.25
	31	3,007,110.21	1,227,724.99	5,913.86	CB3	0.6668			0.25
	32	3,007,158.61	1,227,542.79	5,927.55	TH*		0.5		0.25
	32	3,007,144.84	1,227,731.27	5,913.29	CB2	0.5			0.25
	G1	3,006,091.45	1,227,670.30	5,920.73	TH		0.4		0.25
	G2	3,007,172.84	1,227,704.16	5,905.84	CB3		0.6668		0.25
	G3	3,007,182.70	1,227,610.45	5,910.93	CB3	0.6668			0.25
	G4	3,006,078.61	1,227,576.22	5,922.08	CB2	0			0
Total						**18.0356**	**15.1668**	**33.2024**	**16.75**
SPIKE BUCK Section 1	1	3,012,423.89	1,228,257.69	5,885.96	CB3	0.6668			0.25
	1	3,012,341.74	1,228,413.91	5,887.65	TH*		0.5		0.25
	2	3,012,452.12	1,228,279.20	5,885.16	CB	0.5			0.25
	2	3,012,369.73	1,228,435.87	5,887.63	TH*		0.5		0.25
	3	3,012,479.17	1,228,302.94	5,883.64	CB	0.5			0.25
	3	3,012,395.39	1,228,462.27	5,887.42	TH*		0.5		0.25
	4	3,012,504.77	1,228,329.45	5,881.37	CB	0.5			0.25
	4	3,012,424.43	1,228,482.22	5,885.96	TH*		0.5		0.25
	G1	3,012,289.48	1,228,393.50	5,886.84	TH*		0.5		0.25
	G2	3,012,481.37	1,228,533.17	5,879.50	TH*		0.5		0.25
	G3	3,012,531.42	1,228,361.19	5,878.67	CB	0.5			0.25
	G4	3,012,345.29	1,228,212.70	5,883.39	CB	0.5			0.25
Total						**3.1668**	**3**	**6.1668**	**3**
SPIKE BUCK Section 2	1	3,012,567.15	1,228,392.43	5,879.69	TH	0.4			0.25
	1	3,012,459.40	1,228,505.51	5,880.40	TH*		0.5		0.25
	2	3,012,589.78	1,228,419.39	5,878.29	TH	0.4			0.25
	2	3,012,481.37	1,228,533.17	5,879.50	TH*		0		0
	3	3,012,612.85	1,228,445.88	5,876.94	TH	0.4			0.25
	3	3,012,504.68	1,228,559.41	5,878.49	CB3		0.6668		0.25
	G1	3,012,419.37	1,228,460.64	5,880.15	TH*		0.5		0.25
	G2	3,012,548.37	1,228,607.65	5,875.64	CB3		0.6668		0.25
	G3	3,012,626.28	1,228,471.73	5,871.45	CB3	0.6668			0.25
	G4	3,012,531.42	1,228,361.19	5,878.67	CB2	0			0
Total						**1.8668**	**2.3336**	**4.2004**	**2**

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
SPIKE BUCK Section 3	1	3,012,654.67	1,228,493.61	5,876.89	TH	0.4			0.25
	1	3,012,517.09	1,228,593.71	5,884.73	CB3		0.6668		0.25
	2	3,012,675.44	1,228,521.78	5,876.31	TH	0.4			0.25
	2	3,012,539.41	1,228,620.75	5,883.92	CB3		0.6668		0.25
	3	3,012,696.68	1,228,549.60	5,875.74	TH	0.4			0.25
	3	3,012,561.24	1,228,648.14	5,883.18	CB3		0.6668		0.25
	4	3,012,716.97	1,228,578.11	5,875.15	TH	0.4			0.25
	4	3,012,582.41	1,228,676.02	5,882.52	CB3		0.6668		0.25
	5	3,012,737.22	1,228,606.66	5,874.56	TH	0.4			0.25
	5	3,012,603.54	1,228,703.93	5,881.87	CB3		0.6668		0.25
	6	3,012,757.30	1,228,635.32	5,873.97	TH	0.4			0.25
	6	3,012,626.32	1,228,730.63	5,881.01	CB3		0.6668		0.25
	G1	3,012,481.37	1,228,533.17	5,879.50	TH*		0		0
	G2	3,012,655.80	1,228,796.40	5,881.56	CB3		0.6668		0.25
	G3	3,012,779.69	1,228,675.27	5,871.85	TH	0.4			0.25
	G4	3,012,626.28	1,228,471.73	5,871.45	CB3	0			0
Total						**2.8**	**4.6676**	**7.4676**	**3.5**
SPIKE BUCK Section 4	1	3,012,787.57	1,228,683.58	5,872.94	TH	0.4			0.25
	1	3,012,643.06	1,228,763.45	5,881.46	CB3		0.6668		0.25
	2	3,012,806.75	1,228,712.97	5,872.53	TH	0.4			0.25
	2	3,012,655.80	1,228,796.40	5,881.56	CB3		0		0
	3	3,012,825.98	1,228,742.33	5,872.13	TH	0.4			0.25
	3	3,012,678.03	1,228,824.10	5,880.46	CB3		0.6668		0.25
	4	3,012,845.18	1,228,771.70	5,871.73	TH	0.4			0.25
	4	3,012,699.33	1,228,852.31	5,879.49	CB3		0.6668		0.25
	G1	3,012,603.54	1,228,703.93	5,881.87	CB3		0		0
	G2	3,012,741.30	1,228,917.54	5,878.32	CB3		0.6668		0.25
	G3	3,012,872.43	1,228,819.47	5,869.30	TH	0.4			0.25
	G4	3,012,763.34	1,228,649.07	5,872.29	TH	0.4			0.25
Total						**2.4**	**2.6672**	**5.0672**	**2.5**
SPIKE BUCK Section 5	1	3,012,925.46	1,228,899.85	5,868.58	TH	0.4			0.25
	1	3,012,770.30	1,228,978.29	5,880.40	CB3		0.6668		0.25
	2	3,012,943.00	1,228,930.20	5,868.00	CB2	0.5			0.25
	2	3,012,786.96	1,229,009.08	5,879.70	CB3		0.6668		0.25
	3	3,012,961.03	1,228,960.31	5,867.42	CB2	0.5			0.25
	3	3,012,806.36	1,229,038.49	5,878.62	CB3		0.6668		0.25
	4	3,012,972.10	1,228,978.68	5,867.07	CB2	0.5			0.25
	4	3,012,826.49	1,229,070.74	5,878.13	CB3		0.6668		0.25
	5	3,012,991.14	1,229,008.05	5,866.50	CB2	0.5			0.25
	5	3,012,842.64	1,229,101.95	5,878.08	CB3		0.6668		0.25
	6	3,013,011.33	1,229,036.70	5,865.93	CB	0.5			0.25
	6	3,012,866.38	1,229,128.34	5,876.95	CB3		0.6668		0.25
	7	3,013,018.32	1,229,047.39	5,865.72	CB2	0.5			0.25
	7	3,012,891.52	1,229,158.93	5,876.14	TH*		0.5		0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
SPIKE BUCK Section 5 (continued)	8	3,013,037.02	1,229,077.56	5,865.17	CB2	0.5			0.25
	8	3,012,914.29	1,229,185.51	5,875.56	TH*		0.5		0.25
	9	3,013,054.84	1,229,108.50	5,863.90	TH	0.4			0.25
	9	3,012,938.09	1,229,211.20	5,875.01	TH*		0.5		0.25
	10	3,013,062.11	1,229,120.83	5,863.33	TH	0.4			0.25
	10	3,012,964.75	1,229,240.43	5,874.66	TH*		0.5		0.25
	11	3,013,081.98	1,229,151.86	5,862.08	TH	0.4			0.25
	11	3,012,987.65	1,229,267.74	5,875.11	TH*		0.5		0.25
	12	3,013,102.85	1,229,181.66	5,860.91	TH	0.4			0.25
	12	3,013,008.18	1,229,297.95	5,876.26	TH*		0.5		0.25
	G1	3,012,741.30	1,228,917.54	5,878.32	CB3		0		0
	G2	3,013,065.26	1,229,355.51	5,871.87	TH*		0.5		0.25
	G3	3,013,118.59	1,229,203.42	5,860.07	TH	0.4			0.25
	G4	3,012,890.34	1,228,849.69	5,867.59	CB2	0.5			0.25
Total						**6.4**	**7.5008**	**13.9008**	**6.75**

SPIKE BUCK Section 6	1	3,013,220.49	1,229,349.33	5,861.52	TH	0.4			0.25
	1	3,013,123.24	1,229,404.49	5,865.36	TH*		0.5		0.25
	2	3,013,241.27	1,229,377.78	5,861.47	TH	0.4			0.25
	2	3,013,141.78	1,229,434.21	5,865.17	TH*		0.5		0.25
	3	3,013,259.99	1,229,407.40	5,861.41	TH	0.4			0.25
	3	3,013,163.02	1,229,462.40	5,864.76	TH*		0.5		0.25
	4	3,013,278.26	1,229,437.28	5,861.40	TH	0.4			0.25
	4	3,013,182.41	1,229,491.64	5,864.57	TH*		0.5		0.25
	5	3,013,295.85	1,229,470.38	5,861.38	TH	0.4			0.25
	5	3,013,184.46	1,229,519.45	5,865.34	TH*		0.5		0.25
	6	3,013,308.64	1,229,502.99	5,861.35	TH	0.4			0.25
	6	3,013,196.77	1,229,552.27	5,865.38	TH*		0.5		0.25
	7	3,013,322.74	1,229,542.60	5,861.31	TH	0.4			0.25
	7	3,013,212.33	1,229,585.30	5,865.16	TH*		0.5		0.25
	8	3,013,339.61	1,229,573.60	5,861.34	TH	0.4			0.25
	8	3,013,224.92	1,229,617.96	5,865.14	TH*		0.5		0.25
	9	3,013,355.47	1,229,604.99	5,861.37	CB2	0.5			0.25
	9	3,013,238.93	1,229,650.07	5,865.01	TH*		0.5		0.25
	10	3,013,373.09	1,229,635.70	5,861.44	CB3	0.6668			0.25
	10	3,013,252.43	1,229,682.37	5,864.92	TH*		0.5		0.25
	11	3,013,387.12	1,229,667.80	5,861.45	CB3	0.6668			0.25
	11	3,013,264.33	1,229,715.29	5,864.95	TH*		0.5		0.25
	12	3,013,400.09	1,229,696.18	5,862.03	CB3	0.6668			0.25
	12	3,013,277.41	1,229,749.14	5,865.61	TH*		0.5		0.25
	13	3,013,413.30	1,229,719.18	5,863.73	CB3	0.6668			0.25
	13	3,013,294.69	1,229,782.76	5,867.13	TH*		0.5		0.25
	14	3,013,433.10	1,229,748.28	5,864.87	CB3	0.6668			0.25
	14	3,013,298.76	1,229,820.28	5,869.29	TH*		0.5		0.25
	15	3,013,450.61	1,229,778.61	5,865.95	CB3	0.6668			0.25
	15	3,013,308.59	1,229,854.72	5,871.00	TH*		0.5		0.25
	16	3,013,471.24	1,229,807.26	5,867.13	CB3	0.6668			0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
SPIKE BUCK Section 6 (continued)	16	3,013,343.54	1,229,875.70	5,870.36	TH*		0.5		0.25
	17	3,013,489.23	1,229,837.33	5,868.24	CB3	0.6668			0.25
	17	3,013,353.30	1,229,910.18	5,872.00	TH*		0.5		0.25
	G1	3,013,098.74	1,229,362.63	5,864.08	TH*		0.5		0.25
	G2	3,013,361.05	1,230,018.88	5,864.69	TH*		0.5		0.25
	G3	3,013,516.40	1,229,903.94	5,876.96	CB3	0.6668			0.25
	G4	3,013,203.40	1,229,322.64	5,860.84	TH	0.4			0.25
Total						**10.1012**	**9.5**	**19.6012**	**9.5**
SPIKE BUCK Section 7	1	3,013,516.67	1,229,903.86	5,876.99	CB	0			0
	1	3,013,332.36	1,229,954.15	5,866.26	TH*		0.5		0.25
	2	3,013,503.72	1,229,943.67	5,873.59	CB	0.5			0.25
	2	3,013,346.88	1,229,986.47	5,865.46	TH*		0.5		0.25
	3	3,013,512.42	1,229,977.58	5,872.79	CB	0.5			0.25
	3	3,013,361.05	1,230,018.88	5,864.69	TH*		0		0
	G1	3,013,343.54	1,229,875.70	5,870.36	TH*		0		0
	G2	3,013,386.63	1,230,094.59	5,863.01	TH*		0.5		0.25
	G3	3,013,515.63	1,230,011.45	5,870.65	CB	0.5			0.25
	G4	3,013,489.23	1,229,837.33	5,868.24	CB	0			0
Total						**1.5**	**1.5**	**3**	**1.5**
SPIKE BUCK Section 8	1	3,013,520.71	1,230,042.92	5,871.92	CB3	0.6668			0.25
	1	3,013,386.63	1,230,094.59	5,863.01	TH*		0		0
	2	3,013,538.66	1,230,073.51	5,873.41	CB3	0.6668			0.25
	2	3,013,375.35	1,230,136.44	5,864.46	TH*		0.5		0.25
	3	3,013,565.56	1,230,100.66	5,876.00	CB3	0.6668			0.25
	3	3,013,346.32	1,230,185.13	5,867.31	TH*		0.5		0.25
	4	3,013,588.45	1,230,129.34	5,877.45	CB3	0.6668			0.25
	4	3,013,350.98	1,230,220.84	5,869.51	TH		0.4		0.25
	5	3,013,608.66	1,230,163.55	5,878.30	TH	0.4			0.25
	5	3,013,357.67	1,230,243.10	5,870.61	TH		0.4		0.25
	6	3,013,618.72	1,230,222.67	5,876.30	CB3	0.6668			0.25
	6	3,013,345.29	1,230,205.69	5,868.66	TH		0.4		0.25
	7	3,013,614.86	1,230,257.50	5,874.09	TH	0.4			0.25
	7	3,013,356.27	1,230,240.98	5,870.72	TH		0.4		0.25
	8	3,013,619.71	1,230,306.65	5,872.08	TH	0.4			0.25
	8	3,013,355.95	1,230,240.11	5,870.68	TH		0.4		0.25
	9	3,013,622.83	1,230,343.55	5,870.57	TH	0.4			0.25
	9	3,013,380.35	1,230,282.01	5,868.91	TH		0.4		0.25
	10	3,013,621.23	1,230,333.25	5,870.92	TH	0.4			0.25
	10	3,013,410.49	1,230,344.40	5,866.69	TH		0.4		0.25
	11	3,013,620.41	1,230,368.35	5,868.20	TH	0.4			0.25
	11	3,013,428.21	1,230,378.51	5,865.47	TH		0.4		0.25
	12	3,013,622.22	1,230,340.97	5,870.64	TH	0.4			0.25
	12	3,013,450.70	1,230,422.70	5,864.21	TH		0.4		0.25
	13	3,013,621.16	1,230,380.24	5,867.55	TH	0.4			0.25
	13	3,013,466.44	1,230,453.97	5,863.42	TH		0.4		0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
SPIKE BUCK Section 8 (continued)	14	3,013,623.82	1,230,417.75	5,865.61	RUBBER TRACK	0.5			0.25
	14	3,013,480.34	1,230,486.12	5,862.63	TH		0.4		0.25
	15	3,013,614.04	1,230,461.18	5,862.97	RUBBER TRACK	0.5			0.25
	15	3,013,496.07	1,230,517.40	5,861.76	TH		0.4		0.25
	16	3,013,600.75	1,230,506.28	5,860.73	RUBBER TRACK	0.5			0.25
	16	3,013,512.43	1,230,548.37	5,860.87	TH		0.4		0.25
	17	3,013,619.79	1,230,535.98	5,860.05	RUBBER TRACK	0.5			0.25
	17	3,013,527.60	1,230,579.91	5,860.02	CB		0.5		0.25
	18	3,013,633.78	1,230,568.08	5,859.17	CB3	0.6668			0.25
	18	3,013,540.98	1,230,612.30	5,859.25	TH		0.4		0.25
	19	3,013,645.39	1,230,601.32	5,858.20	CB3	0.6668			0.25
	19	3,013,556.71	1,230,643.58	5,858.39	TH		0.4		0.25
	20	3,013,656.36	1,230,634.87	5,857.22	CB3	0.6668			0.25
	20	3,013,571.58	1,230,675.26	5,857.55	TH		0.4		0.25
	21	3,013,678.65	1,230,663.01	5,856.64	CB3	0.6668			0.25
	21	3,013,586.19	1,230,707.07	5,856.73	TH		0.4		0.25
	22	3,013,735.23	1,230,674.82	5,858.19	CB3	0.6668			0.25
	22	3,013,601.47	1,230,738.57	5,855.88	TH		0.4		0.25
	23	3,013,749.15	1,230,706.96	5,857.26	CB3	0.6668			0.25
	23	3,013,616.26	1,230,770.29	5,855.05	TH		0.4		0.25
	24	3,013,754.85	1,230,743.01	5,855.76	CB3	0.6668			0.25
	24	3,013,631.43	1,230,801.83	5,854.21	TH		0.4		0.25
	G1	3,013,380.29	1,230,042.29	5,860.20	TH*		0.5		0.25
	G2	3,013,638.54	1,230,843.71	5,861.04	TH		0.4		0.25
	G3	3,013,804.67	1,230,814.94	5,860.76	CB3	0.6668			0.25
	G4	3,013,512.42	1,229,977.58	5,872.79	CB3	0			0
Total						**13.8684**	**10.4**	**24.2684**	**12.5**

SPIKE BUCK Section 9	1	3,013,844.21	1,230,968.55	5,855.86	TH	0.4			0.25
	1	3,013,728.49	1,231,007.82	5,852.12	TH*		0.5		0.25
	2	3,013,854.45	1,231,002.03	5,855.72	TH	0.4			0.25
	2	3,013,741.19	1,231,040.47	5,852.04	TH*		0.5		0.25
	3	3,013,864.43	1,231,035.61	5,855.57	TH	0.4			0.25
	3	3,013,753.22	1,231,073.35	5,851.97	TH*		0.5		0.25
	4	3,013,873.70	1,231,069.42	5,855.36	TH	0.4			0.25
	4	3,013,771.30	1,231,104.17	5,851.85	TH*		0.5		0.25
	5	3,013,882.80	1,231,103.29	5,855.24	TH	0.4			0.25
	5	3,013,783.89	1,231,136.86	5,851.89	TH*		0.5		0.25
	6	3,013,892.54	1,231,136.95	5,855.74	TH	0.4			0.25
	6	3,013,797.97	1,231,169.04	5,852.49	TH*		0.5		0.25
	7	3,013,903.17	1,231,170.30	5,856.97	TH	0.4			0.25
	7	3,013,810.57	1,231,201.73	5,853.76	TH*		0.5		0.25
	8	3,013,914.58	1,231,203.39	5,858.25	TH	0.4			0.25
	8	3,013,809.07	1,231,239.20	5,855.11	TH*		0.5		0.25
	9	3,013,925.48	1,231,237.76	5,859.48	TH	0.4			0.25

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FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
SPIKE BUCK Section 9 (continued)	9	3,013,811.36	1,231,271.17	5,856.36	TH*		0.5		0.25
	10	3,013,934.34	1,231,277.45	5,860.38	TH	0.4			0.25
	10	3,013,811.32	1,231,284.34	5,856.91	TH*		0.5		0.25
	11	3,013,939.23	1,231,312.23	5,860.50	TH	0.4			0.25
	11	3,013,808.46	1,231,319.56	5,857.45	TH*		0.5		0.25
	12	3,013,941.71	1,231,347.14	5,859.99	CB	0.5			0.25
	12	3,013,806.37	1,231,354.73	5,856.95	TH*		0.5		0.25
	13	3,013,945.66	1,231,381.98	5,859.47	CB	0.5			0.25
	13	3,013,804.48	1,231,389.89	5,856.35	TH*		0.5		0.25
	14	3,013,947.77	1,231,421.73	5,858.71	CB	0.5			0.25
	14	3,013,801.85	1,231,405.81	5,856.14	TH*		0.5		0.25
	15	3,013,950.66	1,231,457.26	5,859.44	CB	0.5			0.25
	15	3,013,795.84	1,231,440.36	5,854.93	TH*		0.5		0.25
	16	3,013,954.52	1,231,492.89	5,860.47	CB	0.5			0.25
	16	3,013,759.53	1,231,471.61	5,854.61	TH*		0.5		0.25
	17	3,013,947.50	1,231,530.11	5,860.61	CB	0.5			0.25
	17	3,013,762.76	1,231,498.88	5,853.62	TH		0.4		0.25
	18	3,013,939.77	1,231,564.30	5,861.15	CB	0.5			0.25
	18	3,013,778.59	1,231,537.05	5,852.62	TH*		0.5		0.25
	19	3,013,950.83	1,231,601.67	5,863.98	CB	0.5			0.25
	19	3,013,773.50	1,231,571.69	5,852.04	TH*		0.5		0.25
	G1	3,013,704.39	1,230,969.50	5,857.85	TH*		0.5		0.25
	G2	3,013,762.57	1,231,625.32	5,850.82	TH*		0.5		0.25
	G3	3,013,932.61	1,231,666.13	5,861.14	FOOT	0.5			0.25
	G4	3,013,831.93	1,230,927.91	5,856.92	CB	0.5			0.25
Total						**9.4**	**10.4**	**19.8**	**10.5**

SPIKE BUCK Section 10	1	3,013,911.09	1,231,657.92	5,850.62	FOOT	0.5			0.25
	1	3,013,762.57	1,231,625.32	5,850.82	TH*		0		0
	2	3,013,907.87	1,231,693.04	5,850.81	FOOT	0.5			0.25
	2	3,013,751.01	1,231,658.62	5,851.03	TH		0.4		0.25
	3	3,013,904.86	1,231,728.22	5,851.02	FOOT	0.5			0.25
	3	3,013,750.00	1,231,694.23	5,850.63	TH		0.4		0.25
	4	3,013,895.80	1,231,758.28	5,850.83	FOOT	0.5			0.25
	4	3,013,747.64	1,231,730.29	5,850.34	TH		0.4		0.25
	5	3,013,903.82	1,231,779.04	5,851.43	FOOT	0.5			0.25
	5	3,013,746.02	1,231,768.11	5,850.12	TH		0.4		0.25
	6	3,013,880.10	1,231,811.35	5,850.13	FOOT	0.5			0.25
	6	3,013,745.57	1,231,803.36	5,849.94	TH		0.4		0.25
	7	3,013,895.37	1,231,847.32	5,851.03	FOOT	0.5			0.25
	7	3,013,747.12	1,231,838.51	5,849.69	TH		0.4		0.25
	8	3,013,913.02	1,231,883.43	5,852.33	FOOT	0.5			0.25
	8	3,013,751.18	1,231,873.82	5,849.35	TH		0.4		0.25
	G1	3,013,773.50	1,231,571.69	5,852.04	TH*		0		0
	G2	3,013,755.79	1,231,903.13	5,848.39	TH		0.4		0.25
	G3	3,013,955.60	1,231,993.73	5,854.74	FOOT	0.5			0.25
	G4	3,013,923.45	1,231,608.33	5,849.18	FOOT	0.5			0.25
Total						**5**	**3.2**	**8.2**	**4.5**

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 1	1	3,014,548.85	1,232,730.28	5,843.13	TH		0.4		0.25
	1	3,014,611.46	1,232,567.58	5,851.50	TH	0.4			0.25
	2	3,014,585.04	1,232,733.69	5,842.26	TH		0.4		0.25
	2	3,014,644.15	1,232,580.09	5,850.67	TH	0.4			0.25
	3	3,014,621.53	1,232,736.33	5,841.45	TH		0.4		0.25
	3	3,014,676.61	1,232,593.19	5,849.76	TH	0.4			0.25
	4	3,014,658.27	1,232,738.30	5,840.70	TH		0.4		0.25
	4	3,014,709.62	1,232,604.85	5,848.91	TH	0.4			0.25
	5	3,014,697.88	1,232,739.18	5,840.02	TH		0.4		0.25
	5	3,014,727.80	1,232,632.14	5,846.00	TH	0.4			0.25
	6	3,014,734.08	1,232,739.68	5,839.61	TH		0.4		0.25
	6	3,014,761.89	1,232,640.21	5,845.29	TH	0.4			0.25
	7	3,014,772.52	1,232,741.33	5,839.41	TH		0.4		0.25
	7	3,014,778.83	1,232,643.37	5,845.02	TH	0.4			0.25
	8	3,014,807.51	1,232,742.64	5,839.23	TH		0.4		0.25
	8	3,014,813.71	1,232,646.37	5,844.79	CB3	0.6668			0.25
	9	3,014,842.50	1,232,743.93	5,839.06	TH		0.4		0.25
	9	3,014,848.74	1,232,647.10	5,844.78	CB3	0.6668			0.25
	10	3,014,877.39	1,232,746.83	5,838.85	TH		0.4		0.25
	10	3,014,883.52	1,232,651.61	5,844.41	CB3	0.6668			0.25
	11	3,014,912.25	1,232,750.04	5,838.63	TH		0.4		0.25
	11	3,014,918.16	1,232,658.22	5,843.86	CB3	0.6668			0.25
	12	3,014,947.15	1,232,752.64	5,838.42	TH		0.4		0.25
	12	3,014,953.16	1,232,659.30	5,843.81	CB2	0.5			0.25
	G1	3,014,466.09	1,232,702.55	5,841.45	TH		0.4		0.25
	G2	3,014,986.17	1,232,756.89	5,839.67	TH		0.4		0.25
	G3	3,014,987.93	1,232,660.14	5,842.89	CB2	0.5			0.25
	G4	3,014,552.52	1,232,541.53	5,851.06	CB2	0.5			0.25
Total						**6.9672**	**5.6**	**12.5672**	**7**

PARKDALE Section 2	1	3,015,030.22	1,232,763.18	5,840.70	TH		0.4		0.25
	1	3,015,034.62	1,232,669.06	5,838.36	TH	0.4			0.25
	2	3,015,065.19	1,232,764.53	5,840.24	TH		0.4		0.25
	2	3,015,069.57	1,232,670.96	5,837.91	TH	0.4			0.25
	3	3,015,100.26	1,232,764.00	5,839.67	TH		0.4		0.25
	3	3,015,104.57	1,232,671.82	5,837.47	TH	0.4			0.25
	4	3,015,135.25	1,232,764.94	5,839.18	TH		0.4		0.25
	4	3,015,139.56	1,232,672.89	5,837.03	TH	0.4			0.25
	5	3,015,170.23	1,232,766.26	5,838.72	TH		0.4		0.25
	5	3,015,174.62	1,232,672.25	5,836.61	TH	0.4			0.25
	6	3,015,205.68	1,232,757.39	5,837.73	TH*		0.5		0.25
	6	3,015,209.68	1,232,671.88	5,836.19	TH	0.4			0.25
	7	3,015,240.18	1,232,768.92	5,837.81	TH		0.4		0.25
	7	3,015,244.64	1,232,673.53	5,835.76	TH	0.4			0.25
	8	3,015,275.16	1,232,770.02	5,837.45	TH		0.4		0.25
	8	3,015,279.65	1,232,674.05	5,835.44	TH	0.4			0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 2 (continued)	9	3,015,310.13	1,232,771.56	5,837.26	TH		0.4		0.25
	9	3,015,314.70	1,232,673.75	5,835.28	TH	0.4			0.25
	10	3,015,344.96	1,232,776.05	5,837.23	TH		0.4		0.25
	10	3,015,349.73	1,232,674.07	5,835.12	TH	0.4			0.25
	11	3,015,379.92	1,232,777.70	5,837.05	TH		0.4		0.25
	11	3,015,384.75	1,232,674.45	5,834.96	TH	0.4			0.25
	12	3,015,414.89	1,232,779.07	5,836.85	TH		0.4		0.25
	12	3,015,419.66	1,232,677.16	5,834.75	TH	0.4			0.25
	13	3,015,449.84	1,232,780.98	5,836.68	TH		0.4		0.25
	13	3,015,454.52	1,232,680.96	5,834.54	TH	0.4			0.25
	14	3,015,484.78	1,232,783.04	5,836.52	TH		0.4		0.25
	14	3,015,489.75	1,232,676.78	5,834.45	TH	0.4			0.25
	G1	3,014,986.17	1,232,756.89	5,839.67	TH		0		0
	G2	3,015,524.98	1,232,778.52	5,833.68	TH*		0.5		0.25
	G3	3,015,526.61	1,232,686.48	5,833.03	TH	0.4			0.25
	G4	3,015,009.56	1,232,668.42	5,838.14	TH	0.4			0.25
Total						**6.4**	**6.2**	**12.6**	**7.75**
PARKDALE Section 3	1	3,015,559.46	1,232,687.50	5,832.39	TH	0.4			0.25
	1	3,015,567.60	1,232,776.56	5,835.40	TH*		0.5		0.25
	2	3,015,594.32	1,232,684.32	5,832.35	TH	0.4			0.25
	2	3,015,602.33	1,232,772.02	5,835.27	TH*		0.5		0.25
	3	3,015,629.00	1,232,679.29	5,832.32	TH	0.4			0.25
	3	3,015,636.97	1,232,766.48	5,835.08	TH*		0.5		0.25
	4	3,015,665.19	1,232,679.39	5,832.21	TH	0.4			0.25
	4	3,015,667.61	1,232,767.08	5,835.12	TH*		0.5		0.25
	5	3,015,701.83	1,232,681.11	5,831.94	TH	0.4			0.25
	5	3,015,695.15	1,232,766.25	5,834.78	TH*		0.5		0.25
	6	3,015,736.80	1,232,682.84	5,831.62	TH	0.4			0.25
	6	3,015,730.16	1,232,767.47	5,834.37	TH*		0.5		0.25
	7	3,015,771.87	1,232,683.33	5,831.29	TH	0.4			0.25
	7	3,015,765.13	1,232,769.24	5,833.98	TH*		0.5		0.25
	G1	3,015,524.98	1,232,778.52	5,833.68	TH*	0.5	0		0
	G2	3,015,797.17	1,232,773.84	5,833.04	TH*		0.5		0.25
	G3	3,015,802.69	1,232,688.24	5,830.27	TH	0.4			0.25
	G4	3,015,526.61	1,232,686.48	5,833.03	TH	0			0
Total						**3.7**	**4**	**7.7**	**4**
PARKDALE Section 4	1	3,015,916.53	1,232,713.47	5,831.87	TH	0.4			0.25
	1	3,015,883.98	1,232,792.31	5,831.81	TH*		0.5		0.25
	2	3,015,949.26	1,232,725.86	5,831.24	TH	0.4			0.25
	2	3,015,916.74	1,232,804.64	5,831.11	TH*		0.5		0.25
	3	3,015,981.11	1,232,740.41	5,830.53	TH	0.4			0.25
	3	3,015,949.58	1,232,816.79	5,830.40	TH*		0.5		0.25
	4	3,016,012.92	1,232,755.05	5,829.82	TH	0.4			0.25
	4	3,015,981.82	1,232,830.38	5,829.74	TH*		0.5		0.25
	5	3,016,044.83	1,232,769.45	5,829.11	TH	0.4			0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 4 (continued)	5	3,016,013.37	1,232,845.67	5,829.14	TH*		0.5		0.25
	6	3,016,077.03	1,232,783.16	5,828.47	TH	0.4			0.25
	6	3,016,044.50	1,232,861.95	5,828.60	TH*		0.5		0.25
	7	3,016,108.93	1,232,797.60	5,827.94	TH	0.4			0.25
	7	3,016,076.40	1,232,876.37	5,828.08	TH*		0.5		0.25
	8	3,016,142.83	1,232,812.05	5,827.62	TH	0.4			0.25
	8	3,016,101.41	1,232,885.72	5,827.68	TH*		0.5		0.25
	9	3,016,175.70	1,232,825.72	5,827.52	TH	0.4			0.25
	9	3,016,131.24	1,232,901.71	5,827.40	TH*		0.5		0.25
	10	3,016,206.14	1,232,843.00	5,827.39	TH	0.4			0.25
	10	3,016,162.15	1,232,918.18	5,827.22	TH*		0.5		0.25
	11	3,016,236.18	1,232,860.96	5,827.26	TH	0.4			0.25
	11	3,016,193.79	1,232,933.41	5,827.03	TH*		0.5		0.25
	12	3,016,264.99	1,232,881.83	5,827.08	TH	0.4			0.25
	12	3,016,220.05	1,232,954.72	5,827.06	TH*		0.5		0.25
	13	3,016,292.68	1,232,903.61	5,826.95	TH	0.4			0.25
	13	3,016,245.79	1,232,979.66	5,827.08	TH*		0.5		0.25
	14	3,016,322.95	1,232,928.95	5,826.91	TH	0.4			0.25
	14	3,016,256.30	1,232,990.03	5,827.05	TH*		0.5		0.25
	15	3,016,347.86	1,232,955.40	5,826.86	TH	0.4			0.25
	15	3,016,275.47	1,233,013.06	5,826.96	TH*		0.5		0.25
	16	3,016,373.54	1,232,980.31	5,826.93	TH	0.4			0.25
	16	3,016,303.95	1,233,033.50	5,826.57	TH*		0.5		0.25
	17	3,016,395.29	1,233,011.36	5,826.84	TH	0.4			0.25
	17	3,016,317.09	1,233,057.49	5,826.57	TH*		0.5		0.25
	18	3,016,410.82	1,233,042.84	5,826.74	TH	0.4			0.25
	18	3,016,316.93	1,233,098.21	5,827.06	TH*		0.5		0.25
	19	3,016,427.11	1,233,081.67	5,826.76	TH	0.4			0.25
	19	3,016,319.95	1,233,107.74	5,827.01	TH*		0.5		0.25
	20	3,016,443.33	1,233,113.74	5,827.00	TH	0.4			0.25
	20	3,016,331.17	1,233,141.03	5,826.77	TH*		0.5		0.25
	21	3,016,461.95	1,233,145.23	5,827.44	TH	0.4			0.25
	21	3,016,343.04	1,233,174.17	5,826.51	TH*		0.5		0.25
	22	3,016,473.59	1,233,166.67	5,827.73	TH	0.4			0.25
	22	3,016,348.05	1,233,212.59	5,826.53	TH*		0.5		0.25
	23	3,016,490.16	1,233,197.87	5,828.20	CB3	0.6668			0.25
	23	3,016,356.99	1,233,246.58	5,826.38	TH*		0.5		0.25
	24	3,016,505.78	1,233,229.43	5,828.65	CB3	0.6668			0.25
	24	3,016,375.60	1,233,277.04	5,825.90	TH		0.4		0.25
	G1	3,015,858.93	1,232,781.06	5,831.70	TH*		0.5		0.25
	G2	3,016,397.31	1,233,300.12	5,824.97	TH		0.4		0.25
	G3	3,016,538.22	1,233,285.89	5,831.11	CB3	0.6668			0.25
	G4	3,015,888.74	1,232,704.88	5,831.69	TH	0.4			0.25
Total						**11.2004**	**12.8**	**24.0004**	**13**

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RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 5	1	3,016,522.87	1,233,254.26	5,831.44	CB3	0.6668			0.25
	1	3,016,410.95	1,233,322.15	5,825.47	TH		0.4		0.25
	2	3,016,538.22	1,233,285.89	5,831.11	CB3	0			0
	2	3,016,429.40	1,233,351.89	5,825.44	TH		0.4		0.25
	3	3,016,553.99	1,233,317.25	5,830.85	CB3	0.6668			0.25
	3	3,016,447.96	1,233,381.56	5,825.42	TH		0.4		0.25
	4	3,016,568.75	1,233,349.23	5,830.47	CB3	0.6668			0.25
	4	3,016,467.54	1,233,410.61	5,825.39	TH		0.4		0.25
	5	3,016,582.90	1,233,381.58	5,830.05	CB3	0.6668			0.25
	5	3,016,486.55	1,233,440.01	5,825.37	TH		0.4		0.25
	6	3,016,598.62	1,233,412.98	5,829.79	CB3	0.6668			0.25
	6	3,016,506.80	1,233,468.67	5,825.33	TH		0.4		0.25
	7	3,016,615.28	1,233,443.81	5,829.61	CB3	0.6668			0.25
	7	3,016,526.01	1,233,497.94	5,825.29	TH		0.4		0.25
	8	3,016,635.81	1,233,472.29	5,829.80	CB3	0.6668			0.25
	8	3,016,544.49	1,233,527.68	5,825.27	TH		0.4		0.25
	9	3,016,655.42	1,233,499.71	5,829.97	CB3	0.6668			0.25
	9	3,016,564.44	1,233,556.92	5,825.25	TH		0.4		0.25
	10	3,016,664.01	1,233,510.63	5,830.04	CB3	0.6668			0.25
	10	3,016,587.61	1,233,589.80	5,825.22	TH		0.4		0.25
	11	3,016,686.37	1,233,537.87	5,829.56	CB3	0.6668			0.25
	11	3,016,610.14	1,233,616.86	5,824.80	TH		0.4		0.25
	12	3,016,709.12	1,233,564.69	5,828.79	CB3	0.6668			0.25
	12	3,016,633.82	1,233,642.71	5,824.31	TH		0.4		0.25
	13	3,016,733.12	1,233,590.21	5,828.19	CB3	0.6668			0.25
	13	3,016,657.63	1,233,668.44	5,823.85	TH		0.4		0.25
	14	3,016,758.93	1,233,613.86	5,827.62	CB3	0.6668			0.25
	14	3,016,682.10	1,233,693.48	5,823.21	TH		0.4		0.25
	G1	3,016,375.60	1,233,277.04	5,825.90	TH				
	G2	3,016,717.76	1,233,704.70	5,821.88	CB3		0.6668		0.25
	G3	3,016,787.79	1,233,639.42	5,826.04	CB3	0.6668			0.25
	G4	3,016,490.16	1,233,197.87	5,828.20	CB3	0			0
Total						**9.3352**	**6.2668**	**15.602**	**7.25**

PARKDALE Section 6	1	3,016,876.25	1,233,874.70	5,824.07	TH		0.4		0.25
	1	3,016,967.57	1,233,747.89	5,827.40	CB	0.5			0.25
	2	3,016,904.48	1,233,895.39	5,824.08	TH		0.4		0.25
	2	3,016,999.06	1,233,764.06	5,827.82	CB	0.5			0.25
	3	3,016,933.95	1,233,914.36	5,824.02	TH		0.4		0.25
	3	3,017,029.87	1,233,781.17	5,828.16	CB	0.5			0.25
	4	3,016,963.74	1,233,932.89	5,823.94	TH		0.4		0.25
	4	3,017,060.42	1,233,798.63	5,828.47	CB	0.5			0.25
	5	3,016,993.51	1,233,951.44	5,823.87	TH		0.4		0.25
	5	3,017,090.11	1,233,817.31	5,828.66	CB	0.5			0.25
	6	3,017,023.07	1,233,970.29	5,823.81	TH		0.4		0.25
	6	3,017,119.84	1,233,835.92	5,828.86	CB	0.5			0.25
	G1	3,016,824.24	1,233,823.49	5,822.35	TH*		0.5		0.25
	G2	3,017,079.45	1,233,985.81	5,821.63	TH*		0.5		0.25
	G3	3,017,155.79	1,233,873.46	5,826.48	CB3	0.6668			0.25
	G4	3,016,932.53	1,233,722.37	5,831.47	CB3	0.6668			0.25
Total						**4.3336**	**3.4**	**7.7336**	**4**

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 7	1	3,017,106.33	1,234,001.69	5,822.11	TH		0.4		0.25
	1	3,017,164.42	1,233,882.23	5,825.04	CB3	0.6668			0.25
	2	3,017,136.78	1,234,019.10	5,821.96	TH		0.4		0.25
	2	3,017,196.02	1,233,897.26	5,824.82	CB3	0.6668			0.25
	3	3,017,169.28	1,234,032.30	5,821.69	TH		0.4		0.25
	3	3,017,228.87	1,233,909.76	5,824.80	CB3	0.6668			0.25
	4	3,017,200.89	1,234,047.32	5,821.48	TH		0.4		0.25
	4	3,017,262.37	1,233,920.88	5,824.91	CB3	0.6668			0.25
	5	3,017,239.78	1,234,061.31	5,821.13	TH		0.4		0.25
	5	3,017,280.12	1,233,920.35	5,825.44	CB3	0.6668			0.25
	6	3,017,271.99	1,234,075.98	5,821.00	TH		0.4		0.25
	6	3,017,314.31	1,233,928.11	5,825.70	CB3	0.6668			0.25
	7	3,017,306.05	1,234,087.80	5,820.84	TH		0.4		0.25
	7	3,017,345.17	1,233,937.07	5,825.45	CB3	0.6668			0.25
	8	3,017,339.56	1,234,098.01	5,820.67	TH		0.4		0.25
	8	3,017,379.43	1,233,944.39	5,825.40	TH	0.4			0.25
	9	3,017,373.15	1,234,107.93	5,820.48	TH		0.4		0.25
	9	3,017,413.06	1,233,954.13	5,825.13	TH	0.4			0.25
	G1	3,017,064.90	1,233,973.29	5,820.77	TH*		0.5		0.25
	G2	3,017,423.66	1,234,105.84	5,818.04	TH*		0.5		0.25
	G3	3,017,461.90	1,233,976.97	5,822.35	TH	0.4			0.25
	G4	3,017,119.84	1,233,835.92	5,828.86	CB	0			0
Total						**5.8676**	**4.6**	**10.4676**	**5.25**

PARKDALE Section 8	1	3,017,473.42	1,234,138.02	5,820.71	TH		0.4		0.25
	1	3,017,538.98	1,234,011.21	5,818.52	TH	0.4			0.25
	2	3,017,524.68	1,234,115.09	5,818.33	TH*		0.5		0.25
	2	3,017,570.48	1,234,026.49	5,818.38	TH	0.4			0.25
	3	3,017,550.72	1,234,144.22	5,818.75	TH*		0.5		0.25
	3	3,017,598.30	1,234,038.67	5,818.30	TH	0.4			0.25
	4	3,017,591.03	1,234,145.51	5,818.04	TH*		0.5		0.25
	4	3,017,619.23	1,234,042.66	5,818.32	TH	0.4			0.25
	5	3,017,625.38	1,234,152.60	5,817.82	TH*		0.5		0.25
	5	3,017,653.28	1,234,050.83	5,818.04	TH	0.4			0.25
	6	3,017,657.51	1,234,158.52	5,817.61	TH*		0.5		0.25
	6	3,017,687.49	1,234,061.71	5,817.68	TH	0.4			0.25
	7	3,017,689.98	1,234,171.97	5,817.59	TH*		0.5		0.25
	7	3,017,720.80	1,234,072.46	5,817.39	TH	0.4			0.25
	8	3,017,724.32	1,234,179.42	5,817.25	TH*		0.5		0.25
	8	3,017,754.23	1,234,082.83	5,817.20	TH	0.4			0.25
	9	3,017,755.82	1,234,195.99	5,817.28	TH*		0.5		0.25
	9	3,017,787.98	1,234,092.15	5,817.05	TH	0.4			0.25
	10	3,017,789.99	1,234,203.99	5,816.95	TH*		0.5		0.25
	10	3,017,821.83	1,234,101.18	5,816.92	TH	0.4			0.25
	11	3,017,823.33	1,234,214.65	5,816.74	TH*		0.5		0.25
	11	3,017,855.03	1,234,112.26	5,816.71	TH	0.4			0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
	G1	3,017,423.66	1,234,105.84	5,818.04	TH*		0		0
	G2	3,017,853.83	1,234,216.11	5,814.45	TH*		0.5		0.25
	G3	3,017,887.48	1,234,128.89	5,815.36	TH	0.4			0.25
	G4	3,017,507.35	1,234,000.48	5,817.72	CB	0.5			0.25
Total						**5.3**	**5.9**	**11.2**	**6.25**
PARKDALE Section 9	1	3,017,889.57	1,234,230.44	5,815.60	TH*		0.5		0.25
	1	3,017,927.23	1,234,143.30	5,815.35	TH	0.4			0.25
	2	3,017,919.85	1,234,248.60	5,815.43	TH*		0.5		0.25
	2	3,017,961.12	1,234,153.11	5,815.14	TH	0.4			0.25
	3	3,017,949.01	1,234,269.35	5,815.41	TH		0.4		0.25
	3	3,017,993.10	1,234,167.35	5,814.78	TH	0.4			0.25
	4	3,017,983.02	1,234,278.88	5,814.85	TH		0.4		0.25
	4	3,018,023.53	1,234,185.14	5,814.29	TH	0.4			0.25
	5	3,018,017.04	1,234,288.38	5,814.32	TH		0.4		0.25
	5	3,018,055.10	1,234,200.33	5,813.90	TH	0.4			0.25
	6	3,018,051.01	1,234,298.00	5,813.80	TH		0.4		0.25
	6	3,018,087.26	1,234,214.12	5,813.56	TH	0.4			0.25
	7	3,018,085.36	1,234,307.50	5,813.29	TH		0.4		0.25
	7	3,018,118.57	1,234,226.79	5,813.22	TH	0.4			0.25
	8	3,018,120.79	1,234,318.45	5,812.85	TH		0.4		0.25
	8	3,018,143.29	1,234,236.16	5,812.79	TH	0.4			0.25
	9	3,018,154.43	1,234,328.09	5,812.45	TH		0.4		0.25
	9	3,018,176.62	1,234,246.98	5,812.33	TH	0.4			0.25
	10	3,018,188.13	1,234,337.53	5,812.05	TH		0.4		0.25
	10	3,018,211.07	1,234,253.68	5,812.00	TH	0.4			0.25
	11	3,018,221.88	1,234,346.82	5,811.65	TH		0.4		0.25
	11	3,018,244.86	1,234,262.77	5,811.60	TH	0.4			0.25
	12	3,018,255.63	1,234,356.08	5,811.24	TH		0.4		0.25
	12	3,018,278.62	1,234,272.01	5,811.20	TH	0.4			0.25
	G1	3,017,853.83	1,234,216.11	5,814.45	TH*		0		0
	G2	3,018,284.95	1,234,362.09	5,810.14	TH		0.4		0.25
	G3	3,018,310.43	1,234,279.64	5,810.06	TH	0.4			0.25
	G4	3,017,899.63	1,234,134.20	5,814.90	TH	0.4			0.25
Total						**5.6**	**5.4**	**11**	**6.75**
PARKDALE Section 10	1	3,018,444.53	1,234,408.25	5,807.22	TH		0.4		0.25
	1	3,018,473.74	1,234,305.23	5,816.02	TH	0.4			0.25
	2	3,018,478.43	1,234,416.99	5,807.09	TH		0.4		0.25
	2	3,018,508.76	1,234,310.00	5,816.40	TH	0.4			0.25
	3	3,018,512.05	1,234,426.72	5,806.92	TH		0.4		0.25
	3	3,018,543.62	1,234,315.36	5,816.71	TH	0.4			0.25
	4	3,018,545.75	1,234,436.18	5,806.76	TH		0.4		0.25
	4	3,018,578.50	1,234,320.65	5,817.04	TH	0.4			0.25
	5	3,018,578.94	1,234,447.42	5,806.52	TH		0.4		0.25
	5	3,018,613.37	1,234,325.97	5,817.37	TH	0.4			0.25
	6	3,018,612.64	1,234,456.88	5,806.36	TH		0.4		0.25
	6	3,018,647.10	1,234,335.32	5,817.17	TH	0.4			0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 10 (continued)	7	3,018,646.42	1,234,466.03	5,806.22	TH		0.4		0.25
	7	3,018,679.60	1,234,349.00	5,816.38	TH	0.4			0.25
	8	3,018,680.11	1,234,475.52	5,806.06	TH		0.4		0.25
	8	3,018,712.79	1,234,360.25	5,815.93	TH	0.4			0.25
	9	3,018,713.66	1,234,485.50	5,805.88	TH		0.4		0.25
	9	3,018,745.25	1,234,374.09	5,815.15	TH	0.4			0.25
	10	3,018,747.35	1,234,494.98	5,805.72	TH		0.4		0.25
	10	3,018,776.74	1,234,391.34	5,813.98	TH	0.4			0.25
	11	3,018,783.66	1,234,504.19	5,805.58	TH		0.4		0.25
	11	3,018,800.72	1,234,403.94	5,813.15	TH	0.4			0.25
	12	3,018,817.83	1,234,512.02	5,805.50	TH		0.4		0.25
	12	3,018,836.27	1,234,403.63	5,813.95	TH	0.4			0.25
	13	3,018,852.04	1,234,519.61	5,805.42	TH		0.4		0.25
	13	3,018,871.05	1,234,407.92	5,814.23	TH	0.4			0.25
	14	3,018,886.28	1,234,527.00	5,805.35	TH		0.4		0.25
	14	3,018,904.19	1,234,421.79	5,813.39	CB	0.5			0.25
	15	3,018,920.36	1,234,535.36	5,805.24	TH		0.4		0.25
	15	3,018,939.70	1,234,421.76	5,814.17	CB	0.5			0.25
	16	3,018,954.51	1,234,543.34	5,805.15	TH		0.4		0.25
	16	3,018,974.31	1,234,426.99	5,814.35	TH	0.4			0.25
	17	3,018,990.19	1,234,551.33	5,805.05	TH		0.4		0.25
	17	3,019,005.39	1,234,431.18	5,814.57	TH	0.4			0.25
	18	3,019,025.28	1,234,556.99	5,805.00	TH		0.4		0.25
	18	3,019,039.26	1,234,432.19	5,815.05	TH	0.4			0.25
	19	3,019,060.09	1,234,560.69	5,805.00	TH		0.4		0.25
	19	3,019,074.37	1,234,433.18	5,815.50	TH	0.4			0.25
	20	3,019,094.80	1,234,565.26	5,804.96	TH		0.4		0.25
	20	3,019,109.43	1,234,434.61	5,815.90	TH	0.4			0.25
	21	3,019,129.46	1,234,570.21	5,804.90	TH		0.4		0.25
	21	3,019,144.24	1,234,438.30	5,816.01	TH	0.4			0.25
	22	3,019,166.63	1,234,574.50	5,804.76	TH		0.4		0.25
	22	3,019,173.42	1,234,440.58	5,816.08	TH	0.4			0.25
	23	3,019,201.54	1,234,577.24	5,804.57	TH		0.4		0.25
	23	3,019,208.27	1,234,444.37	5,815.82	TH	0.4			0.25
	24	3,019,236.42	1,234,580.37	5,804.36	TH		0.4		0.25
	24	3,019,243.22	1,234,446.29	5,815.82	TH	0.4			0.25
	25	3,019,271.29	1,234,583.92	5,804.14	TH		0.4		0.25
	25	3,019,278.25	1,234,446.52	5,816.04	TH	0.4			0.25
	26	3,019,306.24	1,234,585.74	5,803.99	TH		0.4		0.25
	26	3,019,313.39	1,234,444.63	5,816.56	TH	0.4			0.25
	27	3,019,341.21	1,234,587.22	5,803.85	TH		0.4		0.25
	27	3,019,348.05	1,234,452.11	5,815.80	CB3	0.6668			0.25
	28	3,019,376.19	1,234,588.38	5,803.72	TH		0.4		0.25
	28	3,019,382.37	1,234,466.50	5,814.14	CB3	0.6668			0.25
	G1	3,018,412.98	1,234,396.71	5,806.72	TH		0.4		0.25
	G2	3,019,437.88	1,234,588.96	5,803.12	TH		0.4		0.25
	G3	3,019,438.65	1,234,461.08	5,823.11	CB3	0.6668			0.25
	G4	3,018,437.22	1,234,300.69	5,814.63	TH	0.4			0.25
Total						**13.0004**	**12**	**25.0004**	**15**

CB = Crane Basket
TH = Track Hoe mounted drill
TH* = Track Hoe assembled off train car
FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 11	1	3,019,437.88	1,234,588.96	5,803.12	TH		0.4		0.25
	1	3,019,438.65	1,234,461.08	5,823.11	TH	0.4			0.25
	2	3,019,472.88	1,234,589.97	5,802.91	TH		0.4		0.25
	2	3,019,473.62	1,234,466.50	5,821.96	TH	0.4			0.25
	3	3,019,507.87	1,234,590.84	5,802.72	TH		0.4		0.25
	3	3,019,508.62	1,234,465.66	5,822.05	TH	0.4			0.25
	4	3,019,542.87	1,234,591.80	5,802.53	TH		0.4		0.25
	4	3,019,543.57	1,234,474.17	5,820.31	TH	0.4			0.25
	5	3,019,577.87	1,234,591.74	5,802.44	TH		0.4		0.25
	5	3,019,578.55	1,234,478.37	5,819.43	TH	0.4			0.25
	6	3,019,612.86	1,234,592.59	5,802.26	TH		0.4		0.25
	6	3,019,613.48	1,234,489.91	5,817.21	TH	0.4			0.25
	7	3,019,647.86	1,234,592.84	5,802.14	TH		0.4		0.25
	7	3,019,648.49	1,234,488.37	5,817.42	TH	0.4			0.25
	8	3,019,682.86	1,234,593.28	5,802.00	TH		0.4		0.25
	8	3,019,683.54	1,234,479.69	5,818.96	TH	0.4			0.25
	G1	3,019,405.98	1,234,586.05	5,802.78	TH		0.4		0.25
	G2	3,019,717.89	1,234,591.05	5,801.28	TH		0.4		0.25
	G3	3,019,748.26	1,234,462.98	5,819.80	TH	0.4			0.25
	G4	3,019,382.37	1,234,466.50	5,814.14	CB3	0.6668			0.25
Total						**4.2668**	**4**	**8.2668**	**5**
PARKDALE Section 12	1	3,019,760.44	1,234,467.41	5,809.60	TH		0.4		0.25
	1	3,019,766.42	1,234,589.66	5,800.91	CB	0.5			0.25
	2	3,019,801.37	1,234,587.80	5,800.77	TH*		0.5		0.25
	2	3,019,794.82	1,234,453.91	5,810.98	CB3	0.6668			0.25
	3	3,019,836.22	1,234,583.73	5,800.70	TH*		0.5		0.25
	3	3,019,829.66	1,234,449.82	5,811.30	TH	0.4			0.25
	4	3,019,871.28	1,234,584.11	5,800.50	TH*		0.5		0.25
	4	3,019,864.74	1,234,450.63	5,811.01	TH	0.4			0.25
	5	3,019,906.02	1,234,578.11	5,800.51	TH*		0.5		0.25
	5	3,019,899.79	1,234,450.83	5,810.81	TH	0.4			0.25
	6	3,019,940.91	1,234,574.87	5,800.44	TH*		0.5		0.25
	6	3,019,934.79	1,234,449.88	5,810.75	TH	0.4			0.25
	7	3,019,975.93	1,234,574.44	5,800.26	TH*		0.5		0.25
	7	3,019,969.90	1,234,451.25	5,810.39	TH	0.4			0.25
	8	3,020,009.31	1,234,564.69	5,800.49	TH*		0.5		0.25
	8	3,020,005.34	1,234,450.58	5,810.29	TH	0.4			0.25
	9	3,020,037.00	1,234,563.54	5,800.39	TH*		0.5		0.25
	9	3,020,043.13	1,234,449.16	5,810.28	CB3	0.6668			0.25
	10	3,020,071.86	1,234,567.03	5,800.04	TH*		0.5		0.25
	10	3,020,078.26	1,234,447.59	5,810.29	CB3	0.6668			0.25
	11	3,020,101.46	1,234,570.65	5,799.73	TH*		0.5		0.25
	11	3,020,114.23	1,234,461.19	5,808.42	CB3	0.6668			0.25
	12	3,020,136.30	1,234,574.11	5,799.43	TH*		0.5		0.25
	12	3,020,149.09	1,234,464.44	5,808.06	CB3	0.6668			0.25

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RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 12 (continued)	13	3,020,171.15	1,234,577.34	5,799.20	TH*		0.5		0.25
	13	3,020,184.02	1,234,467.10	5,807.88	CB3	0.6668			0.25
	14	3,020,206.03	1,234,580.44	5,798.95	TH*		0.5		0.25
	14	3,020,218.83	1,234,470.72	5,807.64	CB3	0.6668			0.25
	15	3,020,235.45	1,234,582.10	5,798.84	TH*		0.5		0.25
	15	3,020,255.19	1,234,477.75	5,807.11	CB3	0.6668			0.25
	16	3,020,270.32	1,234,586.09	5,798.67	TH*		0.5		0.25
	16	3,020,289.17	1,234,486.41	5,806.49	CB3	0.6668			0.25
	17	3,020,304.18	1,234,595.36	5,798.52	TH*		0.5		0.25
	17	3,020,322.53	1,234,498.35	5,806.11	CB3	0.6668			0.25
	18	3,020,320.24	1,234,602.73	5,798.35	TH*		0.5		0.25
	18	3,020,359.55	1,234,511.58	5,805.81	CB3	0.6668			0.25
	19	3,020,352.59	1,234,616.11	5,798.27	TH*		0.5		0.25
	19	3,020,391.05	1,234,526.93	5,805.71	CB3	0.6668			0.25
	20	3,020,383.05	1,234,618.14	5,798.74	TH*		0.5		0.25
	20	3,020,421.48	1,234,548.12	5,805.13	CB3	0.6668			0.25
	21	3,020,412.31	1,234,637.56	5,798.59	TH*		0.5		0.25
	21	3,020,449.11	1,234,570.52	5,804.54	CB3	0.6668			0.25
	22	3,020,423.53	1,234,649.86	5,798.40	TH*		0.5		0.25
	22	3,020,479.14	1,234,594.46	5,804.50	CB3	0.6668			0.25
	23	3,020,445.28	1,234,677.59	5,798.00	TH*		0.5		0.25
	23	3,020,503.66	1,234,619.43	5,804.29	CB3	0.6668			0.25
	24	3,020,466.20	1,234,693.31	5,798.11	TH*		0.5		0.25
	24	3,020,521.88	1,234,637.83	5,804.29	CB3	0.6668			0.25
	25	3,020,488.97	1,234,720.02	5,797.91	TH*		0.5		0.25
	25	3,020,547.32	1,234,661.90	5,804.52	CB3	0.6668			0.25
	26	3,020,512.00	1,234,746.48	5,797.74	TH*		0.5		0.25
	26	3,020,576.90	1,234,681.83	5,805.45	CB3	0.6668			0.25
	27	3,020,534.92	1,234,773.05	5,797.55	TH*		0.5		0.25
	27	3,020,606.02	1,234,702.22	5,806.37	CB3	0.6668			0.25
	28	3,020,558.20	1,234,799.27	5,797.39	TH*		0.5		0.25
	28	3,020,633.54	1,234,724.21	5,807.06	CB3	0.6668			0.25
	29	3,020,580.14	1,234,826.82	5,797.13	TH*		0.5		0.25
	29	3,020,657.17	1,234,750.08	5,807.06	CB3	0.6668			0.25
	30	3,020,679.77	1,234,776.96	5,806.88	TH		0.4		0.25
	30	3,020,578.32	1,234,878.03	5,795.50	CB3	0.6668			0.25
	31	3,020,702.54	1,234,803.69	5,806.73	TH		0.4		0.25
	31	3,020,603.16	1,234,902.69	5,795.38	CB3	0.6668			0.25
	32	3,020,724.78	1,234,830.93	5,806.49	TH		0.4		0.25
	32	3,020,626.86	1,234,928.49	5,795.21	CB3	0.6668			0.25
	G1	3,019,717.89	1,234,591.05	5,801.28	TH		0		0
	G2	3,020,687.84	1,234,967.90	5,793.63	CB3		0.6668		0.25
	G3	3,020,774.56	1,234,863.13	5,820.35	CB3	0.6668			0.25
	G4	3,019,711.14	1,234,474.17	5,818.44	TH	0.4			0.25
Total						**20.6368**	**16.2668**	**36.9036**	**16.75**

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RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 13	1	3,020,774.56	1,234,863.13	5,820.35	CB3	0			0
	1	3,020,670.95	1,234,936.96	5,794.19	CB3		0.6668		0.25
	2	3,020,794.01	1,234,892.24	5,820.40	CB3	0.6668			0.25
	2	3,020,687.84	1,234,967.90	5,793.63	CB3		0		0
	3	3,020,813.87	1,234,921.07	5,820.58	CB3	0.6668			0.25
	3	3,020,707.56	1,234,996.83	5,793.63	TH		0.4		0.25
	4	3,020,834.26	1,234,949.52	5,820.93	CB3	0.6668			0.25
	4	3,020,726.23	1,235,026.49	5,793.42	TH		0.4		0.25
	5	3,020,856.91	1,234,976.35	5,821.99	CB3	0.6668			0.25
	5	3,020,747.64	1,235,054.22	5,793.76	TH		0.4		0.25
	6	3,020,881.20	1,235,002.02	5,823.60	CB3	0.6668			0.25
	6	3,020,769.97	1,235,081.28	5,794.29	TH		0.4		0.25
	7	3,020,908.55	1,235,025.50	5,826.26	CB3	0.6668			0.25
	7	3,020,792.61	1,235,108.12	5,794.90	TH		0.4		0.25
	G1	3,020,603.16	1,234,902.69	5,795.38	TH		0		0
	G2	3,020,813.17	1,235,131.33	5,794.96	TH		0.4		0.25
	G3	3,020,984.20	1,235,095.51	5,822.53	CB3	0.6668			0.25
	G4	3,020,724.78	1,234,830.93	5,806.49	CB3	0			0
Total						**4.6676**	**3.0668**	**7.7344**	**3.5**

PARKDALE Section 14	1	3,020,931.87	1,235,047.54	5,826.22	CB3	0.6668			0.25
	1	3,020,853.77	1,235,168.48	5,793.71	TH		0.4		0.25
	2	3,020,957.11	1,235,072.95	5,823.90	CB3	0.6668			0.25
	2	3,020,880.29	1,235,191.92	5,792.57	TH		0.4		0.25
	3	3,020,984.20	1,235,095.51	5,822.53	CB3	0			0
	3	3,020,906.88	1,235,215.25	5,791.48	TH		0.4		0.25
	4	3,021,013.77	1,235,114.23	5,822.39	CB3	0.6668			0.25
	4	3,020,935.90	1,235,234.81	5,791.15	CB3		0.6668		0.25
	5	3,021,042.23	1,235,134.66	5,821.26	CB3	0.6668			0.25
	5	3,020,972.68	1,235,242.36	5,793.14	RUBBER TRACK		0.5		0.25
	6	3,021,077.70	1,235,160.88	5,819.33	CB3	0.6668			0.25
	6	3,020,987.40	1,235,257.24	5,791.87	RUBBER TRACK		0.5		0.25
	7	3,021,107.03	1,235,180.77	5,818.16	CB3	0.6668			0.25
	7	3,021,017.49	1,235,276.31	5,791.23	RUBBER TRACK		0.5		0.25
	8	3,021,138.92	1,235,197.93	5,817.93	CB3	0.6668			0.25
	8	3,021,041.44	1,235,301.94	5,789.18	CB3		0.6668		0.25
	9	3,021,178.15	1,235,216.18	5,818.31	CB3	0.6668			0.25
	9	3,021,062.54	1,235,320.92	5,787.95	CB3		0.6668		0.25
	10	3,021,218.63	1,235,226.72	5,820.66	TH	0.4			0.25
	10	3,021,092.67	1,235,340.85	5,787.24	CB3		0.6668		0.25
	G1	3,020,830.47	1,235,148.21	5,793.96	TH		0.4		0.25
	G2	3,021,108.69	1,235,349.32	5,786.64	CB		0.5		0.25
	G3	3,021,344.63	1,235,302.15	5,813.07	CB	0.5			0.25
	G4	3,020,881.20	1,235,002.02	5,823.60	CB3	0			0
Total						**6.2344**	**6.2672**	**12.5016**	**5.5**

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FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 15	1	3,021,197.64	1,235,404.82	5,790.93	TH		0.4		0.25
	1	3,021,252.49	1,235,247.49	5,817.91	CB	0.5			0.25
	2	3,021,230.18	1,235,417.80	5,790.68	TH		0.4		0.25
	2	3,021,284.36	1,235,262.39	5,817.02	CB	0.5			0.25
	3	3,021,262.79	1,235,430.59	5,790.44	TH		0.4		0.25
	3	3,021,313.14	1,235,286.16	5,814.15	CB3	0.6668			0.25
	4	3,021,295.54	1,235,442.96	5,790.25	TH		0.4		0.25
	4	3,021,344.63	1,235,302.15	5,813.07	CB3	0			0
	5	3,021,328.48	1,235,454.82	5,790.12	TH		0.4		0.25
	5	3,021,376.57	1,235,316.85	5,812.28	CB3	0.6668			0.25
	6	3,021,361.47	1,235,466.51	5,790.00	TH		0.4		0.25
	6	3,021,410.81	1,235,324.94	5,812.93	CB	0.5			0.25
	7	3,021,394.41	1,235,478.35	5,789.87	TH		0.4		0.25
	7	3,021,442.98	1,235,339.00	5,812.28	TH	0.4			0.25
	G1	3,021,172.90	1,235,392.54	5,790.76	TH		0.4		0.25
	G2	3,021,425.15	1,235,483.97	5,787.76	TH		0.4		0.25
	G3	3,021,499.89	1,235,367.07	5,810.14	TH	0.4			0.25
	G4	3,021,178.15	1,235,216.18	5,818.31	CB3	0			0
Total						**3.6336**	**3.6**	**7.2336**	**4**
PARKDALE Section 16	1	3,021,452.31	1,235,493.65	5,787.98	TH		0.4		0.25
	1	3,021,499.89	1,235,367.07	5,810.14	TH	0			0
	2	3,021,485.09	1,235,505.92	5,787.84	TH		0.4		0.25
	2	3,021,531.39	1,235,382.74	5,809.13	TH	0.4			0.25
	3	3,021,518.03	1,235,517.76	5,787.77	TH		0.4		0.25
	3	3,021,563.41	1,235,397.01	5,808.45	TH	0.4			0.25
	4	3,021,551.30	1,235,528.71	5,787.80	TH		0.4		0.25
	4	3,021,594.44	1,235,413.94	5,807.20	TH	0.4			0.25
	5	3,021,584.34	1,235,540.28	5,787.75	TH		0.4		0.25
	5	3,021,625.24	1,235,431.48	5,805.85	TH	0.4			0.25
	6	3,021,617.30	1,235,552.07	5,787.68	TH		0.4		0.25
	6	3,021,657.18	1,235,445.96	5,805.16	TH	0.4			0.25
	7	3,021,650.16	1,235,564.13	5,787.57	TH		0.4		0.25
	7	3,021,688.51	1,235,462.08	5,804.15	CB	0.5			0.25
	8	3,021,682.95	1,235,576.37	5,787.45	TH		0.4		0.25
	8	3,021,719.79	1,235,478.36	5,803.12	CB	0.5			0.25
	9	3,021,715.91	1,235,588.14	5,787.38	TH		0.4		0.25
	9	3,021,751.53	1,235,493.37	5,802.37	CB	0.5			0.25
	10	3,021,748.99	1,235,599.59	5,787.35	TH		0.4		0.25
	10	3,021,783.09	1,235,508.87	5,801.53	CB	0.5			0.25
	11	3,021,781.88	1,235,611.56	5,787.25	TH		0.4		0.25
	11	3,021,815.01	1,235,523.40	5,800.89	CB	0.5			0.25
	12	3,021,814.81	1,235,623.41	5,787.18	TH		0.4		0.25
	12	3,021,847.60	1,235,536.17	5,800.59	CB	0.5			0.25
	13	3,021,847.84	1,235,635.00	5,787.13	TH		0.4		0.25
	13	3,021,880.31	1,235,548.62	5,800.35	CB	0.5			0.25

CB = Crane Basket
TH = Track Hoe mounted drill
TH* = Track Hoe assembled off train car
FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 16 (continued)	14	3,021,880.17	1,235,648.47	5,786.86	TH		0.4		0.25
	14	3,021,912.65	1,235,562.04	5,799.94	CB	0.5			0.25
	15	3,021,912.77	1,235,661.19	5,786.69	TH		0.4		0.25
	15	3,021,943.96	1,235,578.21	5,799.02	CB3	0.6668			0.25
	16	3,021,945.79	1,235,672.82	5,786.64	TH		0.4		0.25
	16	3,021,975.26	1,235,594.41	5,798.12	CB3	0.6668			0.25
	17	3,021,978.77	1,235,684.57	5,786.57	TH		0.4		0.25
	17	3,022,011.00	1,235,598.80	5,799.35	CB3	0.6668			0.25
	18	3,022,012.34	1,235,696.36	5,786.52	TH		0.4		0.25
	18	3,022,041.11	1,235,605.03	5,799.99	CB	0.5			0.25
	19	3,022,045.35	1,235,708.03	5,786.47	TH		0.4		0.25
	19	3,022,075.01	1,235,613.93	5,800.42	TH	0.4			0.25
	20	3,022,078.24	1,235,720.11	5,786.32	TH		0.4		0.25
	20	3,022,108.91	1,235,622.79	5,800.81	TH	0.4			0.25
	21	3,022,111.22	1,235,731.91	5,786.07	TH		0.4		0.25
	21	3,022,142.75	1,235,631.87	5,801.03	TH	0.4			0.25
	22	3,022,144.48	1,235,742.81	5,785.87	TH		0.4		0.25
	22	3,022,176.22	1,235,642.07	5,800.98	TH	0.4			0.25
	23	3,022,177.71	1,235,753.80	5,785.67	TH		0.4		0.25
	23	3,022,208.93	1,235,654.73	5,800.48	TH	0.4			0.25
	24	3,022,210.70	1,235,765.55	5,785.38	TH		0.4		0.25
	24	3,022,242.03	1,235,666.13	5,800.21	TH	0.4			0.25
	25	3,022,243.70	1,235,777.30	5,785.08	TH		0.4		0.25
	25	3,022,275.57	1,235,676.15	5,800.20	TH	0.4			0.25
	26	3,022,276.81	1,235,788.67	5,784.84	TH		0.4		0.25
	26	3,022,309.47	1,235,685.02	5,800.41	CB	0.5			0.25
	27	3,022,310.03	1,235,799.68	5,784.63	TH		0.4		0.25
	27	3,022,343.73	1,235,692.74	5,800.84	CB	0.5			0.25
	G1	3,021,425.15	1,235,483.97	5,787.76	TH		0		0
	G2	3,022,345.55	1,235,809.27	5,783.72	TH		0.4		0.25
	G3	3,022,397.16	1,235,698.88	5,801.36	CB3	0.6668			0.25
	G4	3,021,442.98	1,235,339.00	5,812.28	TH	0			0
Total						**12.9672**	**11.2**	**24.1672**	**13.75**

PARKDALE Section 17	1	3,022,360.09	1,235,816.96	5,784.37	TH		0.4		0.25
	1	3,022,397.16	1,235,698.88	5,801.36	CB	0			0
	2	3,022,393.15	1,235,828.50	5,784.19	TH		0.4		0.25
	2	3,022,431.75	1,235,705.55	5,802.06	CB	0.5			0.25
	3	3,022,426.27	1,235,839.86	5,784.02	TH		0.4		0.25
	3	3,022,466.27	1,235,712.44	5,802.73	CB	0.5			0.25
	4	3,022,459.37	1,235,851.27	5,783.85	TH		0.4		0.25
	4	3,022,500.86	1,235,719.09	5,803.46	TH	0.4			0.25
	5	3,022,492.51	1,235,862.58	5,783.69	TH		0.4		0.25
	5	3,022,534.86	1,235,727.67	5,803.82	TH	0.4			0.25
	6	3,022,525.51	1,235,874.29	5,783.50	TH		0.4		0.25
	6	3,022,568.97	1,235,735.87	5,804.25	TH	0.4			0.25
	7	3,022,558.95	1,235,884.62	5,783.20	TH		0.4		0.25

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RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 17 (continued)	7	3,022,603.72	1,235,742.00	5,804.93	TH	0.4			0.25
	8	3,022,592.60	1,235,894.29	5,782.67	TH		0.4		0.25
	8	3,022,638.00	1,235,749.69	5,804.97	TH	0.4			0.25
	9	3,022,626.25	1,235,903.97	5,782.09	TH		0.4		0.25
	9	3,022,672.28	1,235,757.32	5,804.96	TH	0.4			0.25
	10	3,022,659.90	1,235,913.62	5,781.50	TH		0.4		0.25
	10	3,022,706.73	1,235,764.44	5,805.07	TH	0.4			0.25
	11	3,022,693.67	1,235,922.92	5,780.95	TH		0.4		0.25
	11	3,022,740.80	1,235,772.78	5,804.93	TH	0.4			0.25
	12	3,022,727.46	1,235,932.14	5,780.42	TH		0.4		0.25
	12	3,022,774.48	1,235,782.34	5,804.53	TH	0.4			0.25
	G1	3,022,330.37	1,235,804.59	5,783.93	TH		0.4		0.25
	G2	3,022,757.80	1,235,942.53	5,781.38	TH		0.4		0.25
	G3	3,022,831.66	1,235,825.12	5,794.99	CB3	0.6668			0.25
	G4	3,022,343.73	1,235,692.74	5,800.84	CB	0			0
Total						**5.2668**	**5.6**	**10.8668**	**6.5**

PARKDALE Section 18	1	3,022,811.58	1,235,960.73	5,783.29	TH		0.4		
	1	3,022,831.66	1,235,825.12	5,794.99	CB3	0			0
	2	3,022,846.01	1,235,967.19	5,782.98	TH		0.4		0.25
	2	3,022,866.63	1,235,827.92	5,795.04	CB3	0.6668			0.25
	3	3,022,880.44	1,235,973.61	5,782.67	TH		0.4		0.25
	3	3,022,901.49	1,235,831.44	5,794.99	CB3	0.6668			0.25
	4	3,022,914.95	1,235,979.49	5,782.37	TH		0.4		0.25
	4	3,022,935.92	1,235,837.85	5,794.55	CB3	0.6668			0.25
	5	3,022,949.51	1,235,985.01	5,782.09	TH		0.4		0.25
	5	3,022,970.38	1,235,844.10	5,794.13	CB3	0.6668			0.25
	6	3,022,984.08	1,235,990.49	5,781.81	TH		0.4		0.25
	6	3,023,004.70	1,235,851.23	5,793.59	CB3	0.6668			0.25
	7	3,023,018.65	1,235,995.93	5,781.53	TH		0.4		0.25
	7	3,023,039.14	1,235,857.57	5,793.16	CB3	0.6668			0.25
	8	3,023,053.13	1,236,002.04	5,781.23	TH		0.4		0.25
	8	3,023,073.57	1,235,864.03	5,792.71	CB3	0.6668			0.25
	9	3,023,087.61	1,236,008.11	5,780.93	TH		0.4		0.25
	9	3,023,108.43	1,235,867.56	5,792.66	CB	0.5			0.25
	10	3,023,122.08	1,236,014.29	5,780.63	TH		0.4		0.25
	10	3,023,142.67	1,235,875.22	5,792.05	CB2	0.5			0.25
	11	3,023,156.56	1,236,020.40	5,780.34	TH		0.4		0.25
	11	3,023,176.86	1,235,883.27	5,791.40	TH	0.4			0.25
	12	3,023,191.20	1,236,025.35	5,780.08	TH		0.4		0.25
	12	3,023,211.25	1,235,889.96	5,790.93	TH	0.4			0.25
	13	3,023,226.13	1,236,028.42	5,779.87	TH		0.4		0.25
	13	3,023,245.67	1,235,896.46	5,790.49	TH	0.4			0.25
	14	3,023,279.91	1,235,904.21	5,789.88	TH		0.4		0.25
	14	3,023,260.93	1,236,032.35	5,779.65	CB3	0.6668			0.25
	15	3,023,314.09	1,235,912.26	5,789.30	TH		0.4		0.25
	15	3,023,295.36	1,236,038.80	5,779.34	CB3	0.6668			0.25

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RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 18 (continued)	16	3,023,348.89	1,235,918.74	5,789.08	TH		0.4		0.25
	16	3,023,328.50	1,236,041.90	5,779.14	CB3	0.6668			0.25
	17	3,023,383.29	1,235,925.25	5,788.81	TH		0.4		0.25
	17	3,023,365.22	1,236,034.36	5,779.24	CB3	0.6668			0.25
	18	3,023,419.60	1,235,935.22	5,788.13	TH		0.4		0.25
	18	3,023,389.26	1,236,039.30	5,778.89	CB3	0.6668			0.25
	19	3,023,453.28	1,235,944.76	5,787.84	TH		0.4		0.25
	19	3,023,422.78	1,236,049.38	5,778.40	CB3	0.6668			0.25
	20	3,023,489.18	1,235,957.06	5,787.43	TH		0.4		0.25
	20	3,023,444.52	1,236,060.56	5,777.93	CB3	0.6668			0.25
	21	3,023,521.06	1,235,971.54	5,786.85	TH		0.4		0.25
	21	3,023,474.99	1,236,078.27	5,777.29	CB3	0.6668			0.25
	22	3,023,548.59	1,235,998.38	5,784.71	TH		0.4		0.25
	22	3,023,499.88	1,236,091.57	5,776.83	CB3	0.6668			0.25
	23	3,023,584.12	1,236,005.96	5,785.03	TH		0.4		0.25
	23	3,023,530.16	1,236,109.18	5,776.23	CB3	0.6668			0.25
	24	3,023,559.72	1,236,128.19	5,775.59	TH		0.4		0.25
	24	3,023,617.90	1,236,016.89	5,784.93	TH	0.4			0.25
	25	3,023,590.52	1,236,144.80	5,775.08	TH		0.4		0.25
	25	3,023,652.98	1,236,025.33	5,785.25	TH	0.4			0.25
	26	3,023,622.01	1,236,160.12	5,774.77	TH		0.4		0.25
	26	3,023,685.40	1,236,038.86	5,785.00	TH	0.4			0.25
	27	3,023,653.73	1,236,174.99	5,774.49	TH		0.4		0.25
	27	3,023,716.61	1,236,054.70	5,784.43	TH	0.4			0.25
	28	3,023,685.48	1,236,189.81	5,774.22	TH		0.4		0.25
	28	3,023,746.22	1,236,073.61	5,783.45	CB3	0.6668			0.25
	29	3,023,717.29	1,236,204.50	5,773.95	TH		0.4		0.25
	29	3,023,774.36	1,236,095.33	5,782.15	CB3	0.6668			0.25
	G1	3,022,773.17	1,235,946.17	5,781.19	TH		0.4		0.25
	G2	3,023,754.65	1,236,226.69	5,775.29	CB3		0.6668		0.25
	G3	3,023,825.96	1,236,118.17	5,786.59	TH	0.4			0.25
	G4	3,022,760.34	1,235,789.64	5,798.49	CB3	0			0
Total						**16.8692**	**12.6668**	**29.536**	**14.75**

PARKDALE Section 19	1	3,023,779.51	1,236,243.41	5,777.06	TH	0			0
	1	3,023,825.96	1,236,118.17	5,786.59	TH		0.4		0.25
	2	3,023,810.95	1,236,259.28	5,777.01	TH	0.4			0.25
	2	3,023,855.76	1,236,138.48	5,785.73	TH		0.4		0.25
	3	3,023,842.40	1,236,275.15	5,776.97	TH	0.4			0.25
	3	3,023,887.72	1,236,152.94	5,785.61	TH		0.4		0.25
	4	3,023,876.21	1,236,284.62	5,777.07	TH	0.4			0.25
	4	3,023,920.26	1,236,165.85	5,785.67	TH		0.4		0.25
	5	3,023,950.52	1,236,184.93	5,785.00	TH	0.4			0.25
	5	3,023,910.32	1,236,293.30	5,777.21	CB3		0.6668		0.25
	6	3,023,982.03	1,236,206.44	5,784.37	TH	0.4			0.25
	6	3,023,937.88	1,236,299.81	5,777.38	CB3		0.6668		0.25
	7	3,023,959.89	1,236,335.13	5,776.89	TH	0.4			0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 19 (continued)	7	3,024,012.19	1,236,224.55	5,784.27	TH		0.4		0.25
	8	3,023,974.23	1,236,342.66	5,776.90	TH	0.4			0.25
	8	3,024,047.05	1,236,243.24	5,784.56	TH		0.4		0.25
	9	3,024,005.76	1,236,358.86	5,776.94	TH	0.4			0.25
	9	3,024,077.53	1,236,260.86	5,784.83	TH		0.4		0.25
	10	3,024,037.76	1,236,374.39	5,777.01	TH	0.4			0.25
	10	3,024,097.82	1,236,292.39	5,783.30	TH		0.4		0.25
	11	3,024,069.96	1,236,391.45	5,777.02	TH	0.4			0.25
	11	3,024,122.57	1,236,310.73	5,783.02	TH		0.4		0.25
	12	3,024,100.72	1,236,408.34	5,776.91	TH	0.4			0.25
	12	3,024,163.81	1,236,311.55	5,784.86	TH		0.4		0.25
	13	3,024,133.19	1,236,425.34	5,776.80	TH	0.4			0.25
	13	3,024,185.76	1,236,326.00	5,784.53	TH		0.4		0.25
	14	3,024,163.82	1,236,440.54	5,776.72	TH	0.4			0.25
	14	3,024,214.85	1,236,344.12	5,784.19	TH		0.4		0.25
	15	3,024,195.25	1,236,455.99	5,776.65	TH	0.4			0.25
	15	3,024,244.16	1,236,363.55	5,783.74	TH		0.4		0.25
	G1	3,023,754.65	1,236,226.69	5,775.29	CB3		0		0
	G2	3,024,221.14	1,236,466.80	5,776.03	TH		0.4		0.25
	G3	3,024,279.41	1,236,389.92	5,782.22	TH	0.4			0.25
	G4	3,023,774.36	1,236,095.33	5,782.15	CB3	0			0
Total						**6**	**6.9336**	**12.9336**	**7.75**

PARKDALE Section 20	1	3,024,294.83	1,236,507.93	5,776.51	TH		0.4		0.25
	1	3,024,332.63	1,236,415.23	5,783.52	TH	0.4			0.25
	2	3,024,327.37	1,236,520.83	5,776.37	TH		0.4		0.25
	2	3,024,363.32	1,236,432.67	5,782.90	TH	0.4			0.25
	3	3,024,359.01	1,236,535.92	5,776.15	TH		0.4		0.25
	3	3,024,390.25	1,236,459.32	5,781.34	TH	0.4			0.25
	4	3,024,390.66	1,236,550.99	5,775.94	TH		0.4		0.25
	4	3,024,419.44	1,236,480.42	5,780.43	TH	0.4			0.25
	5	3,024,422.38	1,236,565.90	5,775.73	TH		0.4		0.25
	5	3,024,453.66	1,236,489.19	5,780.70	TH	0.4			0.25
	6	3,024,454.07	1,236,580.88	5,775.52	TH		0.4		0.25
	6	3,024,486.11	1,236,502.30	5,780.55	TH	0.4			0.25
	7	3,024,485.94	1,236,595.41	5,775.32	TH		0.4		0.25
	7	3,024,526.13	1,236,496.84	5,782.35	TH	0.4			0.25
	8	3,024,517.34	1,236,611.11	5,775.10	TH		0.4		0.25
	8	3,024,559.20	1,236,508.45	5,782.39	TH	0.4			0.25
	9	3,024,549.37	1,236,625.23	5,774.92	TH		0.4		0.25
	9	3,024,592.33	1,236,519.89	5,782.44	TH	0.4			0.25
	10	3,024,581.59	1,236,638.93	5,774.76	TH		0.4		0.25
	10	3,024,625.04	1,236,532.36	5,782.37	TH	0.4			0.25
	11	3,024,613.19	1,236,654.12	5,774.55	TH		0.4		0.25
	11	3,024,656.92	1,236,546.87	5,782.07	TH	0.4			0.25
	12	3,024,643.40	1,236,668.66	5,774.36	TH		0.4		0.25
	12	3,024,689.77	1,236,560.64	5,781.91	TH	0.4			0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 20 (continued)	13	3,024,670.87	1,236,681.69	5,774.17	TH		0.4		0.25
	13	3,024,724.28	1,236,574.01	5,782.03	TH	0.4			0.25
	14	3,024,702.11	1,236,697.47	5,773.92	TH		0.4		0.25
	14	3,024,754.30	1,236,592.26	5,781.46	TH	0.4			0.25
	15	3,024,733.67	1,236,712.61	5,773.68	TH		0.4		0.25
	15	3,024,787.80	1,236,603.48	5,781.73	TH	0.4			0.25
	16	3,024,764.95	1,236,728.31	5,773.43	TH		0.4		0.25
	16	3,024,819.75	1,236,617.83	5,781.63	TH	0.4			0.25
	17	3,024,795.90	1,236,744.68	5,773.16	TH		0.4		0.25
	17	3,024,852.55	1,236,630.46	5,781.74	TH	0.4			0.25
	18	3,024,827.47	1,236,759.80	5,772.92	TH		0.4		0.25
	18	3,024,881.48	1,236,650.91	5,780.89	CB3	0.6668			0.25
	19	3,024,859.10	1,236,774.78	5,772.69	TH		0.4		0.25
	19	3,024,914.49	1,236,663.10	5,781.05	CB3	0.6668			0.25
	20	3,024,943.39	1,236,683.60	5,780.20	CB3		0.6668		0.25
	20	3,024,891.06	1,236,789.12	5,772.47	CB	0.5			0.25
	21	3,024,973.14	1,236,702.40	5,779.56	CB		0.5		0.25
	21	3,024,922.08	1,236,805.34	5,772.21	CB	0.5			0.25
	G1	3,024,273.59	1,236,494.41	5,776.26	TH		0.4		0.25
	G2	3,024,953.54	1,236,811.87	5,768.77	CB3		0.6668		0.25
	G3	3,025,050.62	1,236,712.16	5,784.26	TH	0.4			0.25
	G4	3,024,279.41	1,236,389.92	5,782.22	TH	0			0
Total						**9.5336**	**9.8336**	**19.3672**	**11.25**

PARKDALE Section 21	1	3,024,982.37	1,236,845.84	5,775.54	TH		0.4		0.25
	1	3,025,050.62	1,236,712.16	5,784.26	TH	0			0
	2	3,025,013.82	1,236,861.20	5,775.60	TH		0.4		0.25
	2	3,025,083.15	1,236,725.41	5,784.65	TH	0.4			0.25
	3	3,025,045.68	1,236,875.76	5,775.66	TH		0.4		0.25
	3	3,025,115.47	1,236,739.08	5,785.00	TH	0.4			0.25
	4	3,025,077.78	1,236,889.86	5,775.73	TH		0.4		0.25
	4	3,025,148.05	1,236,752.25	5,785.41	TH	0.4			0.25
	5	3,025,109.38	1,236,904.95	5,775.79	TH		0.4		0.25
	5	3,025,180.61	1,236,765.43	5,785.83	TH	0.4			0.25
	6	3,025,140.78	1,236,920.42	5,775.85	TH		0.4		0.25
	6	3,025,212.87	1,236,779.22	5,786.17	TH	0.4			0.25
	7	3,025,172.17	1,236,935.91	5,775.91	TH		0.4		0.25
	7	3,025,245.27	1,236,792.72	5,786.56	TH	0.4			0.25
	8	3,025,203.57	1,236,951.36	5,775.97	TH		0.4		0.25
	8	3,025,277.06	1,236,807.43	5,786.78	TH	0.4			0.25
	9	3,025,235.98	1,236,964.86	5,776.05	TH		0.4		0.25
	9	3,025,310.32	1,236,819.27	5,787.41	TH	0.4			0.25
	10	3,025,267.99	1,236,979.14	5,776.13	TH		0.4		0.25
	10	3,025,339.66	1,236,838.76	5,786.96	TH	0.4			0.25
	11	3,025,368.71	1,236,858.83	5,786.44	TH		0.4		0.25
	11	3,025,300.11	1,236,993.19	5,776.21	TH	0.4			0.25
	G1	3,024,953.54	1,236,811.87	5,768.77	CB		0		0

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TH = Track Hoe mounted drill
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FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
	G2	3,025,331.80	1,237,002.08	5,773.87	CB		0.5		0.25
	G3	3,025,448.66	1,236,875.94	5,785.95	TH	0.4			0.25
	G4	3,025,005.57	1,236,707.02	5,781.34	CB3	0.6668			0.25
Total						**5.0668**	**4.9**	**9.9668**	**6**
PARKDALE Section 22	1	3,025,364.01	1,237,016.55	5,774.59	TH	0.4			0.25
	1	3,025,415.29	1,236,865.35	5,785.79	TH		0.4		0.25
	2	3,025,396.60	1,237,029.44	5,774.50	TH	0			0
	2	3,025,448.66	1,236,875.94	5,785.95	TH		0.4		0.25
	3	3,025,429.21	1,237,042.25	5,774.41	TH	0.4			0.25
	3	3,025,481.56	1,236,887.90	5,785.94	TH		0.4		0.25
	4	3,025,462.19	1,237,053.99	5,774.34	TH	0.4			0.25
	4	3,025,514.20	1,236,900.62	5,785.82	TH		0.4		0.25
	5	3,025,547.98	1,236,909.99	5,786.16	TH	0.4			0.25
	5	3,025,495.28	1,237,065.41	5,774.27	CB		0.5		0.25
	6	3,025,581.69	1,236,919.58	5,786.48	TH	0.4			0.25
	6	3,025,528.14	1,237,077.49	5,774.19	CB		0.5		0.25
	7	3,025,615.35	1,236,929.30	5,786.79	TH	0.4			0.25
	7	3,025,561.13	1,237,089.18	5,774.12	CB		0.5		0.25
	8	3,025,648.71	1,236,939.92	5,786.97	TH	0.4			0.25
	8	3,025,594.38	1,237,100.11	5,774.07	CB		0.5		0.25
	9	3,025,682.12	1,236,950.38	5,787.18	TH	0.4			0.25
	9	3,025,627.57	1,237,111.23	5,774.01	CB		0.5		0.25
	10	3,025,713.64	1,236,966.39	5,786.58	TH	0.4			0.25
	10	3,025,662.17	1,237,118.19	5,774.04	CB		0.5		0.25
	11	3,025,743.32	1,236,987.87	5,785.24	TH	0.4			0.25
	11	3,025,695.17	1,237,129.84	5,773.97	CB		0.5		0.25
	12	3,025,776.37	1,236,999.38	5,785.29	TH	0.4			0.25
	12	3,025,729.25	1,237,138.32	5,773.99	CB		0.5		0.25
	G1	3,025,331.80	1,237,002.08	5,773.87	CB		0		0
	G2	3,025,784.97	1,237,168.32	5,779.29	TH		0.4		0.25
	G3	3,025,820.49	1,237,029.76	5,778.04	CB	0.5			0.25
	G4	3,025,339.66	1,236,838.76	5,786.96	CB3	0			0
Total						**4.9**	**6**	**10.9**	**6.25**
PARKDALE Section 23	1	3,025,784.97	1,237,168.32	5,779.29	TH		0		0
	1	3,025,820.49	1,237,029.76	5,778.04	CB3	0			0
	2	3,025,818.75	1,237,177.49	5,779.43	TH		0.4		0.25
	2	3,025,861.02	1,237,012.63	5,779.52	CB3	0.6668			0.25
	3	3,025,853.04	1,237,184.68	5,779.45	TH		0.4		0.25
	3	3,025,891.37	1,237,035.16	5,778.83	CB3	0.6668			0.25
	4	3,025,886.56	1,237,194.87	5,779.65	TH		0.4		0.25
	4	3,025,924.67	1,237,046.21	5,778.82	CB3	0.6668			0.25
	5	3,025,920.35	1,237,203.99	5,779.78	TH		0.4		0.25
	5	3,025,960.99	1,237,045.47	5,779.44	CB3	0.6668			0.25
	6	3,025,954.37	1,237,212.23	5,779.86	TH		0.4		0.25
	6	3,025,993.89	1,237,058.10	5,779.33	CB3	0.6668			0.25

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RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 23 (continued)	7	3,025,988.40	1,237,220.44	5,779.94	TH		0.4		0.25
	7	3,026,027.96	1,237,066.13	5,779.47	CB3	0.6668			0.25
	8	3,026,022.11	1,237,229.88	5,780.09	TH		0.4		0.25
	8	3,026,062.59	1,237,072.00	5,779.74	CB3	0.6668			0.25
	9	3,026,055.07	1,237,242.24	5,780.44	TH		0.4		0.25
	9	3,026,096.89	1,237,079.12	5,779.94	CB	0.5			0.25
	10	3,026,088.55	1,237,252.58	5,780.65	TH		0.4		0.25
	10	3,026,130.51	1,237,088.94	5,779.98	CB	0.5			0.25
	11	3,026,122.22	1,237,262.19	5,780.82	TH		0.4		0.25
	11	3,026,164.06	1,237,099.00	5,780.01	CB	0.5			0.25
	12	3,026,156.07	1,237,271.09	5,780.95	TH		0.4		0.25
	12	3,026,197.69	1,237,108.78	5,780.06	CB	0.5			0.25
	13	3,026,189.85	1,237,280.27	5,781.09	TH		0.4		0.25
	13	3,026,231.46	1,237,117.96	5,780.14	CB	0.5			0.25
	14	3,026,222.79	1,237,292.73	5,781.45	TH		0.4		0.25
	14	3,026,265.43	1,237,126.40	5,780.27	TH	0.4			0.25
	G1	3,025,729.25	1,237,138.32	5,773.99	CB		0		0
	G2	3,026,296.47	1,237,307.97	5,778.51	CB3		0.6668		0.25
	G3	3,026,315.49	1,237,142.16	5,778.65	TH	0.4			0.25
	G4	3,025,776.37	1,236,999.38	5,785.29	CB3	0			0
Total						**7.9676**	**5.8668**	**13.8344**	**7**
PARKDALE Section 24	1	3,026,240.43	1,237,294.95	5,780.86	TH		0.4		0.25
	1	3,026,296.96	1,237,135.65	5,779.51	TH	0.4	0.4		0.25
	2	3,026,273.86	1,237,305.39	5,780.75	TH		0.4		0.25
	2	3,026,330.85	1,237,144.79	5,779.64	TH	0.4	0.4		0.25
	3	3,026,306.86	1,237,317.06	5,780.73	TH		0.4		0.25
	3	3,026,364.87	1,237,153.59	5,779.80	TH	0.4	0.4		0.25
	4	3,026,338.83	1,237,331.61	5,780.93	TH		0.4		0.25
	4	3,026,399.20	1,237,161.50	5,780.01	TH	0.4	0.4		0.25
	5	3,026,370.39	1,237,347.33	5,781.21	TH		0.4		0.25
	5	3,026,433.46	1,237,169.61	5,780.23	TH	0.4	0.4		0.25
	6	3,026,401.24	1,237,365.07	5,781.67	TH		0.4		0.25
	6	3,026,467.44	1,237,178.49	5,780.40	TH	0.4	0.4		0.25
	G1	3,026,177.31	1,237,269.12	5,778.17	TH		0.4		0.25
	G2	3,026,486.79	1,237,402.20	5,781.06	TH		0.4		0.25
	G3	3,026,526.84	1,237,205.57	5,774.68	TH	0.4			0.25
	G4	3,026,251.23	1,237,127.65	5,777.83	CB3	0.6668			0.25
Total						**3.4668**	**5.6**	**9.0668**	**4**
PARKDALE Section 25	1	3,026,423.16	1,237,371.96	5,780.91	TH		0.4		
	1	3,026,526.84	1,237,205.57	5,774.68	TH	0			0
	2	3,026,454.75	1,237,387.44	5,781.03	TH		0.4		0.25
	2	3,026,561.27	1,237,216.50	5,775.00	CB	0.5			0.25
	3	3,026,486.79	1,237,402.20	5,781.06	TH		0		0
	3	3,026,593.10	1,237,231.61	5,775.16	CB	0.5			0.25
	4	3,026,519.11	1,237,416.52	5,780.78	TH		0.4		0.25

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RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 25 (continued)	4	3,026,617.19	1,237,259.13	5,774.84	TH	0.4			0.25
	5	3,026,551.34	1,237,430.97	5,780.43	TH		0.4		0.25
	5	3,026,652.10	1,237,269.29	5,775.32	TH	0.4			0.25
	6	3,026,583.77	1,237,445.11	5,780.08	TH		0.4		0.25
	6	3,026,687.07	1,237,279.34	5,775.77	TH	0.4			0.25
	7	3,026,620.01	1,237,459.59	5,779.64	TH		0.4		0.25
	7	3,026,703.84	1,237,286.52	5,775.73	TH	0.4			0.25
	8	3,026,652.12	1,237,473.60	5,779.51	TH		0.4		0.25
	8	3,026,740.45	1,237,291.23	5,775.96	TH	0.4			0.25
	9	3,026,688.07	1,237,490.67	5,779.64	TH		0.4		0.25
	9	3,026,752.65	1,237,292.14	5,776.04	TH	0.4			0.25
	10	3,026,719.95	1,237,505.83	5,779.89	TH		0.4		0.25
	10	3,026,791.19	1,237,286.79	5,776.88	TH	0.4			0.25
	11	3,026,753.63	1,237,515.42	5,779.73	TH		0.4		0.25
	11	3,026,829.58	1,237,281.92	5,777.80	TH	0.4			0.25
	12	3,026,793.43	1,237,524.78	5,779.50	TH		0.4		0.25
	12	3,026,835.62	1,237,282.63	5,777.79	TH	0.4			0.25
	13	3,026,827.43	1,237,533.58	5,779.90	TH		0.4		0.25
	13	3,026,870.29	1,237,287.56	5,777.70	TH	0.4			0.25
	14	3,026,864.50	1,237,543.63	5,780.39	TH		0.4		0.25
	14	3,026,891.87	1,237,291.10	5,777.60	TH	0.4			0.25
	G1	3,026,338.83	1,237,331.61	5,780.93	TH		0		0
	G2	3,026,940.46	1,237,551.22	5,777.29	TH		0.4		0.25
	G3	3,027,001.42	1,237,320.62	5,770.37	CB3	0.6668			0.25
	G4	3,026,467.44	1,237,178.49	5,780.40	TH	0			0
Total						**6.0668**	**5.6**	**11.6668**	**6.75**

PARKDALE Section 26	1	3,027,127.06	1,237,324.55	5,779.21	TH	0.4			0.25
	1	3,027,122.24	1,237,582.19	5,784.23	RUBBER TRACK		0.5		0.25
	2	3,027,161.96	1,237,330.26	5,778.80	TH	0.4			0.25
	2	3,027,157.70	1,237,558.08	5,781.62	RUBBER TRACK		0.5		0.25
	3	3,027,196.85	1,237,336.39	5,778.37	TH	0.4			0.25
	3	3,027,192.86	1,237,550.05	5,780.77	RUBBER TRACK		0.5		0.25
	4	3,027,231.74	1,237,342.23	5,777.98	TH	0.4			0.25
	4	3,027,227.92	1,237,547.03	5,780.38	RUBBER TRACK		0.5		0.25
	5	3,027,266.63	1,237,348.52	5,777.59	TH	0.4			0.25
	5	3,027,263.05	1,237,540.52	5,779.72	RUBBER TRACK		0.5		0.25
	6	3,027,301.53	1,237,354.37	5,777.24	CB3	0.6668			0.25
	6	3,027,298.05	1,237,540.82	5,779.62	RUBBER TRACK		0.5		0.25
	7	3,027,336.44	1,237,359.60	5,776.95	CB3	0.6668			0.25
	7	3,027,333.05	1,237,540.77	5,779.49	RUBBER TRACK		0.5		0.25
	8	3,027,374.53	1,237,365.92	5,776.67	CB3	0.6668			0.25
	8	3,027,349.39	1,237,540.21	5,779.38	RUBBER TRACK		0.5		0.25

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Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 26 (continued)	9	3,027,409.36	1,237,369.65	5,776.66	CB3	0.6668			0.25
	9	3,027,384.83	1,237,539.66	5,778.89	RUBBER TRACK		0.5		0.25
	10	3,027,444.25	1,237,372.94	5,776.67	CB3	0.6668			0.25
	10	3,027,420.15	1,237,539.99	5,778.49	RUBBER TRACK		0.5		0.25
	11	3,027,479.06	1,237,376.72	5,776.66	CB3	0.6668			0.25
	11	3,027,455.44	1,237,540.46	5,778.11	RUBBER TRACK		0.5		0.25
	12	3,027,513.84	1,237,380.79	5,776.63	CB3	0.6668			0.25
	12	3,027,489.73	1,237,547.93	5,778.22	RUBBER TRACK		0.5		0.25
	13	3,027,548.70	1,237,384.22	5,776.64	CB3	0.6668			0.25
	13	3,027,523.49	1,237,559.02	5,778.60	CB3		0.6668		0.25
	14	3,027,583.64	1,237,387.17	5,776.68	TH	0.4			0.25
	14	3,027,558.25	1,237,563.20	5,778.47	RUBBER TRACK		0.5		0.25
	G1	3,027,005.41	1,237,568.06	5,776.84	RUBBER TRACK		0.5		0.25
	G2	3,027,037.21	1,237,316.91	5,775.83	CB3		0.6668		0.25
	G3	3,027,608.66	1,237,551.41	5,774.34	TH	0.4			0.25
	G4	3,027,640.15	1,237,397.65	5,774.56	CB3	0.6668			0.25
Total						**8.8012**	**8.3336**	**17.1348**	**8**

PARKDALE Section 27	1	3,027,623.64	1,237,398.01	5,773.55	TH	0.4			0.25
	1	3,027,608.66	1,237,551.41	5,774.34	CB		0		0
	2	3,027,658.38	1,237,402.36	5,772.80	TH	0.4			0.25
	2	3,027,642.90	1,237,560.86	5,774.02	CB		0.5		0.25
	3	3,027,693.12	1,237,406.71	5,772.05	TH	0.4			0.25
	3	3,027,677.19	1,237,569.89	5,773.69	CB3		0.6668		0.25
	4	3,027,727.86	1,237,411.15	5,771.30	TH	0.4			0.25
	4	3,027,711.25	1,237,581.18	5,773.55	CB3		0.6668		0.25
	5	3,027,756.57	1,237,414.48	5,770.69	TH	0.4			0.25
	5	3,027,749.37	1,237,581.99	5,772.58	CB3		0.6668		0.25
	6	3,027,791.46	1,237,417.67	5,770.11	TH	0.4			0.25
	6	3,027,784.41	1,237,581.83	5,772.15	CB3		0.6668		0.25
	7	3,027,800.26	1,237,418.34	5,770.00	TH	0.4			0.25
	7	3,027,832.35	1,237,582.64	5,772.12	CB3		0.6668		0.25
	8	3,027,835.94	1,237,418.43	5,769.42	TH	0.4			0.25
	8	3,027,867.63	1,237,580.71	5,772.00	CB3		0.6668		0.25
	9	3,027,869.91	1,237,409.77	5,768.92	TH	0.4			0.25
	9	3,027,902.06	1,237,574.42	5,771.40	CB3		0.6668		0.25
	10	3,027,902.91	1,237,396.14	5,768.66	TH	0.4			0.25
	10	3,027,936.48	1,237,568.06	5,770.80	CB3		0.6668		0.25
	G1	3,027,523.49	1,237,559.02	5,778.60	RUBBER TRACK		0		0
	G2	3,028,032.15	1,237,548.78	5,760.71	CB3		0.6668		0.25
	G3	3,027,943.89	1,237,396.37	5,761.17	TH	0.4			0.25
	G4	3,027,567.34	1,237,393.90	5,772.78	CB3	0.6668			0.25
Total						**5.0668**	**6.5012**	**11.568**	**5.5**

CB = Crane Basket
TH = Track Hoe mounted drill
TH* = Track Hoe assembled off train car
FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 28	1	3,027,985.18	1,237,379.37	5,763.38	TH	0.4			0.25
	1	3,028,032.15	1,237,548.78	5,760.71	CB3		0		0
	2	3,028,019.00	1,237,370.34	5,763.10	TH	0.4			0.25
	2	3,028,068.01	1,237,547.13	5,760.86	TH		0.4		0.25
	3	3,028,052.42	1,237,359.90	5,762.93	TH	0.4			0.25
	3	3,028,100.28	1,237,532.53	5,760.33	TH		0.4		0.25
	4	3,028,085.81	1,237,349.32	5,762.78	TH	0.4			0.25
	4	3,028,133.59	1,237,521.65	5,760.01	TH		0.4		0.25
	5	3,028,119.11	1,237,338.44	5,762.66	TH	0.4			0.25
	5	3,028,168.13	1,237,515.24	5,759.90	TH		0.4		0.25
	6	3,028,152.62	1,237,328.33	5,762.47	TH	0.4			0.25
	6	3,028,204.09	1,237,513.94	5,760.10	TH		0.4		0.25
	7	3,028,186.12	1,237,318.15	5,762.29	TH	0.4			0.25
	7	3,028,238.61	1,237,507.44	5,760.02	TH		0.4		0.25
	8	3,028,220.43	1,237,310.91	5,761.86	TH	0.4			0.25
	8	3,028,273.27	1,237,501.46	5,759.97	TH		0.4		0.25
	9	3,028,254.97	1,237,304.48	5,761.37	TH	0.4			0.25
	9	3,028,308.14	1,237,496.24	5,759.99	TH		0.4		0.25
	10	3,028,288.75	1,237,295.33	5,761.11	TH	0.4			0.25
	10	3,028,343.86	1,237,494.07	5,760.23	CB3		0.6668		0.25
	11	3,028,322.64	1,237,286.57	5,760.81	TH	0.4			0.25
	11	3,028,380.35	1,237,494.67	5,760.74	CB3		0.6668		0.25
	12	3,028,357.03	1,237,279.59	5,760.37	TH	0.4			0.25
	12	3,028,418.14	1,237,499.99	5,761.73	CB3		0.6668		0.25
	G1	3,027,972.03	1,237,545.79	5,758.48	TH		0.4		0.25
	G2	3,028,534.69	1,237,458.42	5,753.14	CB3		0.6668		0.25
	G3	3,028,396.99	1,237,275.48	5,758.54	CB	0.5			0.25
	G4	3,027,943.89	1,237,396.37	5,761.17	CB3	0			0
Total						**5.3**	**6.2672**	**11.5672**	**6.5**

PARKDALE Section 29	1	3,028,464.12	1,237,266.14	5,758.83	TH	0.4			0.25
	1	3,028,455.95	1,237,519.42	5,770.27	CB3		0.6668		0.25
	2	3,028,499.21	1,237,263.77	5,758.98	TH	0.4			0.25
	2	3,028,490.97	1,237,519.23	5,770.07	CB		0.5		0.25
	3	3,028,537.14	1,237,263.13	5,759.09	TH	0.4			0.25
	3	3,028,496.31	1,237,519.47	5,770.10	CB		0.5		0.25
	4	3,028,572.26	1,237,265.18	5,759.15	TH	0.4			0.25
	4	3,028,531.56	1,237,520.71	5,769.84	CB		0.5		0.25
	5	3,028,613.82	1,237,268.33	5,759.46	TH	0.4			0.25
	5	3,028,515.01	1,237,520.46	5,770.21	CB		0.5		0.25
	6	3,028,647.52	1,237,278.25	5,759.55	CB3	0.6668			0.25
	6	3,028,552.23	1,237,521.40	5,769.17	CB3		0.6668		0.25
	7	3,028,691.25	1,237,290.69	5,759.86	CB	0.5			0.25
	7	3,028,523.16	1,237,520.76	5,769.95	CB		0.5		0.25
	8	3,028,719.89	1,237,310.83	5,759.49	CB3	0.6668			0.25
	8	3,028,566.77	1,237,520.39	5,767.98	CB3		0.6668		0.25

CB = Crane Basket
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RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

Anchor and Anchor Transition Frame (ATF) Instalation Schedule (continued)

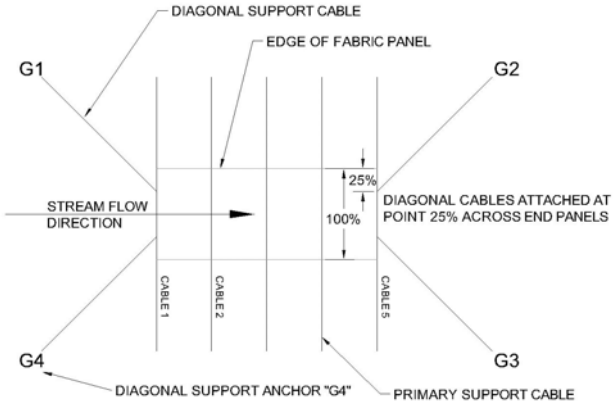
	CABLE	EASTING	NORTHING	ELEV	INSTALL TYPE	DAYS SOUTH HWY SIDE	DAYS NORTH RR SIDE	ANCHOR INSTALLATION DAYS/SECTION	ASSEM. ATF DAYS
PARKDALE Section 29 (continued)	9	3,028,718.39	1,237,309.86	5,759.50	CB3	0.6668			0.25
	9	3,028,652.70	1,237,487.35	5,760.59	TH		0.4		0.25
	10	3,028,744.16	1,237,341.06	5,758.34	CB3	0.6668			0.25
	10	3,028,693.76	1,237,477.25	5,758.63	TH		0.4		0.25
	11	3,028,742.78	1,237,339.67	5,758.40	CB3	0.6668			0.25
	11	3,028,733.79	1,237,481.15	5,758.04	TH		0.4		0.25
	12	3,028,776.10	1,237,367.32	5,757.20	CB3	0.6668			0.25
	12	3,028,768.75	1,237,482.82	5,757.58	TH		0.4		0.25
	G1	3,028,308.03	1,237,495.82	5,759.96	TH		0		0
	G2	3,028,838.33	1,237,492.61	5,760.61	CB3		0.6668		0.25
	G3	3,028,791.43	1,237,376.74	5,753.00	CB3	0.6668			0.25
	G4	3,028,430.70	1,237,272.54	5,757.74	CB3	0.6668			0.25
Total						**7.8344**	**6.7672**	**14.6016**	**6.75**

PARKDALE Section 30	1	3,028,841.59	1,237,366.57	5,760.16	CB3	0.6668			0.25
	1	3,028,838.33	1,237,492.61	5,760.61	CB3		0		0
	2	3,028,877.57	1,237,329.33	5,761.89	TH	0.4			0.25
	2	3,028,873.17	1,237,499.22	5,760.89	TH		0.4		0.25
	3	3,028,901.02	1,237,323.78	5,762.08	TH	0.4			0.25
	3	3,028,911.32	1,237,521.01	5,762.21	TH		0.4		0.25
	4	3,028,936.14	1,237,325.17	5,761.71	TH	0.4			0.25
	4	3,028,946.75	1,237,528.34	5,762.73	TH		0.4		0.25
	G1	3,028,813.53	1,237,480.30	5,754.13	CB		0.5		0.25
	G2	3,028,978.32	1,237,488.66	5,750.73	TH		0.4		0.25
	G3	3,029,001.59	1,237,341.96	5,757.93	CB3	0.6668			0.25
	G4	3,028,814.73	1,237,379.24	5,752.15	CB2	0.5			0.25
Total						**3.0336**	**2.1**	**5.1336**	**2.75**

TOTAL DAYS	**547.408**	**518.6192**		**547.75**
TOTAL HWY/RR		**1,066.0272**		

Areas of Disturbance
Anchors:[1,2] 82,305 sq ft
Track Hoe: 74,160 sq ft
Foot: 7,181 sq ft
Rubber Tire: 6,441 sq ft
Rubber Track: 42,134 sq ft

[1]Anchors are centered on an oriented 8'X6' ellipse.
[2]When multiple anchors are co-located, the areas are combined.



CB = Crane Basket
TH = Track Hoe mounted drill
TH* = Track Hoe assembled off train car
FOOT = Hand carried drill, trailing air hose
RUBBER TRACK = Rubber track drill
RUBBER TIRE = Rubber Tire Drill

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/19/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
COUNTYLINE AREA
SECTION 01
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

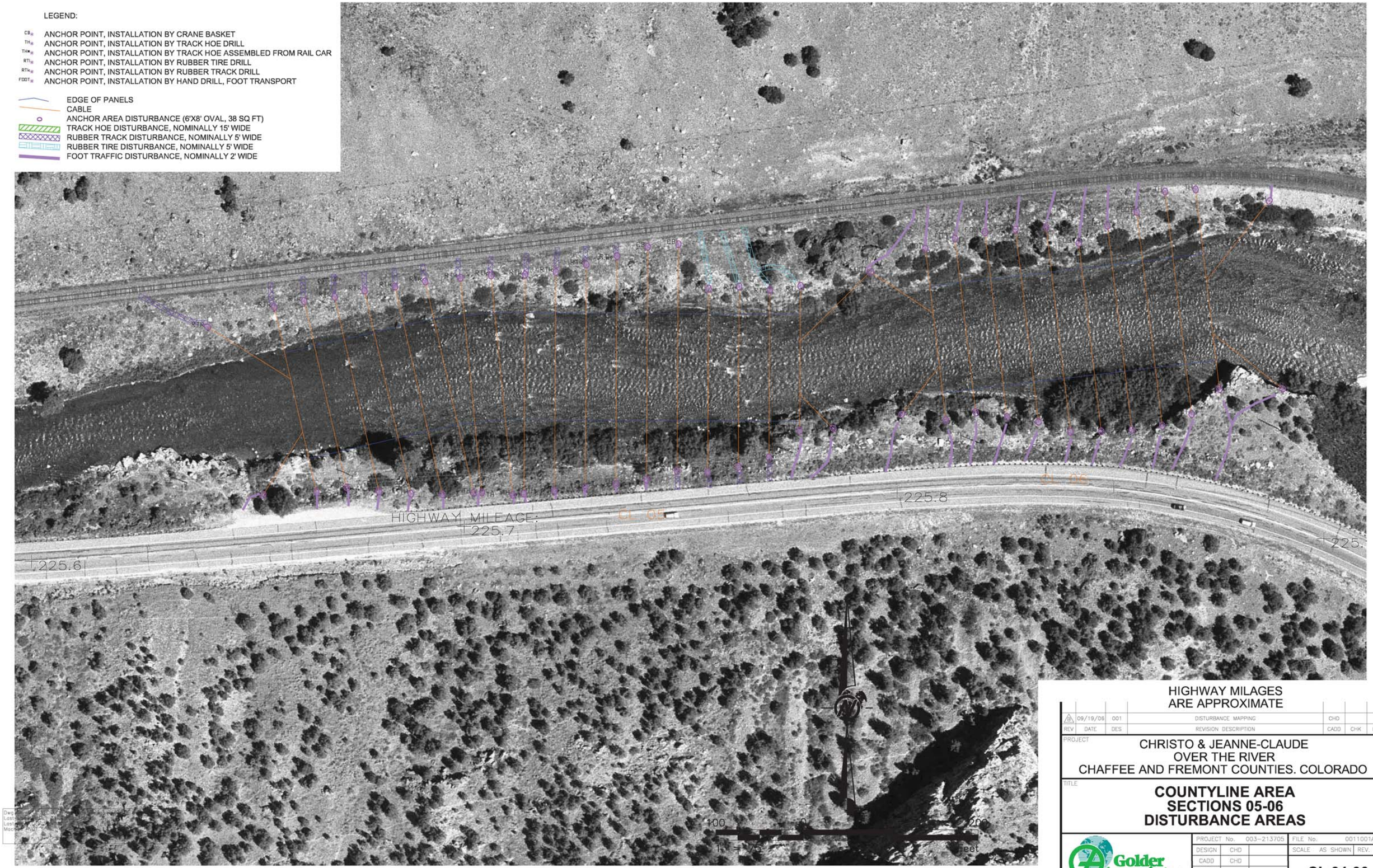
PROJECT No.	003-213705	FILE No.	0011001A001
DESIGN	CHD	SCALE AS SHOWN	REV. A
CADD	CHD		
CHECK			
REVIEW			

CL 01-03

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THR ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE



HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
3	09/19/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
COUNTYLINE AREA
SECTIONS 05-06
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No.	0011001A001
DESIGN	CHD	SCALE	AS SHOWN
CADD	CHD	REV.	A
CHECK			
REVIEW			

CL 04-06

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THM ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
3	09/20/08	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
TUNNEL AREA
SECTIONS 01-02
DISTURBANCE AREAS

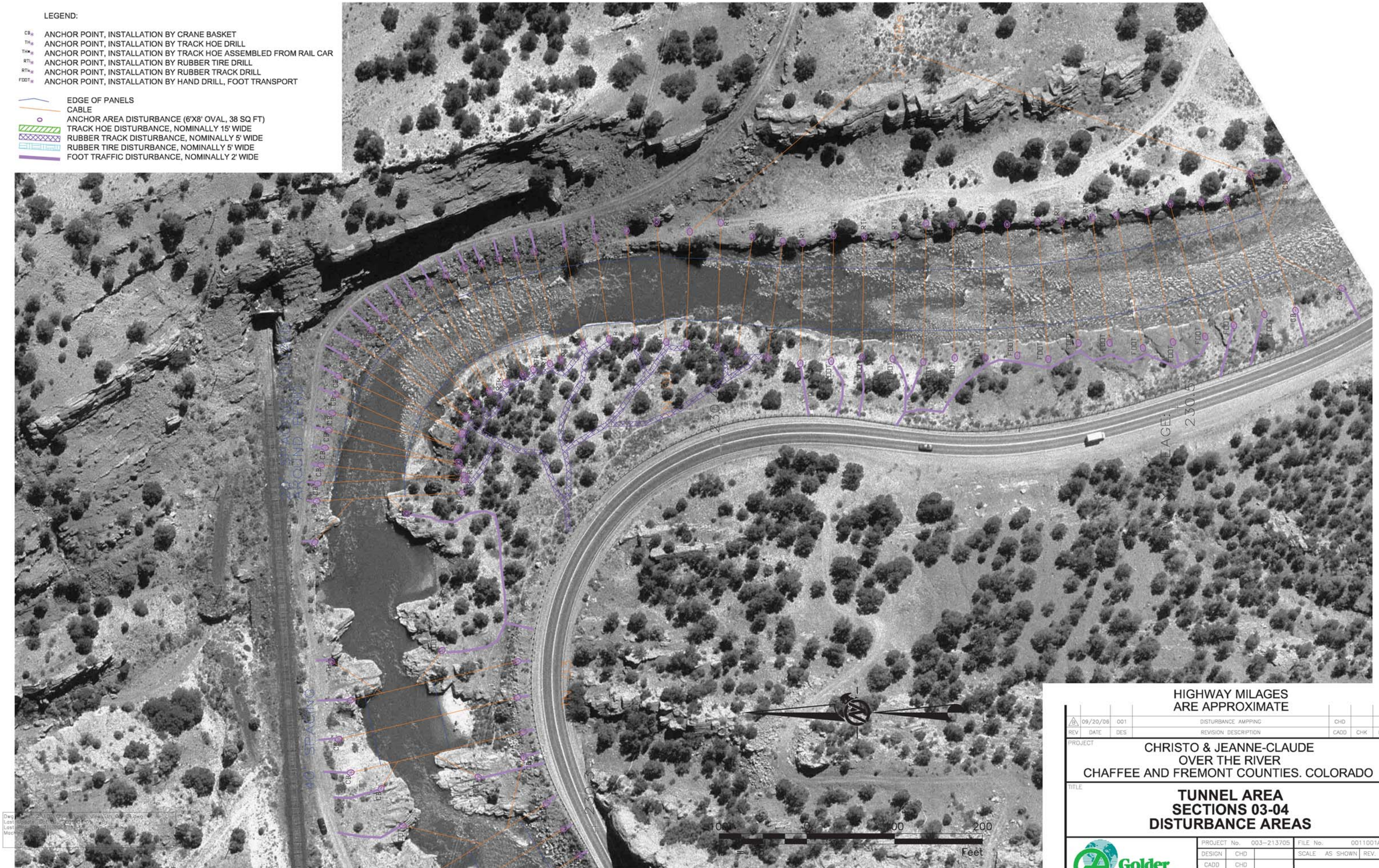
Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No. 0011001A001
DESIGN	CHD	SCALE AS SHOWN REV. A
CADD	CHD	
CHECK		**TN 01-02**
REVIEW		

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THA ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE



HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	09/20/06	001	DISTURBANCE AMPPING	CHD		

PROJECT

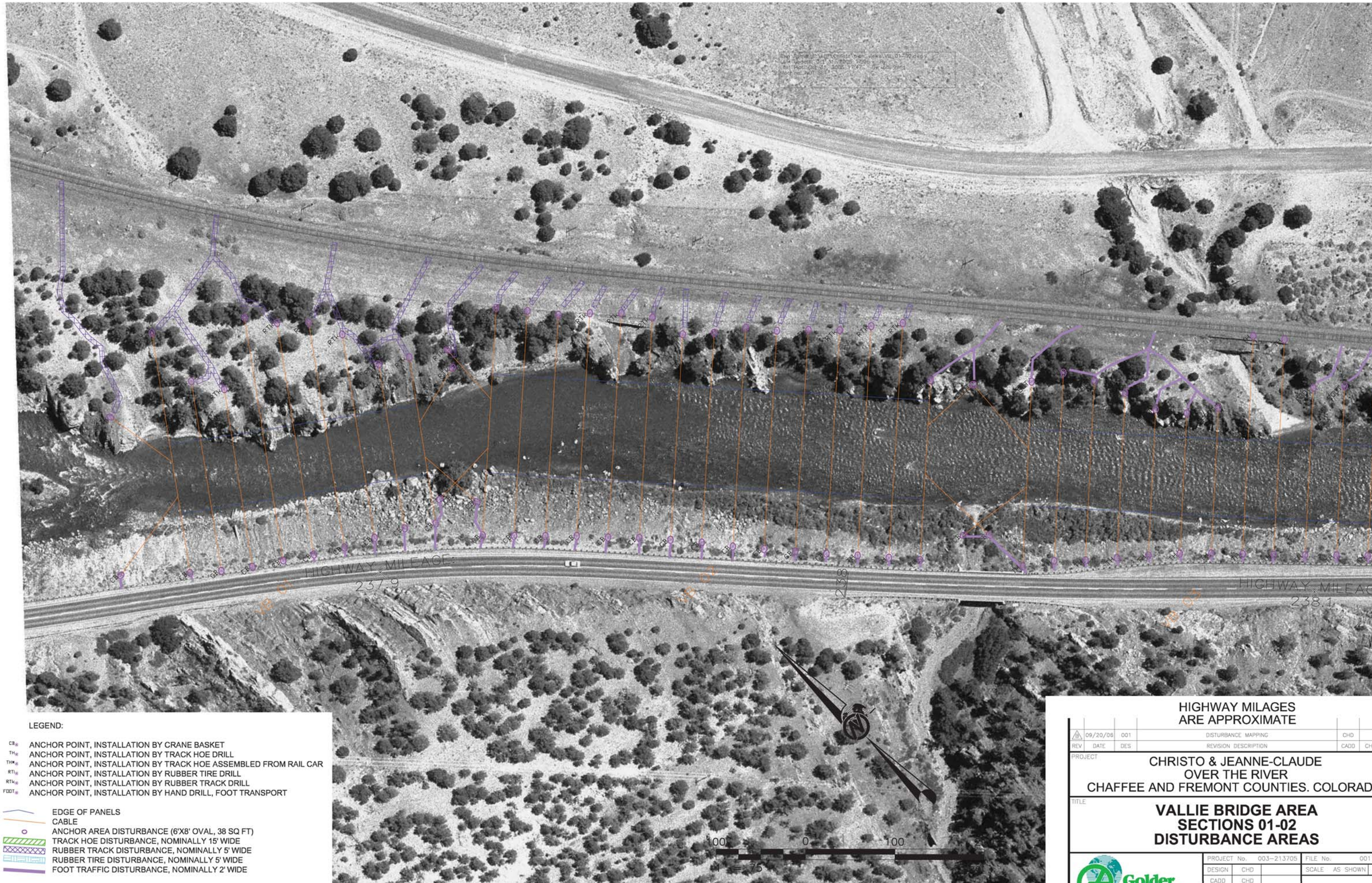
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE

TUNNEL AREA
SECTIONS 03-04
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No. 0011001A001
DESIGN	CHD	SCALE AS SHOWN REV. A
CADD	CHD	
CHECK		**TN 03-04**
REVIEW		



LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THK ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/20/08	001	DISTURBANCE MAPPING	CHD		

PROJECT

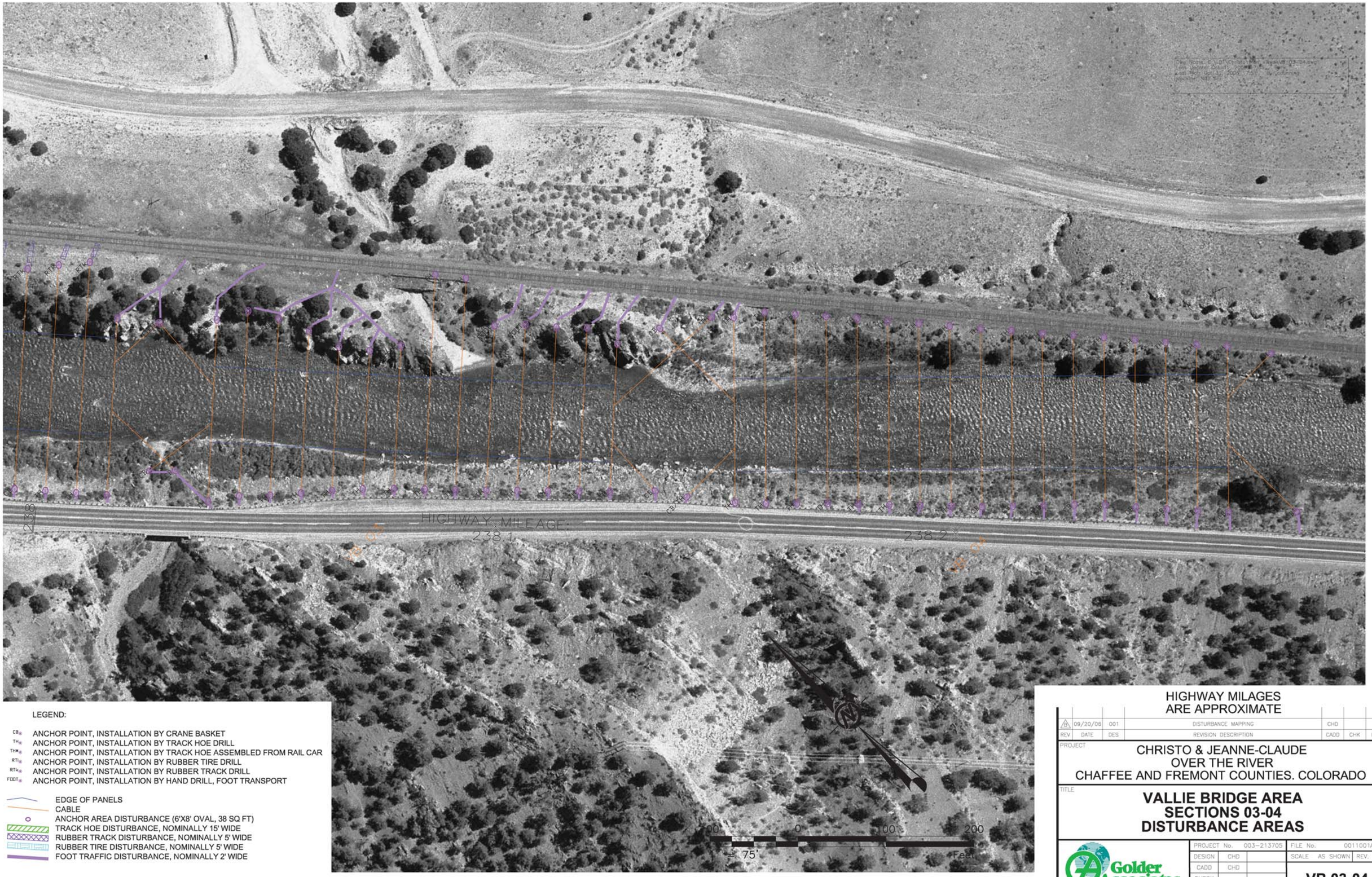
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE

VALLIE BRIDGE AREA
SECTIONS 01-02
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No. 0011001A001
DESIGN	CHD	SCALE AS SHOWN REV. A
CADD	CHD	
CHECK		VB 01-02
REVIEW		



LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THR ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	09/20/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
VALLIE BRIDGE AREA
SECTIONS 03-04
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705		FILE No.	0011001A001
DESIGN	CHD		SCALE AS SHOWN	REV. A
CADD	CHD			
CHECK			**VB 03-04**	
REVIEW				

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THR ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RT ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/20/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
TEXAS CREEK AREA
SECTIONS 01-03
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

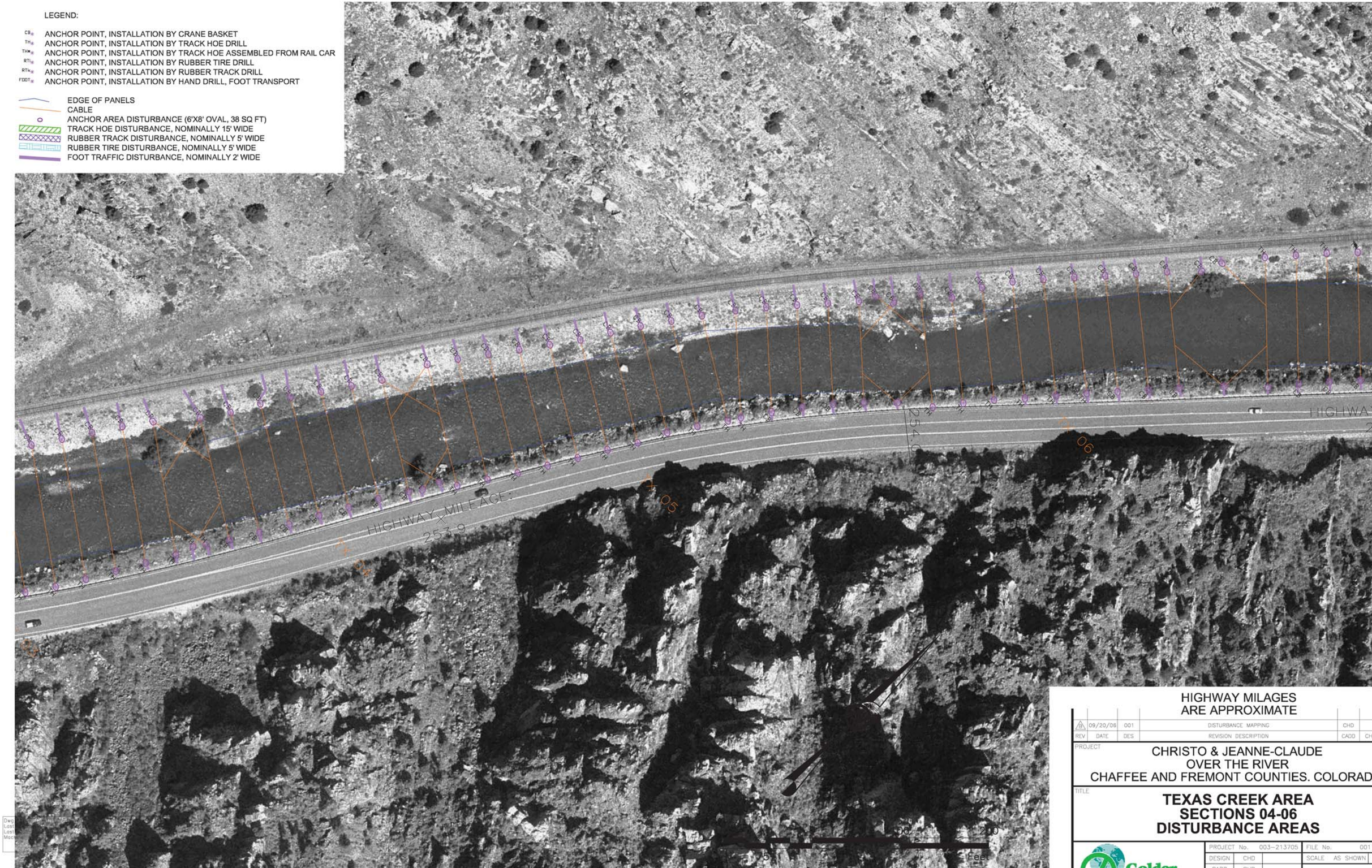
PROJECT No.	003-213705	FILE No.	0011001A001
DESIGN	CHD	SCALE AS SHOWN	REV. A
CADD	CHD		
CHECK			
REVIEW			

TX 01-03

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THK ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE



HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/20/08	001	DISTURBANCE MAPPING	CHD		

PROJECT

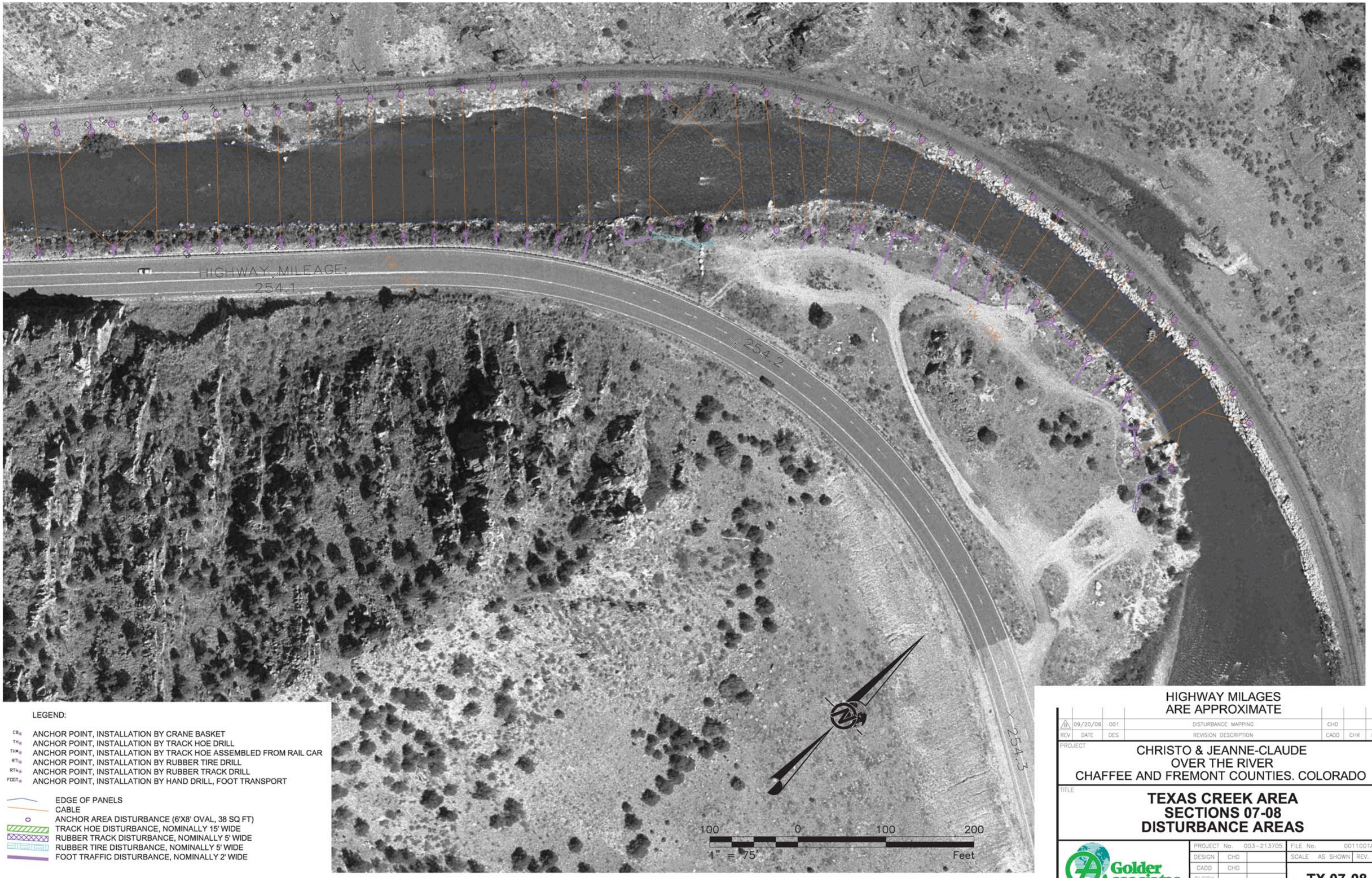
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE

TEXAS CREEK AREA
SECTIONS 04-06
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705		FILE No.	0011001A001
DESIGN	CHD		SCALE AS SHOWN	REV. A
CADD	CHD			
CHECK			**TX 04-06**	
REVIEW				



LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THK ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	09/20/08	001	DISTURBANCE MAPPING	CHD		

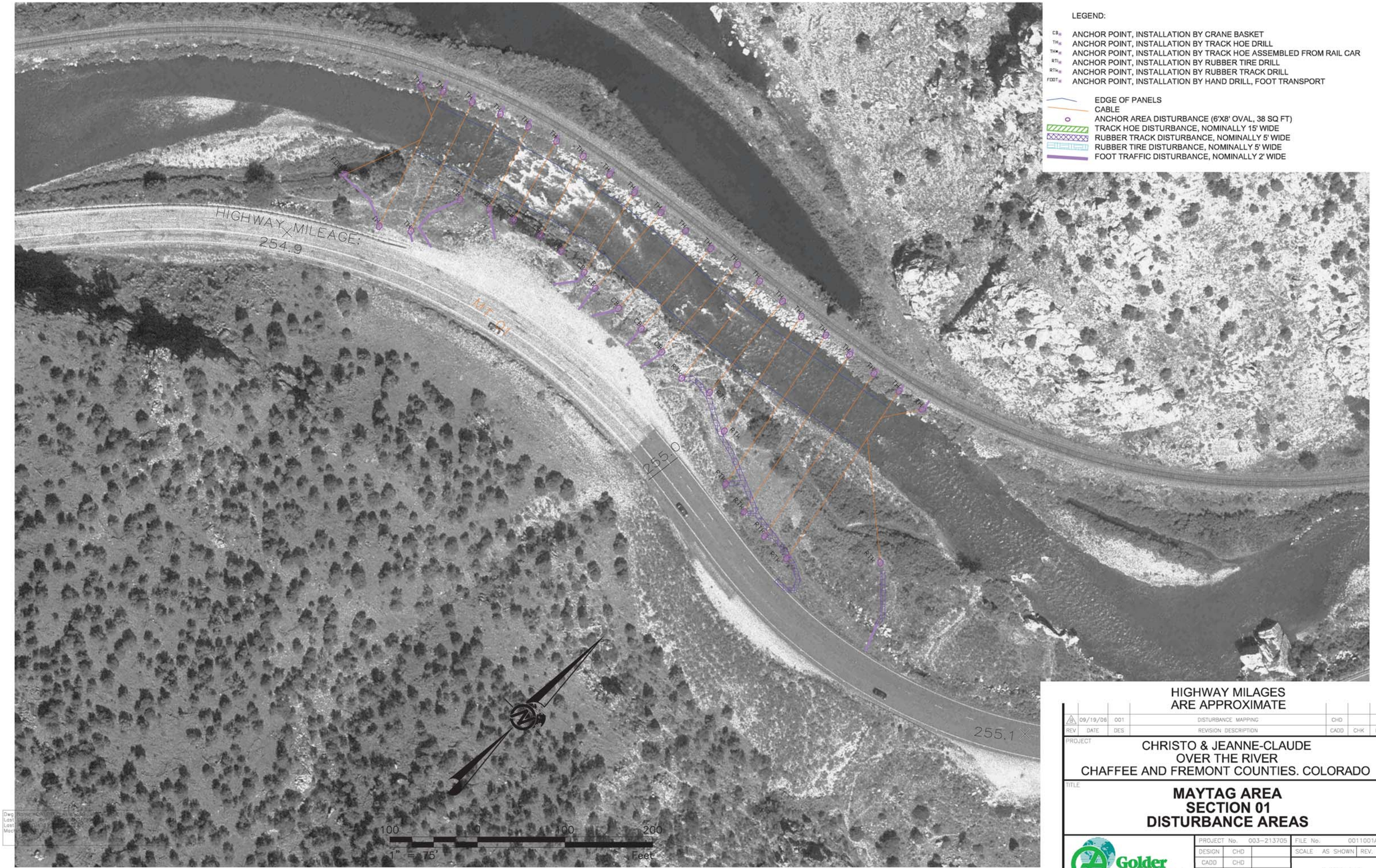
PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
TEXAS CREEK AREA
SECTIONS 07-08
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No.	0011001A001
DESIGN	CHD	SCALE	AS SHOWN
CADD	CHD	REV.	A
CHECK			
REVIEW			

TX 07-08



HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	09/19/06	001	DISTURBANCE MAPPING	CHD		

PROJECT

CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE

MAYTAG AREA
SECTION 01
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No. 0011001A001
DESIGN	CHD	SCALE AS SHOWN REV. A
CADD	CHD	**MT 01**
CHECK		
REVIEW		

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THK ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

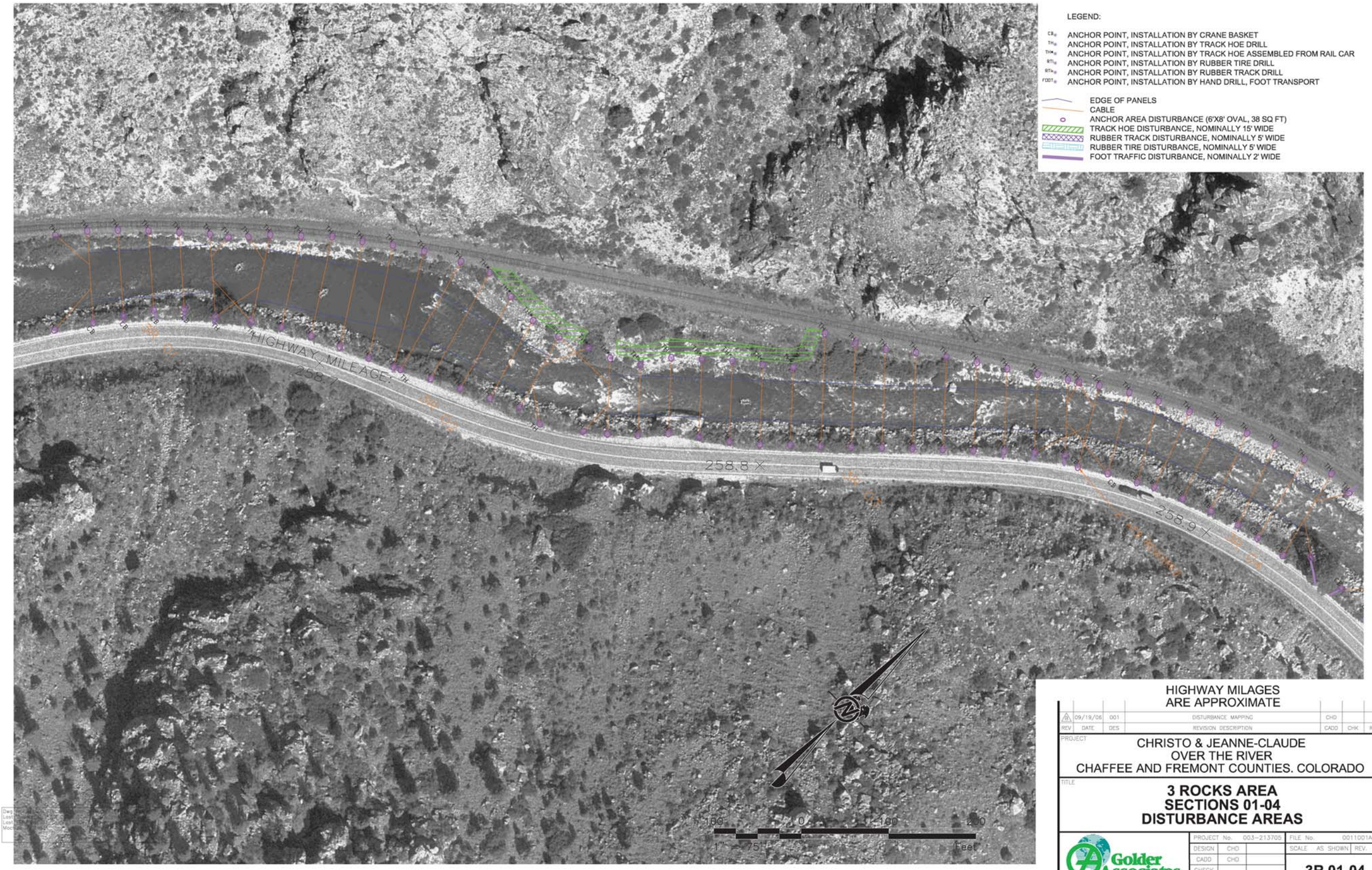
REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/19/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
MAYTAG AREA
SECTIONS 02-03
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No. 0011001A001
DESIGN	CHD	SCALE AS SHOWN REV. A
CADD	CHD	
CHECK		MT 02-04
REVIEW		



HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	09/19/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
3 ROCKS AREA
SECTIONS 01-04
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No.	0011001A001
DESIGN	CHD	SCALE AS SHOWN	REV. A
CADD	CHD		
CHECK			
REVIEW			

3R 01-04

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- TH* ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RT ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	09/19/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
3 ROCKS AREA
SECTIONS 05-06
DISTURBANCE AREAS

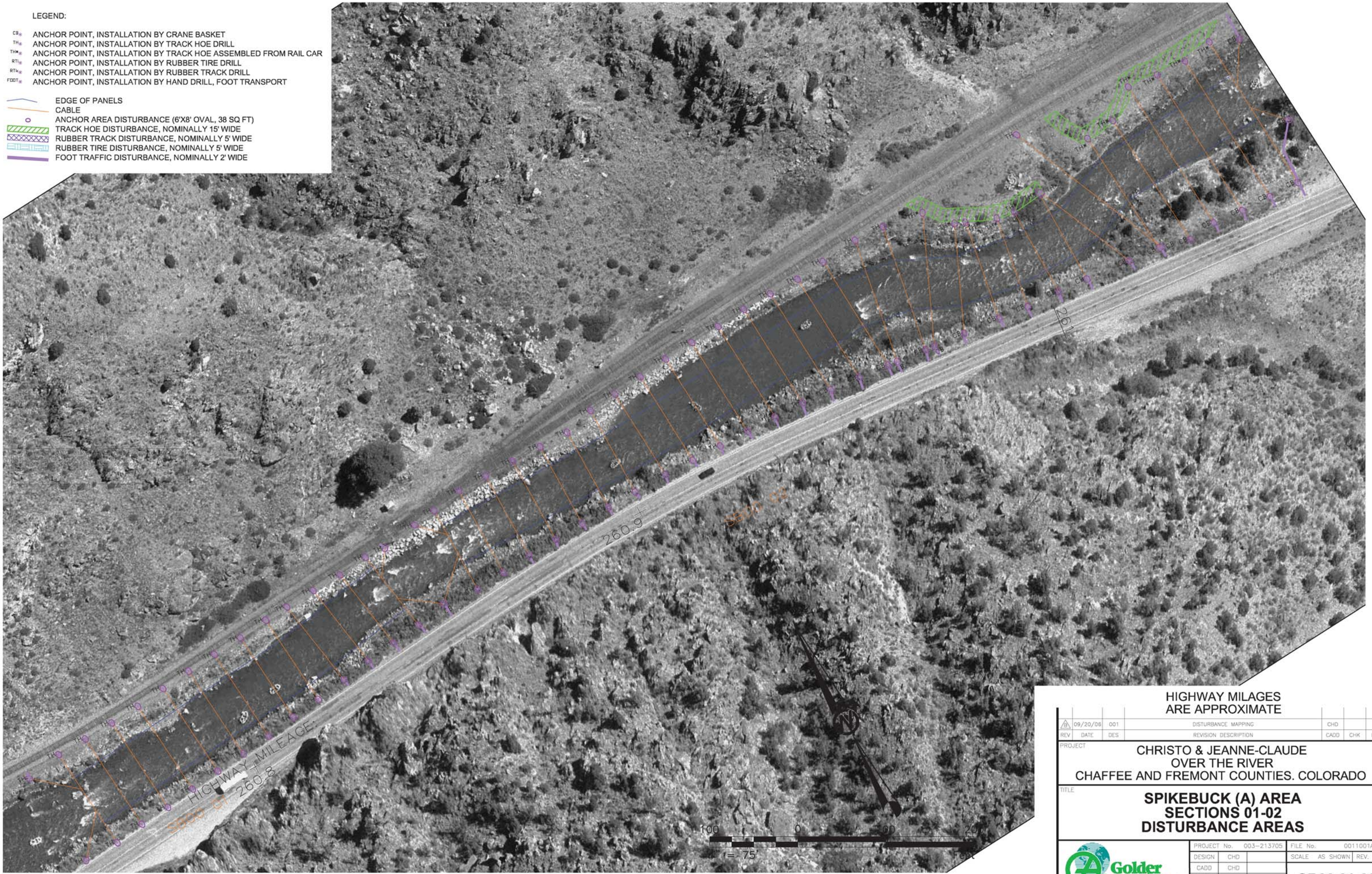
Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No. 0011001A001
DESIGN	CHD	SCALE AS SHOWN REV. A
CADD	CHD	
CHECK		3R 05-06
REVIEW		

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THK ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE



HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/20/06	001	DISTURBANCE MAPPING	CHD		

PROJECT

CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE

SPIKEBUCK (A) AREA
SECTIONS 01-02
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705		FILE No.	0011001A001
DESIGN	CHD		SCALE AS SHOWN	REV. A
CADD	CHD		**SB00 01-02**	
CHECK				
REVIEW				

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THR ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RT ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
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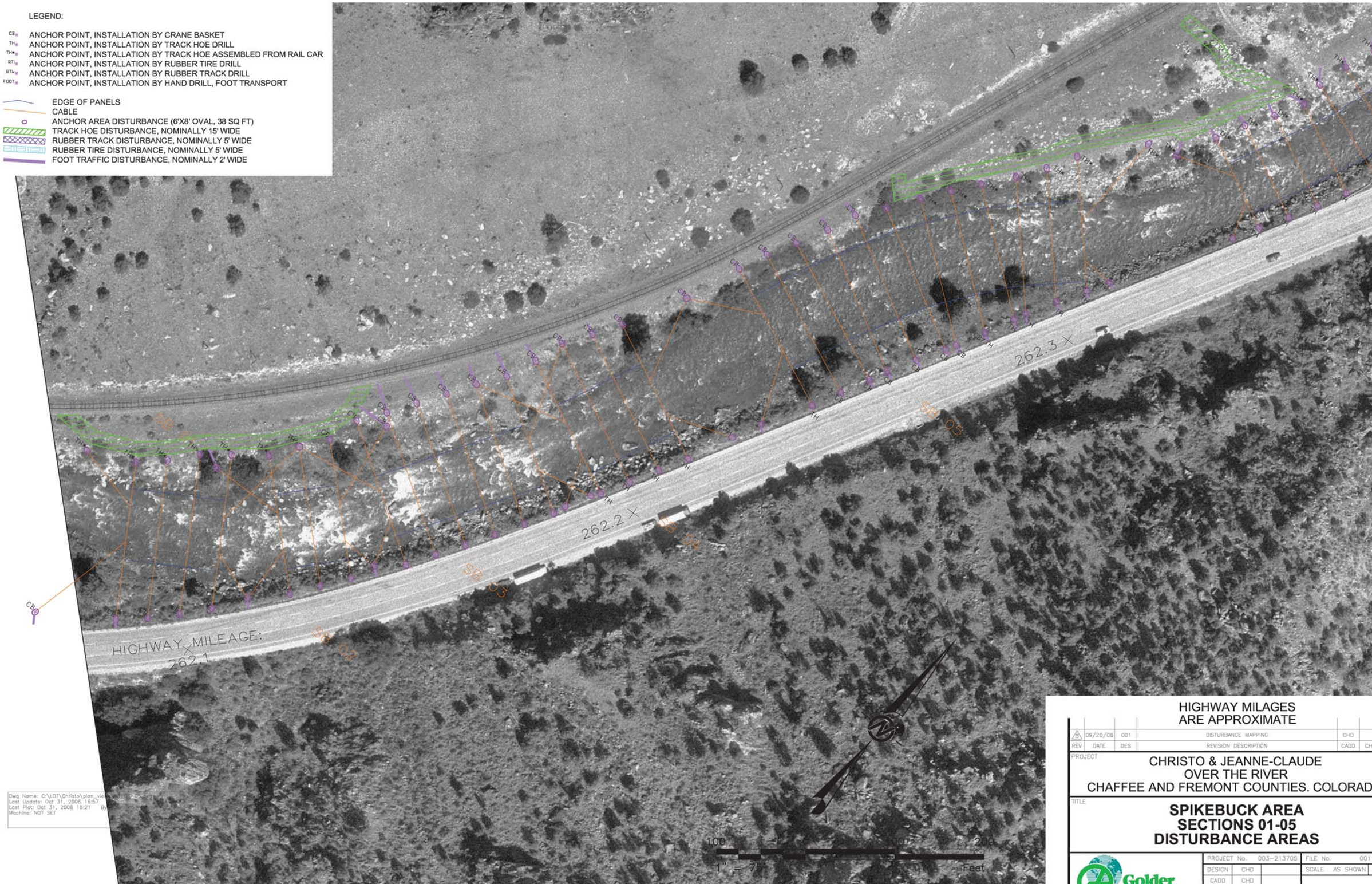

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Machine: NOT SET

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	09/20/06	001	DISTURBANCE MAPPING	CHD		

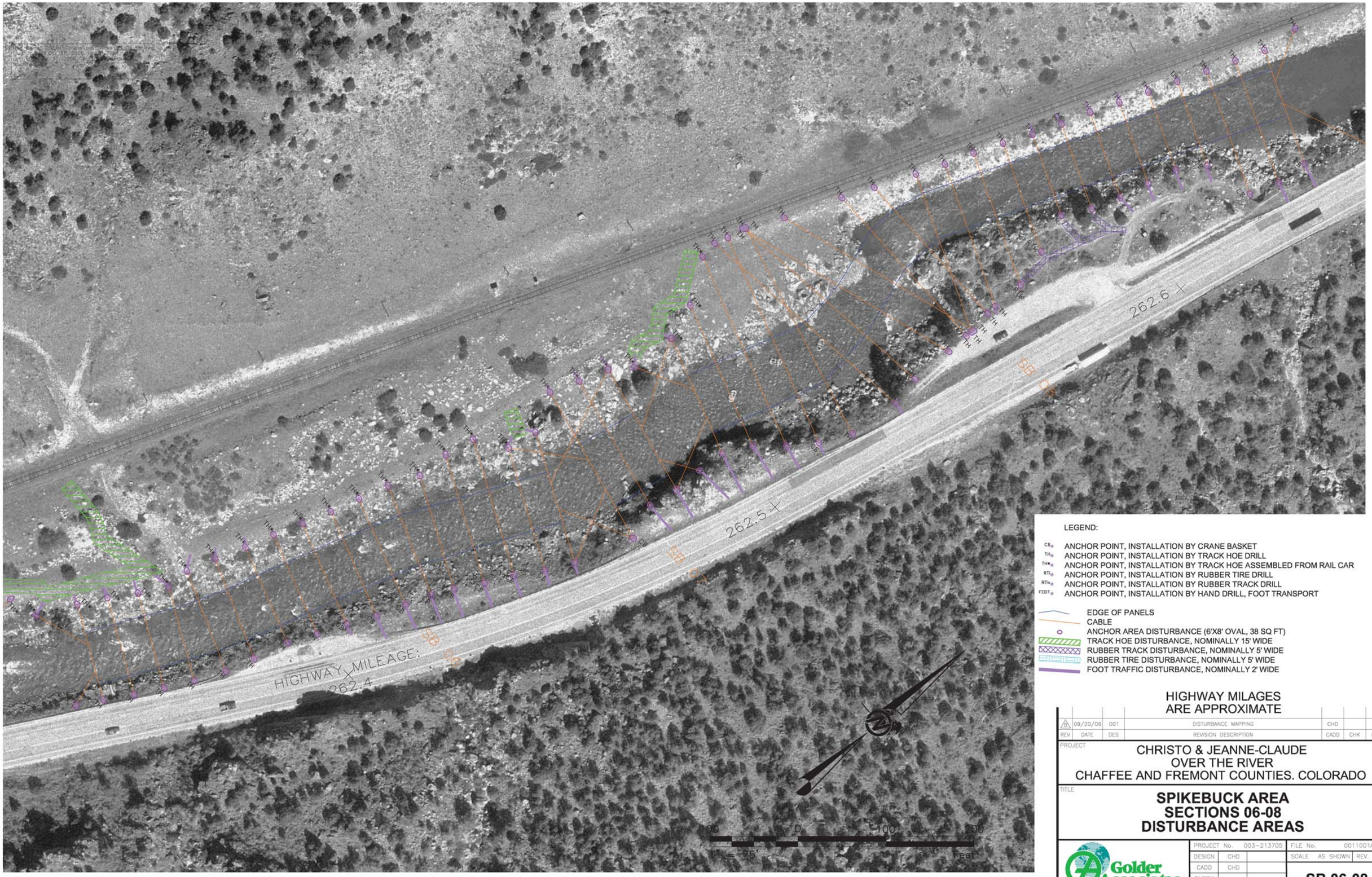
PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
SPIKEBUCK AREA
SECTIONS 01-05
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No.	0011001A001
DESIGN	CHD	SCALE	AS SHOWN
CADD	CHD	REV.	A
CHECK			
REVIEW			

SB 01-05



LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THR ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
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- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/20/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
SPIKEBUCK AREA
SECTIONS 06-08
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705		FILE No.	0011001A001
DESIGN	CHD		SCALE AS SHOWN	REV. A
CADD	CHD		**SB 06-08**	
CHECK				
REVIEW				

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THH ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
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- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	09/20/06	001	DISTURBANCE MAPPING	CHD		

PROJECT

CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE

SPIKEBUCK AREA
SECTIONS 09-10
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No. 0011001A001
DESIGN	CHD	SCALE AS SHOWN REV. A
CADD	CHD	
CHECK		**SB 09-10**
REVIEW		

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/19/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
PARKDALE AREA
SECTIONS 01-03
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705		FILE No.	0011001A001
DESIGN	CHD		SCALE AS SHOWN	REV. A
CADD	CHD		**PD 01-03**	
CHECK				
REVIEW				

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THH ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTH ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/19/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
PARKDALE AREA
SECTIONS 04-05
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No. 0011001A001
DESIGN	CHD	SCALE AS SHOWN REV. A
CADD	CHD	
CHECK		**PD 04-05**
REVIEW		

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THK ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
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- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/19/08	001	DISTURBANCE MAPPING	CHD		

PROJECT

CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE

PARKDALE AREA
SECTIONS 06-09
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705		FILE No.	0011001A001
DESIGN	CHD		SCALE AS SHOWN	REV. A
CADD	CHD		**PD 06-09**	
CHECK				
REVIEW				

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THR ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/19/06	001	DISTURBANCE MAPPING	CHD		

PROJECT

CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE

PARKDALE AREA SECTIONS 10-11 DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705		FILE No.	0011001A001
DESIGN	CHD		SCALE AS SHOWN	REV. A
CADD	CHD		PD 10-11	
CHECK				
REVIEW				

LEGEND:

- CB — ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH — ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THK — ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI — ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK — ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT — ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	09/20/06	001	DISTUBANCE MAPPING	CHD		

PROJECT

CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE

PARKDALE AREA
SECTIONS 12-13
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705		FILE No.	0011001A001
DESIGN	CHD		SCALE AS SHOWN	REV. A
CADD	CHD		**PD 12-13**	
CHECK				
REVIEW				

LEGEND:

- CB – ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH – ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- TH* – ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTi – ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTk – ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT – ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	09/20/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
PARKDALE AREA
SECTIONS 14-16
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705		FILE No.	0011001A001
DESIGN	CHD		SCALE AS SHOWN	REV. A
CADD	CHD			
CHECK			**PD 14-16**	
REVIEW				

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- TH* ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTi ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTk ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
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- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/20/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
PARKDALE AREA
SECTIONS 17-18
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705		FILE No.	0011001A001
DESIGN	CHD		SCALE AS SHOWN	REV. A
CADD	CHD		**PD 17-18**	
CHECK				
REVIEW				

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- TH* ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RT ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
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HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
A	09/20/06	001	DISTURBANCE MAPPING	CHD		

PROJECT

CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE

PARKDALE AREA
SECTIONS 19-20
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No.	0011001A001
DESIGN	CHD	SCALE AS SHOWN	REV. A
CADD	CHD		
CHECK		**PD 19-20**	
REVIEW			

LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THR ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

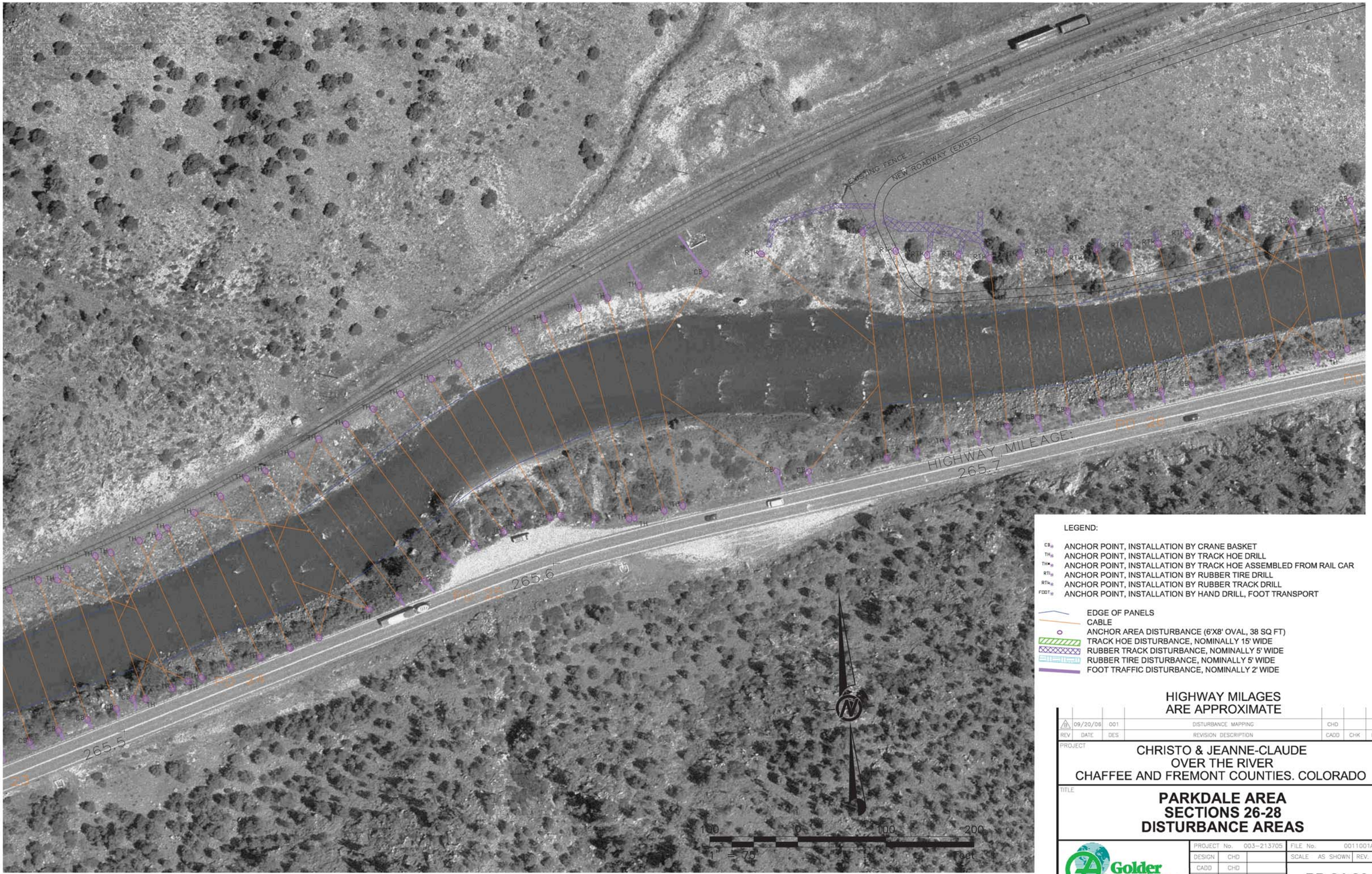
REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/20/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
PARKDALE AREA
SECTIONS 21-24
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No. 0011001A001
DESIGN	CHD	SCALE AS SHOWN REV. A
CADD	CHD	
CHECK		**PD 21-24**
REVIEW		



LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- TH* ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

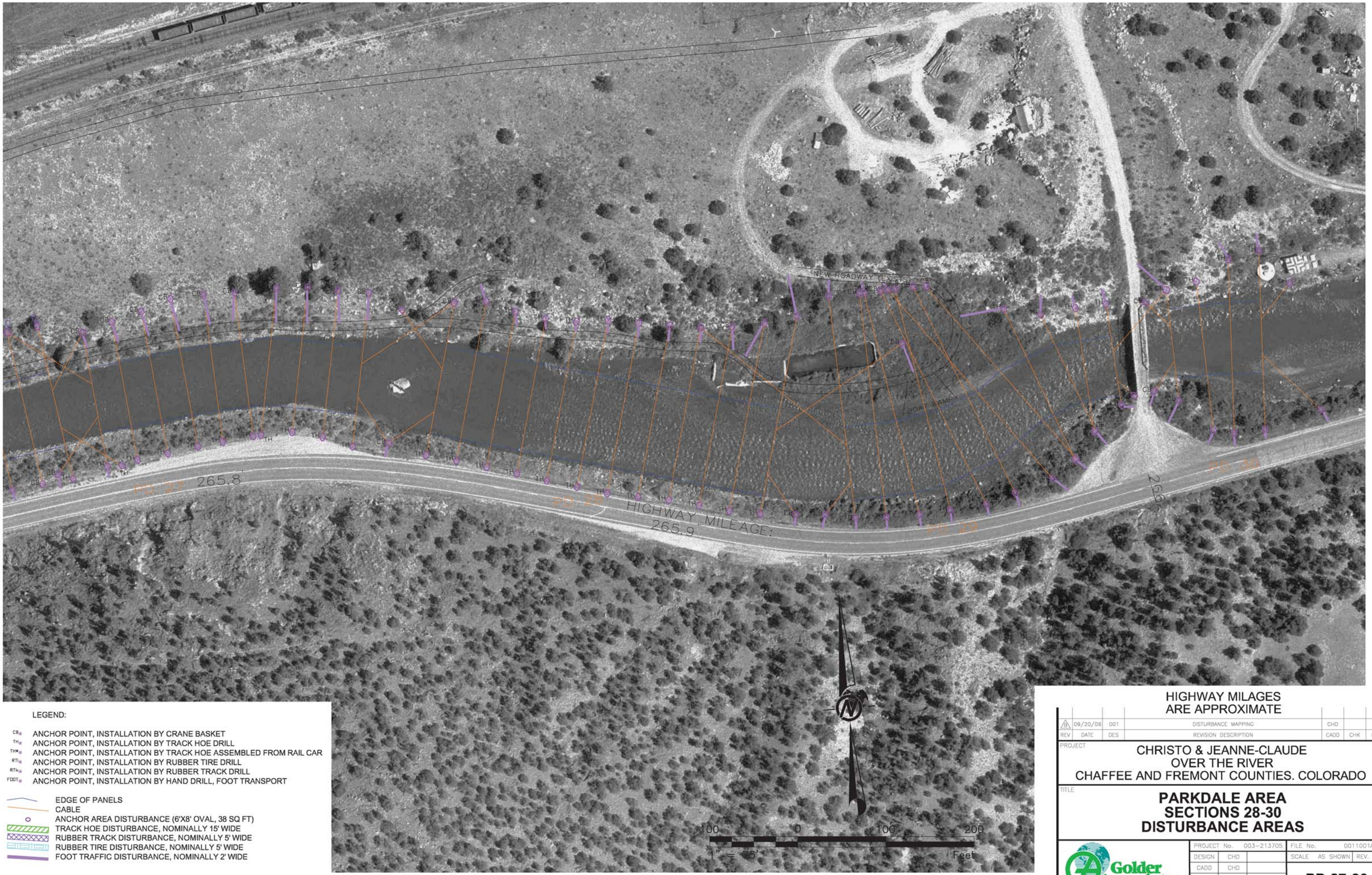
REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/20/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
PARKDALE AREA
SECTIONS 26-28
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No. 0011001A001
DESIGN	CHD	SCALE AS SHOWN REV. A
CADD	CHD	
CHECK		**PD 24-26**
REVIEW		



LEGEND:

- CB ANCHOR POINT, INSTALLATION BY CRANE BASKET
- TH ANCHOR POINT, INSTALLATION BY TRACK HOE DRILL
- THK ANCHOR POINT, INSTALLATION BY TRACK HOE ASSEMBLED FROM RAIL CAR
- RTI ANCHOR POINT, INSTALLATION BY RUBBER TIRE DRILL
- RTK ANCHOR POINT, INSTALLATION BY RUBBER TRACK DRILL
- FOOT ANCHOR POINT, INSTALLATION BY HAND DRILL, FOOT TRANSPORT

- EDGE OF PANELS
- CABLE
- ANCHOR AREA DISTURBANCE (6'X8' OVAL, 38 SQ FT)
- TRACK HOE DISTURBANCE, NOMINALLY 15' WIDE
- RUBBER TRACK DISTURBANCE, NOMINALLY 5' WIDE
- RUBBER TIRE DISTURBANCE, NOMINALLY 5' WIDE
- FOOT TRAFFIC DISTURBANCE, NOMINALLY 2' WIDE

HIGHWAY MILAGES
ARE APPROXIMATE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
B	09/20/06	001	DISTURBANCE MAPPING	CHD		

PROJECT
CHRISTO & JEANNE-CLAUDE
OVER THE RIVER
CHAFFEE AND FREMONT COUNTIES. COLORADO

TITLE
PARKDALE AREA
SECTIONS 28-30
DISTURBANCE AREAS

Golder Associates
Denver, Colorado

PROJECT No.	003-213705	FILE No. 0011001A001
DESIGN	CHD	SCALE AS SHOWN REV. A
CADD	CHD	
CHECK		**PD 27-30**
REVIEW		

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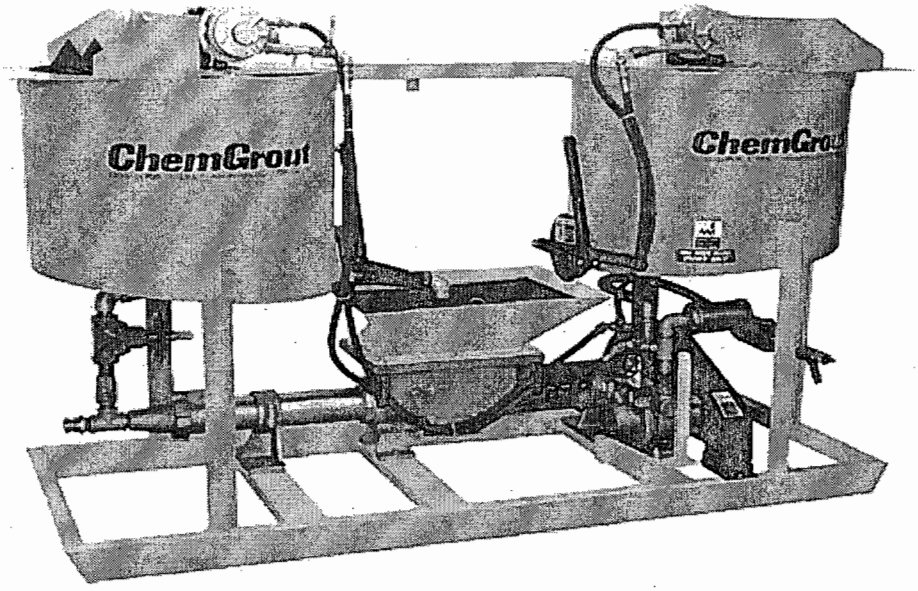
ChemGrout®

"Mfg. Grout Pumps, Grout Mixers, Largest Selection of Grouting Equipment in the World"

CG-500 Versatile Series



CG-500 Air Powered Shown

The ChemGrout CG-500 series are high volume production skid mounted grout plants. This versatile unit is designed to mix and pump neat cement, sanded grouts and most commercial pre-blended grout mixes. These units feature two 70-gallon (265 liters) mixing tanks, a 15-gallon (57 liters) holding hopper and an open throat progressive cavity grout pump. The unique double mix tank design permits continuous pumping as each mix tank alternates feeding the pump. Each mixer is equipped with baffles, bag breakers and variable speed high-efficiency paddles that provide rapid mixing. The tank outlet valves are large slide gates that allow the thickest materials to fall easily into the pump hopper. The holding hopper has an auger in it to keep the material thoroughly mixed while constantly supplying the grout pump with material for the continuous pumping operation. The grout pump is a variable speed, positive displacement, progressive cavity, rotor-stator pump. The rugged steel frame stands up to the toughest conditions on the job site. Operator controls are centrally located for efficient production. All components are easily accessible for operating, cleaning, and maintenance.

Click here to see a picture of the self-contained gas/hydraulic model.

Applications include: soil compaction, rock grouting, voidfilling, waterproofing, soil anchors, cable bolts, rock bolts, well encasements, contact grouting, well abondonment, marine/underwater, post tensioning, precast, machine base installation, self leveling floor underlayments, slab undersealing, and slabjacking.

Pump Specifications

Progressing Cavity Pump	Hopper Volume	Maximum Output	Maximum Pressure
ChemGrout -2C6 Grout Pump	15 Gallons (57 Liters)	20 GPM (75 LPM)	174 PSI (12 BAR)
ChemGrout -3C6 Grout Pump	15 Gallons (57 Liters)	20 GPM (75 LPM)	261 PSI (18 BAR)

Model Number	Description	Dimensions	Weight
CG500/2C6/A	Skid Mounted Air Powered Grout Plant Requires 250 CFM, 100 PSI	88" L X 34" W X 58" H	1100 lbs
CG500/2C6/H	Skid Mounted Hydraulic Grout Plant Requires 12 GPM, 1200 PSI	88" L X 34" W X 50" H	950 lbs
CG500/2C6/EH3	Skid Mounted Electric/Hydraulic Grout Plant Requires 230/460 V 38/19 A	88" L X 34" W X 58" H	1550 lbs
CG500/2C6/GHES	Skid Mounted Gas/Hydraulic Grout Plant 18 HP Briggs & Staton Vanguard, Electric Start	88" L X 34" W X 58" H	1425 lbs
CG500/2C6/DH	Skid Mounted Diesel/Hydraulic Grout Plant 20 HP Lombardini, Electric Start	100" L X 34" W X 58" H	1625 lbs

Power Options = Air, Hydraulic, Electric/Hydraulic, Gas/Hydraulic or Diesel/Hydraulic

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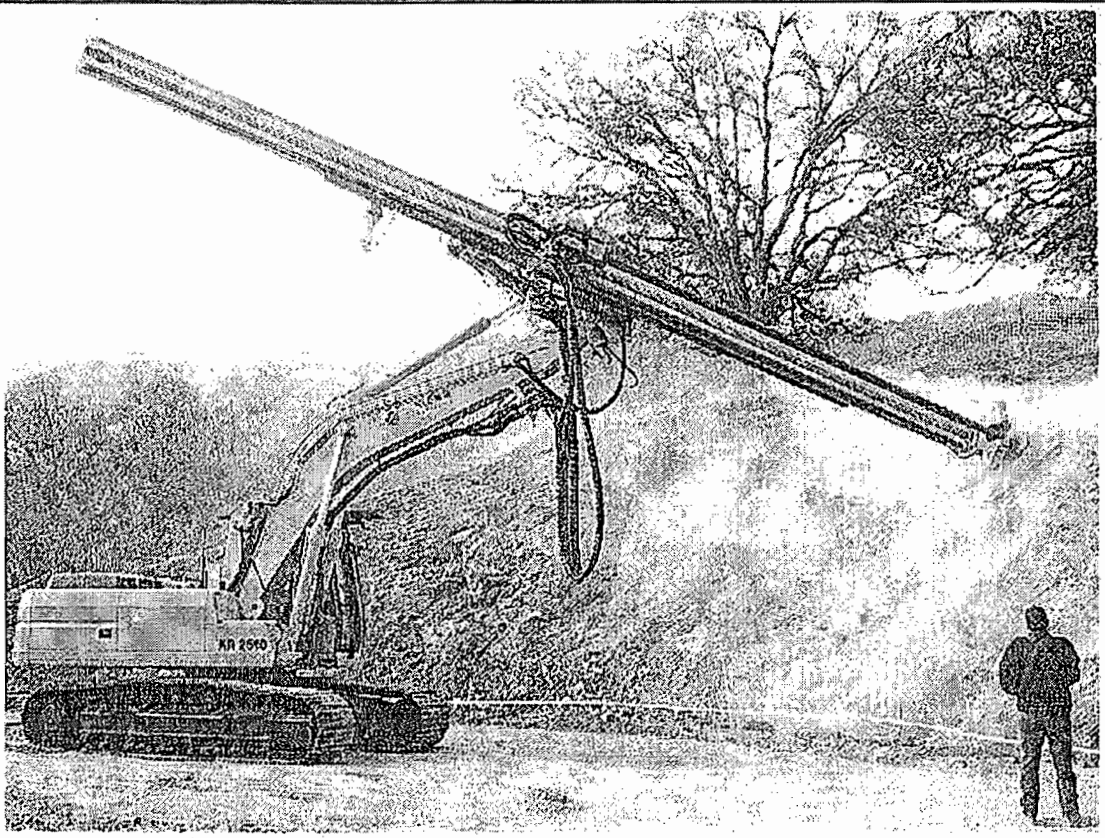
E-mail: info@chemgrout.com

KR 2510

Hydraulisches Bohrgerät
Hydraulic Drill Rig



KLEMM
Bohrtechnik

KR 2510

Das Universalbohrgerät KR 2510 ist ein Gerät der 30 Tonnenklasse. Die Kompaktanlage mit Antriebseinheit an Bord und einer Gerätebreite von 3390 mm ermöglicht eine Vielzahl neuer und nützlicher Anwendungen.

Für die optimale Anpassung an das jeweilige Bohrverfahren steht eine Reihe von Optionen zur Verfügung:

- Kraftdrehköpfe bis 16 kNm (KH 9, KH 13, KH 13 S, KH 16, KH 10 SF)
- Hydraulikhammer KD 1011
- Hydraulische Klemmvorrichtung für Rohre bis max. Ø 254 mm (10")
- Duplexköpfe für verrohrte Bohrungen bis Ø 254 mm
- Spülköpfe für Zentralspülung (Luft, Wasser, Suspension)
- Druckluftsteuerung und Öler für TLH-Anwendungen

Eine hohe Geräteverfügbarkeit wird durch die Verwendung eines Caterpillar Trägergerätes gewährleistet.

Schwierigste Bohrpositionen können durch die neuartige Kinematik (zum Patent angemeldet) der KR 2510 erreicht werden.

Durch die Lafettenlänge und den dadurch zur Verfügung stehenden Verfahrweg von max. 11500 mm können Bohrrohre bis zu einer max. Nutzlänge von 10 m verwendet werden.

(Bitte beachten Sie die Vorschublängen unter „Technische Daten").

Durch das neue modulare Vorschubsystem werden vorteilhafte Schwerpunktlagen erreicht.

The multipurpose usable KR 2510 is a drill rig of the 30 ton class. This machine with on-board power unit and a width of 3390 mm was developed for various drilling applications.

A series of options is available to provide the optimum rig configuration for a particular drilling process:

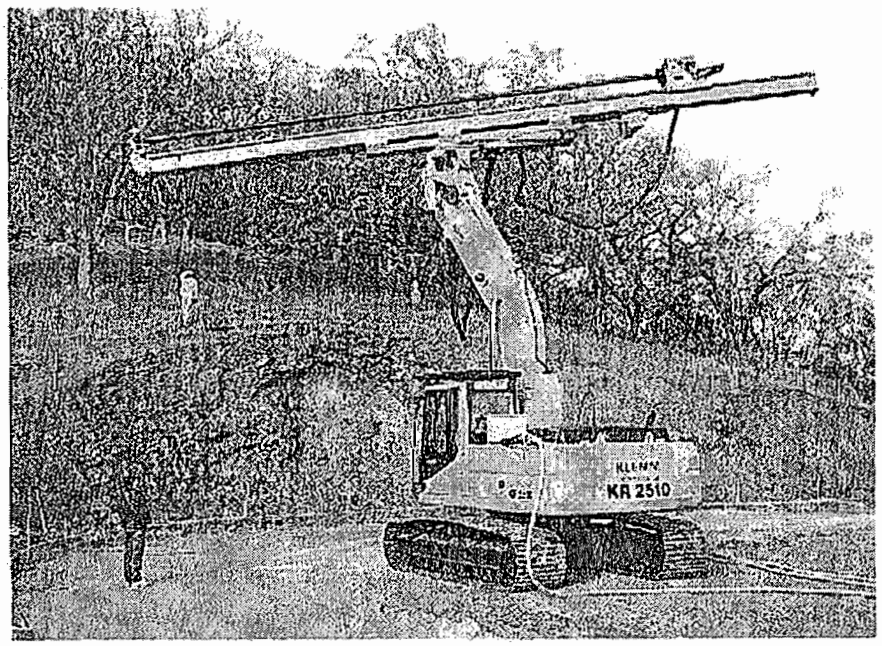
- *Rotary heads up to 16 kNm / 12300 ftlbs torque (KH 9, KH 13, KH 13 S, KH 16, KH 10 SF)*
- *Hydraulic drifter KD 1011*
- *Hydraulic clamping device for drill tubes up to Ø 254 mm (10")*
- *Duplex heads for cased holes up to Ø 254 mm (10")*
- *Flushing heads for central flushing (air, water, grout)*
- *Inline oiler for DTH application with air and water flow control*

High utilization is guaranteed by the CAT carrier. The new kinematics (patent pending) of the rig allow various difficult drilling positions.

Due to the drill mast length and available feed stroke of 11 500 mm / 37' 8 2/5" drill tubes up to 10 000 mm / 32' 9 3/5" in length can be used in accordance with the selected drilling process.

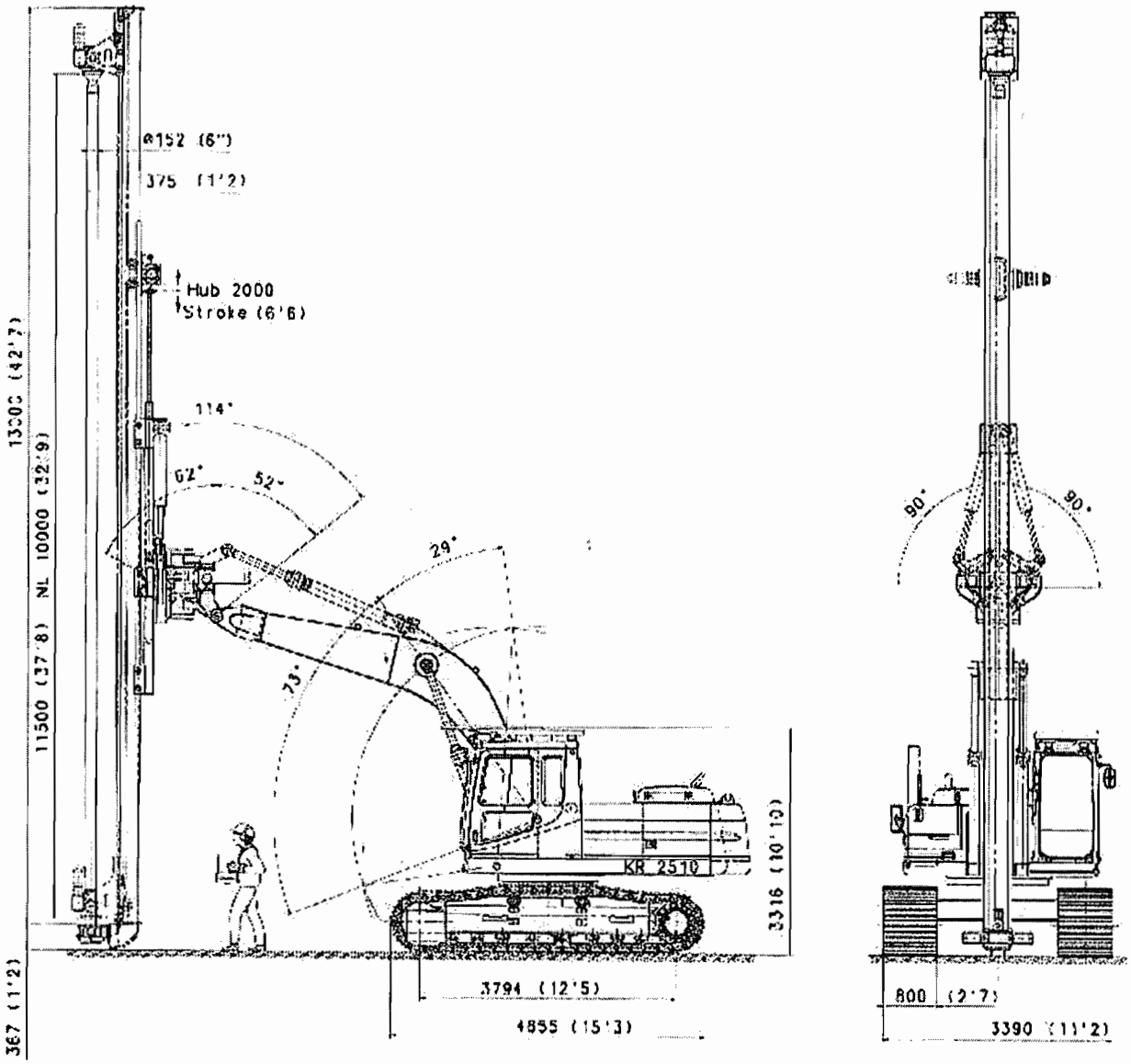
(Please check for feed strokes under "Technical Specification")

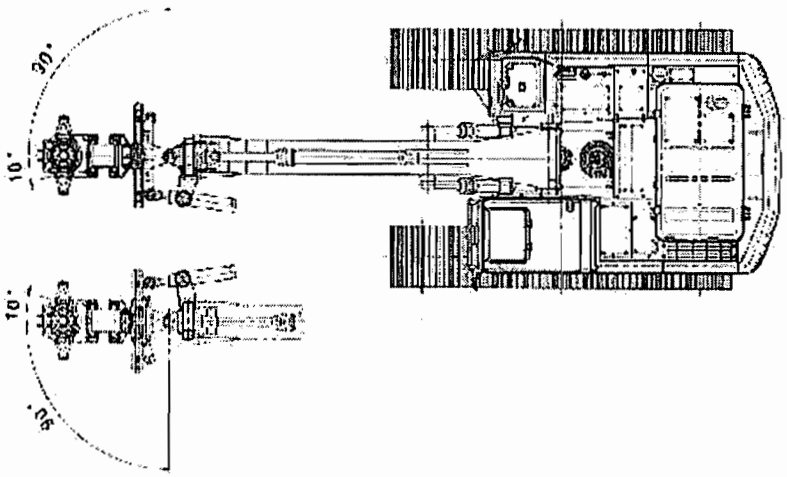
The new modular feed system provides an advantageous stability.



Abmessungen / Dimensions

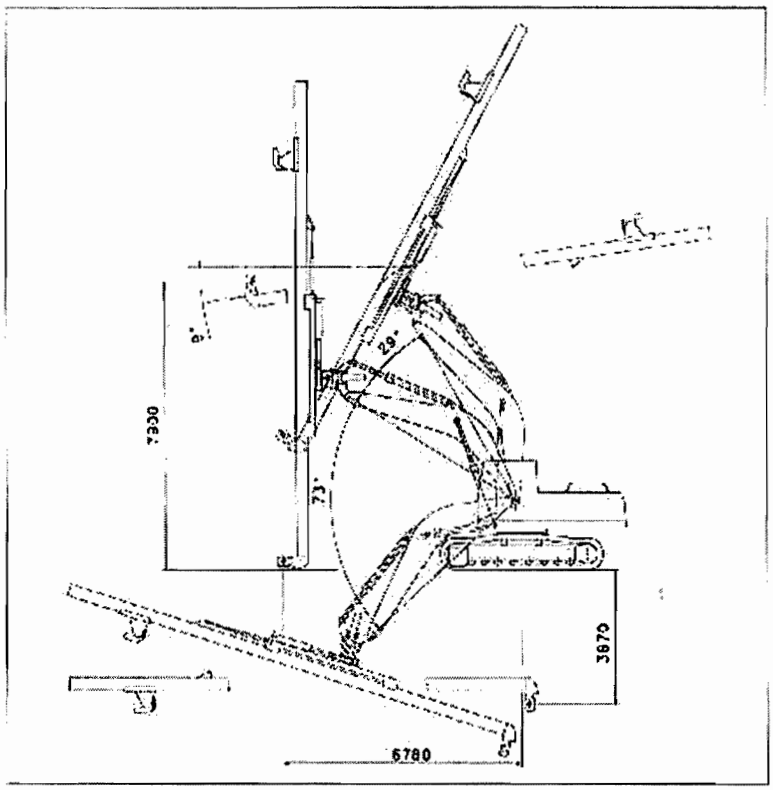
KR 2510



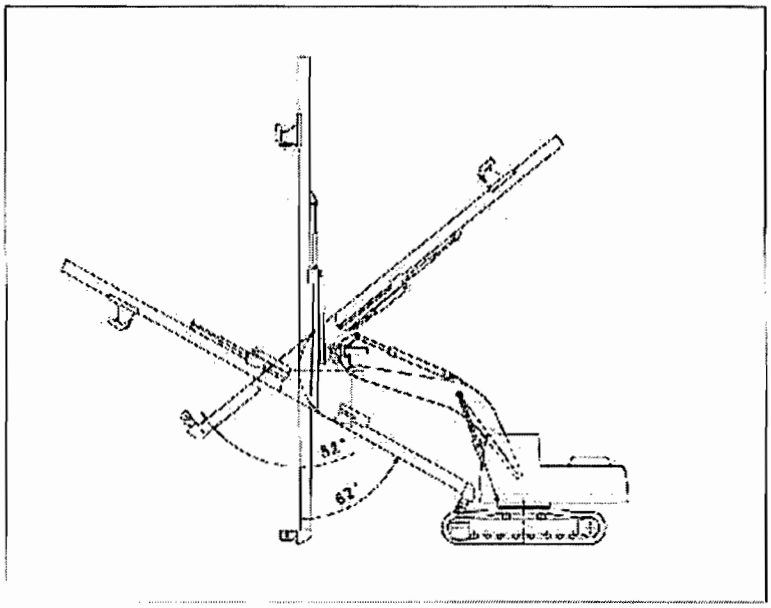


Schwenkbereiche / Mast Movements

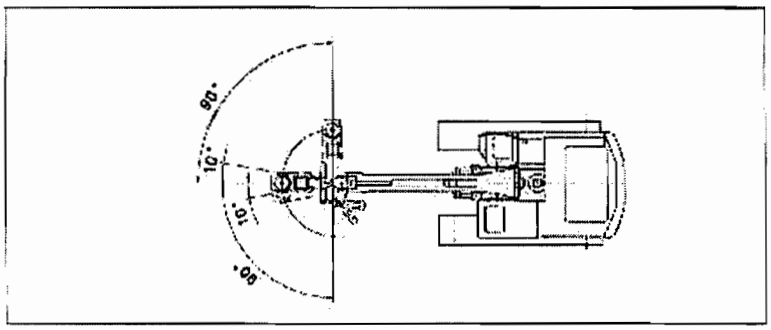
KR 2510



Ausleger heben / senken
boom lift / lower



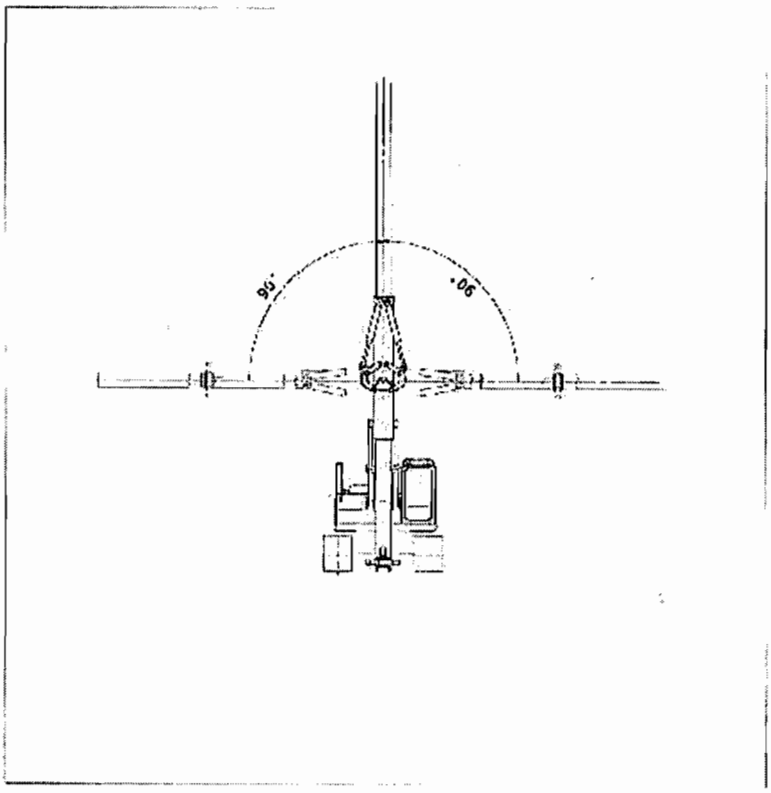
Lafette mit Schwenkkopf 1 kippen
drill mast tilting with slewing head 1



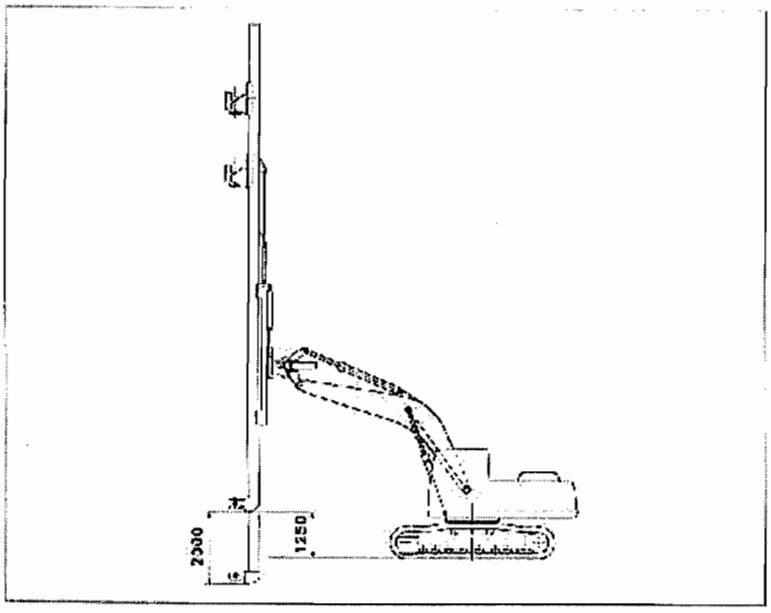
Lafette mit Schwenkkopf 2 schwenken
drill mast tilting with slewing head 2

Schwenkbereiche / Mast Movements

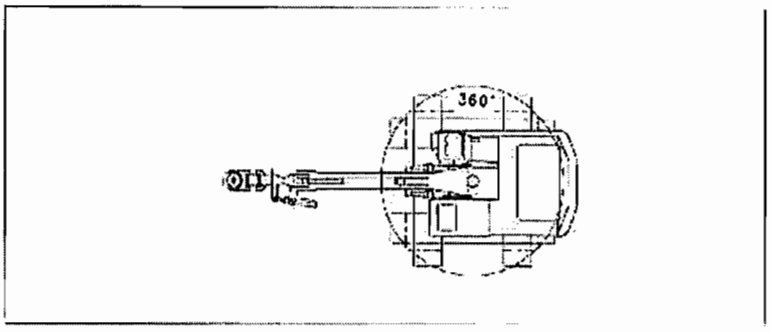
KR 2510



Lafette drehen
side inclination of drill mast



Lafette verschieben
drill mast shifting

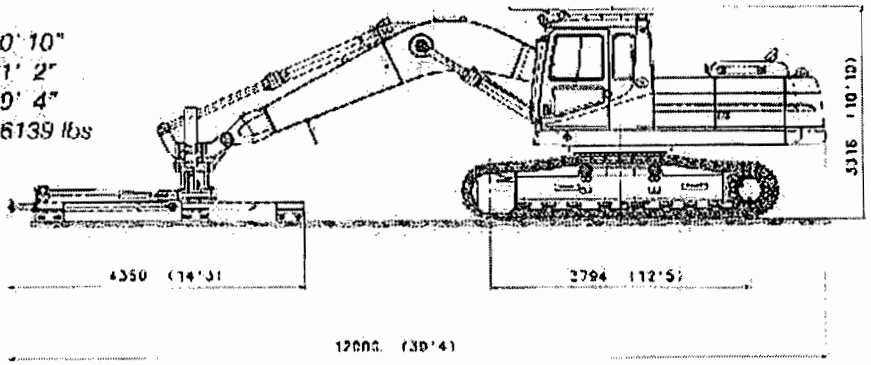


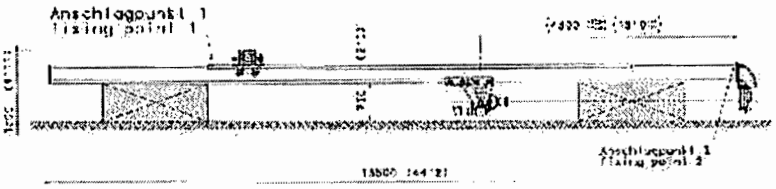
Oberwagen drehen
uppercarriage slewing

Transportabmessungen / Transport Dimensions KR 2510

Transportabmessungen Bagger
Transport Dimensions Excavator

Höhe	*height*	3316 mm	/ *10' 10"*
Breite	*width*	3390 mm	/ *11' 2"*
Länge	*length*	12000 mm	/ *39' 4"*
Gewicht	*weight*	30 t	/ *66139 lbs*





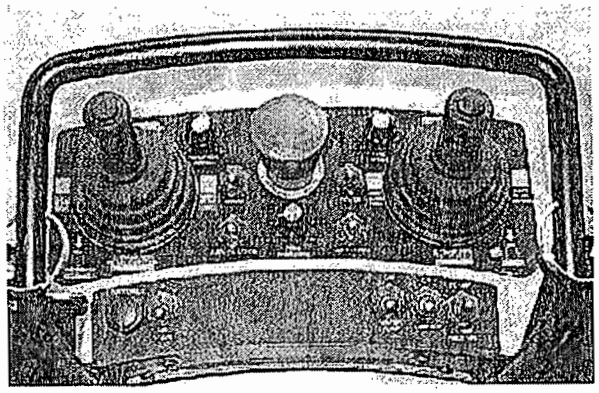
Transportabmessungen Lafette
Transport Dimensions drill mast

Höhe	*height*	1500 mm	/ *5'*
Breite	*width*	1500 mm	/ *5'*
Länge	*length*	13500 mm	/ *44' 4"*
Gewicht	*weight*	2,8 t	/ *6173 lbs*

Bohrverfahren / Drilling Applications KR 2510

- Drehbohren mit Bohrschnecke
- Drehbohren im Spülverfahren (verrohrt / unverrohrt)
- Drehschlagbohren mit Im-Lochhammer
- Aufschlussbohrungen
- Ischebeck Anker
- CSV-Verfahren

- *Rotary drilling with auger*
- *Rotary flush drilling (cased or uncased)*
- *Rotary percussive drilling with down-the-hole hammer (+ air compressor)*
- *Drilling for ground investigation*
- *Ischebeck anchor*
- *CSV method*



Funkfernsteuerung (Option)
Radio remote control (optional)

Technische Daten / Technical Specification KR 2510

Trägergerät	***Base Carrier***	**CAT 325 BL**	**CAT 325 CL** *
Motor (wassergekühlt)	*engine (watercooled)*	3116 DITA EPA	3126B ATAAC EPA
Nettoleistung ISO 9249	*net power ISO 9249*	126 kW / *2000 rpm*	128 kW / *1800 rpm*
Dieseltankinhalt	*Diesel tank capacity*	420 l	500 l
Ausleger	*boom*	CAT ME 5500 mm	CAT ME 5500 mm
Schwenkmoment	*swing torque*	76 kNm	82 kNm
Unterwagen	***Undercarriage***	**325 BL standard**	**325 CL standard**
max. Zugkraft	*max. drawbar pull*	215 kN	236 kN
Gesamtlänge	*track length*	4660 mm / *15' 4"*	4660 mm / *15' 4"*
Gesamtbreite	*total width*	3390 mm / *11' 2"*	3390 mm / *11' 2"*
Kettenbreite	*shoes width*	800 mm / *2' 8"*	800 mm / *2' 8"*
Bodenplatten	*shoes type*	3-steg / *triple grouser*	3-steg / *triple grouser*
Hydrauliksystem	***Hydraulic system***		
max. Fördermenge	*max. flow*	2 x 208 l/min	2 x 235 l/min
Systemdruck	*operating pressure*	max. 340 bar	max. 340 bar
Hydraulikölmenge inkl. Tank	*hydraulik system incl. tank*	310 l	310 l
Vorsteuerung (max. Werte)	*pilot system (max. data)*	41 l/min / 41 bar	32,5 l/min / 41 bar
Kabine	***Cab***	**325 B Standard**	**325 C Standard**
mit FOPS-Gitter	*with falling object guard*		
und Klimaanlage	*system (FOGS) and air con*		
Elektrosystem	***Electric system***	24 V /100 Ah	
Option: Funkfernsteuerung	*optional: radio remote control*		
Bohrlafette	***Drill mast***	**Typ 306 / type *306***	
mit Vorschubgetriebe	*with feed gear*		
Gesamtlänge mit Klemmvorrichtung	*total length with clamping device*	13367 mm / *43' 11"*	
Verfahrweg des Schlittens (Gleitschlitten KH 16)	*feed stroke (glide slide KH 16)*	11500 mm / *37' 7"*	
Andruck- und Rückzugkraft	*thrust- and retraction force*	60 kN bei / *at* 250 bar	
Vorschubgeschwindigkeit 0-100 l/min	*feed speed 0-100 l/min*	0-30 m/min	
Hydraulischer Drehantrieb	***hydraulic rotary head***	**Typ KH 16 / type *KH 16***	
Aluminiumgehäuse	*aluminium housing*		
Abmessungen ohne Lafette	***Dimensions w/o drill mast***	**325 BL**	**325 CL**
Länge	*length*	12000 mm / *39' 5"*	12000 mm / *39' 5"*
Breite	*width*	3390 mm / *11' 2"*	3390 mm / *11' 2"*
Höhe	*height*	3316 mm / *10' 11"*	3170 mm / *10' 5"*
Gewicht mit Lafette	*weight with drill mast*	ca. / *approx.* 32,8 t	ca. / *approx.* 32,8 t

Andruck- bzw. Rückzugkräfte entsprechen DIN EN 471, d.h. 3,5fache Sicherheit bezüglich Bruchkraft der Hollenvorschubkette. Angegebene Werte sind rechnerische Werte.

Thrust and retraction forces follow the DIN EC 471 standards safety of the feed chain related to breakage is 3.5. All data as given above are calculated data.

* 325 CL ersetzt 325 BL.

* *325 CL replaces 325 BL*

Machines
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» Backhoe Loaders
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» Off Highway Trucks
» Paving Equipment
» Pipelayers
» Road Reclaimers
» Scrapers
» Skid Steer Loaders
» Skidders
» Soil Stabilizers
» Telehandlers
» Track Loaders
» Track-Type Tractors
» Underground Mining
» Wheel Dozers
» Wheel Excavators
» Wheel Loaders

325D L HYDRAULIC EXCAVATORS

--- Sele

Overview & Specifications | **Benefits & Features** | **Standard Equipment** | **Optional Equipment** | **Worktools / Attachments**

325D L OVERVIEW & SPECIFICATIONS

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325D L

Increased work tool options, new powerful engine and easier operation lead to increased productivity and lower operating costs.

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Use the resc
help you ma
decision.
- Find Your
- Financing
- Rentals
- Insurance
- Training
- Maintenar
- Build & Qu

325D L DETAILED SPECIFICATIONS

Engine	
Engine Model	Cat® C7 ACERT™
Net Flywheel Power	204 hp / 152 kW
Net Power - ISO 9249	204 hp / 152 kW
Net Power - SAE J1349	202 hp / 151 kW
Net Power - EEC 80/1269	204 hp / 152 kW
Bore	4.3 in / 110 mm
Stroke	5 in / 127 mm
Displacement	440 in3 / 7.2 L
Weights	
Operating Weight	64460 lb / 29240 kg
Drive	
Maximum Drawbar Pull	55977 lb / 249 kN
Maximum Travel Speed	3.3 mph / 5.3 km/h
Hydraulic System	
Main Implement System - Maximum Flow (2x)	62 gal/min / 235 L/min
Max. pressure - Equipment	5076 psi / 35000 kPa
Max. pressure - Equipment - Heavy	5221 psi / 36000 kPa
Max. pressure - Travel	5076 psi / 35000 kPa
Max. pressure - Swing	3989 psi / 27500 kPa
Pilot System - Maximum flow	8.6 gal/min / 32.4 L/min
Pilot System - Maximum pressure	566 psi / 3900 kPa
Boom Cylinder - Bore	5.5 in / 140 mm

RELATED IN
- Heavy Co
- Construct

325D L HYD EXCAVATOR
Download pr specification

Download G Specificatio

Boom Cylinder - Stroke	55.4 in / 1407 mm
Stick Cylinder - Bore	5.9 in / 150 mm
Stick Cylinder - Stroke	64.8 in / 1646 mm
CB2 Family Bucket Cylinder - Bore	5.3 in / 135 mm
CB2 Family Bucket Cylinder - Stroke	46 in / 1156 mm
DB Family Bucket Cylinder - Bore	5.9 in / 150 mm
DB Family Bucket Cylinder - Stroke	46 in / 1156 mm

Service Refill Capacities

Fuel Tank Capacity	137 gal / 520 L
Cooling System	7.9 gal / 30 L
Engine Oil	7.9 gal / 30 L
Swing Drive	2.6 gal / 10 L
Final Drive (each)	1.6 gal / 6 L
Hydraulic System (including tank)	82 gal / 310 L
Hydraulic Tank	38 gal / 145 L

Sound Performance

Performance	ANSI/SAE

Standards

Brakes	SAE J1026 APR90
Cab/FOGS	SAE J1356 FEB88 ISO 10262

Swing Mechanism

Swing Speed	10.2 RPM / 10.2 RPM
Swing Torque	60628 lb ft / 82.2 kN·m

Track

Standard w/Long Undercarriage	32 in / 800 mm
Optional	24 in / 600 mm
Optional	28 in / 700 mm
Optional	32 in / 800 mm
Number of Shoes Each Side - Long Undercarriage	50
Number of Track Rollers Each Side - Long Undercarriage	9
Number of Carrier Rollers Each Side - Long Undercarriage	2

Dimensions

Transport width	133.5 in / 3390 mm

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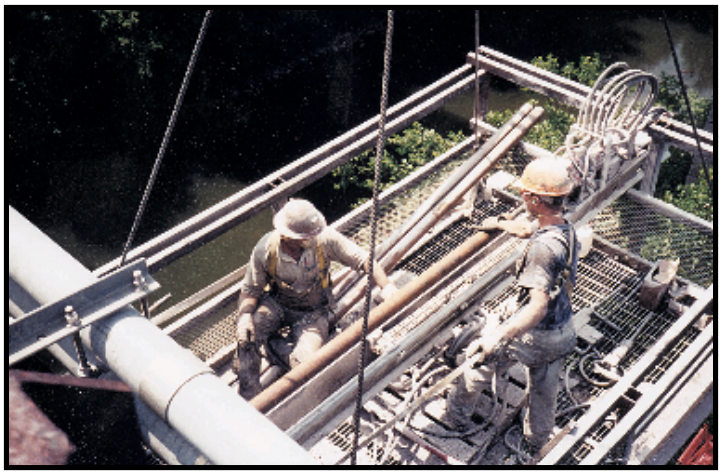
TEI Rock Drills

Product line for Hayward Baker Engineers 2003



Montrose, Colorado USA

www.teirockdrills.com

(970) 249-1515 (800) 777-3745

Fax (970) 249-1999

Drilling attachments for Excavators, Backhoes and Skid Steers.

- Attachments configured on most any carrier
- Hole sizes from 1” to 24” in rock or soils
- Drifters or Rotary drilling available
- Take advantage of TEI’s drilling knowledge

HCM Skid Steer mounted drills

- 360 degree positioning
- Rotary or percussion
- Torques up to 5,000 lb/ft
- Up to a 2 meter stroke
- Good for limited access
- Uses standard mounting plate, so it can be easily moved between offices
- **Available for rent**

HBM Backhoe mounted drills

- High mobility
- Can be attached to rental backhoes
- Excellent for seismic retrofit jobs
- Uses TE300 drifter or RDS528 rotary head

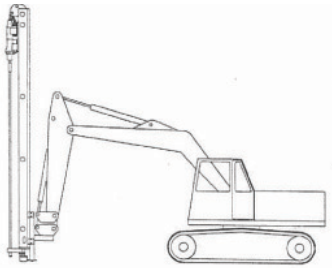
HEM Excavator drills

- 360 degree positioning
- More reach than any other drill
- Torques up to 10,000 lb/ft
- Best drill for soil nails & tie-backs

ACF 26 lightweight drill

Used on mini-excavators
from 3T to 7T

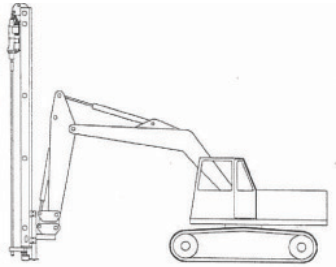
- Excavator supplies hydraulic power for the feed motor, 20 liters/minute.
- 185 cfm air compressor is required to power the drifter.
- Total depths to 10 meters possible.
- Up to 3 meter steel changes.
- One piece grout swivel.
- 20 degree left/right swing.
- Can also be used indoors with the optional floor mounting bracket.



HEM300

- For use on excavators from 15T to 20T

- Total flow required 140 l/min
- System pressure150 bar
- Depths up to 30 meters
- Easy addition of rod extensions
- 360 degree positioning
- Reliable components
- Proven installation method
- Radio controls available



HEM500

- For excavators from 18T to 25T

- Total flow required 160 l/min
- System pressure 170 bar
- Designed to install anchors and soil nails to greater depth and capacity
- 360 degree positioning
- Radio controls available

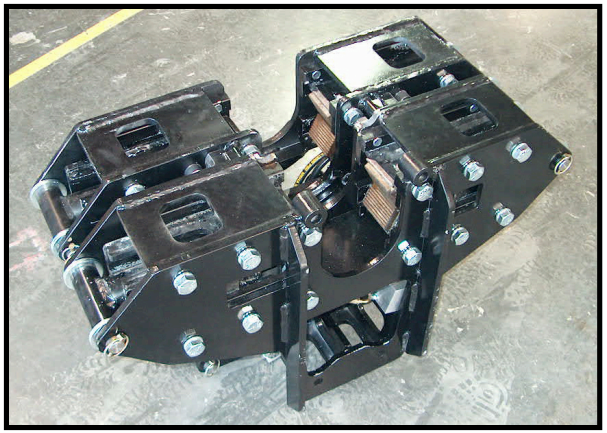
Options for HEM drills

Manual Control Valves

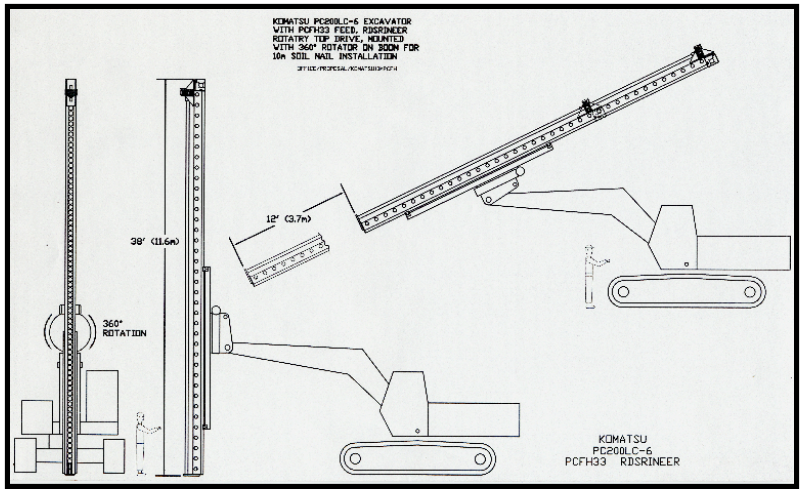
Electric/ hydraulic Control Valves

Radio Control Valves

Clamp And Breaker



New in 2003 the HEMH



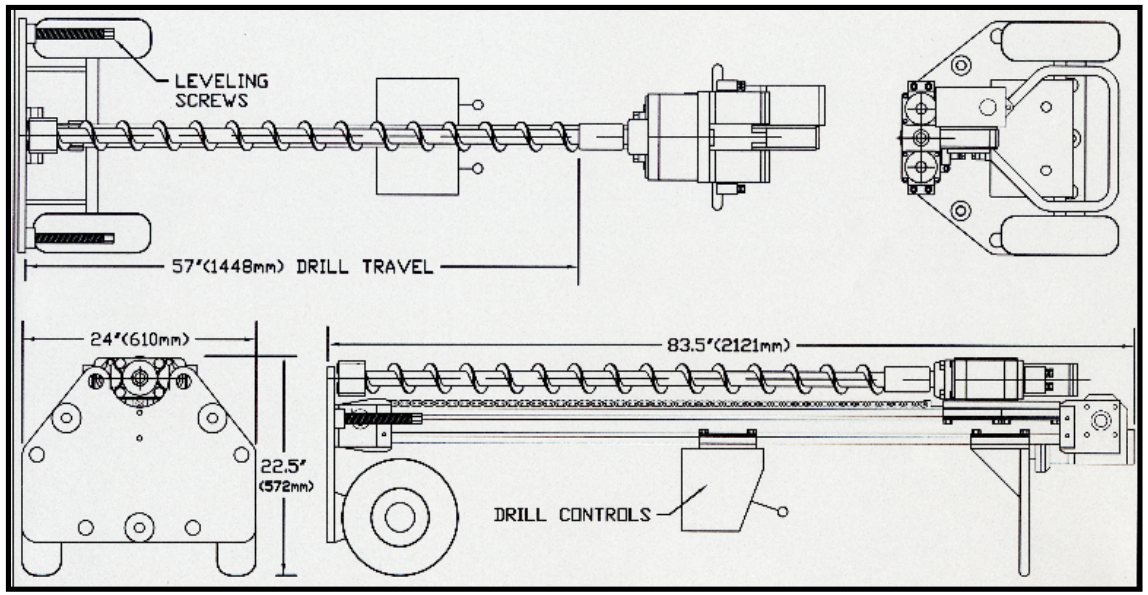
- Up to a 40’ stroke
- Drifter or rotary
- 360 positioning
- Hose carrier
- Mid-point centralizer
- Must remove the dipper stick
- Two-rod adder design finished

Wagons & Special projects

WD50 Limited access drill

- Uses 20HP electric motor
- Runs on 30Kw generator
- Diameter up to 5”
- Depths to 100’
- Fits through a 30” door
- Front drive wheels
- **Available for rent**

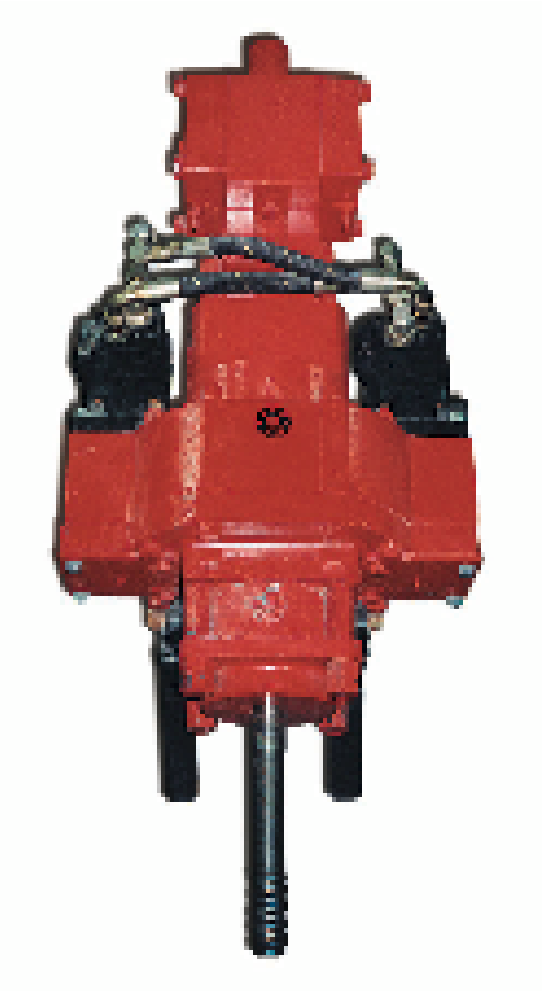
The ACF man-portable drill



- Uses the ACF feed with either the TE250 or RDS 250
- Install the micropile directly next to the foundation
- Ability to drill in the tightest of spaces
- Three leveling screws, easy to use control panel
- Works with separate 25 HP power pack

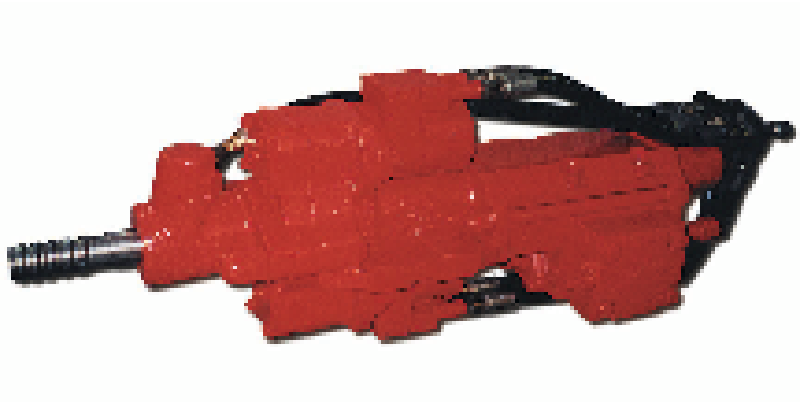
Call TEI to discuss your needs before you submit your next bid.

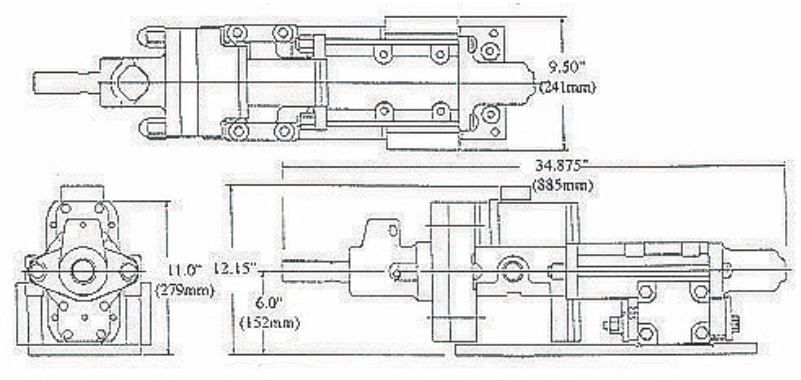
TEI Drifters & Rotary Heads



- Manufactured in our Colorado plant
- Total parts availability
- Developed over 23 years in the business
- Adaptable to drill rigs of other manufacture

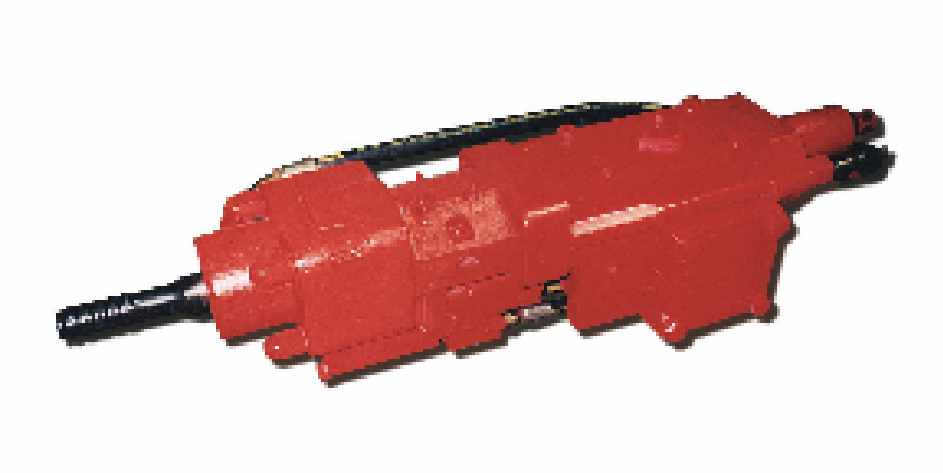
TE300HT Hydraulic Drifter

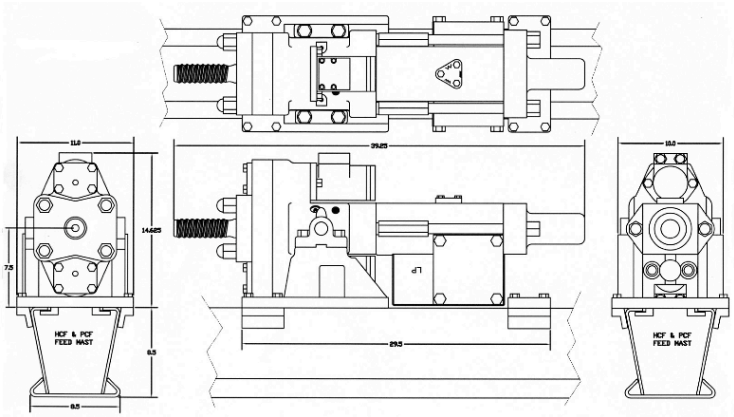




- Torque up to 1400 lb/ft
- Rotation up to 200 rpm
- Impact energy 140 lb/ft
- 2800 blows per minute
- 1.25 rope & T38 thread
- External grout swivel
- Total weight 225 lbs.
- Supply pressure 2250 psi
- Hammer requires 17 gpm
- Rotation 14 gpm
- **Available for rent**

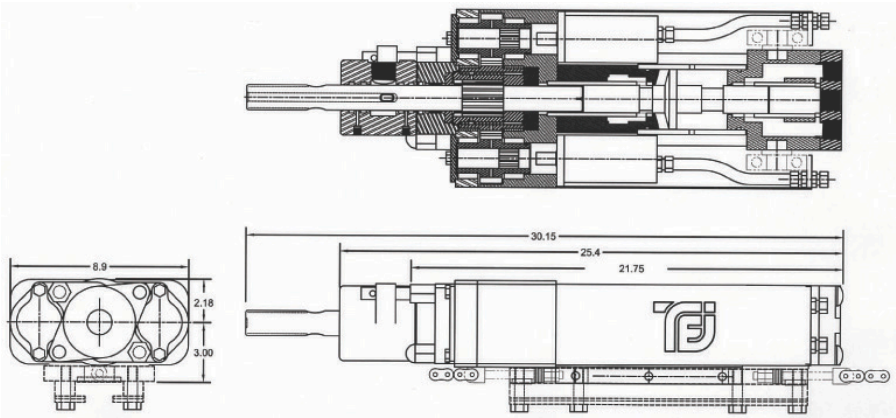
TE500DR Hydraulic Drifter





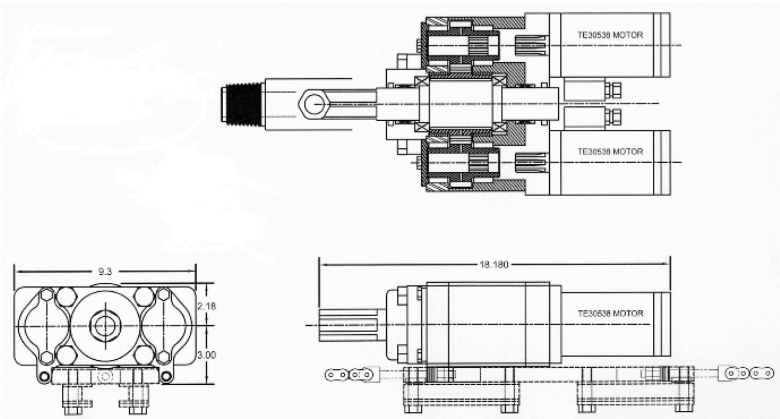
- Torque up to 1800 lb/ft
- Rotation up to 200 rpm
- Impact energy 300 lb/ft
- 2400 blows per minute
- T38 and T45 thread
- External grout swivel
- Total weight 456 lbs.
- Supply pressure 2500 psi
- Hammer requires 20 gpm
- Rotation 160 gpm
- **Available for rent**

New for the ACF attachment in 2003



TE250 Drifter

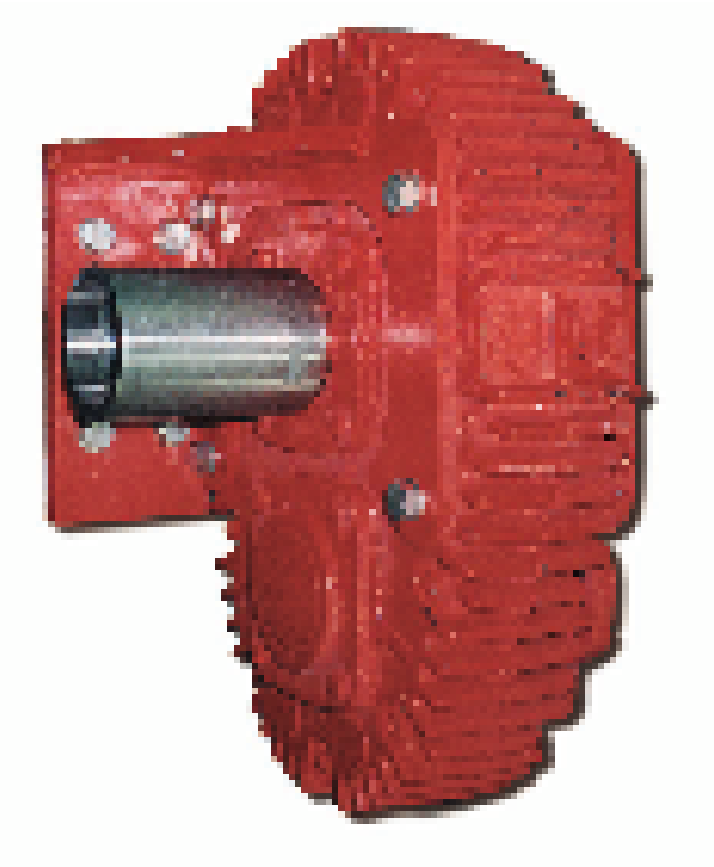
- Independent hydraulic rotation
- Pneumatic hammer section
- External grout swivel
- Available with Titan 30, R32, R28
- Simple design, easy mainentence
- Total weight 120 lbs.



RDS250 Rotary Drill

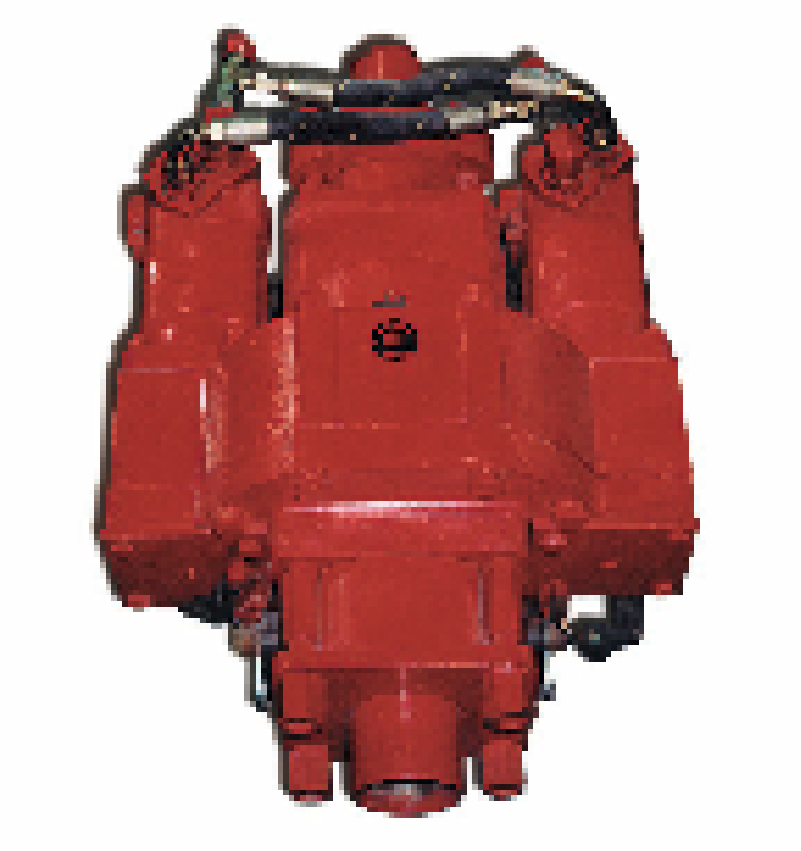
- Rotary version of the TE250
- Torque up to 750 lb/ft
- Up to 250 RPM, 7.8 rev/gal
- Air through shaft for DTH
- Max dynamic thrust 8,000 lb/ft
- Grout swivel for anchors

RDS528 Rotary Head



- 1800 lb/ft of torque
- Weight 120 lbs.
- 2 3/8 API output
- Double lead DG thread available
- Simple/Reliable
- **Available for Rent**

RDSH1000 Rotary Head



- 10,000 lb/ft of torque
- Weight 800 lbs.
- 3 1/2 API output shaft
- No swivel needed, internal V packing
- Continuous circulation of lubrication oil
- Extreme duty design
- **Available for rent**

TEI is also the North America distributor for EuroDrill.

- Torques up to 20,000 lb/ft
- Drifter shanks to 114 mm
- Complete inventory of parts for next day shipping
- Reliable damping device
- More efficient shuttle and piston action than Klemm or Krupp

TEI Rock Drills wants to help you complete your next job.

TEI Rock Drills
Montrose, Colorado USA

210 Apollo Rd Montrose, Colorado 81401 USA

PHONE (970) 249-1515 FAX (970) 249-1999

www.teirockdrills.com

Please call for .dwg files

Videos or more specs

GROVE®

TMS875C

TRUCK MOUNTED HYDRAULIC CRANE

Superstructure Specifications

Boom (Standard)
36 ft. - 110 ft. (10.9 m - 33.5 m) four section full power boom. Equipped with remote greasing lines for upper wear pad area. Maximum Tip Height: 118 ft. (35.9 m).

Folding Lattice Extension
110 ft. (33.5 m) Main boom
31 ft. or 56 ft. (9.4 m or 17 m) folding lattice swingaway extension offsettable at 1.5°, 25° or 45°. Stows alongside base boom section. Maximum Tip Height: 172 ft. (52.4 m).

*Boom (Optional)
40 ft. - 125 ft. (12.2 m - 38.1 m) four section full power boom. Equipped with remote greasing lines for upper wear pad area. Maximum Tip Height: 133 ft. (40.5 m).

*Lattice Extension
125 ft. (38.1 m) Main boom
35 ft. - 60 ft. (10.7 m - 18.3 m) telescoping lattice swingaway extension offsettable at 2° or 30°. Stows alongside the base boom section. Maximum Tip Height: 191 ft. (58.2 m).

*Boom (Optional)
35 ft. - 138 ft. (10.8 m - 42 m) five section full power boom. Equipped with remote greasing lines for upper wear pad area. Maximum Tip Height: 147 ft. (44.8 m).

*Folding Lattice Extension
138 ft. (42 m) Main boom
31 ft. or 56 ft. (9.4 m or 17 m) folding lattice swingaway extension offsettable at 1.5°, 25° or 45°. Stows alongside the base boom section. Maximum Tip Height: 202 ft. (61.5 m).

*Optional Luffing Lattice Extension
138 ft. (42 m) Main boom.
31 ft. or 56 ft. (9.4 m or 17 m) folding lattice swingaway extension hydraulically offsettable from the superstructure cab. Infinite offsets 1.5° through 45°. Stows alongside the base boom section. Maximum Tip Height: 202 ft. (61.5 m).

Boom Nose
Five nylatron sheaves (six with 125' boom), mounted on heavy duty tapered roller bearings with removable pin-type rope guards. Quick reeving type boom nose. Removable auxiliary boom nose with removable pin type rope guard.

Boom Elevation
One double acting hydraulic cylinder with integral holding valve provides elevation from -3° to 80° (-3° to 78° with 125 ft. boom).

Load Moment & Anti-Two Block System
Standard load moment and anti-two block system with audio-visual warning and control lever lockout. These systems provide electronic display of boom angle, boom length, radius, tip height, relative load moment, maximum permissible load, load indication and warning of impending two-block condition.

Cab
High visibility, all steel cab with acoustical lining and tinted safety glass throughout. Deluxe seat with armrest mounted hydraulic single axis controls. Dash panel incorporates gauges for all engine functions. Other standard features include: sliding side and rear windows, hot water heat, electric windshield wash/wipe, circulating air fan, sliding skylight with sunscreen and electric skylight wiper, fire extinguisher, cup holder.

Swing
Planetary swing with foot applied multi-disc wet brake. Spring applied, hydraulically released parking brake, plunger type mechanical house lock and 360° house lock operated from cab. Maximum speed: 2.0 RPM.

Counterweight
8,500 lbs. (3856 kg) total consisting of (1) 5,500 lbs. (2495 kg) section and (1) 3,000 lbs. (1361 kg) section. Hydraulic installation/removal. *Optional 9,500 lbs. (4309 kg) to be used in conjunction with standard counterweight to provide 12,500 lbs. (5670 kg) or 18,000 lbs. (8165 kg) total counterweight.

Hydraulic System
Four main gear pumps with a combined capacity of 160 GPM (730.5 lpm). Three individual valve banks. Return line type filter with full flow by-pass protection and service indicator. Replaceable cartridge with beta rating of 5/12/16. 170 gallons (643 L) reservoir. Remote mounted oil cooler with thermostatically controlled hydraulic motor driven fan.

Hoist specifications
Main and Auxiliary Hoists - Model HO3OG-26G

Planetary reduction with integral automatic brake, electronic hoist drum rotation indicator, hoist drum cable follower and grooved drum.

Maximum Hoist Line Pull: 17,866 lb. (8103 kg)

Maximum Rope Permissible Line Pull: 12,920 lb. (5860 kg)

Maximum Single Line Speed: 504 fpm (154 m/m)

Rope Diameter: 3/4 in. (19 mm)

Rope Length: 620 ft. (189 m)

Maximum Rope Stowage: 1,163 ft. (354 m)

Denotes optional equipment

Carrier Specifications

Chassis
Triple box section, four-axle carrier fabricated from high-strength, low alloy steel with towing and tie-down lugs.

Outrigger System
Four hydraulic telescoping, two-stage, double box beam outriggers with inverted jack and integral holding valves. Quick release type outrigger floats 24 in. (610 mm) diameter. Three position setting with fully extended, intermediate (50%) extended and fully retracted capacities. Maximum outrigger pad load: 100,500 lbs. (45 587 kg).

Outrigger Controls
Located in the superstructure cab on left side (umbilical design) and on either side of carrier with lighted boxes. Requires two hand operation. Crane level indicator (sight bubble) on right side console.

Engine
Cummins ISM 400 diesel, six cylinders, turbo-charged after cooled, 661 cu. in. (10.8 L), 400 bhp (298 kW) (gross) @ 1500 RPM. Maximum torque 1,450 ft. lbs. (1966 Nm) @ 1200 RPM. Equipped with engine brake and audio-visual engine distress system.

Fuel Tank Capacity
100 gallons (376 L).

Transmission
Roadranger 11 speeds forward, 3 reverse.
Drive 8 x 4 x 4.

Steering
Front axle, single circuit, mechanical steering with hydraulic power assist. Turning radius: 45' 1".

Axles
Front: (2) Eaton beam-type steering axles, 84 in. (2.13 m) track.
Rear: (2) Eaton single reduction drive axles, 74.46 in. (1.89 m) track. Inter-axle differential locks.

Brakes
S-cam, dual air split system operating on all wheels. Spring-applied, air released parking brake acting on rear axles.
Air dryer.

Suspension
Front: Walking beam with air bags and shock absorbers.
Rear: Walking beam with air bags and shock absorbers.

Tires
Front: 445/65R 22.5 Goodyear G286, tubeless, mounted on aluminum disc wheels.
Rear: 315/80R 22.5 Goodyear G286, tubeless, mounted on aluminum disc wheels.

*Optional Tires
Front: 445/65R 22.5 Bridgestone M844F, tubeless.
445/65R 22.5 Michelin XZY (WB), tubeless.
Rear: 315/80R 22.5 Bridgestone M843, tubeless.
315/80R 22.5 Michelin XZY-1 tubeless.

Lights
Full lighting package including turn indicators, head, tail, brake, and hazard warning lights.

Cab
One man design, all steel fabricated with acoustical lining and tinted safety glass throughout. Deluxe fabric covered seat with air height adjustment . Complete driving controls and engine instrumentation including tilt telescope steering wheel, tachometer, speedometer, voltmeter, water temp., oil pressure, fuel level, air pressure gauge with A/V warning and engine high temp./low oil pressure A/V warning. Other standard items include hot water heater/defroster, electric windshield wash/wipe, fire extinguisher, seat belt, door lock and electric window.

Electrical System
Two 12 V - maintenance free batteries. 12 V carrier driving lights, remaining systems 24 V Standard battery disconnect.

Maximum Speed
65 MPH (104 kph).

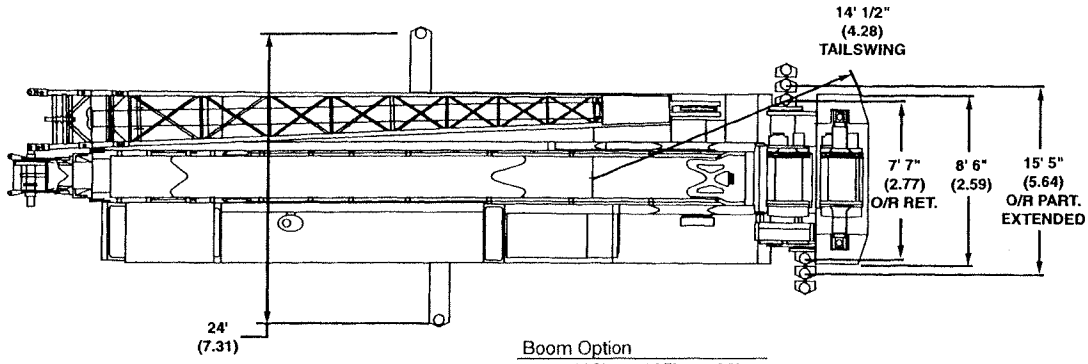
Gradeability (Theoretical)
83%.

Miscellaneous Standard Equipment
Aluminum fenders with rear storage compartments; dual rear view mirrors; electronic back-up alarm; sling/tool box; pump disconnect; tire inflation kit; air cleaner restriction indicator; block and ball stowage; and chrome package which includes aluminum wheels.

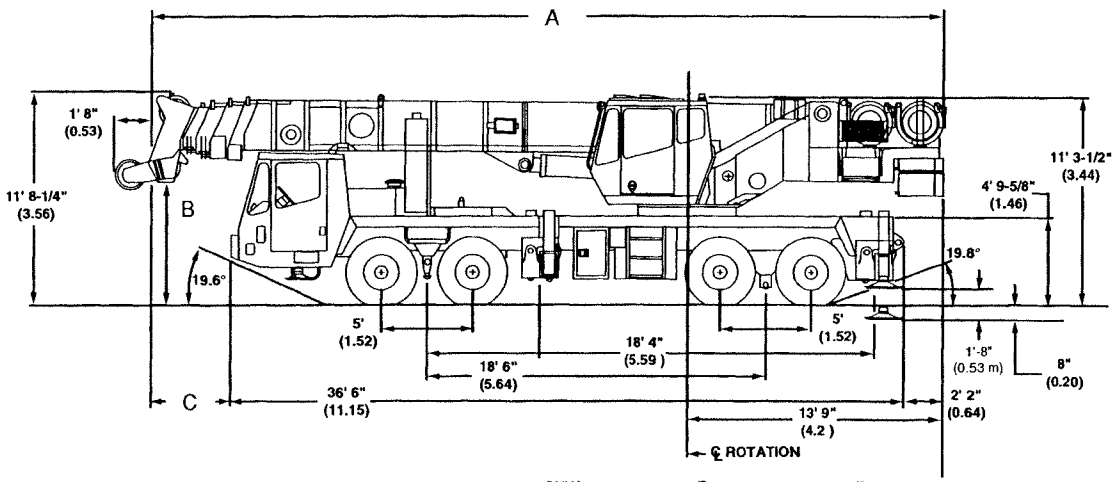
Optional Equipment
*Cold Weather Package (Includes cold weather kit for main and auxiliary hoist, remote controlled heated carrier mirrors).
*Auxiliary Lighting Package (Includes cab mounted work lights, boom base mounted floodlights, hoist mounted work light).
*Flashing Light Package (Includes amber strobe for superstructure and carrier cabs).
*Trailing Boom Package (Includes trailer air and electrical disconnects, and trailing boom kit [less dolly]).
*Air conditioning, either cab.
*Remote controlled cab mounted work lights.
*Hookblocks and headache ball.
*Pintle hook (rear).
*Cross axle differential locks.
*Aluminum outrigger pads.
*Air horn.
*LMI light bar.
*PAT data logger.
*Grease system for turntable, air powered.
*On rubber load chart, including calibration.

Denotes optional equipment

Dimensions



Boom Option	110'	125'	138'
A	43' 4"	47' 5"	43' 3"
B	5' 11"	6' 0"	7' 0"
C	4' 4"	8' 5"	4' 3"



Axle/Tire Allowable Weights	GVW lb.	GVW kg	Front lb.	Front kg	Rear lb.	Rear kg
	109,200	49,533	49,200	22,317	60,000	27,216
TMS875C Basic Machine with 110 ft. boom, main and auxiliary hoists w/ rope, and no counterweight.	79,961	36,270	34,392	15,600	45,569	20,670
Add: 3,000 lb. counterweight (superstructure)	3,000	1,361	-1,353	-614	4,353	1,975
Add: 5,500 lb. counterweight (superstructure)	5,500	2,495	-2,480	-1,125	7,980	3,620
Add: 9,500 lb. counterweight (superstructure)	9,500	4,309	-4,284	-1,943	13,784	6,252
Add: 3,000 lb. counterweight (carrier)	3,000	1,361	2,704	1,227	296	134
Add: 5,500 lb. counterweight (carrier)	5,500	2,495	4,958	2,249	542	246
Add: 9,500 lb. counterweight (carrier)	9,500	4,309	8,564	3,885	936	425
Add: 75 ton, 6 sheave hookblock (stowed in trough)	1,711	776	2,443	1,108	-732	-332
Add: 45 ton, 3 sheave hookblock (stowed in trough)	830	376	1,185	538	-355	-161
Add: 10 ton headache ball (stowed in trough)	560	254	800	363	-240	-109
Substitute: 125 ft. Boom	3,970	1,801	5,100	2,313	-1,130	-515
Substitute: 138 ft. Boom	4,211	1,910	2,971	1,348	1,240	562
Remove: Auxiliary hoist cable	-775	-352	347	157	-1,122	-509

110 ft. and 138 ft. Boom Options						
Add: 31 ft. Fixed length extension	1,553	704	1,556	706	-3	-1
Add: 31 ft. - 56 ft. Bi-fold extension	2,240	1,016	1,973	895	267	121
Add: 31 ft. - 56 ft. Luffing bi-fold extension (138 ft. boom only)	3,122	1,416	3,298	1,496	-176	-80
Add: Auxiliary boom nose	127	58	234	106	-107	-49

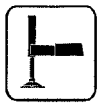
125 ft. Boom Options						
Add: 35 ft. Fixed length extension	2,154	977	2,362	1,071	-208	-94
Add: 35 ft. - 60 ft. telescopic extension	2,893	1,312	3,172	1,439	-279	-127
Add: Auxiliary boom nose	116	53	235	107	-119	-54

Working Range

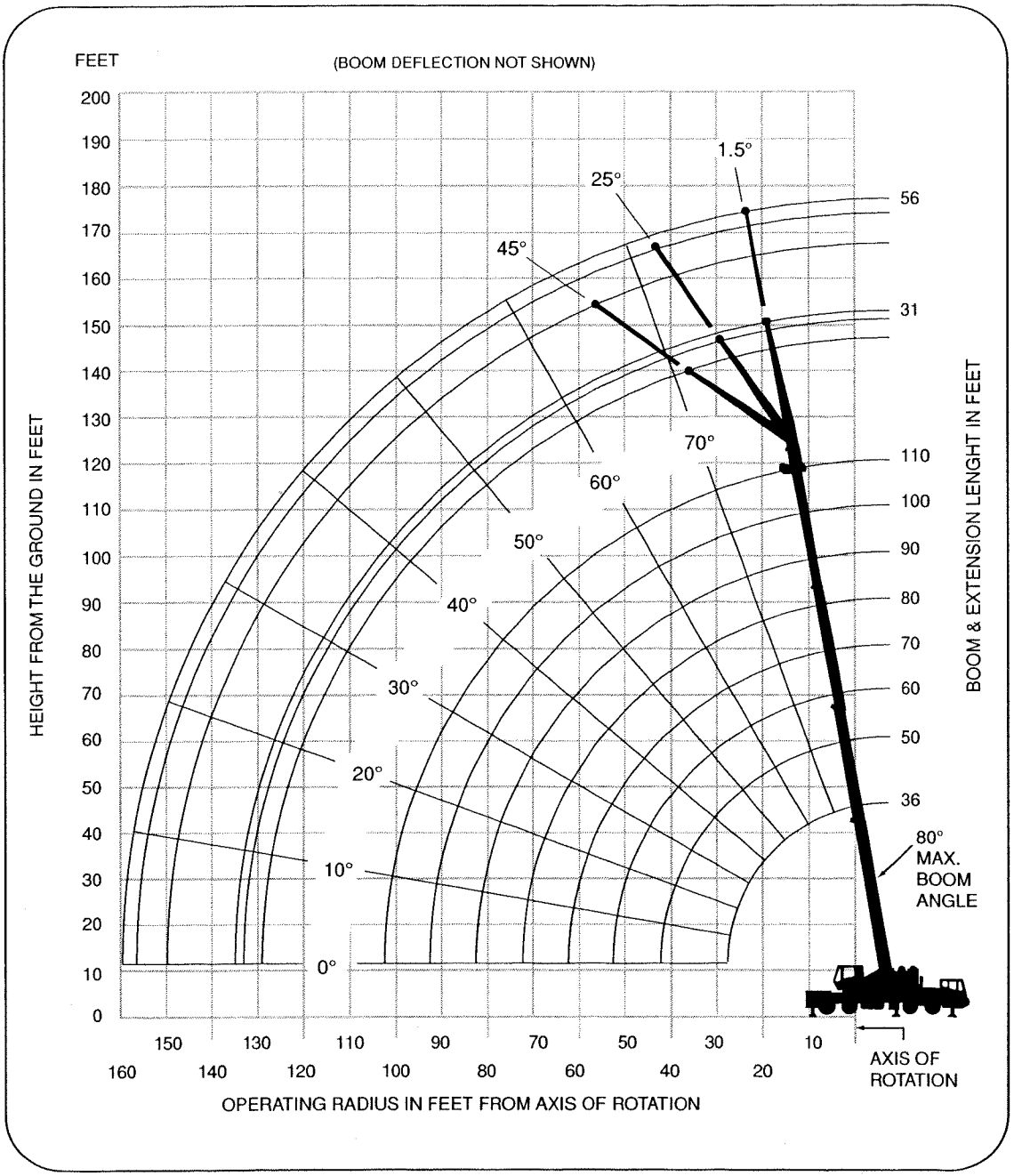
36-110 ft.
(10.9-33.5 m)

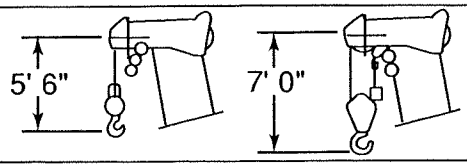
31-56 ft.
(9.4-17 m)

18,000 lbs.
(8165 kg)


100%

360°





DIMENSIONS ARE FOR LARGEST GROVE FURNISHED HOOK BLOCK AND HEADACHE BALL, WITH ANTI-TWO BLOCK ACTIVATED.

RATED LIFTING CAPACITIES IN POUNDS WITH 18,000 LB. COUNTERWEIGHT
36 FT. - 110 FT. BOOM

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	#0501							
	Main Boom Length in Feet							
	36	50	*60	70	80	90	100	110
10	150,000+ (68)	109,500 (75)	84,200 (78)	**56,450 (80)				
12	110,500 (64)	104,500 (72.5)	79,850 (76)	56,450 (78.5)				
15	96,800 (58.5)	91,400 (69)	73,900 (73)	56,450 (76)	56,500 (78.5)	**47,850 (80)		
20	78,750 (47)	75,300 (62)	59,600 (67.5)	56,450 (71.5)	50,950 (74.5)	41,000 (77)	40,350 (79)	**27,350 (80)
25	59,800 (32.5)	59,750 (55)	50,000 (62.5)	48,900 (67)	43,800 (71)	35,250 (73.5)	34,750 (76)	27,350 (78.5)
30		47,300 (47)	42,300 (56.5)	41,900 (62.5)	38,300 (67)	31,050 (70.5)	30,450 (73)	27,350 (75.5)
35		38,550 (37.5)	36,950 (50)	36,400 (57.5)	33,900 (63)	27,650 (67)	27,000 (70)	25,300 (72.5)
40		28,450 (24.5)	28,450 (43)	29,700 (52)	30,300 (58.5)	24,350 (63)	24,250 (67)	22,900 (70)
45			23,400 (34.5)	24,650 (46.5)	25,550 (54)	22,050 (59.5)	21,900 (63.5)	20,850 (67)
50			19,450 (23)	20,700 (39.5)	21,600 (49)	20,050 (55.5)	19,950 (60)	19,100 (64)
55				17,500 (32)	18,450 (43.5)	18,350 (51)	18,300 (56.5)	17,550 (61)
60				14,900 (21)	15,850 (37.5)	16,550 (46.5)	16,850 (53)	16,200 (57.5)
65					13,650 (30)	14,350 (41.5)	14,900 (49)	15,050 (54.5)
70					11,650 (20)	12,500 (35.5)	13,050 (44.5)	13,500 (50.5)
75						10,900 (29)	11,450 (39.5)	11,900 (47)
80						9,480 (19)	10,000 (34.5)	10,500 (43)
85							8,790 (28)	9,260 (38.5)
90							7,690 (18.5)	8,150 (33)
95								7,170 (27)
100								6,280 (18.5)
Minimum boom angle (deg.) for indicated length (no load)								0
Maximum boom length (ft.) at 0 degree boom angle (no load)								110

NOTE: ( ) Boom angles are in degrees.

#LMI operating code. Refer to LMI manual for instructions.
**This capacity is based on maximum boom angle.

Lifting Capacities On Outriggers Fully Extended - 360° At Zero Degree Boom Angle								
Boom Angle	Main Boom Length in Feet							
	36	50	*60	70	80	90	100	110
0°	27,600 (28.3)	16,200 (42.8)	11,350 (53.1)	9,150 (62.8)	7,410 (72.8)	6,040 (82.8)	4,950 (92.8)	4,060 (102.8)

NOTE: ( ) Reference radii in feet. A6-829-100857

*60 ft. boom length is with inner-mid extended and outer-mid & fly retracted.

+12 parts line required to lift this capacity (using aux. boom nose). Refer to Operator's and Safety Handbook for reeving diagram.

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

31 FT. - 56 FT. FOLDING BOOM EXTENSION WITH 18,000 LB. COUNTERWEIGHT

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	31 FT. LENGTH			56 FT. LENGTH		
	#0521	**#0522**	**#0523**	**#0541**	**#0542**	**#0543**
	1.5° OFFSET	25° OFFSET	45° OFFSET	1.5° OFFSET	25° OFFSET	45° OFFSET
25	*12,900 (80)					
30	12,900 (78.5)					
35	12,900 (76.5)	8,340 (79.5)		8,220 (79.5)		
40	12,750 (74.5)	8,020 (77.5)	*6,370 (80)	8,220 (78)		
45	12,350 (72.5)	7,730 (76)	6,300 (79)	8,220 (76.5)		
50	11,500 (70.5)	7,390 (74)	6,250 (77)	8,220 (75)	*4,780 (80)	
55	10,950 (68.5)	7,130 (72)	6,190 (74.5)	8,220 (74)	4,640 (79.5)	
60	10,400 (66.5)	6,870 (69.5)	6,120 (72)	8,220 (72)	4,490 (78)	
65	9,960 (64)	6,660 (67.5)	6,090 (69.5)	8,220 (70)	4,340 (76)	*3,770 (80)
70	9,480 (61.5)	6,450 (65)	6,050 (67)	8,080 (68)	4,190 (74)	3,740 (78)
75	9,060 (59)	6,280 (62.5)	6,050 (64.5)	7,650 (66)	4,070 (72)	3,720 (76)
80	8,630 (56.5)	6,110 (60)	6,050 (62)	7,220 (64)	3,940 (70)	3,700 (73.5)
85	8,270 (54)	5,970 (57.5)	6,050 (59)	6,870 (62)	3,830 (67.5)	3,700 (71.5)
90	7,900 (51)	5,840 (54.5)	6,050 (56)	6,530 (60)	3,730 (65.5)	3,700 (69)
95	7,580 (48.5)	5,740 (51.5)		6,130 (58)	3,640 (63.5)	3,700 (66.5)
100	7,060 (45.5)	5,650 (48.5)		5,730 (55.5)	3,550 (61)	3,700 (64)
110	5,600 (38.5)	5,510 (41.5)		5,060 (51)	3,420 (56)	3,480 (59)
120	4,400 (30.5)			4,510 (46)	3,320 (51)	
130	3,400 (18.5)			4,050 (40)	3,280 (45)	
140				3,190 (33.5)	2,320 (37.5)	
150				2,460 (24.5)		
No Load Stability Data						
Minimum boom angle (deg.) for indicated length	2	25	45	2	25	45
Maximum boom length (ft.) at 0 deg. boom angle	110			110		

NOTE: ( ) Boom angles are in degrees. A6-829-015081
#LMI operating code. Refer to LMI manual for operating instructions.
*This capacity is based on maximum boom angle.

1. All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765 NOV93.
2. 31 ft. and 56 ft. folding boom extension lengths may be used for single line lifting service only.
3. For main boom lengths less than 110 ft., rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is set up. For boom angles not shown, use rating of the next lower boom angle.
4. **WARNING**: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
5. Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
6. Capacities listed are with outriggers properly extended and vertical jacks set only.

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

RATED LIFTING CAPACITIES IN POUNDS WITH 8,500 LB. COUNTERWEIGHT
36 FT. - 110 FT. BOOM

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	#0001							
	Main Boom Length in Feet							
	36	50	*60	70	80	90	100	110
10	150,000+ (68)	109,500 (75)	84,200 (78)	**56,450 (80)				
12	110,500 (64)	104,500 (72.5)	79,850 (76)	56,450 (78.5)				
15	96,800 (58.5)	91,400 (69)	73,900 (73)	56,450 (76)	56,500 (78.5)	**47,850 (80)		
20	72,000 (47)	71,850 (62)	59,600 (67.5)	56,450 (71.5)	50,950 (74.5)	41,000 (77)	40,350 (79)	**27,350 (80)
25	54,450 (32.5)	54,350 (55)	50,000 (62.5)	48,900 (67)	43,800 (71)	35,250 (73.5)	34,750 (76)	27,350 (78.5)
30		42,900 (47)	42,300 (56.5)	41,900 (62.5)	38,300 (67)	31,050 (70.5)	30,450 (73)	27,350 (75.5)
35		32,300 (37.5)	32,600 (50)	33,900 (57.5)	33,900 (63)	27,650 (67)	27,000 (70)	25,300 (72.5)
40		24,300 (24.5)	25,450 (43)	26,500 (52)	27,450 (58.5)	24,350 (63)	24,250 (67)	22,900 (70)
45			20,350 (34.5)	21,200 (46.5)	22,150 (54)	22,050 (59.5)	21,900 (63.5)	20,850 (67)
50			16,300 (23)	17,250 (39.5)	18,150 (49)	19,100 (55.5)	19,450 (60)	19,100 (64)
55				14,150 (32)	15,050 (43.5)	15,950 (51)	16,300 (56.5)	16,700 (61)
60				11,600 (21)	12,600 (37.5)	13,400 (46.5)	13,800 (53)	14,150 (57.5)
65					10,550 (30)	11,400 (41.5)	11,750 (49)	12,150 (54.5)
70					8,830 (20)	9,720 (35.5)	10,050 (44.5)	10,450 (50.5)
75						8,300 (29)	8,670 (39.5)	9,060 (47)
80						7,070 (19)	7,460 (34.5)	7,850 (43)
85							6,420 (28)	6,810 (38.5)
90							5,510 (18.5)	5,900 (33)
95								5,100 (27)
100								4,390 (18.5)
Minimum boom angle (deg.) for indicated length (no load)								0
Maximum boom length (ft.) at 0 degree boom angle (no load)								110

NOTE: ( ) Boom angles are in degrees.

#LMI operating code. Refer to LMI manual for instructions.
**This capacity is based on maximum boom angle.

Lifting Capacities On Outriggers Fully Extended - 360° At Zero Degree Boom Angle								
Boom Angle	Main Boom Length in Feet							
	36	50	*60	70	80	90	100	110
0°	27,600 (28.3)	16,200 (42.8)	11,350 (53.1)	9,150 (62.8)	7,410 (72.8)	6,040 (82.8)	4,950 (92.8)	4,010 (102.8)

NOTE: ( ) Reference radii in feet. A6-829-100859

*60 ft. boom length is with inner-mid extended and outer-mid & fly retracted.

+12 parts line required to lift this capacity (using aux. boom nose). Refer to Operator's and Safety Handbook for reeving diagram.

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31 FT. - 56 FT. FOLDING BOOM EXTENSION WITH 8,500 LB. COUNTERWEIGHT

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	31 FT. LENGTH			56 FT. LENGTH		
	#0021	**#0022**	**#0023**	**#0041**	**#0042**	**#0043**
	1.5° OFFSET	25° OFFSET	45° OFFSET	1.5° OFFSET	25° OFFSET	45° OFFSET
25	*12,900 (80)					
30	12,900 (78.5)					
35	12,900 (76.5)	8,340 (79.5)		8,220 (79.5)		
40	12,750 (74.5)	8,020 (77.5)	*6,370 (80)	8,220 (78)		
45	12,350 (72.5)	7,730 (76)	6,300 (79)	8,220 (76.5)		
50	11,500 (70.5)	7,390 (74)	6,250 (77)	8,220 (75)	*4,780 (80)	
55	10,950 (68.5)	7,130 (72)	6,190 (74.5)	8,220 (74)	4,640 (79.5)	
60	10,400 (66.5)	6,870 (69.5)	6,120 (72)	8,220 (72)	4,490 (78)	
65	9,960 (64)	6,660 (67.5)	6,090 (69.5)	8,220 (70)	4,340 (76)	*3,770 (80)
70	9,480 (61.5)	6,450 (65)	6,050 (67)	8,080 (68)	4,190 (74)	3,740 (78)
75	9,060 (59)	6,280 (62.5)	6,050 (64.5)	7,650 (66)	4,070 (72)	3,720 (76)
80	8,630 (56.5)	6,110 (60)	6,050 (62)	7,220 (64)	3,940 (70)	3,700 (73.5)
85	7,910 (54)	5,970 (57.5)	6,050 (59)	6,870 (62)	3,830 (67.5)	3,700 (71.5)
90	6,950 (51)	5,840 (54.5)	6,050 (56)	6,530 (60)	3,730 (65.5)	3,700 (69)
95	6,120 (48.5)	5,740 (51.5)		6,130 (58)	3,640 (63.5)	3,700 (66.5)
100	5,370 (45.5)	5,650 (48.5)		5,730 (55.5)	3,550 (61)	3,700 (64)
110	4,120 (38.5)	4,360 (41.5)		4,820 (51)	3,420 (56)	3,480 (59)
120	3,090 (30.5)			3,780 (46)	3,320 (51)	
130	2,240 (18.5)			2,920 (40)	3,280 (45)	
140				2,200 (33.5)	2,320 (37.5)	
150				1,580 (24.5)		
No Load Stability Data						
Minimum boom angle (deg.) for indicated length	2	25	45	2	25	45
Maximum boom length (ft.) at 0 deg. boom angle	110			110		

NOTE: ( ) Boom angles are in degrees. A6-829-015083
#LMI operating code. Refer to LMI manual for operating instructions.
*This capacity is based on maximum boom angle.

1. All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765 NOV93.
2. 31 ft. and 56 ft. folding boom extension lengths may be used for single line lifting service only.
3. For main boom lengths less than 110 ft., rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is set up. For boom angles not shown, use rating of the next lower boom angle.
4. **WARNING**: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
5. Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
6. Capacities listed are with outriggers properly extended and vertical jacks set only.

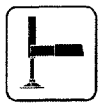
THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

Working Range

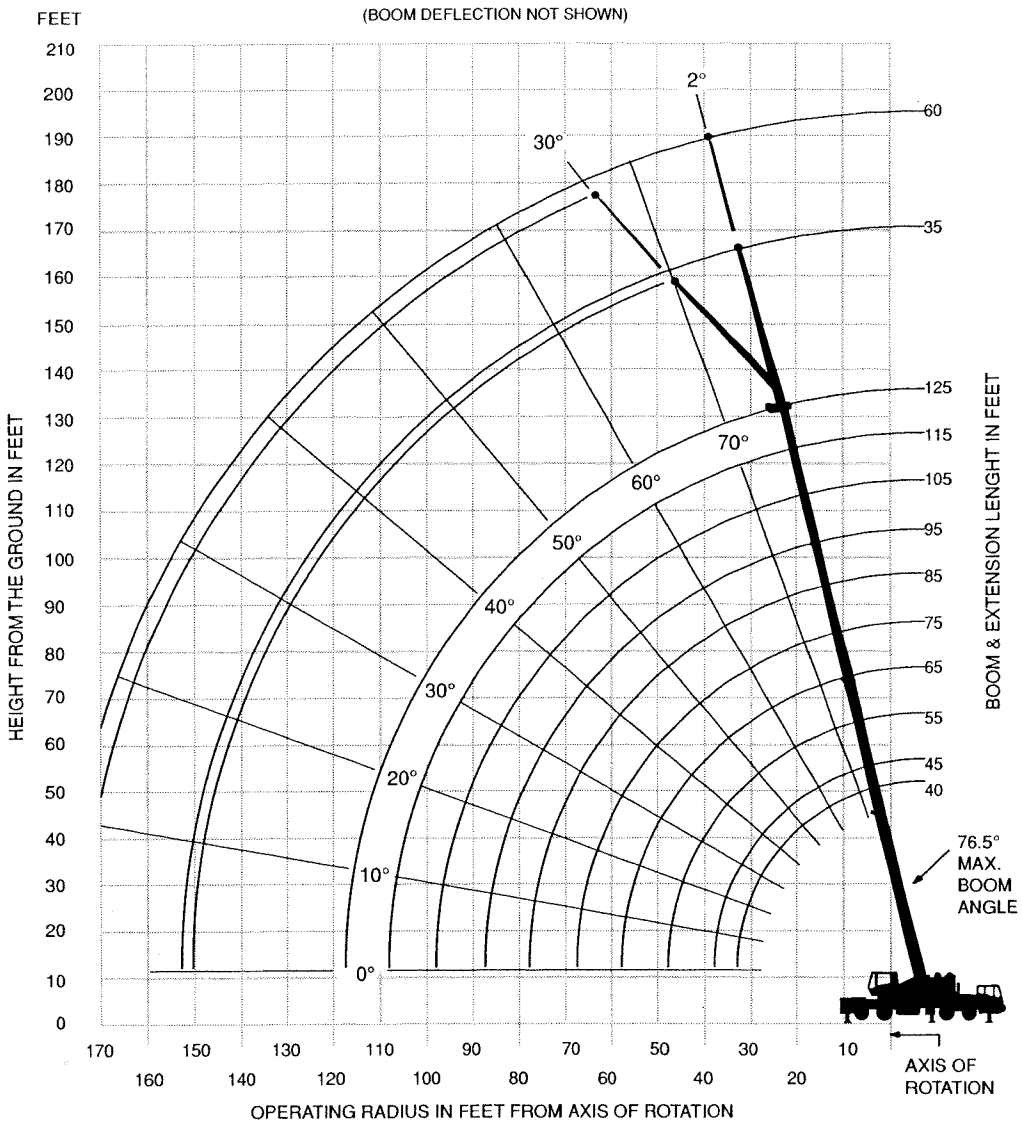
40-125 ft.
(12.2-38.1m)

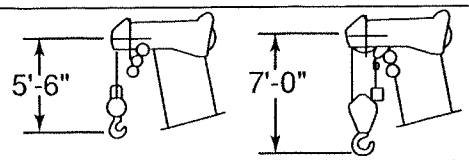
35-60 ft.
(10.7-18.3 m)

18,000 lbs.
(8165 kg)


100%

360°





DIMENSIONS ARE FOR LARGEST GROVE FURNISHED HOOK BLOCK AND HEADACHE BALL, WITH ANTI-TWO BLOCK ACTIVATED.

RATED LIFTING CAPACITIES IN POUNDS WITH 18,000 LB. COUNTERWEIGHT
40 FT. - 125 FT. BOOM

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	#0001									
	Main Boom Length in Feet									
	40	45	55	65	75	85	95	105	115	125
10	+150,000 (70)	105,000 (72.5)								
12	123,500 (67)	105,000 (70)	94,600 (74)							
15	108,000 (61.5)	104,000 (65.5)	88,250 (70.5)	71,050 (74)						
20	84,200 (52.5)	83,650 (58)	76,350 (65)	60,400 (69.5)	55,250 (72.5)	48,150 (75)				
25	64,050 (41.5)	63,550 (49.5)	62,850 (58.5)	56,100 (64.5)	47,950 (68.5)	41,700 (71.5)	38,000 (73.5)	33,350 (75.5)		
30	50,750 (26)	50,350 (39.5)	49,700 (52)	48,250 (59)	41,950 (64)	36,700 (67.5)	33,300 (70.5)	30,750 (72.5)	24,550 (75)	*23,700 (76.5)
35		40,350 (26)	39,750 (44.5)	39,250 (53.5)	36,250 (59.5)	32,600 (64)	29,550 (67)	27,300 (69.5)	21,700 (72)	21,900 (74)
40			31,250 (35.5)	31,250 (47.5)	31,500 (55)	29,000 (60)	26,450 (63.5)	24,450 (66.5)	19,350 (69.5)	20,300 (71.5)
45			24,250 (23)	25,050 (40.5)	25,350 (49.5)	25,750 (55.5)	23,850 (60)	22,000 (63.5)	17,450 (66.5)	18,800 (69)
50				20,000 (32.5)	20,750 (44)	21,750 (51.5)	21,300 (56.5)	19,850 (60.5)	15,800 (64)	17,050 (66.5)
55				12,900 (21)	17,050 (38)	18,100 (46.5)	19,000 (52.5)	17,950 (57)	14,550 (61)	15,600 (64)
60					14,150 (30)	15,100 (41.5)	16,000 (48.5)	16,050 (53.5)	13,250 (58)	14,150 (61.5)
65					9,420 (19.5)	12,650 (35.5)	13,550 (44)	14,050 (50)	12,300 (55)	13,000 (58.5)
70						10,600 (28.5)	11,450 (39)	12,000 (46)	11,400 (51.5)	11,850 (55.5)
75						7,250 (18.5)	9,700 (33.5)	10,250 (42)	10,600 (48)	10,750 (52.5)
80							8,190 (27)	8,740 (37.5)	9,290 (44.5)	9,660 (49.5)
85							5,620 (17.5)	7,430 (32)	7,970 (40.5)	8,470 (46.5)
90								6,280 (25.5)	6,810 (36)	7,320 (42.5)
95								4,410 (16.5)	5,800 (31)	6,300 (39)
100									4,890 (25)	5,390 (34.5)
105									3,300 (16.5)	4,560 (30)
110										3,820 (24)
Minimum boom angle (deg.) for indicated length (no load)										0
Maximum boom length (ft.) at 0 degree boom angle (no load)										125

NOTE: ( ) Boom angles are in degrees.
*Based on maximum obtainable boom angle.
#LMI operating code. Refer to LMI manual for operating instructions.
+12 parts line required to lift this capacity (using aux. boom nose). Refer to Operator's and Safety Handbook for reeving diagram.

Lifting Capacities at Zero Degree Boom Angle										
Boom Angle	Main Boom Length in Feet									
	40	45	55	65	75	85	95	105	115	
0°	22,800 (32.3)	18,250 (37.8)	12,200 (47.8)	7,990 (57.8)	5,720 (67.8)	4,320 (77.8)	3,210 (87.8)	2,380 (97.8)	1,570 (107.8)	

Note: ( ) Reference radii are in feet. A6-829-101412

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

35 FT. - 60 FT. TELE. EXTENSION WITH 18,000 LB. COUNTERWEIGHT

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	**35 ft. LENGTH		60 ft. LENGTH	
	#0021	#0023	#0041	#0043
	2° OFFSET	30° OFFSET	2° OFFSET	30° OFFSET
40	*12,900 (76.5)			
45	11,600 (75.5)			
50	10,900 (73.5)		*6,700 (76.5)	
55	10,300 (71.5)	*7,500 (76.5)	6,320 (75)	
60	9,750 (69.5)	7,250 (74.5)	6,000 (73.5)	
65	9,250 (67.5)	7,110 (72.5)	5,630 (71.5)	
70	8,810 (65.5)	6,980 (70.5)	5,260 (70)	
75	8,400 (63.5)	6,860 (68)	4,900 (68.5)	*4,000 (76.5)
80	8,030 (61.5)	6,750 (66)	4,630 (66.5)	3,700 (74.5)
85	7,690 (59)	6,650 (64)	4,360 (65)	3,500 (72.5)
90	7,370 (57)	6,560 (61.5)	4,100 (63)	3,350 (71)
95	6,710 (54.5)	6,480 (59)	3,800 (61)	3,270 (69)
100	5,820 (52.5)	5,790 (56.5)	3,640 (59.5)	3,210 (67)
105	5,010 (50)	5,170 (54)	3,490 (57.5)	3,150 (65)
110	4,290 (47.5)	4,590 (51.5)	3,350 (55.5)	3,100 (63)
115	3,630 (44.5)	4,060 (48.5)	3,220 (53.5)	3,050 (61)
120	3,040 (41.5)	3,550 (45.5)	3,100 (51)	3,010 (58.5)
125	2,500 (38.5)	2,960 (42.5)	2,990 (49)	2,970 (56.5)
130	2,000 (35)	2,410 (39)	2,770 (47)	2,770 (54)
135	1,540 (31.5)		2,430 (44.5)	2,400 (51.5)
140	1,120 (27)		2,120 (42)	2,060 (48.5)
145			1,820 (39)	1,730 (46)
150			1,550 (36.5)	1,420 (42.5)
155			1,290 (33.5)	1,120 (39.5)

NOTE: ( ) Boom angles are in degrees. A6-829-101454

*This capacity is based upon maximum boom angle.
**35 ft. tele. length is also applicable to 35 ft. fixed length, however, the LMI codes will change to #0051 and #0053 for the 2° and 30° offset respectively.
#LMI operating code. Refer to LMI manual for instructions.

1. All capacities above the bold line are based on structural strength of boom extension.
2. 35 ft. and 60 ft. boom extension lengths may be used for single line lifting service only.
3. Radii listed are for a fully extended boom with the boom extension erected. For main boom lengths less than fully extended, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is configured. For boom angles not shown, use the rating of the next lower boom angle.

   WARNING: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
4. Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
5. Capacities listed are with outriggers fully extended and vertical jacks set only.
6. 35 FT. FIXED OR TELE. OFFSETTABLE BOOM EXTENSION WARNING: For main boom length greater than 115 ft. with 35 ft. fixed or tele. boom extension in working position, the boom angle must not be less than 24° since loss of stability will occur causing a tipping condition. The boom angle is not restricted for main boom length equal to or less than 115 ft. This warning also applies for boom extension erection purposes.

   60 FT. TELE. OFFSETTABLE BOOM EXTENSION WARNING: For main boom length greater than 105 ft. with 60 ft. tele. boom extension in working position, the boom angle must not be less than 30° since loss of stability will occur causing a tipping condition. The boom angle is not restricted for main boom length equal to or less than 105 ft. This warning also applies for boom extension erection purposes.

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RATED LIFTING CAPACITIES IN POUNDS WITH 8,500 LB. COUNTERWEIGHT
40 FT. - 125 FT. BOOM

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	#0201									
	Main Boom Length in Feet									
	40	45	55	65	75	85	95	105	115	125
10	+150,000 (70)	105,000 (72.5)								
12	123,500 (67)	105,000 (70)	94,600 (74)							
15	108,000 (61.5)	104,000 (65.5)	88,250 (70.5)	71,050 (74)						
20	77,400 (52.5)	76,900 (58)	76,150 (65)	60,400 (69.5)	55,250 (72.5)	48,150 (75)				
25	58,650 (41.5)	58,150 (49.5)	57,500 (58.5)	56,100 (64.5)	47,950 (68.5)	41,700 (71.5)	38,000 (73.5)	33,350 (75.5)		
30	45,100 (26)	44,650 (39.5)	43,950 (52)	42,950 (59)	41,950 (64)	36,700 (67.5)	33,300 (70.5)	30,750 (72.5)	24,550 (75)	*23,700 (76.5)
35		34,450 (26)	33,650 (44.5)	32,250 (53.5)	32,800 (59.5)	32,600 (64)	29,550 (67)	27,300 (69.5)	21,700 (72)	21,900 (74)
40			26,100 (35.5)	24,850 (47.5)	25,350 (55)	26,550 (60)	26,450 (63.5)	24,450 (66.5)	19,350 (69.5)	20,300 (71.5)
45			20,700 (23)	19,500 (40.5)	19,850 (49.5)	20,950 (55.5)	22,050 (60)	22,000 (63.5)	17,450 (66.5)	18,800 (69)
50				15,450 (32.5)	15,800 (44)	16,850 (51.5)	17,850 (56.5)	18,450 (60.5)	15,800 (64)	17,050 (66.5)
55				11,700 (21)	12,700 (38)	13,650 (46.5)	14,650 (52.5)	15,200 (57)	14,550 (61)	15,600 (64)
60					10,150 (30)	11,150 (41.5)	12,050 (48.5)	12,600 (53.5)	13,100 (58)	13,600 (61.5)
65					8,130 (19.5)	9,120 (35.5)	10,000 (44)	10,500 (50)	10,950 (55)	11,450 (58.5)
70						7,380 (28.5)	8,300 (39)	8,760 (46)	9,210 (51.5)	9,650 (55.5)
75						5,920 (18.5)	6,810 (33.5)	7,290 (42)	7,720 (48)	8,140 (52.5)
80							5,540 (27)	6,030 (37.5)	6,450 (44.5)	6,850 (49.5)
85							4,440 (17.5)	4,910 (32)	5,360 (40.5)	5,740 (46.5)
90								3,940 (25.5)	4,380 (36)	4,770 (42.5)
95								3,080 (16.5)	3,510 (31)	3,910 (39)
100									2,740 (25)	3,120 (34.5)
105									2,050 (16.5)	2,430 (30)
110										1,800 (24)
Minimum boom angle (deg.) for indicated length (no load)										0
Maximum boom length (ft.) at 0 degree boom angle (no load)										125

NOTE: ( ) Boom angles are in degrees.
*Based on maximum obtainable boom angle.
#LMI operating code. Refer to LMI manual for operating instructions.
+12 parts line required to lift this capacity (using aux. boom nose). Refer to Operator's and Safety Handbook for reeving diagram.

Lifting Capacities at Zero Degree Boom Angle										
Boom Angle	Main Boom Length in Feet									
	40	45	55	65	75	85	95	105	115	
0°	22,800 (32.3)	18,250 (37.8)	12,200 (47.8)	7,990 (57.8)	5,720 (67.8)	4,320 (77.8)	3,210 (87.8)	2,380 (97.8)	1,570 (107.8)	

Note: ( ) Reference radii are in feet. A6-829-101414

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

35 FT. - 60 FT. TELE. BOOM EXTENSION WITH 8,500 LB. COUNTERWEIGHT

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	**35 ft. LENGTH		60 ft. LENGTH	
	#0221	**#0223**	**#0241**	**#0243**
	2° OFFSET	30° OFFSET	2° OFFSET	30° OFFSET
40	*12,900 (76.5)			
45	11,600 (75.5)			
50	10,900 (73.5)		*6,700 (76.5)	
55	10,300 (71.5)	*7,500 (76.5)	6,320 (75)	
60	9,750 (69.5)	7,250 (74.5)	6,000 (73.5)	
65	9,250 (67.5)	7,110 (72.5)	5,630 (71.5)	
70	8,810 (65.5)	6,980 (70.5)	5,260 (70)	
75	8,400 (63.5)	6,860 (68)	4,900 (68.5)	*4,000 (76.5)
80	7,390 (61.5)	6,750 (66)	4,630 (66.5)	3,700 (74.5)
85	6,250 (59)	6,650 (64)	4,360 (65)	3,500 (72.5)
90	5,250 (57)	6,330 (61.5)	4,100 (63)	3,350 (71)
95	4,380 (54.5)	5,380 (59)	3,800 (61)	3,270 (69)
100	3,600 (52.5)	4,510 (56.5)	3,640 (59.5)	3,210 (67)
105	2,910 (50)	3,710 (54)	3,490 (57.5)	3,150 (65)
110	2,280 (47.5)	3,000 (51.5)	3,350 (55.5)	3,100 (63)
115	1,720 (44.5)	2,350 (48.5)	2,990 (53.5)	3,050 (61)
120	1,210 (41.5)	1,770 (45.5)	2,500 (51)	3,010 (58.5)
125		1,240 (42.5)	2,050 (49)	2,970 (56.5)
130			1,640 (47)	2,610 (54)
135			1,260 (44.5)	2,100 (51.5)
140				1,630 (48.5)
145				1,190 (46)

NOTE: ( ) Boom angles are in degrees. A6-829-101456

*This capacity is based upon maximum boom angle.
**35 ft. tele. length is also applicable to 35 ft. fixed length, however, the LMI codes will change to #0251 and #0253 for the 2° and 30° offset respectively.
#LMI operating code. Refer to LMI manual for instructions.

1. All capacities above the bold line are based on structural strength of boom extension.
2. 35 ft. and 60 ft. boom extension lengths may be used for single line lifting service only.
3. Radii listed are for a fully extended boom with the boom extension erected. For main boom lengths less than fully extended, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is configured. For boom angles not shown, use the rating of the next lower boom angle.

   WARNING: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
4. Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
5. Capacities listed are with outriggers fully extended and vertical jacks set only.
6. 35 FT. FIXED OR TELE. OFFSETTABLE BOOM EXTENSION WARNING: For main boom length greater than 85 ft. with 35 ft. fixed or tele. boom extension in working position, the boom angle must not be less than 39° since loss of stability will occur causing a tipping condition. The boom angle is not restricted for main boom length equal to or less than 85 ft. This warning also applies for boom extension erection purposes.

   60 FT. TELE. OFFSETTABLE BOOM EXTENSION WARNING: For main boom length greater than 85 ft. with 60 ft. tele. boom extension in working position, the boom angle must not be less than 42° since loss of stability will occur causing a tipping condition. The boom angle is not restricted for main boom length equal to or less than 85 ft. This warning also applies for boom extension erection purposes.

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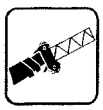
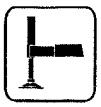
Working Range

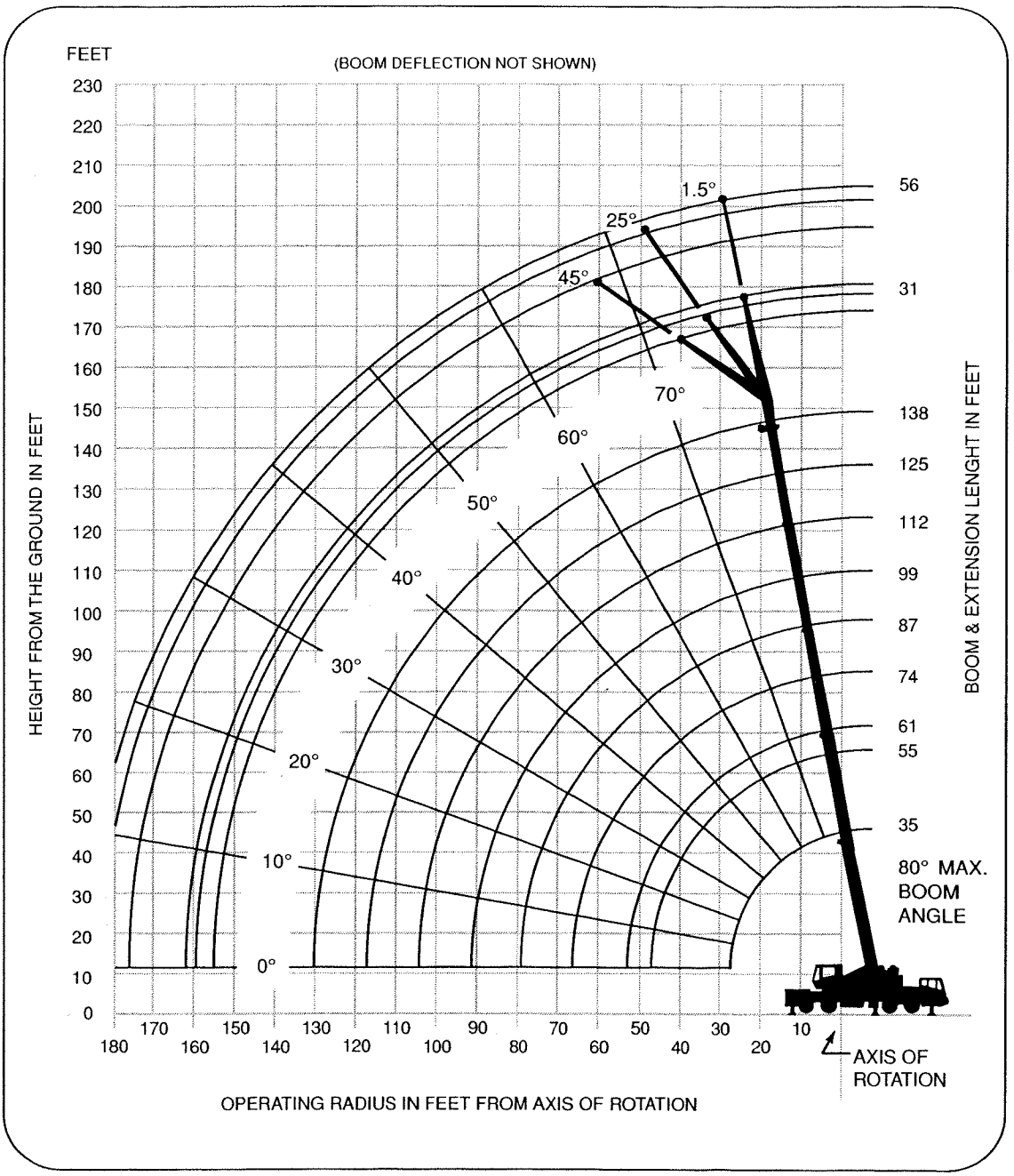
35-138 ft.
(10.8-42.0 m)

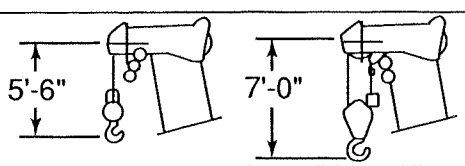

31-56 ft.
(9.4-17 m)

18,000 lbs.
(8165 kg)


100%

360°





DIMENSIONS ARE FOR LARGEST GROVE FURNISHED HOOK BLOCK AND HEADACHE BALL, WITH ANTI-TWO BLOCK ACTIVATED.

RATED LIFTING CAPACITIES IN POUNDS WITH 18,000 LB. COUNTERWEIGHT
35 FT. - 138 FT. BOOM (MODE A)

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	#0501						
	Main Boom Length in Feet						
	35	61	74	87	99	112	138
10	+150,000 (65.5)	42,900 (77.5)	*32,100 (80)				
12	110,000 (62)	42,000 (75.5)	32,100 (78.5)	*31,850 (80)			
15	95,800 (56)	36,550 (72.5)	32,100 (76)	31,850 (78.5)	*21,350 (80)		
20	77,250 (44.5)	29,400 (67.5)	31,350 (71.5)	28,850 (75)	21,350 (77.5)	19,000 (79.5)	
25	58,500 (29.5)	24,350 (62)	26,450 (67.5)	25,050 (71.5)	20,850 (74.5)	18,150 (77)	*19,000 (80)
30		20,500 (56.5)	22,300 (63)	21,550 (68)	18,650 (71.5)	17,300 (74.5)	18,300 (78.5)
35		17,450 (50)	19,100 (58.5)	18,500 (64)	16,900 (68.5)	16,450 (71.5)	17,650 (76.5)
40		15,050 (43)	16,500 (53.5)	16,000 (60)	15,300 (65)	15,650 (69)	17,000 (74)
45		13,100 (35)	14,450 (48.5)	14,000 (56)	13,650 (61.5)	14,150 (66)	16,350 (72)
50		11,450 (24.5)	12,750 (42.5)	12,350 (52)	12,100 (58.5)	12,700 (63)	15,700 (69.5)
60			10,050 (28)	9,780 (42.5)	9,580 (51)	10,150 (57)	13,300 (65)
70				7,860 (30)	7,710 (42.5)	8,220 (50)	11,050 (60)
80					6,270 (32)	6,730 (42.5)	9,120 (55)
90					4,800 (15.5)	5,550 (33.5)	7,380 (49.5)
100						4,010 (21)	5,500 (43)
110							4,000 (36)
120							2,760 (27)
130							1,720 (9.5)
Minimum boom angle (deg.) for indicated length (no load)						0	9
Maximum boom length (ft.) at 0 degree boom angle (no load)						112	125

NOTE: ( ) Boom angles are in degrees.

#LMI operating code. Refer to LMI manual for instructions.
*This capacity is based on maximum boom angle.
+12 parts line required to lift this capacity (using aux. boom nose). Refer to Operator's and Safety Handbook for reeving diagram.

Lifting Capacities On Outriggers Fully Extended - 360° At Zero Degree Boom Angle							
Boom Angle	Main Boom Length in Feet						
	35	61	74	87	99	112	
0°	26,400 (28.2)	10,150 (53.8)	6,240 (66.6)	3,420 (79.4)	2,440 (92.2)	1,680 (105)	

NOTE: ( ) Reference radii in feet. A6-829-100798

Ext. %							
Inner-mid	0	0	0	0	0	0	100
Center-mid	0	100	100	100	100	100	100
Outer-mid	0	0	25	50	75	100	100
Fly	0	0	25	50	75	100	100

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RATED LIFTING CAPACITIES IN POUNDS WITH 18,000 LB. COUNTERWEIGHT
35 FT. - 138 FT. BOOM (MODE B)

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	#0501								
	Main Boom Length in Feet								
	35	55	61	74	87	99	112	125	138
10	+150,000 (65.5)	79,100 (76)	78,450 (77.5)	*57,050 (80)					
12	110,000 (62)	79,100 (73.5)	77,500 (75.5)	57,050 (78.5)	*43,300 (80)				
15	95,800 (56)	79,100 (70)	69,850 (72.5)	51,650 (76)	43,300 (78.5)	*32,100 (80)			
20	77,250 (44.5)	70,850 (64.5)	59,850 (67.5)	44,350 (71.5)	39,550 (75)	32,100 (77.5)	30,050 (79.5)	*20,150 (80)	
25	58,500 (29.5)	58,200 (58)	52,200 (62)	38,750 (67.5)	33,800 (71.5)	32,100 (74.5)	30,050 (77)	20,150 (79)	*19,000 (80)
30		45,850 (51)	46,200 (56.5)	34,200 (63)	29,200 (68)	30,200 (71.5)	27,350 (74.5)	19,100 (76.5)	18,300 (78.5)
35		37,100 (43.5)	37,500 (50)	29,050 (58.5)	25,800 (64)	26,600 (68.5)	24,300 (71.5)	18,100 (74)	17,650 (76.5)
40		27,050 (34.5)	27,500 (43)	25,150 (53.5)	22,900 (60)	23,450 (65)	21,600 (69)	17,250 (72)	17,000 (74)
45		22,000 (21.5)	22,450 (35)	21,800 (48.5)	20,000 (56)	20,450 (61.5)	19,250 (66)	16,450 (69)	16,350 (72)
50			18,500 (24.5)	18,550 (42.5)	17,500 (52)	17,900 (58.5)	16,900 (63)	15,750 (66.5)	15,700 (69.5)
60				12,800 (28)	12,800 (42.5)	14,000 (51)	13,250 (57)	13,100 (61.5)	13,300 (65)
70					8,830 (30)	10,150 (42.5)	10,700 (50)	10,700 (56)	11,050 (60)
80						7,160 (32)	8,240 (42.5)	8,660 (49.5)	9,120 (55)
90						4,800 (15.5)	5,870 (33.5)	6,700 (43)	7,380 (49.5)
100							4,010 (21)	4,840 (35)	5,500 (43)
110								3,340 (24.5)	4,000 (36)
120									2,760 (27)
130									1,720 (9.5)
Minimum boom angle (deg.) for indicated length (no load)									9
Maximum boom length (ft.) at 0 degree boom angle (no load)									125

NOTE: ( ) Boom angles are in degrees.

#LMI operating code. Refer to LMI manual for instructions.
*This capacity is based on maximum boom angle.
+12 parts line required to lift this capacity (using aux. boom nose). Refer to Operator's and Safety Handbook for reeving diagram.

Lifting Capacities On Outriggers Fully Extended - 360° At Zero Degree Boom Angle									
Boom Angle	Main Boom Length in Feet								
	35	55	61	74	87	99	112	125	
0°	26,400 (28.2)	12,500 (47.4)	10,150 (53.8)	6,240 (66.6)	3,420 (79.4)	2,440 (92.2)	1,680 (105)	1,070 (117.8)	

NOTE: ( ) Reference radii in feet. A6-829-100803

Ext. %									
Inner-mid	0	50	50	75	100	100	100	100	100
Center-mid	0	25	50	75	100	100	100	100	100
Outer-mid	0	0	0	0	0	25	50	75	100
Fly	0	0	0	0	0	25	50	75	100

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31 FT. - 56 FT. FOLDING BOOM EXTENSION
WITH 18,000 LB. COUNTERWEIGHT USING 125 FT. MAIN BOOM LENGTH
ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	31 FT. LENGTH			56 FT. LENGTH		
	#0521	**#0522**	**#0523**	**#0541**	**#0542**	**#0543**
	1.5° OFFSET	25° OFFSET	45° OFFSET	1.5° OFFSET	25° OFFSET	45° OFFSET
30	*11,500 (80)					
35	11,500 (78.5)					
40	11,500 (77)	*10,000 (80)		6,950 (79.5)		
45	11,500 (75)	9,300 (78.5)	*8,000 (80)	6,780 (78.5)		
50	11,000 (73.5)	8,790 (76.5)	6,810 (78.5)	6,620 (77)		
60	10,050 (70)	7,960 (72.5)	6,490 (74.5)	6,290 (74)	*4,900 (80)	
70	9,220 (66)	7,360 (68.5)	6,400 (70.5)	5,960 (71)	4,560 (76.5)	*3,700 (80)
80	8,440 (62)	6,900 (64.5)	6,350 (66)	5,640 (67.5)	4,230 (73)	3,520 (76.5)
90	7,340 (57.5)	6,590 (60)	6,340 (61.5)	5,260 (64.5)	3,870 (69.5)	3,400 (72.5)
100	6,020 (53)	6,250 (55)	6,320 (56.5)	4,980 (60.5)	3,700 (65.5)	3,290 (68.5)
110	4,510 (47.5)	5,050 (50)	5,260 (51)	4,650 (56.5)	3,480 (61.5)	3,190 (64)
120	3,280 (41.5)	3,690 (44)		4,070 (52)	3,290 (57.5)	3,110 (59.5)
130	2,250 (34.5)	2,540 (36.5)		3,020 (47.5)	3,120 (52.5)	3,040 (54)
140	1,380 (26)			2,140 (42.5)	2,750 (47.5)	
150				1,380 (36.5)	1,840 (41)	
No Load Stability Data						
Minimum boom angle (deg.) for indicated length	24	25	45	35	37	45
Maximum boom length (ft.) at 0 deg. boom angle.	112			99		

NOTE: ( ) Boom angles are in degrees. A6-829-014930
#LMI operating code. Refer to LMI manual for operating instructions.
*This capacity is based on maximum boom angle.

1. All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765 NOV93.
2. 31 ft. and 56 ft. folding boom extension lengths may be used for single line lifting service only.
3. For main boom lengths less than 125 ft. with the boom extension erected, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is set up. For boom angles not shown, use rating of the next lower boom angle.
4. **WARNING:** Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
5. Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
6. Capacities listed are with outriggers properly extended and vertical jacks set only.

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31 FT. - 56 FT. FOLDING BOOM EXTENSION
WITH 18,000 LB. COUNTERWEIGHT USING 138 FT. MAIN BOOM
ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	31 FT. LENGTH			56 FT. LENGTH		
	#0521	**#0522**	**#0523**	**#0541**	**#0542**	**#0543**
	1.5° OFFSET	25° OFFSET	45° OFFSET	1.5° OFFSET	25° OFFSET	45° OFFSET
35	9,500 (79.5)					
40	9,500 (78)			*5,500 (80)		
45	9,500 (76.5)	*8,750 (80)		5,400 (79.5)		
50	9,500 (75)	7,490 (78.5)	*7,800 (80)	5,300 (78)		
60	9,110 (71.5)	7,060 (75)	6,740 (77)	5,100 (75.5)	*4,640 (80)	
70	8,450 (68.5)	6,720 (71.5)	6,460 (73.5)	4,900 (72.5)	4,430 (78)	*3,600 (80)
80	7,550 (64.5)	6,330 (68)	6,350 (69.5)	4,700 (69.5)	4,220 (74.5)	3,500 (77.5)
90	6,990 (60.5)	6,060 (64)	6,280 (65.5)	4,500 (66.5)	4,120 (71)	3,400 (74)
100	6,330 (56.5)	5,820 (60)	6,220 (61)	4,300 (63.5)	3,810 (67.5)	3,300 (70.5)
110	4,820 (52)	5,400 (55.5)	5,670 (56.5)	4,100 (59.5)	3,600 (64)	3,200 (67)
120	3,580 (47)	4,050 (50.5)	4,050 (52)	3,900 (56)	3,400 (60.5)	3,100 (63)
130	2,550 (41.5)	2,910 (45)		3,190 (52)	3,190 (56)	3,000 (58.5)
140	1,680 (35.5)	1,940 (38.5)		2,300 (47.5)	2,980 (51.5)	2,900 (53.5)
150				1,540 (42.5)	2,100 (46.5)	
160					1,300 (41)	
No Load Stability Data						
Minimum boom angle (deg.) for indicated length	32	32	45	40	40	45
Maximum boom length (ft.) at 0 deg. boom angle	112			99		

NOTE: ( ) Boom angles are in degrees. A6-829-014929
#LMI operating code. Refer to LMI manual for operating instructions.
*This capacity is based on maximum boom angle.

1. All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765 NOV93.
2. 31 ft. and 56 ft. folding boom extension lengths may be used for single line lifting service only.
3. For main boom lengths between 125 ft. and fully extended with the boom extension erected, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is set up. For boom angles not shown, use rating of the next lower boom angle.
4. **WARNING:** Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
5. Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
6. Capacities listed are with outriggers properly extended and vertical jacks set only.

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31 FT. - 56 FT. **LUFFING** FOLDING BOOM EXTENSION WITH 18,000 LB. COUNTERWEIGHT USING 125 FT. MAIN BOOM LENGTH

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet (reference)	31 FT. LENGTH			56 FT. LENGTH		
	#5910	**#5911**	**#5912**	**#5920**	**#5921**	**#5922**
	1.5° OFFSET	25° OFFSET	45° OFFSET	1.5° OFFSET	25° OFFSET	45° OFFSET
30	*11,000 (80)					
35	11,000 (78.5)					
40	11,000 (77)	*10,000 (80)		6,450 (79.5)		
45	11,000 (75)	9,300 (78.5)	*8,000 (80)	6,450 (78.5)		
50	11,000 (73.5)	8,790 (76.5)	6,810 (78.5)	6,450 (77)		
60	10,050 (70)	7,960 (72.5)	6,490 (74.5)	6,290 (74)	*4,900 (80)	
70	9,220 (66)	7,360 (68.5)	6,400 (70.5)	5,960 (71)	4,560 (76.5)	*3,700 (80)
80	8,440 (62)	6,900 (64.5)	6,350 (66)	5,640 (67.5)	4,230 (73)	3,520 (76.5)
90	7,340 (57.5)	6,590 (60)	6,340 (61.5)	5,260 (64.5)	3,870 (69.5)	3,400 (72.5)
100	6,000 (53)	6,250 (55)	6,320 (56.5)	4,980 (60.5)	3,700 (65.5)	3,290 (68.5)
110	4,470 (47.5)	4,860 (50)	4,530 (51)	4,650 (56.5)	3,480 (61.5)	3,190 (64)
120	3,210 (41.5)	3,530 (44)		4,070 (52)	3,290 (57.5)	3,110 (59.5)
130	2,160 (34.5)	2,420 (36.5)		3,020 (47.5)	3,120 (52.5)	3,040 (54)
140	1,280 (26)			2,140 (42.5)	2,750 (47.5)	
150				1,350 (36.5)	1,840 (41)	
No Load Stability Data						
Minimum boom angle (deg.) for indicated length	24	25	45	35	37	45
Maximum boom length (ft.) at 0° boom angle	112			99		

NOTE: ( ) Boom angles are in degrees. A6-829-100353

#LMI operating code, for reference only (does not require input - automatically displayed). Refer to LMI manual for operating instructions.

* This capacity is based on maximum boom angle.

1. Capacities are based on main boom angles in conjunction with extension offset angle. Radii are for 125' main boom length only.
2. All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765.
3. 31 ft. and 56 ft. luffing folding boom extension lengths may be used for single line lifting service only.
4. For main boom lengths less than 125 ft. with the boom extension erected, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is set up. For boom angles not shown, use rating of the next lower boom angle. For extension offset angles not shown, use rating of next greater offset angle.
5. **WARNING**: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
6. Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
7. Capacities listed are with outriggers properly extended and vertical jacks set only.

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

31 FT. - 56 FT. **LUFFING** FOLDING BOOM EXTENSION WITH 18,000 LB. COUNTERWEIGHT USING 138 FT. MAIN BOOM

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet (reference)	31 FT. LENGTH			56 FT. LENGTH		
	#5910	**#5911**	**#5912**	**#5920**	**#5921**	**#5922**
	1.5° OFFSET	25° OFFSET	45° OFFSET	1.5° OFFSET	25° OFFSET	45° OFFSET
35	9,500 (79.5)					
40	9,500 (78)			*5,500 (80)		
45	9,500 (76.5)	*8,750 (80)		5,400 (79.5)		
50	9,500 (75)	7,490 (78.5)	*7,800 (80)	5,300 (78)		
60	9,110 (71.5)	7,060 (75)	6,740 (77)	5,100 (75.5)	*4,640 (80)	
70	8,450 (68.5)	6,720 (71.5)	6,460 (73.5)	4,900 (72.5)	4,430 (78)	*3,600 (80)
80	7,550 (64.5)	6,330 (68)	6,350 (69.5)	4,700 (69.5)	4,220 (74.5)	3,500 (77.5)
90	6,990 (60.5)	6,060 (64)	6,160 (65.5)	4,500 (66.5)	4,120 (71)	3,400 (74)
100	6,250 (56.5)	5,820 (60)	5,880 (61)	4,300 (63.5)	3,810 (67.5)	3,300 (70.5)
110	4,760 (52)	5,340 (55.5)	5,470 (56.5)	4,100 (59.5)	3,600 (64)	3,200 (67)
120	3,540 (47)	3,920 (50.5)	3,960 (51)	3,900 (56)	3,400 (60.5)	3,100 (63)
130	2,530 (41.5)	2,750 (45)		3,190 (52)	3,190 (56)	3,000 (58.5)
140	1,670 (35.5)	1,750 (38.5)		2,300 (47.5)	2,980 (51.5)	2,900 (53.5)
150				1,540 (42.5)	2,100 (46.5)	
160					1,300 (41)	
No Load Stability Data						
Minimum boom angle (deg.) for indicated length	32	32	45	40	40	45
Maximum boom length (ft.) at 0° boom angle	112			99		

NOTE: ( ) Boom angles are in degrees. A6-829-100347

#LMI operating code, for reference only (does not require input - automatically displayed). Refer to LMI manual for operating instructions.
*This capacity is based on maximum boom angle.

1. Capacities are based on main boom angles in conjunction with extension offset angle. Radii are for 138' main boom length only.
2. All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765.
3. 31 ft. and 56 ft. luffing folding boom extension lengths may be used for single line lifting service only.
4. For main boom lengths between125 ft. and fully extended with the boom extension erected, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is set up. For boom angles not shown, use rating of the next lower boom angle. For extension offset angles not shown, use rating of next greater offset angle.
5. **WARNING**: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
6. Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
7. Capacities listed are with outriggers properly extended and vertical jacks set only.

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

RATED LIFTING CAPACITIES IN POUNDS WITH 8,500 LB. COUNTERWEIGHT 35 FT. - 138 FT. BOOM (MODE A)

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	#0001						
	Main Boom Length in Feet						
	35	61	74	87	99	112	138
10	+150,000 (65.5)	42,900 (77.5)	*32,100 (80)				
12	110,000 (62)	42,000 (75.5)	32,100 (78.5)	*31,850 (80)			
15	95,800 (56)	36,550 (72.5)	32,100 (76)	31,850 (78.5)	*21,350 (80)		
20	70,700 (44.5)	29,400 (67.5)	31,350 (71.5)	28,850 (75)	21,350 (77.5)	19,000 (79.5)	
25	53,150 (29.5)	24,350 (62)	26,450 (67.5)	25,050 (71.5)	20,850 (74.5)	18,150 (77)	*19,000 (80)
30		20,500 (56.5)	22,300 (63)	21,550 (68)	18,650 (71.5)	17,300 (74.5)	18,300 (78.5)
35		17,450 (50)	19,100 (58.5)	18,500 (64)	16,900 (68.5)	16,450 (71.5)	17,650 (76.5)
40		15,050 (43)	16,500 (53.5)	16,000 (60)	15,300 (65)	15,650 (69)	17,000 (74)
45		13,100 (35)	14,450 (48.5)	14,000 (56)	13,650 (61.5)	14,150 (66)	16,350 (72)
50		11,450 (24.5)	12,750 (42.5)	12,350 (52)	12,100 (58.5)	12,700 (63)	15,700 (69.5)
60			10,050 (28)	9,780 (42.5)	9,580 (51)	10,150 (57)	13,300 (65)
70				7,860 (30)	7,710 (42.5)	8,220 (50)	10,200 (60)
80					6,270 (32)	6,730 (42.5)	7,430 (55)
90					4,800 (15.5)	5,550 (33.5)	5,370 (49.5)
100						4,010 (21)	3,770 (43)
110							2,510 (36)
120							1,480 (27)
Minimum boom angle (deg.) for indicated length (no load)						0	10
Maximum boom length (ft.) at 0 degree boom angle (no load)						112	

NOTE: ( ) Boom angles are in degrees.

#LMI operating code. Refer to LMI manual for instructions.
*This capacity is based on maximum boom angle.
+12 parts line required to lift this capacity (using aux. boom nose). Refer to Operator's and Safety Handbook for reeving diagram.

Lifting Capacities On Outriggers Fully Extended - 360° At Zero Degree Boom Angle							
Boom Angle	Main Boom Length in Feet						
	35	61	74	87	99	112	
0°	26,400 (28.2)	10,150 (53.8)	6,240 (66.6)	3,420 (79.4)	2,440 (92.2)	1,680 (105)	

NOTE: ( ) Reference radii in feet. A6-829-100800

Ext. %							
Inner-mid	0	0	0	0	0	0	100
Center-mid	0	100	100	100	100	100	100
Outer-mid	0	0	25	50	75	100	100
Fly	0	0	25	50	75	100	100

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

RATED LIFTING CAPACITIES IN POUNDS WITH 8,500 LB. COUNTERWEIGHT
35 FT. - 138 FT. BOOM (MODE B)
ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	#0001								
	Main Boom Length in Feet								
	35	55	61	74	87	99	112	125	138
10	+150,000 (65.5)	79,100 (76)	78,450 (77.5)	*57,050 (80)					
12	110,000 (62)	79,100 (73.5)	77,500 (75.5)	57,050 (78.5)	*43,300 (80)				
15	95,800 (56)	79,100 (70)	69,850 (72.5)	51,650 (76)	43,300 (78.5)	*32,100 (80)			
20	70,700 (44.5)	70,300 (64.5)	59,850 (67.5)	44,350 (71.5)	39,550 (75)	32,100 (77.5)	30,050 (79.5)	*20,150 (80)	
25	53,150 (29.5)	52,850 (58)	52,200 (62)	38,750 (67.5)	33,800 (71.5)	32,100 (74.5)	30,050 (77)	20,150 (79)	*19,000 (80)
30		41,400 (51)	41,800 (56.5)	34,200 (63)	29,200 (68)	30,200 (71.5)	27,350 (74.5)	19,100 (76.5)	18,300 (78.5)
35		31,850 (43.5)	31,950 (50)	29,050 (58.5)	25,800 (64)	26,600 (68.5)	24,300 (71.5)	18,100 (74)	17,650 (76.5)
40		24,700 (34.5)	24,750 (43)	24,800 (53.5)	22,900 (60)	23,450 (65)	21,600 (69)	17,250 (72)	17,000 (74)
45		19,550 (21.5)	19,550 (35)	19,750 (48.5)	19,500 (56)	20,450 (61.5)	19,250 (66)	16,450 (69)	16,350 (72)
50			15,700 (24.5)	15,400 (42.5)	15,350 (52)	16,550 (58.5)	16,900 (63)	15,750 (66.5)	15,700 (69.5)
60				9,490 (28)	9,730 (42.5)	10,800 (51)	11,900 (57)	13,000 (61.5)	13,300 (65)
70					6,020 (30)	7,040 (42.5)	8,080 (50)	9,130 (56)	10,200 (60)
80						4,390 (32)	5,390 (42.5)	6,400 (49.5)	7,430 (55)
90						2,420 (15.5)	3,390 (33.5)	4,370 (43)	5,370 (49.5)
100							1,840 (21)	2,800 (35)	3,770 (43)
110								1,550 (24.5)	2,510 (36)
120									1,480 (27)
Minimum boom angle (deg.) for indicated length (no load)								5	10
Maximum boom length (ft.) at 0 degree boom angle (no load)								112	

NOTE: ( ) Boom angles are in degrees.

#LMI operating code. Refer to LMI manual for instructions.
*This capacity is based on maximum boom angle.
+12 parts line required to lift this capacity (using aux. boom nose). Refer to Operator's and Safety Handbook for reeving diagram.

Lifting Capacities On Outriggers Fully Extended - 360° At Zero Degree Boom Angle									
Boom Angle	Main Boom Length in Feet								
	35	55	61	74	87	99	112		
0°	26,400 (28.2)	12,500 (47.4)	10,150 (53.8)	6,240 (66.6)	3,420 (79.4)	2,060 (92.2)	1,200 (105)		

NOTE: ( ) Reference radii in feet. A6-829-100805

Ext. %									
Inner-mid	0	50	50	75	100	100	100	100	100
Center-mid	0	25	50	75	100	100	100	100	100
Outer-mid	0	0	0	0	0	25	50	75	100
Fly	0	0	0	0	0	25	50	75	100

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

31 FT. - 56 FT. FOLDING BOOM EXTENSION
WITH 8,500 LB. COUNTERWEIGHT USING 125 FT. MAIN BOOM LENGTH
ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	31 FT. LENGTH			56 FT. LENGTH		
	#0021	**#0022**	**#0023**	**#0041**	**#0042**	**#0043**
	1.5° OFFSET	25° OFFSET	45° OFFSET	1.5° OFFSET	25° OFFSET	45° OFFSET
30	*11,500 (80)					
35	11,500 (78.5)					
40	11,500 (77)	*10,000 (80)		6,950 (79.5)		
45	11,500 (75)	9,300 (78.5)	*8,000 (80)	6,780 (78.5)		
50	11,000 (73.5)	8,790 (76.5)	6,810 (78.5)	6,620 (77)		
60	10,050 (70)	7,960 (72.5)	6,490 (74.5)	6,290 (74)	*4,900 (80)	
70	9,220 (66)	7,360 (68.5)	6,400 (70.5)	5,960 (71)	4,560 (76.5)	*3,700 (80)
80	7,910 (62)	6,900 (64.5)	6,350 (66)	5,640 (67.5)	4,230 (73)	3,520 (76.5)
90	5,790 (57.5)	6,380 (60)	6,340 (61.5)	5,260 (64.5)	3,870 (69.5)	3,400 (72.5)
100	4,140 (53)	4,550 (55)	5,110 (56.5)	4,980 (60.5)	3,700 (65.5)	3,290 (68.5)
110	2,840 (47.5)	3,090 (50)	3,460 (51)	4,060 (56.5)	3,480 (61.5)	3,190 (64)
120	1,770 (41.5)	1,900 (44)		2,860 (52)	3,290 (57.5)	3,110 (59.5)
130				1,860 (47.5)	2,380 (52.5)	2,830 (54)
140				1,020 (42.5)	1,430 (47.5)	
No Load Stability Data						
Minimum boom angle (deg.) for indicated length	37	39	46	42	46	47
Maximum boom length (ft.) at 0 deg. boom angle.	99			87		

NOTE: ( ) Boom angles are in degrees. A6-829-014542
#LMI operating code. Refer to LMI manual for operating instructions.
*This capacity is based on maximum boom angle.

1. All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765 NOV93.
2. 31 ft. and 56 ft. folding boom extension lengths may be used for single line lifting service only.
3. For main boom lengths less than 125 ft. with the boom extension erected, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is set up. For boom angles not shown, use rating of the next lower boom angle.
4. **WARNING:** Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
5. Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
6. Capacities listed are with outriggers properly extended and vertical jacks set only.

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

31 FT. - 56 FT. FOLDING BOOM EXTENSION
WITH 8,500 LB. COUNTERWEIGHT USING 138 FT. MAIN BOOM
ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	31 FT. LENGTH			56 FT. LENGTH		
	#0021	**#0022**	**#0023**	**#0041**	**#0042**	**#0043**
	1.5° OFFSET	25° OFFSET	45° OFFSET	1.5° OFFSET	25° OFFSET	45° OFFSET
35	9,500 (79.5)					
40	9,500 (78)			*5,500 (80)		
45	9,500 (76.5)	*8,750 (80)		5,400 (79.5)		
50	9,500 (75)	7,490 (78.5)	*7,800 (80)	5,300 (78)		
60	9,110 (71.5)	7,060 (75)	6,740 (77)	5,100 (75.5)	*4,640 (80)	
70	8,450 (68.5)	6,720 (71.5)	6,460 (73.5)	4,900 (72.5)	4,430 (78)	*3,600 (80)
80	7,550 (64.5)	6,330 (68)	6,350 (69.5)	4,700 (69.5)	4,220 (74.5)	3,500 (77.5)
90	6,200 (60.5)	6,060 (64)	6,280 (65.5)	4,500 (66.5)	4,120 (71)	3,400 (74)
100	4,530 (56.5)	5,330 (60)	5,580 (61)	4,300 (63.5)	3,810 (67.5)	3,300 (70.5)
110	3,200 (52)	3,860 (55.5)	3,970 (56.5)	4,100 (59.5)	3,600 (64)	3,200 (67)
120	2,120 (47)	2,660 (50.5)	2,660 (52)	3,120 (56)	3,400 (60.5)	3,100 (63)
130	1,220 (41.5)	1,660 (45)		2,150 (52)	2,640 (56)	3,000 (58.5)
140				1,320 (47.5)	1,640 (51.5)	1,920 (53.5)
No Load Stability Data						
Minimum boom angle (deg.) for indicated length	39	44	45	47	49	50
Maximum boom length (ft.) at 0 deg. boom angle	99			87		

NOTE: ( ) Boom angles are in degrees. A6-829-014543A
#LMI operating code. Refer to LMI manual for operating instructions.
*This capacity is based on maximum boom angle.

1. All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765 NOV93.
2. 31 ft. and 56 ft. folding boom extension lengths may be used for single line lifting service only.
3. For main boom lengths between 125 ft. and fully extended with the boom extension erected, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is set up. For boom angles not shown, use rating of the next lower boom angle.
4. **WARNING:** Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
5. Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
6. Capacities listed are with outriggers properly extended and vertical jacks set only.

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

31 FT. - 56 FT. **LUFFING** FOLDING BOOM EXTENSION WITH 8,500 LB. COUNTERWEIGHT USING 125 FT. MAIN BOOM LENGTH

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet (reference)	31 FT. LENGTH			56 FT. LENGTH		
	#0910	**#0911**	**#0912**	**#0920**	**#0921**	**#0922**
	1.5° OFFSET	25° OFFSET	45° OFFSET	1.5° OFFSET	25° OFFSET	45° OFFSET
30	*11,000 (80)					
35	11,000 (78.5)					
40	11,000 (77)	*10,000 (80)		6,450 (79.5)		
45	11,000 (75)	9,300 (78.5)	*8,000 (80)	6,450 (78.5)		
50	11,000 (73.5)	8,790 (76.5)	6,810 (78.5)	6,450 (77)		
60	10,050 (70)	7,960 (72.5)	6,490 (74.5)	6,290 (74)	*4,900 (80)	
70	9,220 (66)	7,360 (68.5)	6,400 (70.5)	5,960 (71)	4,560 (76.5)	*3,700 (80)
80	7,780 (62)	6,900 (64.5)	6,350 (66)	5,640 (67.5)	4,230 (73)	3,520 (76.5)
90	5,630 (57.5)	6,170 (60)	6,320 (61.5)	5,260 (64.5)	3,870 (69.5)	3,400 (72.5)
100	3,960 (53)	4,370 (55)	4,340 (56.5)	4,980 (60.5)	3,700 (65.5)	3,290 (68.5)
110	2,590 (47.5)	2,940 (50)	2,700 (51)	3,630 (56.5)	3,480 (61.5)	3,190 (64)
120	1,480 (41.5)	1,780 (44)		2,500 (52)	3,290 (57.5)	3,110 (59.5)
130				1,570 (47.5)	2,300 (52.5)	2,590 (54)
140					1,290 (47.5)	
No Load Stability Data						
Minimum boom angle (deg.) for indicated length	37	39	46	42	46	47
Maximum boom length (ft.) at 0 deg. boom angle.	87			74		

NOTE: ( ) Boom angles are in degrees. A6-829-100355

#LMI operating code, for reference only (does not require input - automatically displayed). Refer to LMI manual for operating instructions.

* This capacity is based on maximum boom angle.

1. Capacities are based on main boom angles in conjunction with extension offset angle. Radii are for 125' main boom length only.
2. All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765.
3. 31 ft. and 56 ft. luffing folding boom extension lengths may be used for single line lifting service only.
4. For main boom lengths less than 125 ft. with the boom extension erected, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is set up. For boom angles not shown, use rating of the next lower boom angle. For extension offset angles not shown, use rating of next greater offset angle.
5. **WARNING:** Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
6. Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
7. Capacities listed are with outriggers properly extended and vertical jacks set only.

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

31 FT. - 56 FT. **LUFFING** FOLDING BOOM EXTENSION WITH 8,500 LB. COUNTERWEIGHT USING 138 FT. MAIN BOOM

ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet (reference)	31 FT. LENGTH			56 FT. LENGTH		
	#0910	**#0911**	**#0912**	**#0920**	**#0921**	**#0922**
	1.5° OFFSET	25° OFFSET	45° OFFSET	1.5° OFFSET	25° OFFSET	45° OFFSET
35	9,500 (79.5)					
40	9,500 (78)			*5,500 (80)		
45	9,500 (76.5)	*8,750 (80)		5,400 (79.5)		
50	9,500 (75)	7,490 (78.5)	*7,800 (80)	5,300 (78)		
60	9,110 (71.5)	7,060 (75)	6,740 (77)	5,100 (75.5)	*4,640 (80)	
70	8,450 (68.5)	6,720 (71.5)	6,460 (73.5)	4,900 (72.5)	4,430 (78)	*3,600 (80)
80	7,550 (64.5)	6,330 (68)	6,350 (69.5)	4,700 (69.5)	4,220 (74.5)	3,500 (77.5)
90	5,600 (60.5)	6,060 (64)	6,160 (65.5)	4,500 (66.5)	4,120 (71)	3,400 (74)
100	4,020 (56.5)	5,030 (60)	5,220 (61)	4,300 (63.5)	3,810 (67.5)	3,300 (70.5)
110	2,760 (52)	3,470 (55.5)	3,590 (56.5)	3,950 (59.5)	3,600 (64)	3,200 (67)
120	1,740 (47)	2,200 (50.5)	2,270 (51)	2,820 (56)	3,400 (60.5)	3,100 (63)
130		1,140 (45)		1,780 (52)	2,580 (56)	2,940 (58.5)
140					1,600 (51.5)	1,880 (53.5)
No Load Stability Data						
Minimum boom angle (deg.) for indicated length	39	44	45	47	49	50
Maximum boom length (ft.) at 0 deg. boom angle	87			74		

NOTE: ( ) Boom angles are in degrees. A6-829-100349

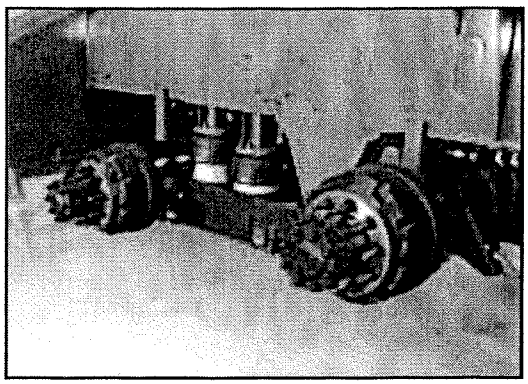
#LMI operating code, for reference only (does not require input - automatically displayed). Refer to LMI manual for operating instructions.
*This capacity is based on maximum boom angle.

1. Capacities are based on main boom angle in conjunction with extension offset angle. Radii are for 138 ft. main boom length only.
2. All capacities above the bold line are based on structural strength of boom extension and do not exceed 85% of tipping loads, in accordance with SAE J-765.
3. 31 ft. and 56 ft. luffing folding boom extension lengths may be used for single line lifting service only.
4. For main boom lengths between 125 ft. and fully extended with the boom extension erected, the rated loads are determined by boom angle. Use only the column which corresponds to the boom extension length and offset for which the machine is set up. For boom angles not shown, use rating of the next lower boom angle. For extension offset angles not shown, use rating of next greater offset angle.
5. **WARNING**: Operation of this machine with heavier loads than the capacities listed is strictly prohibited. Machine tipping with boom extension occurs rapidly and without advance warning.
6. Boom angle is the angle above or below horizontal of the longitudinal axis of the boom base section after lifting rated load.
7. Capacities listed are with outriggers properly extended and vertical jacks set only.

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

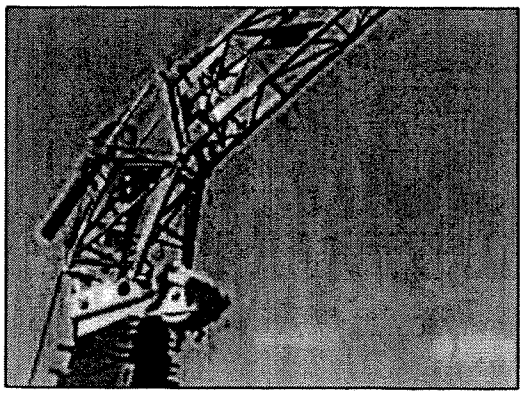
GROVE®

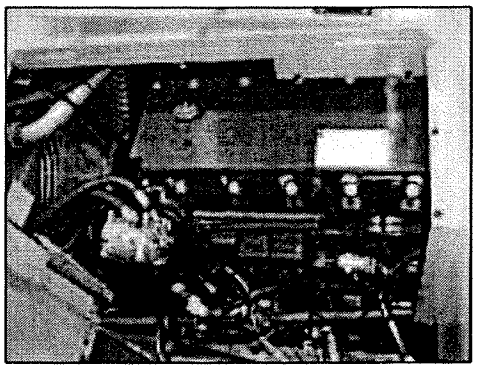
TMS875C Features and Benefits



- Standard front and rear air ride suspension provides comfortable ride at max speed of 65 mph

- Optional luffing swingaway for five section boom offers ability to offset in air under load

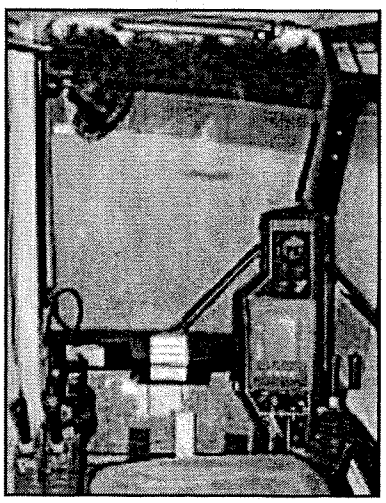




- Electronically controlled Cummins six cylinder, turbo charged, 400 bhp diesel -- highest in 75 ton class

- Both carrier and operator's cab constructed from galvannealed metal and finished with Imron 5000 to improve longevity

  Hot water cab heater/defrosters also standard in both cabs



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Form No.: TMS875C Series Part No.: 00-009 0501-4M Printed in U.S.A.

Machines

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325D L HYDRAULIC EXCAVATORS

--- Sele

Overview & Specifications | **Benefits & Features** | **Standard Equipment** | **Optional Equipment** | **Worktools / Attachments**

325D L OVERVIEW & SPECIFICATIONS

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325D L

Increased work tool options, new powerful engine and easier operation lead to increased productivity and lower operating costs.

NEXT STEPS
Use the resc
help you ma
decision.

- Find Your
- Financing
- Rentals
- Insurance
- Training
- Maintenar
- Build & Qu

325D L DETAILED SPECIFICATIONS

RELATED IN

- Heavy Co
- Construct

Engine	
Engine Model	Cat® C7 ACERT™
Net Flywheel Power	204 hp / 152 kW
Net Power - ISO 9249	204 hp / 152 kW
Net Power - SAE J1349	202 hp / 151 kW
Net Power - EEC 80/1269	204 hp / 152 kW
Bore	4.3 in / 110 mm
Stroke	5 in / 127 mm
Displacement	440 in3 / 7.2 L
Weights	
Operating Weight	64460 lb / 29240 kg
Drive	
Maximum Drawbar Pull	55977 lb / 249 kN
Maximum Travel Speed	3.3 mph / 5.3 km/h
Hydraulic System	
Main Implement System - Maximum Flow (2x)	62 gal/min / 235 L/min
Max. pressure - Equipment	5076 psi / 35000 kPa
Max. pressure - Equipment - Heavy	5221 psi / 36000 kPa
Max. pressure - Travel	5076 psi / 35000 kPa
Max. pressure - Swing	3989 psi / 27500 kPa
Pilot System - Maximum flow	8.6 gal/min / 32.4 L/min
Pilot System - Maximum pressure	566 psi / 3900 kPa
Boom Cylinder - Bore	5.5 in / 140 mm

325D L HYD EXCAVATOR
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specification

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Boom Cylinder - Stroke	55.4 in / 1407 mm
Stick Cylinder - Bore	5.9 in / 150 mm
Stick Cylinder - Stroke	64.8 in / 1646 mm
CB2 Family Bucket Cylinder - Bore	5.3 in / 135 mm
CB2 Family Bucket Cylinder - Stroke	46 in / 1156 mm
DB Family Bucket Cylinder - Bore	5.9 in / 150 mm
DB Family Bucket Cylinder - Stroke	46 in / 1156 mm

Service Refill Capacities

Fuel Tank Capacity	137 gal / 520 L
Cooling System	7.9 gal / 30 L
Engine Oil	7.9 gal / 30 L
Swing Drive	2.6 gal / 10 L
Final Drive (each)	1.6 gal / 6 L
Hydraulic System (including tank)	82 gal / 310 L
Hydraulic Tank	38 gal / 145 L

Sound Performance

Performance	ANSI/SAE

Standards

Brakes	SAE J1026 APR90
Cab/FOGS	SAE J1356 FEB88 ISO 10262

Swing Mechanism

Swing Speed	10.2 RPM / 10.2 RPM
Swing Torque	60628 lb ft / 82.2 kN·m

Track

Standard w/Long Undercarriage	32 in / 800 mm
Optional	24 in / 600 mm
Optional	28 in / 700 mm
Optional	32 in / 800 mm
Number of Shoes Each Side - Long Undercarriage	50
Number of Track Rollers Each Side - Long Undercarriage	9
Number of Carrier Rollers Each Side - Long Undercarriage	2

Dimensions

Transport width	133.5 in / 3390 mm

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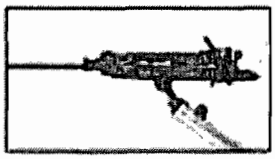
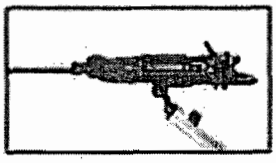
A Reliable Team of Efficient Pusher Leg Drills

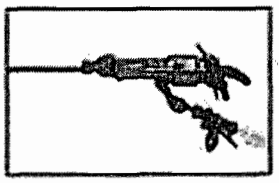
Atlas Copco rock drills and rock drilling tools are an unbeatable combination of high performance and superior reliability. The pneumatic pusher leg drills are characterized by low spare parts consumption and minimum maintenance requirements. They are robust but simply designed, with high impact energy and low air consumption.
The uniform high quality of materials and manufacturing processes contribute to the long service life of the machines. Together with the pusher legs the rock drills form an attractive and cost effective drilling unit. The pneumatic telescopic and double-telescopic pusher legs are available in a number of versions. All are of a simple, robust design for reliable operation and minimum maintenance requirements.



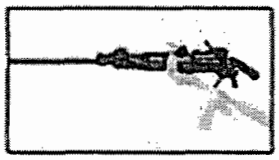
BBC 16W (Puma)
All-round rock drill which suits most drilling applications. It has a robust rifle bar rotation mechanism, long stroke and good penetration rates in hard rock. The pusher leg control is placed at the backhead of the rock drill. Suitable pusher legs for BBC 16W are BMT 51, ALF 71-1 and 71, and ALF 67/80.



BBC 34W (Leopard)
Highly efficient rock drill for medium to hard rock. It has a powerful rifle bar rotation mechanism, long stroke and high impact energy. The large diameter piston makes it very efficient even with low air pressure. The pusher leg control is placed at the backhead of the rock drill. Suitable pusher legs for BBC 34W are BMT 51, ALF 71-1 and 71, and ALF 67/80.



BBD 94W (Panther)
High performance rock drill for soft to hard rock. It has a ratchet wheel rotation mechanism, short stroke and high impact rate. It is also efficient at low air pressure. The pusher leg control is placed on the pusher leg itself. Suitable pusher legs for BBD 94W are ALF 72D-1 and 72D, and ALF 67/80D.



RH 656W
A rock drill with a very favourable relation of high penetration/low air consumption. It has a robust rifle bar rotation mechanism and flushing system with double concentric tubes. The low weight makes the drill handy also as a sinker. Supplied with a T-handle. A suitable pusher leg is BMK 625.

Stopers BBD 46WS/WR (Falcon)
All-steel rock drills suitable for production drilling, raise driving and bolting. They have a robust ratchet wheel rotation mechanism, short stroke and good penetration rates in soft and medium-hard rock. The large diameter piston makes them very efficient even with low air pressure. The WR version has clockwise rotation and can be used for nut tightening when roof bolting.

Pusher legs
The pneumatic telescopic and double-telescopic pusher legs are available in a number of versions. All are of a simple, robust design for reliable operation and minimum maintenance requirements.

Rock drills

Description	Hole range mm	Air requirement at 6 bar l/s	Impact frequency Hz	Stroke length mm	Piston bore mm	Weight kg	Length mm
BBC 16W	27 - 40	61	39	55	70	26	710
BBC 34W	27 - 41	89	38	70	80	31	775
BBD 94W	27 - 48	97	55	45	90	77	670
RH 656W	27 - 49	49	34	60	65	22	630

Stopers

Description	Air consumption at 6 bar l/s (cfm)	Rock drill piston bore mm	Stroke length mm	Impact rate at 6 bar Hz	Rotation rate at 6 bar rev/sec	Feeding length mm	Length retracted mm	Length extracted mm	Feed piston bore mm	Weight kg
BBD 46WS 6	75 (159)	75	45	51	4.0	770	1435	2205	75	39
BBD 46WS 8	75 (159)	75	45	51	4.0	970	1650	2620	75	40
BBD 46WR 6	75 (159)	75	45	49	6.5	770	1435	2205	75	39
BBD 46WR 8	75 (159)	75	45	49	6.5	970	1650	2620	75	40

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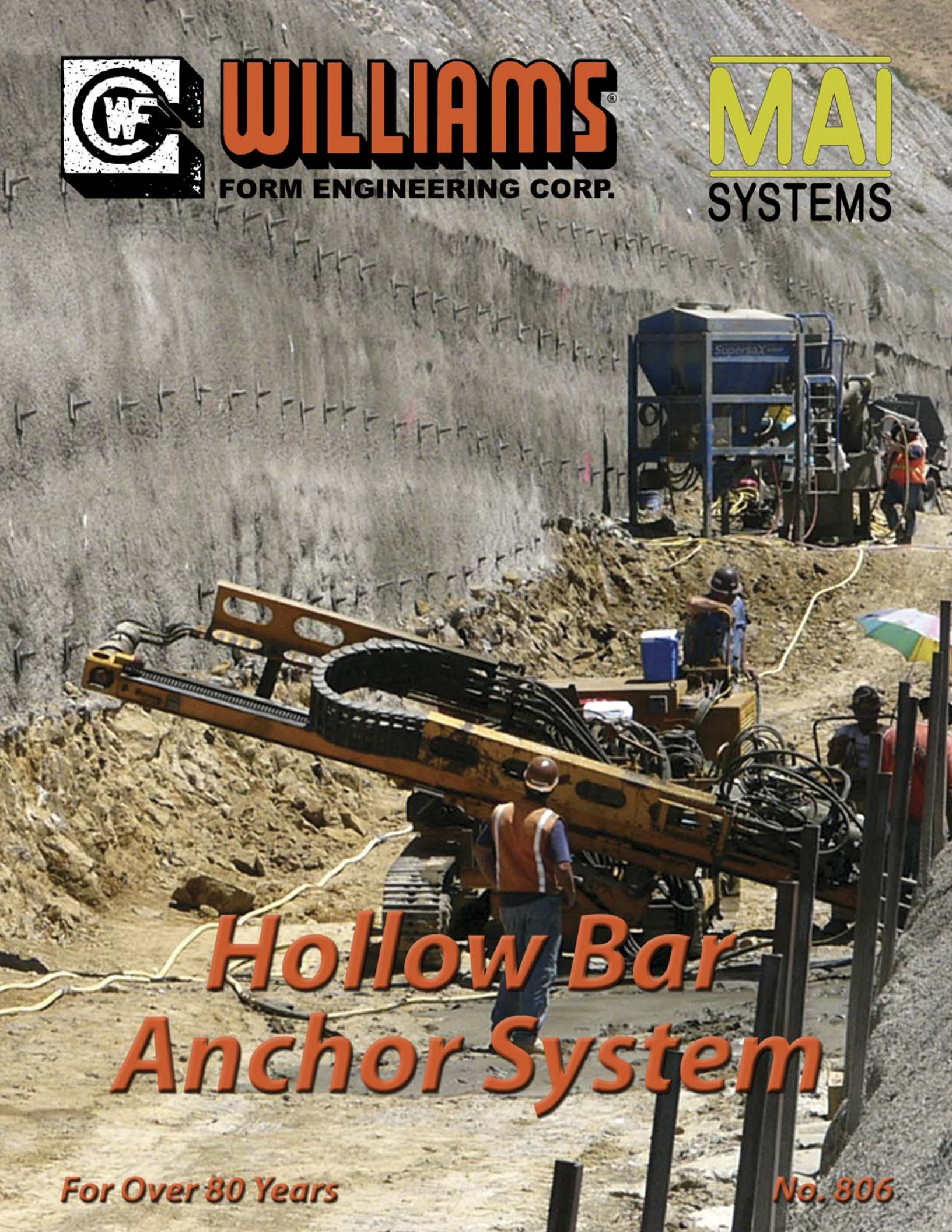


Hollow Bar Anchor System

For Over 80 Years

No. 806

Hollow Bar Anchor System

Introduction

The Williams / Atlas Copco MAI Hollow Bar Anchor System is today's solution for a fast and efficient anchoring system into virtually any type of soil. The MAI system has historically been known as "self-drilling anchoring" because the hollow fully-threaded bar serves as both the drill string and the grouted anchor, thus installation is performed in a single operation. The sacrificial drill bit is threaded onto the end of the MAI Bar and left in place following drilling. The drilling fluid (air, water, or grout) is introduced through the hollow bar and allows the spoils to flush from the borehole.

The Williams / MAI System is particularly suitable for soils that do not allow for open-hole drilling (i.e. granular soils that are collapsible in nature). In such cases, drilling with a grout fluid serves the purpose of flushing spoils from the borehole and prevents looser, surrounding material from collapsing due to the higher relative density of the grout. The Williams / MAI Hollow Bar Anchor System should be considered on any project desiring fast production that would otherwise need to involve a casing system in order to maintain borehole stability.

Advantages of the Williams / MAI Hollow Bar Anchor System

- Fast, single-step anchoring system with simple equipment.
- Eliminates the need for a cased borehole in collapsing soils.
- Efficient installation since drilling and grouting can be performed in a single operation, saving both time and money.
- Continuously drilling and grouting under high pressure causes the grout to permeate into looser soils and creates a bulb-effect for increased bond capacity.
- Suitable for working in limited space and areas of difficult access.
- Multiple ranges of drill bits suitable for most soil conditions.
- Installed with standard track drill (top hammer) or hand-held drilling equipment, eliminating the need for larger casing rigs.
- R25-R51 bars contain standard left-hand rope thread pattern to easily adapt to most drilling equipment.
- Continuously threaded bar pattern can be cut and coupled anywhere along its length.
- Full stock of 3 meter long anchors, accessories and drill bits available in two different warehouse locations.
- Corrosion protection systems available upon request.
- FHWA approved for use as a micro pile.
- Rope thread exceeds requirement of DIN 1045-1 for permissible grout crack width formation under tensile loading.

Limitations of System

In general, Williams / MAI recommends using the hollow hollow bar anchor system in difficult soils that do not allow for open-hole drilling. Ground conditions featuring large voids or the presence of underground water are generally not suitable for a drilled and grouted hollow bar. In hard rock, conventional DTH (Down the Hole Hammers) in open-hole drilling offer a more efficient alternative. In all such cases, Williams offers solutions in their complete line of solid bar anchor systems and multi-strand tendon systems.

Williams / MAI Hollow Bar Hollow Bar Anchors

Anchor Designation	Outside Diameter	Internal Diameter (Average)	Effective Cross Sectional Area (Average)	Ultimate Load Capacity	Yield Load Capacity	Weight per Foot
R 25	1" (25 mm)	0.55" (14 mm)	0.38 in^2 (245 mm^2)	45 kips (200 kN)	33.8 kips (150 kN)	1.5 lbs (0.68 kg)
R 32N	1-1/4" (32 mm)	0.73" (19 mm)	0.61 in^2 (394 mm^2)	63 kips (280 kN)	52 kips (230 kN)	2.3 lbs (1.04 kg)
R 32S	1-1/4" (32 mm)	0.59" (15 mm)	0.76 in^2 (490 mm^2)	81 kips (360 kN)	63 kips (280 kN)	2.85 lbs (1.29 kg)
R 38	1-1/2" (38 mm)	0.75" (19 mm)	1.11 in^2 (716 mm^2)	112 kips (498 kN)	90 kips (400 kN)	4.0 lbs (1.81 kg)
R 51L	2" (51 mm)	1.42" (36 mm)	1.20 in^2 (774 mm^2)	124 kips (550 kN)	101 kips (450 kN)	4.7 lbs (2.13 kg)
R 51N	2" (51 mm)	1.30" (33 mm)	1.46 in^2 (942 mm^2)	180 kips (801 kN)	142 kips (630 kN)	5.6 lbs (2.54 kg)
T 76N	3" (76 mm)	2" (51 mm)	2.84 in^2 (1832 mm^2)	360 kips (1601 kN)	270 kips (1201 kN)	10.0 lbs (4.54 kg)
T 76S	3" (76 mm)	1.77" (45 mm)	3.72 in^2 (2400 mm^2)	428 kips (1904 kN)	338 kips (1503 kN)	13.2 lbs (5.99 kg)

Accessories

Threaded Bar Profile

The Williams / MAI Hollow Bar is manufactured from heavy-wall steel tubing that's cold threaded to form a standard left-hand rope thread (R-Series) profile for R25-R51 bar diameters. The standard rope thread of the bar produces an excellent bond between the grout and the bar as well as enabling connection to all conventional drill rigs and allows the use with a wide range of drill steel accessories and bits.

The T76 hollow bar bar features a trapezoidal thread profile. All diameters of the Williams / MAI Hollow Bar are readily available in standard three-meter lengths. Upon special request, lengths up to 12 meters are available with added lead-time.

Comments on Crack Width

The rope thread profile of the Williams / MAI Hollow Bar exceeds the requirements of German Standard DIN 1045-1 for permissible crack width in grout under incremental tensile loading, up to 1.5 times the working load of the bar. In all tests, the crack width at the steel surface was clearly below 0.1 mm in width. This testing was performed and documented by Brandenburg Technical University. Upon request, Williams can provide a complete copy of the test report.

Couplings

The Williams / MAI Hollow Bar Couplings feature a direct end-to-end bearing between each bar, reducing energy loss and ensuring maximum percussion energy at the drill bit. The coupling's unique, patented design also provides a convenient center-stop for guaranteed 50-50 engagement onto each bar. O-Ring seals in each coupling prevent leakage during continuous drilling and grouting installations.

Caution: When field cutting of bars is required, precision cutting at right angles is necessary to ensure end-to-end bearing. If possible, however, Williams / MAI recommends cut ends to be engaged in the drill bit or at the opposite end with the plate and nut.

Anchor Designation	Coupling Diameter	Coupling Length	Hex Nut Thickness	Hex Nut Across the Flats
R 25	1-3/8" (34 mm)	5-7/8" (150 mm)	1-3/8" (35 mm)	1-5/8" (41 mm)
R 32N	1-5/8" (42 mm)	6-1/4" (160 mm)	1-3/4" (45 mm)	1-13/16" (46 mm)
R 32S	1-5/8" (42 mm)	6-1/4" (160 mm)	1-3/4" (45 mm)	1-13/16" (46 mm)
R 38	2" (51 mm)	8-3/4" (221 mm)	2" (50 mm)	2" (51 mm)
R 51L	2-1/2" (63 mm)	5-1/2" (140 mm)	2-3/4" (70 mm)	3" (75 mm)
R 51N	2-1/2" (63 mm)	7-7/8" (201 mm)	2-3/4" (70 mm)	3" (75 mm)
T 76N	3-3/4" (95 mm)	7-7/8" (201 mm)	3-1/8" (80 mm)	4-1/16" (100 mm)
T 76S	3-3/4" (95 mm)	7-7/8" (201 mm)	3-1/8" (80 mm)	4-1/16" (100 mm)

Drill Bits

EX Drill Bit
Hardened cross cut drill bit, suitable for the majority of applications including narrow bands of soft rock.
Soil Types: Fills, Shales, and Gravels

ESF Drill Bit
Hardened hemispherical button profile drill bit suitable for gravels and medium strength rock.
Rock Types: Soft to Medium Rock

EXX Drill Bit
Tungsten carbide cross-cut drill bit. Excellent choice for majority of granular soils with mixed hard formations.
Soil Types: Fills, Gravels, and seamy rock formations.

ESSF Drill Bit
Tungsten carbide hemispherical button drill bit for moderately strong to strong rock, boulders and rubble.
Rock Types: Mudstone, Limestone, and Granite

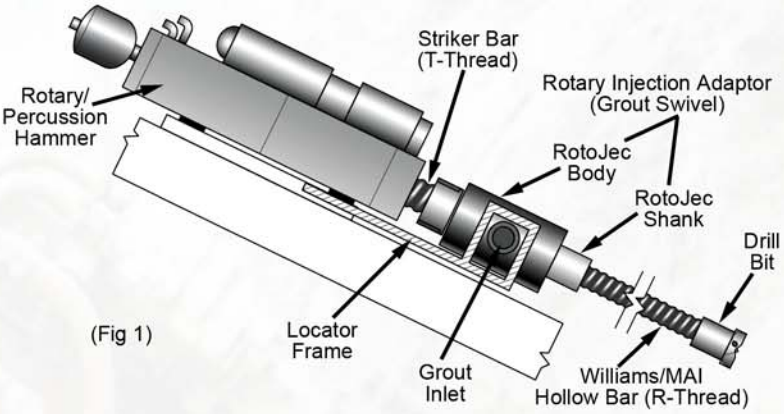
XX Drill Bit
Two stage cross cut drill bit, suitable for loose ground and fills.
Soil Types: Sand, Clay and Medium Dense Gravels

Anchor Designation	Drill Bits				
	EX	EXX	ESF	ESSF	XX
R 25		2" (51 mm)			
R 32	2", 3" (51 mm, 76 mm)	2-1/2", 3" (64 mm, 76 mm)	2" (51 mm)	2" (51 mm)	
R 38	3", 3-1/2" (76 mm, 90 mm)	3", 3-1/2", 4" (76 mm, 90 mm, 100 mm)		3" (76 mm)	4-1/2" (110 mm)
R 51		3-1/2", 4" (90 mm, 100 mm)	4" (100 mm)	4" (100 mm)	4-1/2" (110 mm)
T 76		5", 6" (125 mm, 150 mm)			7" (175 mm)

Installation Equipment

Drill Rigs

The preferred method of installation for the Williams / MAI Hollow Bar System is rotary percussion drilling, as this method offers good directional stability and high rates of production. Hand-held drill rigs can be used to install R25 and R32 bars. Hand-held equipment works best when used in conjunction with an air leg or within a slideframe arrangement.



(Fig 1)

Rotary Injection Adapters (Grout-Swivel) for Rig Installation

For simultaneous drilling and grouting installations, a rotary injection adapter is required. The rotary injection adapter or grout-swivel consists of a RotoJec Body and RotoJec Shank. The RotoJec Shank fits within the RotoJec Body and contains grout inlet ports. One end of the shank attaches to the striker bar while the other end attaches to the hollow bar anchor. The RotoJec Body contains an inlet pipe to allow grout to enter into the shank and down the hollow bar. The body remains stationary while the shank spins with the rotary action of the drill. To hold the body into position and prevent spinning with the rotary action of the drill, it is necessary to attach a locator frame from the body to the drifter. Some rock drills, such as a TEI Drill and an Atlas Copco IRIA (Integrated Rotary Injection Adapter) System, offer an integrated grout-swivel to facilitate installation and reduce time-consuming retro fits of traditional top hammer drilling equipment.

Caution should be applied that only water or grout flush be used with the grout-swivel system. Air flush could burn the seals within the RotoJec Body. In all cases, grease should be applied to the grout-swivel system prior to use.

Rotary Injection System (Grout-Swivel) for Hand-Held Drill Installation

The Combi System is used for hand-held installations of R25 and R32 anchors. As with the rig grout-swivel system, the Combi Grout-Swivel System must also contain a locator frame connection from the body to the drifter to prevent spinning. In all cases, grease the Combi System prior to use.

Grout Injection Adapter

An Injection Adapter connects to the end of the hollow bar and serves as a conduit between the grout line and the hollow bar. Generally this adapter would be used for post-installation grouting following air or water flush drilling.

Coupling Box

A Coupling Box is a machined and case hardened adapter, which is usually located just below the drill hammer and is used to connect the striker bar to the hollow bar. Sizes are available in any striker bar thread type to connect to any Williams / MAI Hollow Bar size. Generally a Coupling Box would be used in place of a grout-swivel during an air flush installation.

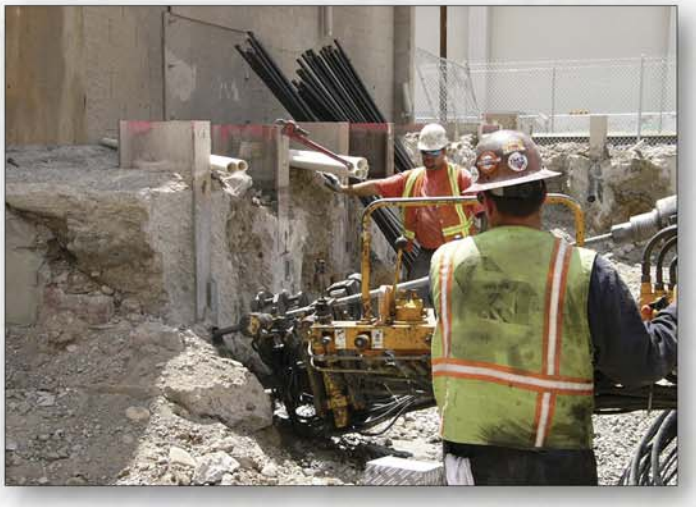
Drill Bit Adapter Sleeves

Adapter Sleeves enable the use of a larger diameter drill bit with a particular bar size than normal to increase the borehole size and achieve higher loads in poor ground conditions. Caution needs to be applied that the use of larger diameter drill bits with smaller diameter hollow bars be restricted to clay/soft ground in order to reduce the risk of torsion buckling in the bar. Sizes available are R25/R32, R32/R38 and R38/R51.

Project Photos

Project: Queens Crossing
Contractor: Urban Foundation
Location: New York, NY

Project: Bank of America Headquarters
Contractor: Civetta Cousins
Location: New York, NY



Project: Reno Retrack Project
Contractor: Condon Johnson
Location: Reno, NV

Project: Morenci Copper Mines
Contractor: Hi-Tech Rockfall
Location: Morenci, AZ

Project: Hana Highway
Contractor: Prometheus Construction
Location: Maui, HI

Project: North & East Telluride
Contractor: Mays Construction Specialties
Location: Telluride, CO

Applications

Soil Nails

Soil Nails are non-tensioned, in-situ reinforcement for the stability of excavations and embankments in top-down construction. The Williams / MAI Hollow Bar System is an ideal choice for soil nailing in difficult soils as it offers high installation rates. Hollow bar anchors have gained European approval for permanent soil nail use and have been used extensively for permanent use in the United States.

Prestressed Ground Anchors

Williams / MAI Hollow Bar Anchors can be used as a choice for pre-tensioned anchors in loose or collapsing soils without the need for a casing. A free length must be installed onto the anchor if the project specifications call for a pre-tension load to be applied from the bond length. Please consult with a Williams specialist for suggestions to properly attach a free length sleeve. Note to Designer: Consult with Williams for an appropriate level of corrosion protection if prestressed ground anchors are intended to be used for a permanent application.

Micro Piles

Williams / MAI Hollow Bar Anchors offer an excellent choice for micro piles in difficult ground conditions where open-hole drilling isn't possible. The continuously threaded bar profile lends itself perfectly for restricted headroom applications because the bar can be cut and coupled at any length. The FHWA has approved hollow bar anchors for permanent use in micro pile applications.

Tunnel Spiles and Forepoling

The Williams / MAI Hollow Bar System are often used for spiling in NATM tunneling. Spiles are continuously drilled and grouted pre-support reinforcement to enable the heading of a tunnel to advance without the risk of falling debris. The anchors can also be used as face stabilization of portals.

Installation

The Williams / MAI Hollow Bar Anchor System is optimally used in poor or very poor ground conditions ranging from inconsistent fill, boulders, rubble and weathered rock to sand and gravel. Generally the system is installed with rotary percussive drilling and continuous grouting. The thickness of grout can be varied depending on susceptibility of the borehole to collapse, however a grout mixture of 0.4 water to cement ratio is recommended in poor, collapsible soils to ensure a high enough density to support the annulus. In all cases, a final grout mixture of 0.40 w/c should be used for adequate in-situ structural capacity. Williams / MAI recommends mixing the grout in a colloidal (shear type) mixer, so once pumped, the fine grout particles are fully able to disperse into the small voids of the surrounding soil. This well mixed grout exits the side ports of the drill bit under pressure to flush and remove the softer parts of the soil while penetrating into the firmer material for increased bond capacity. Also the percussive action of the drill acts as a "poker" to further consolidate the grout. Williams / MAI recommends to partially withdraw each fully drilled section up the drill mast prior to attaching new sections, this way the drilling can begin in a plunging type action to even further improve grout penetration. Utilizing proper drilling and grouting techniques is important as the system would generally fail between the soil/anchor interface, not the grout/anchor interface.

In all cases the hollow bar system should be drilled slow enough to ensure rotation through the soil as opposed to excessive percussion and feed pressure with limited rotation. Such practice will provide the formation of a true borehole with consistent grout cover. Grouting pressure should be sufficient to maintain circulation at all times with a small amount of grout return visible at the mouth of the borehole. Normal drilling rotation is in the range of 40 and 100 RPM.

Helpful Hints to Release and Add Sections

An installer must be able to stop drilling and add sections in an expeditious manner in order to maintain high levels of productivity. The Williams / MAI R-Thread Hollow Bars are often used in conjunction with T-thread striker bars (see fig.1, pg 4). For maximum efficiency, it is necessary to remove and attach new sections of rope-thread hollow bar while preventing the striker bar from turning and releasing. The following are helpful suggestions in ensuring release from the hollow bar end (R-thread) while preventing release from the striker bar end (T-thread):

- Keep the number of top components to a minimum.
- Apply a locking torque to the striker bar end. Horse hair and Loc-Tite are available from Williams to facilitate in preventing release. Williams / MAI can also provide the striker bar end of the rotojec shank or coupling box to be machined to a tighter than normal thread tolerance so that a permanent, locking torque can be applied in the field.
- Liberally grease the top end of each hollow bar going into the rotojec shank or coupling box.
- To release the installer should grip the hollow bar and apply percussion combined with feed pressure in a clockwise rotation. Caution: Care should be taken not to allow more than two turns of clockwise rotation as further rotation would detach the drill bit or couplers within the borehole.

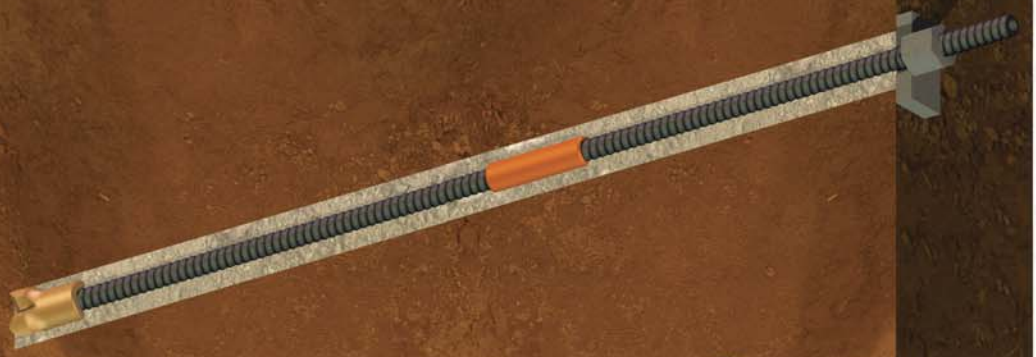
Installation

1. Williams / MAI Hollow Bar Anchor set into position for installation.

2. Installation begins with rotary percussive drilling and either grout, water or air flushing.

3. Once the first three meter section is installed, drilling stops long enough to add the second section.

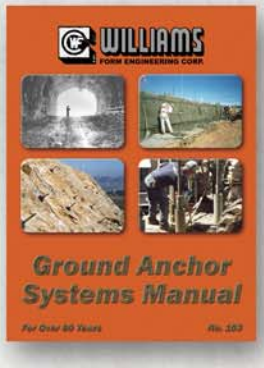
4. Raise the anchor high enough to get visible evidence of flush return from the mouth of the bore hole and begin drilling again in a normal fashion.



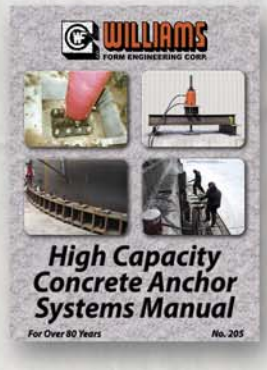
5. Add sections in the manner noted in step four until anchor reaches final depth. Completely flush all drilling grout and debris with competent compressive strength grout.

Williams offers a full line of Ground Anchors, Concrete Anchors, Post-Tensioning Systems, and Concrete Forming Hardware Systems for whatever your needs may be.

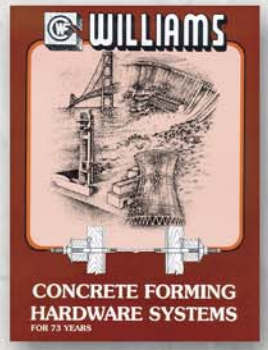
Ground Anchor Systems Manual



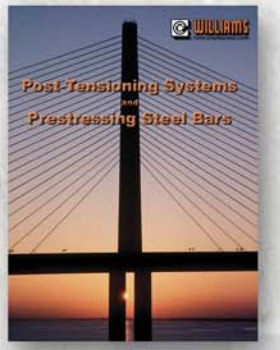
High Capacity Concrete Anchor Systems



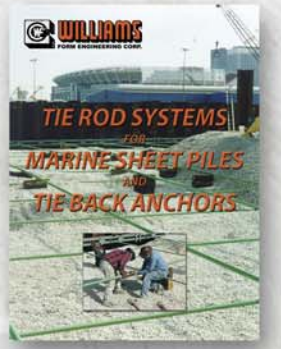
Concrete Forming Hardware Systems



Post Tensioning Systems



Tie Rod & Tie-Back Anchor Systems



Also available from Williams are *Rock & Soil Anchor Sample Specifications*, *High Capacity Concrete Anchor Sample Specifications*, and our Interactive CD Rom

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"MAI" is the trademark name of the hollow bar anchor owned and manufactured by Atlas Copco, a leading global supplier of equipment and ground support products for the mining and construction industry. Williams Form Engineering is an authorized distributor for the MAI products in the United States.

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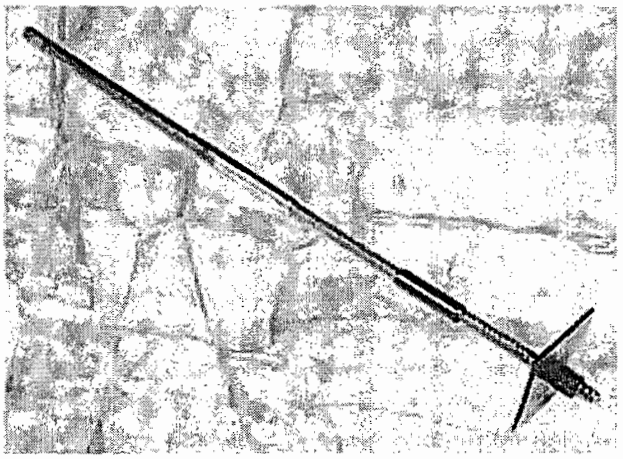
aci ADSC ASBI ASDSO CAMA DFI pti

Swellex® Hybrid Rockbolts



A Hybrid bolt for pre-tensioning and post grouting, providing immediate support and long term life expectancy.

The **Swellex® Hybrid** consists of a Swellex bolt coupled with one or more MAI Self Drilling Anchors (MAI SDA®). A special connection coupling welded onto the Swellex bolt, enables it to be inflated and the SDA portion to be grouted. After inflating the Swellex bolt, the rock mass between the face plate and the Swellex is pre-tensioned to the desired value. The rock mass is then exposed to confinement pressure and after pumping grout through the centre hole of the SDA, the hole annulus is filled with grout. The pre-tensioned support element is fully grouted for full protection and long lasting anchorage.

Safety characteristics

- Immediate support - no curing time
- Quality assurance with every installation
- Safe and easy installation
- Pre-tensioning for immediate active support
- Perfect grouting from the bottom of the hole
- Grouting provides full column reinforcement and corrosion protection for long term applications

Productivity

- Efficient installation that is easy, fast and trouble free every time
- SDA with R-thread, easy to connect
- Grouting operation does not require a breathing tube
- No need for a specialized crew
- Can be used in manual or semi-mechanized installation
- Improved productivity throughout the whole cycle

Applications

Swellex® Hybrid rock bolts are recommended for rock support in tunnelling, civil engineering and mining applications where active (pre-tensioned) support is required to preserve rock mass structure and grouting needed for long life expectancy. The system is ideal in weak ground and around structural discontinuities. It is also recommended as a problem solver for long anchorage requirements

Installation equipment

- Atlas Copco Swellex pumps and MAI m400NT Grout Pump

Specifications

General data	Swellex	SDA R32N
Max profile diameter	36 mm	
Outside diameter		32 mm
Inside diameter		10.5 mm
Average weight	3.95 kg/m	2.4 kg/m
Thread type		R32
Recommended hole diameter	48-51 mm	
Inflation pressure	300 bar (30MPa)	

Steel Data	Swellex	SDA R32N
Steel type	S355 MC	EN 10 149
Average yield strength, Rp02		500 N/mm²
Average tensile strength, Rm		720 N/mm²
Minimum breaking load*	240 kN	280 kN
Yield load *	200 kN	220 kN

*) According to EN10 025

Swellex® *Manganese Line*

– a much safer investment

WILLIAMS FORM ENGINEERING CORP.

WILLIAMS CONCRETE ACCESSORIES DIVISION

Spin-Lock Mechanical Rock Anchor Systems

Spin-Lock Information | Parts & Accessories | Head Assemblies | Spin-Lock Installation | Installation Equipment | Case Histories | Corrosion Protection

R1H High Grade Hollow-Core Spin-Lock
R1S High Tensile Spin-Lock
R1J Solid Rebar Spin-Lock
R1V High Impact Spin-Lock
R7S 150 KSI Spin-Lock
Spin-Lock Accessories
Spin-Lock Anchor Head Assemblies
Spin-Lock Installation Procedures
Spin-Lock Installation Equipment
Spin-Lock Torque Tension Charts

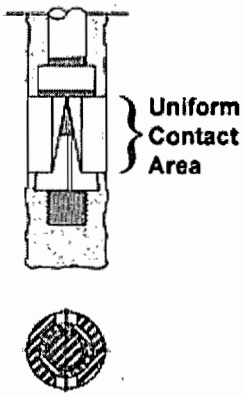
Williams Spin-Lock anchors were first used in the 1950's for rock/roof bolting in projects such as NORAD and Australia's Snowy Mountain power facility. Since then many engineers contractors and owners have seen the advantages of the Spin-Locks on dams, locks, water/waste treatment facilities and many other large scale civil projects. Williams Spin-Lock anchors provide the advantage of immediate anchorage for pre-stressing and require shorter embedments than traditional grout bond anchor systems.

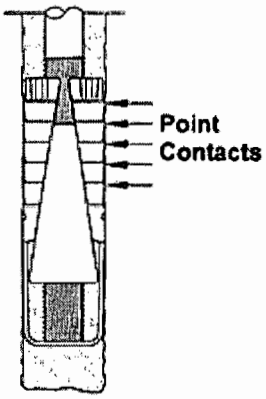
The Spin-Lock has been job-proven, time and time again to meet all bolting requirements in any strata which can be bolted.

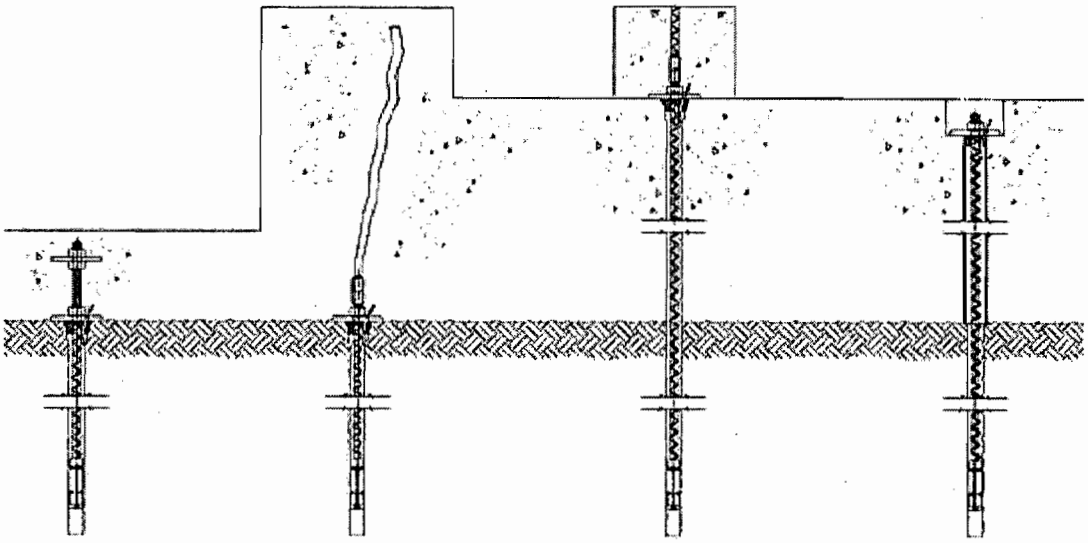
To comply with the need for bolts which will satisfactorily anchor a broad range of variable rock formations, Williams has developed a complete family of rock bolts with a simple and efficient system of installation. Williams offers a complete line of rental equipment for installing, testing and grouting of Spin-Lock anchors.

Before proceeding with your next project, consult with a design agency familiar with Williams Rock Bolting. Williams would be pleased to recommend an ideal system for you.

Williams Spin-Lock Anchor	Serrated Anchor by others
Expansion shell receives full bearing support from solid 300° cone design.	Quartered cone design leaves expansion shell unsupported at adjacent gaps. Shell can collapse in under high stress.







Method A
Anchor is pre-stressed to rock and used in thin slab locations.

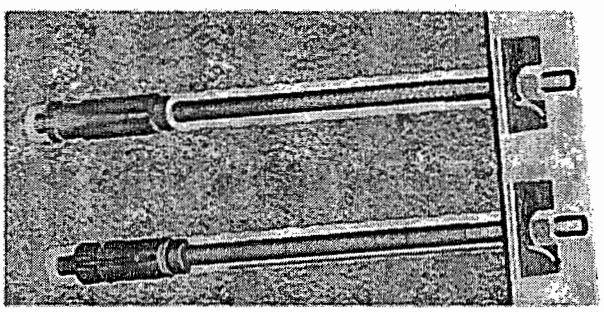
Method B
Less expensive method. Used where pre-stressed rock is anchored to large slabs or footings.

Method C
Exposed nut and plate where slab is pre-stressed to rock.

Method D
Non-exposed nut and plate where pre-stressed slab is required to have flush anchor.

Spin-Lock Rock Anchor Specifications

For a detailed breakdown of the parts and components involved in resin anchoring, click on the image to the right.



Spin-Lock Parts & Head Spin-Lock Installation

OVER THE RIVER Restoration Plan

Introduction

Following the viewing of the temporary work of art, all materials would be removed and all disturbances in the Arkansas River Canyon would be restored to conditions as close to preproject conditions as possible. Removal of the physical features of the temporary work of art (fabric panels, cables, and anchors) would commence immediately after the summer viewing period and be completed within 12 weeks, weather permitting. The fabric panels would be removed first, followed by the cables. As soon as the fabric panels and cables are removed from one location, anchor removal would begin. The following sections provide details on the various removal and restoration steps.

Removal of Materials

The fabric panels would be unhooked from one side of the river and pulled across the suspended cables, with the carabiners being unhooked as the fabric panel is pulled along. The fabric panels would then be gathered, folded, and loaded on a truck for transport to a warehouse leased by OTR Corporation for OTR materials. Cables would then be removed by releasing the tension on the cables so that they could be disconnected from each other and from the surface anchors. The cables would be pulled to the side of the river by hand, where they would be wound on spools on a truck and transported to the warehouse. The anchor transition frames (ATFs) would be disconnected from the underground anchor bolts and lifted onto a flatbed truck or rail car by a crane, a truck-mounted winch, or a skid-steer vehicle, and transported out of the canyon to an OTR Corporation storage area. Finally, the underground anchor bolts would be cut off a minimum of 12 inches below the ground surface. Chapter 1, Section 1.3, Project Description, provides additional information on the removal requirements.

All materials would be industrially recycled (fabric panels, steel cables, carabiners, and other supporting hardware) after they are removed. Fabric from other Christo and Jeanne-Claude temporary works of art has been used for erosion control material, mattress stuffing, carpet underpadding, and agricultural purposes. There is also a salvage market for steel cable.

Site Restoration

Anchor sites would be reclaimed in several steps. When the anchor sites are constructed, any soils excavated to prepare the site would be placed in a large canvas bag. Each surface anchor has an identification number and that same identification number would be placed on the canvas bag of soils. The bags of soils would be stored in the leased warehouse during the viewing of OTR. For the anchor removal process, the bags of soil would be brought back to the site and placed near the appropriate surface anchor. After the surface anchor is removed, the bagged soils would be used to restore the ground surface to original contours and tamped to stabilize the site. This replacement of soil to its original location is anticipated to speed vegetation recovery because it contains inoculum (seeds and microbes) from the original site.

Anchors located in rock are not expected to occur in large numbers, but grout would be used to fill and seal any holes in rocks that were made for anchors. Grout in rock would be colored to blend with adjacent rock material. Nontoxic grout would be mixed on site, as needed for each section of anchors. Grout is a very impervious material, but it may possibly weather differently from native rock. What this means is that the grout-filled holes could become more noticeable in the future; therefore, efforts would be made to use the best grout available for long-term purposes. However, these grout-filled holes represent a very small feature in rocky areas and are not expected to be a visual intrusion.

Soil Revegetation

Finally, soil surfaces would be revegetated in accordance with adjacent vegetative cover (for example, principally grass, forbs, shrubs) and with use of BLM-approved seed mixtures using native species. OTR Corporation would purchase certified, weed-free seeds or seed mixtures for use in reseeding disturbed areas as directed by the BLM. In addition to the anchor sites, numerous footpaths and vehicle paths would require restoration. Pathways would be scarified with hand tools if compaction has occurred to a significant degree. The anchor sites and pathways would have seeds or seed mixtures spread by hand and lightly raked into the soil. The soil would be tamped by hand to complete the site restoration.

Cleanup crews would check the area for trash and litter daily during the removal activities and at the end of the restoration period to ensure that all material generated by the work crews has been picked up and removed.

OVER THE RIVER

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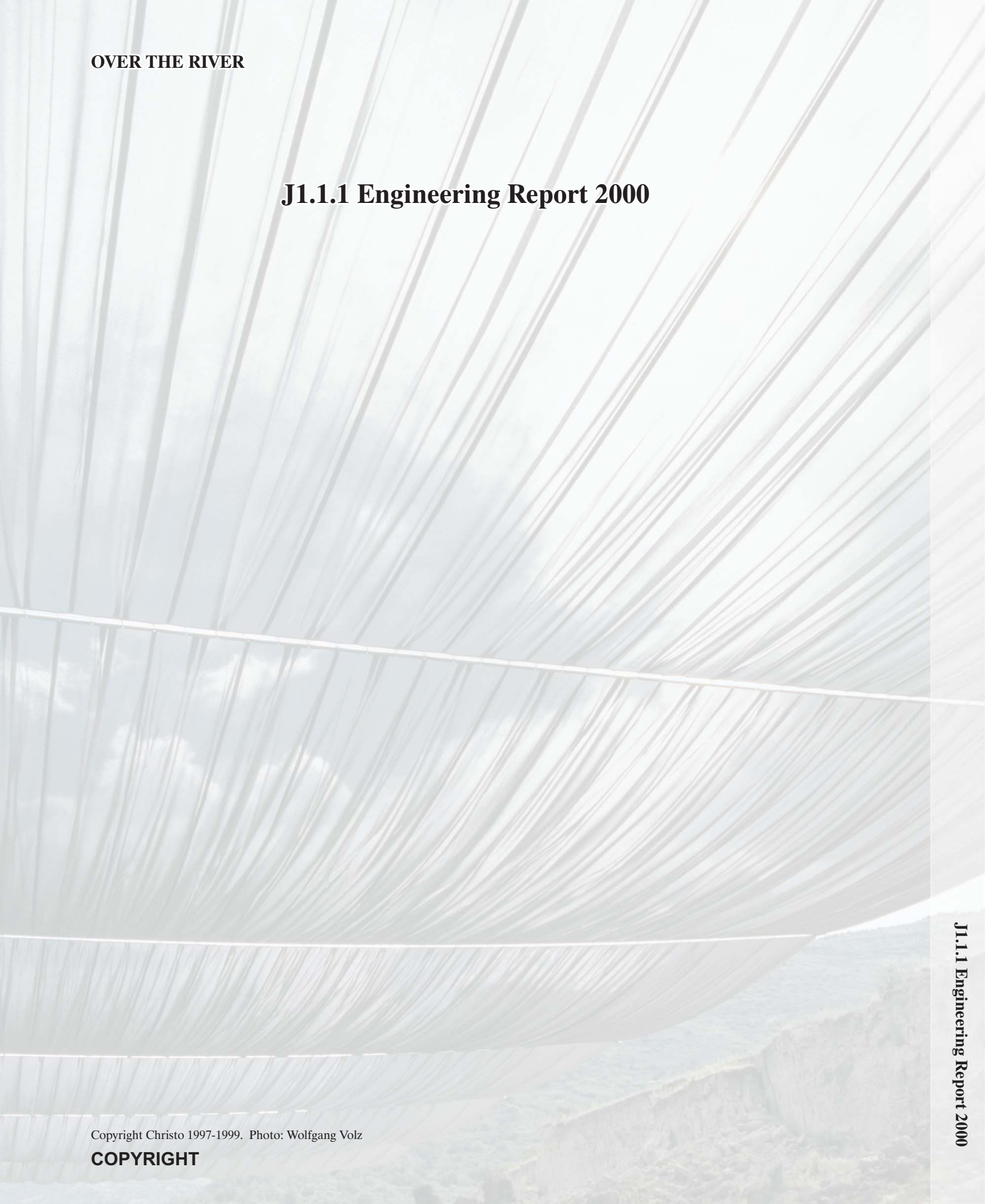

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Golder Associates

D R A F T

PRELIMINARY DESIGN ENGINEERING REPORT CHRISTO AND JEANNE-CLAUDE OVER THE RIVER ART PROJECT FREMONT AND CHAFEE COUNTIES, COLORADO

Prepared for

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Eugene, Oregon 97440

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1 copy – Christo and Jeanne-Claude
1 copy – J F Sato & Associates

June 9, 2000 003-2137

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1.0 INTRODUCTION

This report presents an overview of the engineering design effort that CVJ Corporation intends to pursue in implementing the *Over the River Art Project* in Fremont and Chafee Counties, Colorado. Design engineering for this project is being performed by Golder Associates Inc. (Golder), and subconsultant Finley McNary Engineers (FME), under the direction of Mr. Vince Davenport of CVJ. The reader should understand that this is a preliminary design report, and is intended to convey to the reader the engineering procedures and protocols that Golder and FME will follow in design of the project. Key design decisions such as cable types and sizes; anchor types, capacities, and depths; and geometric layout of the project have not been determined, and will be finalized as the project progresses through design.

This report is organized as follows:

Chapter 1 – Introduction

Chapter 2 – Cable System Design Engineering, which is the work product of Finley McNary

Chapter 3 – Geologic Setting and Ground Conditions, which is the work product of Golder

Chapter 4 – Preliminary Anchor Design, also the work product of Golder

2.0 CABLE SYSTEM DESIGN ENGINEERING

The *Over the River Art Project* will consist of eight sections of fabric panels installed intermittently over approximately 40 miles of the Arkansas River between Salida and Canon City, Colorado. Each section will consist of a series of segments interrupted by rocks, trees, and other natural obstacles. Each segment, made up of four or more fabric panels, will be supported by an independent system of cables. The main cross-river cables will span the river with adjacent fabric panels attached at grommets. Under dead load, the cross-river cables will take a roughly parabolic shape with maximum sag of about 2.5 feet for a 175-foot span. Under moderate wind load, the cross-river cables will move to a maximum hog roughly equal to the sag as the fabric panels billow upward. In addition to the cross-river cables, diagonal cables will stabilize each segment in the direction parallel to the river.

The objective of this preliminary design report, with regard to the cable system, is to:

- Outline the layout of typical segments including potential cable and connection types; and
- Describe the design philosophy for sizing cables and connections.

Layout

Figure 1 illustrates the layout of a typical segment of fabric panels. Cables CR-1U, CR-2U, CR-3, CR-2D, and CR-1D will be present in every segment. Cables CR-4U/D, CR-5U/D, etc. (not shown) will be included in longer segments. Panel length H will vary between 35 and 40 feet while the cross-river cable span L will vary between 150 and 250 feet. Diagonal cables D-1U through D-4U and D-1D through D-4D attach to cross-river cables CR-1U and CR-1D, respectively. Cross-river and diagonal cables terminate at rock/soil anchors of similar elevation (approximately 9 to 25 feet above waterline). Either a turnbuckle (shown in detail A) or an adjustable bridge socket will

allow final adjustment of cable sag. Cable connections are achieved through either Guy-Grips or poured (zinc or resin) sockets. The cables themselves will consist of either seven-wire guy strand or 19-wire structural strand.

Design Philosophy

A load and resistance factor design approach, consistent with U.S. design codes, will be used for sizing cables and connections. The cable system is considered a temporary structure given the short duration of service (3 weeks or less).

Controlling loads to the cable system are categorized into (1) dead load of cables, fabric, and connections and (2) wind load. Field tests indicate that the porosity of the fabric panels prevents ponding of rainwater. Hail will most likely be accompanied by high enough winds to induce billowing of the fabric panels. While the billowing effect should prevent any collection of hail, this condition will be considered in final design for completeness.

Loads

Dead load tensions for draped cables are computed as a function of the span to sag ratio and the distributed or point loads along the cable. The computed dead load tension gives the required pretensioning force to achieve the desired sag.

To determine the cable tensions due to wind loading, Rowan, Williams, Davies, and Irwin, Inc. (RWDI) conducted a wind engineering study. The study consisted of statistical analysis of recorded wind speeds in the area surrounding the project and an aeroelastic model of typical segment configurations. The aeroelastic model was verified by a full-scale field test of a typical segment. The results indicated in RWDI's report are briefly summarized in the following:

- A design wind speed based on a 10-year return period is recommended;
- Analysis of wind statistics in the area surrounding the project indicates that a one minute mean wind speed of 42 mph will be exceeded on average once in 10 years during the period of July through September for most locations along the river;
- The Red Rocks and Three Rocks locations encounter notably higher wind speeds that should be given special consideration;
- Test results indicate the fabric panel configurations tested are aerodynamically stable.

Maximum cable forces from the aeroelastic model were determined for a 42 mph one-minute mean wind speed for two different panel configurations. Because of the variability in span and above river height along all sections as well as the higher wind speeds at the Red Rocks and Three Rocks sections, actual cable forces will vary throughout the project. Cable forces from the aeroelastic tests will be used as a guide to determine the final design forces at each site.

Two points are worth noting regarding the conservatism of the maximum cable forces in RWDI's wind engineering report. First, the 42 mph one minute mean wind speed is based on a probability of exceedence within a period of 3 months. However, the duration of service (3 weeks or less) indicates an actual return period much higher than 10 years for the 42 mph wind speed. The actual return period is approximately four times higher for the 3-week duration. Second, the maximum wind load on cross-river cables occurs when the wind direction is at 45 degrees to the river valley. While it is important to consider these winds, they only occur about 10 percent of the time and the probability of maximum winds occurring at the least desirable wind direction is unlikely. These two factors indicate a much higher level of conservatism built into the loads corresponding to 42 mph winds. Thus, while the Red Rocks and Three Rocks sections encounter higher wind speeds than other river sections, it has been determined that a 42 mph design wind speed is adequate for design of the cross-river cables in all sections. However, diagonal cables in

the Red Rocks and Three Rocks sections will be designed for a higher wind speed because of their diminished sensitivity to the wind direction. Because these members are essential components in the cable system, they are treated with an extra measure of conservatism.

The loads presented in RWDI's wind study report include estimated cable pretensioning forces for the cross-river and diagonal cables. In final design, the pretensioning force for cross-river cables will be computed according to the dead load of materials and the desired sag. Required pretensioning for diagonal cables is a function of the cable dead load and the tension required to maintain a stable system. The magnitude of this force will be estimated in final design and adjusted in the field.

Load and Resistance Factors

For the governing load case of dead load plus wind load, ASCE 19-96 (*Structural Applications of Steel Cables for Buildings*) gives the following load combination

$$S_d \geq 2.0(D + P + W)$$

where S_d is the design cable strength and D, P, and W represent dead load, prestress, and wind load, respectively. The 2.0 load factor is typical of permanent cable structures designed for 50-year load events and subject to long-term fatigue concerns. In a temporary application such as this one, a 2.0 load factor is overly conservative. One approach for temporary structures is to multiply the stated load factor by 0.75 (0.75 x 2.0 = 1.5). This is also consistent with an allowable stress approach that permits a one-third increase in allowable stresses for wind load combinations (2.0 / 1.33 = 1.5). For the sizing of cables and connections in the *Over the River Art Project*, a 1.5 load factor will be used.

According to ASCE 19-96, the design cable strength is computed according to

$$S_d = \phi S_n$$

where S_n is the specified nominal strength of the cable (typically furnished by the manufacturer) and ϕ is a reduction factor for fittings. It is anticipated that either

Guy-Grips as shown in Figure 2 or strand sockets will be used in this project. In both cases, the connections are designed to develop greater strength than the cable itself and do not compromise the strength of the cable so that $\phi = 1.0$.

3.0 GEOLOGIC SETTING AND GROUND CONDITIONS

3.1 Descriptions of Observed Material Types

On March 29 and 30, 2000, a Golder geotechnical engineer conducted a field surface reconnaissance of the project area. Each of the project sections was visited and reviewed for general site conditions pertinent to placement of anchors. Based on these observations, the project river corridor includes the following predominant material types:

Rockfill: This material type consists of relatively "clean" (few fines) rock particles used as embankment construction materials. In some cases, the rockfill may form only a facing (as ripap) over less coarse embankment or natural slope materials. Particle sizes are predominantly 1-foot diameter and larger, up to about 4 feet maximum size (with occasional exceptions). The material is usually derived from local bedrock, but "imported" material is occasionally used along the railroad fill, particularly as riprap.

Colluvium and Fills Constructed from Colluvium: These materials generally have a relatively high rock content (approximately 40 percent or more), although they can vary considerable from place to place. In general, the material appears to have a lesser rock content and may be matrix-supported (i.e., coarse particles are "suspended" in finer-grained material) where metamorphic rocks are the source material. The rock material is usually angular and may be as large as the particle sizes found in the rockfill.

Alluvium/Outwash/Fan Deposits: Occurrence of these materials is limited to areas where there is a confluence of a side drainage with the river, or flatter gradients of the river where the channel meanders somewhat. These materials are usually characterized by rounded cobbles and boulders which are matrix supported. At a few of the steeper drainage mouths the particles are angular and locally-derived.

Bedrock: Bedrock found in the project area includes igneous, metamorphic, and sedimentary rocks:

- Igneous rocks are found in the downstream (east) portions of the project area. They consist of Quartz Diorite, a hard, durable rock with (generally) widely spaced jointing.
- Metamorphic rocks found in the middle sections of the project, and at the extreme upstream (west) end, are hard, durable Gneiss.
- Sedimentary rocks found in the upstream portions of the project area include sandstone, conglomerate, shale, limestone, and dolomite. Except for the shale which is generally soft and weathered, these rocks are well-cemented and competent, with joints typically spaced on the order of 1 to 2 feet. The shales make up no more than about 10 to 20 percent of the rock mass, and probably significantly less in most areas.

Other Materials: Limited quantities of other materials were noted along the banks during the reconnaissance:

- Concrete slabs, apparently debris from concrete pavement and/or bridge decking, were used to form or face the railroad fill in two locations. This material may be regarded as rockfill for design purposes.
- Minor areas of finer-grained soils, likely silty sands with gravel, were noted in relatively small areas. These appear to be river-deposited sand bars and overbank deposits. This material may be regarded as alluvium/outwash for design purposes.

These various material types are expected to yield the following likely combinations of ground conditions for anchoring:

1) Anchoring in Rockfill
2) Anchoring in Colluvium or Colluvial Fill
3) Anchoring in Alluvium or Outwash Deposits

4) Anchoring in Bedrock, from ground surface to full depth
5) Anchoring in Bedrock below Rockfill
6) Anchoring in Bedrock below Colluvium or Colluvial Fill
7) Anchoring in Bedrock below Alluvium or Outwash Deposits

These potential anchoring conditions occur in various frequencies and combinations within the various project sections as described below. Various types of bedrock occur, depending on location, as noted below.

3.2 Section-by-Section Description of Conditions

The following discussion describes the conditions found in each project section, as observed during the surface reconnaissance. For each section, approximate estimated subsurface conditions pertinent to anchoring, expressed in percentages of the total section riverbank length (which is approximately twice the stated length, to cover both sides), have been inferred. Anchorage inferred to be in bedrock includes anchors placed in bedrock overlain by surface deposits as well as where bedrock is exposed at the ground surface. Clearly, actual conditions may vary considerably from these estimates, and can only be firmly determined when the anchor holes are drilled.

PARKDALE SECTION
(Approximately 2 ¾ miles)

Banks are characterized by alluvial/fan deposits at extreme downstream (east) end of section, (mostly confined to "Alternative C" extension beyond "Alternative B"). Upstream from the approximate downstream end of "Alternative B," banks are characterized by local colluvial materials, in place or used as fill, which are very rocky, with particles up to 2 feet or more in diameter. Occasional outcrops (sound igneous rock) are seen, and are more frequent toward the upstream end of the section. Much of bank materials throughout this section appear to be characterized as rockfill, although greater

content of smaller particle sizes occur at confluences of side canyons with the river, where fan deposits contribute more "fines" to the natural river banks. Approximately ¼ mile of the north bank (railroad side) near the center of the section is constructed or armored with concrete rubble in the form of large slabs of what appears to have been concrete pavement or bridge decking. Other debris (such as timber) may also be included here.

Estimated Percentage of Anchoring Conditions

Igneous Bedrock: 10 – 25%

Rocky Colluvium/Fill: 20 –50%

Alluvium/Fan Deposits: < 5%

Coarse Rockfill: 30 – 70% (includes concrete rubble)

SPIKEBUCK SECTION
(Approximately 1 ½ miles)

This section is predominated by rockfill with occasional outcrops of igneous rocks. In some areas the outcrops are relatively continuous and along both banks. Colluvial-based fills appear in some areas, particularly at the mouths of gullies on the south bank. In two areas, fan deposits are found along the north bank.

Estimated Percentage of Anchoring Conditions

Igneous Bedrock: 15 – 40%

Rocky Colluvium/Fill: 20 – 40%

Alluvium/Fan Deposits: 5 – 15%

Coarse Rockfill: 40 – 60%

FIVE POINTS SECTION
(Approximately 1 ¼ miles)

Along this section the river meanders somewhat, and thus bank conditions appear to contain more fines in some areas, as characteristic of fan and alluvial deposits. However,

coarse rockfill is still common. Bedrock in portions of this section is sound metamorphic rock, although this rock type appears to result in finer particles in fan and colluvial deposits than was apparent in the igneous sections.

Estimated Percentage of Anchoring Conditions

Metamorphic and Igneous Bedrock: 5 – 20%

Rocky Colluvium/Fill: 20 – 50%

Alluvium/Fan Deposits: 20 – 40%

Coarse Rockfill: 20 – 40%

THREE ROCKS SECTION
(Approximately ¾ mile)

This section appears to be predominated by coarse rockfill and very rocky colluvium/fill. However, bedrock outcrops (metamorphic) may be shallow below the surface cover. Outwash fans from the side drainages appear to be composed of relatively coarse, angular debris.

Estimated Percentage of Anchoring Conditions

Metamorphic Bedrock: 5 – 15%

Rocky Colluvium/Fill: 20 – 50%

Alluvium/Fan Deposits: < 5%

Coarse Rockfill: 30 – 70%

MAYTAG SECTION
(Approximately ¾ mile)

Much of the banks in this section appears to have large rock riprap covering the surface of finer-grained alluvial and colluvial deposits/fills. There are also areas of huge rounded boulders and/or outcrops.

Estimated Percentage of Anchoring Conditions

Metamorphic Bedrock: 5 – 20%

Rocky Colluvium/Fill: 20 – 50%

Alluvium/Fan Deposits: 5 – 50%

Coarse Rockfill: 20 – 50%

TEXAS CREEK SECTION
(Approximately ¾ mile)

There are frequent outcrops of metamorphic bedrock along this section. At the downstream (east) end of the section, bedrock is overlain/covered by alluvium containing rounded cobbles (few boulders).

Estimated Percentage of Anchoring Conditions

Metamorphic Bedrock: 20 – 70%

Rocky Colluvium/Fill: 30 – 70%

Alluvium/Fan Deposits: 5 – 20%

Coarse Rockfill: 10 – 40%

VALLIE BRIDGE SECTION
(Approximately ½ mile)

The south bank (road side) of this section is predominated by colluvial fill. The north bank (railroad side) is characterized by alluvium/fan deposits with rounded cobbles in the downstream portion, and sedimentary bedrock outcrops in the upstream portion. The bedrock is steeply-dipping (60 to 70 degrees to the southwest) well-cemented, competent sandstones and conglomerates, with softer, weathered shale layers, typically less than 3 feet in thickness making up an estimated 10 to 20 percent of the rock mass.

Estimated Percentage of Anchoring Conditions

Competent Sedimentary Bedrock: 20 – 50%

Weaker Sedimentary Bedrock: < 5%

Rocky Colluvium/Fill: 40 – 60%

Alluvium/Fan Deposits: 20 – 40%

Coarse Rockfill: 5 - 20%

TUNNEL SECTION
(Approximately 1 mile)

Most of this section has sedimentary bedrock outcrops characterizing both banks. The bedrock is sandstone and conglomerate, with occasional shale over most of the section, with limestone/dolomite at the upstream (west) end. The sediments dip about 30 degrees to the southeast in this section. Where covered, the overburden appears thin, and generally consists of cobbly alluvium on the north bank, and coarse rockfill (of local materials) on the south bank.

Estimated Percentage of Anchoring Conditions

Competent Sedimentary Bedrock: 60 – 90%

Weaker Sedimentary Bedrock: < 5%

Rocky Colluvium/Fill: 10 – 20%

Alluvium/Fan Deposits: 10 – 30%

Coarse Rockfill: 10 - 20%

COUNTY LINE SECTION
(Approximately 1 mile)

The typical colluvial fill covering both banks appears to be shallow, over frequent bedrock outcrops. Most bedrock appears to be limestone and/or dolomite, although metamorphic rocks may occur at the upstream end of the section. A portion of the north bank (railroad side) appears to be fan deposits.

Estimated Percentage of Anchoring Conditions

Competent Sedimentary/Metamorphic Bedrock: 20 – 60%

Rocky Colluvium/Fill: 30 – 70%

Alluvium/Fan Deposits: 5 – 25%

Coarse Rockfill: 5 - 20%

4.0 ANCHOR DESIGN

4.1 Description of Proposed Anchors

Each of the cables used to support the fabric structure will be fastened to eyes attached to ground anchors. The type of anchor used will depend on the type of soil and/or rock materials encountered at each individual anchor location. Where subsurface conditions can be correctly inferred from the ground surface, such as where anchors are to be placed in surface bedrock exposures, anchor selection will be straightforward. In many cases, however, the anchor type will be selected only after the anchor hole has been drilled and actual conditions are verified. The anchors will be temporary, and protruding hardware will be removed at the project's conclusion.

Several anchor types are tentatively identified to allow selection of a suitable anchor at each location for the range of ground conditions anticipated throughout the project. All of the anchor types have several features in common. All anchors will utilize either "spin-lock" mechanical anchors or pumped grout anchorage. The rock bolts, anchors, and their associated hardware are to be supplied by Williams Form Engineering Company, and will include their proprietary "spin-lock" mechanical anchors.

On each anchor, a section of threaded bar will be coupled to the rock bolt or rebar anchor below the ground surface, such that the surface hardware can be easily removed following the project. The proposed anchor types are illustrated in Figures 3 through 8, and are described below. In many cases, more than one option (for example, mechanical versus grouted) may exist for providing appropriate anchorage at a given location. The anchor detail figures include conceptual required lengths for anchorage in the various earth materials expected to be encountered. These requirements were determined from the calculated cable loadings presented in Chapter 2.

Non-toxic grout will be used in the grouted anchors. Installation of the grout will be non-pressurized, thus minimizing the potential for leaks and spills. In some cases, the anchor holes for grouted or mechanical anchors may be filled with grout to the ground surface.

At completion of the project, all anchors will be removed to below the ground surface. The anchor holes will be refilled with local materials to match the existing surface. Holes in rock surfaces will be patched with color-matched grout to blend with the surrounding surface. Figures 9 and 10 show conceptual details for abandonment of the anchor holes.

TYPE 1: ANCHORS IN COMPETENT BEDROCK

Type 1 anchors are to be used where anchors can be installed in competent bedrock. Type 1 anchors utilize a mechanical "spin-lock" anchor head, which is relatively simple to install.

Surface-Exposed Bedrock Locations (Condition A)

These anchors will be installed where surface exposures of bedrock occur. The required anchor steel lengths depend on the rock type in which the anchor is to be placed.

Anchors Located in Mixed Ground (Condition B)

Type 1 anchors are an option to be used where mixed ground conditions are encountered such as unconsolidated surface materials on top of bedrock. In these areas, it is expected that bedrock will likely be encountered in the lower portion of the anchor holes, and the anchors will be placed in the bedrock underlying the unconsolidated surface materials. The unconsolidated materials are expected to include: 1) coarse Rockfill potentially containing many large voids between particles, 2) Rocky Colluvium or Fill constructed from local colluvial and possibly blasted materials, and 3) Alluvium or Outwash Deposits, typically found where the river crosses the mouths of side valleys or where the river

gradient becomes flat enough that sand and gravel bars have been deposited. A fourth type of surface material observed during reconnaissance was concrete slabs and debris used as fill and/or armoring of the railroad fill in limited areas. This material is expected to be similar to Rockfill for anchoring considerations.

Type 1 anchors in mixed ground will be placed in bedrock using the same materials and procedures as for the Type 1 anchors. The only difference in these cases will be that the upper (non-bonded) portion of the anchor will be placed through unconsolidated materials. In most cases, these anchors will be longer than for bedrock-only installations, since the unconsolidated materials in the upper portion of the anchor locations will present less resistance to pullout than continuous bedrock. Also, anchor lengths may be longer in order to provide sufficient penetration of bedrock for adequate bonding lengths.

TYPE 2: ANCHORS IN COMPETENT OR WEAK BEDROCK

If weak bedrock is encountered, where the mechanical heads may lose strength from rock crushing, Type 2 anchors will be used. Type 2 anchors will be used in exposed bedrock or mixed conditions as for Type 1 anchors where weaker bedrock materials exist. In most cases, the need for Type 2 rather than Type 1 anchors will be predictable prior to installation, based on the local geology apparent from the ground surface. In a few cases, weaker rocks may be unexpectedly encountered, such as a buried weathered or sheared zone in an area of otherwise competent rock. The Type 2 anchor uses grout to bond the anchor to the rock. The length of the anchor steel and the grouted length are determined based on the estimated strength of the rock material.

TYPE 3: ANCHORS IN UNCONSOLIDATED MATERIALS (EXCEPT ROCKFILL)

Anchors to be placed in unconsolidated soil materials will be installed as grouted soil nails. These anchors will be grouted along the entire length of the anchor bar and will not be pre-tensioned, unlike all the other anchor types. Type 3 anchors will be used at all locations

(except for Rockfill – see Type 4) where the anchor bond cannot be completed in bedrock or an adequate depth into bedrock. Type 3 anchors are also on option for use in mixed ground where bearing strengths of the surface materials are unfavorable for the Type 1 or Type 2 pre-tensioned anchors. The length of anchor required depends on the type and density of materials encountered.

TYPE 4: ANCHORS IN ROCKFILL

Anchors to be placed in Rockfill will utilize the Type 4 anchor detail. It is anticipated that anchors through rockfill can be extended to allow anchorage in bedrock (Type 1 or 2) in most circumstances. However, if anchors are required to bond within the Rockfill itself, Type 4 anchors are to be used. These anchors utilize a grout sock to facilitate a grouted bond in the irregular voids which may exist within the Rockfill. These anchors must be pre-stressed to verify adequate strength, since the character of the bond will be uncertain due to the nature of rockfill. Thus, the anchors will be installed to take advantage of suitably sized rock particles to provide bearing for anchor pre-tensioning.

4.2 Anchor Installation Procedures

All anchors will be installed in accordance with the manufacturer's instructions and recommended procedures. When anchors are to be installed in competent bedrock which outcrops to the ground surface, Type 1 anchors are clearly indicated. In most circumstances, however, the appropriate anchor type must be verified once the anchor hole is drilled. In most cases, anchors to be used on the various combinations of ground conditions anticipated will be selected as summarized in Table 1.

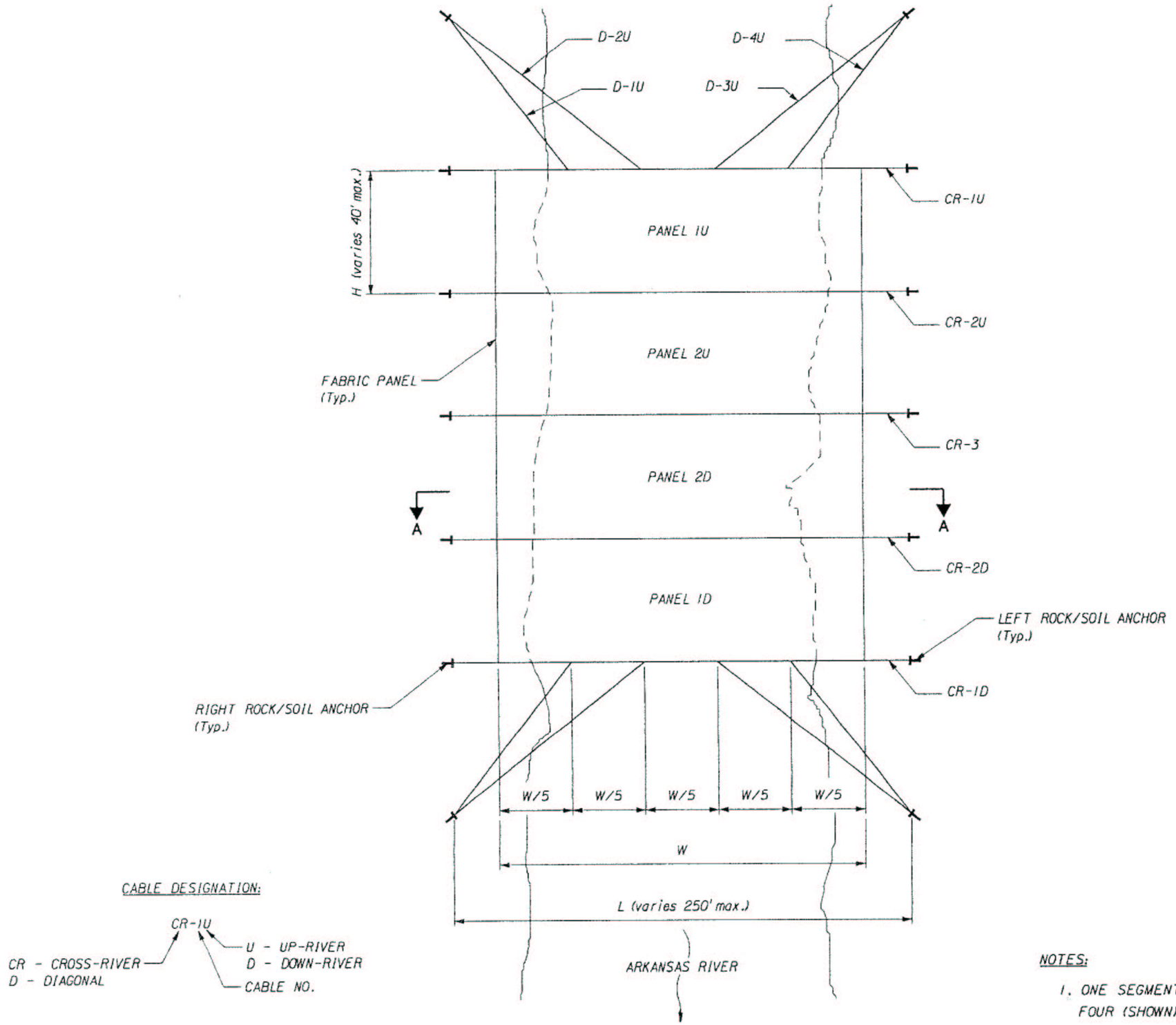
TABLE 1

ANCHOR TYPES OF EXPECTED GROUND CONDITIONS

Ground Conditions	Anchor Type
1) Anchoring in Bedrock, from ground surface to full depth	Type 1 or Type 2
2) Anchoring in Bedrock below Unconsolidated Materials, including Rockfill	Type 1 or Type 2
3) Anchoring in Unconsolidated Materials other than Rockfill	Type 3
4) Anchoring in Rockfill	Type 4

Where the required anchor type is not clear from observations at the ground surface, anchor selection and installation will be made in the field once the individual location conditions are determined from the drilling. The procedure outlined in the decision tree diagram of Figure 11 will facilitate the selection process.

FIGURES



CABLE DESIGNATION:

CR-1U

CR - CROSS-RIVER
D - DIAGONAL

U - UP-RIVER
D - DOWN-RIVER
CABLE NO.

NOTES:

1. ONE SEGMENT SHOWN. SEGMENTS CONSIST OF FOUR (SHOWN) OR MORE FABRIC PANELS.

PLAN - TYPICAL SEGMENT

PRELIMINARY (6-08-00) - NOT FOR CONSTRUCTION

		DATE		CLIENT	PROJECT	SHEET TITLE	FIGURE
DRAWN BY	KJB	5-31-00	FINLEY McNARY *Bridging Challenges with Solutions*	CVJ CORPORATION	OVER THE RIVER PROJECT	TYPICAL CABLE LAYOUT	1
CKD. BY	JNC	5-31-00					
APPVD. BY	WSM	5-31-00					

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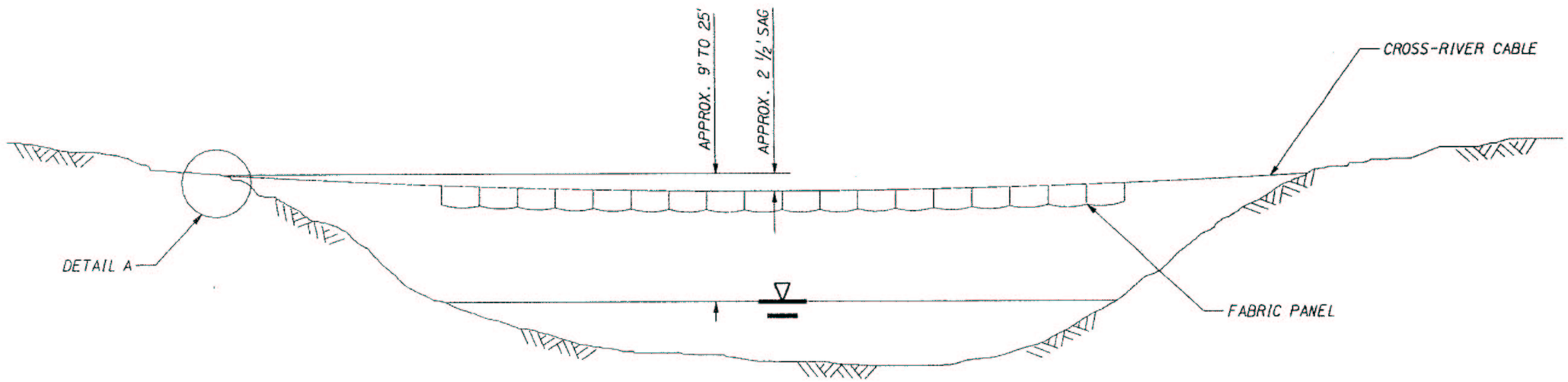
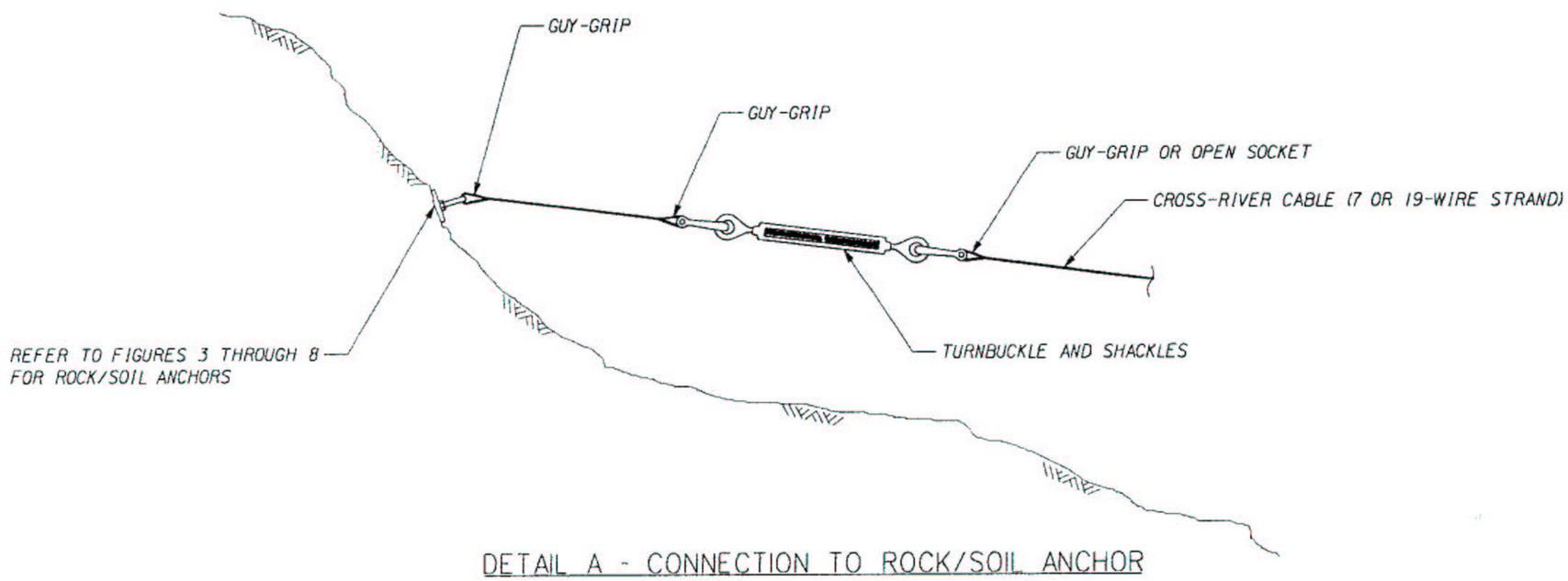


SECTION A-A - CROSS-RIVER CABLES



DETAIL A - CONNECTION TO ROCK/SOIL ANCHOR

PRELIMINARY (6-08-00) - NOT FOR CONSTRUCTION

		DATE		CLIENT	PROJECT	SHEET TITLE	FIGURE
DRAWN BY	KJB	5-31-00	FINLEY McNARY *Bridging Challenges with Solutions*	CVJ CORPORATION	OVER THE RIVER PROJECT	CABLE DETAILS	2
CKD. BY	JNC	5-31-00					
APPVD. BY	WSM	5-31-00					

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ANCHOR TYPE 1A REQUIRED DIMENSIONS
SPINLOCK ANCHOR IN BEDROCK:
FOR ALL INSTALLATIONS
MINIMUM FREE STRESS LENGTH = 2.5 FT.
MINIMUM BAR LENGTH = 3.0 FT.

DRAFT
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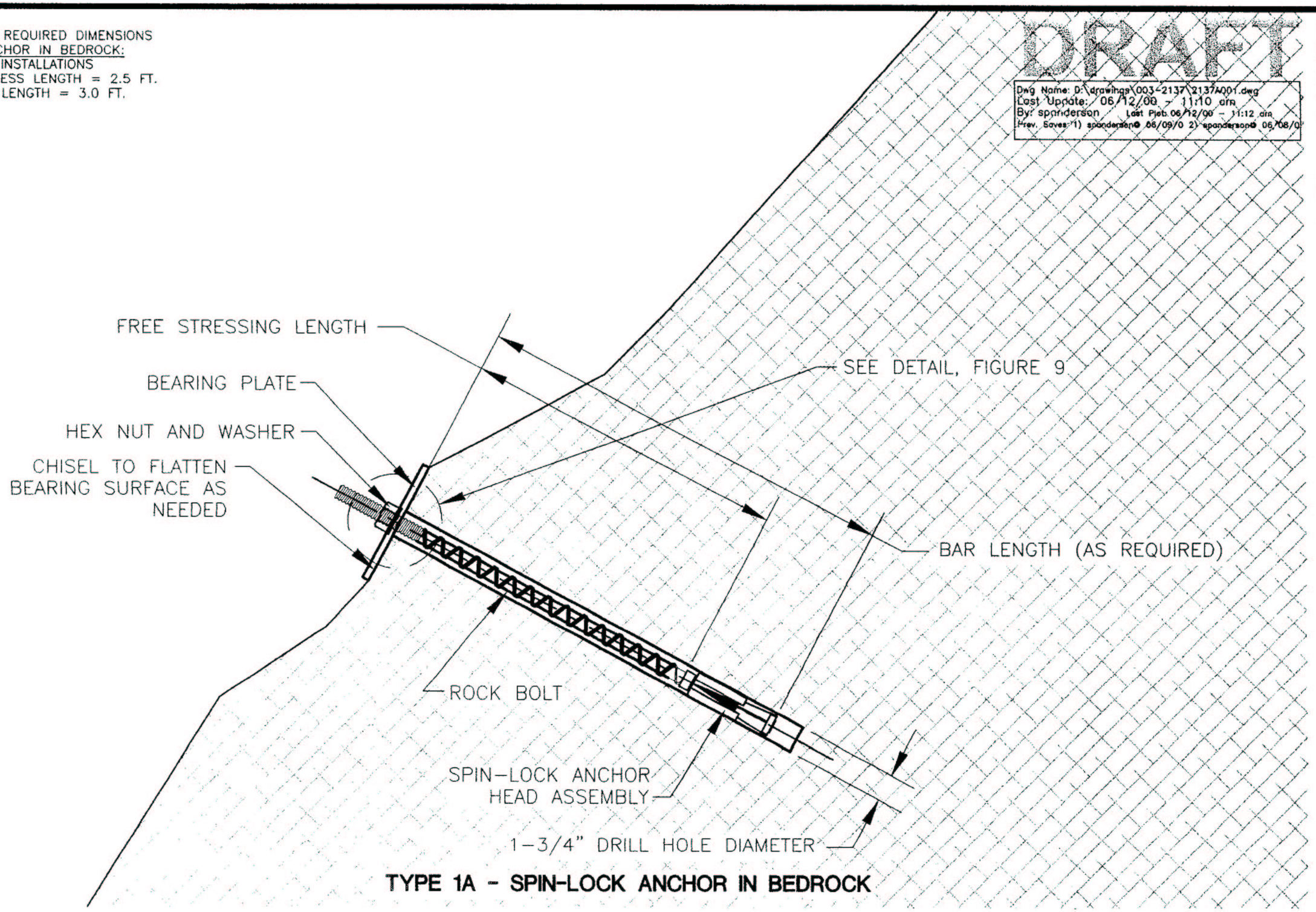
Last Update: 06/12/00 - 11:10 am
By: spanderson Last Plot: 06/12/00 - 11:12 am
Prev. Saves: 1) spanderson@ 06/09/0 2) spanderson@ 06/08/0



TYPE 1A - SPIN-LOCK ANCHOR IN BEDROCK

CLIENT/PROJECT									
CVJ CORPORATION OVER THE RIVER PROJECT			Golder Associates Denver, Colorado				TITLE **TYPICAL BEDROCK ANCHOR TYPE 1A**		
DRAWN BDC	CHECKED DRJ	REVIEWED FEH	DATE MAY 2000	SCALE N.T.S.	FILE NO. 2137A001		JOB NO. 003-2137	DWG NO./REV.NO. –	FIGURE 3

DRAFT

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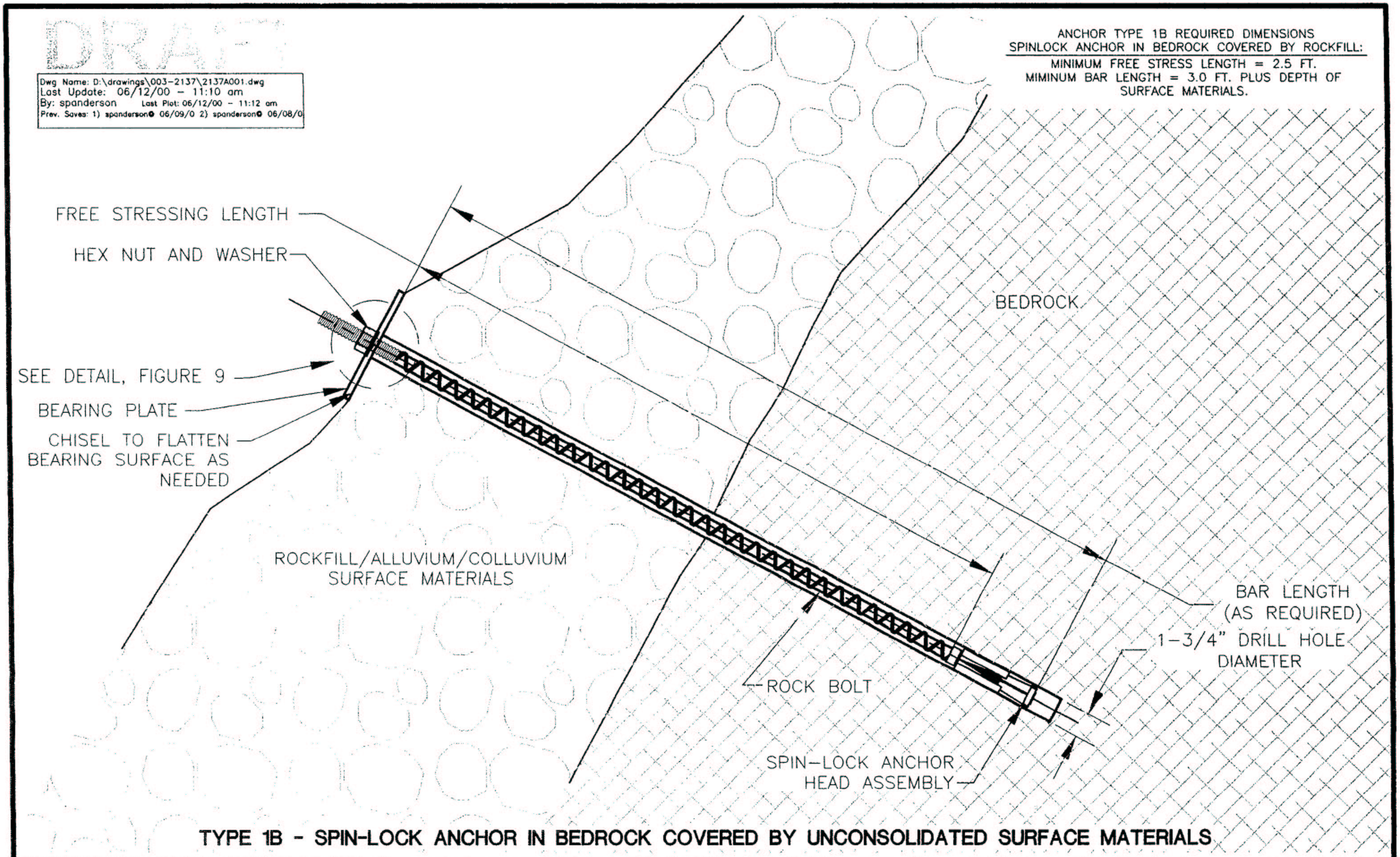
By: spanderson Last Plot: 06/12/00 - 11:12 am
Prev. Saves: 1) spanderson0 06/09/0 2) spanderson0 06/08/0

ANCHOR TYPE 1B REQUIRED DIMENSIONS
SPINLOCK ANCHOR IN BEDROCK COVERED BY ROCKFILL:
MINIMUM FREE STRESS LENGTH = 2.5 FT.
MIMINUM BAR LENGTH = 3.0 FT. PLUS DEPTH OF SURFACE MATERIALS.

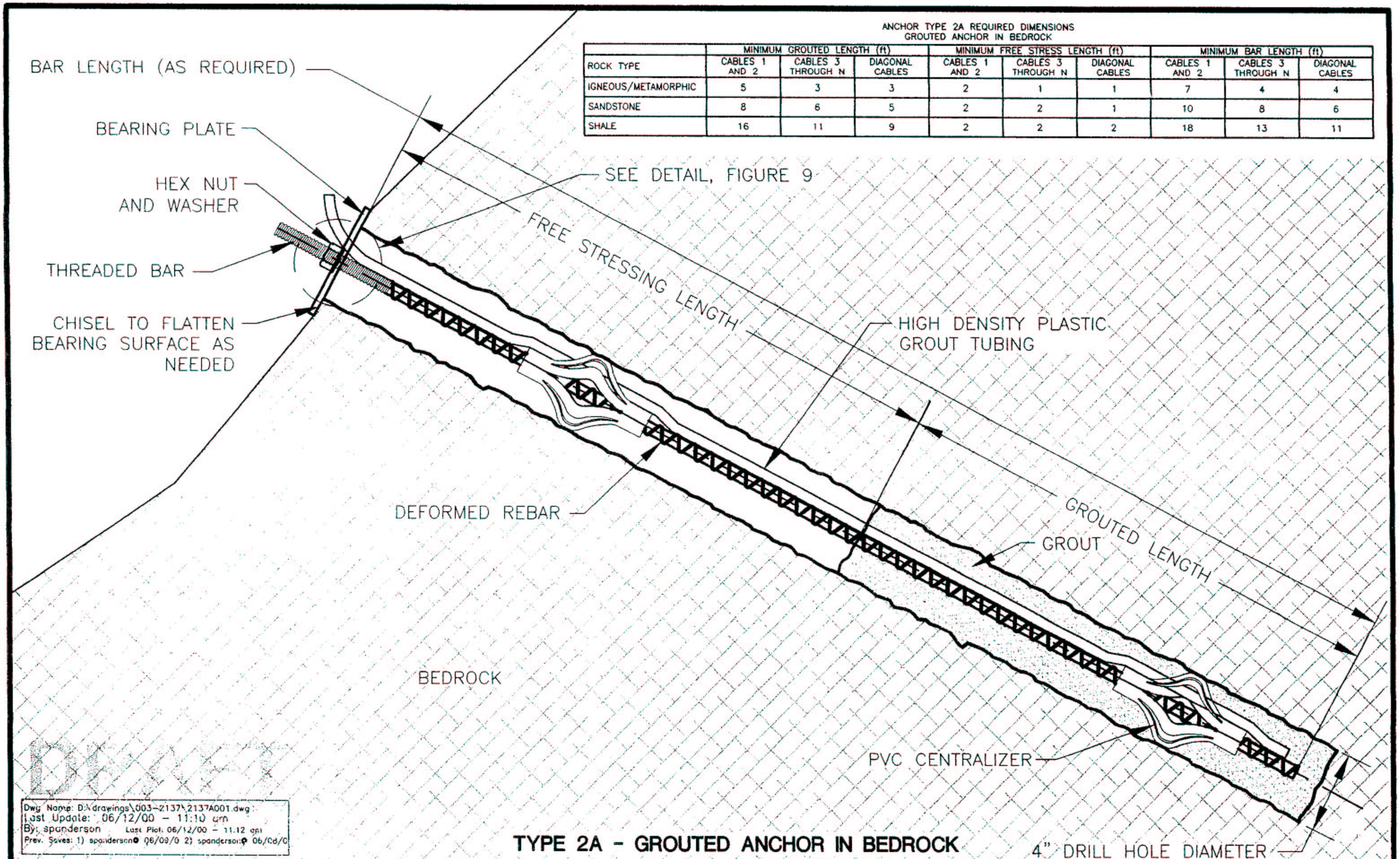


TYPE 1B - SPIN-LOCK ANCHOR IN BEDROCK COVERED BY UNCONSOLIDATED SURFACE MATERIALS

CLIENT/PROJECT									
CVJ CORPORATION OVER THE RIVER PROJECT	Golder Associates Denver, Colorado						TITLE **TYPICAL MIXED CONDITIONS ANCHOR TYPE 1B**		
DRAWN BDC	CHECKED DRJ	REVIEWED FEH	DATE MAY 2000	SCALE N.T.S.	FILE NO. 2137A001		JOB NO. 003-2137	DWG NO./REV.NO. –	FIGURE 4

ANCHOR TYPE 2A REQUIRED DIMENSIONS
GROUTED ANCHOR IN BEDROCK

ROCK TYPE	MINIMUM GROUTED LENGTH (ft)			MINIMUM FREE STRESS LENGTH (ft)			MINIMUM BAR LENGTH (ft)		
	CABLES 1 AND 2	CABLES 3 THROUGH N	DIAGONAL CABLES	CABLES 1 AND 2	CABLES 3 THROUGH N	DIAGONAL CABLES	CABLES 1 AND 2	CABLES 3 THROUGH N	DIAGONAL CABLES
IGNEOUS/METAMORPHIC	5	3	3	2	1	1	7	4	4
SANDSTONE	8	6	5	2	2	1	10	8	6
SHALE	16	11	9	2	2	2	18	13	11



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By: spanderson Last Plot: 06/12/00 - 11:12 am
Prev. Saves: 1) spanderson@ 06/09/0 2) spanderson@ 06/06/0

TYPE 2A - GROUTED ANCHOR IN BEDROCK

CLIENT/PROJECT								
CVJ CORPORATION OVER THE RIVER PROJECT	Golder Associates Denver, Colorado					TITLE **TYPICAL BEDROCK ANCHOR TYPE 2A**		
DRAWN BDC	CHECKED DRJ	REVIEWED FEH	DATE MAY 2000	SCALE N.T.S.	FILE NO. 2137A001	JOB NO. 003-2137	DWG NO./REV.NO. –	FIGURE 5

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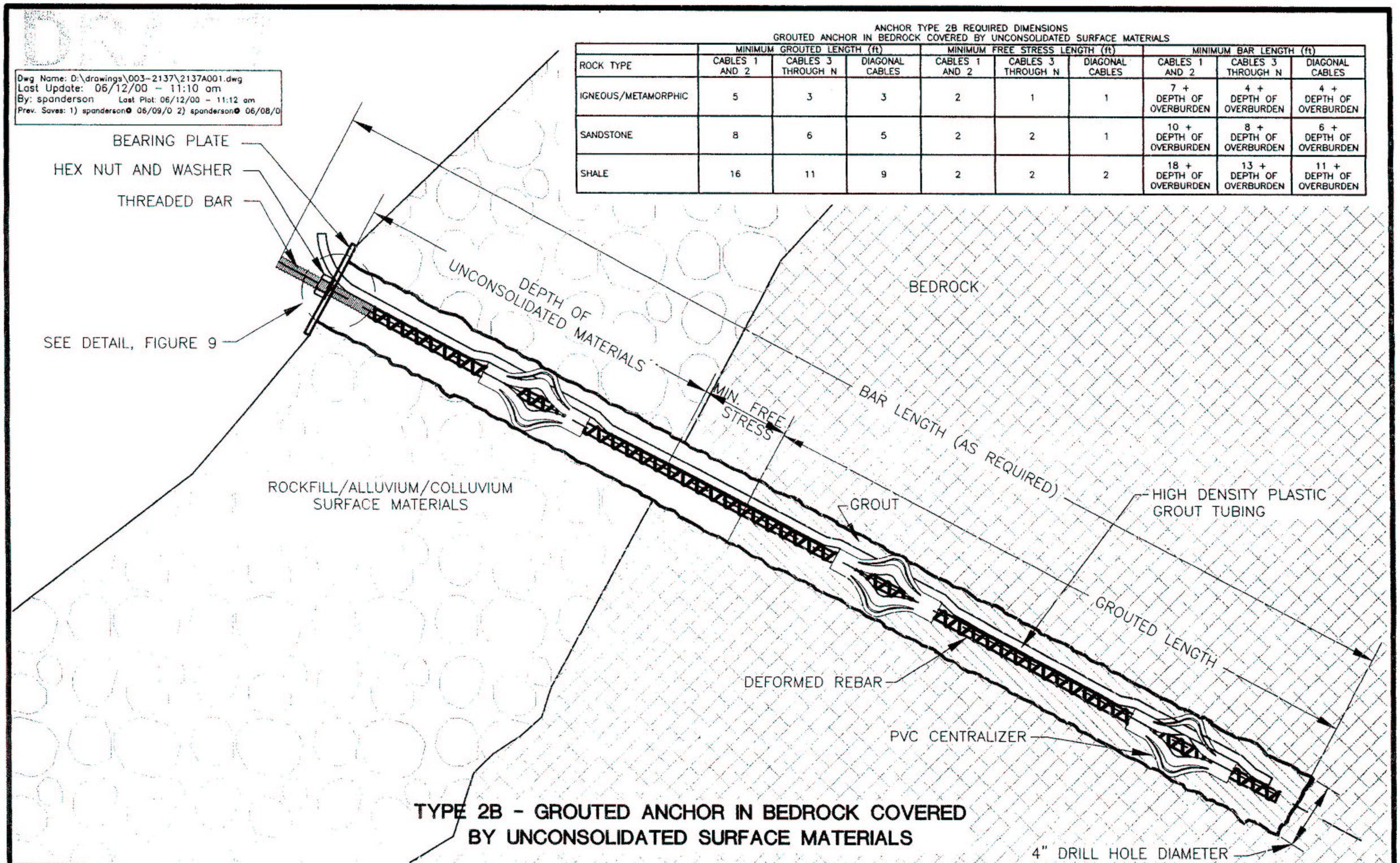
By: spanderson Last Plot: 06/12/00 - 11:12 am
Prev. Saves: 1) spanderson0 06/09/0 2) spanderson0 06/08/0

ANCHOR TYPE 2B REQUIRED DIMENSIONS
GROUTED ANCHOR IN BEDROCK COVERED BY UNCONSOLIDATED SURFACE MATERIALS

ROCK TYPE	MINIMUM GROUTED LENGTH (ft)			MINIMUM FREE STRESS LENGTH (ft)			MINIMUM BAR LENGTH (ft)		
	CABLES 1 AND 2	CABLES 3 THROUGH N	DIAGONAL CABLES	CABLES 1 AND 2	CABLES 3 THROUGH N	DIAGONAL CABLES	CABLES 1 AND 2	CABLES 3 THROUGH N	DIAGONAL CABLES
IGNEOUS/METAMORPHIC	5	3	3	2	1	1	7 + DEPTH OF OVERBURDEN	4 + DEPTH OF OVERBURDEN	4 + DEPTH OF OVERBURDEN
SANDSTONE	8	6	5	2	2	1	10 + DEPTH OF OVERBURDEN	8 + DEPTH OF OVERBURDEN	6 + DEPTH OF OVERBURDEN
SHALE	16	11	9	2	2	2	18 + DEPTH OF OVERBURDEN	13 + DEPTH OF OVERBURDEN	11 + DEPTH OF OVERBURDEN

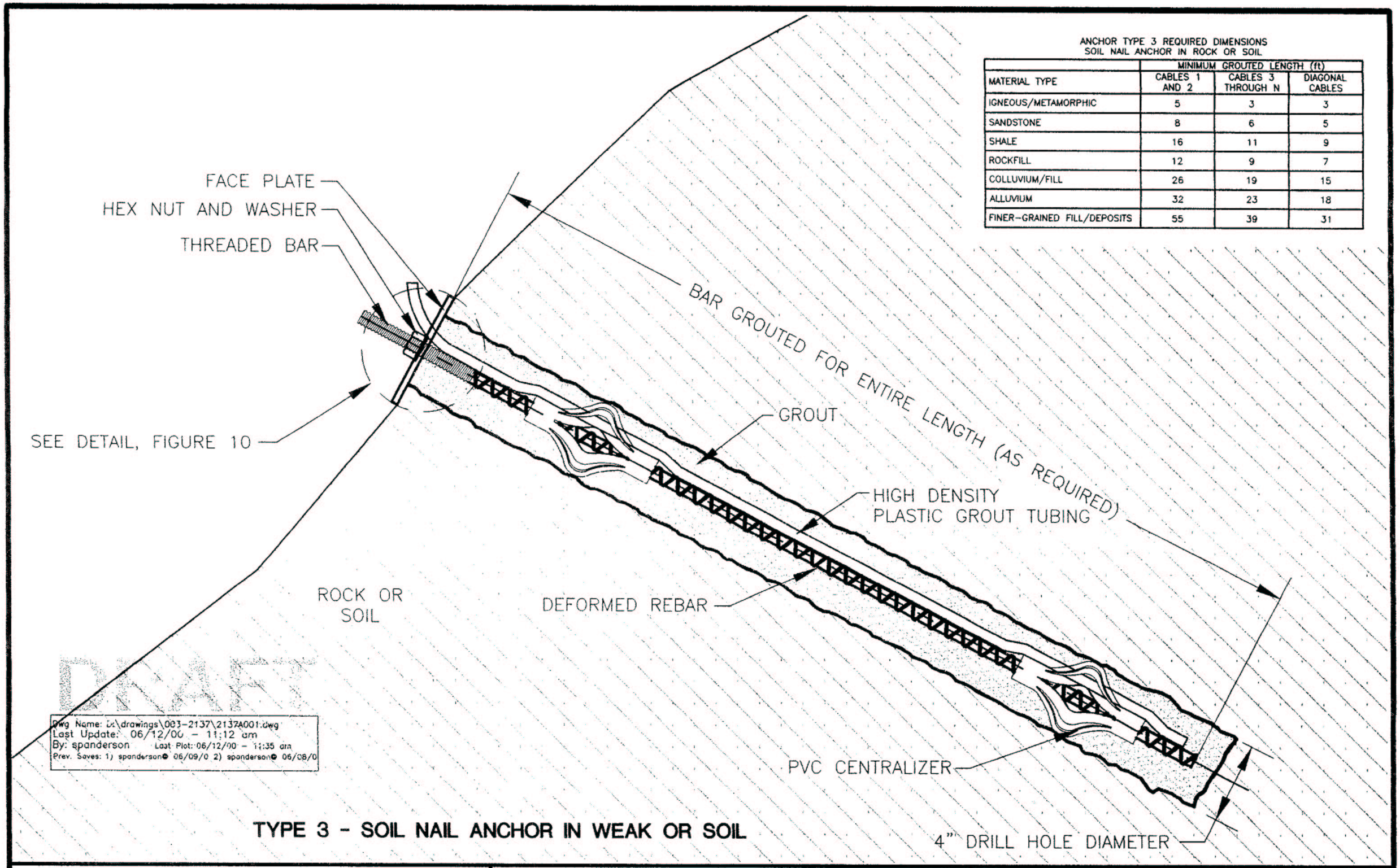


TYPE 2B - GROUTED ANCHOR IN BEDROCK COVERED BY UNCONSOLIDATED SURFACE MATERIALS

CLIENT/PROJECT							TITLE		
CVJ CORPORATION OVER THE RIVER PROJECT			Golder Associates Denver, Colorado				**TYPICAL MIXED CONDITIONS ANCHOR TYPE 2B**		
DRAWN BDC	CHECKED DRJ	REVIEWED FEH	DATE MAY 2000	SCALE N.T.S.	FILE NO. 2137A001		JOB NO. 003-2137	DWG NO./REV.NO. –	FIGURE 6

ANCHOR TYPE 3 REQUIRED DIMENSIONS
SOIL NAIL ANCHOR IN ROCK OR SOIL

MATERIAL TYPE	MINIMUM GROUTED LENGTH (ft)		
	CABLES 1 AND 2	CABLES 3 THROUGH N	DIAGONAL CABLES
IGNEOUS/METAMORPHIC	5	3	3
SANDSTONE	8	6	5
SHALE	16	11	9
ROCKFILL	12	9	7
COLLUVIUM/FILL	26	19	15
ALLUVIUM	32	23	18
FINER-GRAINED FILL/DEPOSITS	55	39	31

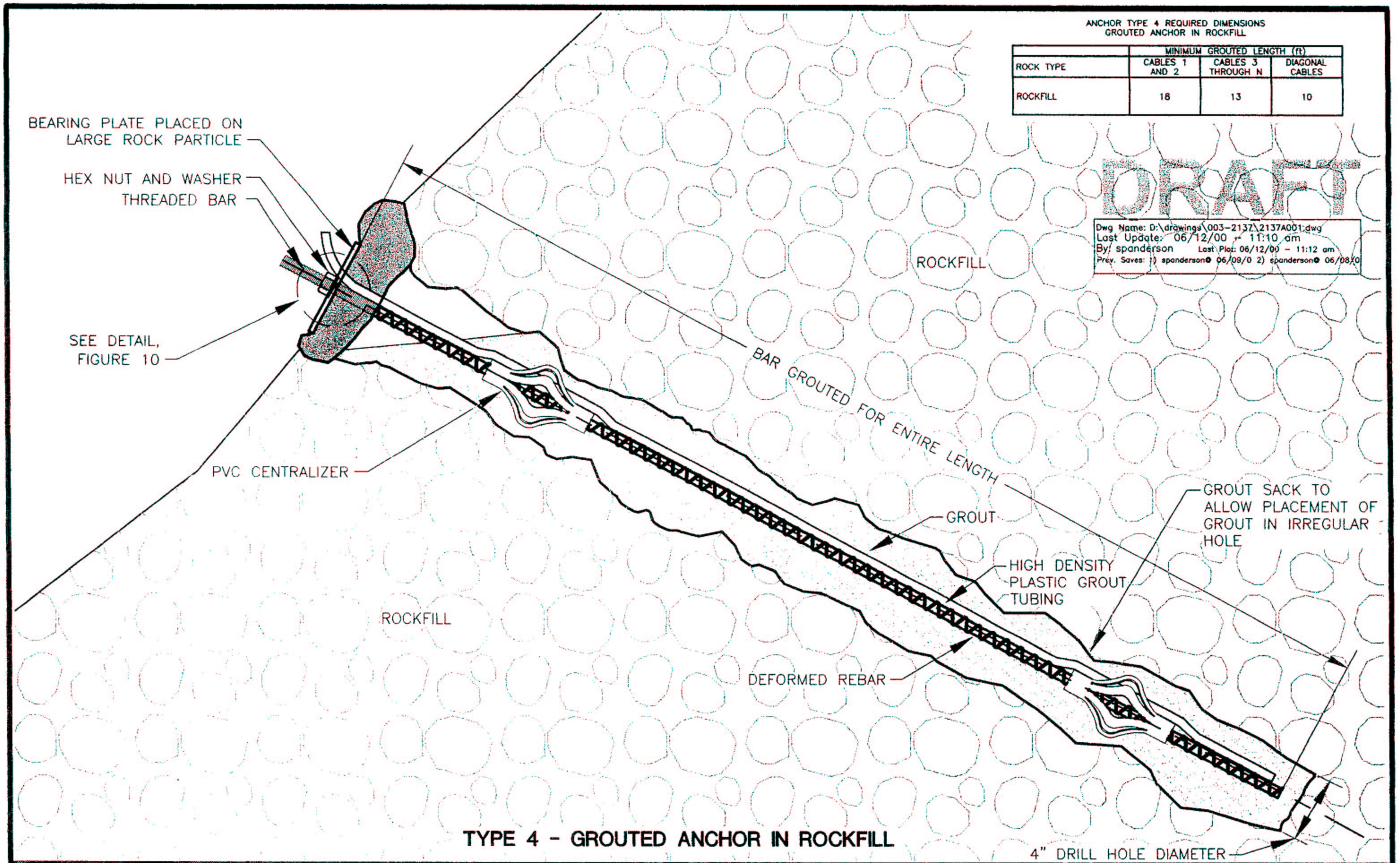


TYPE 3 - SOIL NAIL ANCHOR IN WEAK OR SOIL

CLIENT/PROJECT								
CVJ CORPORATION OVER THE RIVER PROJECT	Golder Associates Denver, Colorado					TITLE **TYPICAL SOIL NAIL ANCHOR TYPE 3**		
DRAWN BDC	CHECKED DRJ	REVIEWED FEH	DATE MAY 2000	SCALE N.T.S.	FILE NO. 2137A001	JOB NO. 003-2137	DWG NO./REV.NO. –	FIGURE 7

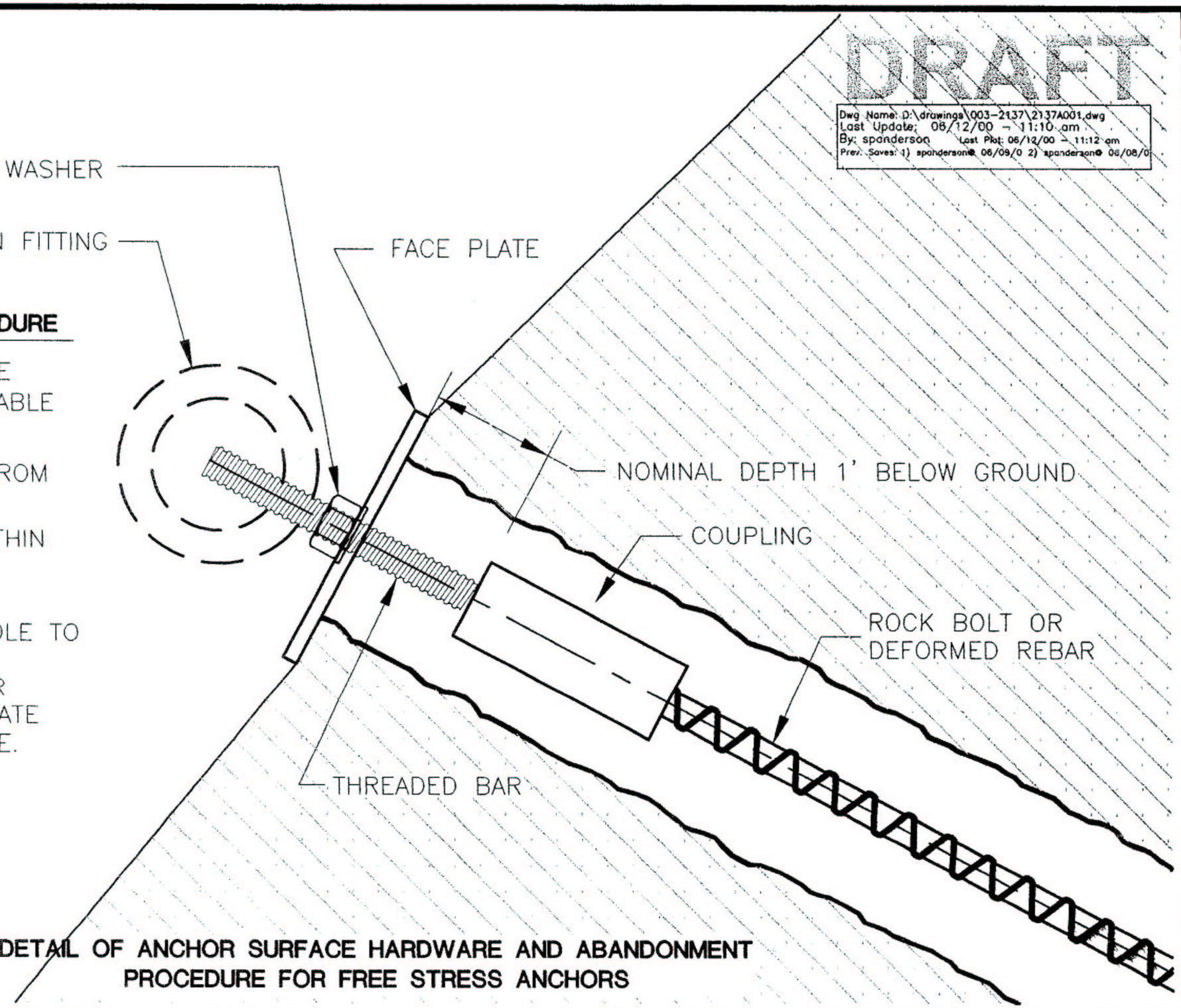
ANCHOR TYPE 4 REQUIRED DIMENSIONS
GROUTED ANCHOR IN ROCKFILL

ROCK TYPE	MINIMUM GROUTED LENGTH (ft)		
	CABLES 1 AND 2	CABLES 3 THROUGH N	DIAGONAL CABLES
ROCKFILL	18	13	10



TYPE 4 - GROUTED ANCHOR IN ROCKFILL

CLIENT/PROJECT								
CVJ CORPORATION OVER THE RIVER PROJECT	Golder Associates Denver, Colorado					TITLE: TYPICAL ROCKFILL ANCHOR TYPE 4		
DRAWN BDC	CHECKED DRJ	REVIEWED FEH	DATE MAY 2000	SCALE N.T.S.	FILE NO. 2137A001	JOB NO. 003-2137	DWG NO./REV.NO. –	FIGURE 8

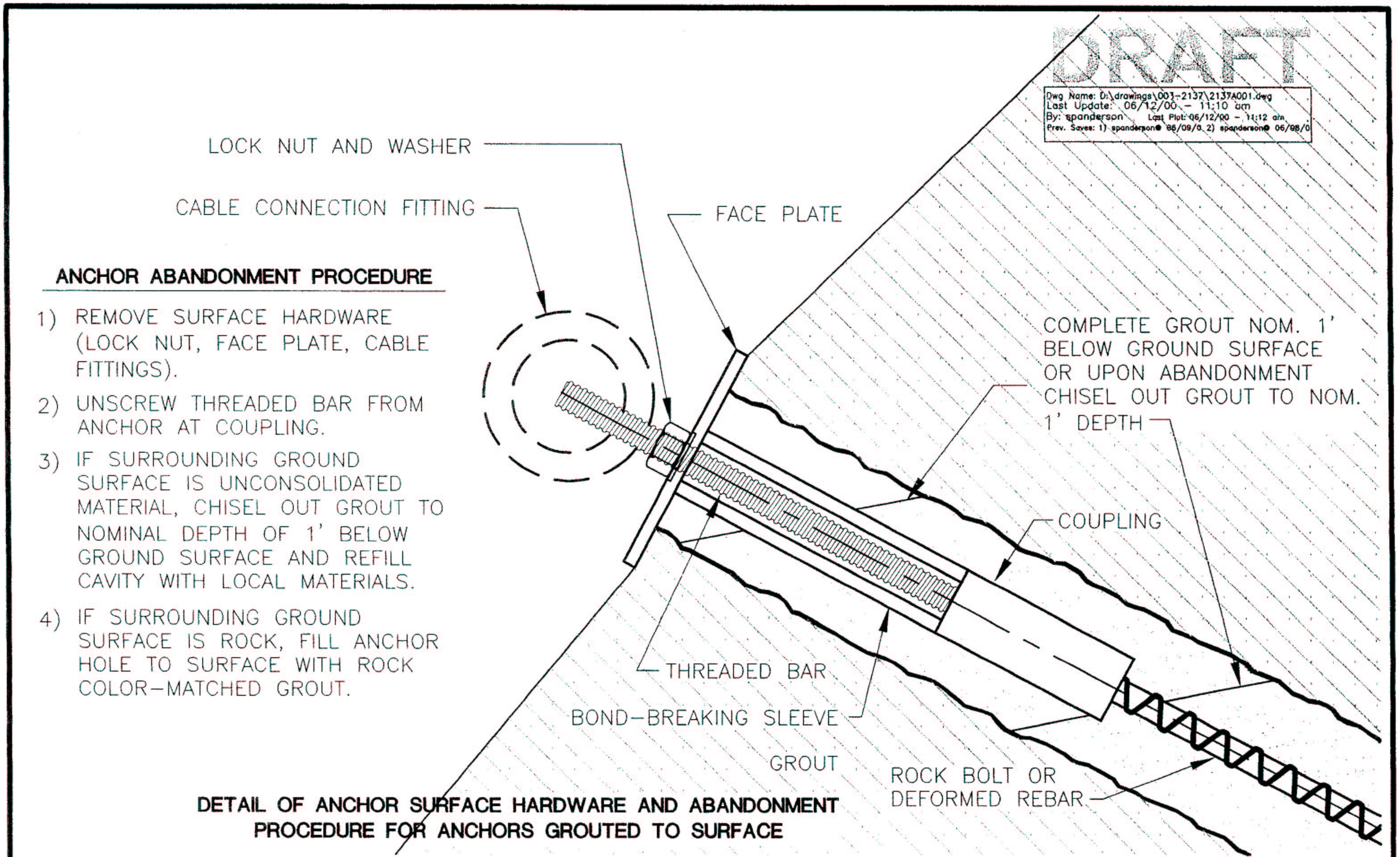


ANCHOR ABANDONMENT PROCEDURE

1) REMOVE SURFACE HARDWARE (LOCK NUT, FACE PLATE, CABLE FITTINGS).
2) UNSCREW THREADED BAR FROM ANCHOR AT COUPLING.
3) PLUG ANCHOR HOLE TO WITHIN FEW INCHES OF GROUND SURFACE.
4) FILL REMAINING ANCHOR HOLE TO SURFACE WITH ROCK COLOR-MATCHED GROUT OR LOCAL SOILS, AS APPROPRIATE FOR SURROUNDING SURFACE.

DETAIL OF ANCHOR SURFACE HARDWARE AND ABANDONMENT PROCEDURE FOR FREE STRESS ANCHORS

CLIENT/PROJECT								
CVJ CORPORATION OVER THE RIVER PROJECT	Golder Associates Denver, Colorado					TITLE **ABANDONMENT DETAIL FOR FREE STRESS ANCHOR**		
DRAWN BDC	CHECKED DRJ	REVIEWED FEH	DATE MAY 2000	SCALE N.T.S.	FILE NO. 2137A001	JOB NO. 003-2137	DWG NO./REV.NO. –	FIGURE 9



ANCHOR ABANDONMENT PROCEDURE

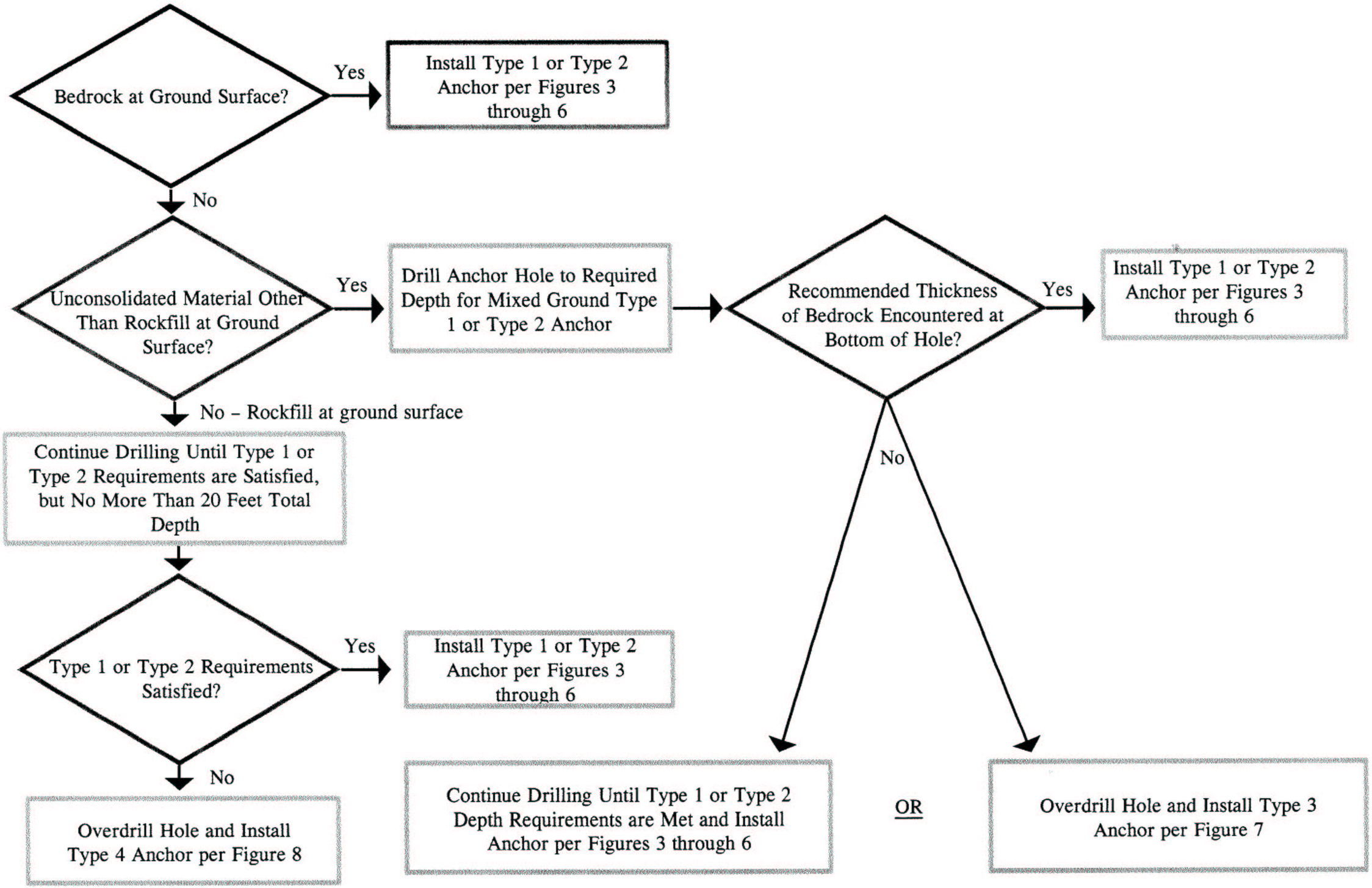
1) REMOVE SURFACE HARDWARE (LOCK NUT, FACE PLATE, CABLE FITTINGS).
2) UNSCREW THREADED BAR FROM ANCHOR AT COUPLING.
3) IF SURROUNDING GROUND SURFACE IS UNCONSOLIDATED MATERIAL, CHISEL OUT GROUT TO NOMINAL DEPTH OF 1' BELOW GROUND SURFACE AND REFILL CAVITY WITH LOCAL MATERIALS.
4) IF SURROUNDING GROUND SURFACE IS ROCK, FILL ANCHOR HOLE TO SURFACE WITH ROCK COLOR-MATCHED GROUT.

DETAIL OF ANCHOR SURFACE HARDWARE AND ABANDONMENT PROCEDURE FOR ANCHORS GROUTED TO SURFACE

CLIENT/PROJECT								
CVJ CORPORATION OVER THE RIVER PROJECT	Golder Associates Denver, Colorado					TITLE **ABANDONMENT DETAIL FOR FULLY GROUTED ANCHOR**		
DRAWN BDC	CHECKED DRJ	REVIEWED FEH	DATE MAY 2000	SCALE N.T.S.	FILE NO. 2137A001	JOB NO. 003-2137	DWG NO./REV.NO. –	FIGURE 10

Figure 11

Decision Tree for Anchor Selection



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I:\0\2137\2137FIG.PPT

Golder Associates

OVER THE RIVER

J1.1.2 Engineering Report 2006

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November 15, 2006 Our Ref.: 003-2137

OTR Corporation
1942 Westlake Avenue #2814
Seattle, WA 98101

Attention: Mr. Vince Davenport

RE: PRELIMINARY DESIGN REPORT CHRISTO AND JEANNE-CLAUDE OVER THE RIVER ART PROJECT

Dear Mr. Davenport:

This report presents an overview of preliminary design concepts for the Over the River Art Project, including geometric layout, approximate anchor loads, approximate cable sizes, general anchor types, approximate capacities, and Anchor Transition Frame (ATF) concepts.

This report supersedes the previous design report by Golder and Parsons titled, "Draft – Preliminary Design Engineering Report, Christo and Jeanne-Claude, Over the River Art Project, Fremont and Chaffee Counties, Colorado," dated June 2000. This report focuses on the ATF concept and ground anchor design for the various ground conditions that are anticipated within the project alignment.

Sincerely,

GOLDER ASSOCIATES INC.

Frank E. Harrison, P.E.
Principal

MAM/FEH/srs

PRELIMINARY DESIGN ENGINEERING REPORT
CHRISTO AND JEANNE-CLAUDE
OVER THE RIVER ART PROJECT
FREMONT AND CHAFFEE COUNTIES, COLORADO

Prepared for

OTR Corporation
1942 Westlake Avenue #2814
Seattle, Washington, 98101

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1 copy – J F Sato & Associates

November 15, 2006 003-2137

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1.0 INTRODUCTION

This report presents an overview of the engineering design effort that OTR Corporation (OTR) has pursued in the design of the *Over the River Art Project* in Fremont and Chaffee Counties, Colorado. Design engineering for this project is being performed by Golder Associates Inc. (Golder), and subconsultant Parsons, under the direction of Mr. Vince Davenport of OTR. This preliminary design report is intended to convey to the reader the conceptual design and engineering procedures and protocols that Golder and Parsons have followed in design of the project. This report presents the general geometric layout, approximate anchor loads, approximate cable sizes, general anchor types, approximate capacities, and Anchor Transition Frame (ATF) concepts. Specifics of the individual design elements and loadings will likely evolve as the project progresses through final design.

This report supersedes the previous design report by Golder and Parsons titled "Draft – Preliminary Design Engineering Report, Christo and Jeanne-Claude, Over the River Art Project, Fremont and Chaffee Counties, Colorado," dated June 2000. This report focuses on the ATF concept and the ground anchor design for the various ground conditions that are anticipated within the project alignment.

This report is organized as follows:

Chapter 1 – Introduction

Chapter 2 – Cable System and Anchorage Design Engineering (work product of Parsons)

Chapter 3 – Geologic Setting and Ground Condition (work product of Golder)

Chapter 4 – Anchor Design (work product of Golder)

2.0 CABLE SYSTEM AND ANCHORAGE DESIGN ENGINEERING

The *Over the River Art Project* will consist of eight areas of fabric panels installed intermittently over approximately 40 miles of the Arkansas River between Salida and Canon City, Colorado. Each area will consist of a series of sections interrupted by rocks, trees, and other natural obstacles. Each section, made up of three or more fabric panels, will be supported by an independent system of cables. The main cross-river cables will span the river with adjacent fabric panels attached at grommets. Under dead load, the cross-river cables will take a roughly parabolic shape with maximum sag of about 2.5 feet for a 175-foot span. Under moderate wind load, the cross-river cables will move to a maximum "hog" (upward deflection) roughly equal to the sag as the fabric panels billow upward. In addition to the cross-river cables, diagonal cables will stabilize each section in the direction parallel to the river.

The cross-river and diagonal cables will be attached to Anchor Transition Frames (ATF) at each anchorage point along the river bank. Each ATF will be attached to four (4) ground anchors, each designed to resist the maximum tensile load of the cables.

The objective of this design report, with regard to the cable system, ATF and ground anchor design, is to:

- Outline the anchorage system and connections for the layout of a typical section; and
- Describe the design philosophy for sizing cables, connections, and ground anchors.

2.1 Cable and Anchor Layout

Figure 1 illustrates the layout of a typical section of fabric panels. The complete geometric layout is not provided in this report. The complete layout has been provided under a separate cover and includes a unique number for each anchor, ATF, cable, and fabric panel.

Cross-river and diagonal cables terminate at the ATF. ATF's will be located at roughly 9 to 25 feet above the waterline, and will raise the cable approximate 3 to 4 feet above the ground surface. ATF'S will each be connected to a group of four (4) ground anchors as illustrated in Figure 3. Ground anchors will be installed in pairs, two (2) compression anchors installed in the vertical plane

perpendicular to the cable tension loads, and two (2) tension anchors installed at 45 degrees from horizontal.

Cables will be attached to the ATF's by either a turnbuckle or an adjustable bridge socket to allow for final adjustment of cable sag. Cable connections are achieved through either Guy-Grips or poured (zinc or resin) sockets. The cables themselves will consist of either seven-wire guy strand or 19-wire structural strand.

2.2 Design Philosophy

A load and resistance factor design approach, consistent with U.S. design codes, will be used for sizing cables and connections. The cable system is considered a temporary structure given the short duration of service (12 weeks or less).

Controlling loads to the cable system are categorized into (1) dead load of cables, fabric, and connections and (2) wind load. Field tests indicate that the porosity of the fabric panels prevents ponding of rainwater. Hail will most likely be accompanied by high enough winds to induce billowing of the fabric panels. While the billowing effect should prevent any collection of hail, this condition will be considered in final design for completeness.

2.3 Loads

Dead load tensions for draped cables are computed as a function of the span to sag ratio and the distributed or point loads along the cable. The computed dead load tension gives the required pretensioning force to achieve the desired sag.

As presented in the previous design report by Golder and Parsons, preliminary cable tensions due to wind loading were determined by Rowan, Williams, Davies, and Irwin, Inc. (RWDI). Preliminary design cable tension forces ranged from 11,000 lbs to 22,000 lbs based on the wind conditions of a specific section. A brief summary of the wind study performed by RWDI is presented in Appendix A.

RWDI is currently conducting a revised wind study to further investigate potential wind loading on the fabric and cables. The revised wind study may have an effect on the final cable loads, sizes, and connections; however, the revised wind loads will have very little effect on the ground anchor design. Standard ground anchor installation methods proposed for this project have been utilized to resist

loads that are orders of magnitude higher than the anticipated range of cable loads that have been estimated for this project.

2.4 Load and Resistance Factors

For the governing load case of dead load plus wind load, ASCE 19-96 (*Structural Applications of Steel Cables for Buildings*) gives the following load combination:

$$S_d \geq 2.0(D + P + W)$$

where S_d is the design cable strength and D, P, and W represent dead load, prestress, and wind load, respectively. The 2.0 load factor is typical of permanent cable structures designed for 50-year load events and subject to long-term fatigue concerns. In a temporary application such as this one, a 2.0 load factor is overly conservative. One approach for temporary structures is to multiply the stated load factor by 0.75 (0.75 x 2.0 = 1.5). This is also consistent with an allowable stress approach that permits a one-third increase in allowable stresses for wind load combinations (2.0 / 1.33 = 1.5). For the sizing of cables and connections in the *Over the River Art Project*, a 1.5 load factor will be used.

According to ASCE 19-96, the design cable strength is computed according to

$$S_d = \phi S_n$$

where S_n is the specified nominal strength of the cable (typically furnished by the manufacturer) and ϕ is a reduction factor for fittings. It is anticipated that either Guy-Grips as shown in Figure 2 or strand sockets will be used in this project. In both cases, the connections are designed to develop greater strength than the cable itself and do not compromise the strength of the cable so that $\phi = 1.0$.

3.0 GEOLOGIC SETTING AND GROUND CONDITIONS

3.1 Description of Observed Ground Conditions

On March 29 and 30, 2000, a Golder geotechnical engineer conducted a field surface reconnaissance of the project. Each of the project areas was visited and reviewed for general site conditions pertinent to placement of anchors. Based on these observations, the project river corridor includes the following predominant material types:

Rockfill: This material type consists of relatively "clean" (few fines) rock particles used as embankment construction materials. In some cases, the rockfill may form only a facing (as riprap) over less coarse embankment or natural slope materials. Particle sizes are predominantly 1-foot diameter and larger, up to about 4 feet maximum size (with occasional exceptions). The material is usually derived from local bedrock, but "imported" material is occasionally used along the railroad fill, particularly as riprap.

Colluvium and Fills Constructed from Colluvium: These materials generally have a relatively high rock content (approximately 40 percent or more), although they can vary considerable from place to place. In general, the material appears to have a lesser rock content and may be matrix-supported (i.e., coarse particles are "suspended" in finer-grained material) where metamorphic rocks are the source material. The rock material is usually angular and may be as large as the particle sizes found in the rockfill.

Alluvium/Outwash/Fan Deposits: Occurrence of these materials is limited to areas where there is a confluence of a side drainage with the river, or flatter gradients of the river where the channel meanders somewhat. These materials are usually characterized by rounded cobbles and boulders which are matrix supported. At a few of the steeper drainage mouths the particles are angular and locally-derived.

Bedrock: Bedrock found in the project area includes igneous, metamorphic, and sedimentary rocks:

- Igneous rocks are found in the downstream (east) portions of the project area. They consist of Quartz Diorite, a hard, durable rock with (generally) widely spaced jointing.

- Metamorphic rocks found in the middle sections of the project, and at the extreme upstream (west) end, are hard, durable Gneiss.

- Sedimentary rocks found in the upstream portions of the project area include sandstone, conglomerate, shale, limestone, and dolomite. Except for the shale which is generally soft and weathered, these rocks are well-cemented and competent, with joints typically spaced on the order of 1 to 2 feet. The shales make up no more than about 10 to 20 percent of the rock mass, and probably significantly less in most areas.

Other Materials: Limited quantities of other materials were noted along the banks during the reconnaissance:

- Concrete slabs, apparently debris from concrete pavement and/or bridge decking, were used to form or face the railroad fill in two locations. This material may be regarded as rockfill for design purposes.

- Minor areas of finer-grained soils, likely silty sands with gravel, were noted in relatively small areas. These appear to be river-deposited sand bars and overbank deposits. This material may be regarded as alluvium/outwash for design purposes.

These various material types are expected to yield the following likely combinations of ground conditions for anchoring:

1. Anchoring in Rockfill
2. Anchoring in Colluvium or Colluvial Fill
3. Anchoring in Alluvium or Outwash Deposits
4. Anchoring in Bedrock, from ground surface to full depth
5. Anchoring in Bedrock below Rockfill
6. Anchoring in Bedrock below Colluvium or Colluvial Fill
7. Anchoring in Bedrock below Alluvium or Outwash Deposits

These potential anchoring conditions occur in various frequencies and combinations within the various project areas as described below. Various types of bedrock occur, depending on location. Appendix B provides an area-by-area description of the ground conditions observed in each of the project areas.

4.0 ANCHOR DESIGN

4.1 Description of Proposed Anchor System

Based on the anticipated range of cable loads, either mechanical or grouted ground anchors can be utilized to resist the forces using standard ground anchor installation methods. Tension forces from the cables will be transferred to the ground anchors using an Anchor Transition Frame (ATF) as illustrated in Figure 3. The ATF will be supported by a group of four (4) ground anchors. Ground anchor groups will be comprised of two (2) compression and two (2) tension anchors. Coupled pairs consisting of one tension and one compression anchor will each be sized to support the maximum tension load from the cable; thereby providing an added level of conservatism to the design.

Cables will be attached to the ATF's by either a turnbuckle or an adjustable bridge socket to allow for final adjustment of cable tension and sag. Each of the ground anchors will be attached to the ATF through either eye connections or bearing plate connections as shown in Figure 3.

4.2 Description of Anchor Types and Installation Methods

4.2.1 General

The type of anchorage used will depend on the soil and/or rock materials encountered at each individual anchor location. Where subsurface conditions can be inferred from the ground surface, such as where anchors are to be placed in surface bedrock exposures, anchor selection and installation methods will be straightforward. In many cases, however, the installation methods will be selected based on the inferred subsurface soil and/or rock conditions, and the anchor type will be selected only after the anchor hole has been drilled and actual conditions are verified.

All ground anchors will be passive elements, therefore that they will not be pre-tensioned prior to application of the cable tension loads. Passive ground anchors require some movement to mobilize the available anchor capacity. However, based on the anticipated cable tension loads and anchor sizes, the movement required to mobilize the ground anchor capacity will be minimal.

The anchors will be temporary, and protruding hardware will be removed at the project's conclusion. On each anchor, a section of threaded bar will be coupled to the rock bolt or anchor below the ground surface, such that the surface hardware can be easily removed following completion of the project.

At completion of the project, all anchors will be removed to below the ground surface. The anchor holes will be refilled with local materials to match the existing surface. Holes in rock surfaces will be patched with color-matched grout to blend with the surrounding surface. Figure 7 shows conceptual details for abandonment of the anchor holes.

In many cases, more than one option (for example, mechanical versus grouted) may exist for providing appropriate anchorage at a given location. Several anchor types, and installation methods have been identified to allow for selection of a suitable anchorage at each location. Anchor types and installation methods were chosen that apply to the wide range of ground conditions that are anticipated throughout the project. All of the anchor types have several features in common. All anchors will be either mechanical or grouted anchors. The proposed anchor types are illustrated in Figures 4 through Figure 6, and are described below

4.2.2 Mechanical Anchors

Mechanical anchors will consist of rock bolts, and ground anchors (such as Williams Form Engineering Company's proprietary "spin-lock" technology), or expansive mechanical anchors such as the Swellex rock bolting system by ALTAS COPCO, or an engineer approved equivalent.

4.2.2.1 Spin-Lock Anchors (such as by Williams Form Engineering Company)

Application conditions for mechanical "spin-lock" anchors will be limited to the ground conditions where anchorage can be obtained in competent bedrock or large boulders of sufficient size to resist the required anchor loads. Geologic conditions suitable for mechanical "spin-lock" anchors consist of the following:

- Competent bedrock or large boulders encountered at the ground surface;
- Competent bedrock encountered below a surficial layer of unconsolidated materials. Unconsolidated materials are expected to include: 1) coarse Rockfill potentially containing many large voids between particles, 2) Rocky Colluvium or Fill constructed from local colluvial and possibly blasted materials, and 3) Alluvium or Outwash Deposits, typically found where the river crosses the mouths of side valleys or where the river gradient becomes flat enough that sand and gravel bars have been deposited. A fourth type of surface material observed during reconnaissance was concrete slabs and debris used as fill and/or armoring of the railroad fill in limited areas. This material is expected to be similar to Rockfill for anchoring considerations.

- Large boulders or material encountered within rockfill, alluvium, colluvium or other unconsolidated surface materials of sufficient size to secure the ground anchor and resist the required anchor loads. If mechanical anchors utilize a large boulder or other buried object for anchorage, verification of anchor capacity will be required.

Figures 4 and 5 illustrate the typical installation of mechanical "spin-lock" anchors installed in the above conditions.

4.2.2.2 Expansive Mechanical Anchors (such as Swellex Rock Bolting System - ATLAS COPCO)

Expansive anchors (such as ATLAS Copco Swellex rock bolting system) will be utilized in difficult ground conditions that are not suitable for either mechanical "spin-lock" anchors or grouted anchors. Such conditions would include a combination of: 1) rock fill or other ground conditions in which the open characteristics of soil and/or rock matrix will not contain grout; and 2) rock fill or other ground conditions in which there are no large boulders or other materials sufficient for mechanical "spin-lock" type anchors.

Figure 5 illustrates the typical installation and conditions for Swellex mechanical anchor applications.

4.2.3 Grouted Anchors

Non-toxic grout will be used in the grouted anchors. Grouted anchors will be installed utilizing two drilling methods consisting of either: 1) cased hole drilling methods, or 2) hollow bar injection grout drilling methods. Each drilling method has specific advantages and limitations; therefore the applicability of either system will depend on the ground conditions encountered. The required anchorage length for grouted anchors will be dependent on the soil and rock conditions encountered.

4.2.3.1 Cased Hole Drilling Methods

Cased hole drilling methods will be utilized in ground conditions where the soil/rock matrix will not provide adequate containment of the anchor grout. Typically, this will include areas where an anchor will be installed into competent soil or rock through a surficial layer of unconsolidated materials such as rock fill or other open soil/rock matrix that will not support an open hole. Unconsolidated surficial materials that may require cased drill methods are expected to include: 1) coarse Rockfill potentially containing many large voids between particles, 2) Rocky Colluvium or Fill constructed from local colluvial and possibly blasted materials, and 3) Alluvium or Outwash Deposits, typically found where

the river crosses the mouths of side valleys or where the river gradient becomes flat enough that sand and gravel bars have been deposited. A fourth type of surface material observed during reconnaissance was concrete slabs and debris used as fill and/or armoring of the railroad fill in limited areas. This material is expected to be similar to Rockfill for anchoring considerations.

The drill casing will contain the grout through the open matrix and transport the grout to the anchorage portion of the drill hole. Cased drill hole methods will also be utilized to install mechanical anchors through surficial soil/rock layers where the conditions will not support open hole drilling methods.

Figure 6 illustrates the installation and ground conditions for cased hole drilling and grouting applications.

4.2.3.2 Hollow Bar Injection Grouting Drilling Methods

Hollow bar injection grouting drilling methods will be utilized in conditions where the soil/rock matrix will provide containment of drilling grout. Hollow bar injection grouting can be done in either soil or rock conditions where grout will be contained. Anchors will be grouted along the entire length. This method of drilling utilizes the anchor bar as the drill steel and grouting tube, and provides an efficient way to install anchors in ground conditions that would not support open hole drilling. This drilling method will be limited to those conditions in which the soil/rock matrix will provide containment of the drilling grout.

Injection grouted anchors will typically be used in ground conditions consisting of weak bedrock or soil. Weak bedrock applications will consist of those conditions where the use of mechanical heads may lose strength from rock crushing. In most cases, the use of injection grouted anchors will be predictable prior to installation, based on the local geology or ground conditions, apparent from the ground surface. The length of the anchor steel and the grouted length are determined based on the estimated bond strength between the grout and the strength of the soil and/or rock material.

Figure 6 illustrates the installation and ground conditions for hollow bar injection grouting drilling applications.

4.3 Anchor Application Decision and Verification

All anchors will be installed in accordance with the manufacturer's instructions and recommended procedures. In most cases, anchors to be used on the various combinations of ground conditions anticipated will be selected as summarized in Table 1; however, specific conditions at each site, such as the depth to competent bedrock, may be a deciding factor in using either a mechanical or grouted anchor.

TABLE 1
ANCHOR TYPES FOR EXPECTED GROUND CONDITIONS

Ground Conditions	Anchor Type	Drilling Method
1) Anchoring In Rockfill	MECHANICAL Spin-Lock (Or) Swellex	CASED HOLE
2) Anchoring Colluvium Or Colluvial Fill	Grouted	Cased Hole Or Hollow Bar
3) Anchoring In Alluvium Or Outwash Deposits	Grouted	Cased Hole Or Hollow Bar
4) Anchoring In Bedrock, From Ground Surface To Full Depth	Mechanical	Open Hole
5) Anchoring In Bedrock Below Rockfill	Mechanical	Cased Hole
6) Anchoring In Bedrock Below Colluvium Or Colluvial Fill	Mechanical	Cased Hole
7) Anchoring In Bedrock Below Alluvium Or Outwash Deposits	Mechanical	Cased Hole Or Hollow Bar

The ground anchor installation contractor will be required to have knowledgeable staff on hand during installation to evaluate the specific ground conditions and make appropriate decisions regarding the type of anchor and installation method. Decisions will be verified and documented by a representative of OTR. Anchor selection and installation methods will be made in the field once the individual location and conditions are determined. Table 2 provides a guide to help facilitate the anchor type and drilling method selection process.

The appropriate anchor type must be verified once the anchor hole is drilled. The anchor capacity for each type of anchor will need to be verified through an anchor proof testing program. FHWA-SA-96 provides design, construction, and testing guidelines for soil nails, which are passive ground anchors. FHWA-SA-96 requires proof testing of five percent (5%) of ground anchors. For this project, one (1)

ground anchor will be proof tested in accordance with FHWA-SA-96 for every twenty (20) ground anchors installed. Proof tests will be required to verify that the tested anchors have at least 150% of the required load capacity for each anchor.

Additionally, based on the variability of subsurface conditions and ground anchor types, one (1) ground anchor at each ATF location will be tested to provide an indication of the anchor capacity associated with each ATF ground anchor group. This additional testing can be done by jacking, torquing or other method approved by the engineer.

FIGURES

APPENDIX A

APPENDIX A: SUMMARY OF RWDI WIND STUDIES

To determine the cable tensions due to wind loading, Rowan, Williams, Davies, and Irwin, Inc. (RWDI) have conducted a preliminary wind engineering study, and are in the process of completing a revised study. The studies consist of statistical analysis of recorded wind speeds in the area surrounding the project and an aeroelastic model of typical section configurations. The aeroelastic model was verified by a full-scale field test of a typical section. The results indicated in RWDI's preliminary report are briefly summarized in the following:

- A design wind speed based on a 10-year return period is recommended;
- Analysis of wind statistics in the area surrounding the project indicates that a one minute mean wind speed of 42 mph will be exceeded on average once in 10 years during the period of July through September for most locations along the river;
- The Red Rocks and Three Rocks locations encounter notably higher wind speeds that should be given special consideration;
- Test results indicate the fabric panel configurations tested are aerodynamically stable.

Maximum cable forces from the preliminary aeroelastic model were determined for a 42 mph one-minute mean wind speed for two different panel configurations. Because of the variability in span and above river height along all sections as well as the higher wind speeds at the Red Rocks and Three Rocks sections, actual cable forces will vary throughout the project. Cable forces from the aeroelastic tests currently being conducted will be used as a guide to determine the final design forces at each site.

Two points are worth noting regarding the conservatism of the maximum cable forces in RWDI's wind engineering report. First, the 42 mph one minute mean wind speed is based on a probability of exceedence within a period of 3 months. However, the duration of service (3 weeks or less) indicates an actual return period much higher than 10 years for the 42 mph wind speed. The actual return period is approximately four times higher for the 3-week duration. Second, the maximum wind load on cross-river cables occurs when the wind direction is at 45 degrees to the river valley. While it is important to consider these winds, they only occur about 10 percent of the time and the probability of maximum winds occurring at the least desirable wind direction is unlikely. These two factors indicate a much higher level of conservatism built into the loads corresponding to 42 mph winds.

Thus, while the Red Rocks and Three Rocks sections encounter higher wind speeds than other river sections, it has been determined that a 42 mph design wind speed is adequate for design of the cross-river cables in all sections. However, diagonal cables in the Red Rocks and Three Rocks sections will be designed for a higher wind speed because of their diminished sensitivity to the wind direction. Because these members are essential components in the cable system, they are treated with an extra measure of conservatism.

The loads presented in RWDI's wind study report include estimated cable pretensioning forces for the cross-river and diagonal cables. In final design, the pretensioning force for cross-river cables will be computed according to the dead load of materials and the desired sag. Required pretensioning for diagonal cables is a function of the cable dead load and the tension required to maintain a stable system. The magnitude of this force will be estimated in final design and adjusted in the field.

APPENDIX B

APPENDIX B: AREA-BY-AREA DESCRIPTION OF CONDITIONS

The following discussion describes the conditions found in each project area, as observed during the surface reconnaissance. For each area, approximate estimated subsurface conditions pertinent to anchoring, expressed in percentages of the total section riverbank length (which is approximately twice the stated length, to cover both sides), have been inferred. Anchorage inferred to be in bedrock includes anchors placed in bedrock overlain by surface deposits as well as where bedrock is exposed at the ground surface. Clearly, actual conditions may vary considerably from these estimates, and can only be firmly determined when the anchor holes are drilled.

PARKDALE AREA
(Approximately 2 ¾ miles)

Banks are characterized by alluvial/fan deposits at extreme downstream (east) end of section, (mostly confined to "Alternative C" extension beyond "Alternative B"). Upstream from the approximate downstream end of "Alternative B," banks are characterized by local colluvial materials, in place or used as fill, which are very rocky, with particles up to 2 feet or more in diameter. Occasional outcrops (sound igneous rock) are seen, and are more frequent toward the upstream end of the section. Much of bank materials throughout this section appear to be characterized as rockfill, although greater content of smaller particle sizes occur at confluences of side canyons with the river, where fan deposits contribute more "fines" to the natural river banks. Approximately ¼ mile of the north bank (railroad side) near the center of the section is constructed or armored with concrete rubble in the form of large slabs of what appears to have been concrete pavement or bridge decking. Other debris (such as timber) may also be included here.

Estimated Percentage of Anchoring Conditions

Igneous Bedrock: 10 – 25%
Rocky Colluvium/Fill: 20 –50%
Alluvium/Fan Deposits: < 5%
Coarse Rockfill: 30 – 70% (includes concrete rubble)

SPIKEBUCK AREA
(Approximately 1 ½ miles)

This section is predominated by rockfill with occasional outcrops of igneous rocks. In some areas the outcrops are relatively continuous and along both banks. Colluvial-based fills appear in some areas, particularly at the mouths of gullies on the south bank. In two areas, fan deposits are found along the north bank.

Estimated Percentage of Anchoring Conditions

Igneous Bedrock: 15 – 40%
Rocky Colluvium/Fill: 20 – 40%
Alluvium/Fan Deposits: 5 – 15%
Coarse Rockfill: 40 – 60%

THREE ROCKS AREA
(Approximately ¾ mile)

This section appears to be predominated by coarse rockfill and very rocky colluvium/fill. However, bedrock outcrops (metamorphic) may be shallow below the surface cover. Outwash fans from the side drainages appear to be composed of relatively coarse, angular debris.

Estimated Percentage of Anchoring Conditions

Metamorphic Bedrock: 5 – 15%
Rocky Colluvium/Fill: 20 – 50%
Alluvium/Fan Deposits: < 5%
Coarse Rockfill: 30 – 70%

MAYTAG AREA
(Approximately ¾ mile)

Much of the banks in this section appears to have large rock riprap covering the surface of finer-grained alluvial and colluvial deposits/fills. There are also areas of huge rounded boulders and/or outcrops.

Estimated Percentage of Anchoring Conditions

Metamorphic Bedrock: 5 – 20%
Rocky Colluvium/Fill: 20 – 50%
Alluvium/Fan Deposits: 5 – 50%
Coarse Rockfill: 20 – 50%

TEXAS CREEK AREA
(Approximately ¾ mile)

There are frequent outcrops of metamorphic bedrock along this section. At the downstream (east) end of the section, bedrock is overlain/covered by alluvium containing rounded cobbles (few boulders).

Estimated Percentage of Anchoring Conditions

Metamorphic Bedrock: 20 – 70%

Rocky Colluvium/Fill: 30 – 70%

Alluvium/Fan Deposits: 5 – 20%

Coarse Rockfill: 10 – 40%

VALLIE BRIDGE AREA
(Approximately ½ mile)

The south bank (road side) of this section is predominated by colluvial fill. The north bank (railroad side) is characterized by alluvium/fan deposits with rounded cobbles in the downstream portion, and sedimentary bedrock outcrops in the upstream portion. The bedrock is steeply-dipping (60 to 70 degrees to the southwest) well-cemented, competent sandstones and conglomerates, with softer, weathered shale layers, typically less than 3 feet in thickness making up an estimated 10 to 20 percent of the rock mass.

Estimated Percentage of Anchoring Conditions

Competent Sedimentary Bedrock: 20 – 50%

Weaker Sedimentary Bedrock: < 5%

Rocky Colluvium/Fill: 40 – 60%

Alluvium/Fan Deposits: 20 – 40%

Coarse Rockfill: 5 - 20%

TUNNEL AREA
(Approximately 1 mile)

Most of this section has sedimentary bedrock outcrops characterizing both banks. The bedrock is sandstone and conglomerate, with occasional shale over most of the section, with limestone/dolomite at the upstream (west) end. The sediments dip about 30 degrees to the southeast in this section. Where covered, the overburden appears thin, and generally consists of cobbly alluvium on the north bank, and coarse rockfill (of local materials) on the south bank.

Estimated Percentage of Anchoring Conditions

Competent Sedimentary Bedrock: 60 – 90%

Weaker Sedimentary Bedrock: < 5%

Rocky Colluvium/Fill: 10 – 20%

Alluvium/Fan Deposits: 10 – 30%

Coarse Rockfill: 10 - 20%

COUNTY LINE AREA
(Approximately 1 mile)

The typical colluvial fill covering both banks appears to be shallow, over frequent bedrock outcrops. Most bedrock appears to be limestone and/or dolomite, although metamorphic rocks may occur at the upstream end of the section. A portion of the north bank (railroad side) appears to be fan deposits.

Estimated Percentage of Anchoring Conditions

Competent Sedimentary/Metamorphic Bedrock: 20 – 60%

Rocky Colluvium/Fill: 30 – 70%

Alluvium/Fan Deposits: 5 – 25%

Coarse Rockfill: 5 - 20%

TABLE 2: ANCHOR TYPE AND DRILLING METHOD RATING SYSTEM

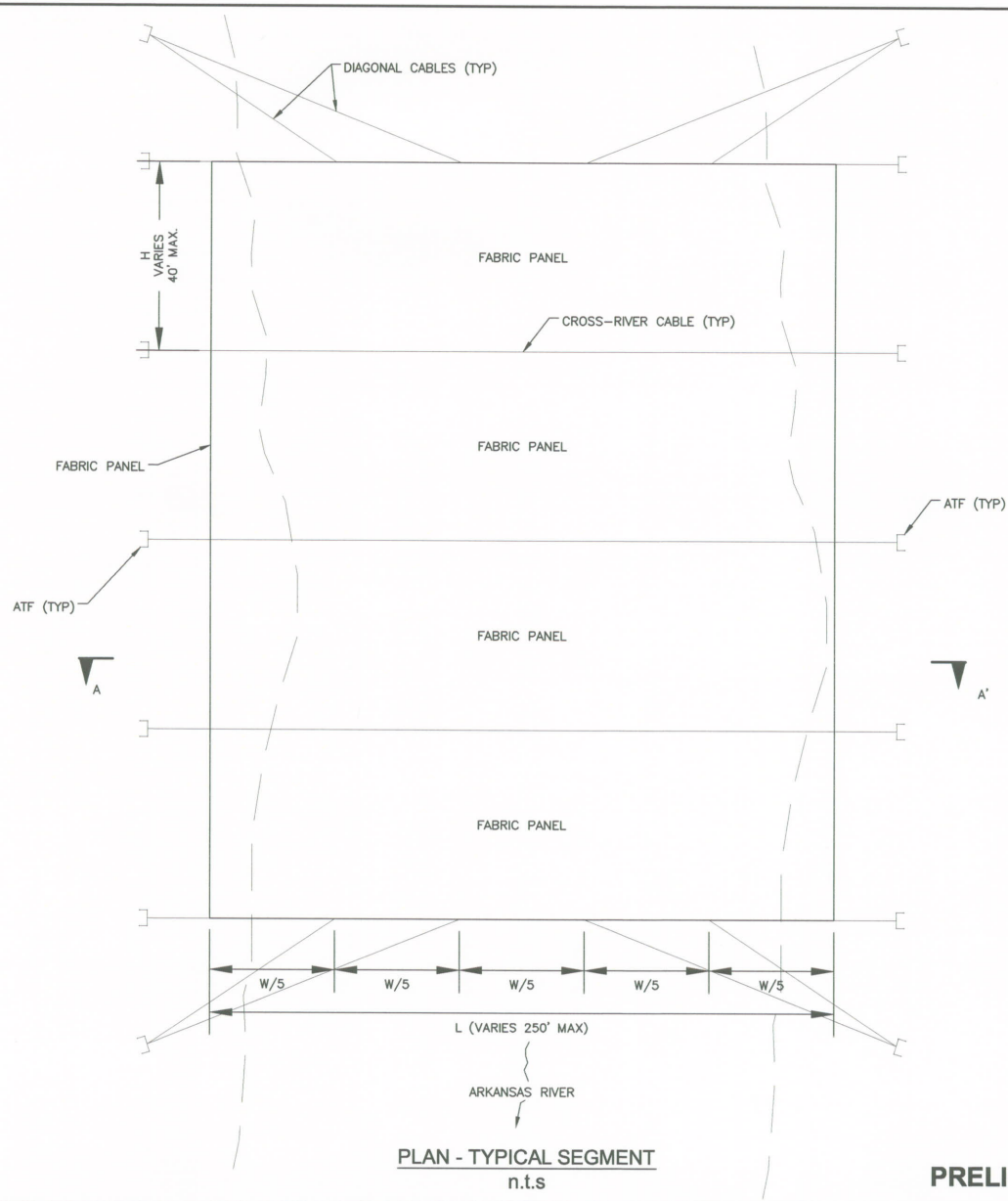
GEOLOGIC CONDITIONS

	Bedrock at Ground Surface	Bedrock less than 20' below Ground Surface Condition No. 1	Bedrock less than 20' below Ground Surface Condition No. 2	Bedrock greater than 20' below Ground Surface Condition No. 1	Bedrock greater than 20' below Ground Surface Condition No. 2
Spin-Lock Mechanical Anchor - Open Hole Drilling	**A**	**D**	**B**	**D**	**D**
Spin-Lock Mechanical Anchor - Cased Hole Drilling	**C**	**A**	**A**	**C**	**C**
Expansive Mechanical Anchor - Cased Hole Drilling	**C**	**C**	**C**	**A**	**D**
Grouted Anchor - Hollow Bar Injection	**B**	**F**	**B**	**F**	**A**
Grouted Anchor - Cased Hole Drilling	**C**	**B**	**B**	**F**	**B**
Grouted Anchor - Open Hole Drilling	**B**	**F**	**C**	**F**	**B**

Surface Condition No. 1:
Unconsolidated soil and/or rock consisting of rockfill,
concrete debris, colluvium, or fill derived from colluvium,
or other material that is **not** matrix supported, such that it **will not** contain grouting fluid.

Surface Condition No. 2:
Unconsolidated soil and/or rock consisting of rockfill,
concrete debris, colluvium, or fill derived from colluvium,
or other material that **is** matrix supported, such that it **will** contain grouting fluid.

RATING	DESCRIPTION
A	Best practice for Most Conditions
B	Acceptable for Most Conditions
C	Acceptable for Some Conditions
D	Not Acceptable for Some Conditions
F	Not Acceptable for Most Conditions



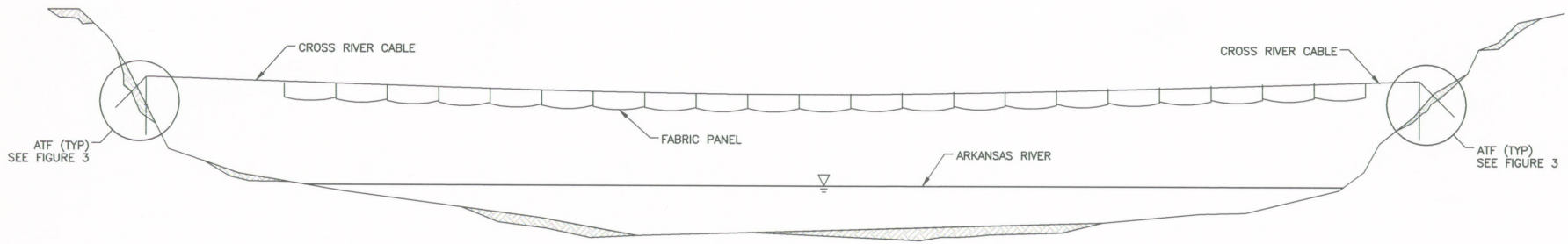
PLAN - TYPICAL SEGMENT
n.t.s

NOTES

1. ONE SEGMENT SHOWN, SEGMENTS CONSIST OF FOUR (SHOWN) OR MORE FABRIC PANELS.

PRELIMINARY - NOT FOR CONSTRUCTION

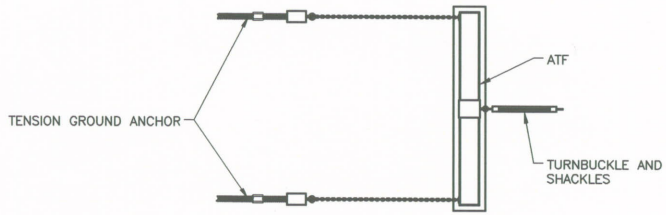
CLIENT/PROJECT								
CVJ CORPORATION OVER THE RIVER PROJECT			Golder Associates Denver, Colorado			TITLE: TYPICAL CABLE LAYOUT		
DRAWN MAM	CHECKED FEH	REVIEWED FEH	DATE NOV. 2006	SCALE N.T.S	FILE NO. 003-2137	JOB NO. 003-2137	DWG NO./REV.NO. 000217F01	FIGURE 1



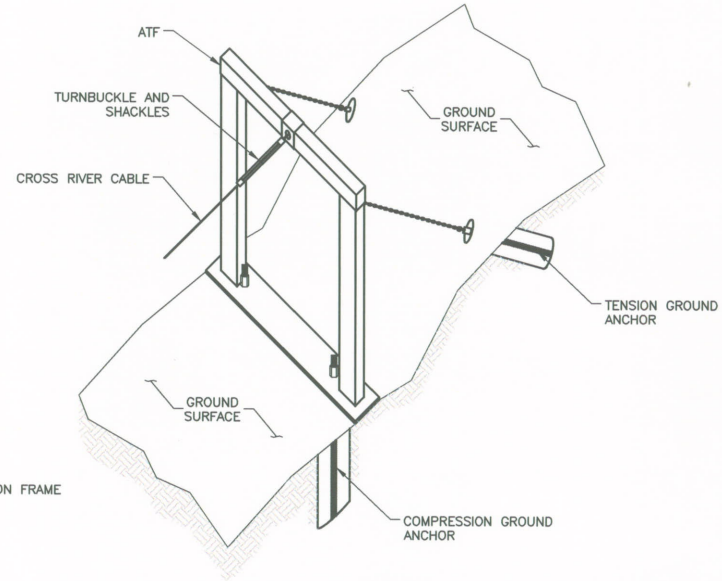
SECTION A-A' - CROSS RIVER CABLES
n.t.s

PRELIMINARY - NOT FOR CONSTRUCTION

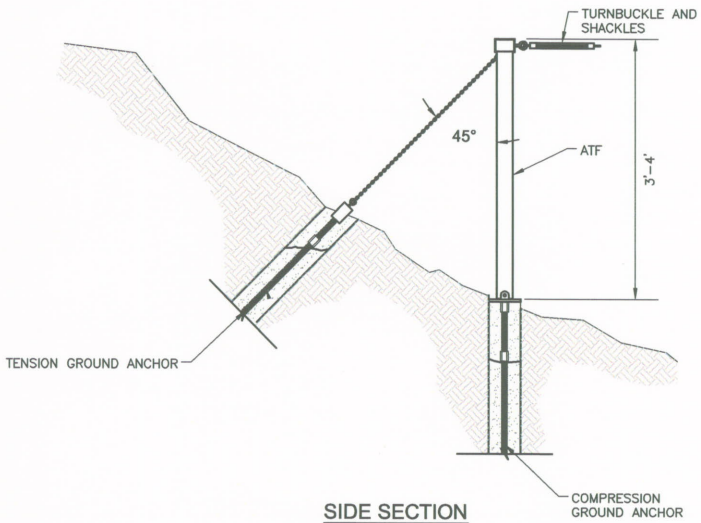
CLIENT/PROJECT						TITLE		
CVJ CORPORATION OVER THE RIVER PROJECT			Golder Associates Denver, Colorado			CABLE SECTION - A-A'		
DRAWN MAM	CHECKED FEH	REVIEWED FEH	DATE NOV. 2006	SCALE N.T.S	FILE NO. 003-2137	JOB NO. 003-2137	DWG NO./REV.NO. 000217F01	FIGURE 2



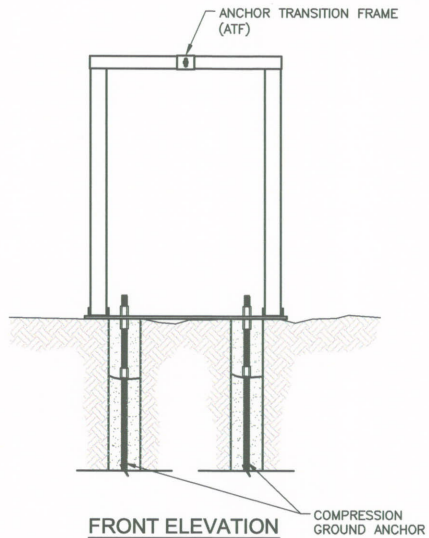
PLAN
n.t.s.



ISOMETRIC
n.t.s.



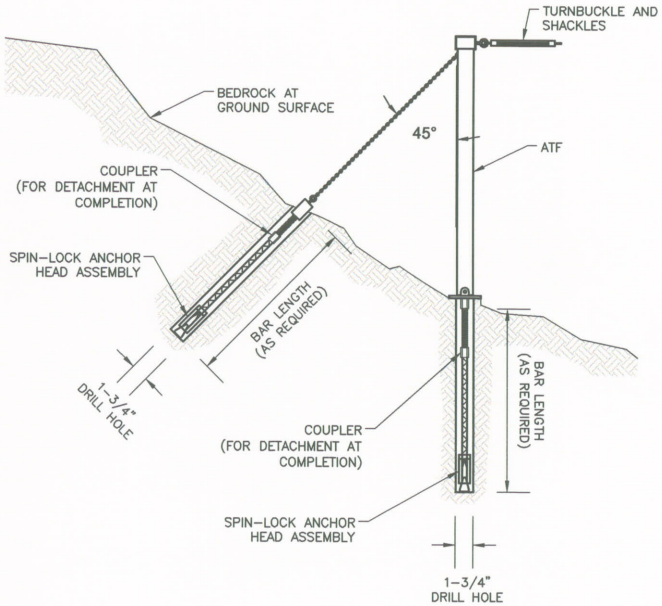
SIDE SECTION
n.t.s



FRONT ELEVATION
n.t.s

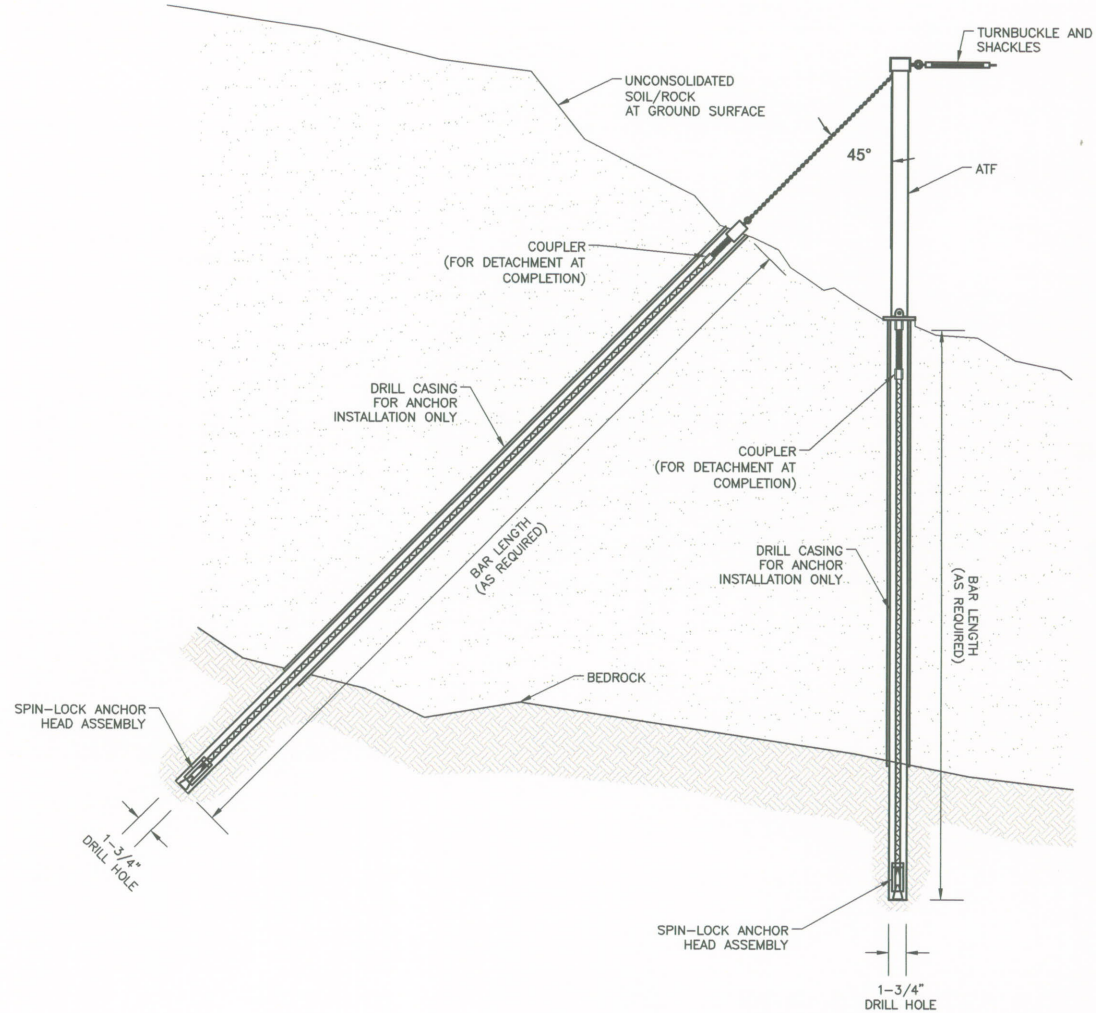
PRELIMINARY - NOT FOR CONSTRUCTION

CLIENT/PROJECT							TITLE		
CVJ CORPORATION OVER THE RIVER PROJECT			Golder Associates Denver, Colorado				ANCHOR TRANSITION FRAME (ATF)		
DRAWN MAM	CHECKED FEH	REVIEWED FEH	DATE NOV. 2006	SCALE N.T.S	FILE NO. 003-2137		JOB NO. 003-2137	DWG NO./REV.NO. 000217F01	FIGURE 3



MECHANICAL ANCHOR WITH BEDROCK AT GROUND SURFACE

n.t.s

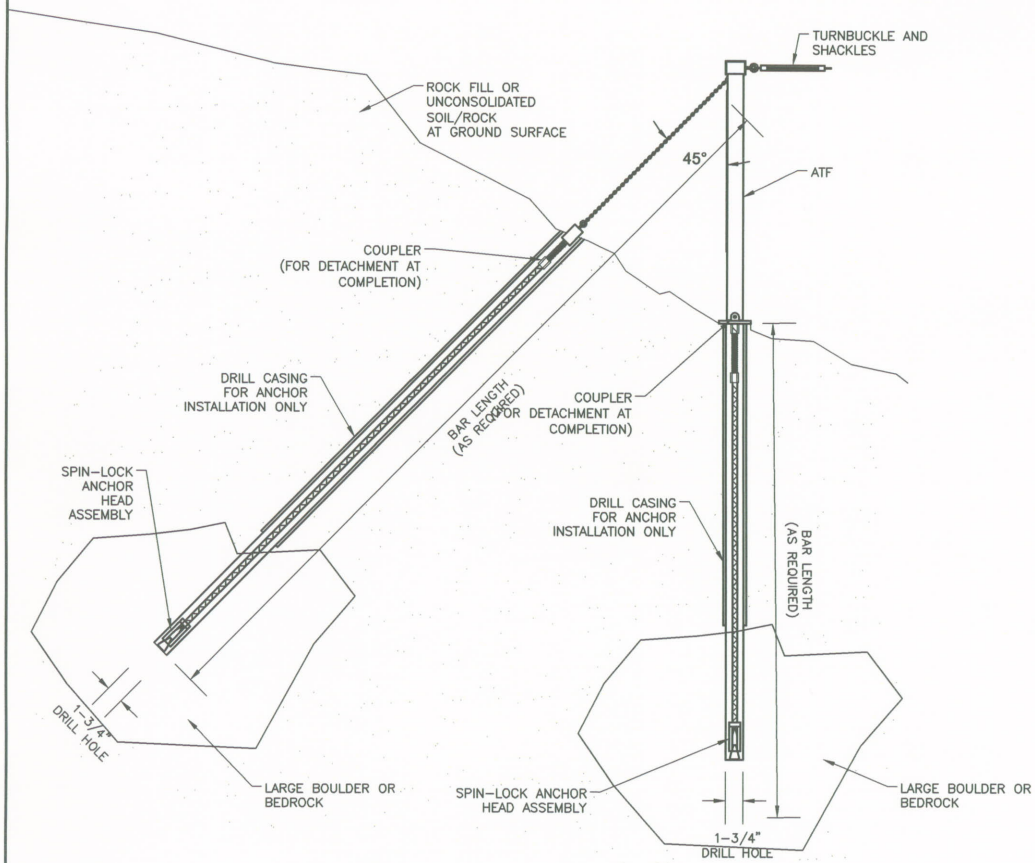


MECHANICAL ANCHOR WITH BEDROCK AT DEPTH

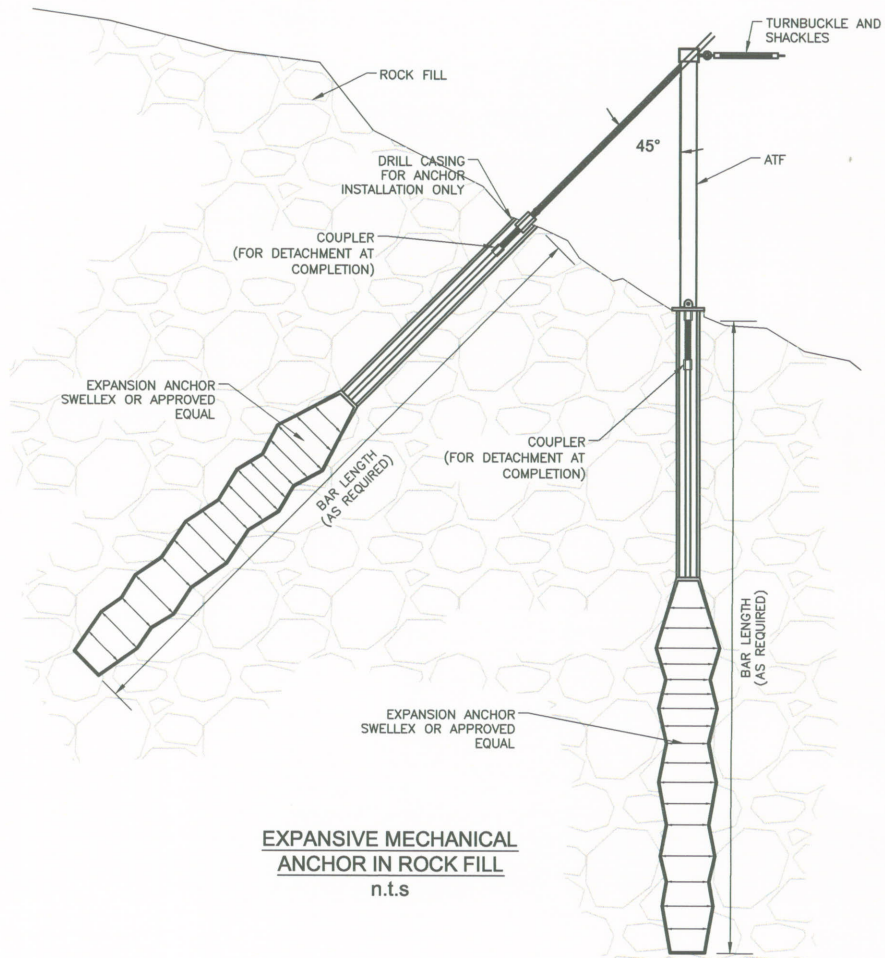
n.t.s

PRELIMINARY - NOT FOR CONSTRUCTION

CLIENT/PROJECT									
CVJ CORPORATION OVER THE RIVER PROJECT			Golder Associates Denver, Colorado			TITLE: MECHANICAL ANCHOR IN BEDROCK			
DRAWN MAM	CHECKED FEH	REVIEWED FEH	DATE NOV. 2006	SCALE N.T.S	FILE NO. 003-2137	JOB NO. 003-2137	DWG NO./REV.NO. 000217F01	FIGURE 4	



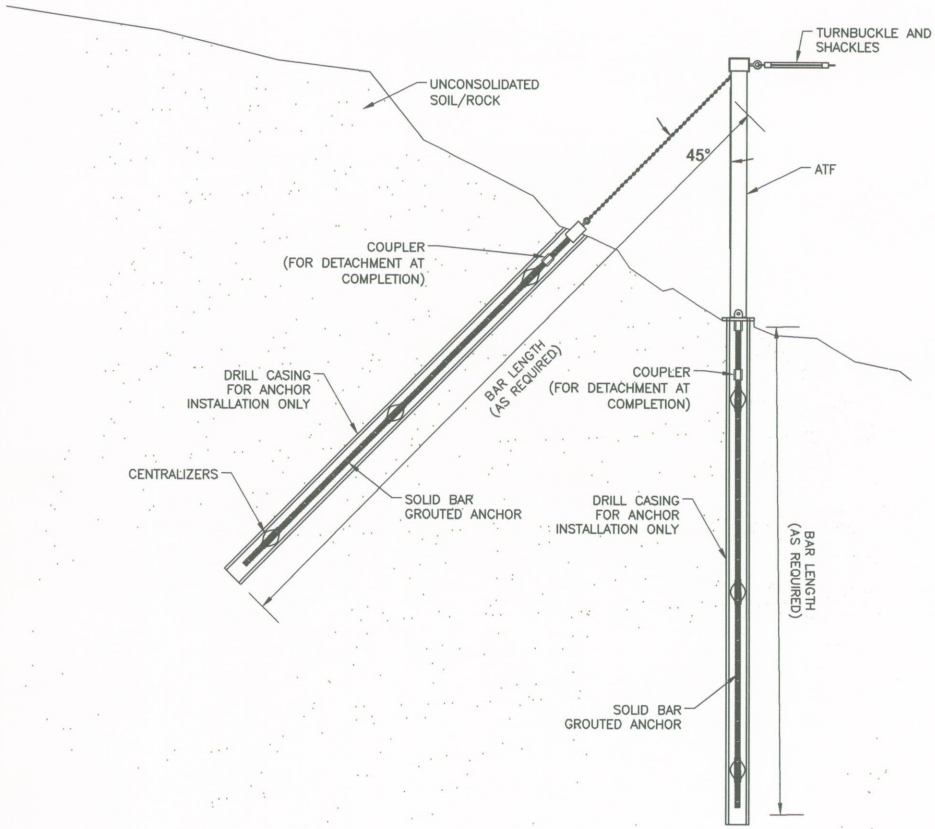
MECHANICAL ANCHOR IN LARGE BOULDER AT DEPTH
n.t.s



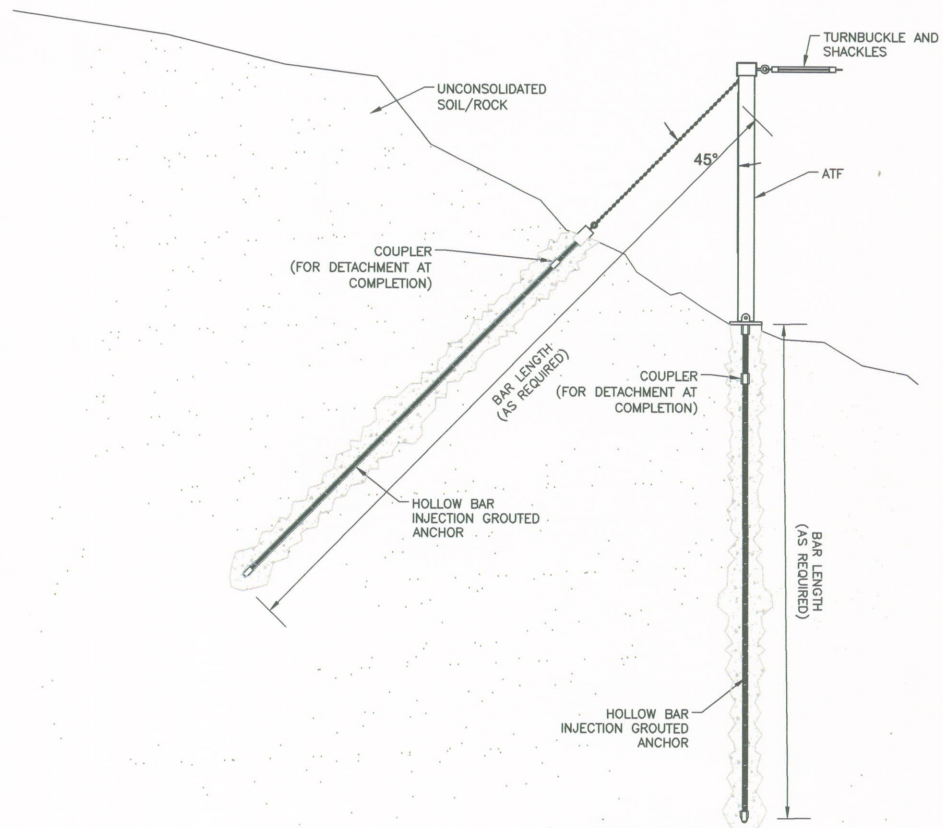
EXPANSIVE MECHANICAL ANCHOR IN ROCK FILL
n.t.s

PRELIMINARY - NOT FOR CONSTRUCTION

CLIENT/PROJECT								
CVJ CORPORATION OVER THE RIVER PROJECT			Golder Associates Denver, Colorado			TITLE: MECHANICAL ANCHOR IN BOULDER OR ROCKFILL		
DRAWN MAM	CHECKED FEH	REVIEWED FEH	DATE NOV. 2006	SCALE N.T.S	FILE NO. 003-2137	JOB NO. 003-2137	DWG NO./REV.NO. 000217F01	FIGURE 5



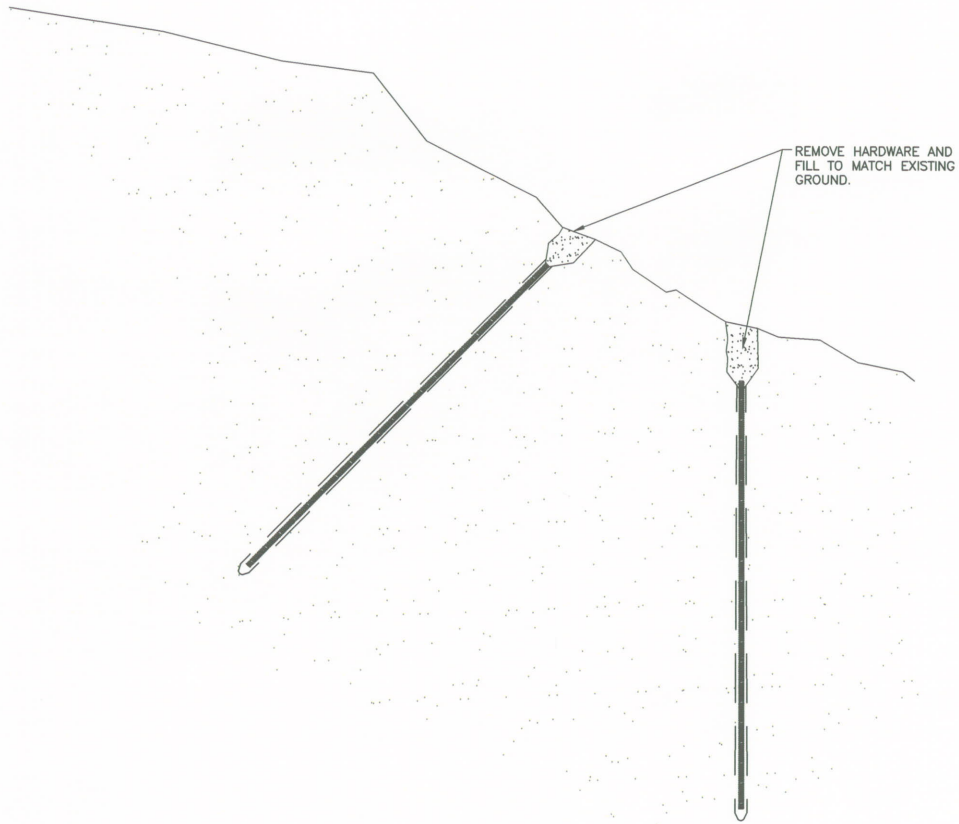
CASED HOLE GRAVITY GROUTED ANCHOR
n.t.s



HOLLOW BAR INJECTION GROUTED ANCHOR
n.t.s

PRELIMINARY - NOT FOR CONSTRUCTION

CLIENT/PROJECT									
CVJ CORPORATION OVER THE RIVER PROJECT			Golder Associates Denver, Colorado			TITLE: GROUTED ANCHOR - CASED HOLE OR HOLLOW BAR			
DRAWN MAM	CHECKED FEH	REVIEWED FEH	DATE NOV. 2006	SCALE N.T.S	FILE NO. 003-2137	JOB NO. 003-2137	DWG NO./REV.NO. 000217F01	FIGURE 6	



ABANDONED ANCHOR
n.t.s

NOTES

1. REMOVE SURFACE HARDWARE (ATF).
2. UNSCREW THREADED BAR FROM ANCHOR AT COUPLING.
3. PLUG ANCHOR HOLE WITHIN A FEW INCHES OF GROUND SURFACE.
4. FILL REMAINING ANCHOR HOLE TO SURFACE WITH ROCK, COLOR MATCHED GROUT, OR LOCAL SOILS AS APPROPRIATE FOR SURROUNDING SURFACE.

PRELIMINARY - NOT FOR CONSTRUCTION

CLIENT/PROJECT								
CVJ CORPORATION OVER THE RIVER PROJECT			Golder Associates Denver, Colorado			TITLE ABANDONMENT DETAIL		
DRAWN MAM	CHECKED FEH	REVIEWED FEH	DATE NOV. 2006	SCALE N.T.S	FILE NO. 003-2137	JOB NO. 003-2137	DWG NO./REV.NO. 000217F01	FIGURE 7

J1.1.3 Wind Engineering Services Report

J1.1.3 Wind Engineering Services Report

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FINAL REPORT

WIND ENGINEERING SERVICES

OVER THE RIVER PROJECT

ARKANSAS RIVER, COLORADO

Project Number: 98-130

Date: January 17, 2000

Submitted By: Rowan Williams Davies & Irwin Inc.

Project Manager - Mark A. Hunter, CET

Principal - Scott L. Gamble, P.Eng.

Project Engineer - John Kilpatrick, M.E.Sc., P.Eng.

Project Engineer - Valerie Sifton, B.A.Sc. (Eng.)

Instrumentation Specialist - Marco Accardo

Field Technician - Dean MacLanders

Submitted to: CVJ Corporation

EXECUTIVE SUMMARY

This report on the wind engineering studies provided for the Over the River Project on the Arkansas River in Colorado has been prepared by Rowan Williams Davies & Irwin Inc. The proposed project will consist of fabric panels suspended horizontally clear of and above the water level and will follow the configuration and width of the changing course of the river. Steel wire cables which are anchored on the upper parts of the river banks will cross the river and serve as the attachments for the fabric panels. The woven fabric panels with rows of grommets at the edges perpendicular to the river will allow loose folds of fabric to gather at the middle of the curving cables 10 ft to 25 ft above the river bed. The various lengths of successive panels will be interrupted by bridges, rocks, trees or bushes. The fabric will be located over the river for approximately a three week period in either July, August or September.

The objectives of the studies can be simply stated as follows:

1. To assess the aerodynamic stability of the proposed panels.

2. To determine the wind loads for the design of the cables and anchors.

To meet these two objectives, the wind engineering studies were divided into three distinct parts. The first part of the study involved the installation of wind speed/wind direction instrumentation on the project site and the monitoring of site specific wind information for the time of year that the project is likely to be present. This data set was then analyzed in conjunction with meteorological data that are available at a nearby airport site in order to determine the directionality and likely wind speeds that will be experienced by the project when it is installed. The second part of the studies included the construction and wind tunnel testing of an 1:16 scale aeroelastic model of typical panels sizes to assess the potential for wind-induced instabilities of the fabric panels as well as determine the wind loads on the cables and anchors for a range of wind speeds, wind directions and surrounding configurations. The third part of the program included measuring wind loads on a full scale mock-up of the project. These tests were completed in order to verify that assumptions made

on the aeroelastic model of the project were not overly conservative and that the predicted wind loads were representative of the full scale conditions.

The key findings of the studies are:

1. One minute mean wind speeds of 35 mph will likely be experienced during the period of July through September.

2. For the design of temporary structures such as the Over the River project, one must take into consideration an acceptable level of risk when determining the design wind speed. A design wind speed based on that which will occur once in 10 year (i.e. 10 years return period) appears to be in keeping with that used for other temporary facilities and therefore is recommended for determining the wind loads acting in the cables and anchors. Whether this return period reflects an acceptable level of risk is the decision of the design team. The analyses of the historical wind statistics for the area and the data gathered at on-site anemometer locations indicates that a one minute mean wind speed of 42 mph will be exceeded on average once in ten years during the period of July through September for most of the locations along the river.

3. For Red Rocks (#3) and Three Rocks (#6) the anemometer data indicates higher wind speeds. At these locations 10 year return period, one minute mean speeds of 53 and 50 mph were noted. These locations require special consideration by the design team.

4. With regard to directionality, although winds tend to align with the river valley, there are sufficient occurrences of strong wind events at 45° to 90° to the river valley that these directions cannot be dismissed when estimating the wind loads on the cables and anchors.

4. The tests of the aeroelastic scale model show that the fabric panel configurations of the Over the River project tested by RWDI are aerodynamically stable.

5. Based on a 42 mph one minute mean wind speed, the maximum wind load on the across-river cables for the configurations tested by RWDI was approximately 22,000 lbs. Wind loads of this magnitude are expected on the first and second across-river cables. The first cable is defined as the across-river cable at the leading edge of a series of panels, it would only support one fabric panel and it would be attached to the diagonal cables. The second across wind cable is defined as the cable next to the first cable and would support two fabric panels.

6. For the third and fourth across-river cables, the maximum wind load measured during the tests was approximately 17,000 lbs for a 42 mph one minute mean wind speed.

7. The maximum wind load expected on a diagonal cable is approximately 11,000 lbs for a 42 mph one minute mean wind speed.

8. The wind loads on the cables are affected by the position of the panels above the river. Reducing the height of the panels above the river from 25 ft to 10 ft reduced the wind loads for the tested configuration in the across-river cables 1 and 2 by approximately 30%.

9. The wind loads recorded for the full scale mock-up tests are generally consistent with those measured on the aeroelastic scale model. This would indicate that the effects of assumptions and simplifications of the scaling parameters used on the aeroelastic model had a relatively minor effect on the wind load estimates. Therefore using the results of the aeroelastic model study to directly predict the wind loads that will be experienced by the full scale project is appropriate and does not require further modification.

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1. INTRODUCTION

This report on the wind engineering studies provided for the Over the River Project on the Arkansas River in Colorado has been prepared by Rowan Williams Davies & Irwin Inc. The proposed project will consist of fabric panels suspended horizontally clear of and above the water level and will follow the configuration and width of the changing course of the river. Steel wire cables which are anchored on the upper parts of the river banks will cross the river and serve as the attachments for the fabric panels. The woven fabric panels with rows of grommets at the edges perpendicular to the river will allow loose folds of fabric to gather at the middle of the curving cables 10 ft to 25 ft above the river bed. The various lengths of successive panels will be interrupted by bridges, rocks, trees or bushes. The fabric will be located over the river for approximately a three week period in either July, August or September. Maps showing the proposed locations of the fabric in the Over the River Project are provided in Figure 1-1. Figure 1-2 provides Christo's sketches of the proposed project.

The objectives of the studies were:

1. To assess the aerodynamic stability of the proposed panels.

2. To determine the wind loads for the design of the cables and anchors.

To meet these two objectives, the wind engineering studies were divided into three distinct parts.

1. The first part of the study involved the installation of wind speed/wind direction instrumentation on the project site and the monitoring of site specific wind information for the time of year that the project is likely to be present. This data set was then analyzed in conjunction with meteorological data that were available from a nearby airport site in order to determine the directionality and wind speeds that likely will be experienced by the project when it is installed.

2. The second part of the studies included the construction and wind tunnel testing of an aeroelastic model of typical panel sizes to assess the potential for wind-induced instabilities of the fabric panels as well as determine the wind loads on the cables and anchors for a range of wind speeds, wind directions and surrounding configurations.

3. The third part of the program included measuring wind loads on a full scale mock-up of the project. These tests were completed in order to verify that assumptions made on the aeroelastic model of the project were appropriate and that the predicted wind loads were representative of the full scale conditions.

The following sections describe the three components of the studies, the methodology used, the findings and our recommendations.

2. METEOROLOGICAL ANALYSIS

2.1 Overview

The objective of this part of the study was to determine the range of wind speeds and directions that can be expected to occur during the installation period of the Over the River project. This information was used to determine the design wind loads for the cables supporting the fabric and their anchors.

As part of the meteorological data analysis, the probability of exceeding various wind speeds was determined. This is important in order to establish appropriate design wind speeds for the project. For permanent structures (buildings and bridges etc.), building codes such as the American Society of Civil Engineers (ASCE) 7-98 Standard recommend that wind speeds exceeded on average once in 50 or 100 years be used for design. These are often referred to as the 50 or 100 year return period wind speeds. However, for temporary structures, such as the Over the River project, it may be acceptable to relax this design criterion. For example, the ASCE Standard allows a 0.87 factor to be applied to wind loads (0.93 factor on wind speed) for buildings and other temporary structures

that represent a low hazard to human life in the event of failure. The ASCE wind speed times the 0.93 factor is equivalent to a wind speed exceeded on average in the once in 10 to 20 year range. This is consistent with the return period used to determine design wind speeds for the construction stages of large cable stayed or suspension bridges.

Based on the above discussion, the focus of the meteorological data analysis has been on determining the wind speed that will be exceeded on average once in 10 years. **It is however up to the project design team to determine if using a 10 year return period for the design of the cables and anchors provides the appropriate level of risk.**

The meteorological data analysis was divided into two parts. The first part of the study included analysis of the long term wind statistics in the region in general. This historical wind data were reviewed to obtain a general understanding of the wind climate in the area. However, the proposed project is located in mountainous terrain. This topography can have a significant impact on the local wind speeds and directions as the river valley cuts its way through the mountains. Therefore to assess this affect, wind speed and direction data were also collected at several on-site locations.

2.2 Analysis of Historical Wind Data

Meteorological data from Salida, Colorado were obtained for the years 1973 to 1992. The data were scaled to a height of 15 ft. above the ground, which corresponds to the height above ground of most of the on-site anemometers. This was necessary since wind speeds generally increase as one measures at higher elevations and the scaling to a specific height of 15 ft. allowed for a direct comparison between data sets. Only meteorological records for the three month period of July through September for all the years of record at Salida were considered, since this is the most likely time of the project's installation.

The wind records obtained from Salida were taken to be mean hourly wind speeds. Figure 2-1 illustrates the frequency distribution for the mean-hourly wind speeds. This figure indicates that

the most frequent winds are in the 10 mph to 20 mph range and that mean hourly wind speeds over 40 mph rarely occur.

The maximum daily wind speeds from Salida were also extracted from the data set for the three month period of July through September for all the years of record. In order to provide a direct comparison of the Salida data to wind speeds obtained from the on-site measurements, the Salida wind speeds were converted to a one-minute averaging time using the relationship between wind speeds of varying averaging time as described by Durst[1], which is a relationship accepted by the American Society of Civil Engineers (ASCE-7) Standard. A time averaged speed of a one minute duration was selected because, given the size of the fabric panels to be used for this project, gust durations of this length of time are likely required to initiate a dynamic wind loading response. Shorter gust durations, caused by smaller eddies of wind cannot be expected to effect a large enough portion of the fabric at any given point in time to produce peak loading of the cable system.

The one minute duration wind speeds were subjected to an extreme value analysis to determine the probability of exceeding various wind speeds. A plot of probability verses wind speed is included in Figure 2-2. As an example, this figure indicates that wind gusts of one minute duration exceeding 35 mph are expected to occur only 0.8% of the time. In terms of return period, a 35 mph wind speed with a probability of being exceeded of 0.8% would have a return period of once in 1.36 years as shown in the following equation:

$$R = (1/P)/D \tag{1}$$

where: P is the probability of exceeding a selected wind speed

D is the duration of interest (in this case 92 days representative of the period of July through September);

R is the return period in years and reflects how often the selected wind speed will be exceeded on average

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[1] Durst, C.S. Wind speeds over short periods of time, *Meteor. Mag.*, 89, 181-187, ©1960.

therefore

$$R = (1/0.008)/92$$

$$R = 1.36$$

Using the data plotted in Figure 2-2 and the above described relationship, a peak daily one minute mean wind speed of 40 mph will occur on average once every seven years during the three month period from July through September and a 45 mph one minute mean wind speed will occur on average once every 13.5 years during the same three month period. The 10 year return wind speed based on the Salida data is approximately 42 mph.

2.4 Assessment of Site-Specific Wind Conditions

2.4.1 General

On-site wind data collection was conducted to supplement the historical wind record analysis as well as to assess the localized effects of topography on wind speed and directionality. Based on a site visit and a review of topographical maps of the area, eight anemometer sites were selected at locations in the Arkansas River valley spanning the section where the Over the River project will be installed. Additional details concerning each anemometer site, the instrumentation used and sampling parameters are provided in Appendix A.

The eight anemometer sites were selected to represent a cross-section of the types of terrain where fabric panels are likely to be located. These sites were named as follows:

Site No.	Site Name
1	Chaffee-Fremont County Line
2	Swissvale - Tunnel Area
3	Red Rocks
4	Texas Creek
5	Maytag
6	Three Rocks
7	Spikebuck
8	Parkdale Siding - Canyons

Each anemometer site was equipped with an ENV-50-WDT Anemometer Station provided by SensorMetrics. The stations were set-up to sample once every second and record the following parameters for each 30 minute time span:

- Hi/Low Temperature: The highest and lowest temperature in °F;
- Average Temperature: The average temperature in °F;
- Average Wind Direction: The average wind direction in degrees, clockwise from true North;
- Average Wind Speed: The wind speed in mph averaged over each 30 minute time span;
- Peak Wind Speed: The peak 1-second gust wind speed that occurred during the 30 minute time span, in mph; and
- Peak Wind Direction: The wind direction associated with the peak 1-second gust wind speed, in degrees, clockwise from true North.

The on-site wind data collection was carried out from July 21, 1998 to October 2, 1998, and from June 17, 1999 to September 22, 1999. As previously noted, this time of year reflects the most likely time of year that the Over the River project will be present on the river.

2.4.2 Wind Speed Assessment

The quality of data recorded by each anemometer was assessed and clearly erroneous records were removed. Where necessary, wind direction readings were adjusted to account for apparent inconsistencies in the directional alignment of the anemometers. The one second peak gust data were converted to a one minute averaging time and the mean half hourly data were converted to mean hourly, using the Durst [1] relationship. The distributions of the one minute and the mean hourly wind speeds for each anemometer are illustrated graphically in Appendix B, and the combined results for all stations are illustrated in Figure 2-3. It can be seen in this figure that the most common winds in the river valley have mean wind speeds of approximately 0 to 10 mph with one minute gusts 5 to 15 mph range.

An extreme value analysis was conducted on the one minute mean winds to determine the probability of exceeding various wind speeds at each anemometer station. The results of this analysis showed that the probability of exceeding selected wind speeds was in the same range as noted from the Salida airport data. Figure 2-4 shows a comparison of the Salida data to the data recorded at Station #2 - Swissvale - Tunnel and Station # 3: Red Rocks. The probability distributions of these two stations provide an indication of the range of all stations sampled. Station #2 showed the lowest probability of high wind speeds and Station #3 showed the highest probability of high wind speeds. This range in probability is likely attributed to two factors. The first, is local topographical effects at the individual anemometer sites affecting the wind speeds. Some sites are more exposed than others. The second is related to the sampling equipment, in that not all stations were functioning for the entire period of record and therefore may not reflect all high wind speed events.

Again using the relationship provided in Equation 1, the 10 year return period one minute mean wind speeds for Stations #2 and #3 was 41 mph and 53 mph during the months of July through September. Through further review of the data contained in Appendix B, it is noted that most of the locations compare well with the 10 year return value of 42 mph found in the analysis of the Salida airport data, with the notable exceptions of Red Rocks (#3) and Three Rocks (#6). These locations are significantly windier.

2.4.3 Directional Distribution of On-site Winds

The wind data for each anemometer were also analyzed to determine the directional distribution of winds in the river valley. For this study, wind direction has been defined as the wind angle with respect to the local river valley. Wind direction is also defined as the direction from which wind blow. For example, a wind direction of 0° means winds that are blowing either directly upstream, or directly downstream along the river valley. This can also be referred to as an offset angle of 0°. An offset angle of 22.5° indicates winds at an angle of ±22.5° from upstream or downstream, i.e. it is the sum of winds from 4 specific directions.

Directional distributions for the individual anemometer stations are provided in Appendix C. Figure 2-5 illustrates a summary of the directional distribution of winds for all stations. The four plots indicate the percent of time the winds come from a particular angle for each of four threshold one minute wind speeds of 0, 10, 20 and 30 mph. For example, when considering all winds (i.e. a threshold of 0 mph), 45% of the time, the winds will approach the fabric at an offset angle of 0° (i.e. directly upstream or downstream), whereas approximately 33% of the time, they can be expected to approach the fabric at an offset angle of ±22.5° from directly upstream or downstream.

When considering only the stronger winds that exceed 30 mph in the 4th plot, approximately 54% and 38% of the time, winds have an offset angle of 0° and ±22.5° respectively. This indicates that, for the majority of the time, winds generally tend to align themselves with the river valley, and for higher speed events it is even more likely for winds to be aligned with the valley. Wind offset angles of 45° to 90° were seen to occur less than 10% of the time.

This strong alignment with the river valley indicates that the typical wind speeds and directions at all anemometer sites are highly dependent on surrounding terrain. In mountainous regions, wind speed and direction can vary greatly over a small distance, as they are mostly determined by the surrounding terrain and diurnal-thermal effects.

2.5 Conclusions

The analyses of the long term wind statistics obtained for Salida and the wind information gathered at the eight anemometer sites along the project indicate that one minute mean wind speeds of 35 mph can be expected to occur during the period of July through September. For the design of temporary structures such as the Over the River project, one must take into consideration an acceptable level of risk when determining the appropriate return period wind speed. A design wind speed based on a 10 year return period appears to be in keeping with that used for other temporary facilities and therefore is recommended for determining the wind loads acting in the cables and anchors. The once in 10 year wind speed of 42 mph obtained from the Salida data set appears to be representative of the general conditions at the project site. Again, the notable exceptions are Red

Rocks (#3) and Three Rocks (#6) which exhibit 10 year, one minute mean wind speeds of 53 mph and 50 mph respectively.

With regard to directionality, the most important finding is that although winds tend to align with the river valley, there are sufficient occurrences of strong wind events with offset wind angles in the 45° to 90° range that these directions cannot be dismissed when estimating the wind loads on the cables and anchors.

3. AEROELASTIC TESTS

3.1 Overview

The objectives of the aeroelastic wind tunnel model study were to determine the stability of the fabric panels under varying wind speeds and directions, and to determine anchorage loads for the across-river and diagonal cables, which tie the fabric panels to the banks of the Arkansas River.

Wind tunnel tests were conducted using a 1:16.67 scale model of the proposed fabric panels in the presence of a simplified model of the Arkansas River valley, representing a cross-section of the valley approximately 270 feet in width. Photographs of the model are provided in Figure 3-1. Figures 3-2a and 3-2b provide orientation plans of the fabric panels in the wind tunnel. The coordinate system which is used to present the results in this report is also defined in Figure 3-3.

The following sections describe the details of the test model, the test methodology, and the test results.

3.2 Description of the Aeroelastic Model

Since the primary objective of this part of the study was to investigate the aerodynamic stability of the fabric panels, the aeroelastic model was mainly designed and constructed to simulate the properties of the fabric and across-river cables.

The testing of the fabric panels was completed in RWDI's 16 ft x 8 ft wind tunnel. The aeroelastic model was instrumented with strain gauges at the locations shown in Figure 3-3. These locations were selected so that the peak anchorage loads in the diagonal and across-river cables could be determined.

The general approach to the design of the aeroelastic model followed the principles of similarity between the model and the full-scale structure. This similarity considers both aerodynamics and structural dynamics. In order to obtain dynamic similarity between the aeroelastic model and full scale, it is necessary that the values of certain non-dimensional parameters be kept the same on the model as at full scale. The most important of these parameters are:

$$M_F/(\rho B),\ E_c A_c/L \text{ and } gB/V^2$$

where: M_F = mass of fabric per unit area

ρ = air density (at standard atmospheric conditions);

B = characteristic dimension of the fabric panel;

E_c = modulus of elasticity of the cable;

A_c = cross-sectional area of cable;

L = cable length;

g = gravitational constant (32.2 ft/sec^2)

V = wind velocity.

If the above non-dimensional parameters above are set the same on the model as at full scale, then the model responses at a given wind speed will be a scaled down representation of the full scale responses. Based on the first non-dimensional parameter above, the length scale was selected as 1:16.67.

Based on the cable dimensions and the fabric material selected by the Christo Jeanne-Claude design team, a number of materials were evaluated for the design of the aeroelastic model. The model-scale across-river cables were designed to simulate the mass, geometry, and axial stiffness

of the full-scale cables, and were constructed of steel piano wire augmented with small springs to provide the correct axial stiffness. Light-weight Contender Ultralite 0.4 oz sailcloth was selected to simulate the mass of the fabric panels. The geometric shape and the details of the panels, such as the sag and number of pleats in the panels, were simulated directly by the amount of sailcloth used on the model. The model-scale fabric panels were attached to the across-river cables with small metal hooks. The number of hooks used was selected to approximate the mass of the carabiners to be used in the full-scale set-up. The hooks also allowed the fabric panels to undulate in the wind with little interference from the across-river cables.

The mass distribution of the model-scale fabric was slightly greater than that strictly required by similarity. However, for very lightweight fabrics and/or membranes, the mass of the air surrounding the fabric becomes very important to the overall response. In effect, the air surrounding the fabric is "added mass", which exerts a pressure on the fabric as it undulates. The overall response of the fabric in the wind is actually a function of the mass of the fabric panels plus the "added mass" of the air. If the ratio of the fabric mass to the "added mass" of the air is small (as is the case for the model-scale Over the River fabric panels), the similarity requirements may be relaxed.

For the Over the River aeroelastic model study, matching the previously discussed scaling parameters meant that the model-scale wind speeds tested were about 25% of the full-scale wind speeds.

3.3 Wind Tunnel Testing

The aeroelastic model was tested in RWDI's 16 ft wide by 8 ft high boundary layer wind tunnel at its Guelph laboratory. The tests were conducted for two sizes, and several configurations of fabric panels. The panel configurations tested were sized 120 ft x 40 ft and 90 ft x 35 ft. The model scale panels were mounted on a turntable, allowing any wind direction to be simulated by rotating the model to the appropriate angle in the wind tunnel. During the tests, a number of strain gauges were connected to the wind tunnel's digital data acquisition system which recorded the time-

histories of the signals for post-test analysis.

The primary objective of this study was to investigate the aerodynamic stability of the fabric panels. Generally, aerodynamic instabilities tend to be somewhat suppressed in turbulent wind flow, such as will occur at the site, but would be more apparent in a low turbulence flow regime, if they exist. Therefore, the tests were performed in relatively low turbulence flow conditions, to identify inherent aerodynamic behaviour.

The tests were designed to determine the stability of the fabric panels for a wide range of wind speeds, varying from about 10 mph to 55 mph. The wind-induced responses were measured in 22.5° degree increments, encompassing essentially half of the entire range of azimuths. (0° - straight ahead of the fabric panels, to 180° - straight behind the panels). Azimuth angles in the wind tunnel tests are equivalent to offset angles from the river valley as referred to in the site wind monitoring section of the report.

Wind direction is defined as the direction from which the wind blows in degrees clockwise from straight up the modelled river valley. The earth's turbulent boundary layer approaching the site was simulated with a roughened floor and specially designed turbulence generators at the upwind end of the working section of the tunnel. Details of the test configurations are given in Table 3-1.

3.4 Aeroelastic Responses

Detailed results from the aeroelastic model tests are presented in Appendices D and E. Appendix D provides the responses for the larger 120 ft x 40 ft panels while Appendix E provides the responses for the 90 ft x 35 ft panels.

The positions at which the cable anchorage loads were measured are defined in Figure 3-2a and 3-2b. The mean wind loads correspond to wind speeds averaged over one minute. The maximum and minimum values were taken as the mean plus or minus the peak dynamic response. The peak factor for dynamic response was calculated to be equal to 3.0. The wind tunnel test data

were also corrected to consider the reduced air density due to elevation along the Arkansas River site. The correction factor of 0.87 was applied to the wind tunnel data, which considers that the air density was approximately 15% greater at RWDI's test facility during the tests than it would be at the site.

Maximum cable anchorage loads for each of the across-river cables and upwind and/or downwind diagonal cables are plotted against the one minute mean wind speed in Appendices D and E. Note that the wind loads in Appendices D and E do not include pre-tension loads. Data for 360° and 45° (where available) are presented, and represent the responses of the cable anchors for the most frequent wind direction (0° - winds along the river valley) and the response of the cable anchors for the wind direction (45° - quartering winds) causing the highest loading in the anchors.

The fabric panels themselves were found to be aerodynamically stable. The cable anchorage loads in general increased with increasing wind speed. However, in some instances, cable loads decreased with an increase in the wind speed. This phenomenon is related to the changes in the aerodynamic shape that the fabric panels assume under wind loading for certain angles of attack and wind speeds.

3.5 Wind Loads on the Cable and Anchors

The estimated wind loads on the cables and anchors for a 42 mph one-minute mean wind speed are provided in Table 3.2 and Table 3.3. Table 3.2 presents the results for the 120 ft x 40 ft panels and Table 3.3 provides the results for 90 ft x 35 ft panels. These wind loads include pre-tensioning of 2,800 lbs on the across river cables and 250 lbs in the diagonal cables. The wind loads in the tables have been provided for each test configuration and for winds aligned with the valley(i.e. 0°) and for quartering winds (i.e.45°).

The results presented in Table 3.2 indicate that the maximum wind load on the cables supporting 120 ft x 40 ft panels was 21,850 lbs which occurs for quartering winds on the second across-river cable. A similar wind load (20,850 lbs) was noted on the first across-river cable (at the

windward edge of the series of panels) for quartering winds. The maximum wind loads on the third and fourth cables dropped to 16,550 lbs and 11,300 lbs respectively. Maximum wind loads on the diagonal cables were generally in the 10,000 lbs range. The data in Table 3-2 shows in general, that wind loads due to winds from 45° are similar regardless of the amount of sag of the cables. One configuration of interest however, is the case where the fabric panels are located 10 ft above the surface of the river (Test 9) rather than the 25 ft above the river as tested for all other configurations. For Test 9, the wind loads in the across-river cables drops to 11,300 lbs (Cable 4) and the wind loads on the diagonal cables drops to 4,800 lbs.

For winds aligned with the river (0°), the wind loads on the across-river cables were lower than those measured for quartering winds. The maximum wind load on the across-river cables was 15,600 lbs (Cable 2) and the maximum wind loads on the diagonals was 11,000 lbs. Again, the case with the fabric panels located closer to the river (Test 9), showed reduced wind loads on the cables. For Test 9, the maximum across-river cable wind load was 8,500 lbs (Cable 4) and the maximum wind load on the diagonal cables was measured to be 7,650 lbs.

For the smaller 90 ft x 35 ft cables, the wind loads on the cables are presented in Table 3.3. The results presented in this table show that the wind loads on the cables are similar to those noted for the larger panels. The maximum wind loads on the across-river cables are 16,000 lbs and 20,450 lbs for winds from 0° and 45° respectively. The maximum wind loads measured on the across-river cables occur on the first two cables from the windward edge. The maximum wind loads on the third and fourth cables was 16,000 lbs. On the diagonal cables, the maximum wind loads were 7,900 lbs and 9,800 lbs respectively for winds from 0° and 45°. Again, it worth noting that, if the panels are located closer to surface of the river (Test 16), lower wind loads on the across-river cable (10,850 lbs) and diagonal cables (5,450 lbs) can be expected.

3.6 Conclusions

The overall conclusion drawn from the aeroelastic test results is that the fabric panel configurations of the Over the River project tested by RWDI have sufficient aerodynamic stability

that they should not be a concern.

Based on a 42 mph one minute mean wind speed, the maximum wind load on the across-river cables for the configurations tested by RWDI was approximately 22,000 lbs. Wind loads of this magnitude are expected on the first and second across-river cables. For the third and fourth across-river cables, the maximum wind load measured during the tests was approximately 17,000 lbs. The maximum wind load expected on a diagonal cable is approximately 11,000 lbs for a 42 mph one minute mean wind speed.

The wind loads on the cables are affected by the position of the panels above the river. Reducing the height of the panels above the river from 25 ft to 10 ft reduced the wind loads for the tested configuration in the across-river cables 1 and 2 by approximately 30%.

It must be noted that the wind speeds at Red Rocks (#3) and Three Rocks (#6) can be expected to be higher that for the rest of the locations and as such the loading of panels in these locations will be higher than indicated above. A more detailed look at the expected panel clearances above the river and panel geometries should be carried out for these regions. The data presented in Appendices D and E should be consulted for the wind speeds expected at these locations.

3.7 Applicability of the Results

The aeroelastic results presented in this report pertain to the two fabric panel configurations (120 ft x 40 ft and 90 ft x 35 ft) and the simplified model of the surrounding river valley constructed and tested at RWDI's wind tunnel test facility. Some variability due to site and panel geometry specifics can be expected.

4. FULL SCALE MOCK-UP TESTS

4.1 Overview

The objectives of the full scale mock up tests were to verify the assumptions and validate the results of the wind loading information obtained from the aeroelastic model tests. This was achieved by monitoring the loads and wind speeds on a full scale mockup which was built over a dry stream bed (arroyo) in Colorado for a period of 36 days from June 21, 1999 to July 26, 1999. Photographs of the mock-up tests are included in Figure 4-1.

4.2 Methodology

The methodology of the full-scale mockup tests involved instrumenting selected cables so that the tensile loads in the cables could be measured. A diagram of the mock-up test setup showing the location of the measuring equipment is included in Figure 4-2.

The tensile loads in the cables were measured by tension link load cells manufactured by Strainsert, Model STL-8.5(SS) Shackle Tension Link, having a full-scale range of 17,000 lbs. Appendix F lists the calibration data of all load cells used during the test program.

Also measured were the wind speed and wind direction. The wind speed and direction were measured using a RM Young Wind Sensor, the calibration of the wind sensor can be found in Appendix G.

All transducer signals were measured and logged using a Campbell Scientific model CR23X datalogger. The tensile load data was scanned at a rate of 5 samples per second, while the wind speed, wind direction, temperature and datalogger power levels were scanned at a rate of 1 sample per second. All collected data were then summarized into one minute mean, maximum, minimum and standard deviation values covering the one minute interval and stored for later retrieval. The datalogger ran continually for the duration of the test program with data downloaded manually from

the datalogger's final storage area on a routine basis (approximately once every two days).

4.3 Analysis

The test data from the full scale measurements were analyzed so as to be overlayed with the results from the earlier aeroelastic tests. This overlaying of the full-scale results with the aeroelastic results allowed a direct comparison of the predicted wind loads from the aeroelastic model to be made with the full scale wind loads. Since the loads of interest are the tensile loads generated by higher wind conditions, the data collected from the field tests were categorized into days of high winds and days of low winds. From the days of higher wind speed events, July 24th, 25th, and 26th stood out as having the highest wind loads. Appendix H shows the results of the overlaying of the full scale data from these dates with the results of the aeroelastic tests. The results presented in Appendix H are shown by link and wind direction. Figure 4-2 illustrates the layout of the instrumented cables with their identifying labels and also the convention used for wind direction. The wind loads presented for the aeroelastic model were obtained from tests of the 35 ft wide by 90 ft long fabric panels with pre-tensioning of the across-river cables that produced a 2 ft and 4 ft sag in the cables. These test configurations were considered to be those that most closely represented the full scale mock-up configuration.

In the plots in Appendix H, the x-axis is the one minute mean wind speed in mph over the fabric while the y-axis is the tensile load in pounds (lbs) in the cable. Also, as the areoelastic tests were performed at a time when the pretension in the cables was unknown, the aeroelastic data used in the plots of Appendix H have all been adjusted to have the same pretension as the full scale mockup.

4.4 Results

A review of the data presented in Appendix H shows that the results of the field tests line up favourably with the aeroelastic tests where the two overlap and that the aeroelastic tests appear to continue the trend shown at the lower speeds by the full-scale tests. To illustrate this point, the wind

loads measured on the full scale mock-up and aeroelastic model have been compared for various wind directions in Table 4.1 for a one minute mean wind speed of 20 mph. This table shows that while there are some small variations in the predicted wind loads from the aeroelastic tests to those measured on site, the wind loads in the across-river cables are well represented by the aeroelastic tests.

For the diagonal cables, the wind loads from the selected configurations of the aeroelastic tests are in many cases almost double what was measured in the field. However, this difference may be a function of the location of the anchor position with respect the fabric panels. The position of the anchors for diagonal cables was generally below the level of the across-river cables. Aeroelastic tests results presented in Table 3-3, show that the wind loads on diagonals are quite sensitive to their anchorage position and that is there is significant trend for many wind directions for lower wind loads to occur when the cables are located below the across-river cables. Taking these factors into consideration, the wind loads measured on the diagonal cables also compare reasonably well between the aeroelastic test results and the mock-up tests.

4.5 Conclusions

The wind loads recorded for the full scale mock-up tests are consistent with those measured on the aeroelastic scale model. This would indicate that issue of fabric porosity on the wind loads which was not fully duplicated on the wind tunnel model, does not play a significant role in the overall wind loads. Similarly, the effects of other assumptions and simplifications of the scaling parameters used on the aeroelastic model also had a relatively minor effect on the wind loads. Therefore using the results of the aeroelastic model study to directly predict the wind loads that will be experienced by the full scale project is appropriate and do not require further modification.

TABLES

Table 3.1: Summary of Test Configurations

Test #	120ft x 40ft Panel	90ft x 35ft Panel	2ft Sag	4ft Sag	6ft Sag	Diagonals Anchored 10ft Above Bank	Diagonals Anchored 10ft Below Bank	River clearance (ft)	Angle of Attack (degrees)	# of Fabric Panels
1	✓		✓					25	0	3
2	✓			✓				25	0	3
3	✓				✓			25	0	3
4	✓		✓				✓	25	0	3
5	✓		✓			✓		25	0	3
6	✓		✓					25	0	4
7	✓		✓					25	0	5
8*	-	-	-	-	-	-	-	-	-	-
9	✓		✓					10	0	3
10*	-	-	-	-	-	-	-	-	-	-
11		✓			✓			25	0	3
12		✓		✓				25	0	3
13		✓	✓					25	0	3
14		✓	✓				✓	25	0	3
15		✓	✓			✓		25	0	3
16		✓	✓					10	0	3
17a		✓	✓					25	+5	3
17b		✓	✓					25	-5	3
18		✓	✓					25	0	4
19		✓	✓					25	0	5

*No data available

Table 3.2: Predicted Wind Loads on Cables and Anchors 120 ft by 40ft Fabric Panels

Wind Loads (lbf)

0 Degree Wind	Test 1 *2 ft sag*	Test 2 *4 ft sag*	Test 3 *6 ft sag*	Test 4 *Diag Dwn*	Test 5 *Diag Up*	Test 6 *4 panels*	Test 7 *5 panels*	Test 9 *H=10 ft*
Across River Cable 1	9550	6650	5050	14600	12400	8100	8150	6800
Across River Cable 2	14200	7400	5900	12000	15600	6250	6150	6350
Across River Cable 3	6050	7600	4800	7250	10400	8050	6400	6300
Across River Cable 4	12650	12500	7500	11000	14050	6550	6550	8500
Diagonal One	10350	9200	6500	8750	6400	7250	6550	7050
Diagonal Two	11000	8300	5800	10150	9300	7950	7950	7650

	Max *lbf*	Min *lbf*	Average *lbf*
Across River Cable 1	14600	5050	8950
Across River Cable 2	15600	5900	9250
Across River Cable 3	10400	4800	7150
Across River Cable 4	14050	6550	9950
Diagonal One	10350	6400	7800
Diagonal Two	11000	5800	8550
Across River Cables	15600	4800	8825
Diagonals	11000	5800	8175

Wind Loads (lbf)

45 Degree Wind	Test 1 *2 ft sag*	Test 2 *4 ft sag*	Test 3 *6 ft sag*	Test 4 *Diag Dwn*	Test 5 *Diag Up*	Test 6 *4 panels*	Test 7 *5 panels*	Test 9 *H=10 ft*
Across River Cable 1	15050	14900	13750	11400	20850	-	-	5900
Across River Cable 2	19700	20700	21850	21550	21500	-	-	10600
Across River Cable 3	13350	14950	13500	16550	12900	-	-	10800
Across River Cable 4	9300	10050	7200	7250	10700	-	-	11300
Diagonal One	9750	8550	8400	9800	4900	-	-	4800
Diagonal Two	10100	9450	7400	8350	8850	-	-	4400

	Max *lbf*	Min *lbf*	Average *lbf*
Across River Cable 1	20850	5900	13650
Across River Cable 2	21850	10600	19350
Across River Cable 3	16550	10800	13700
Across River Cable 4	11300	7200	9300
Diagonal One	9800	4800	7700
Diagonal Two	10100	4400	8100
Across River Cables	21850	5900	14000
Diagonals	10100	4400	7900

Table 3.3: Predicted Wind Loads on Cables and Anchors
90ft by 35ft Fabric Panels

Wind Load (lbf)

0 Degree Wind

	Test 13 *2 ft sag*	Test 12 *4 ft sag*	Test 11 *6 ft sag*	Test 14 *Diag Dwn*	Test 15 *Diag Up*	Test 18 *4 panels*	Test 19 *5 panels*	Test 17a *+5 deg*
Across River Cable 1	4900	4850	4050	8750	11700	5400	5150	4900
Across River Cable 2	5100	6150	4450	8950	8200	4950	5400	5500
Across River Cable 3	5200	4850	4150	8450	9450	6650	5400	3900
Across River Cable 4	10550	10050	7050	8600	8950	6350	8000	-
Diagonal One	6600	5000	4650	4800	7100	6600	6100	5400
Diagonal Two	6400	4900	4800	4850	7200	4750	4450	3700
Diagonal Three	5150	4050	3800	3550	7100	3750	4950	2650
Diagonal Four	5700	4050	3900	3600	7900	6250	4300	3100

	Max *lbf*	Min *lbf*	Average *lbf*
Across River Cable 1	11700	3750	5350
Across River Cable 2	8950	4450	5850
Across River Cable 3	16000	3900	6900
Across River Cable 4	13750	5800	7950
Diagonal One	7100	4650	5850
Diagonal Two	7200	3700	5350
Diagonal Three	7100	2650	4500
Diagonal Four	7900	3100	4650
Across River Cables	16000	5800	7950
Diagonals	7900	4650	5850

Wind Load (lbf)

45 Degree Wind

	Test 13 *2 ft sag*	Test 12 *4 ft sag*	Test 11 *6 ft sag*	Test 14 *Diag Dwn*	Test 15 *Diag Up*	Test 18 *4 panels*	Test 19 *5 panels*	Test 17a *+5 deg*
Across River Cable 1	14450	13250	13000	17600	8200	-	-	10500
Across River Cable 2	20350	19600	19800	19950	14150	-	-	16350
Across River Cable 3	14750	14650	14250	13500	13000	-	-	13700
Across River Cable 4	8900	8400	7350	10300	6250	-	-	9700
Diagonal One	6800	6350	7300	3350	8900	-	-	6250
Diagonal Two	5750	6050	8100	5200	8150	-	-	6850
Diagonal Three	4950	4700	7850	3550	7450	-	-	5150
Diagonal Four	4850	5550	6650	4250	8150	-	-	5700

	Max *lbf*	Min *lbf*	Average *lbf*
Across River Cable 1	17600	6350	12300
Across River Cable 2	20450	9450	17550
Across River Cable 3	15200	10850	13750
Across River Cable 4	10300	6250	8650
Diagonal One	9150	3350	6650
Diagonal Two	9800	4300	6800
Diagonal Three	8250	3550	5700
Diagonal Four	8150	3700	5850
Across River Cables	20450	10850	17550
Diagonals	9800	4300	6800

Table 4.1: Comparison of Wind Loads Measured on Aeroelastic Model to Full Scale Model for One Minute Mean Wind Speed of 20mph

Wind Direction: 0 degrees

Location	Predicted Load on Anchors (lbs) Aeroelastic Tests			Mock-up Tests
	2 ft	4 ft	Avg	
Link 1 - Diagonal One	2045	1521	1783	2000
Link 2 - Cross River Cable 1	3614	3414	3514	4500
Link 3 - Cross River Cable 2	4714	5167	4940	5000
Link 4 - Cross River Cable 4	5871	6395	6133	5700
Link 5 - Diagonal Two	1650	1464	1557	800

Wind Direction: +/ 22.5 degrees

Location	Predicted Load on Anchors (lbs) Aeroelastic Tests			Mock-up Tests
	2 ft	4 ft	Avg	
Link 1 - Diagonal One	2193	1812	2002	1800
Link 2 - Cross River Cable 1	5300	4957	5129	5000
Link 3 - Cross River Cable 2	5776	6614	6195	6000
Link 4 - Cross River Cable 4	5243	6395	5819	6000
Link 5 - Diagonal Two	1707	1464	1586	1100

Wind Direction: +/- 45 degrees

Location	Predicted Load on Anchors (lbs) Aeroelastic Tests			Mock-up Tests
	2 ft	4 ft	Avg	
Link 1 - Diagonal One	1907	1760	1833	1500
Link 2 - Cross River Cable 1	6662	6224	6443	6500
Link 3 - Cross River Cable 2	8019	7981	8000	8100
Link 4 - Cross River Cable 4	4610	4514	4562	6700
Link 5 - Diagonal Two	1174	1469	1321	1400

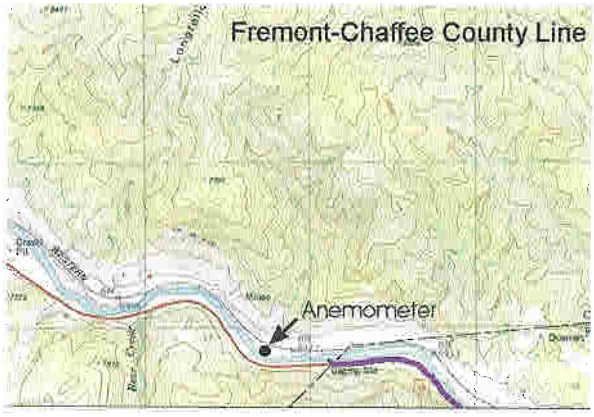
Wind Direction: +/- 67.5 degrees

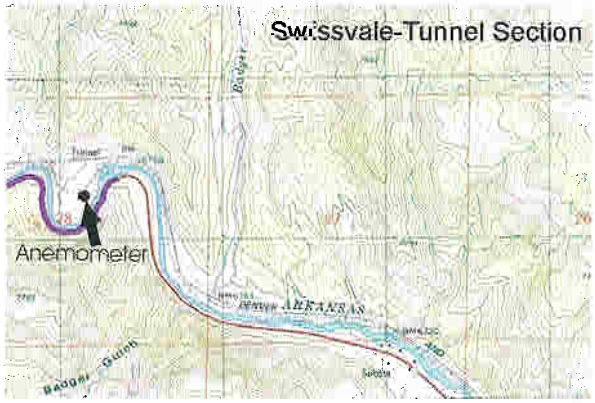
Location	Predicted Load on Anchors (lbs) Aeroelastic Tests			Mock-up Tests
	2 ft	4 ft	Avg	
Link 1 - Diagonal One	1693	1121	1407	1000
Link 2 - Cross River Cable 1	5243	5086	5164	5000
Link 3 - Cross River Cable 2	5757	6357	6057	6000
Link 4 - Cross River Cable 4	3914	3971	3943	4500
Link 5 - Diagonal Two	1307	1079	1193	1000

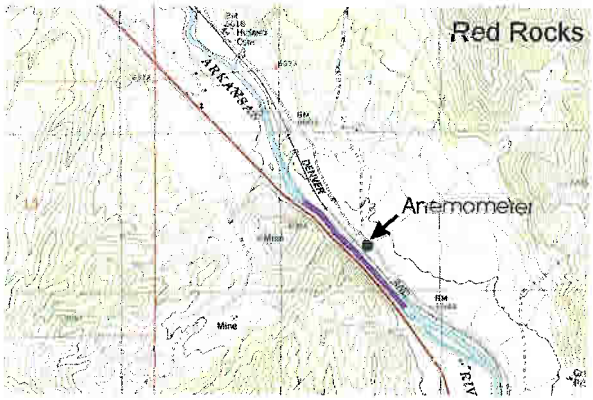
Wind Direction: +/- 90 degrees

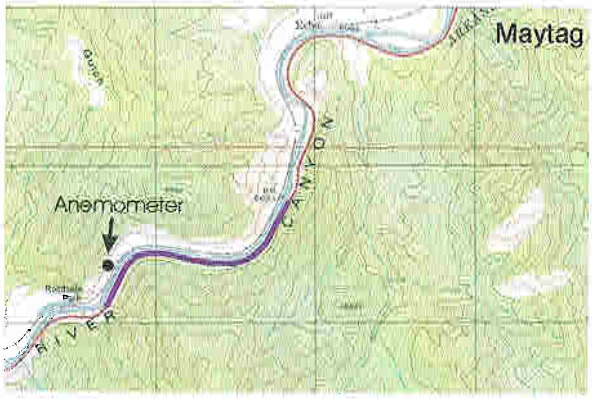
Location	Predicted Load on Anchors (lbs) Aeroelastic Tests			Mock-up Tests
	2 ft	4 ft	Avg	
Link 1 - Diagonal One	777	677	727	1000
Link 2 - Cross River Cable 1	4055	4009	4032	4200
Link 3 - Cross River Cable 2	4436	4964	4700	4800
Link 4 - Cross River Cable 4	3827	3973	3900	4000
Link 5 - Diagonal Two	677	777	727	800

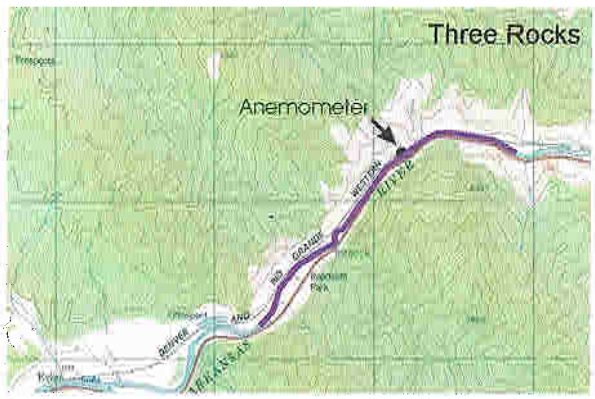
FIGURES

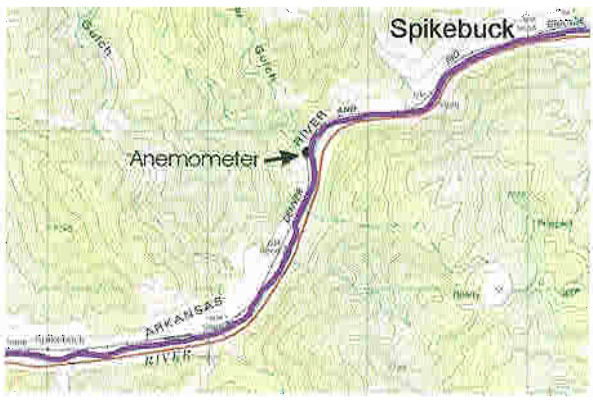






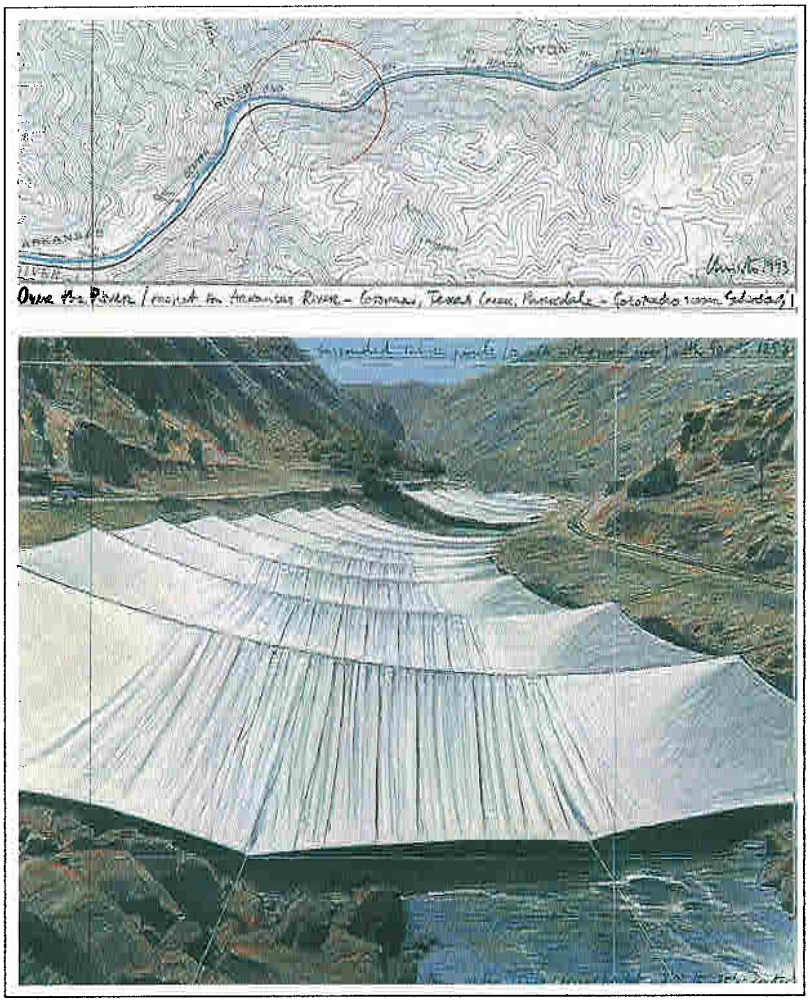




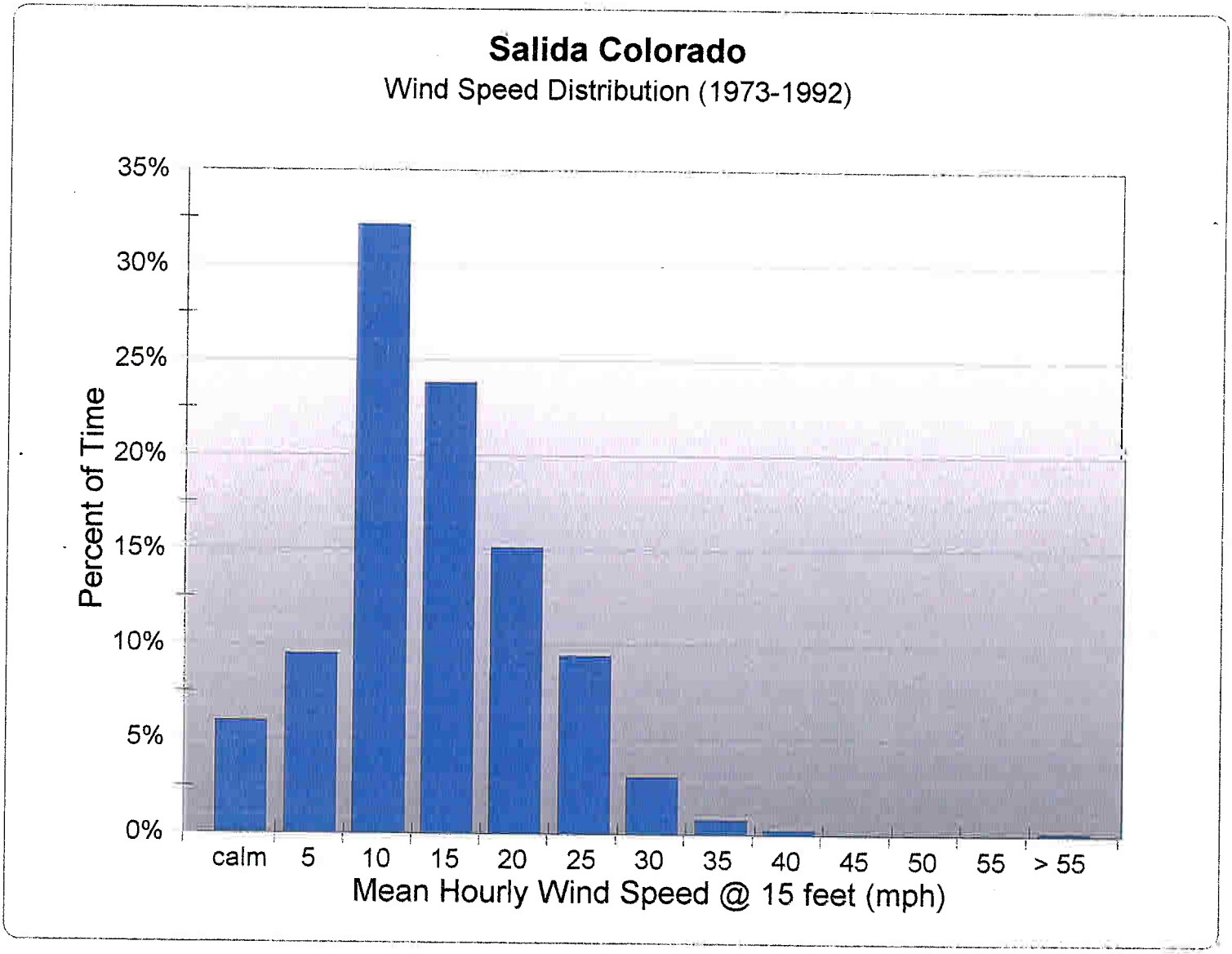


Proposed Locations of Fabric Panels

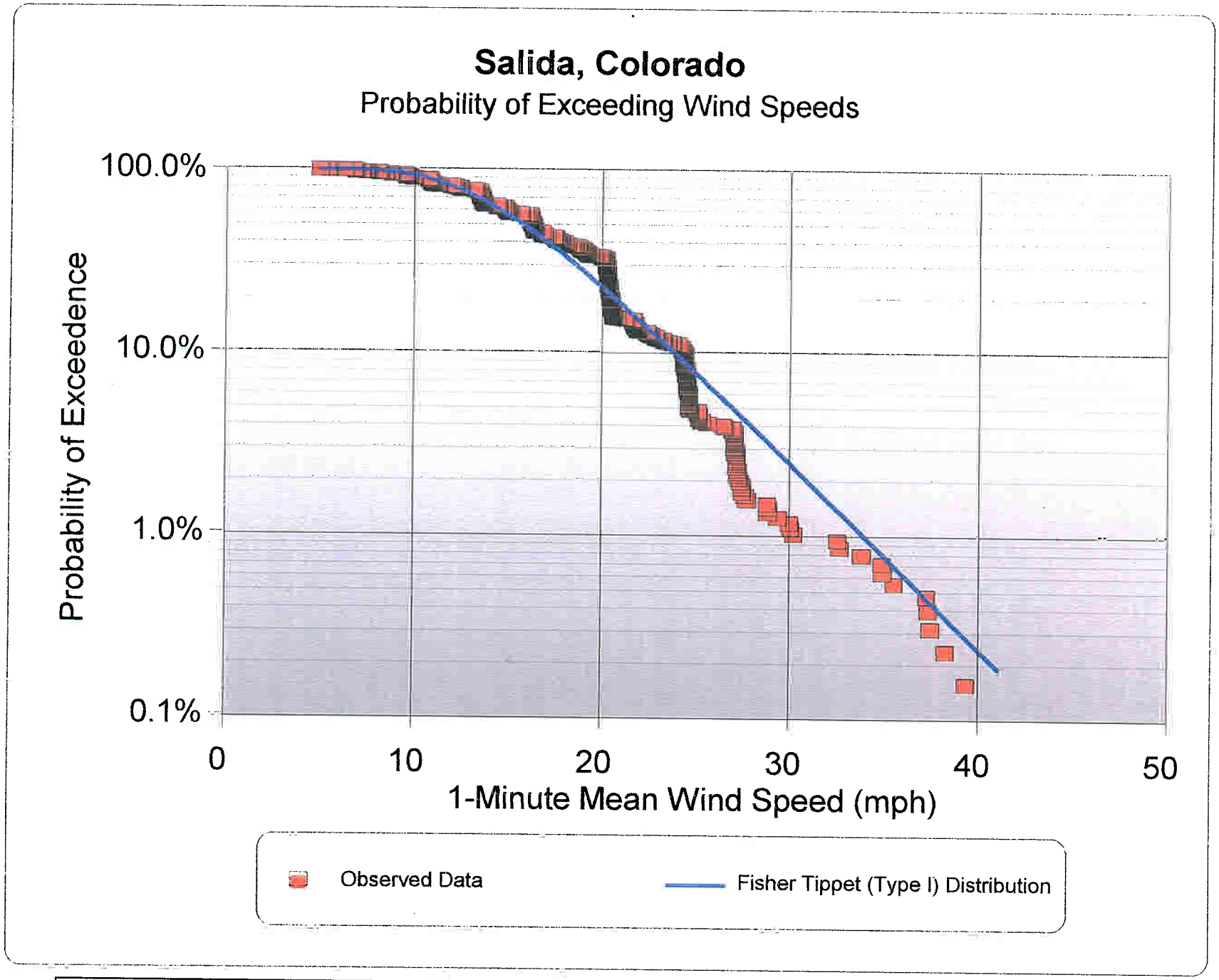
Overview of Project	Figure No. 1-1	RWDI
Over The River - Arkansas River, Colorado — Project #98-130	Date: January 14, 2000	



Christo's Sketches of Over The River Project	Figure No. 1-2	RWDI
Over The River Project - Arkansas River, Colorado — Project #98-130	Date: January 14, 2000	



Frequency Distribution of Mean Hourly Wind Speeds **Salida, Colorado 1973-1992**	Figure No. **2-1**	RWDI
Over the River Project - Arkansas River, Colorado Project #98-130	Date: January 12, 2000	



Probability vs One Minute Mean Wind Speed at 15ft above Grade
Salida, Colorado 1973-1992

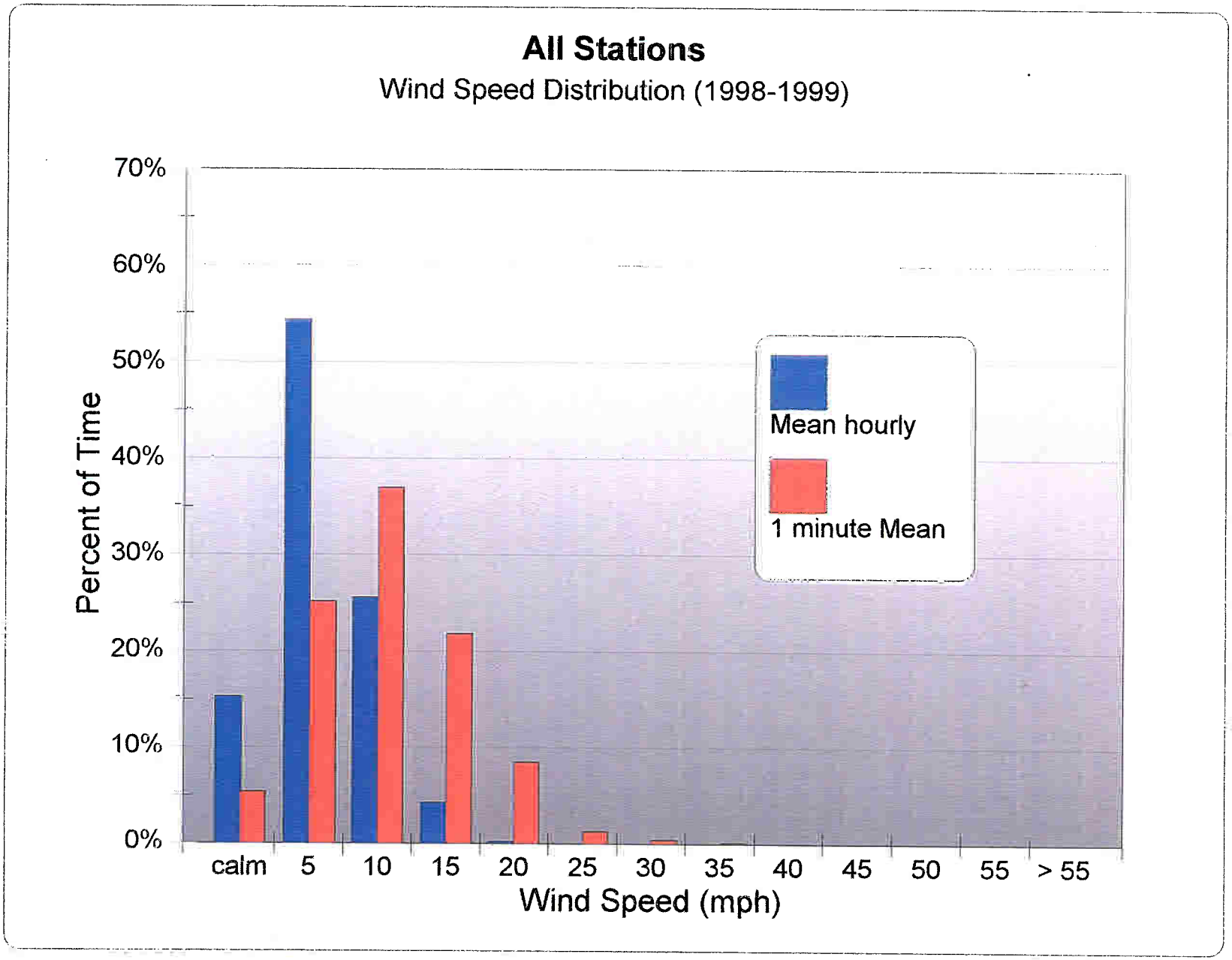
Over the River Project - Arkansas River, Colorado

Project #98-130

Figure No. **2-2**

Date: January 12, 2000

RWDI



Frequency Distribution of One Minute Mean Wind Speeds at 15 ft above Grade
Summary of all On-site Anemometers

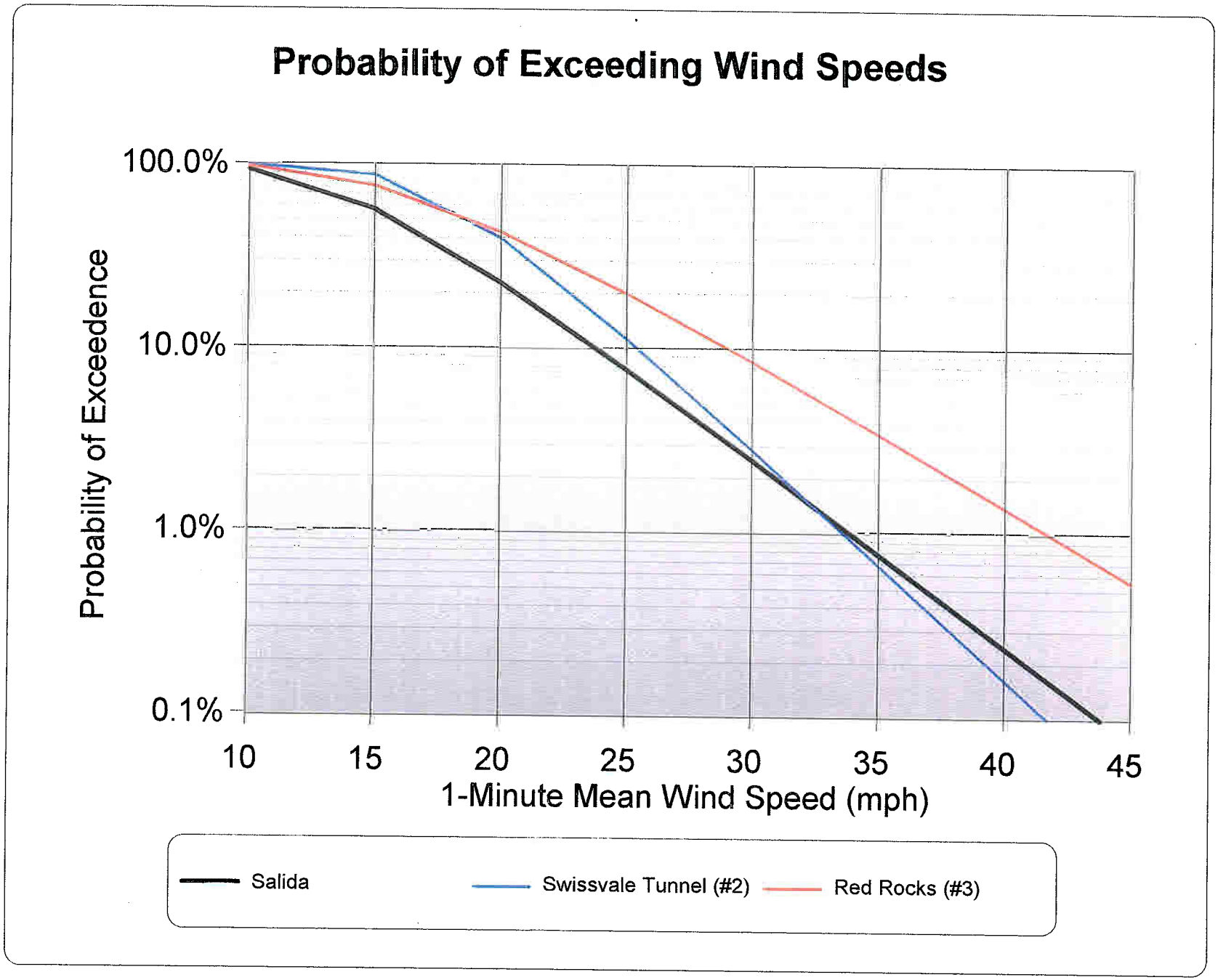
Over the River Project - Arkansas River, Colorado

Project #98-130

Figure No. **2-3**

Date: January 12, 2000

RWDI



Probability vs One Minute Mean Wind Speed at 15 ft above Grade
Stations #2, #3 and Salida, Colorado

Over the River Project - Arkansas River, Colorado

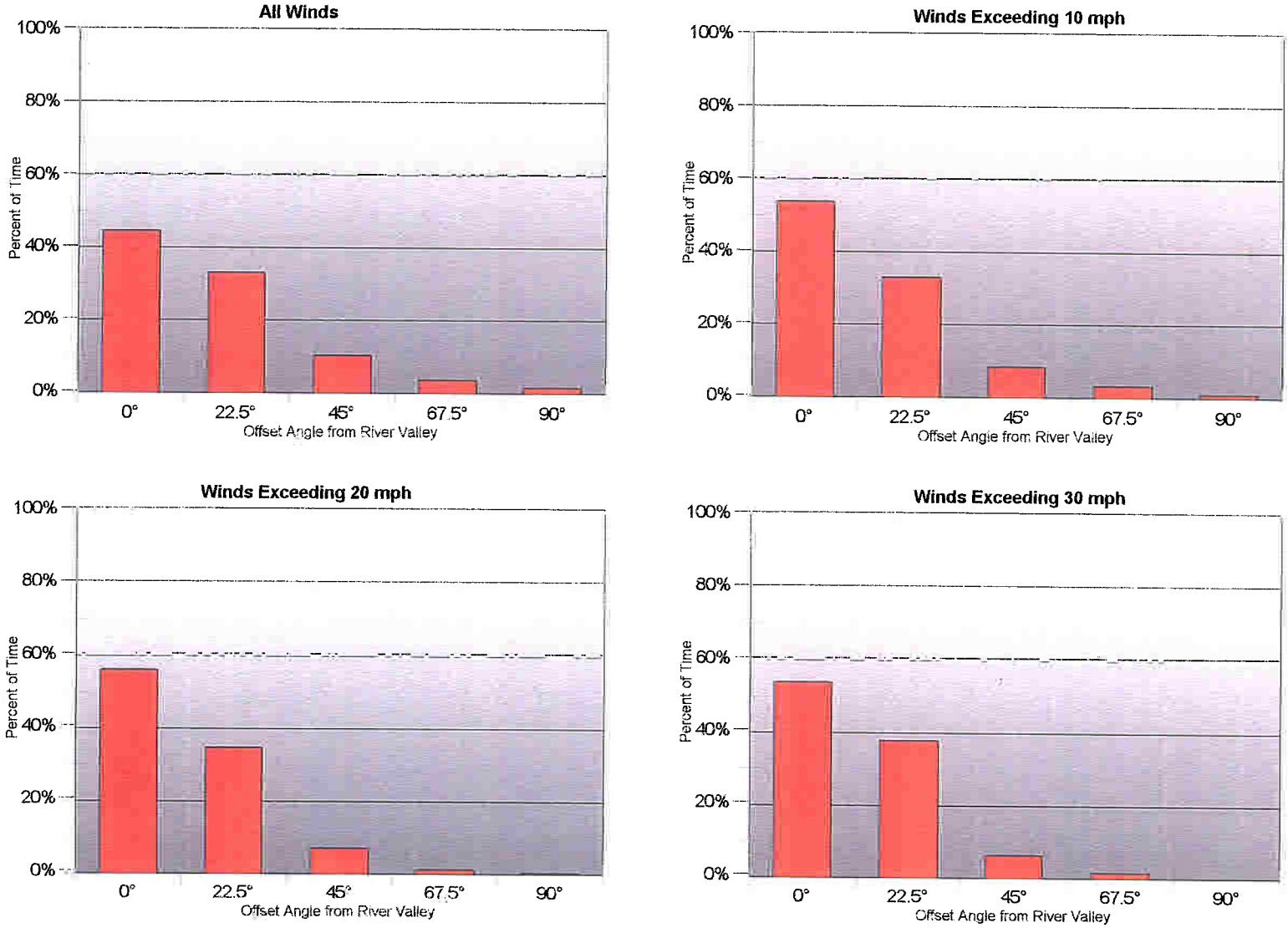
Project #98-130

Figure No. 2-4

Date: January 12, 2000

RWDI

All Stations
1998-1999



Directional Distribution of Winds
Summary of All On-site Anemometers

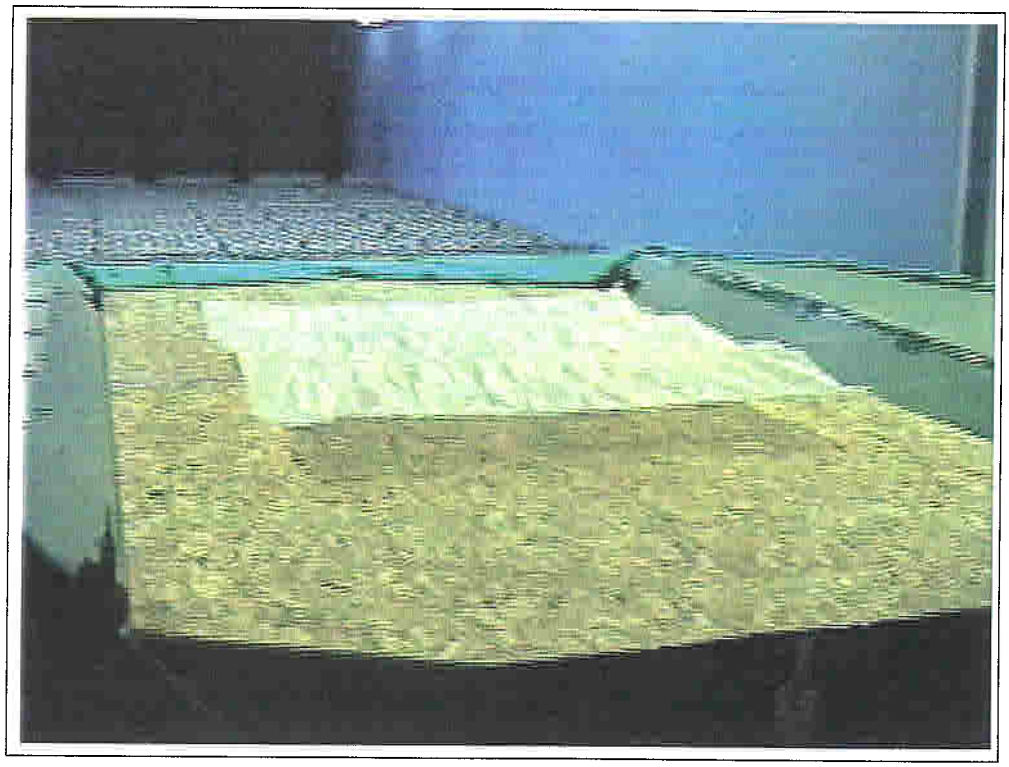
Over the River Project - Arkansas River, Colorado

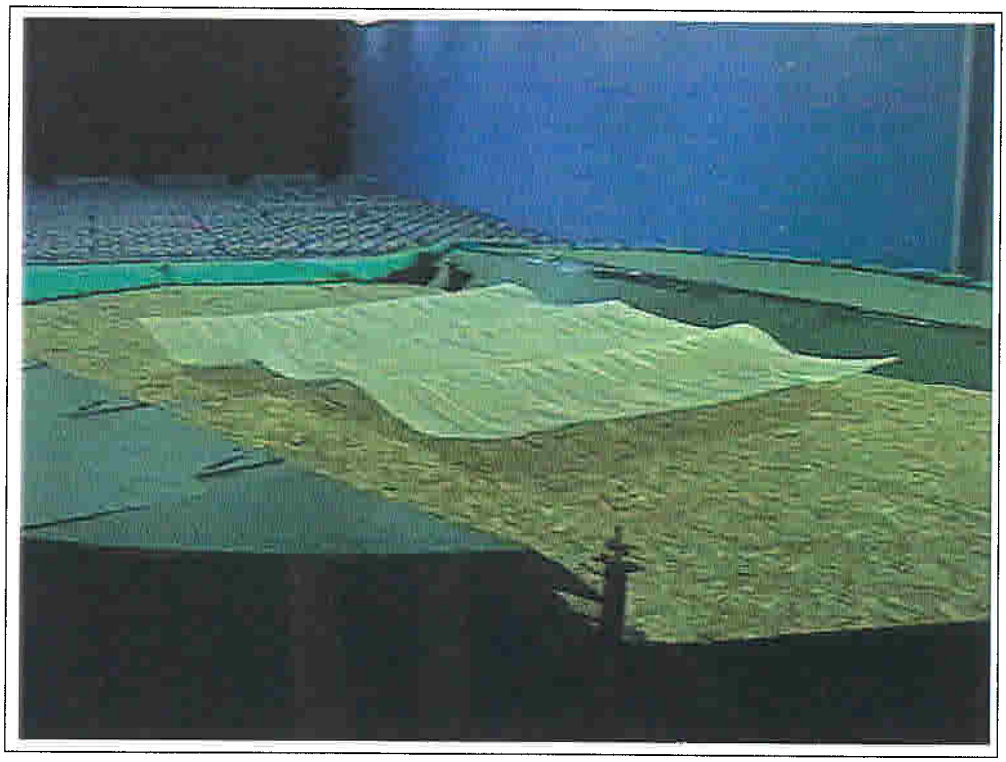
Project #98-130

Figure No. 2-5

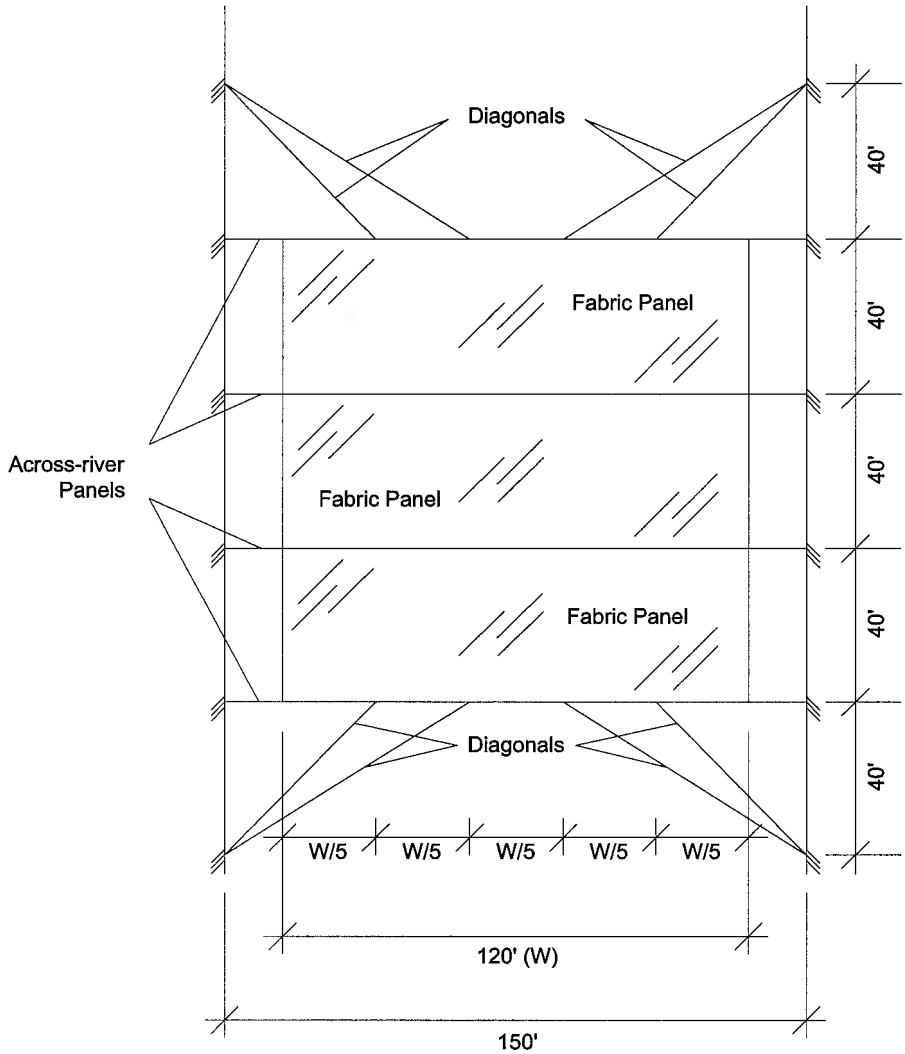
Date: January 12, 2000

RWDI

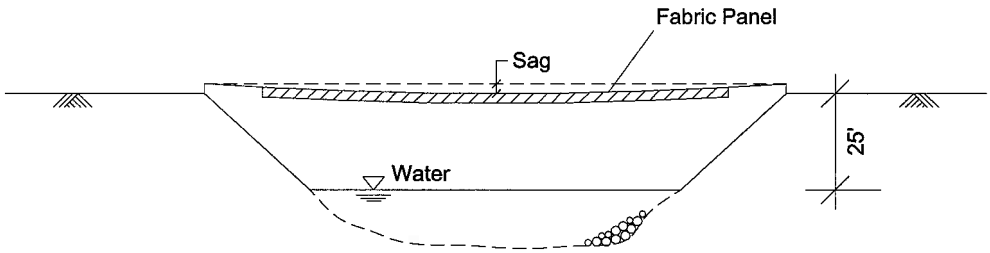




Aeroelastic Test Model	Figure No. 3-1	RWDI
Over the River Project - Arkansas, Colorado Project #98-130	Date: January 14, 2000	

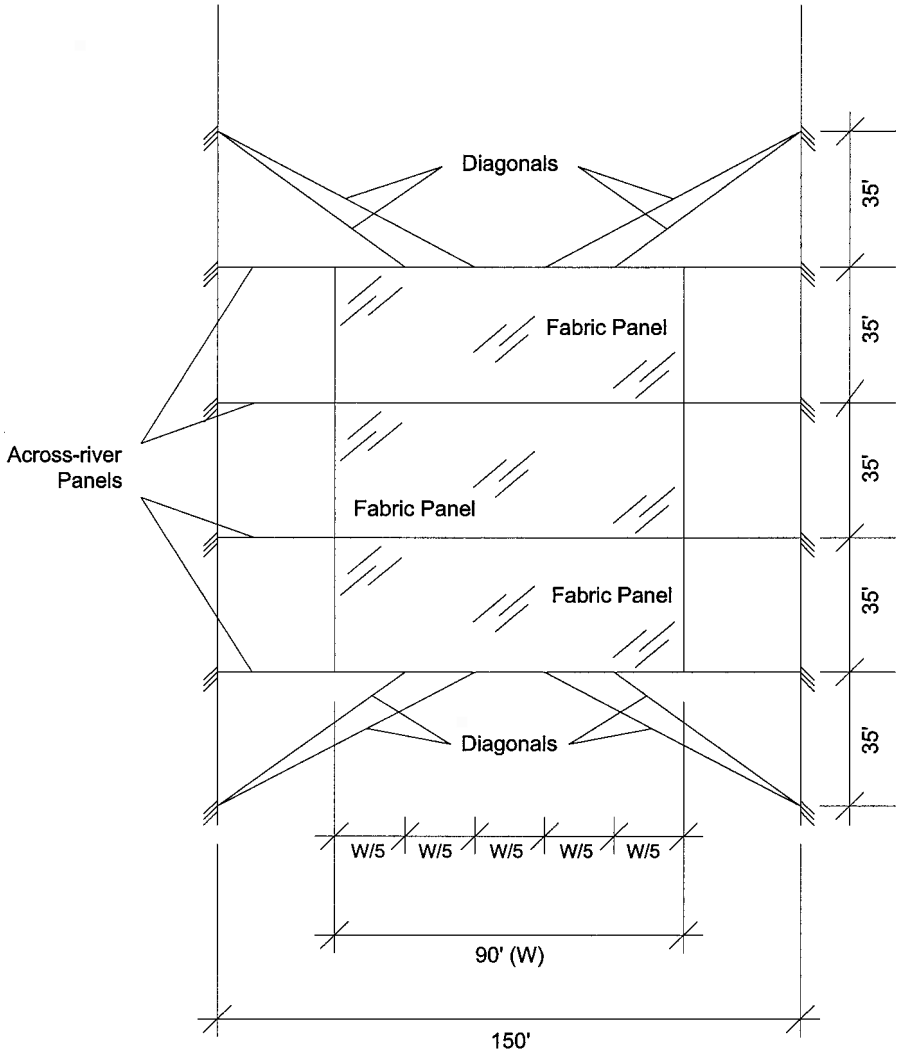


PLAN



RIVER CROSS-SECTION

Dimensions of Aeroelastic Model 120' x 40' Fabric Panels	Drawn by: PKM	Fig: **3-2a**	RWDI
	Approx. Scale:	1"=50'	
Over the River Project - Arkansas, Colorado Project #98-130	Date Revised:	Jan. 13, 2000	



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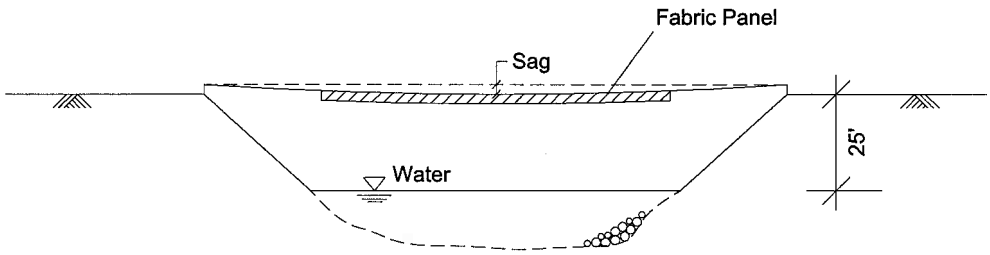
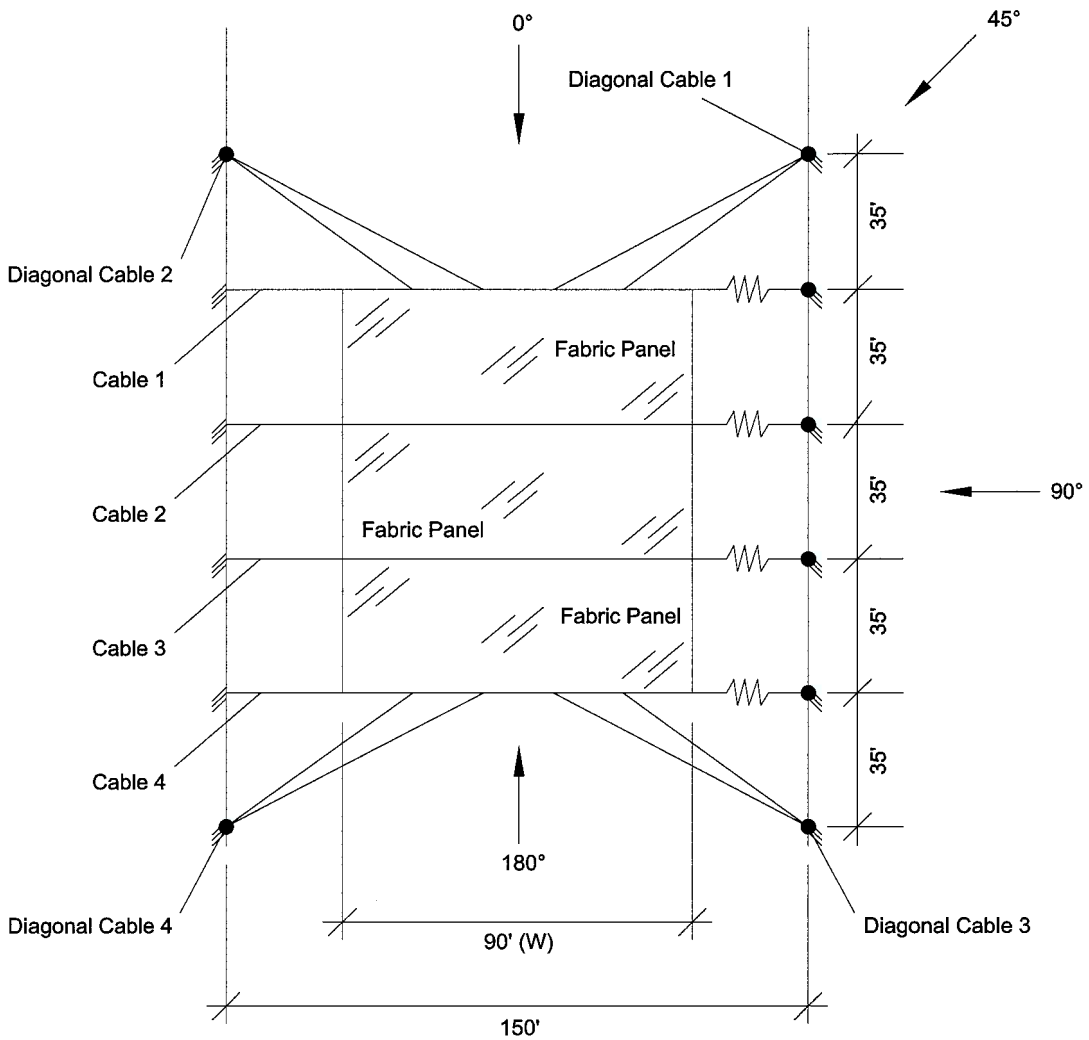


RIVER CROSS-SECTION

Dimensions of Aeroelastic Model 90' x 35' Fabric Panels	Drawn by: PKM	Fig: **3-2b**	RWDI
	Approx. Scale:	1"=50'	
Over the River Project - Arkansas, Colorado Project #98-130	Date Revised:	Jan. 13, 2000	



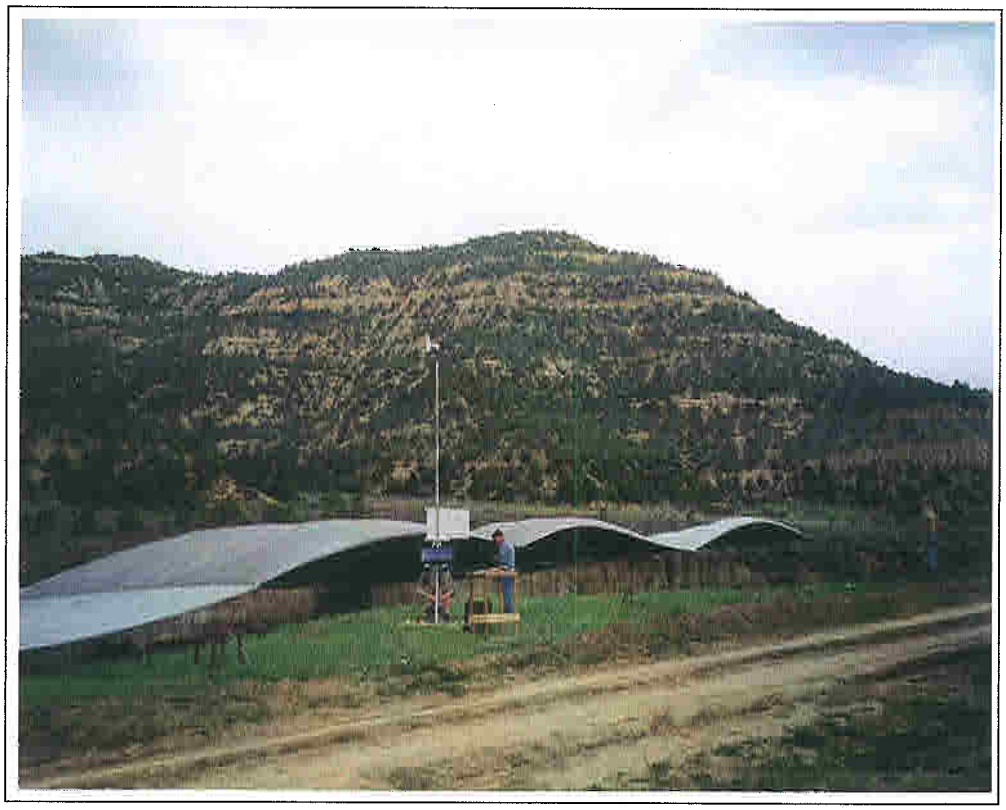
PLAN

NOTE:

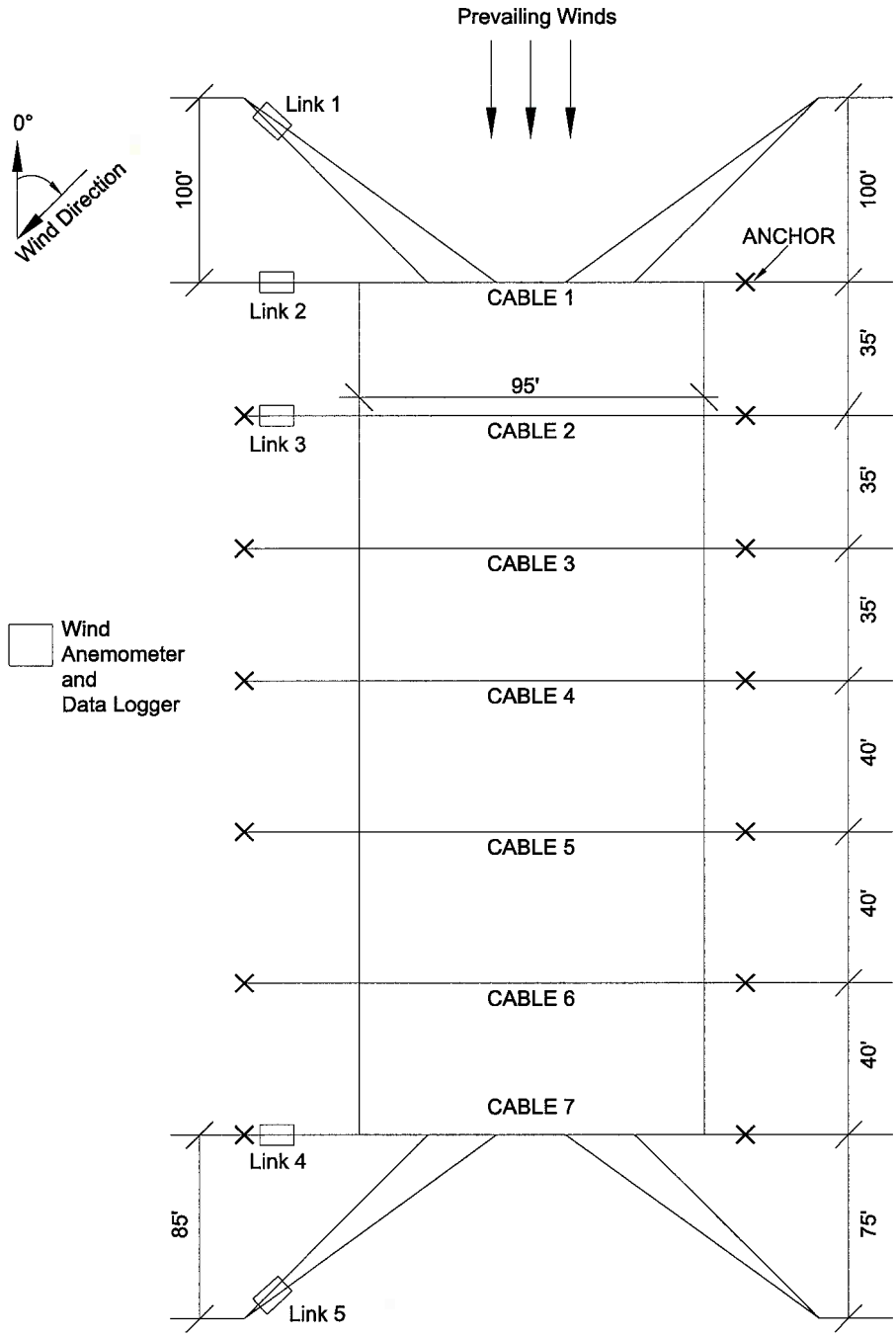
● STRAIN GAGE LOCATIONS

SPRING

Co-ordinate System and Test Setup	Drawn by: PKM	Figure: **3-3**	RWDI
	Approx. Scale:	1"=50'	
Over the River Project - Arkansas, Colorado Project #98-130	Date Revised:	Jan. 14, 2000	



Full Scale Mock - Up Tests	Figure No. 4-1	RWDI
Over The River Project - Arkansas River, Colorado Project #98-130	Date: January 14, 2000	



Dimensions of Full Scale Mock-up and Location of Instrumention	Drawn by: PKM	Figure: **4-2**	RWDI
	Approx. Scale:	N.T.S.	
Over the River Project - Arkansas, Colorado Project #98-130	Date Revised:	Jan. 13, 2000	

APPENDIX A

On-Site Wind Speed Measurements

ON-SITE WIND SPEED MEASUREMENTS
FOR
OVER THE RIVER PROJECT
ARKANSAS RIVER, COLORADO

Project Number: 98-130
Date: July 31, 1998
Submitted By: Rowan Williams Davies & Irwin Inc.
Project Manager - Mark A. Hunter
Principal - Scott L. Gamble
Project Co-ordinator - Bruce McInnis

Submitted to: CVJ Corporation

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc (RWDI) were retained by the CVJ Corporation to install a total of eight wind anemometers at selected sites along the Arkansas River between Cañon City and Salida, Colorado. Each of the sites selected were situated in areas where fabric is proposed to cover the river for the Over the River Project. These sites have been defined as follows:

1. Chaffee- Fremont County Line
2. Swissvale - Tunnel Area
3. Red Rocks
4. Texas Creek
5. Maytag
6. Three Rocks
7. Spikebuck
8. Parkdale Siding - Canyons

The primary objective of installing wind instruments at these sites is to provide detailed information on the wind speeds and wind directions that are present in different sections of the river valley where the Over the River project will be present. This information will be used in conjunction with long term wind records for the area, the results of wind tunnel tests and measurements on full scale mockups of the project to determine the wind loads acting on the fabric, cables and anchors.

All anemometers were installed during the week of July 20, 1998. The present intent is to record wind data at each of the sites over the period of July through October in 1998, 1999 and 2000.

This report provides additional information on the location of the anemometers, the equipment installed, instructions for setting up the anemometers and downloading data from anemometers and bi-monthly inspections that should be carried out at each station. Accordingly, this report has been divided into the following sections:

1. Information on Anemometer Sites
2. Anemometer Components Installed and Measurement Parameters
3. Bi-monthly Inspections and Instructions for Setting-up the ENV50 System and Downloading Data

SECTION 1

INFORMATION ON ANEMOMETER SITES

Anemometer Site No. 1
Fremont-Chaffee County Line

Installed: July 24, 1998 am (No memory board installed due to bad board)

Anemometer Height: 17 ft above local grade

Directionality: Referenced to Magnetic North

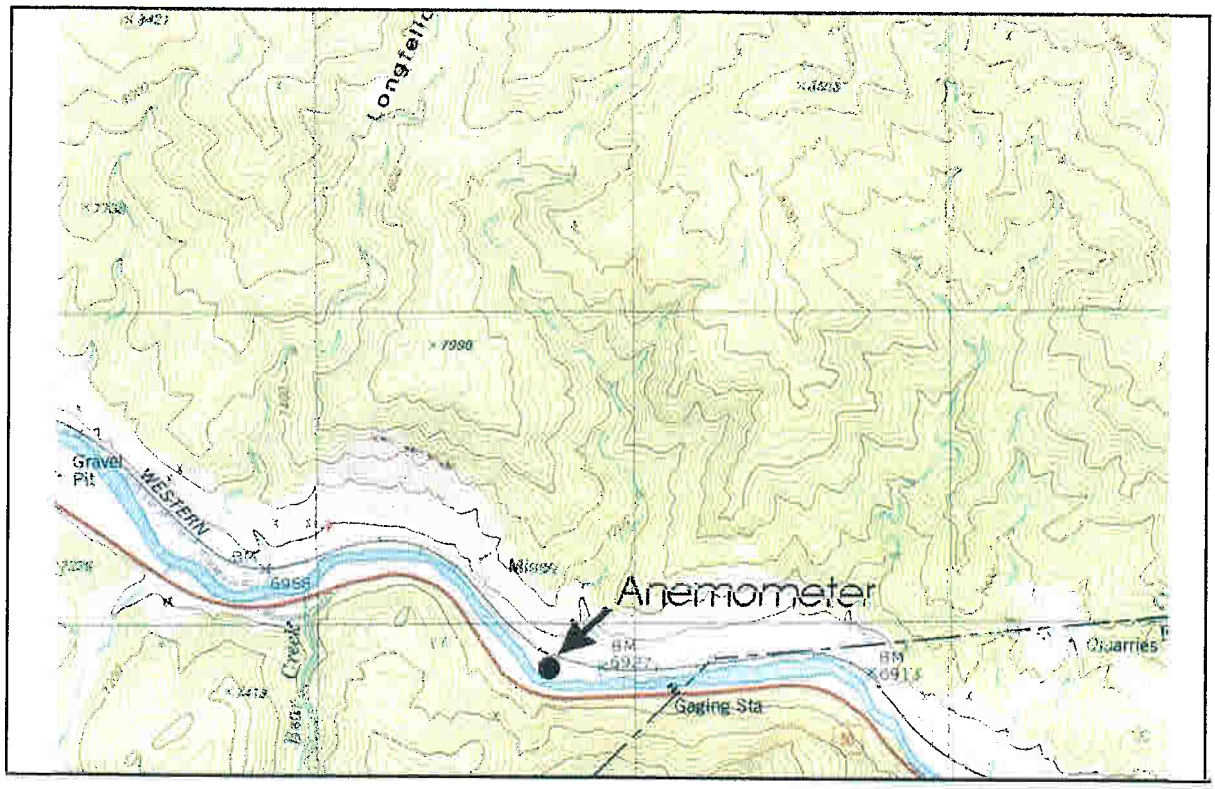
River Orientation: Northwest- Southeast

Site Location: Highway 50 Mile Marker - 225.3

Site Access: From highway, north across bridge over the Arkansas River at Cattle Auction Yard; follow unimproved road east to the end and then walk along railway line approximately 0.75 miles.

General Notes:

- the anemometer is located approximately 20 ft northeast of the river bank; approximately 100 ft southwest of rail line and is situated approximately 25 ft above the water surface
- a fairly level site with good immediate exposure in all directions except towards the river (southwest) where a 12 to 14 ft high tree is situated
- banks on the road and rail sides of the river similar in height
- site in a valley with hills of 80 to 100 ft on both the road and rail side of the river



Anemometer Site No. 1 - Fremont-Chaffee County Line

Anemometer Site No. 2
Swissvale - Tunnel Section

Installed: July 21, 1998 pm

Anemometer Height: 15 ft above local grade

Directionality: Referenced to Magnetic North

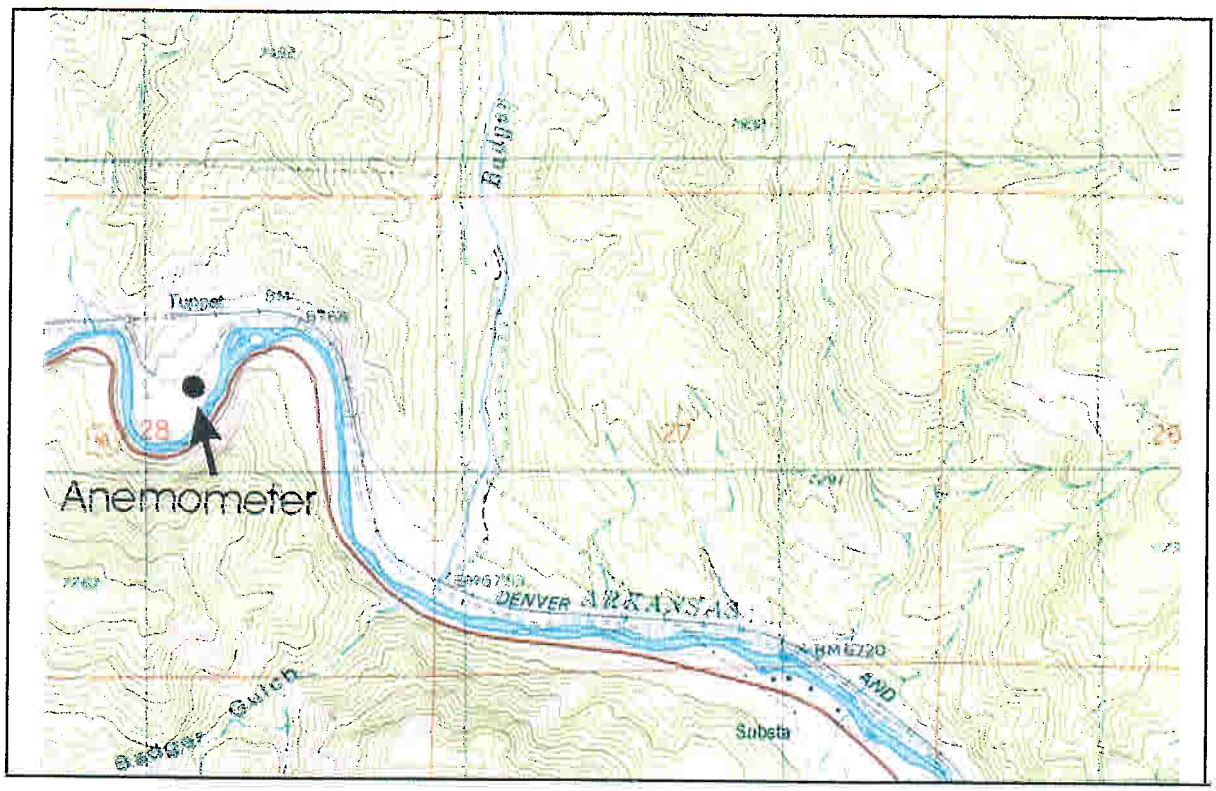
River Orientation: Varied but Northeast-Southwest near anemometer

Site Location: Highway 50 Mile Marker - 230.8

Site Access: Road: Across the Arkansas River at Wellsville and then east on unimproved road to tunnel area

General Notes: - the anemometer is located approximately 30 ft to the west of the river which zig-zags in a north-south direction

- anemometer site situated on fairly flat terrain in its immediate surroundings
- fairly steep slopes on the road side of the river to a height of approximately 100 ft.
- road side of the river bank is generally 15 to 25 ft higher than rail side of the river bank
- far field topography in the area is generally less than a 400 ft change in elevation
- small hill 10 to 15 ft high located approximately 100 yards to the west of the anemometer site
- otherwise good exposure to westerly winds that should make the site representative of this area of the project



Anemometer Site No. 2 - Swissvale - Tunnel Section

Anemometer Site No. 3
Red Rocks

Installed: July 23, 1998: pm

Anemometer Height: 17 ft above local grade

Directionality: Referenced to Magnetic North

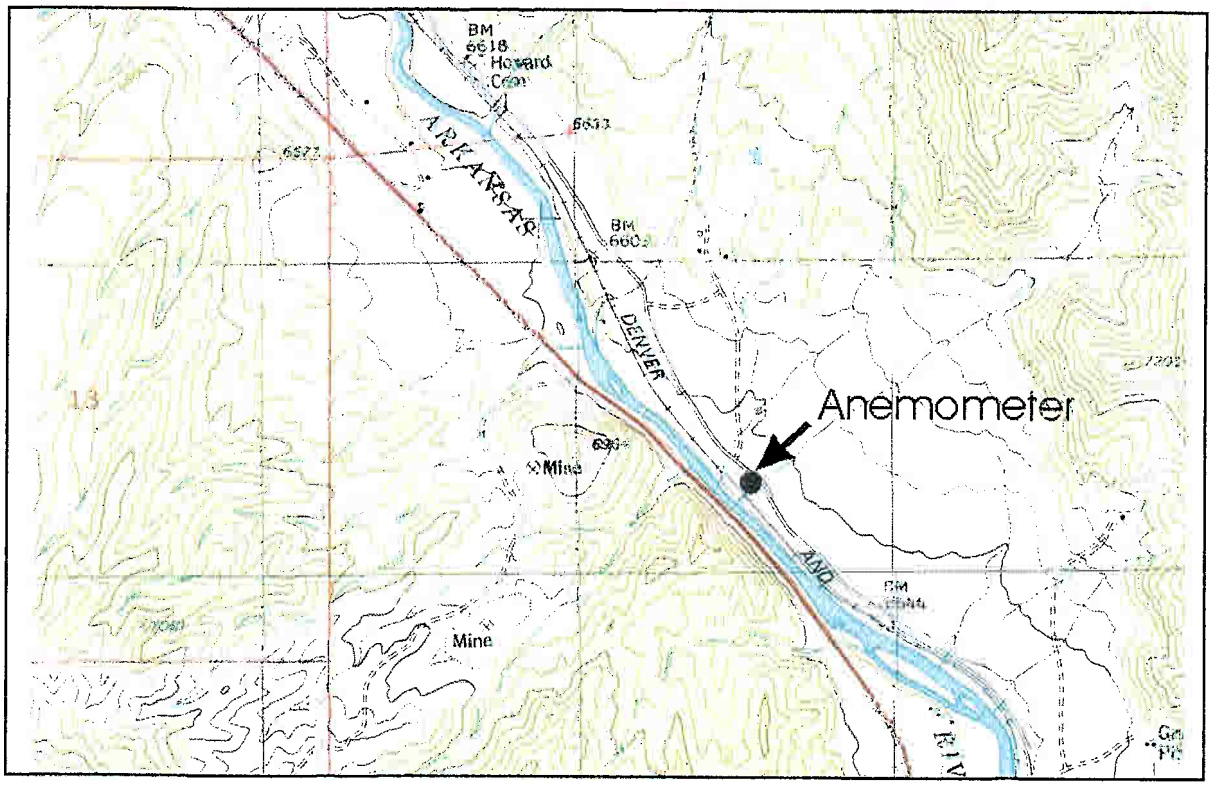
River orientation: Northwest-Southeast

Site Location: Highway 50 Mile Marker - 237.9

Site Access: Road; across Arkansas River from Highway 50 at Vallie and then northeast approximately 1 mile

General Notes: - the anemometer is located approximately 45 ft to the southwest of the river and approximately 25 ft above river

- fairly flat terrain to the northwest and southeast of the anemometer but a 12 to 15 ft embankment is situated approximately 20 ft to the northeast of site running parallel to river and rail tracks
- fairly steep slopes on the road side of the river to a height of approximately 60 to 100 ft.
- road and rail sides of the river bank have similar height
- far field topography to the northeast open range
- anemometer does rise above the embankment to the northeast of the site by 3 to 4 ft
- anemometer situated close to rail line and could be affected by passing trains.



Anemometer Site No. 3 Red Rocks

Anemometer Site No. 4
Texas Creek

Installed: July 22, 1998; am

Anemometer Height: 15 ft above local grade

Directionality: Referenced to Magnetic North

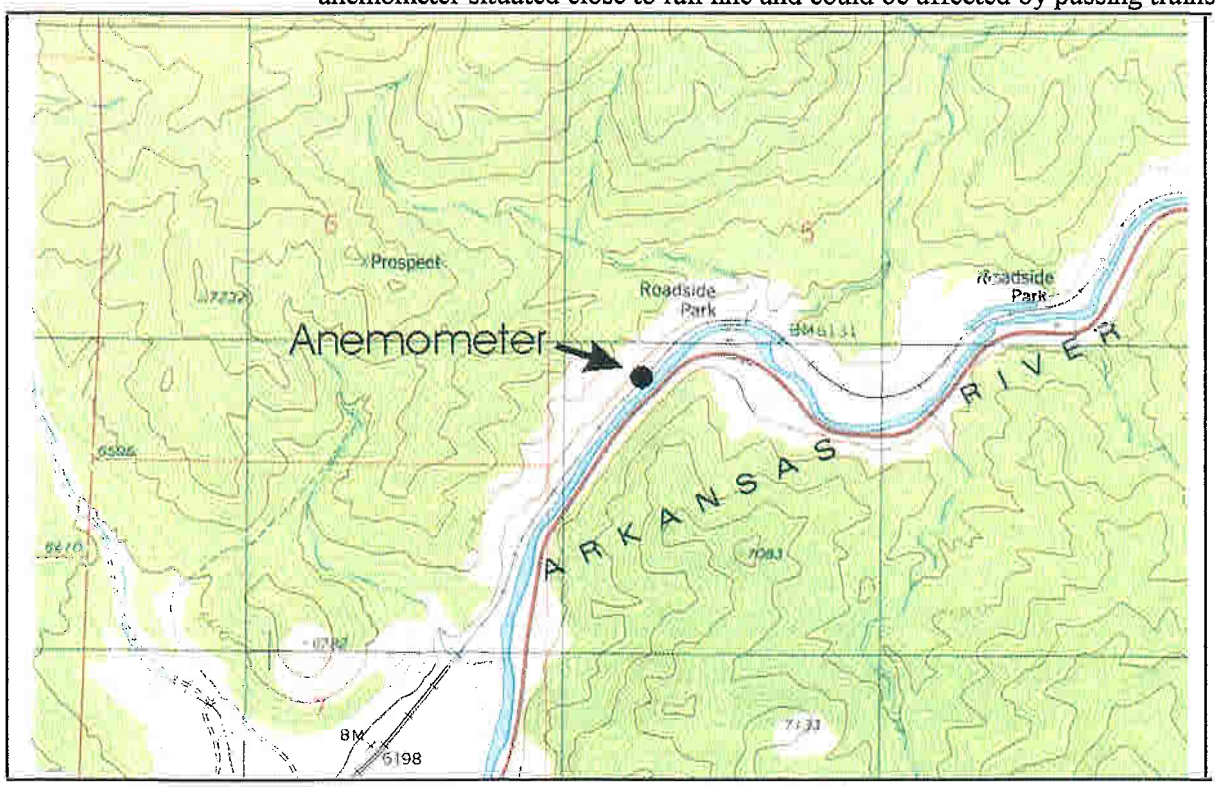
River Orientation: Northeast-Southwest

Site Location: Highway 50 Mile Marker - 254.2

Site Access: Raft; put in at Texas Creek and site is located approximately 1.5 miles down river.

General Notes: the anemometer is located approximately 50 ft to the northwest of the river and approximately 20 to 25 ft above the river

- steep grade change to the river and steep grade change to the northwest of the rail line
- steep slopes on the road and rail sides of the river to heights well over 100 ft creating a valley exposure
- road and rail sides of the river bank similar height
- far field topography to the northwest and southeast rise approximately 800 to 1000 ft.
- sharp turn in the river and valley to an east-west orientation approximately 1/4 mile to the northeast of anemometer
- anemometer situated close to rail line and could be affected by passing trains.



Anemometer Site No. 4 - Texas Creek

Anemometer Site No. 5
Maytag

Installed: July 22, 1998; pm

Anemometer Height: 15 ft above local grade

Directionality: Referenced to Magnetic North

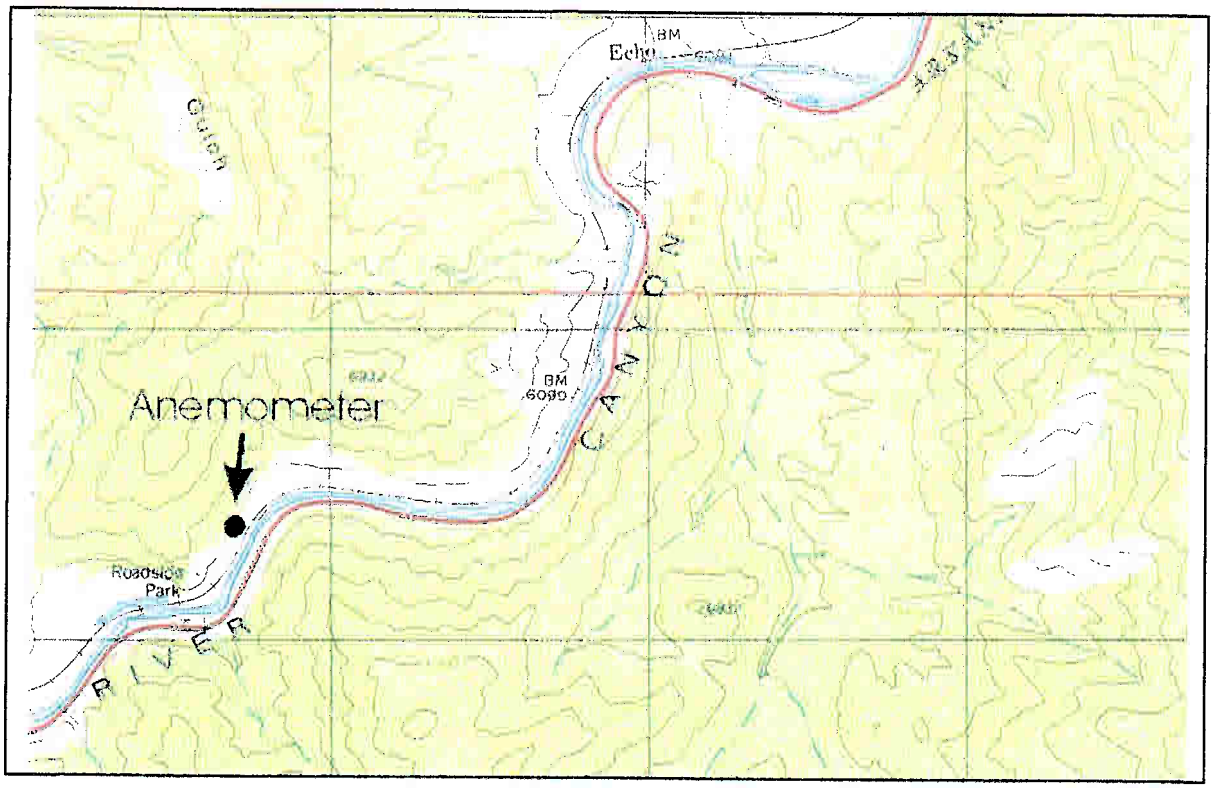
Orientation of River: North-northeast - South-southwest

Site Location: Highway 50 Mile Marker - 255.3

Site Access: Raft: put in at Texas Creek and is located approximately 3 miles down river

General Notes:

- the anemometer is located on flat terrain approximately 60 ft to the west of the river and approximately 15 ft above the river
- steep grade change to the river and steep grade change approximately 50 ft to the west of the anemometer
- steep slopes on the road and rail sides of the river to heights well over 100 ft creating a valley exposure
- road and rail sides of the river bank have similar height
- far field topography to the west and east rise approximately 800 to 1000 ft.
- sharp turn in the river and valley to an east-west orientation approximately 1/4 mile to the north and south of the site
- anemometer situated close to rail line and could be affected by passing trains.



Anemometer Site No. 5 - Maytag

Anemometer Site No. 6
Three Rocks

Installed: July 23, 1998 am

Anemometer Height: 17 ft above local grade

Directionality: Referenced to Magnetic North

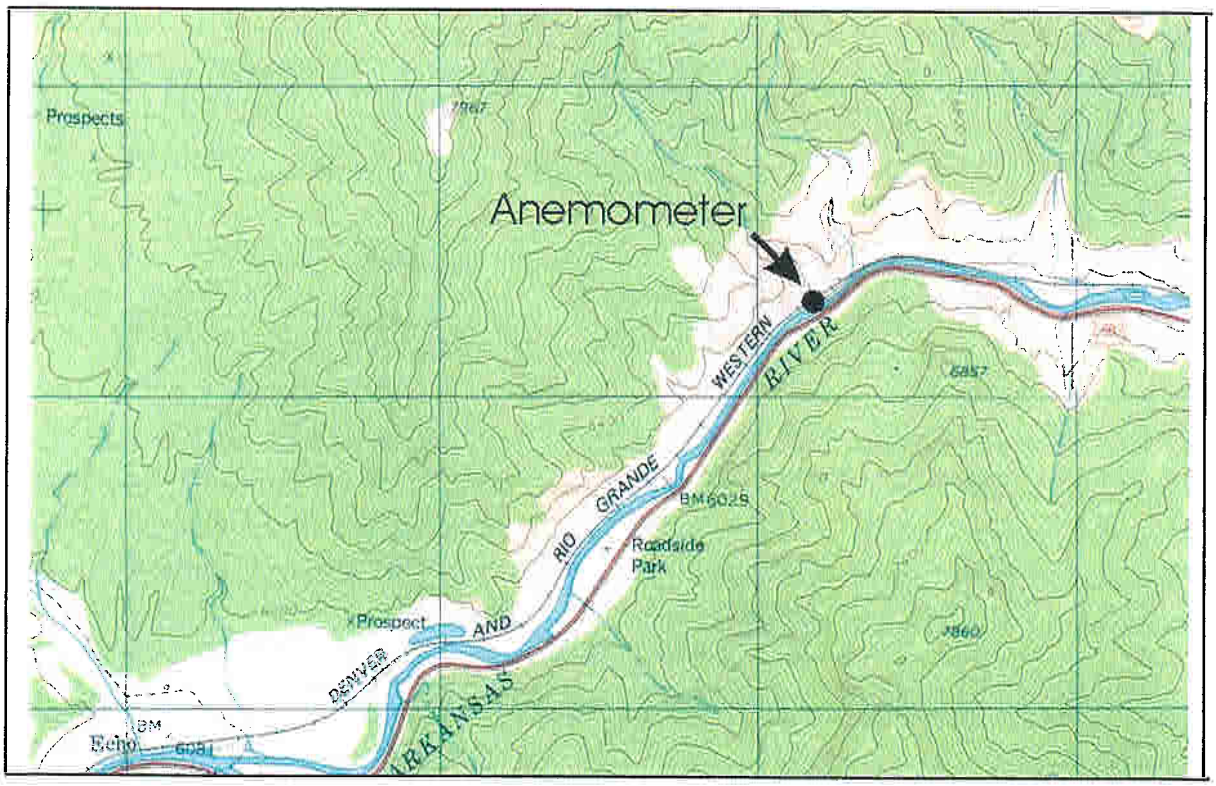
River Orientation: Northeast-Southwest

Site Location: Highway 50 Mile Marker - 258.8

Site Access: Raft; put in at Pinnacle Rock and site is located approximately 0.5 miles down river.

General Notes:

- the anemometer is located approximately 30 ft to the northwest of the river and approximately 20 ft above the river on a rock outcropping
- rocky knoll approximately 12 ft high situated 100 ft to the northeast of the anemometer
- steep slopes on the road and rail sides of the river to heights over 100 ft creating a valley exposure
- road side of the river bank generally 10 to 15 ft higher than rail side of river bank
- far field topography to the northwest and southeast rise approximately 800 to 1000 ft.
- anemometer situated close to rail line and could be affected by passing trains.



Anemometer Site No. 6 - Three Rocks

Anemometer Site No. 7
Spikebuck

Installed: July 23, 1998 pm

Anemometer Height: 15 ft above local grade

Directionality: Referenced to Magnetic North

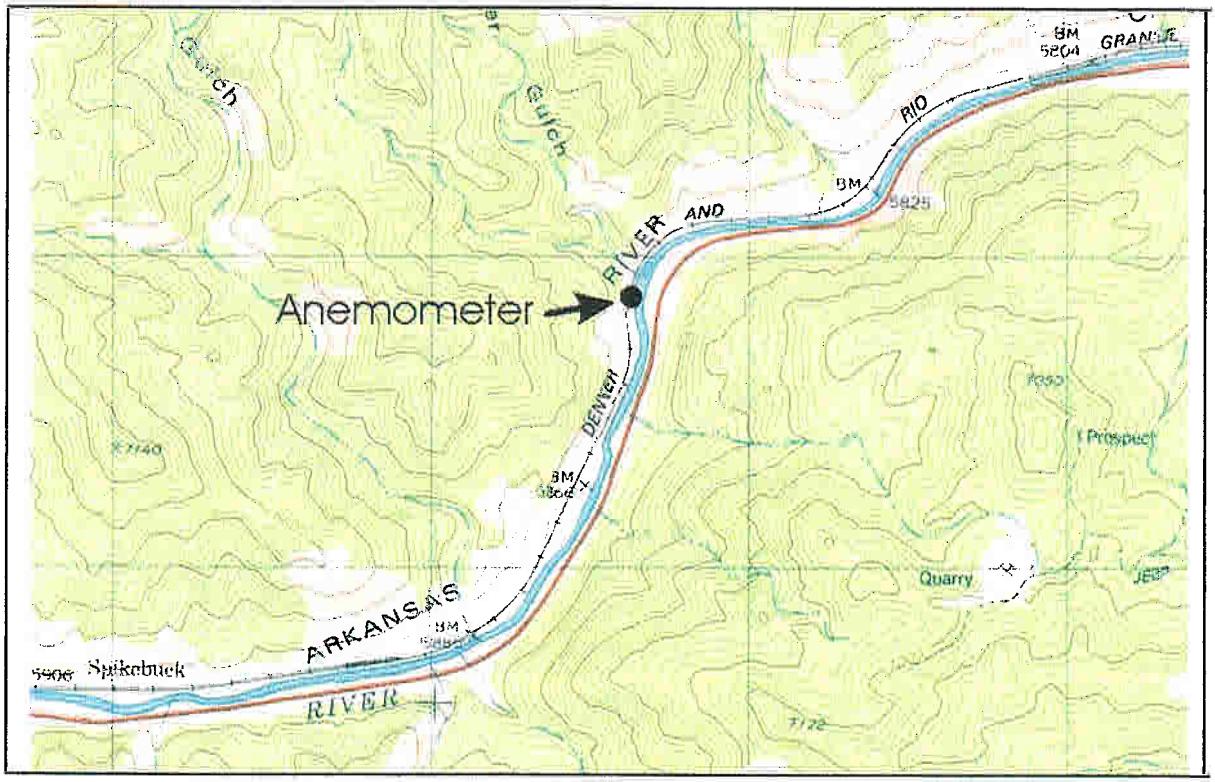
River Orientation: North-northeast - South-southwest

Site Location: Highway 50 Mile Marker - 262.6

Site Access: Raft; put in at Pinnacle Rock and site is located approximately 4.5 miles down river or 4 miles after Three Rock site

General Notes: - the anemometer is located approximately 40 ft to the west of the river and approximately 20 ft above the river on a rock outcropping

- rock pile approximately 10 to 12 ft high situated 50 to 75 ft to the northeast of the anemometer
- steep slopes on the road and rail sides of the river to heights over 100 ft creating a valley exposure
- road and rail sides of the river bank similar with several twist and turns in the river near the site
- far field topography to the northwest and southeast rise approximately 800 to 1000 ft.
- sharp turn in the river and valley to an east-west orientation approximately ½ mile to the northeast of anemometer
- anemometer situated close to rail line and could be affected by passing trains.



Anemometer Site No. 7 - Spikebuck

SECTION 2

ANEMOMETER COMPONENTS INSTALLED AND MEASUREMENT PARAMETERS

2. Anemometer Components Installed and Measurement Parameters

The following components were installed at each site:

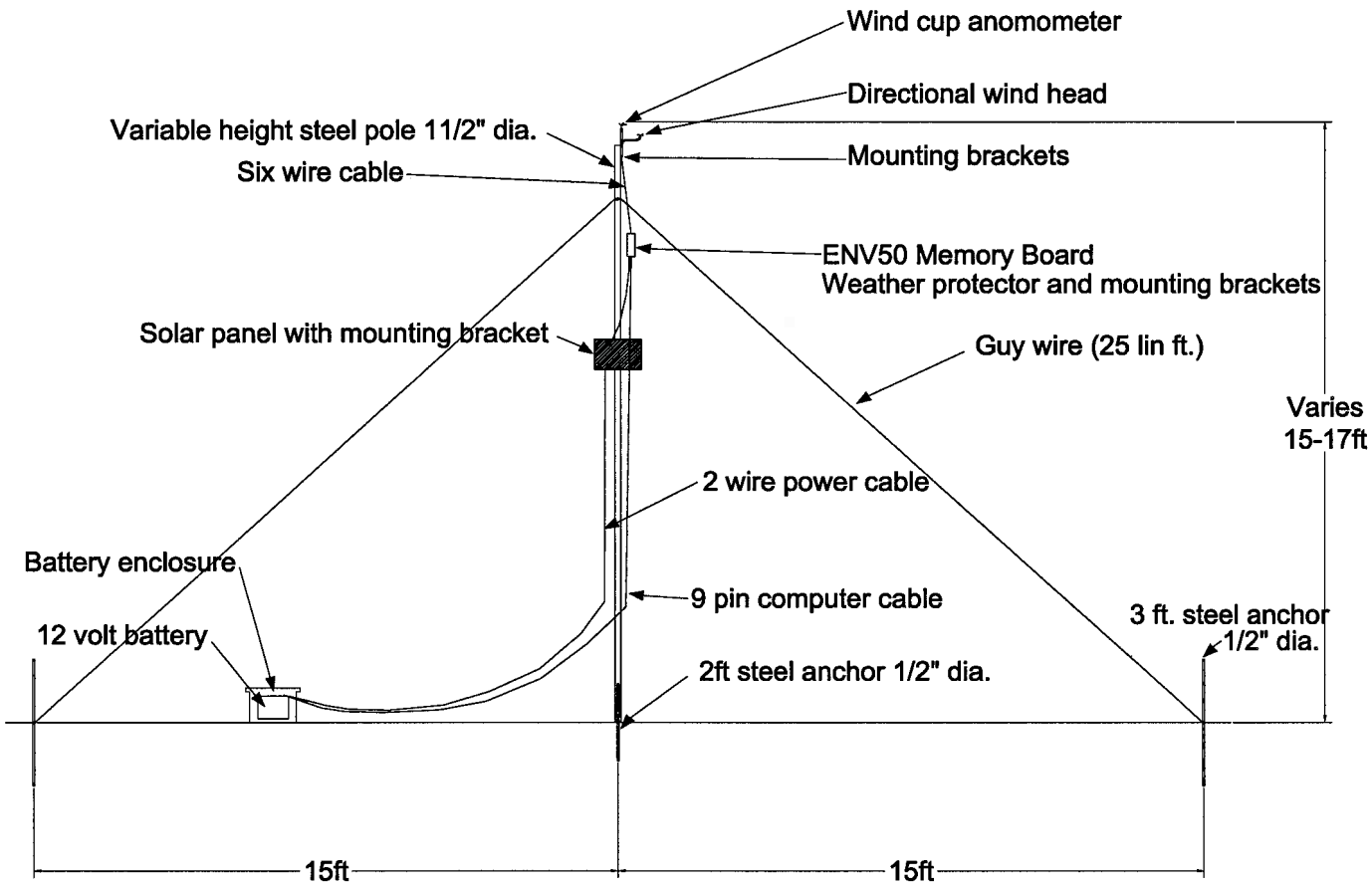
Measurement Equipment	
Quantity	**Item Name**
1	SensorMetrics - ENV-50-WDT including cup anemometer and directional wind head
1	20 ft long 6 wire cable between ENV50 and cup anemometer and directional wind head
1	ICP Global Technologies Solar Panel -Solar Powered 12 volt battery trickle charger; 5 watts and 350 milliamps and 20 ft long power cable
1	20 ft long 9 pin cable connecting ENV50 to laptop computer
1	12 Volt Battery (Garden tractor variety)
Hardware	
Quantity	**Item Name**
1	1 1/2" diameter steel mast with variable height from 10 ft to 20 ft.
4	25 ft long, 1/8" diameter antenna wire (guy wires)
1	1/2" diameter, 2 ft long steel anchor rod (pre-drilled)
4	1/2" diameter, 3 ft long steel anchor rods (pre-drilled)
1	Plastic Battery Enclosure
2	2 1/2" gear clamps for attaching wind heads to mast
1	3 1/2" gear clamp for attaching ENV50 to mast
2	Steel mounting brackets for attaching solar panel to mast
20	plastic tie wraps

A sketch of a typical anemometer setup is shown in Figure 2.1.

The following parameters will be measured and recorded at each site:

1. **Hi/Low Temperature:** The highest and lowest temperature in each 30 minute time span.
2. **Average Temperature**: The average temperature in each 30 minute time span.
3. **Average Wind Direction:** The average wind direction in each 30 minute time span
4. **Average Wind Speed:** The average wind speed over each 30 minute time span
5. **Peak Wind Speed:** The peak wind speed in each 30 minute time span.
6. **Peak Wind Direction:** The wind direction associated with the peak wind speed in each 30 minute time span.

Measurements are made every second (1Hz).



Typical Anemometer Setup	Drawn by: SKM	Figure: 2-1	RWDI
	Approx. Scale:	N.T.S.	
Over The River - Arkansas River, Colorado Job No. 98-130	Date Revised:	July 30, 1998	

SECTION 3

BI-MONTHLY INSPECTIONS REQUIRED
AND
INSTRUCTIONS FOR SETTING UP
AND
DOWNLOADING DATA

3. Bi-monthly Inspections Required

3.1 Inspection

The following tasks should be completed at each site once every 15 days. Based on an average start date of July 22, 1998, each site should be visited on **7th and 22nd of each month.**

3.1.1 Is the directional wind head oriented properly? The black wire or centre wire on the directional wind head sensor should be pointing north.

3.1.2 Remove leads from battery to check voltage of battery. The battery voltage should be approximately 12 volts. If the voltage drops below 7 volts, the station will not run. The leads can be removed from the battery during the daytime as the solar panel by itself will power the station. If the battery voltage is below 7 volts, the following items should be checked:

2.1 Check solar panel cables and connections for disruption of power.

2.2 Check voltage across leads from the solar panel. If the voltage is greater than 15 volts, the diode is damaged. Replace with a Zener Diode, 15 volts and rated at 5 watts. Diode is located in the battery box (see wiring schematic in Figure 3-1).

2.3 Check voltage across leads from the solar panel. If voltage is less than 12-15 volts in daylight conditions (without battery) the solar panel is damaged and needs to be replaced.

In order to ensure an uninterrupted power supply to the station, the voltage of the battery over time should be monitored for each station. By keeping an on-going voltage log for each battery, it can determine if the solar panel is keeping the battery charged.

3.1.3 Remove any water from the battery box.

3.1.4 Keep 9 pin connector out of the wet. Cover female connector from ENV50 unit with duct tape when finished downloading data.

3.1.5 Do a real time spot check using Winlink to see if the data being collected is making sense. For example, Is the wind direction which is indicated on the display matching the actual conditions? Is the wind velocity working OK with respect to the actual conditions?

3.1.6 Perform a visual inspection of the station. For example are the velocity sensor and directional sensor moving freely in the wind? Have animals damaged the wiring at the base of the station or has the station sustained any other damage or vandalism.

3.2 Set-up of ENV50 Environmental Station

Stations 2 through 7 inclusive have already been setup during the week of July 20th. Stations 1 and 8 were setup without an ENV50 board since two of the boards received from SensorMetrics were not functioning properly and had to be returned for replacement. Therefore the following discussion applies to Stations 1 and 8 the first time these sites are visited and any other site which has lost power. See Appendix A for ENV50 Operator's Manual.

3.2.1 Connect 6 wire cable from wind heads (directional and speed) to ENV50 unit with telephone jack. See Figure 3-1 for wiring schematic.

3.2.2 Connect ENV50 to solar panel and battery with power cable. Again see Figure 3-1 for wiring schematic.

3.2.3 Connect wiring harness for laptop to ENV50 as shown in Figure 3-1 (Note for Stations 1 and 8, ENV50 can be located in the battery box rather than on the mast).

3.2.4 Station should be powered up with a voltage of between 7 to 24 volts. Voltage can be checked as per 3.1.2.

3.2.5 Connect 9 pin connector from ENV50 into the male 9 pin adapter in the back of the lap top. Start Winlink program.

3.2.6 Select ***FILE***, click on ***NEW***.

3.2.7 Select ***WDT DOCUMENT***, click OK.

3.2.8 Select ***OPTIONS***, select ***COMMUNICATIONS*** and the default settings should be:

Port COM 1	
Baud Rate 4800	
Type RS 232	
Timeouts 1st character	500
String	1800

Click OK

3.2.9 Select ***OPTIONS,*** select ***UNITS.*** Click OK.

Select

Temperature - Deg F
Wind Velocity - miles/hour
Rainfall - inches

3.2.10 Select ***CONFIGURE***. Click on ***DATE/TIME***. Select ***PC TIME*** if the PC has the correct time. Click OK. If everything is working, the datalogger should respond back.

3.2.11 Select ***CONFIGURE*** and then select ***BAUD RATE***. Click on 4800 and then OK.

3.2.12 Select ***CONFIGURE*** then ***LOGGING CONFIG.***

Select the following:

1. Hi/Lo Temp
2 Ave Temp
3 Wind
4. Wind Gust
5. Avg Wind
6. Set ***LOGGER*** to 0 hrs and 30 min averages.
   Click OK

3.2.13 Select ***CONFIGURE*** and select ***TX MODE.*** Check ***TX MODE*** "off" and click OK to close.

3.2.14 Select ***COMMANDS*** and then ***RESET***. Select the following boxes:

1. Highs/Lows
2. Averages
3. Rain Counter #1
4. Rain Counter #2

Close with OK.

At this point the station should be completely configured and you should now be ready to start the station.

3.2.15 Click on ***COMMANDS*** and ***START LOGGING***. Make sure the "Reset History" and "Reset Averages" are selected and click OK. To confirm that the station is logging, you can click on INFO (tool bar button) to ensure that the:

1. Station is logging
2 30 minute averages
3. Power is good
4. Date is set and correct

Close window.

3.2.16 To save the parameters you have just set, select ***FILE*** and then select ***SAVE AS***. Please be sure to save the file using a name that relates to the station you are at. For example Station 1 would be named ENV1.WDT. Click OK. Note that it is important to leave the extension on the file as WDT.

3.2.17 The system is now up and running. Close Winlink software and Windows 3.1. Turn power off on computer. Unplug 9 pin cable from COM1 port and cover with duct tape and place in battery box.

3.3 Downloading data from ENV50

3.3.1 Plug 9 pin connector from the met station into the male 9 pin adapter on the back of the laptop.

3.3.2 Start Winlink Program.

3.3.3 Go to ***FILE*** and ***OPEN***. Select the file that has been setup for the site (e.g. ENV1.WDT for Site 1, ENV2.WDT for Site 2, etc. and click OK).

3.3.4 Click on ***INFO*** (button on tool bar) to determine the status of the station. Check to see that power status is good. Click OK to close window.

3.3.5 Go to ***COMMANDS*** and click on ***RETRIEVE DATALOG***. You will be prompted next to ***APPEND***, ***OVERWRITE*** or ***CANCEL***. Click on ***APPEND***.

3.3.6 The laptop will now download the data from the Met Station. Once the data is downloaded, click OK to close window.

3.3.7 IMPORTANT: The next step should be to save the file. Go to ***FILE*** and choose ***SAVE AS*** and save the file to the appropriate file to match the station (i.e. same file that you have selected in 3.3.3; ENV1.WDT for Site 1). Click on OK. Click on ***YES*** to replace existing file.

3.3.8 An on-site data check can be performed by looking at the file you have just downloaded using a text editor such as notepad. Go to the end of the file to see if the data looks good. All of the data should be changing over time, i.e. date, Hi/Lo Temp, Ave Temp, Wind, Hi Wind and Ave Wind. Note the date at the end of file correspond to current day.

3.3.9 **AFTER THE FILE HAS BEEN SAVED, <u>YOU MUST RESTART THE MET STATION</u>. GO TO *COMMANDS* AND CLICK ON *START LOGGING*. YOU WILL BE PROMPTED TO RESET AND RESTART THE DATALOGGING. MAKE SURE RESET HISTORY AND RESET AVERAGES ARE SELECTED. CLICK ON OK.**

3.3.10 To ensure that the station is back up and running and collecting data, you should click on ***INFO*** (tool bar button) to be sure the station is in fact collecting data. The ***INFO*** window should tell you that you are logging data, power status is good, correct date and time and you should be logging data every 30 minutes.

3.3.11 The system is now up and running. Close Winlink software and Windows 3.1. Turn power off on computer. Unplug 9 pin cable from COM1 port and cover with duct tape and place in battery box.

NOTE: DATA SHOULD BE DOWNLOADED EVERY 15 DAYS. THERE IS A 3 TO 4 DAY BUFFER IN MEMORY BEYOND THE 15 DAY SPAN.

3.4 Things to Remember

1. Power up station only after all other connections are made.

2. After downloading data, the station must be restarted again, that is, you must go to ***COMMANDS*** and click on ***START LOGGING***.

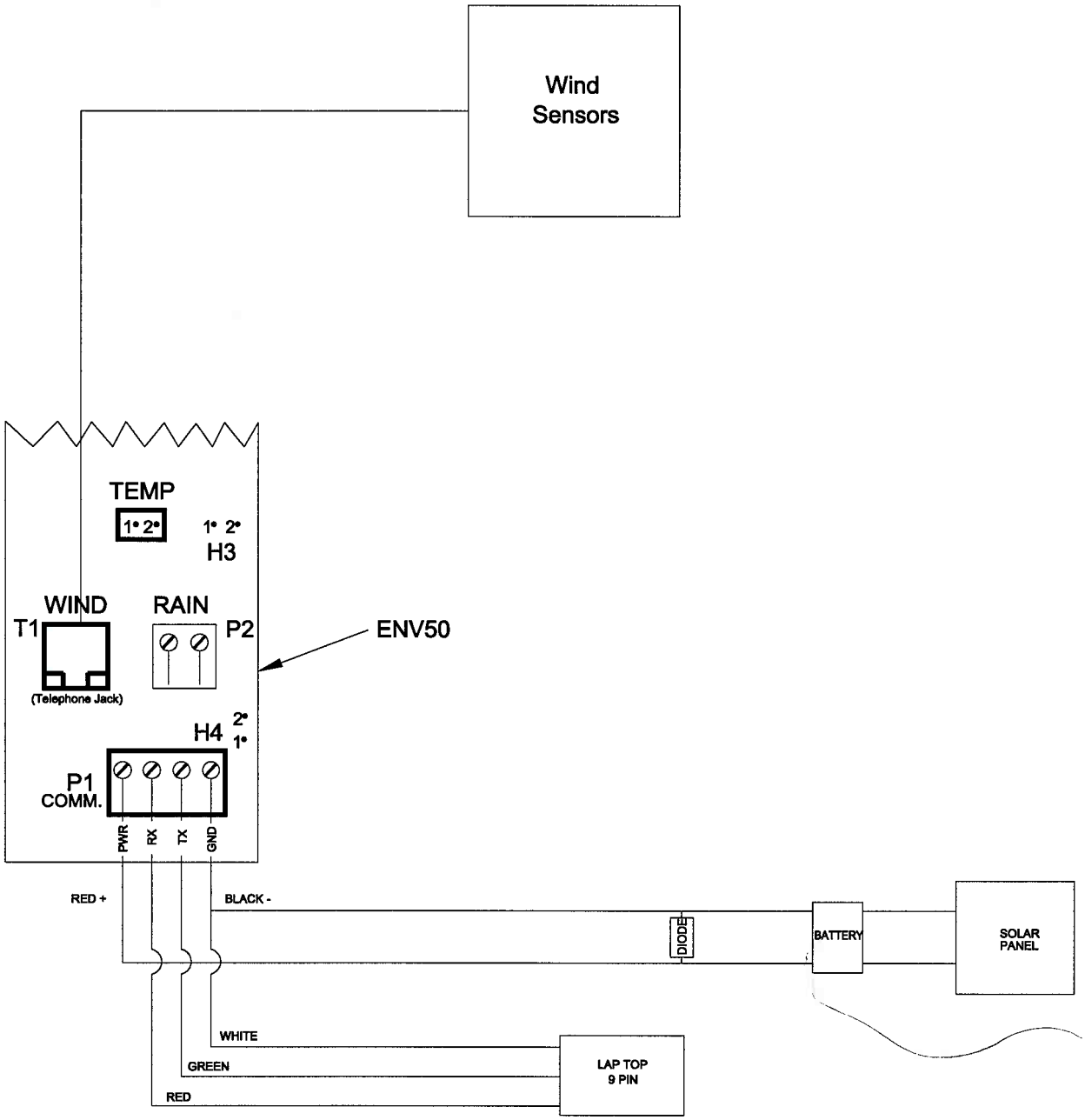
3. Only run station if the power source is between 7 - 24 volts DC. A voltage below 7 volts or above 24 volts may damage the circuit board.

4. If the station loses power, all settings will be lost and you will need to repeat step 3.2.5 through 3.2.17 above.

3.5 Equipment Required of Bi-Monthly Site Visits

The following equipment will be required:

1. Voltmeter.
2. Compass.
3. Laptop computer with Windows 3.1 and Winlink software, extra battery.
4. Two variable wrenches.
5. Duct tape.
6. Tie wraps.
7. Extra computer cable.
8. Small (1/8" head) flat head screwdriver.
9. Log book and manual.

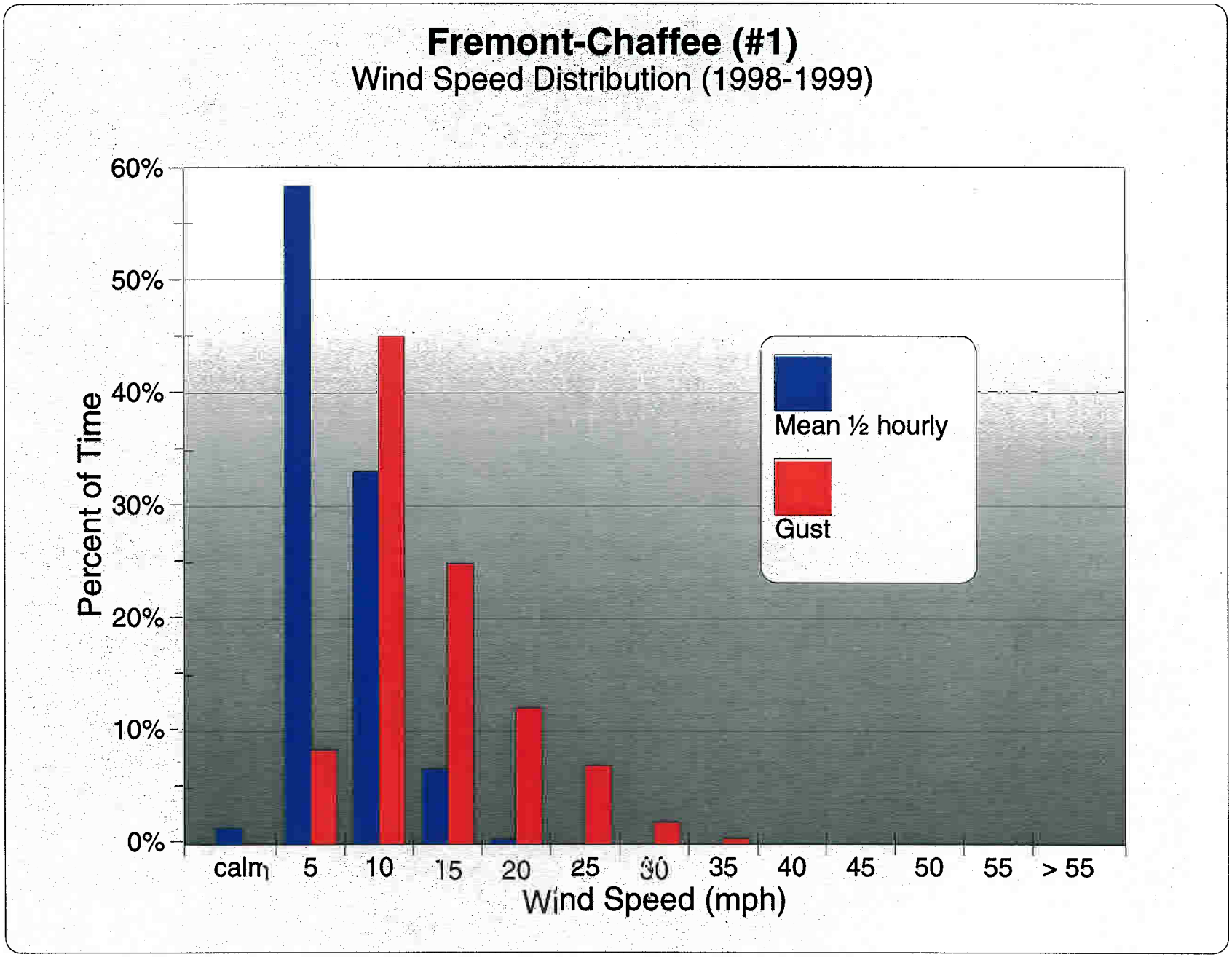


Wiring Diagram For ENV50	Drawn by: SKM	Figure: 3-1	RWDI
	Approx. Scale:	N.T.S	
Over The River - Arkansas River, Colorado Job No. 98-130	Date Revised:	July 29,1998	

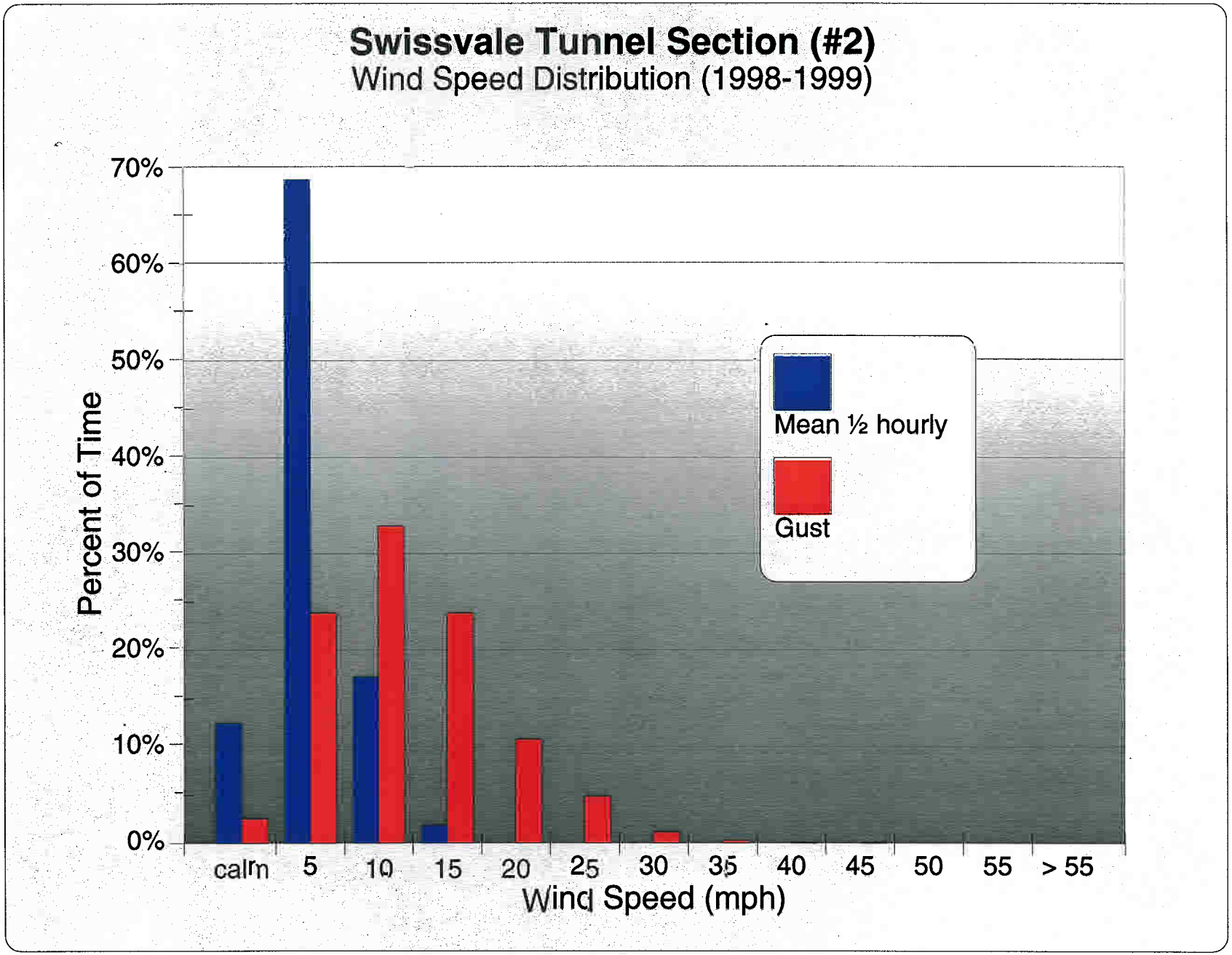
APPENDIX B

Wind Speed Distributions for the Eight Anemometer Sites

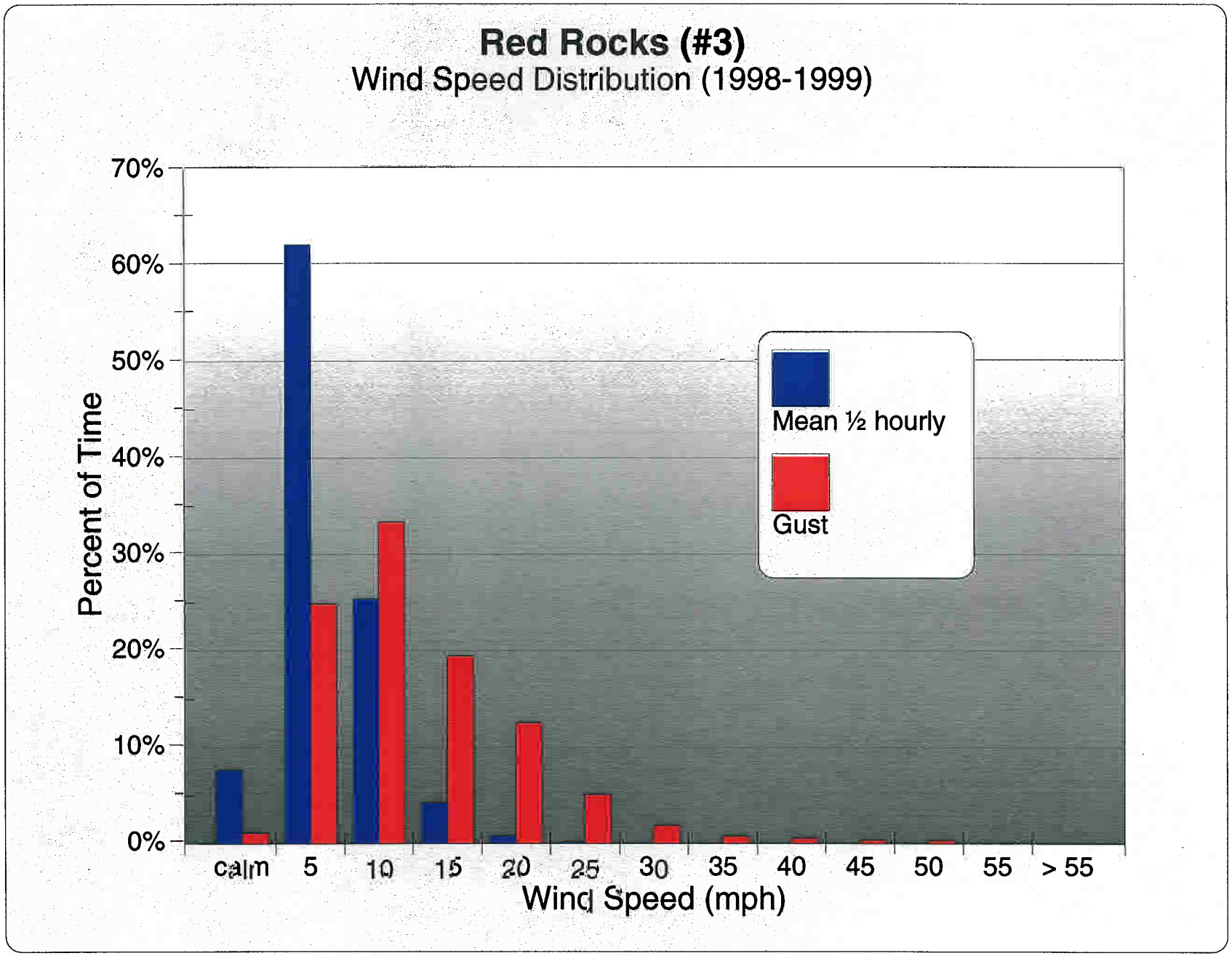
Over The River



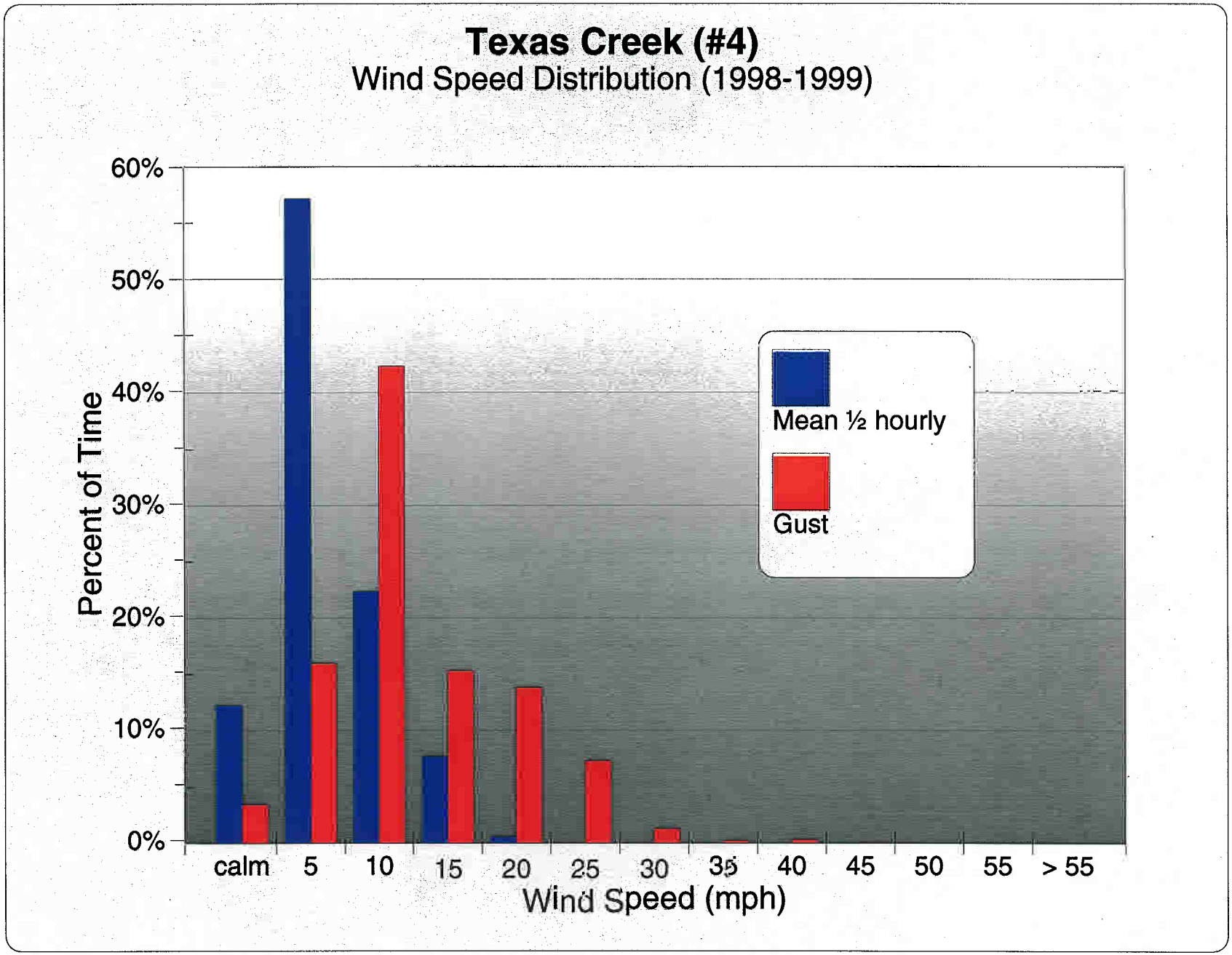
Over The River



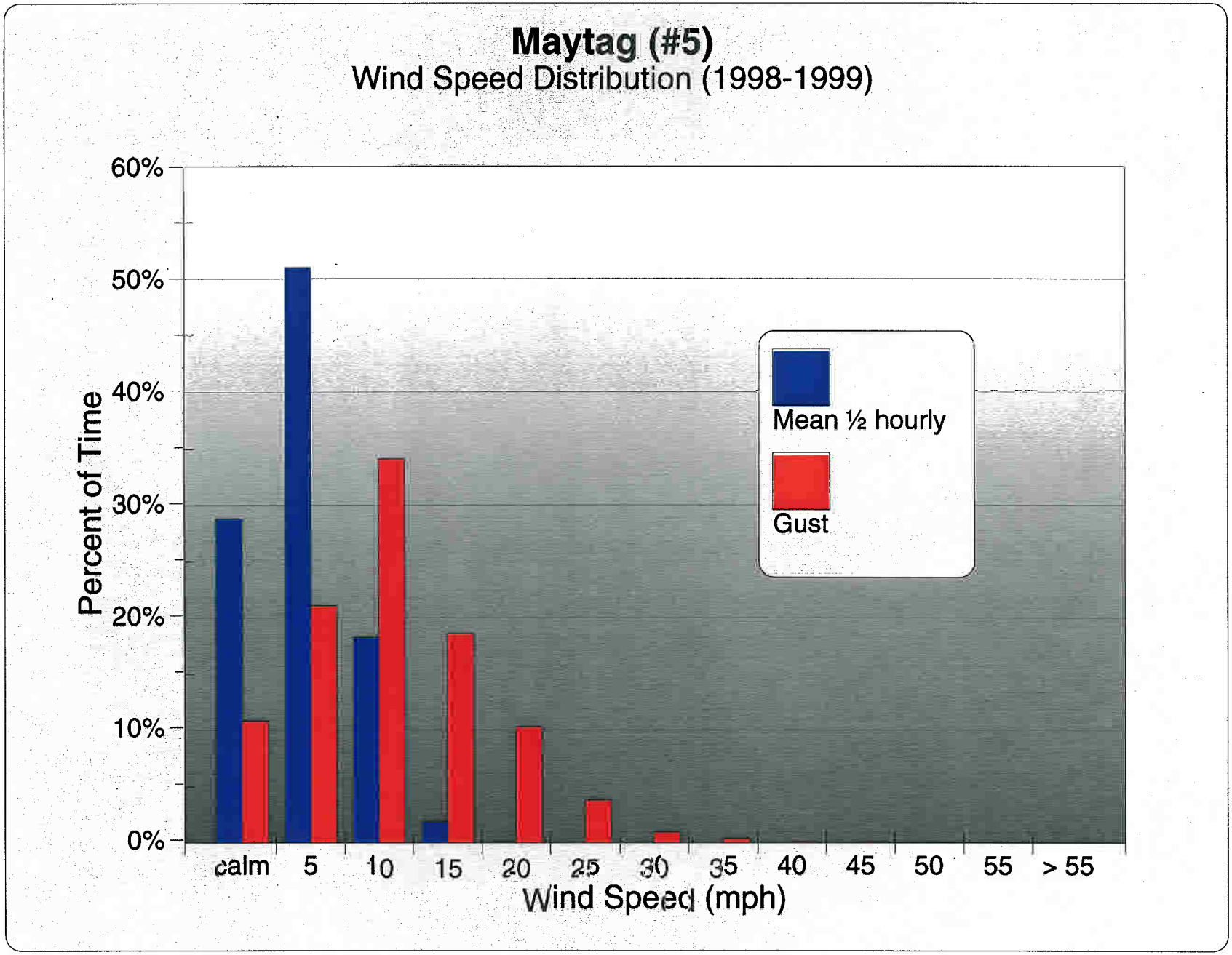
Over The River



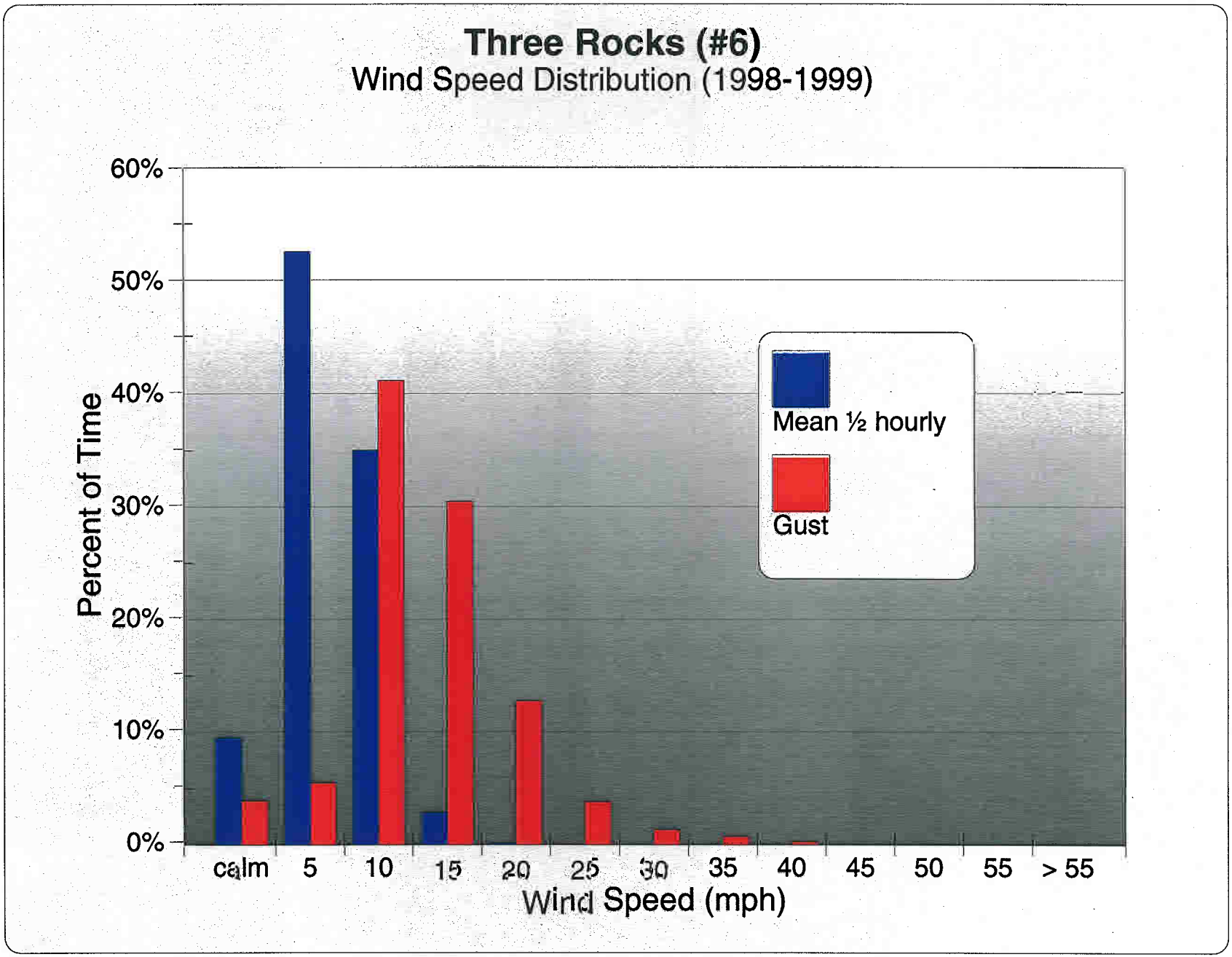
Over The River



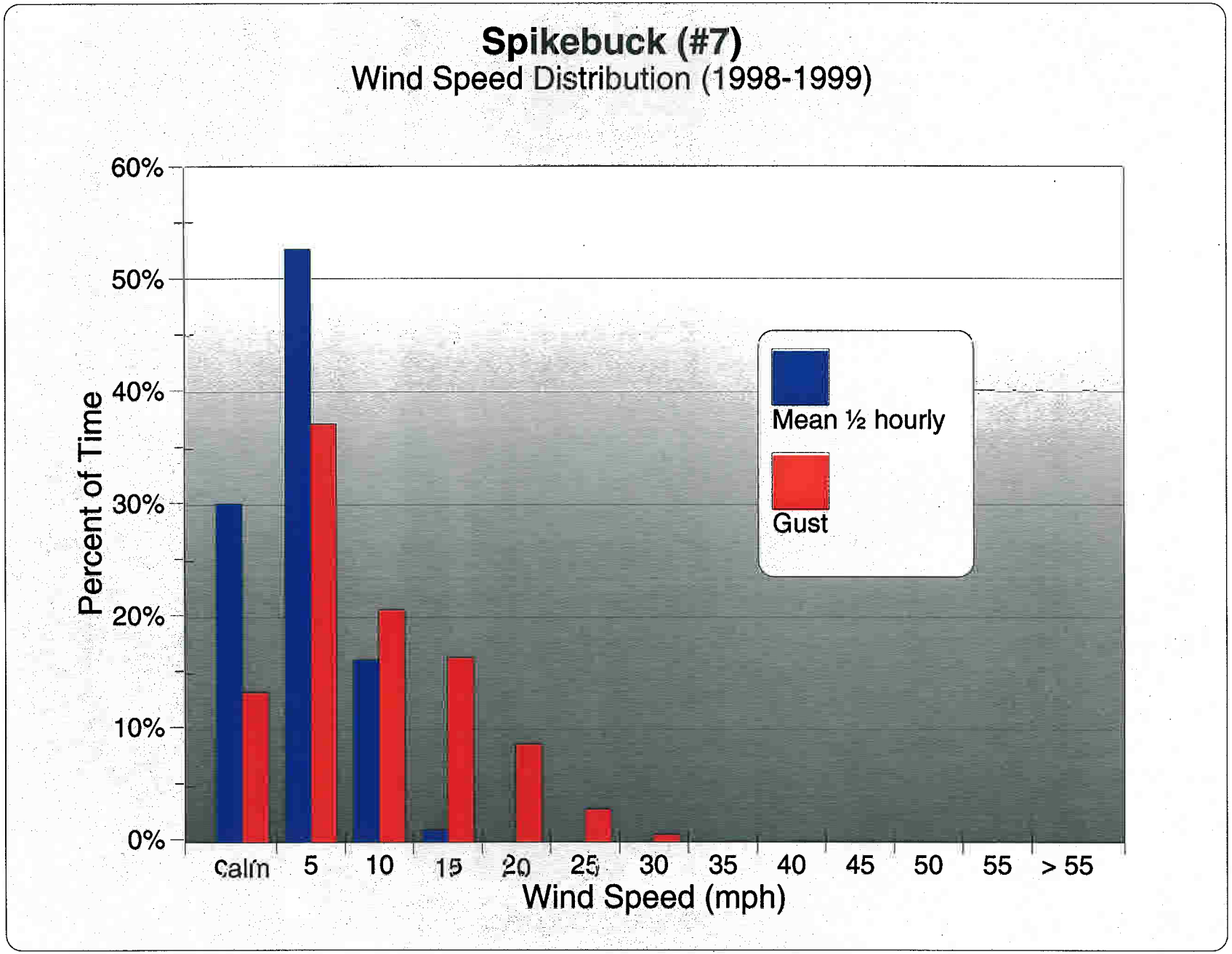
Over The River



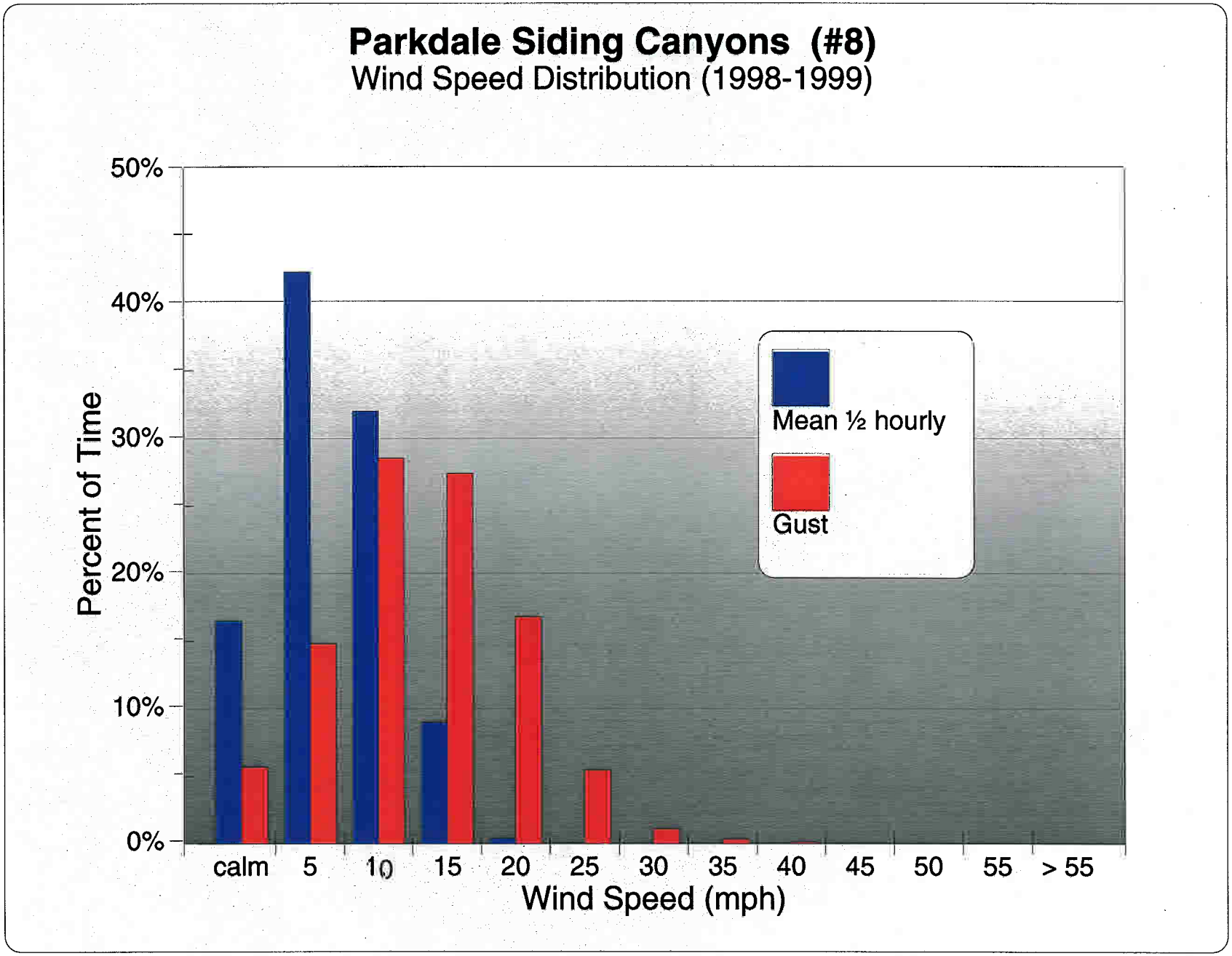
Over The River

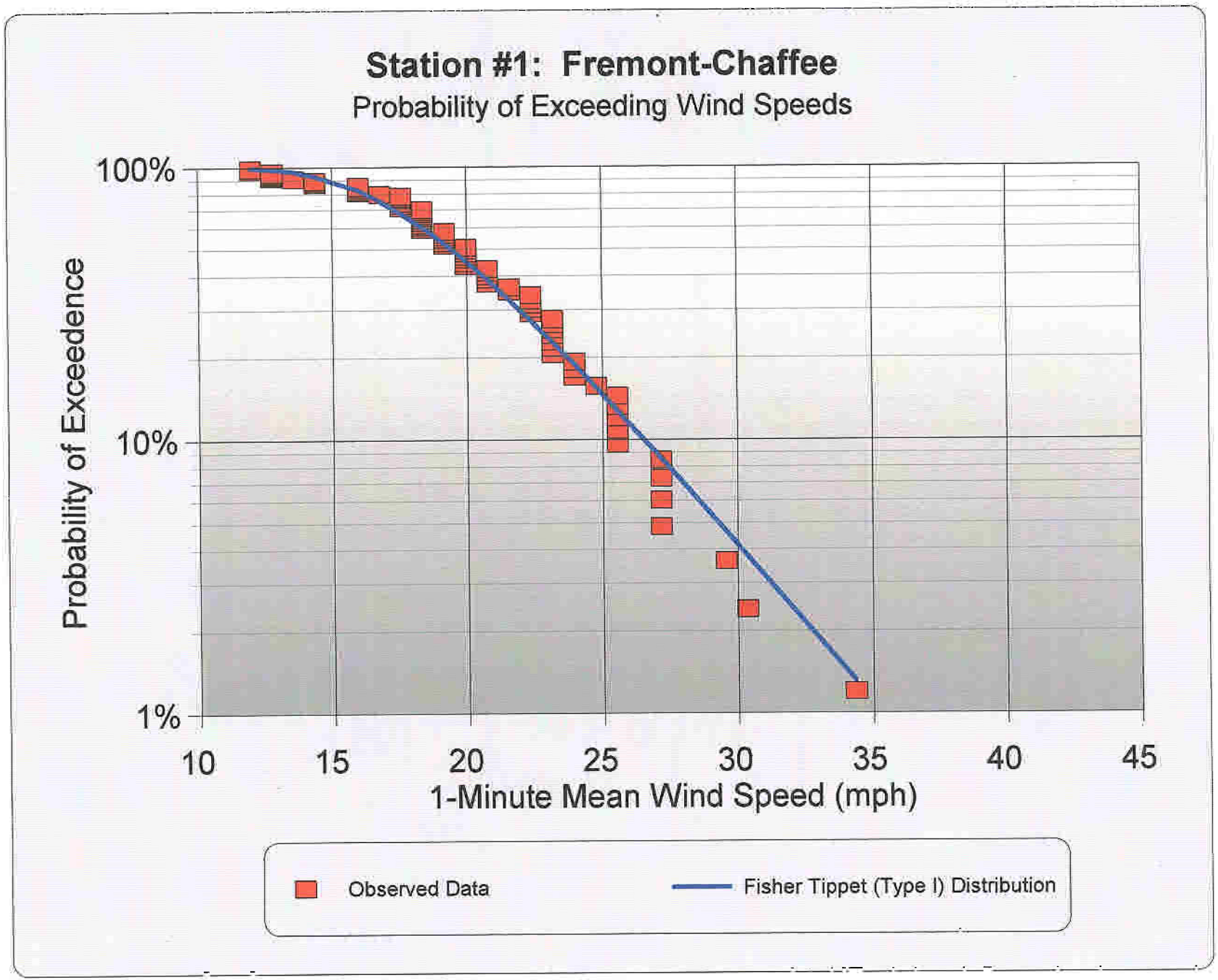


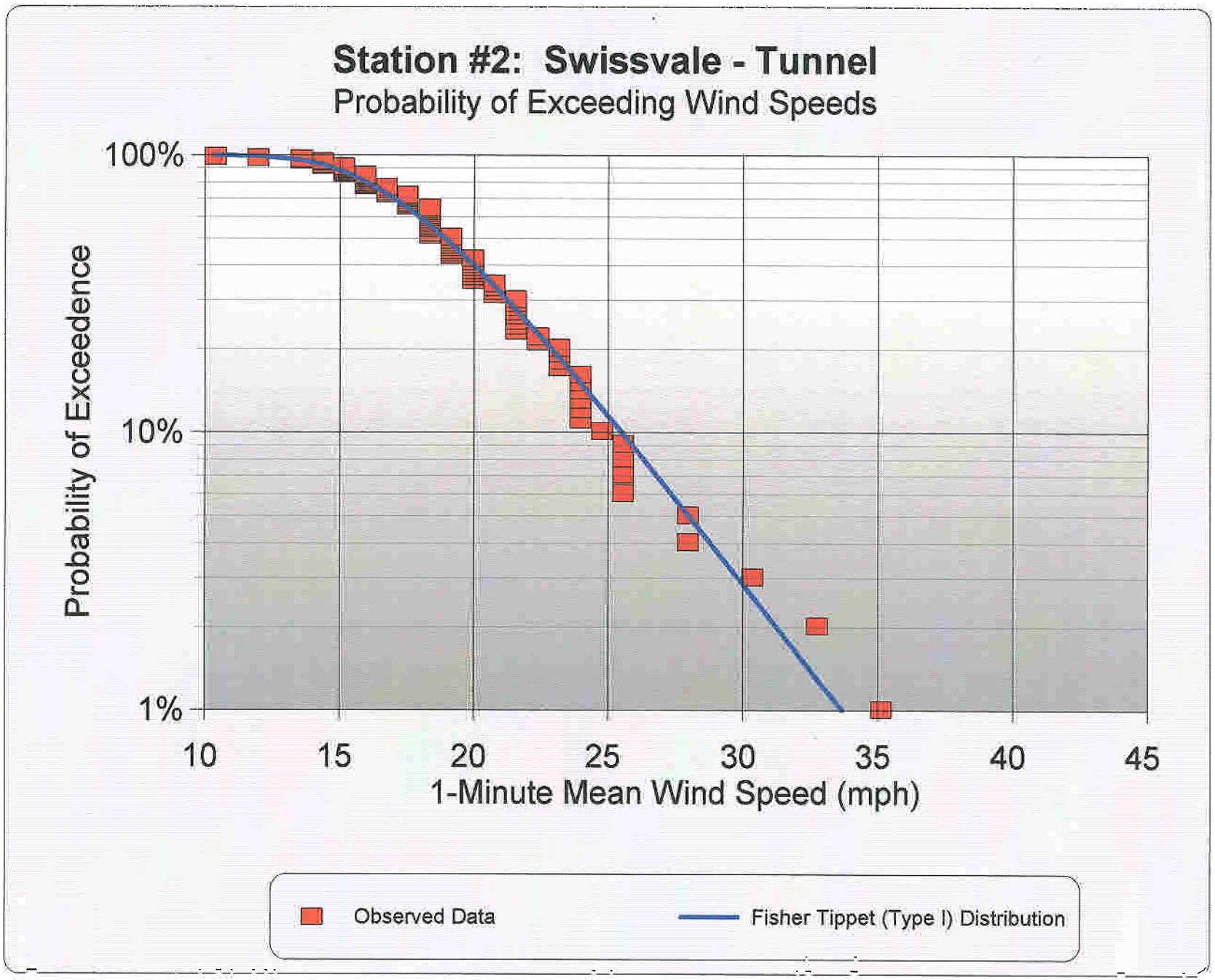
Over The River

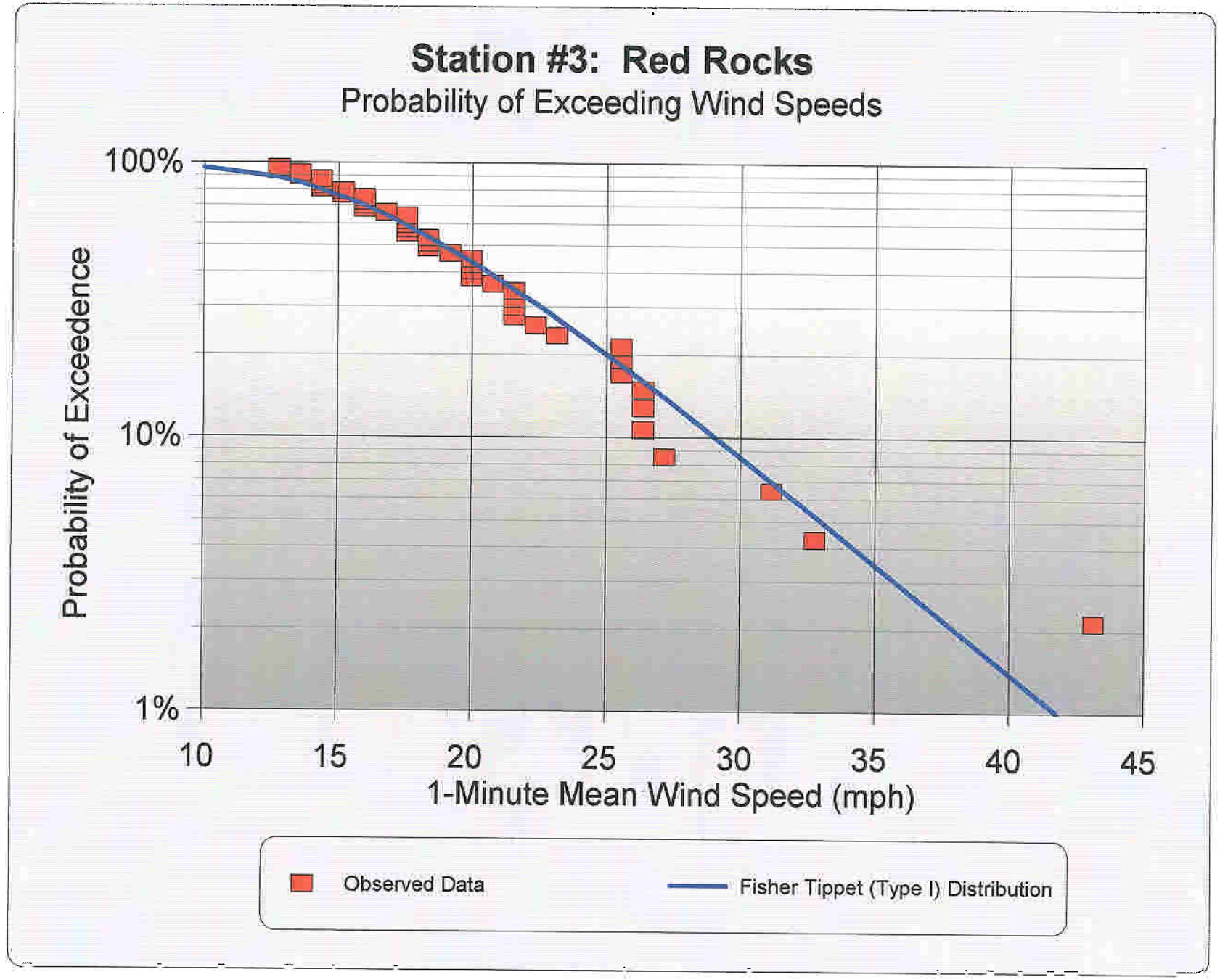


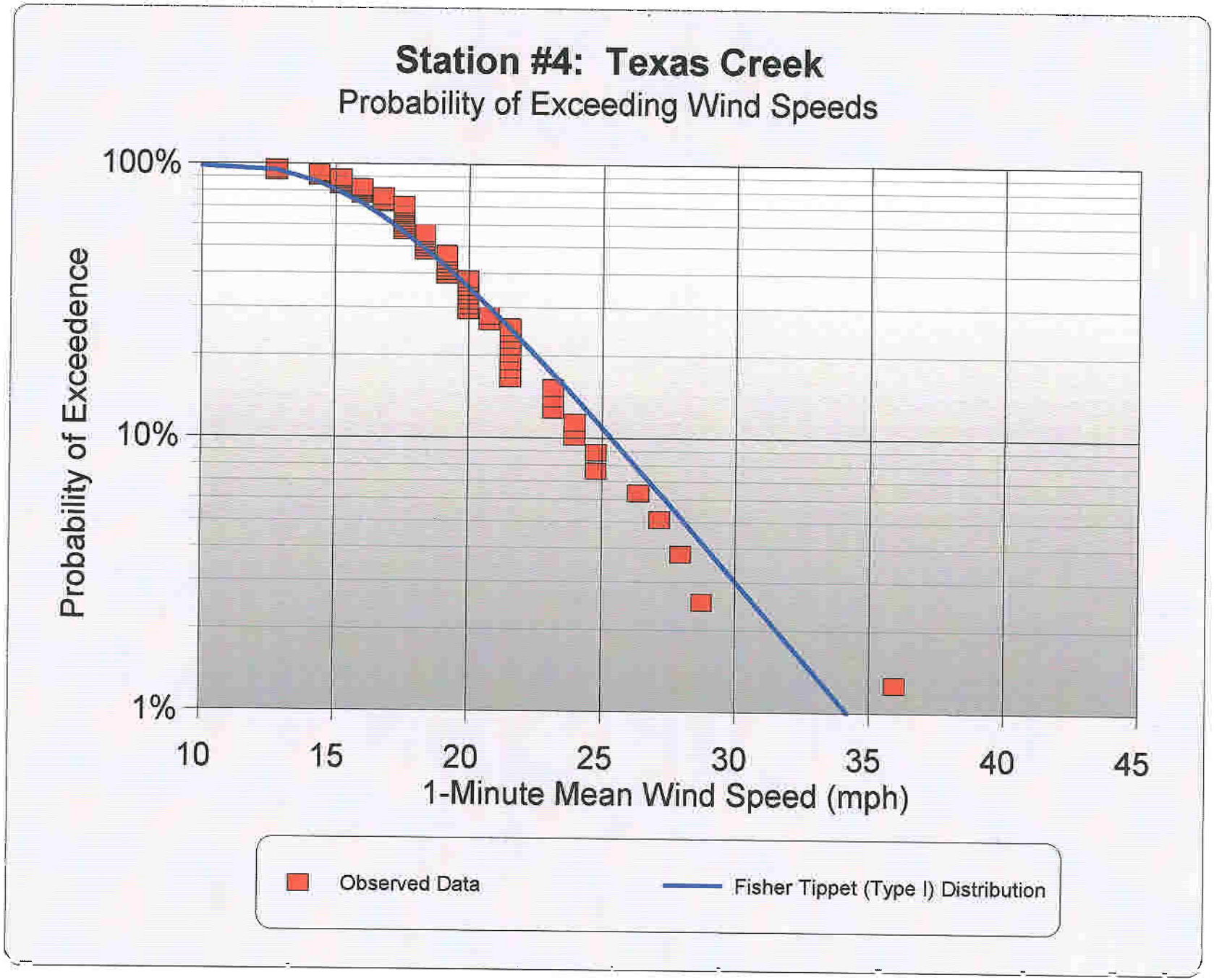
Over The River

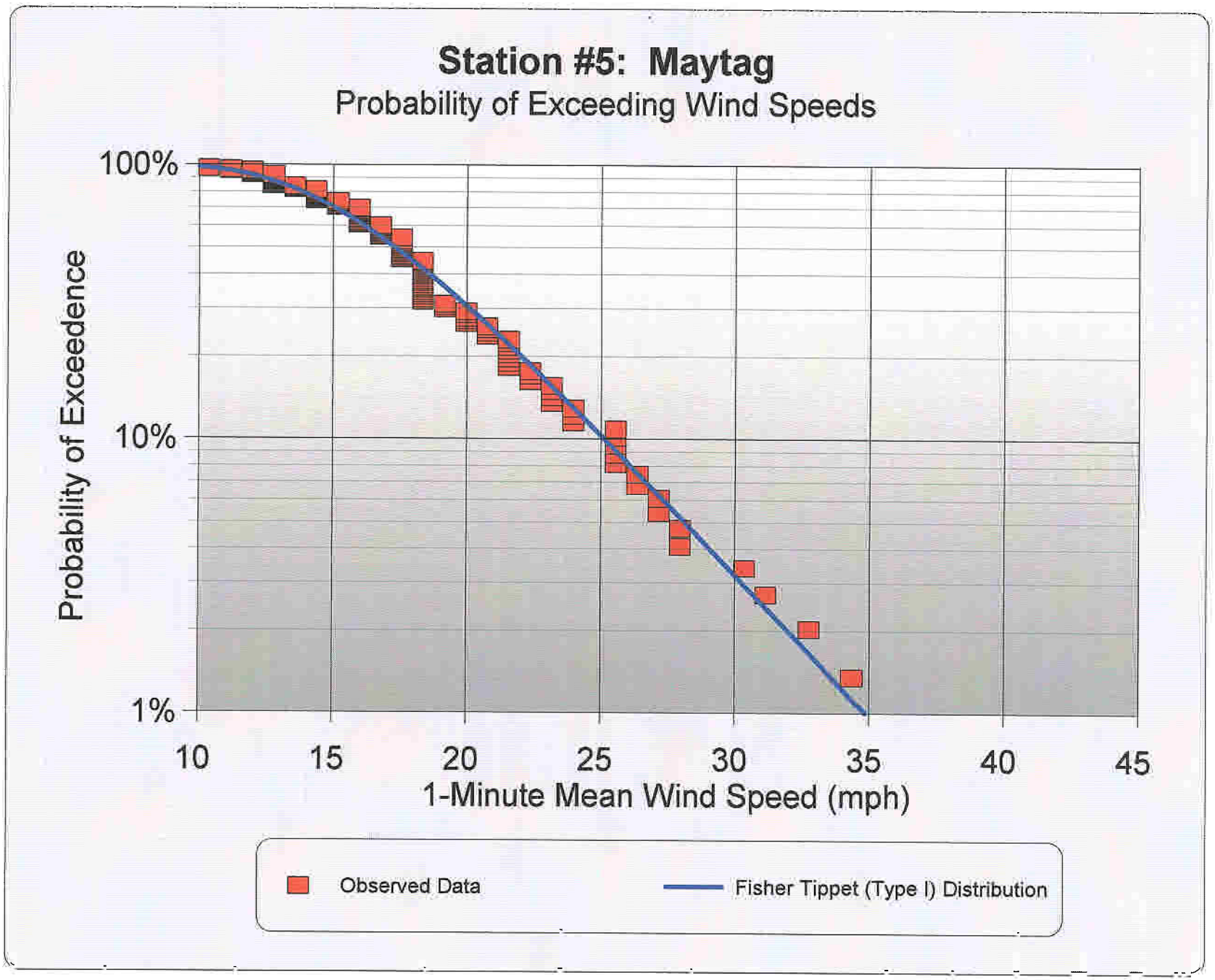


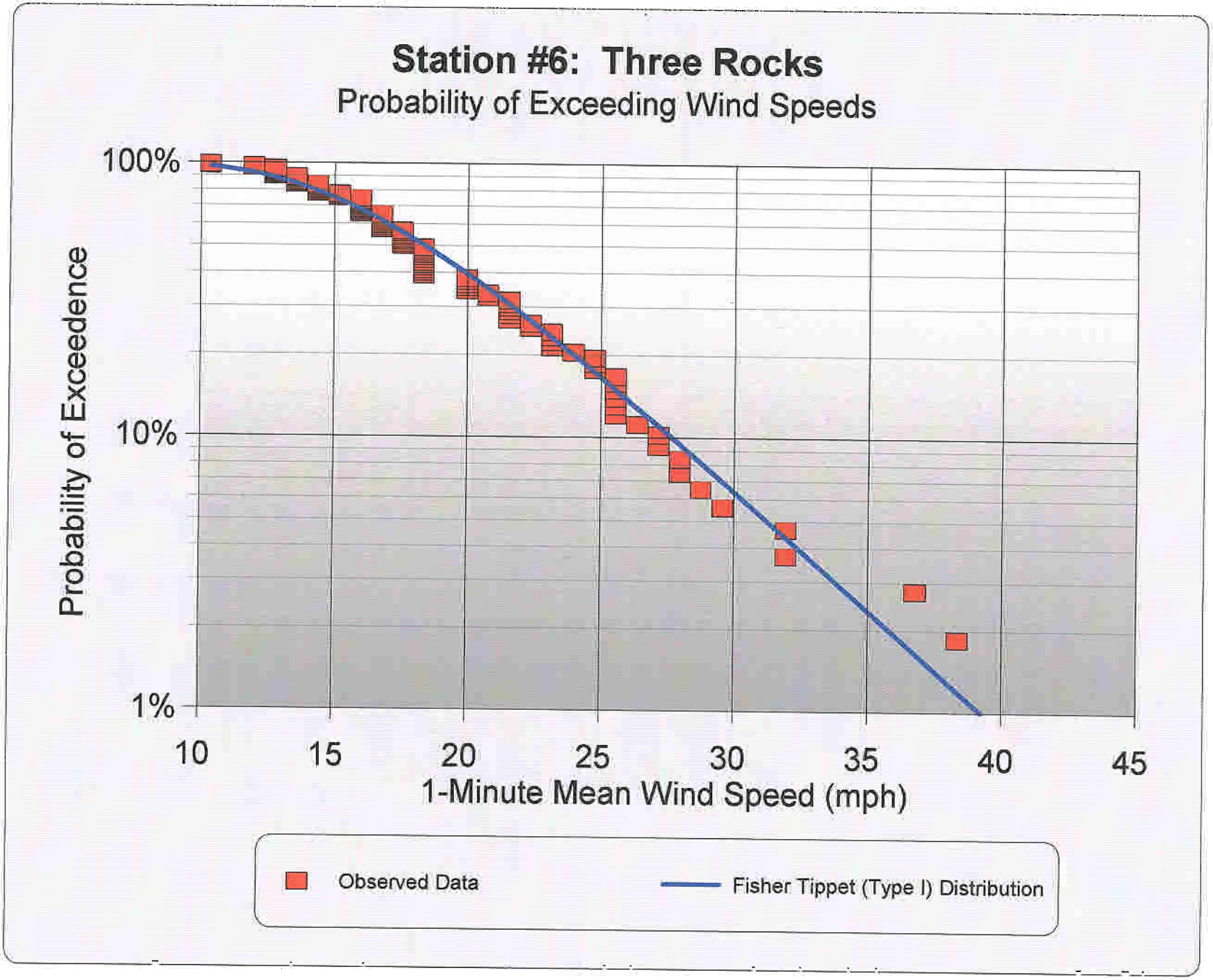

Station #1: Fremont-Chaffee
Probability of Exceeding Wind Speeds
100%
10%
1%
Probability of Exceedence
10
15
20
25
30
35
40
45
1-Minute Mean Wind Speed (mph)
Observed Data
Fisher Tippet (Type I) Distribution

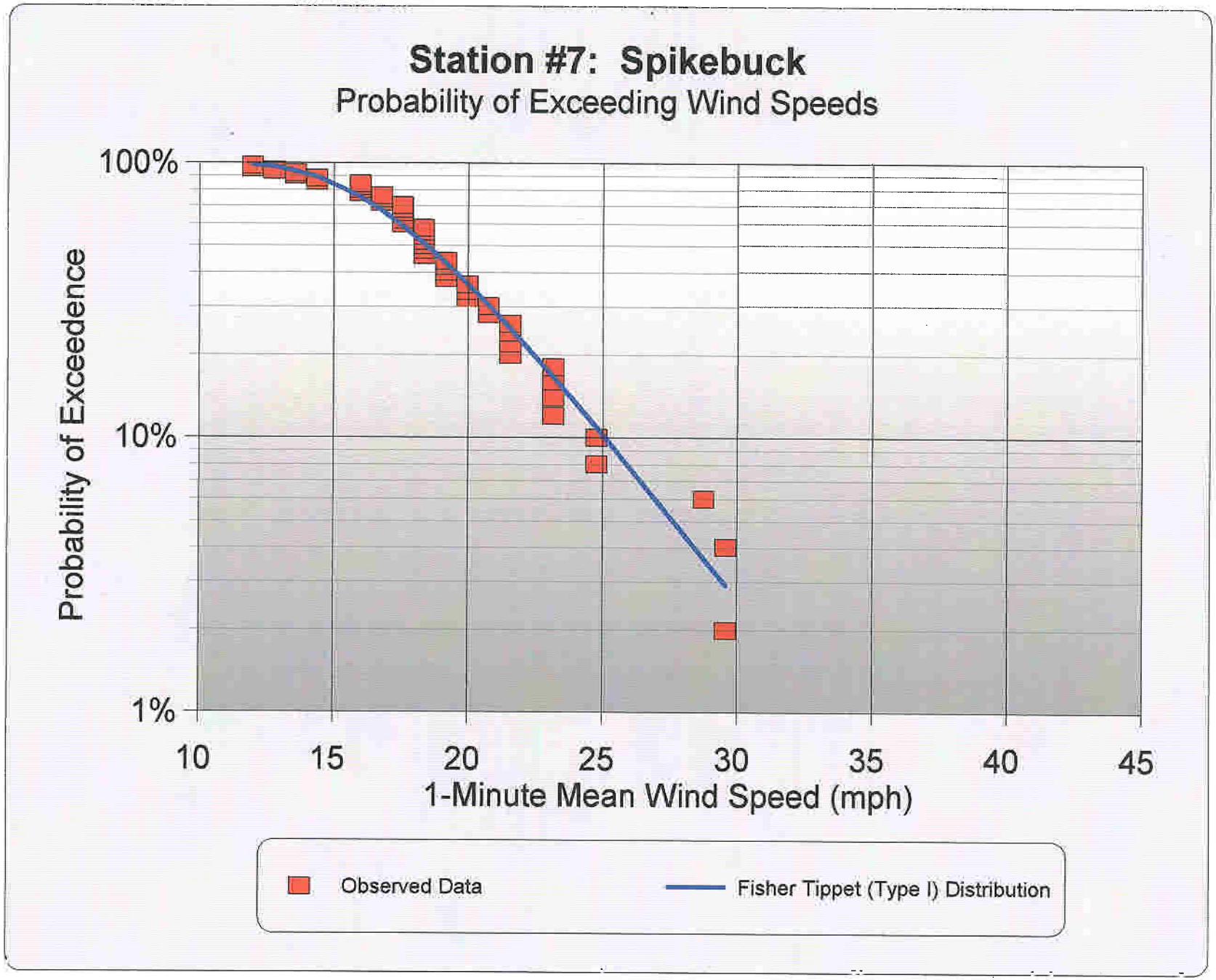

Station #2: Swissvale - Tunnel
Probability of Exceeding Wind Speeds
100%
10%
1%
Probability of Exceedence
10
15
20
25
30
35
40
45
1-Minute Mean Wind Speed (mph)
Observed Data
Fisher Tippet (Type I) Distribution

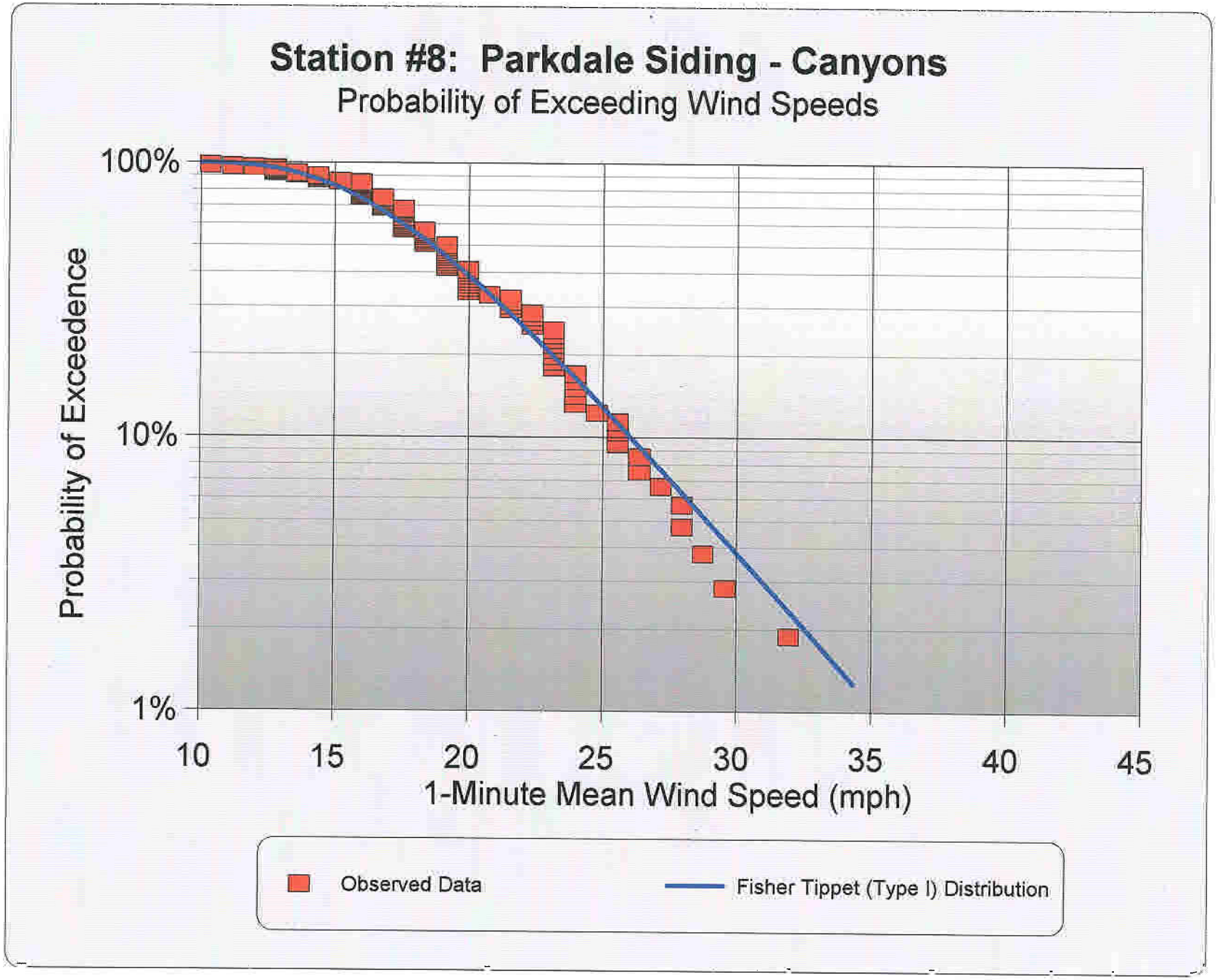

Station #3: Red Rocks
Probability of Exceeding Wind Speeds
100%
10%
1%
Probability of Exceedence
10
15
20
25
30
35
40
45
1-Minute Mean Wind Speed (mph)
Observed Data
Fisher Tippet (Type I) Distribution


Station #4: Texas Creek
Probability of Exceeding Wind Speeds
100%
10%
1%
Probability of Exceedence
10
15
20
25
30
35
40
45
1-Minute Mean Wind Speed (mph)
Observed Data
Fisher Tippet (Type I) Distribution


Station #5: Maytag
Probability of Exceeding Wind Speeds
100%
10%
1%
Probability of Exceedence
10
15
20
25
30
35
40
45
1-Minute Mean Wind Speed (mph)
Observed Data
Fisher Tippet (Type I) Distribution


Station #6: Three Rocks
Probability of Exceeding Wind Speeds
100%
10%
1%
Probability of Exceedence
10
15
20
25
30
35
40
45
1-Minute Mean Wind Speed (mph)
Observed Data
Fisher Tippet (Type I) Distribution


Station #7: Spikebuck
Probability of Exceeding Wind Speeds
100%
10%
1%
Probability of Exceedence
10
15
20
25
30
35
40
45
1-Minute Mean Wind Speed (mph)
Observed Data
Fisher Tippet (Type I) Distribution

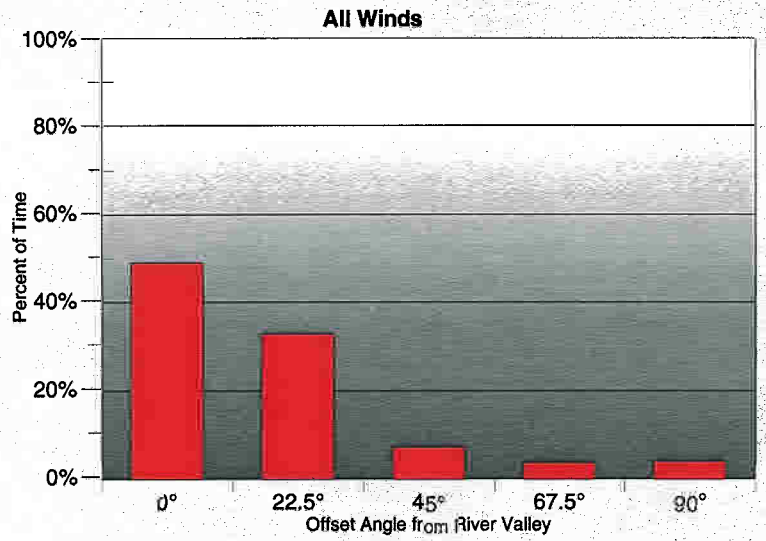

Station #8: Parkdale Siding - Canyons
Probability of Exceeding Wind Speeds
100%
10%
1%
Probability of Exceedence
10
15
20
25
30
35
40
45
1-Minute Mean Wind Speed (mph)
Observed Data
Fisher Tippet (Type I) Distribution

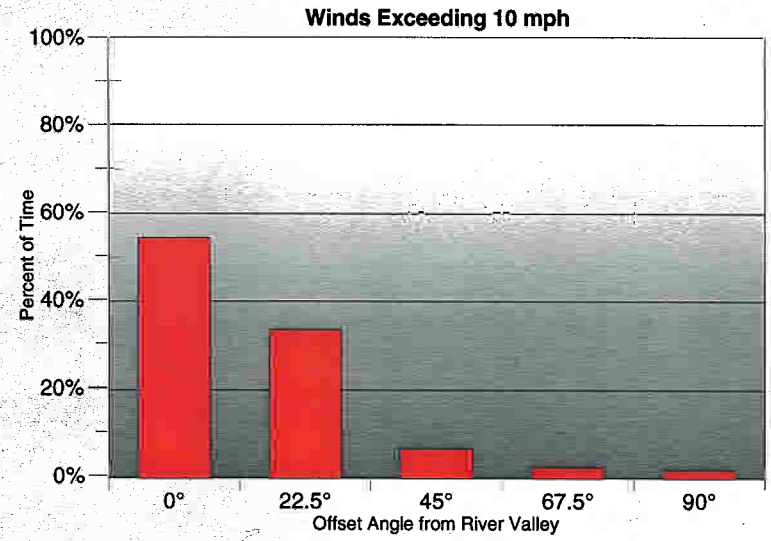
APPENDIX C

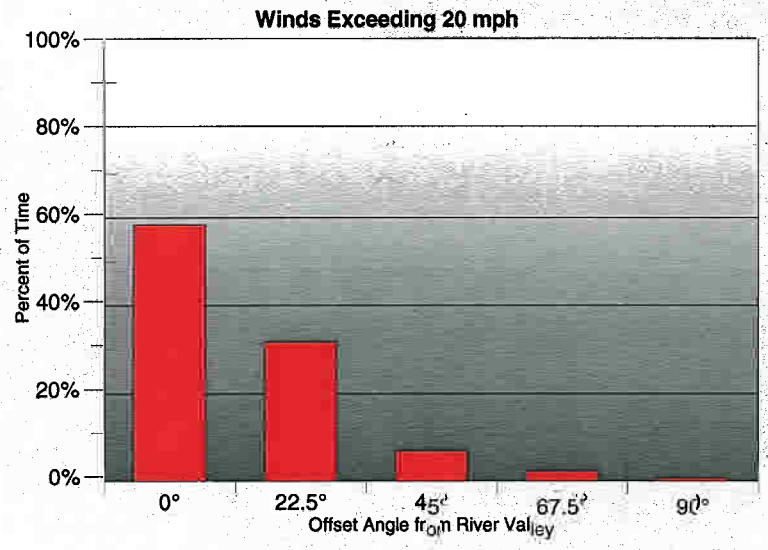
Directional Distribution for the Eight Anemometer Sites

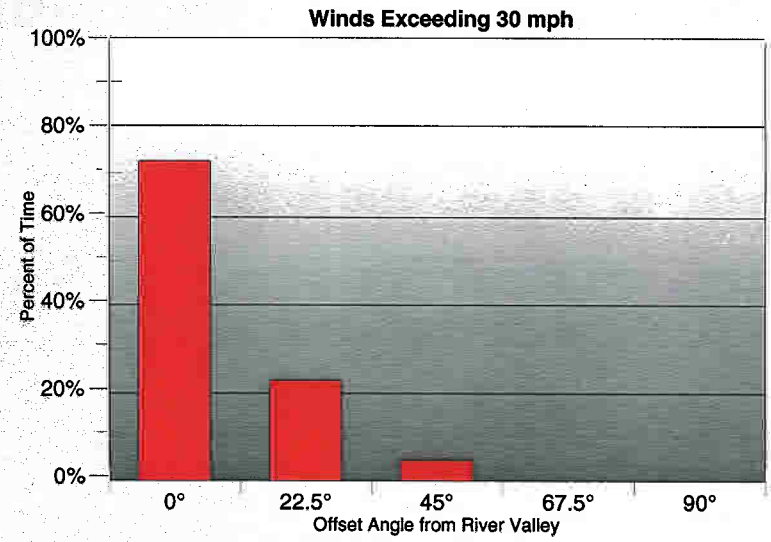
Over The River

Fremont-Chaffee (#1)
1998-1999



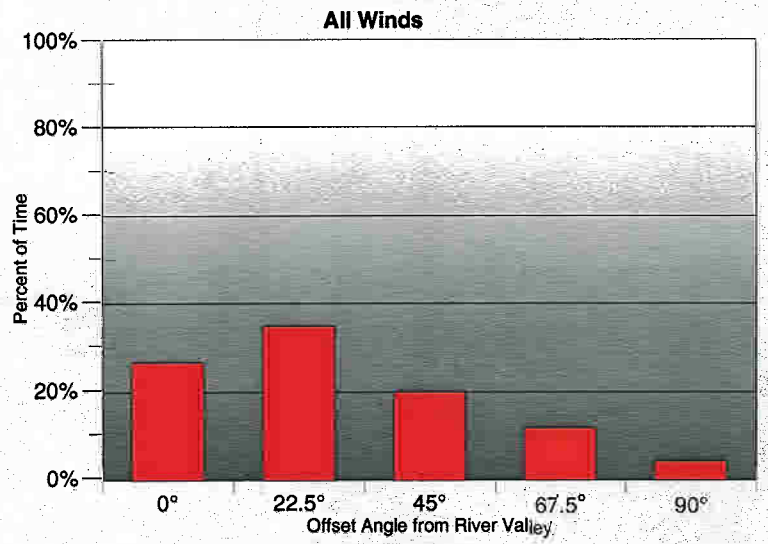


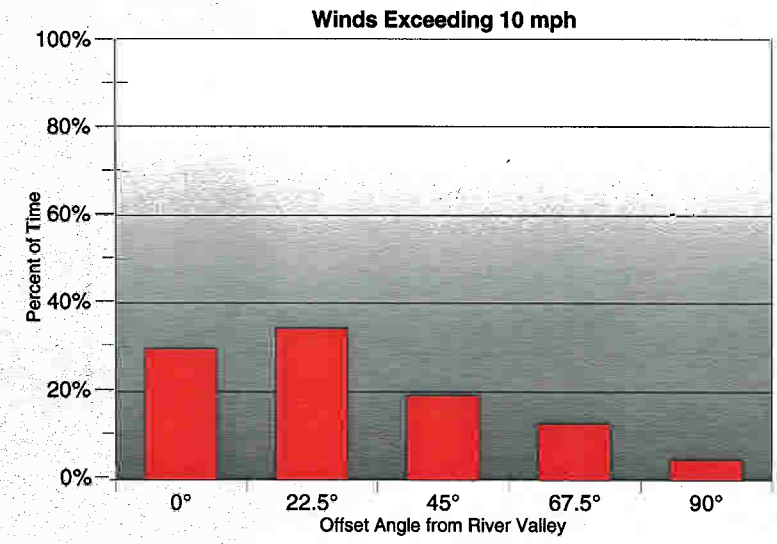


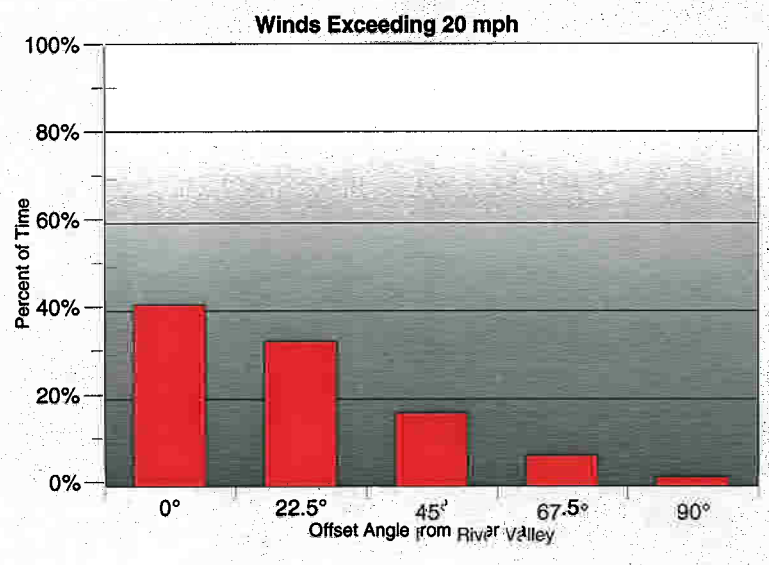


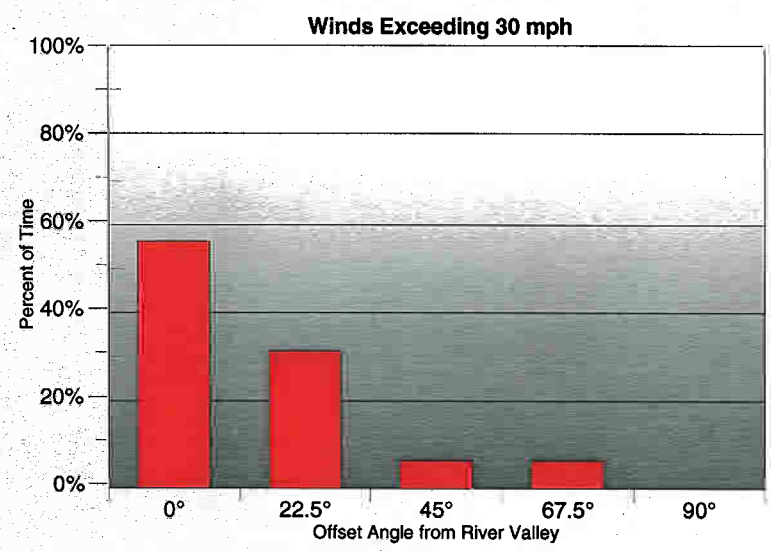
Over The River

Swissvale Tunnel Section (#2)
1998-1999



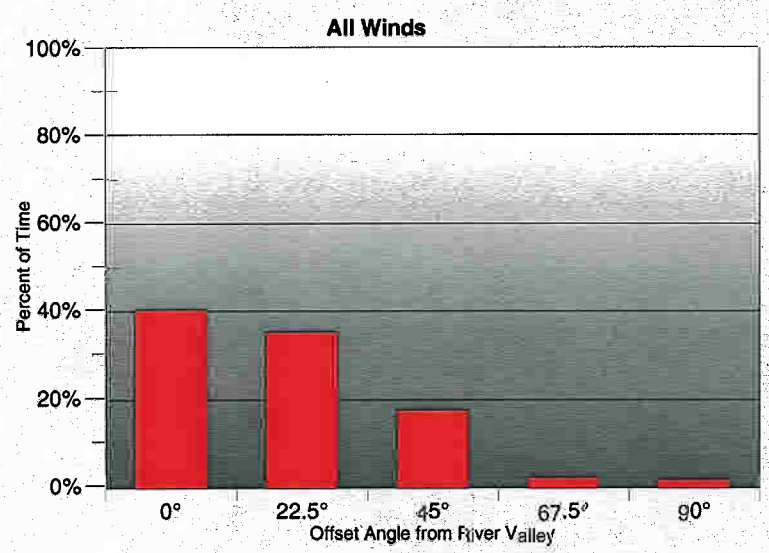


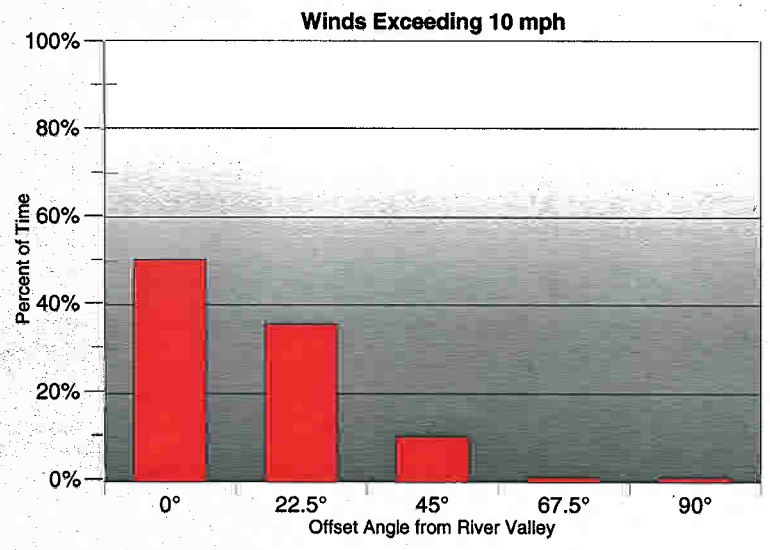


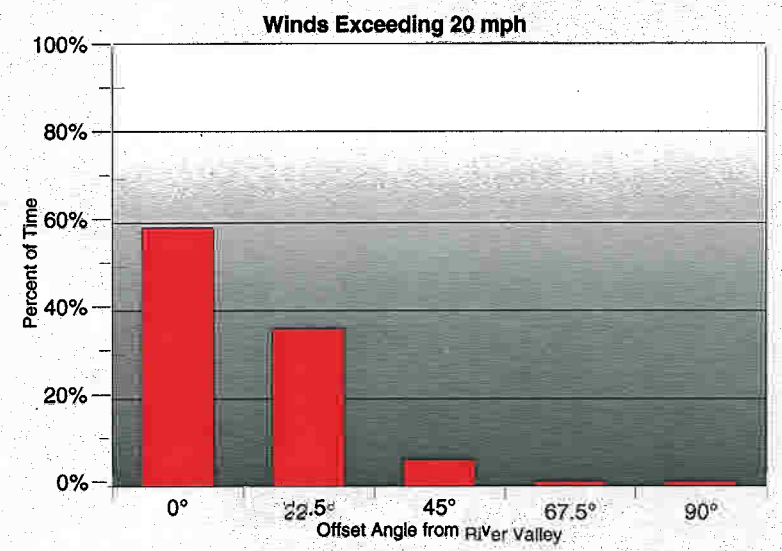


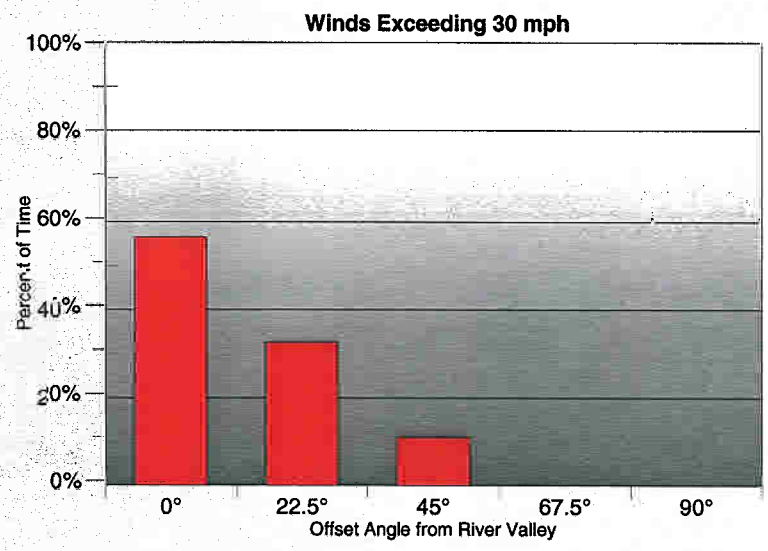
Over The River

Red Rocks (#3)
1998-1999



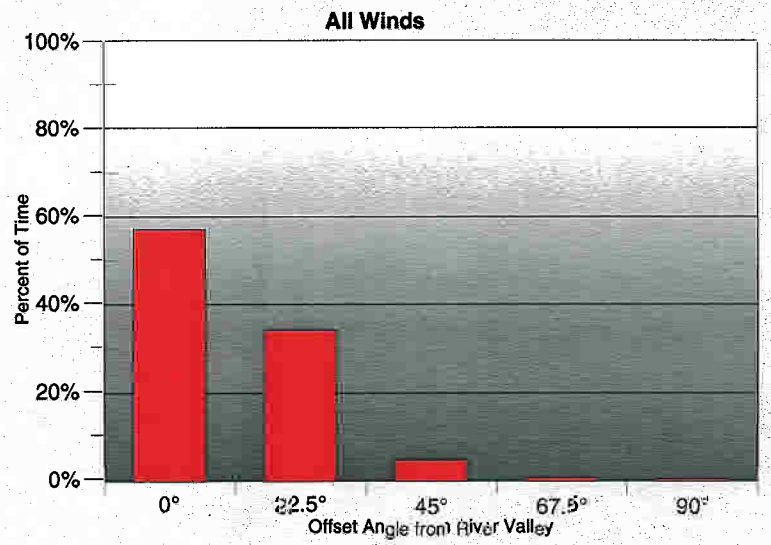


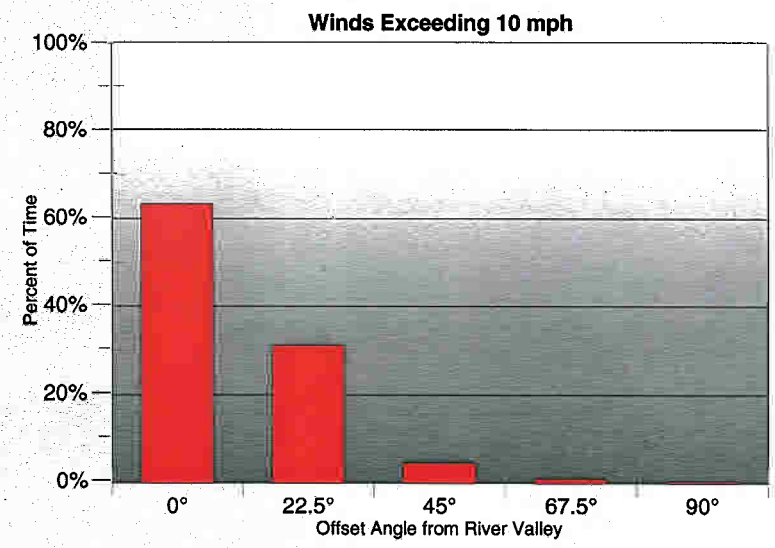


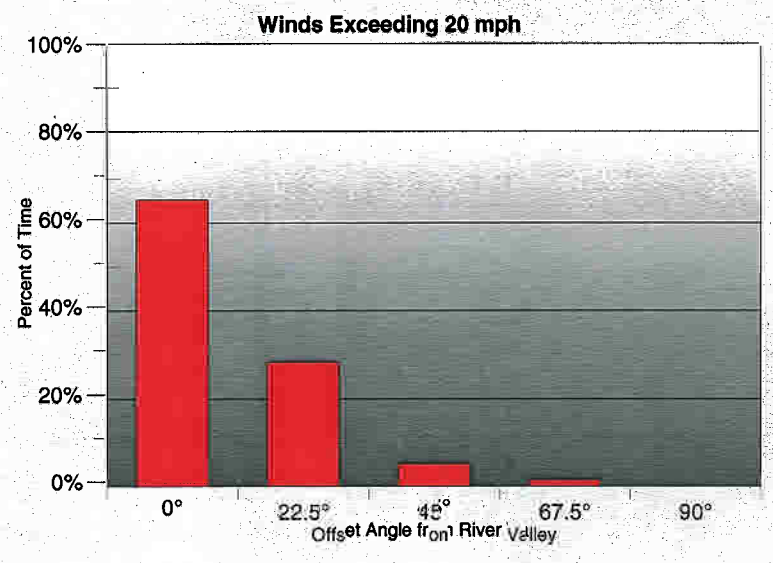


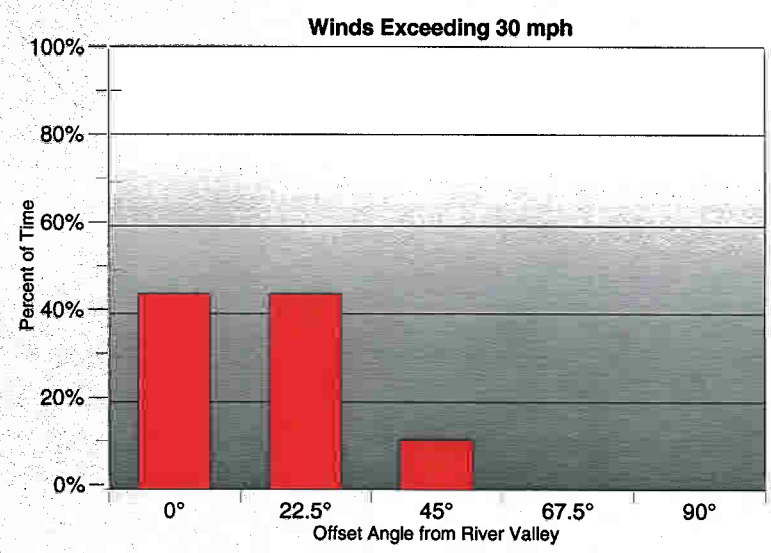
Over The River

Texas Creek (#4)
1998-1999



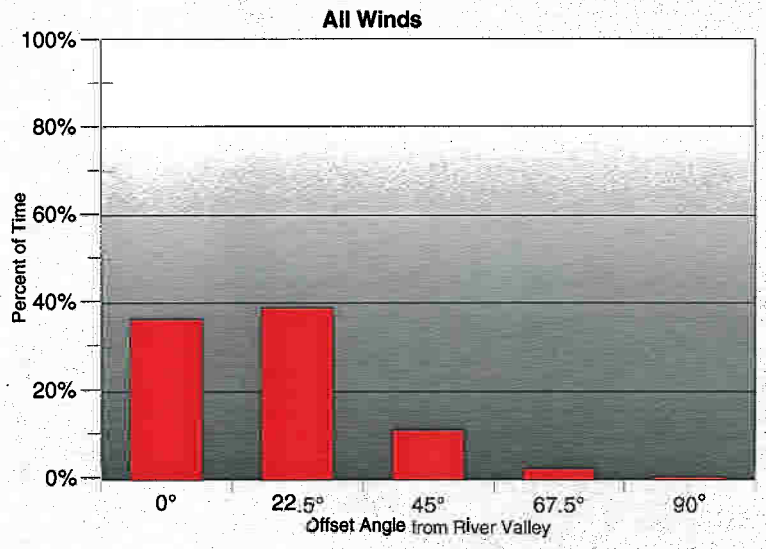


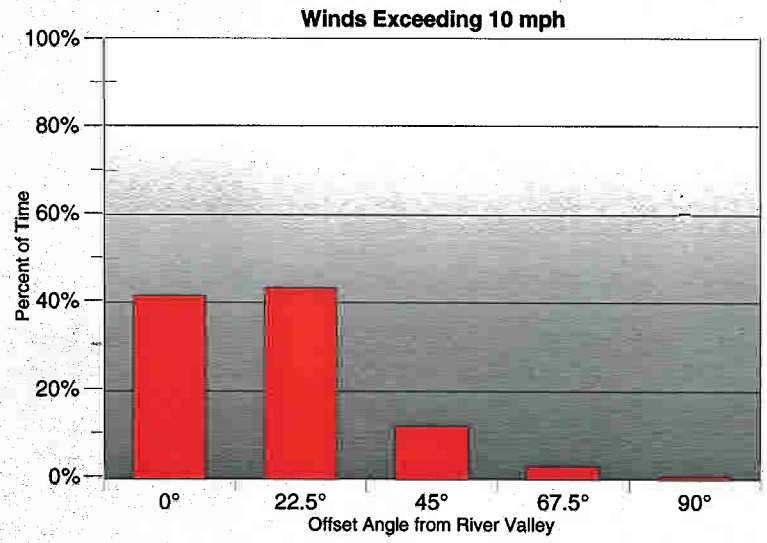


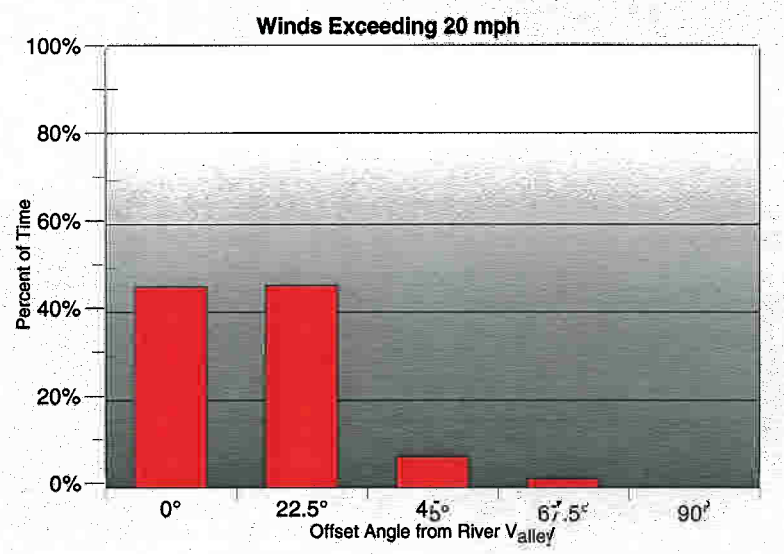


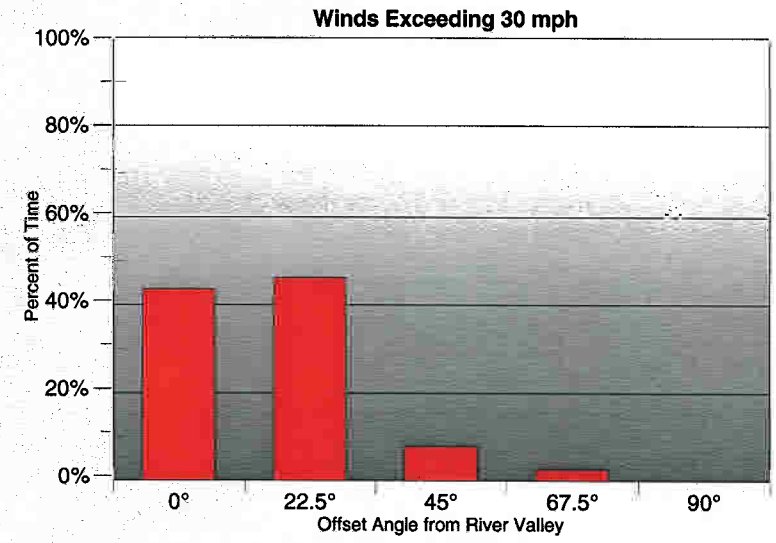
Over The River

Maytag (#5)
1998-1999



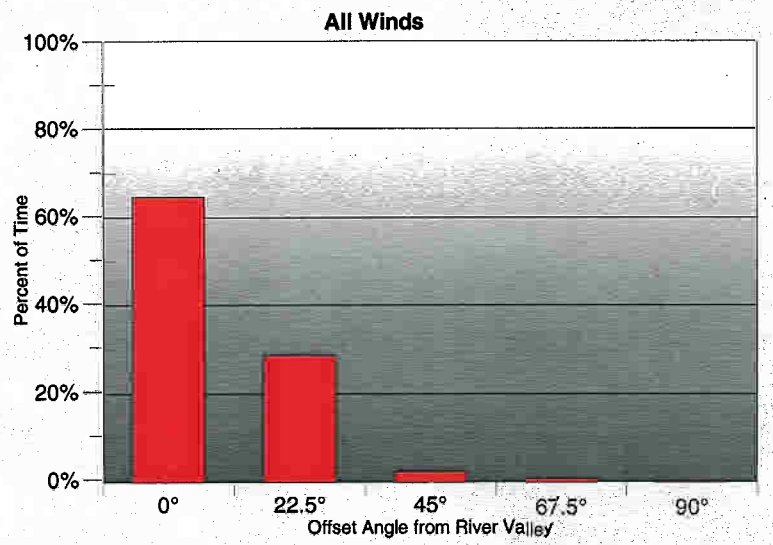


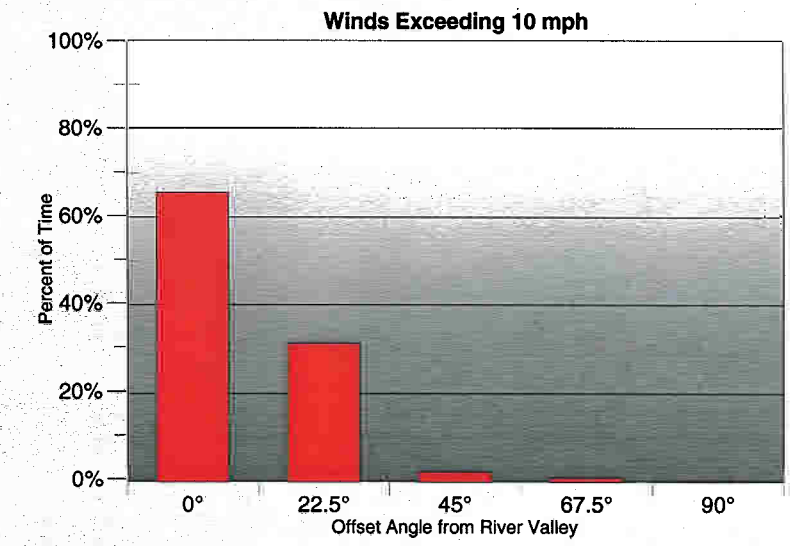


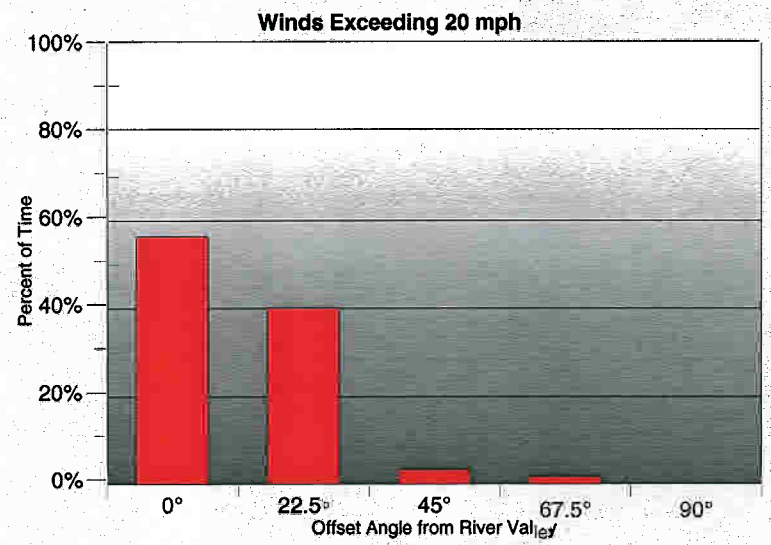


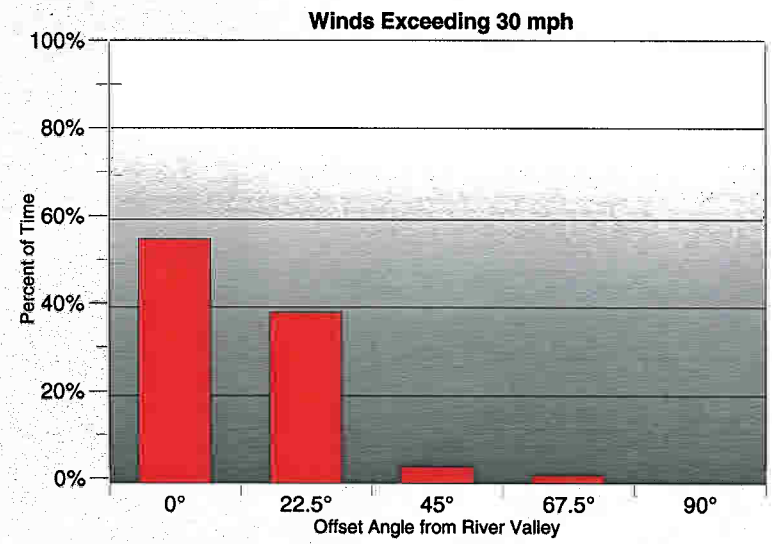
Over The River

Three Rocks (#6)
1998-1999



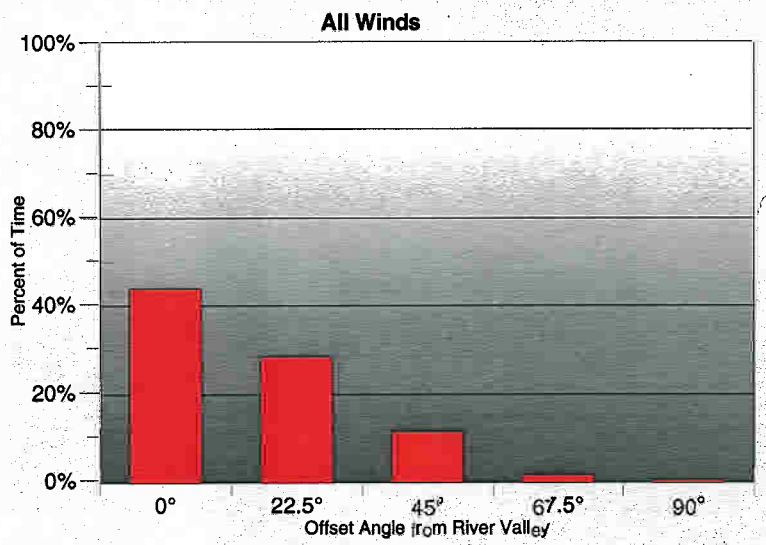


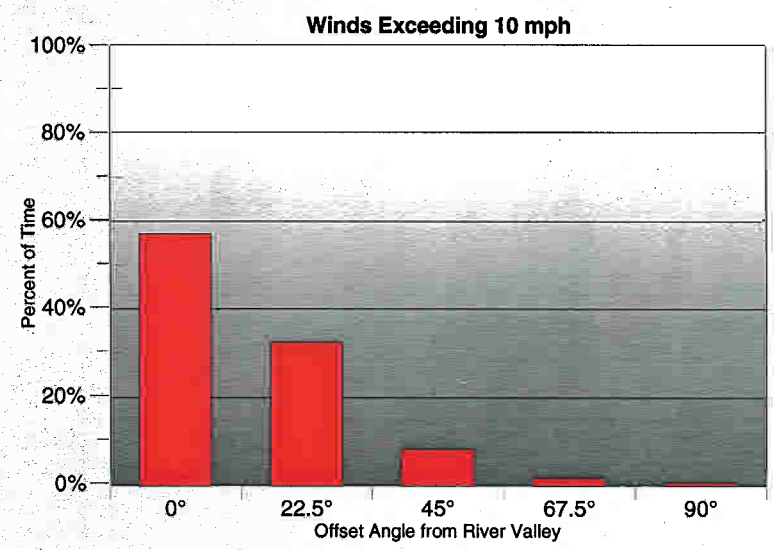


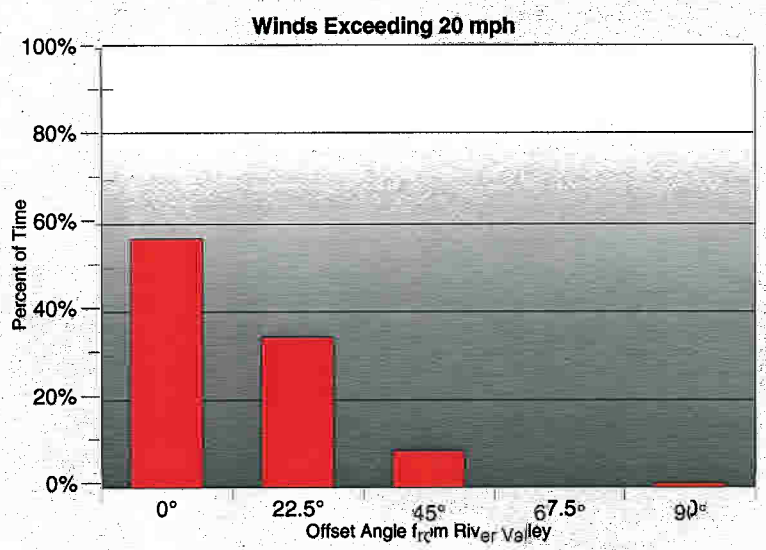


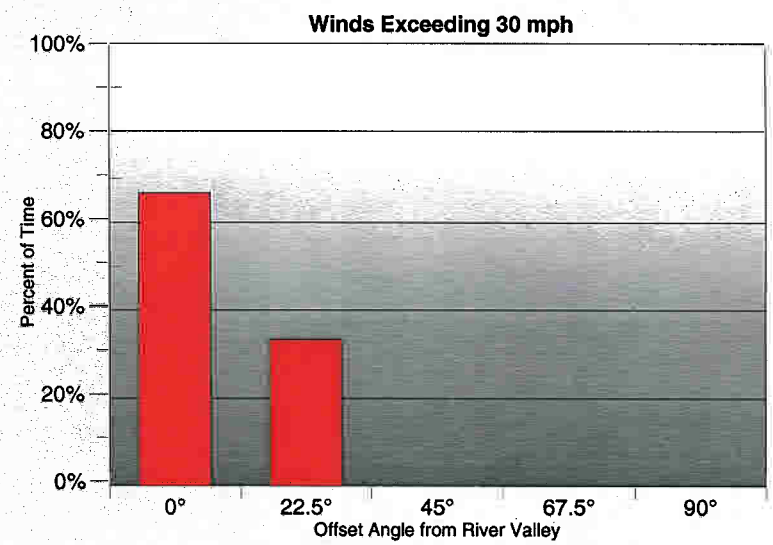
Over The River

Spikebuck (#7)
1998-1999



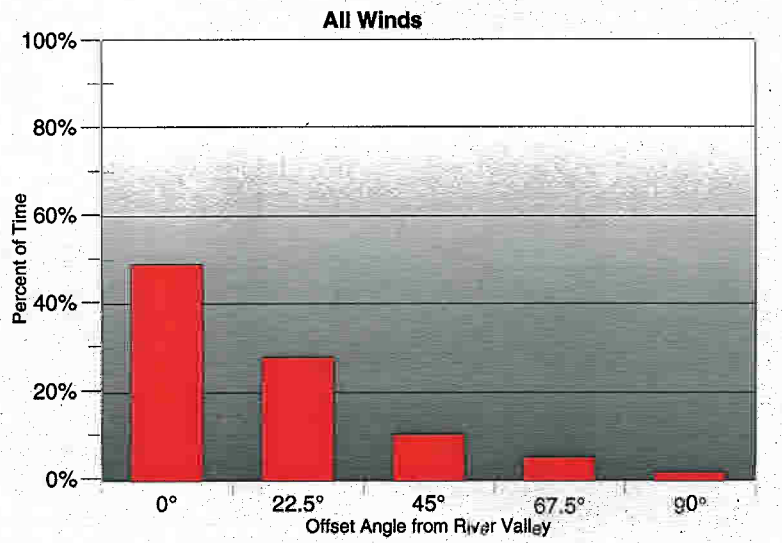


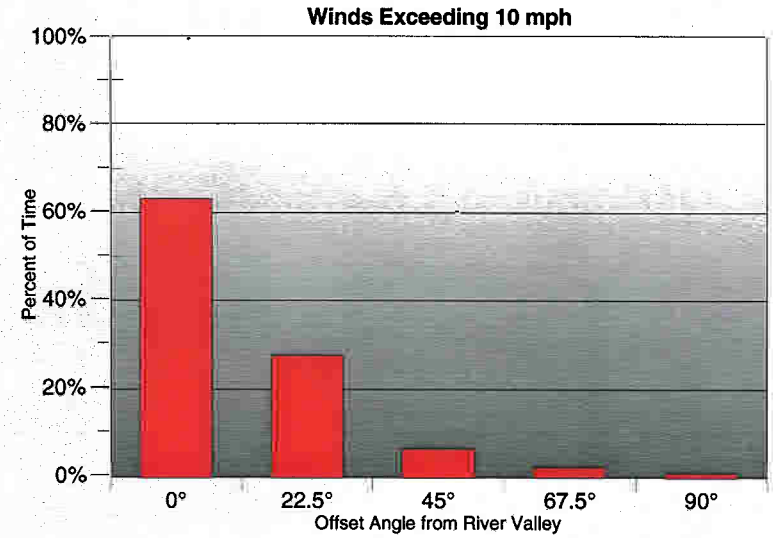


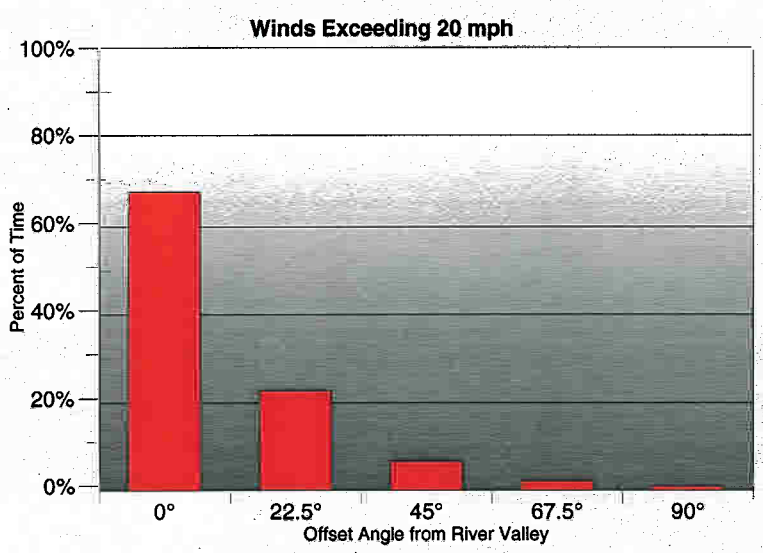


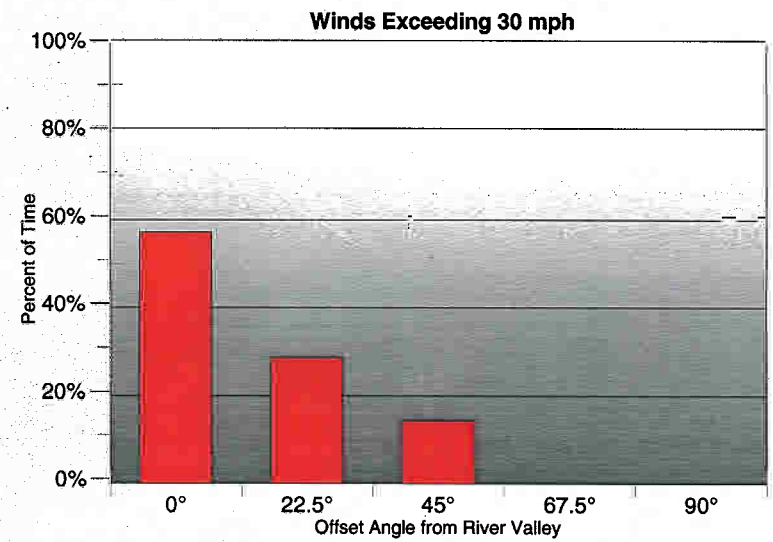
Over The River

Parkdale Siding - Canyons (#8)
1998-1999









APPENDIX D

Detailed Results of Aeroelastic Model Tests - 120ft by 40ft Panels

Test 1

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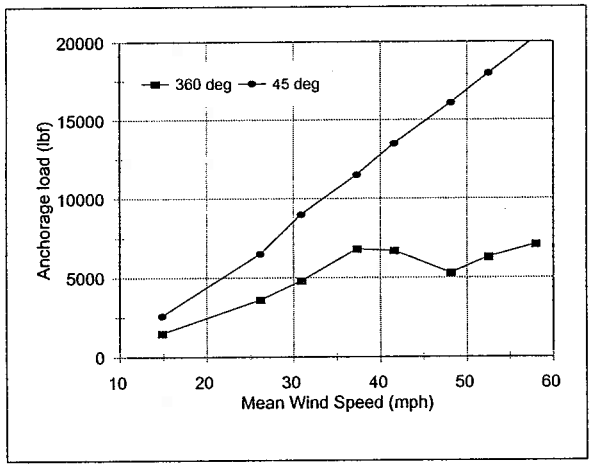
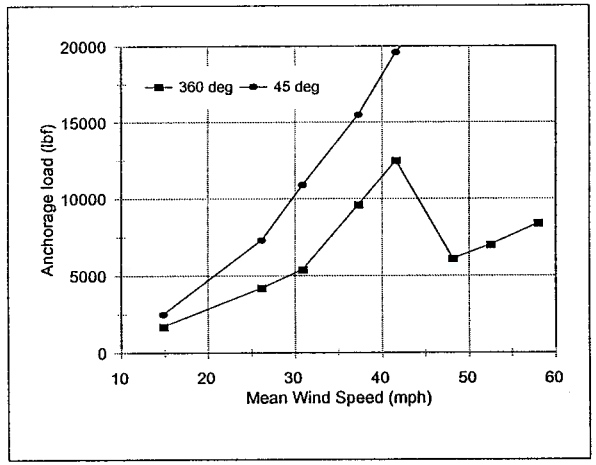
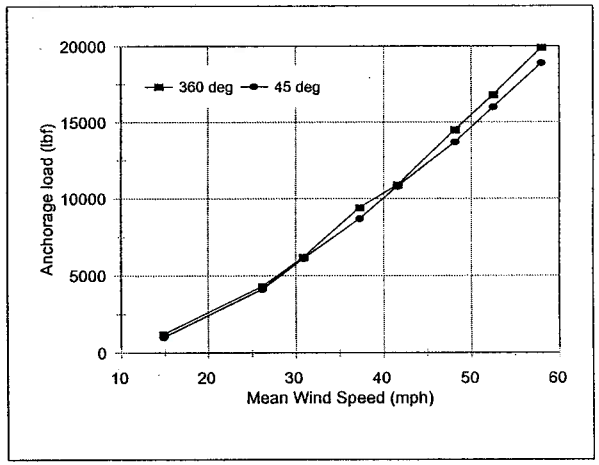


Cable 2



Diagonal 1



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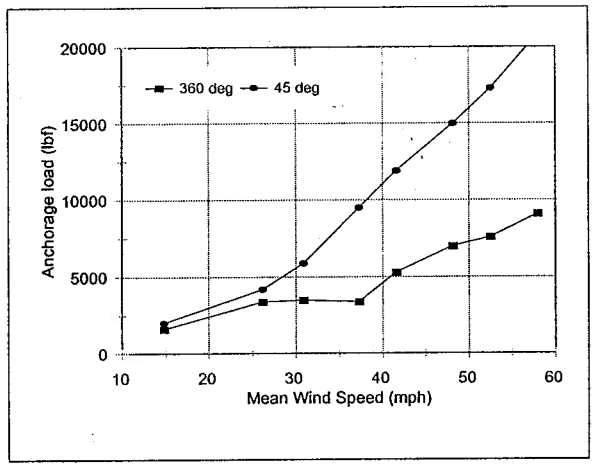
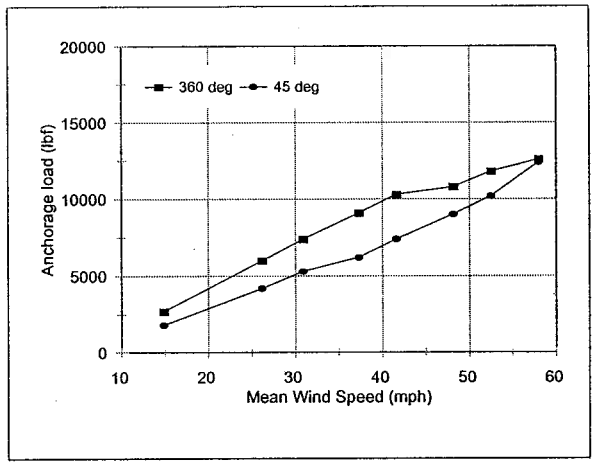


Cable 4



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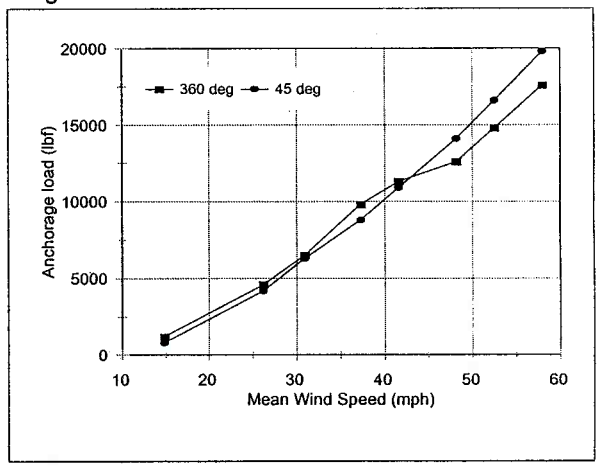


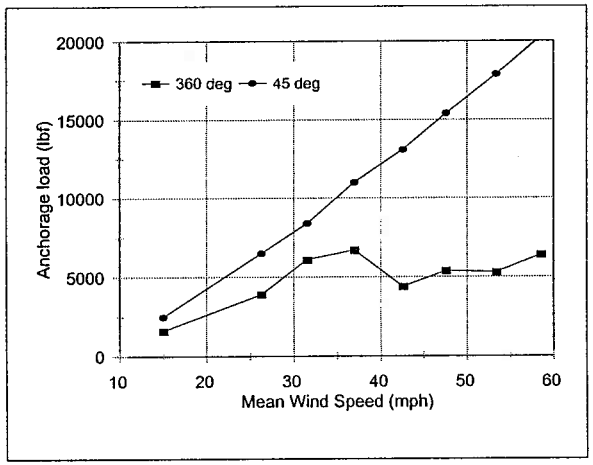
Predicted Anchorage Loads vs One Minute Wind Speeds for 120ft by 40ft Fabric Panels
Over the River Project, Arkansas River, Colorado - Project #98-130

Appendix D - Figure D1

RWDI

Test 2

Cable 1



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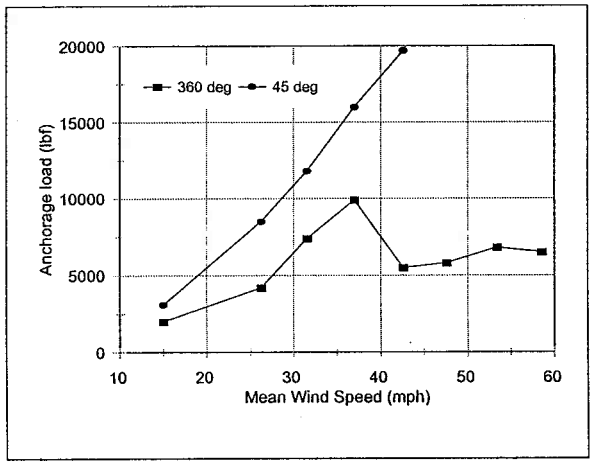
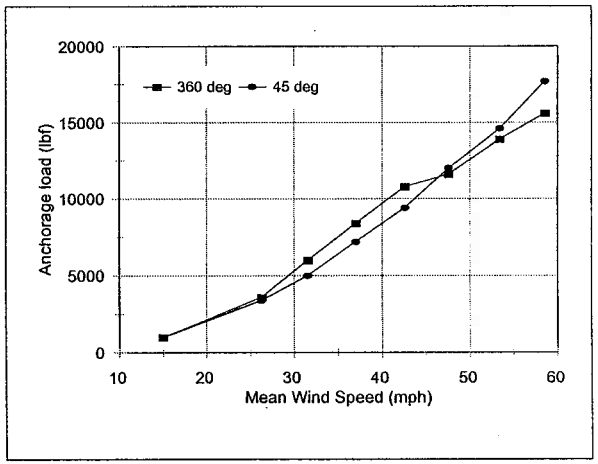


Diagonal 1



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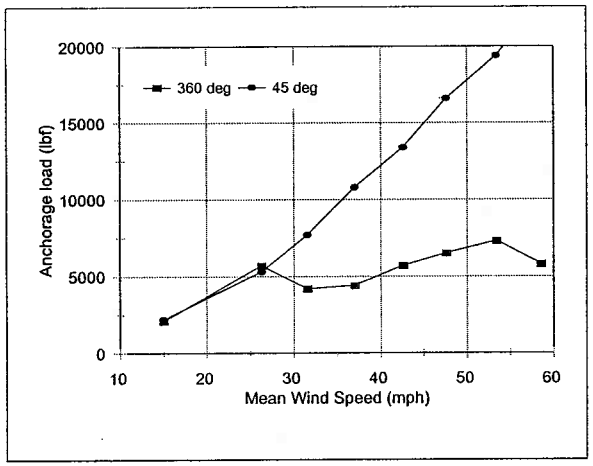

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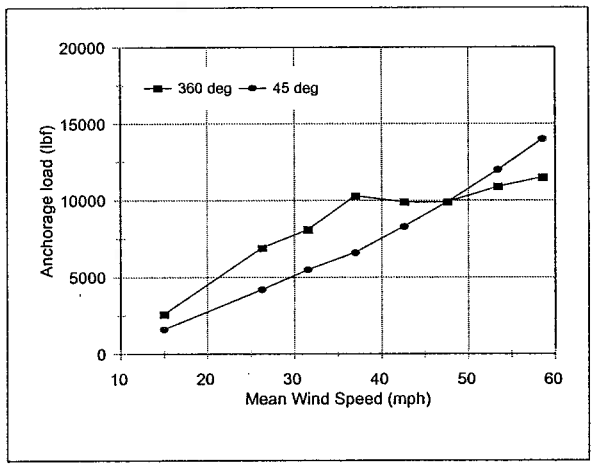

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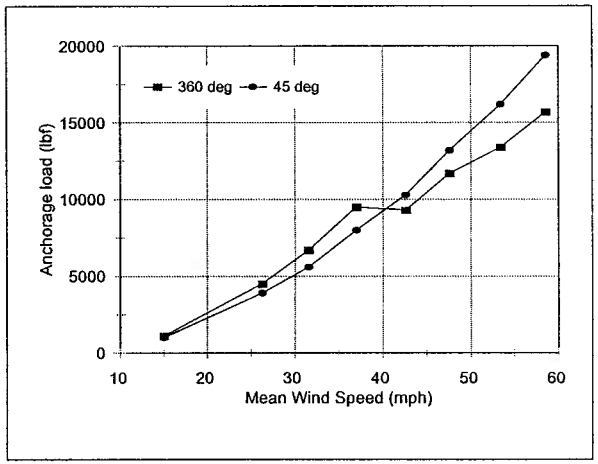
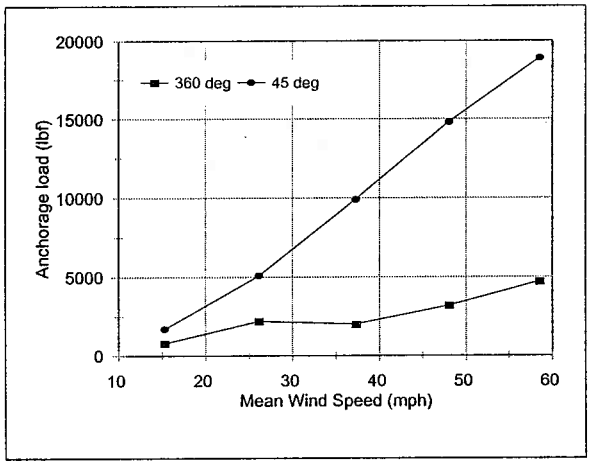


Test 3

Cable 1



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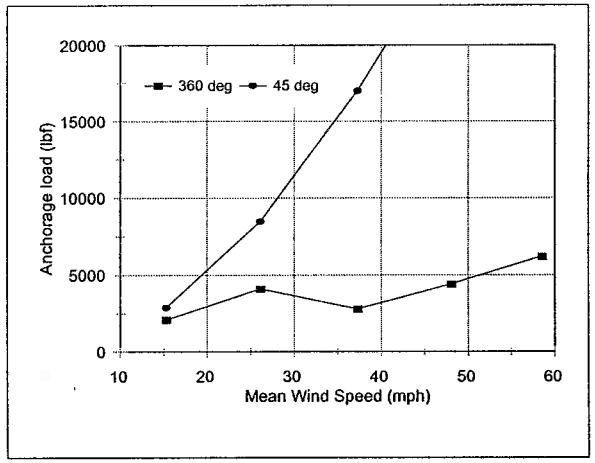
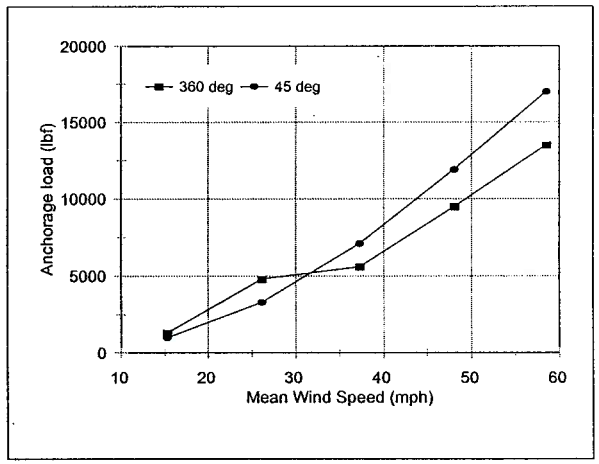


Diagonal 1



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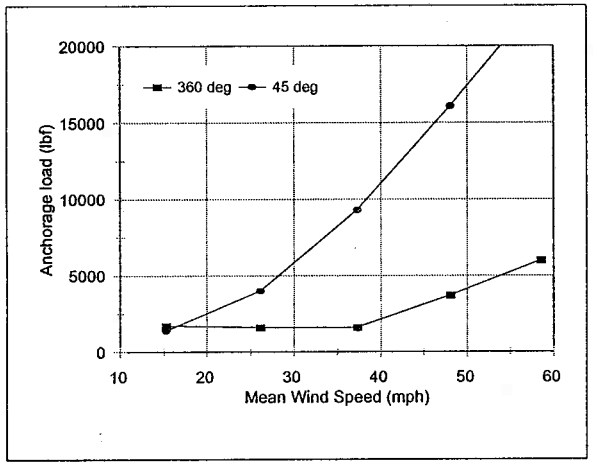

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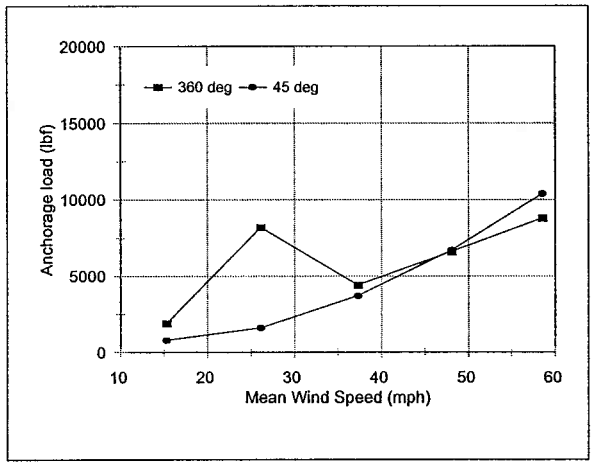

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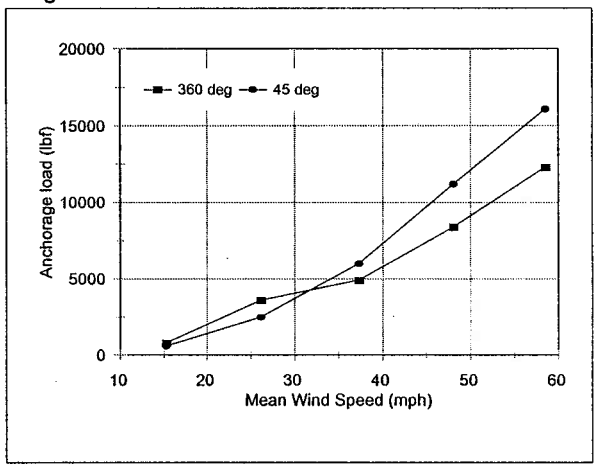

Predicted Anchorage Loads vs One Minute Wind Speeds for 120ft by 40ft Fabric Panels
Over the River Project, Arkansas River, Colorado - Project #98-130

Appendix D - Figure D3

RWDI

Test 4

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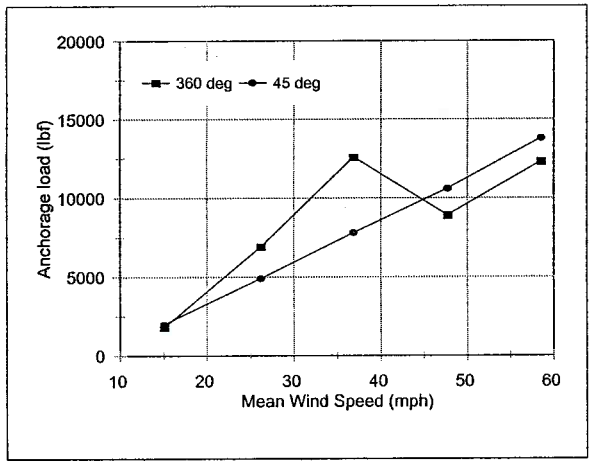

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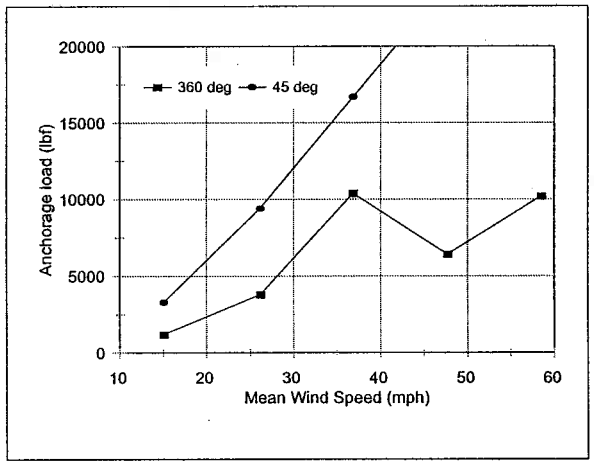

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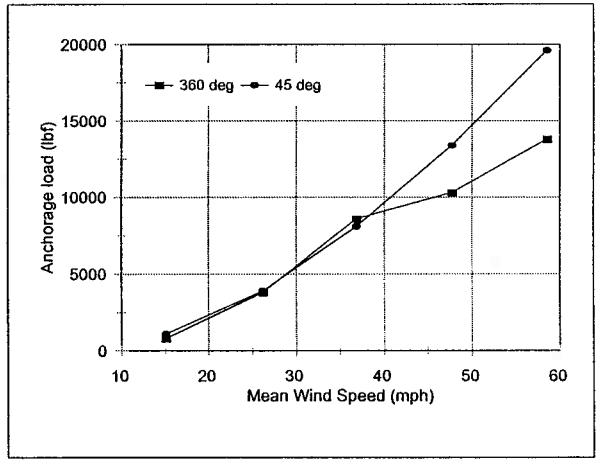

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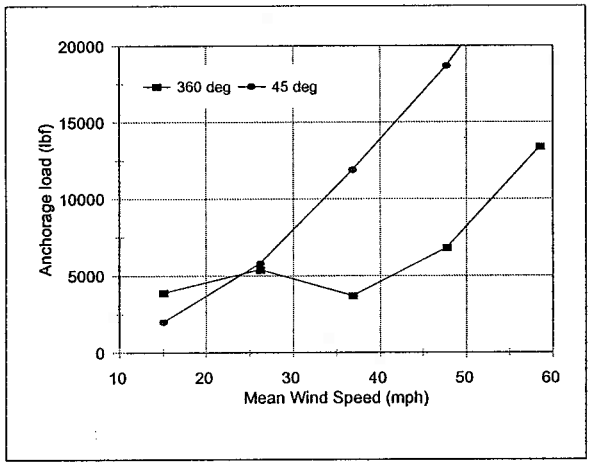

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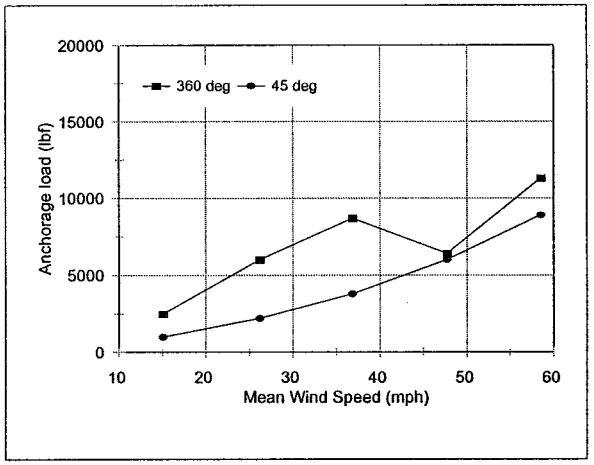

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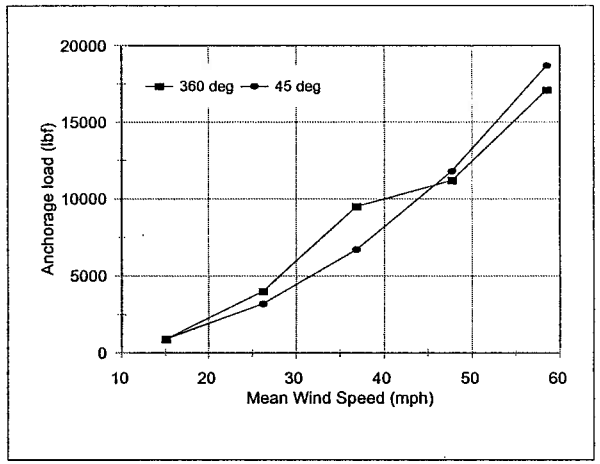

Test 5

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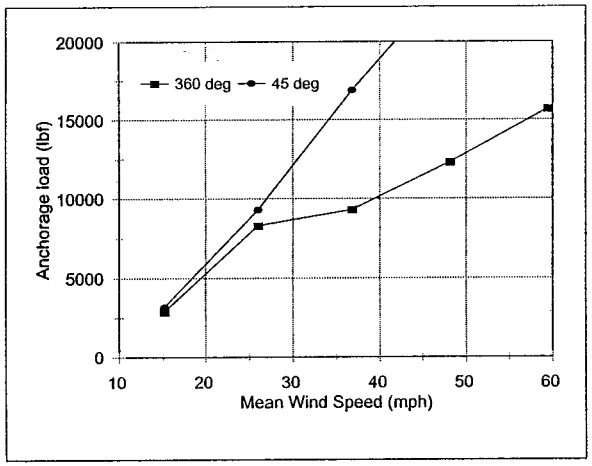

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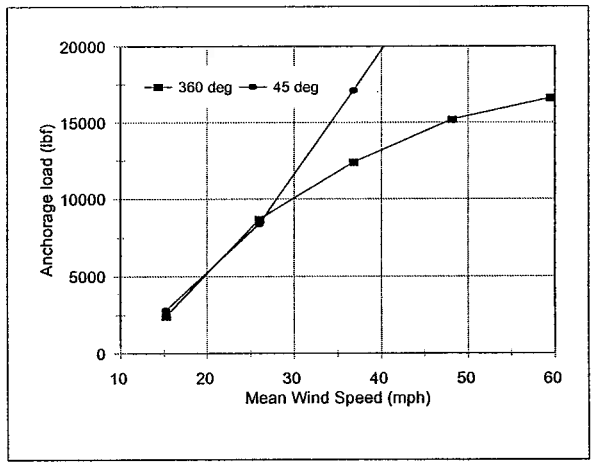

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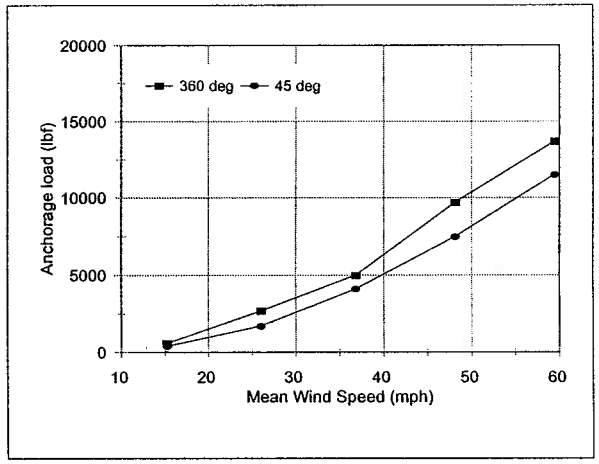

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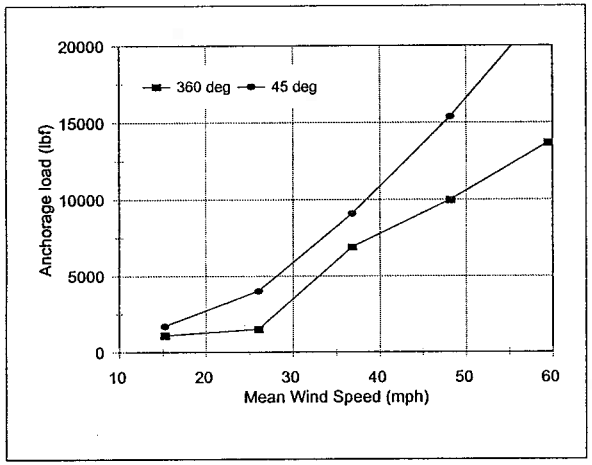

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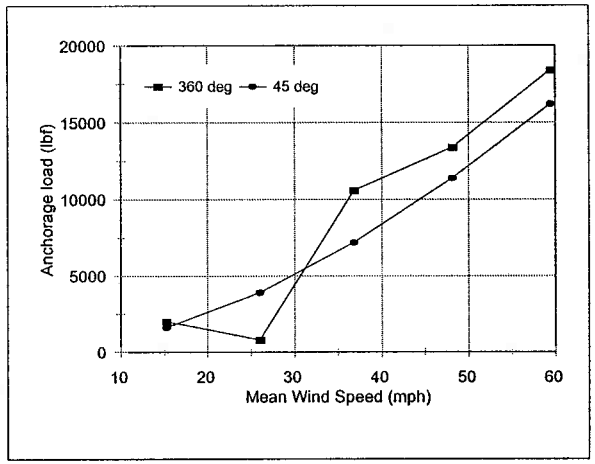

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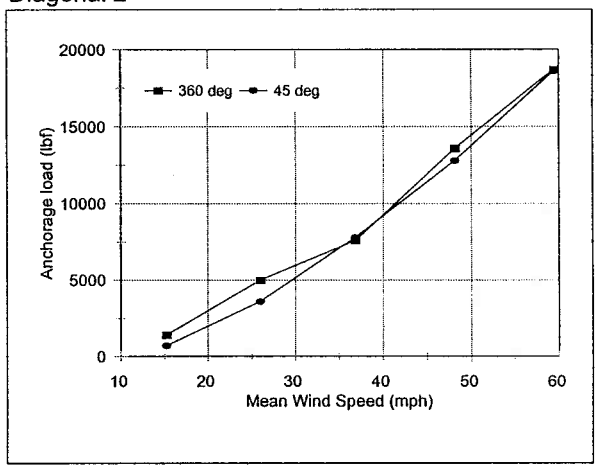

Test 6

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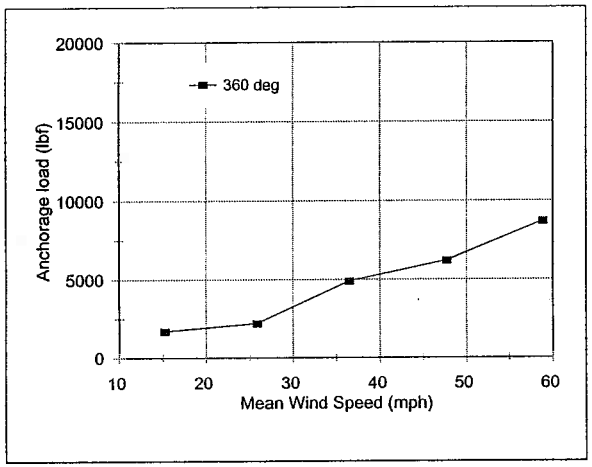

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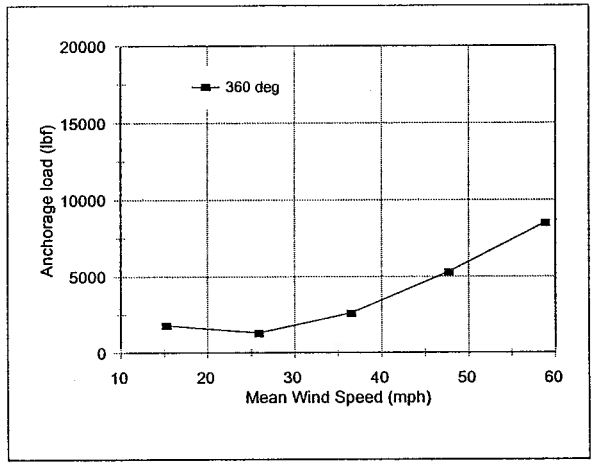

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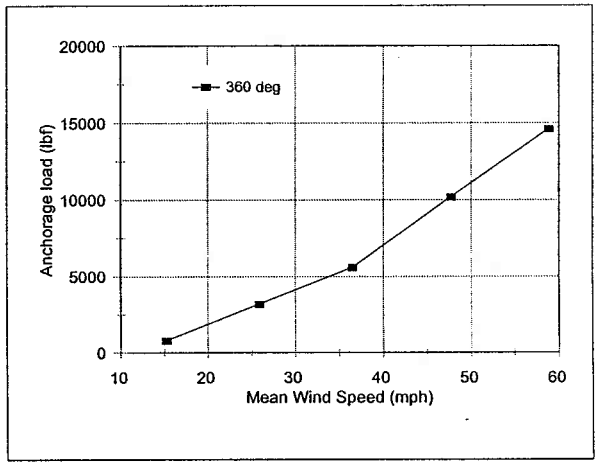

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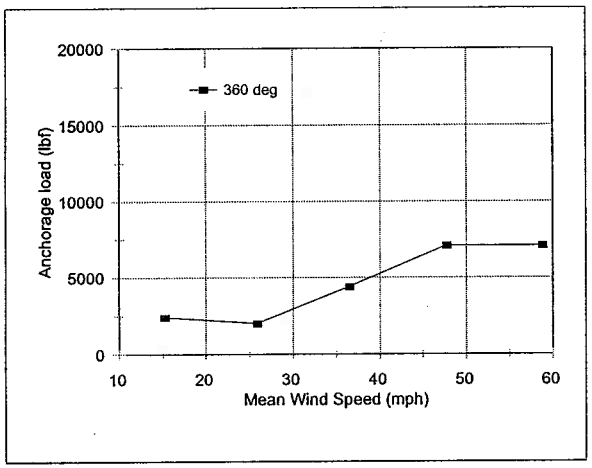

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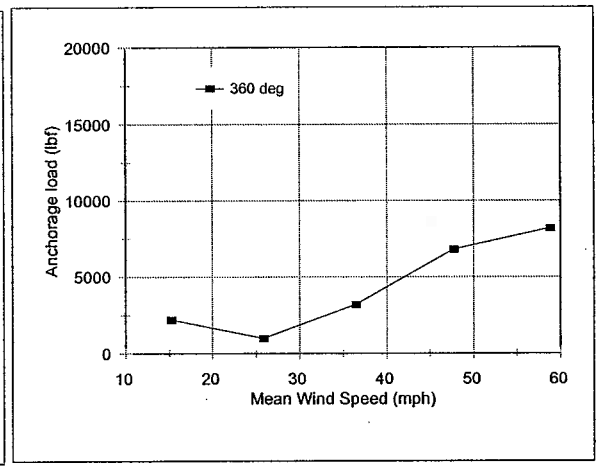

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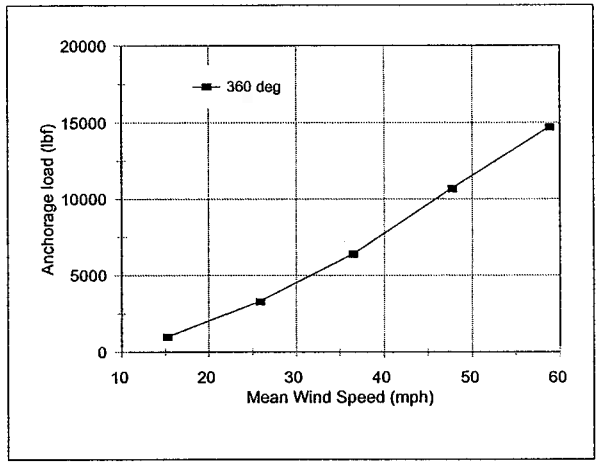

Test 7

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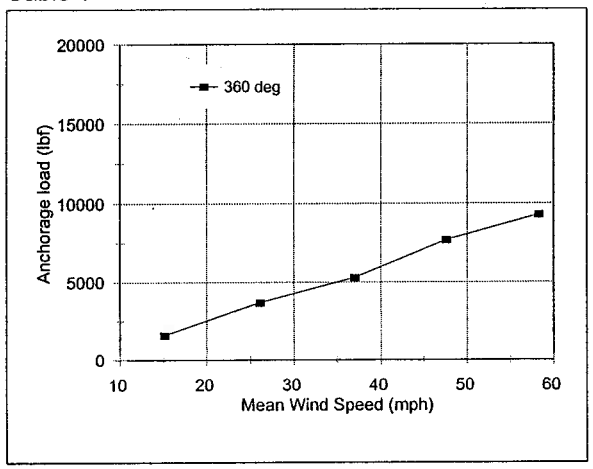

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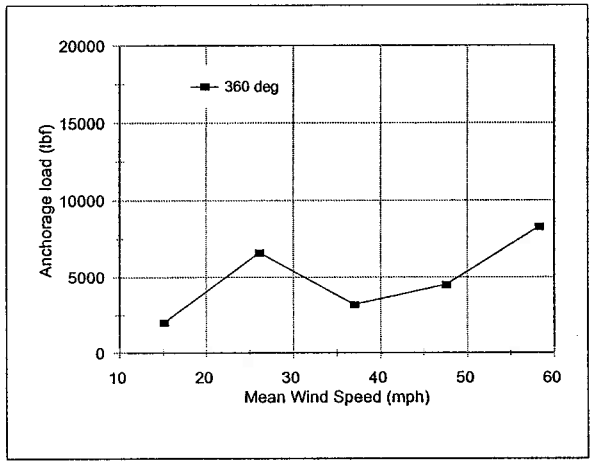

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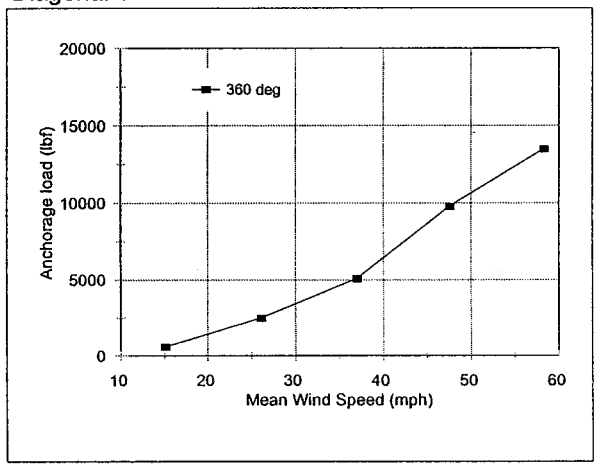

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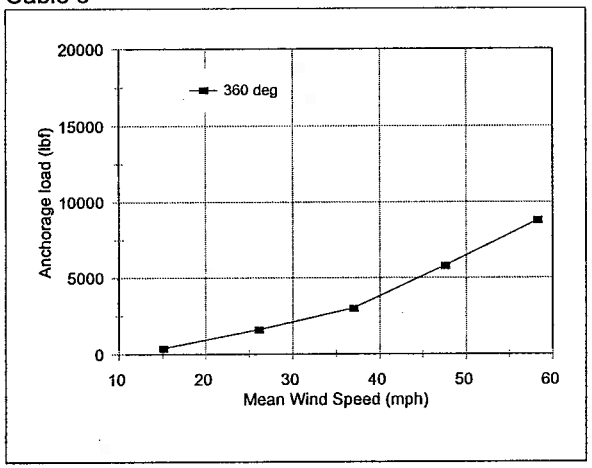

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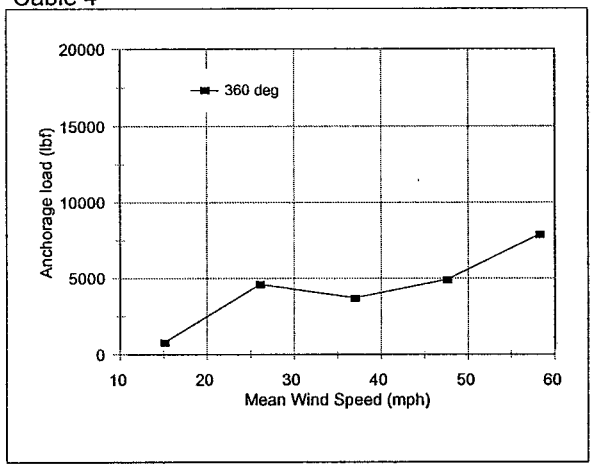
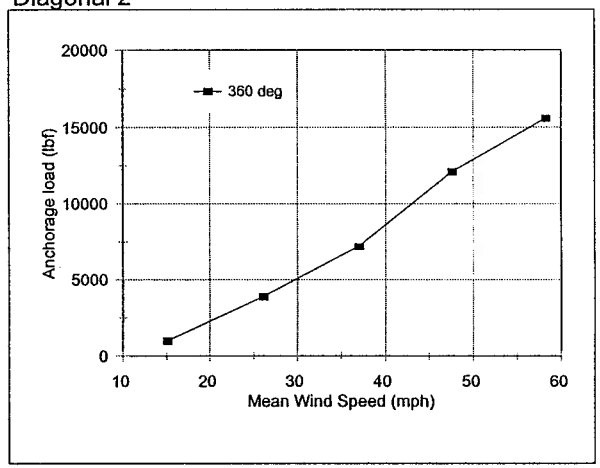


Diagonal 2



Test 9

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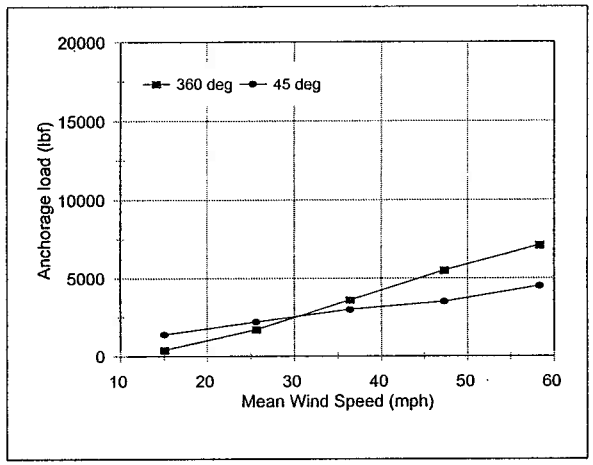
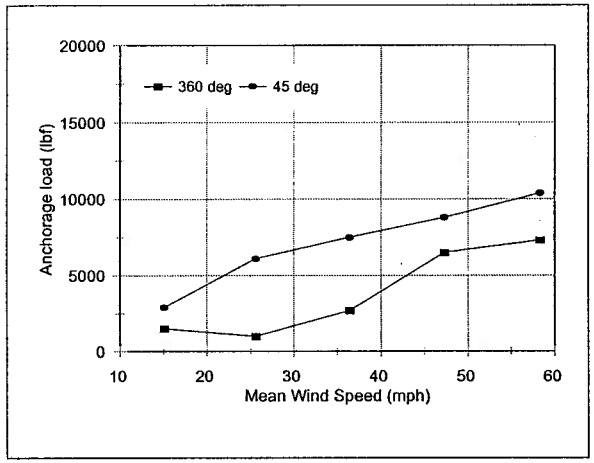
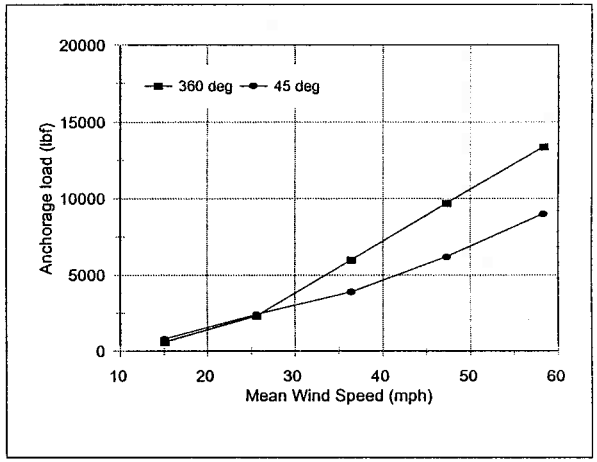


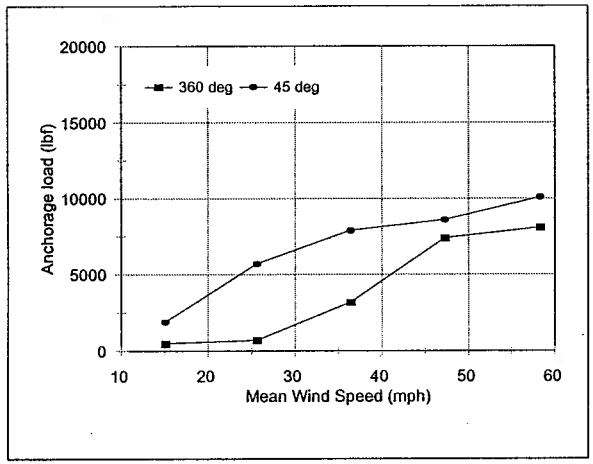
Cable 2



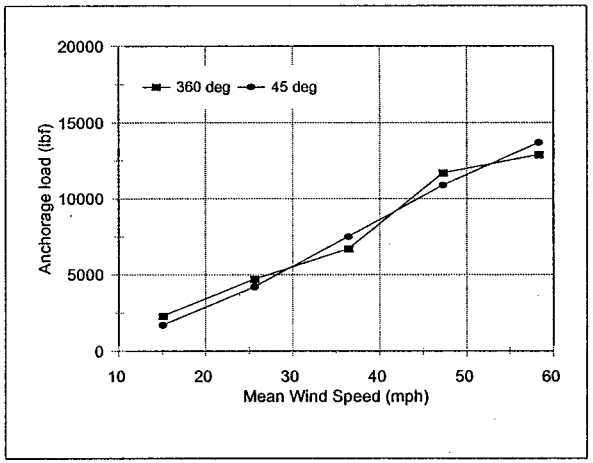
Diagonal 1



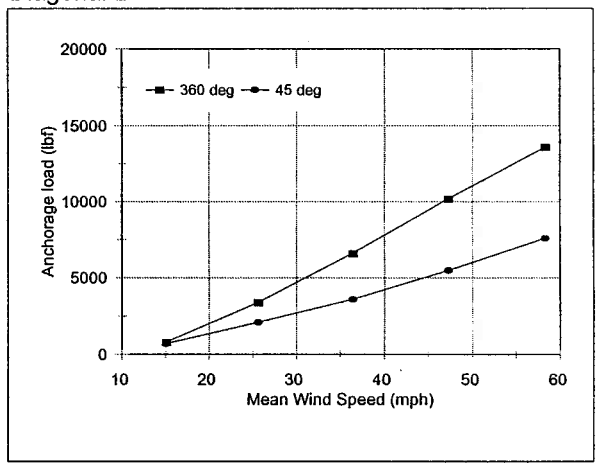
Cable 3



Cable 4



Diagonal 2



Predicted Anchorage Loads vs One Minute Wind Speeds for 120ft by 40ft Fabric Panels
Over the River Project, Arkansas River, Colorado - Project #98-130

Appendix D - Figure D8

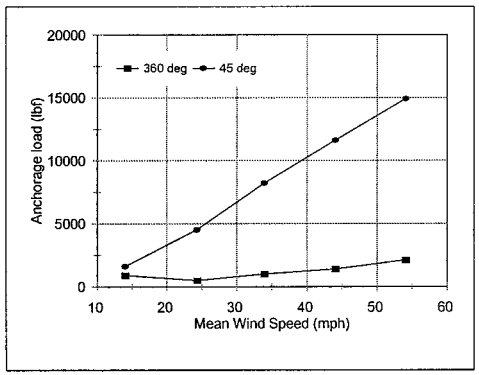
RWDI

APPENDIX E

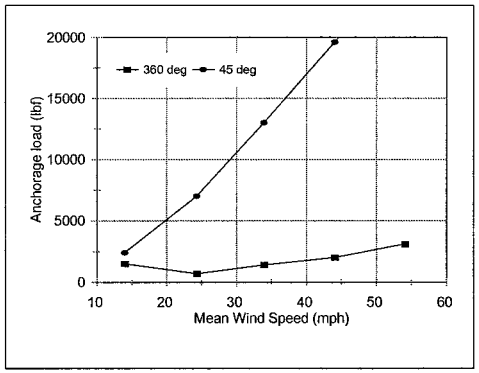
Detailed Results of Aeroelastic Model Tests - 90ft by 35ft Panels

Test 11

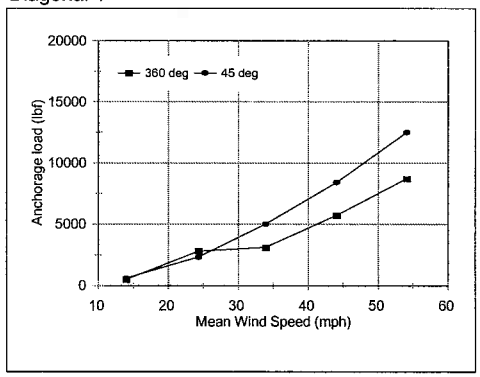
Cable 1



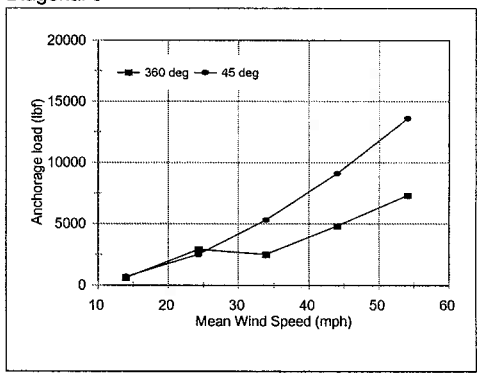
Cable 2



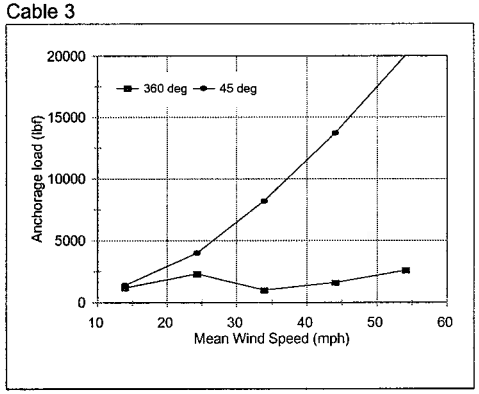
Diagonal 1



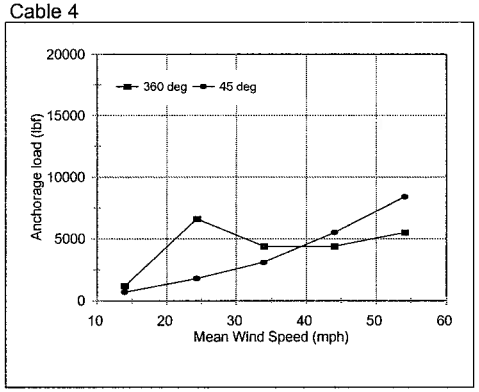
Diagonal 3



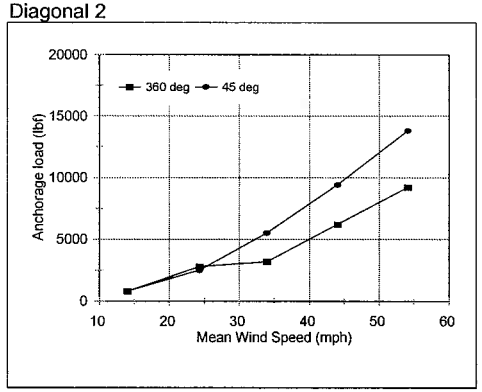
Cable 3



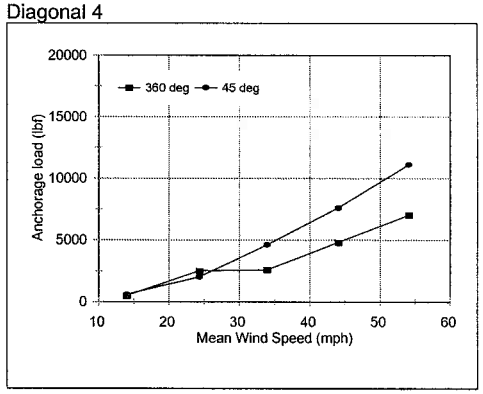
Cable 4



Diagonal 2

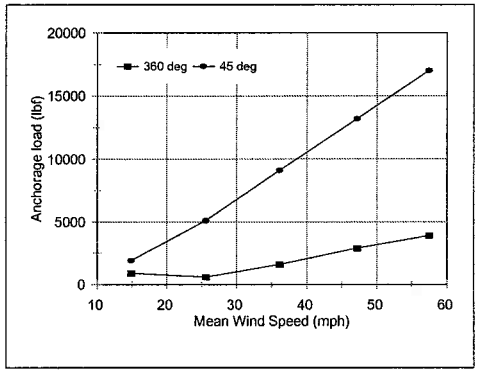


Diagonal 4

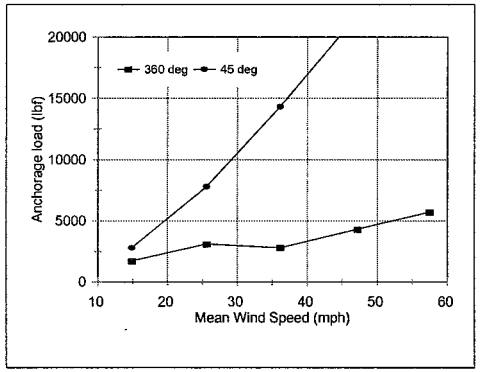


Test 12

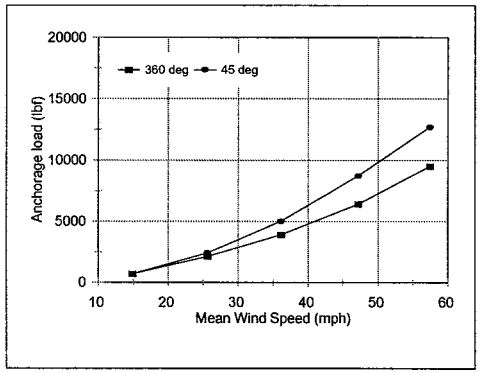
Cable 1



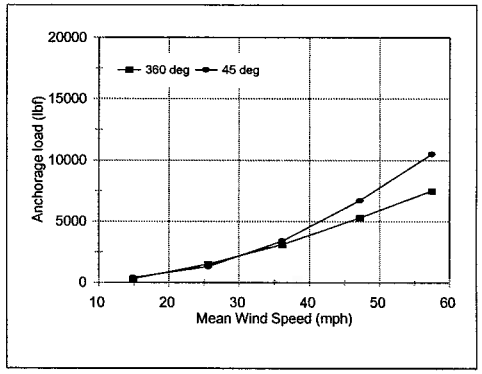
Cable 2



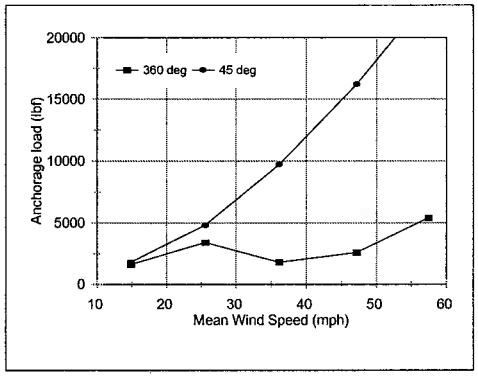
Diagonal 1



Diagonal 3



Cable 3



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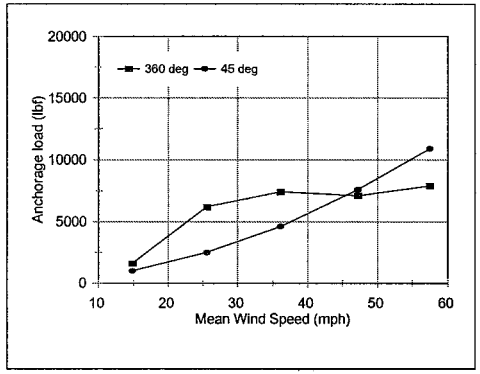
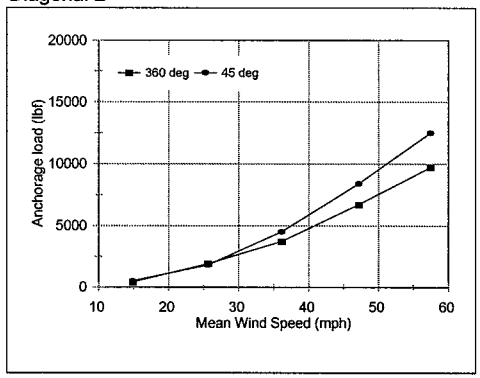
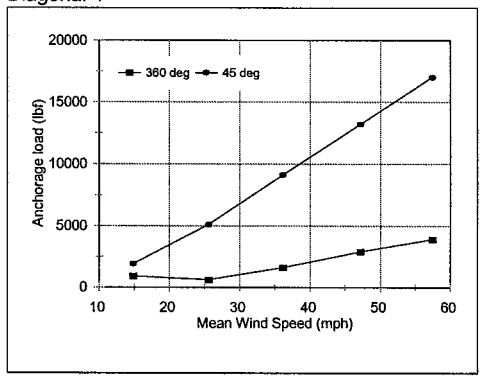


Diagonal 2



Diagonal 4



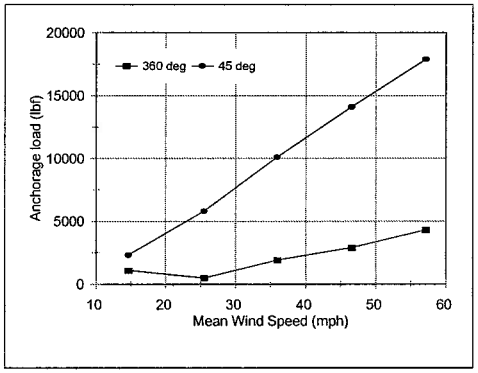
Predicted Anchorage Loads vs One Minute Wind Speeds for 90ft by 35ft Fabric Panels
Over the River Project, Arkansas River, Colorado - Project #98-130

Appendix E - Figure E2

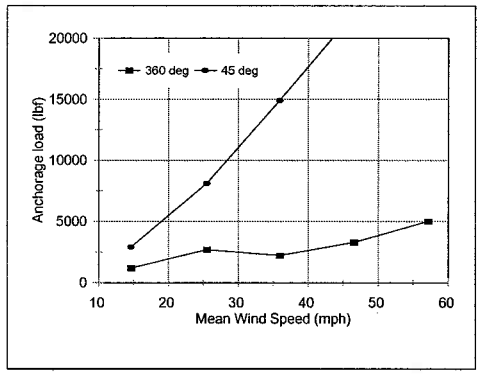
RWDI

Test 13

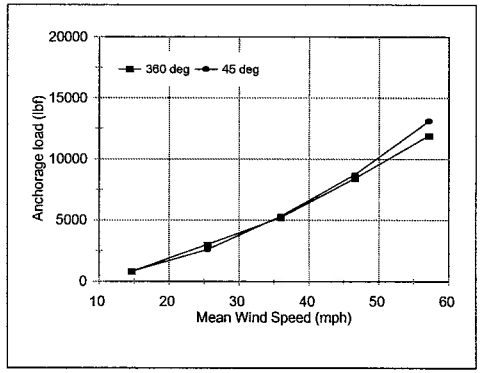
Cable 1



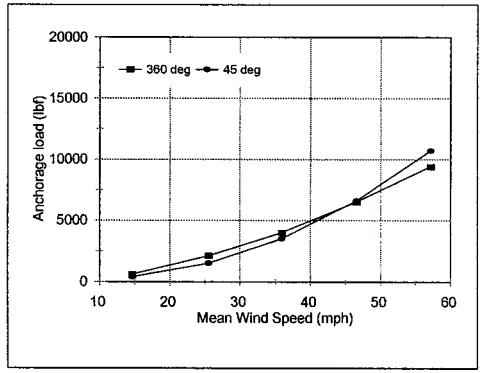
Cable 2



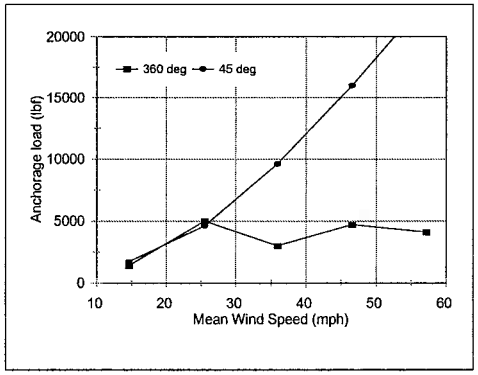
Diagonal 1



Diagonal 3



Cable 3



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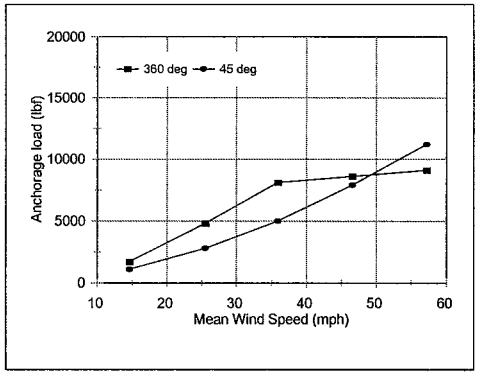
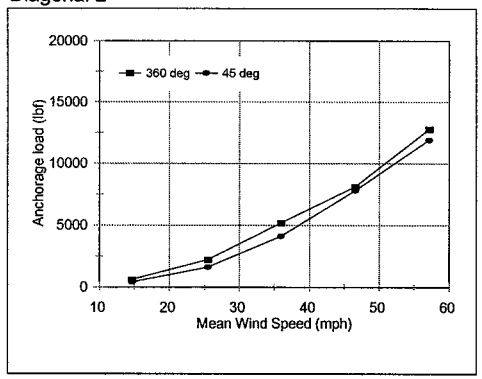
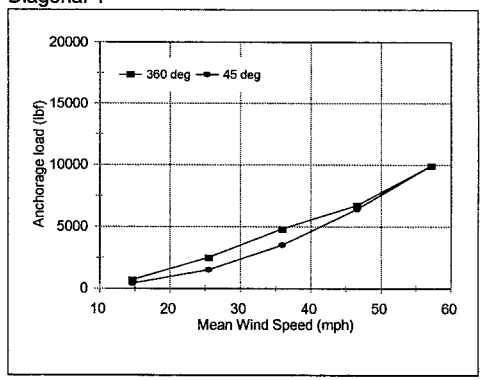


Diagonal 2

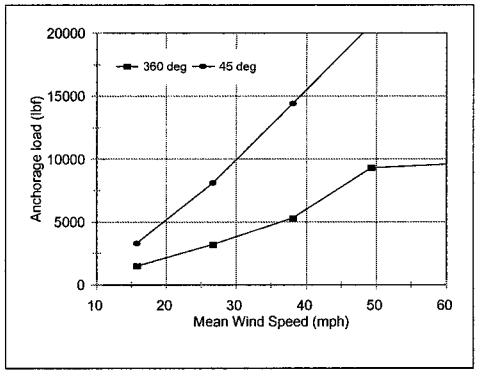


Diagonal 4

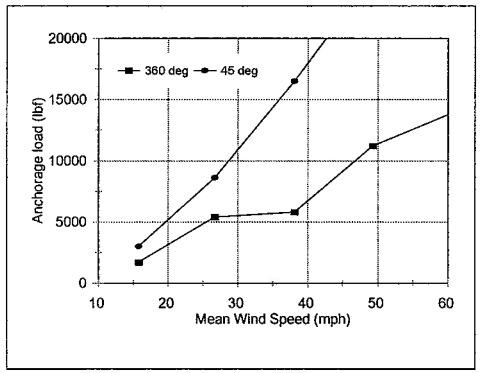


Test 14

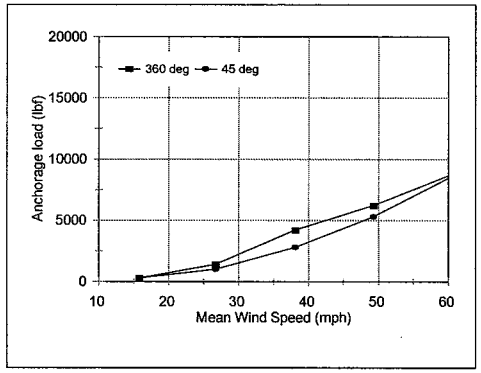
Cable 1



Cable 2



Diagonal 1



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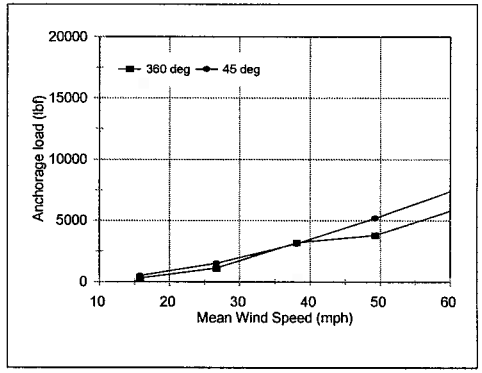
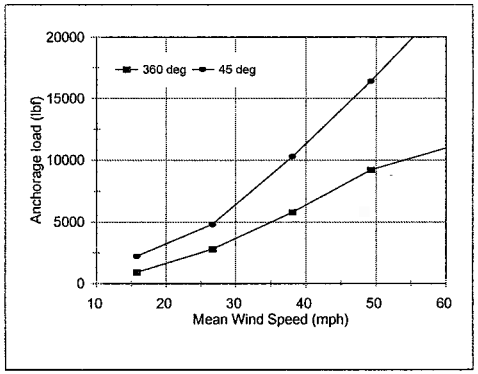
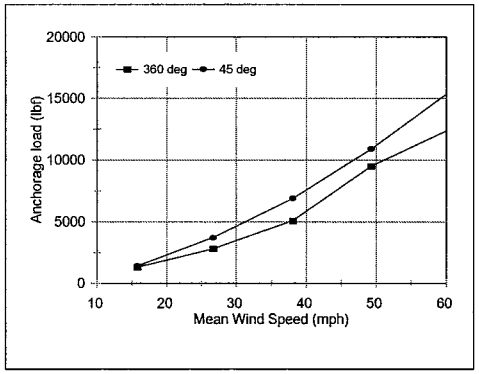


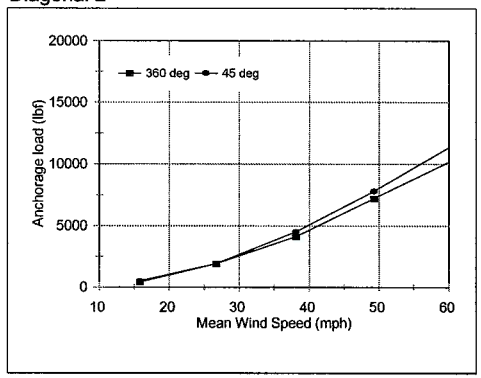
Cable 3



Cable 4



Diagonal 2



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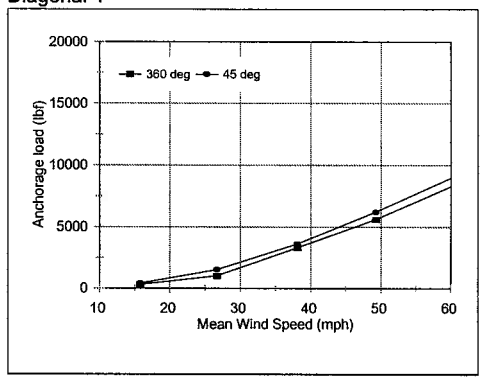
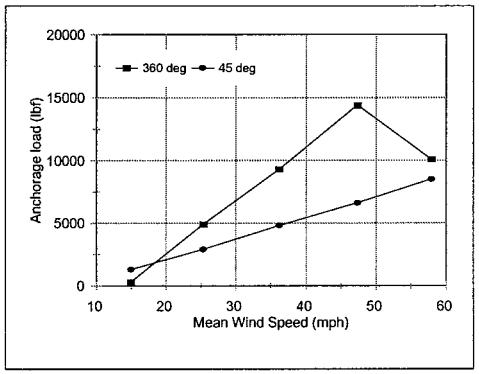
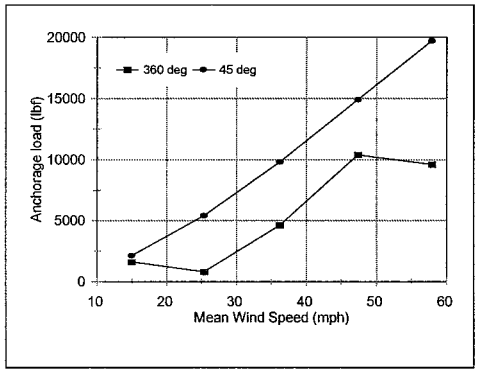


Test 15

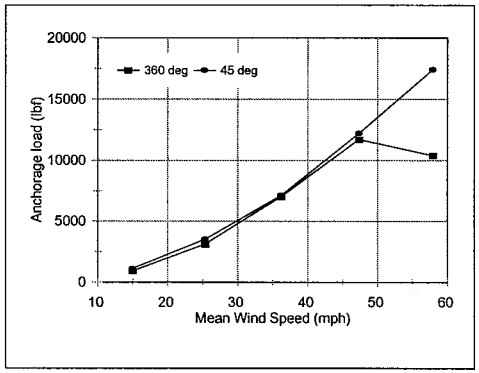
Cable 1



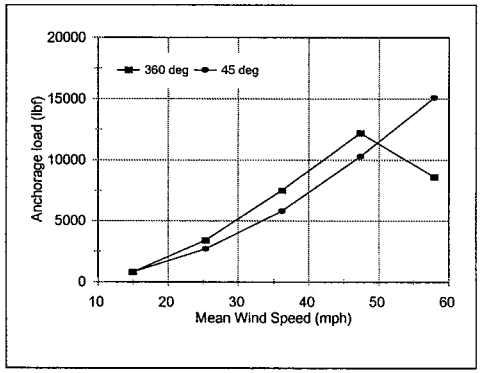
Cable 2



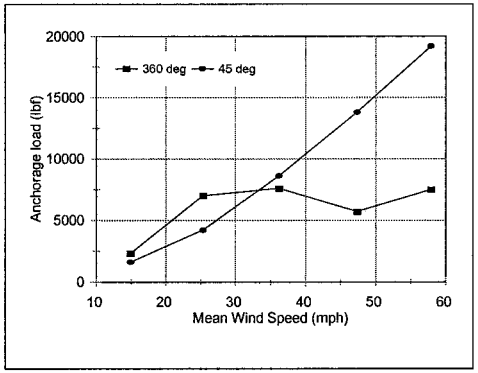
Diagonal 1



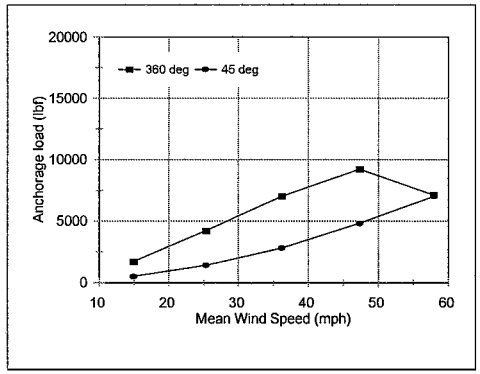
Diagonal 3



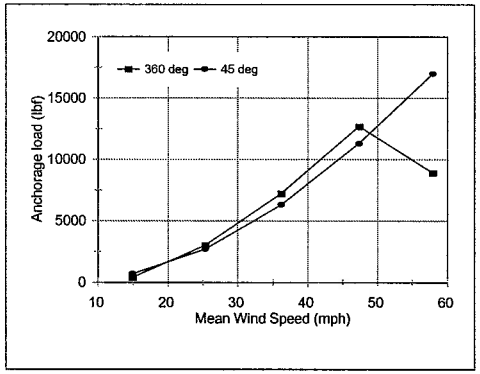
Cable 3



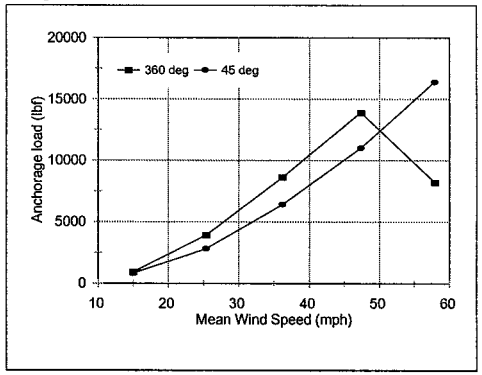
Cable 4



Diagonal 2

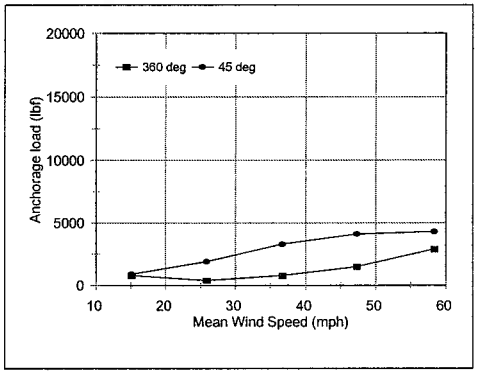


Diagonal 4

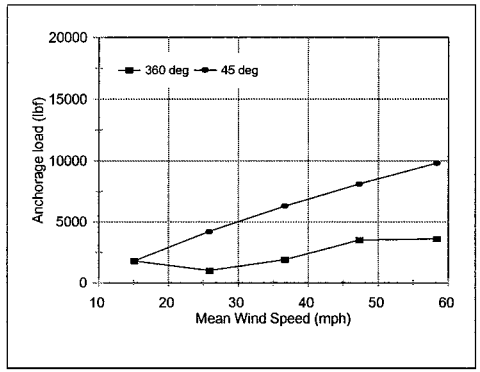


Test 16

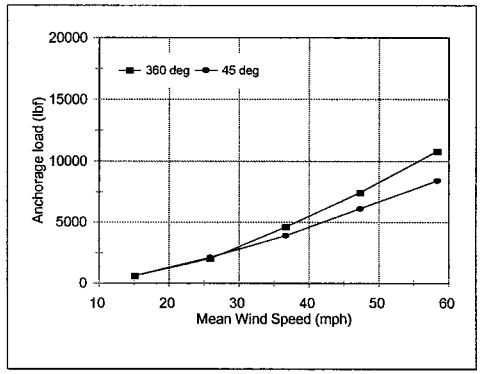
Cable 1



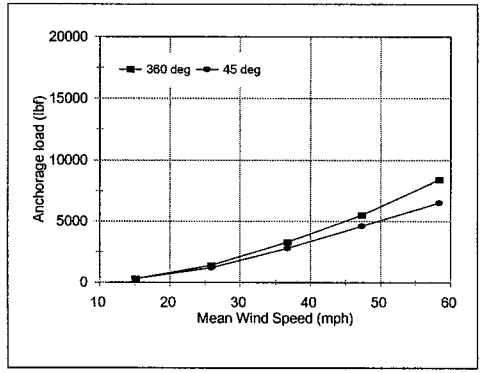
Cable 2



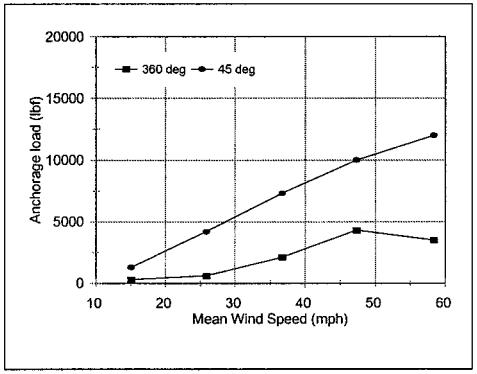
Diagonal 1



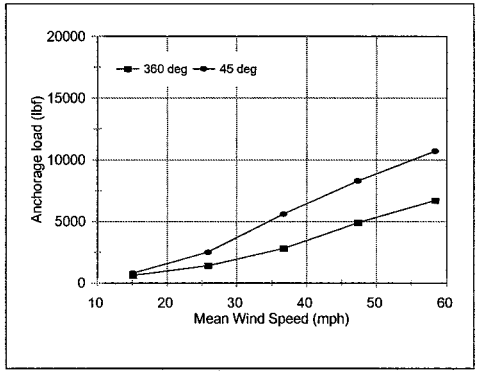
Diagonal 3



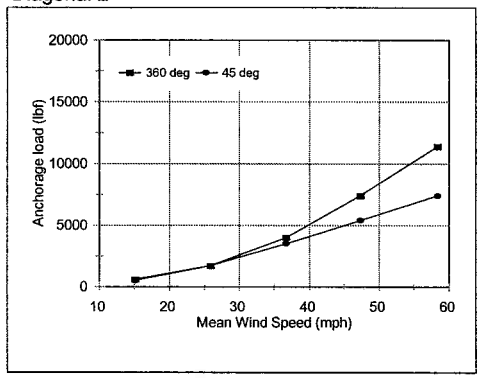
Cable 3



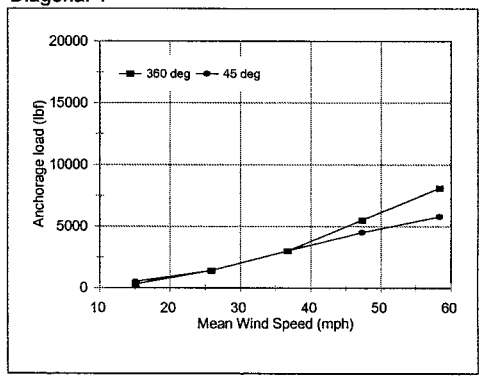
Cable 4



Diagonal 2

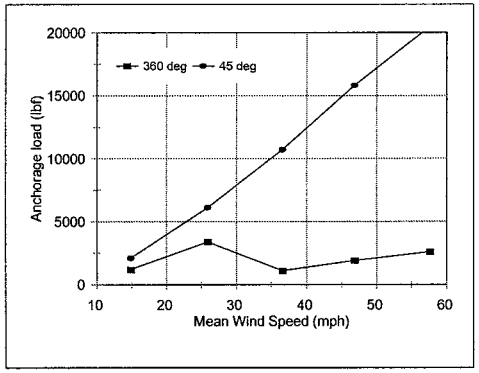


Diagonal 4

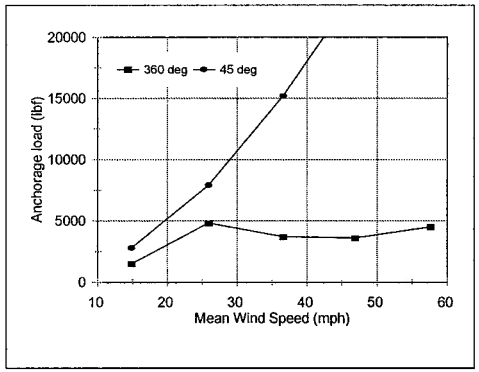


Test 17 A

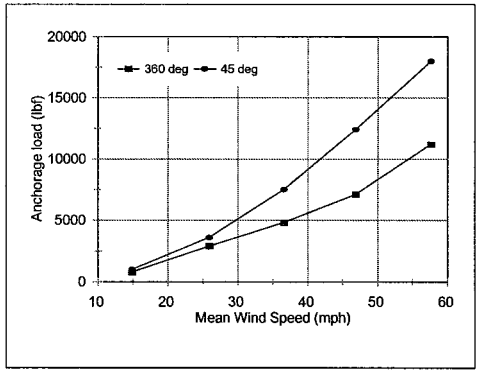
Cable 1



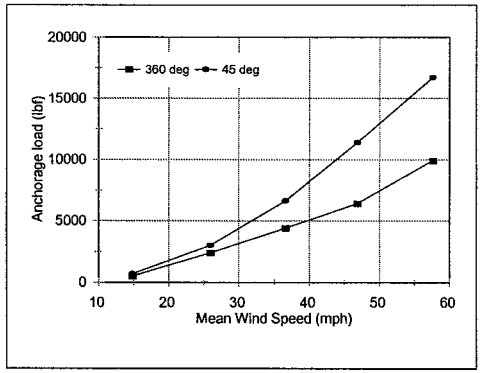
Cable 2



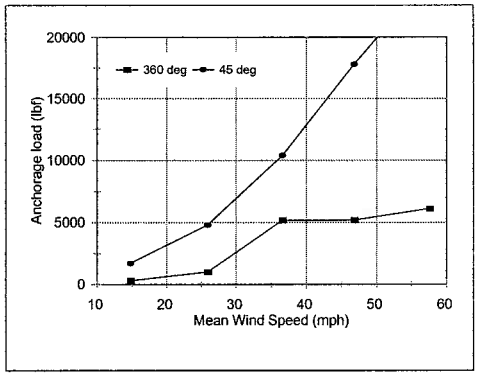
Diagonal 1



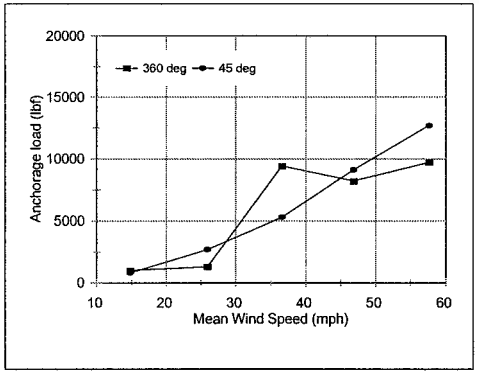
Diagonal 3



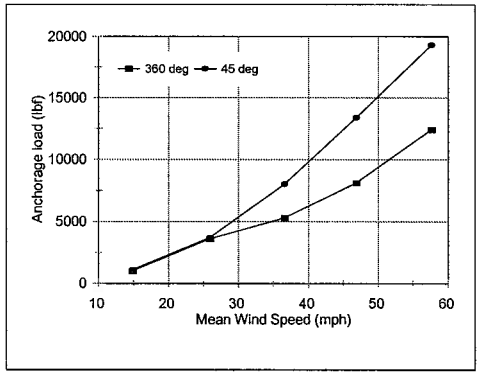
Cable 3



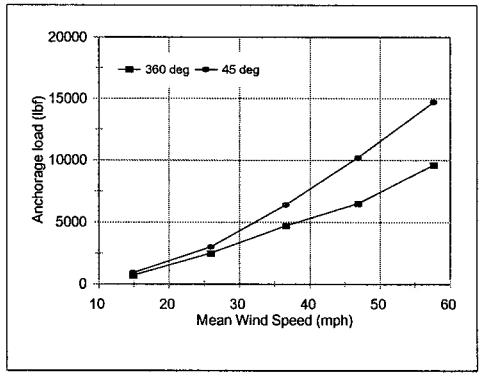
Cable 4



Diagonal 2



Diagonal 4



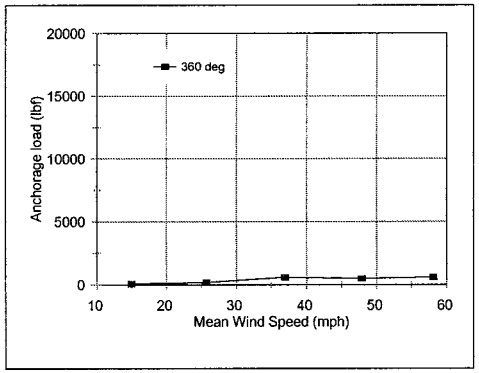
Predicted Anchorage Loads vs One Minute Wind Speeds for 90ft by 35ft Fabric Panels
Over the River Project, Arkansas River, Colorado - Project #98-130

Appendix E - Figure E7

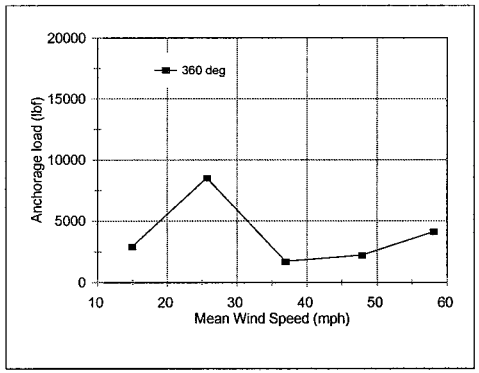
RWDI

Test 17 B

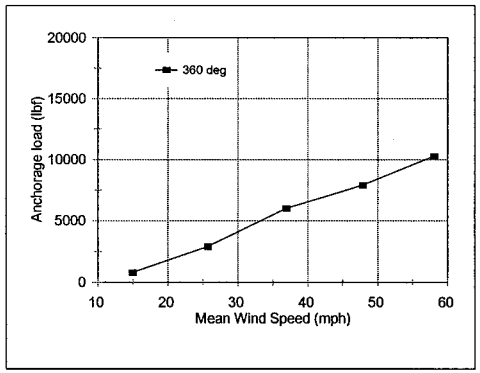
Cable 1



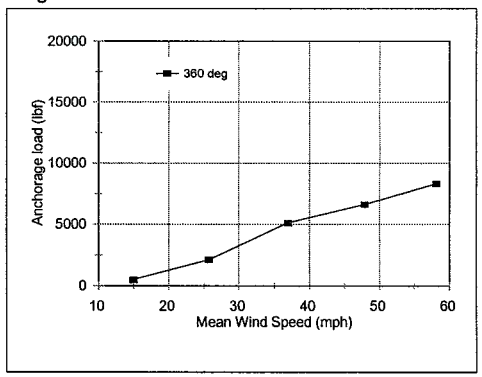
Cable 2



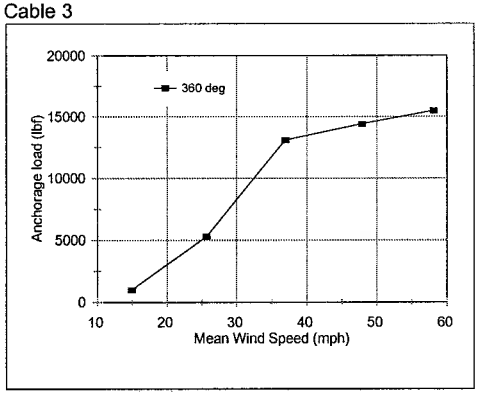
Diagonal 1



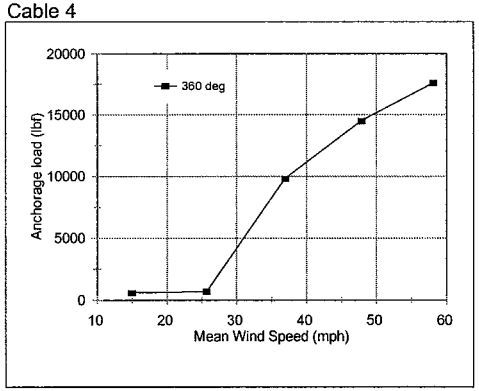
Diagonal 3



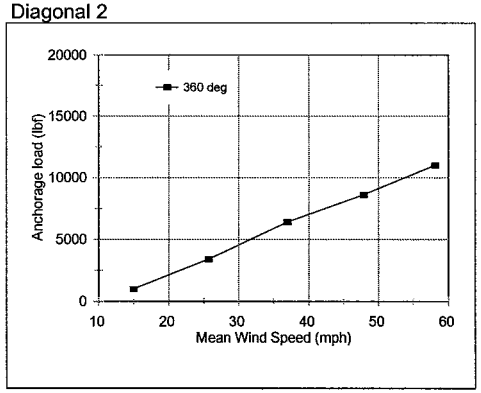
Cable 3



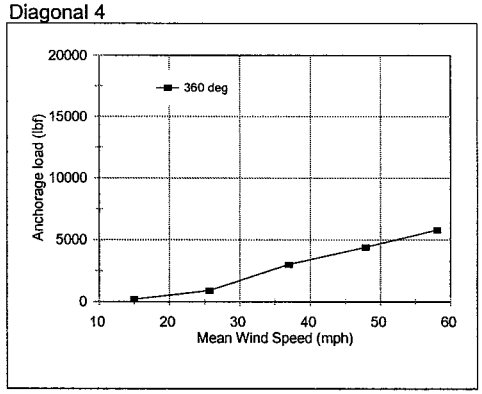
Cable 4



Diagonal 2

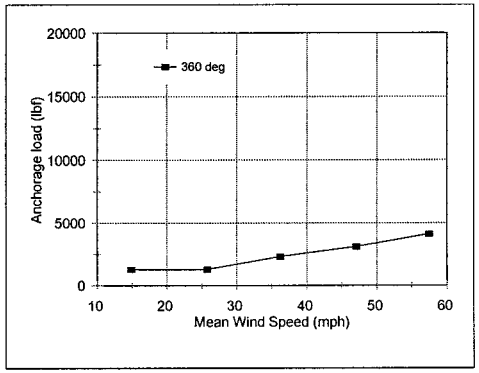


Diagonal 4

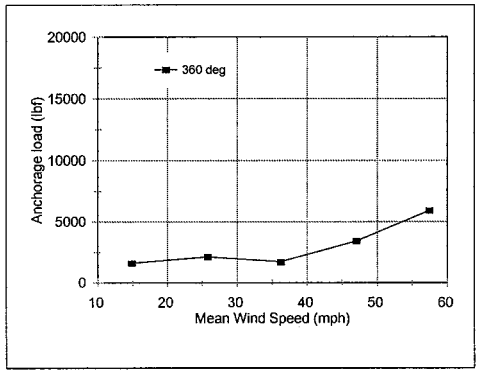


Test 18

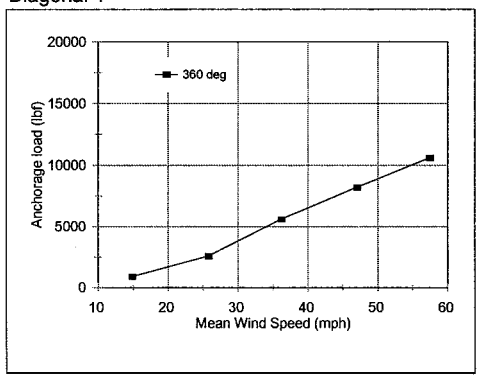
Cable 1



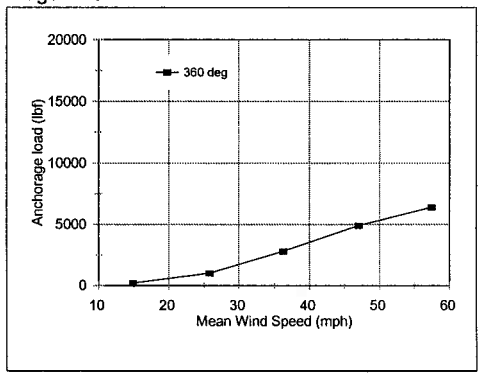
Cable 2



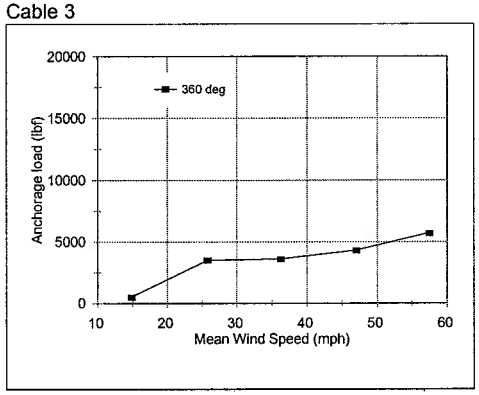
Diagonal 1



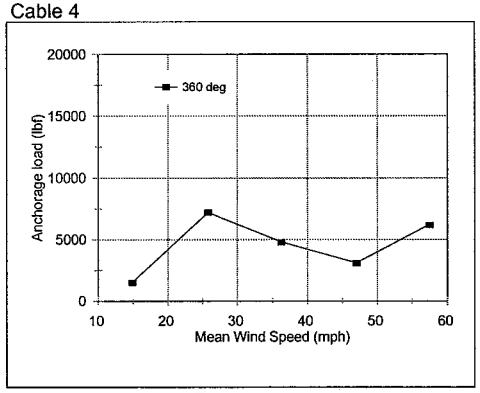
Diagonal 3



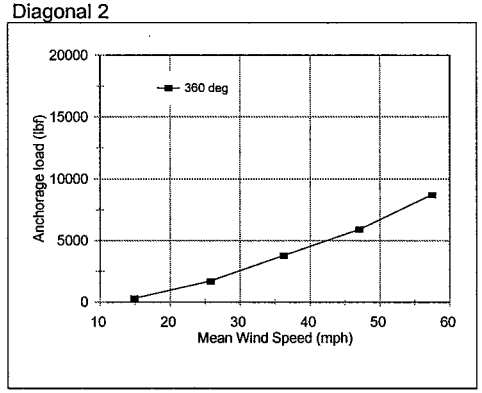
Cable 3



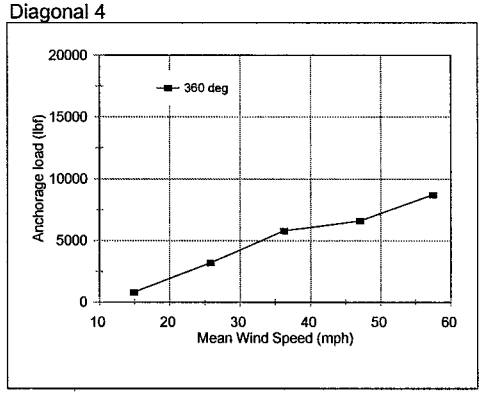
Cable 4



Diagonal 2

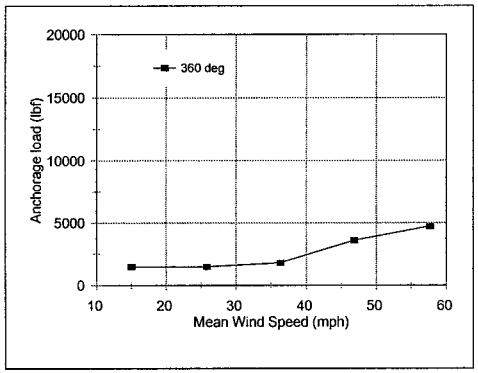


Diagonal 4

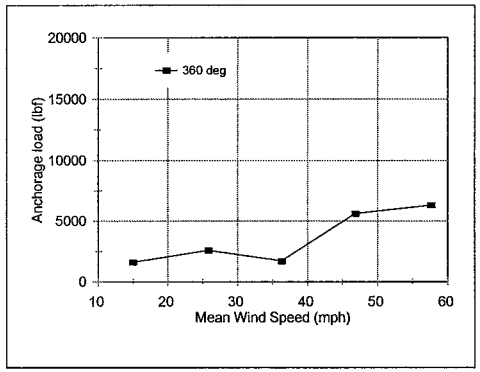


Test 19

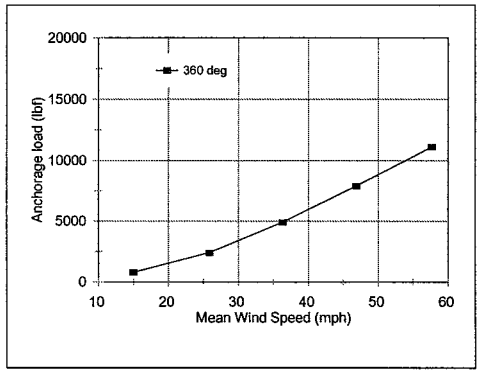
Cable 1



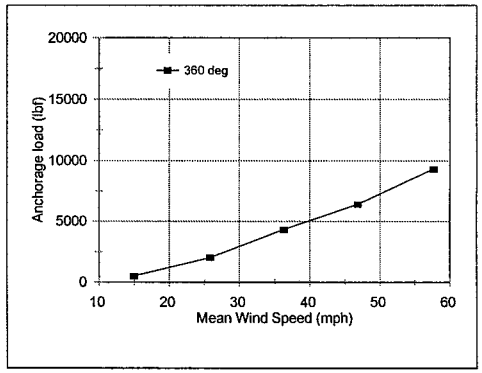
Cable 2



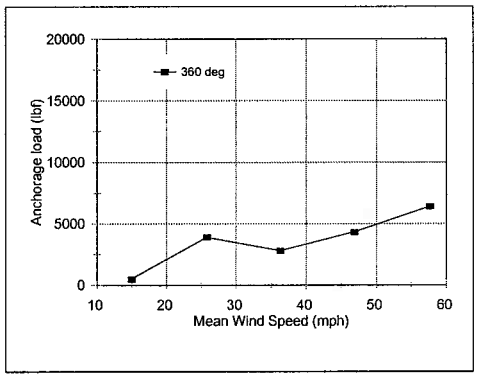
Diagonal 1



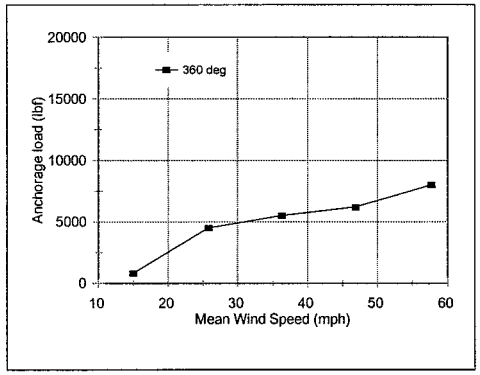
Diagonal 3



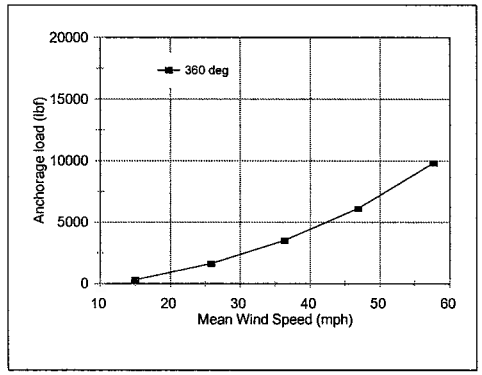
Cable 3



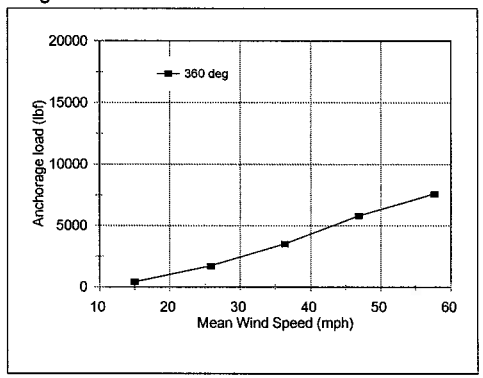
Cable 4



Diagonal 2



Diagonal 4



APPENDIX F

Calibration Data for Load Cells used during the Full Scale Mock-up Tests

STRAINSERT CALIBRATION DATA

Intertechnology Inc. Ontario, Canada For: RWDI Cust. P.O. No. 1727/4606	Q-14490 Strainsert Job No. Date: MAY 0 3 1999 Sign:

Transducer:	Shackle Tension Link, Model STL-8.5 (SS) 17,000-lbs. Capacity, 2-mv/V, 350 Ohms		
		Type:	C (Bendix PT02H-10-6P)
Service Temp.:	150 Deg. F Max.	Ins. Res.:	Over 10,000 megohms

CAL TEMP: 72

S/N: Q14490-4

TEST LOAD LBS	STRAIGHT LINE SIGNAL mv/V	DEVIATIONS-uv/V RUN-1	RUN-2	RUN-3	REP uv/V
0	0.000	0.0	0.0	0.0	0.0
3,400	0.400	-2.0	-2.0	-1.5	0.5
6,800	0.800	-2.5	-2.5	-2.5	0.0
10,200	1.200	-1.5	-2.0	-1.5	0.5
13,600	1.600	1.0	0.5	0.5	0.5
17,000	2.000	3.0	2.5	2.5	0.5
13,600	1.600	1.5	1.0	1.5	0.5
10,200	1.200	1.0	0.5	1.0	0.5
6,800	0.800	0.0	-0.5	-0.5	0.5
3,400	0.400	0.0	0.0	0.0	0.0
0	0.000	0.0	0.0	0.0	0.0
	HYSTERESIS :	2.5	2.5	2.5	

CALIBRATION ANALYSIS :

NON-LINEARITY	:	3.0	PARTS IN	2,000	= 0.15%
REPETITION					
LOADING	:	0.5	PARTS IN	2,000	= 0.03%
UNLOADING	:	0.5	PARTS IN	2,000	= 0.03%
ZERO LOAD	:	0.0	PARTS IN	2,000	= 0.00%
MAX. LOAD	:	0.5	PARTS IN	2,000	= 0.03%
END POINT	:	3.0	PARTS IN	2,000	= 0.15%
HYSTERESIS	:	2.5	PARTS IN	2,000	= 0.13%

SHUNT CAL: 55,000 Ohms connected E+ to S+ = + 13,468 LBS

Calibration traceable to NIST.

STRAINSERT CALIBRATION DATA

Intertechnology Inc. Ontario, Canada For: RWDI Cust. P.O. No. 1727/4606	Q-14490 Strainsert Job No. Date: MAY 0 3 1999 Sign:

Transducer:	Shackle Tension Link, Model STL-8.5 (SS) 17,000-lbs. Capacity, 2-mv/V, 350 Ohms		
		Type:	C (Bendix PT02H-10-6P)
Service Temp.:	150 Deg. F Max.	Ins. Res.:	Over 10,000 megohms

CAL TEMP: 72

S/N: Q14490-3

TEST LOAD LBS	STRAIGHT LINE SIGNAL mv/V	DEVIATIONS-uv/V RUN-1	RUN-2	RUN-3	REP uv/V
0	0.000	0.0	0.0	0.0	0.0
3,400	0.400	-1.5	-1.5	-1.5	0.0
6,800	0.800	-2.0	-2.0	-2.0	0.0
10,200	1.200	-1.0	-1.0	-1.0	0.0
13,600	1.600	0.5	0.5	0.0	0.5
17,000	2.000	2.0	2.0	1.5	0.5
13,600	1.600	1.0	1.0	1.0	0.0
10,200	1.200	0.5	0.5	0.5	0.0
6,800	0.800	-1.0	-1.0	-1.0	0.0
3,400	0.400	0.0	-0.5	-0.5	0.5
0	0.000	0.0	0.0	0.0	0.0
	HYSTERESIS :	1.5	1.5	1.5	

CALIBRATION ANALYSIS :

NON-LINEARITY	:	2.0	PARTS IN	2,000	= 0.10%
REPETITION					
LOADING	:	0.5	PARTS IN	2,000	= 0.03%
UNLOADING	:	0.5	PARTS IN	2,000	= 0.03%
ZERO LOAD	:	0.0	PARTS IN	2,000	= 0.00%
MAX. LOAD	:	0.5	PARTS IN	2,000	= 0.03%
END POINT	:	2.0	PARTS IN	2,000	= 0.10%
HYSTERESIS	:	1.5	PARTS IN	2,000	= 0.08%

SHUNT CAL: 55,000 Ohms connected E+ to S+ = + 13,485 LBS

Calibration traceable to NIST.

STRAINSERT CALIBRATION DATA

Intertechnology Inc. Ontario, Canada For: RWDI Cust. P.O. No. 1727/4606	Q-14490 Strainsert Job No. Date: MAY 0 3 1999 Sign:

Transducer:	Shackle Tension Link, Model STL-8.5 (SS) 17,000-lbs. Capacity, 2-mv/V, 350 Ohms		
		Type:	C (Bendix PT02H-10-6P)
Service Temp.:	150 Deg. F Max.	Ins. Res.:	Over 10,000 megohms

CAL TEMP: 72

S/N: Q14490-2

TEST LOAD LBS	STRAIGHT LINE SIGNAL mv/V	DEVIATIONS-uv/V RUN-1	RUN-2	RUN-3	REP uv/V
0	0.000	0.0	0.0	0.0	0.0
3,400	0.400	-1.0	-1.0	-1.0	0.0
6,800	0.800	-2.0	-1.5	-2.0	0.5
10,200	1.200	-1.5	-1.0	-1.5	0.5
13,600	1.600	0.0	0.5	0.0	0.5
17,000	2.000	2.0	2.0	1.5	0.5
13,600	1.600	1.5	2.0	2.0	0.5
10,200	1.200	1.5	2.0	1.5	0.5
6,800	0.800	1.0	1.0	1.0	0.0
3,400	0.400	2.0	2.0	2.0	0.0
0	0.000	0.0	0.0	0.0	0.0
	HYSTERESIS :	3.0	3.0	3.0	

CALIBRATION ANALYSIS :

NON-LINEARITY	:	2.0	PARTS IN	2,000	= 0.10%
REPETITION					
LOADING	:	0.5	PARTS IN	2,000	= 0.03%
UNLOADING	:	0.5	PARTS IN	2,000	= 0.03%
ZERO LOAD	:	0.0	PARTS IN	2,000	= 0.00%
MAX. LOAD	:	0.5	PARTS IN	2,000	= 0.03%
END POINT	:	2.0	PARTS IN	2,000	= 0.10%
HYSTERESIS	:	3.0	PARTS IN	2,000	= 0.15%

SHUNT CAL: 55,000 Ohms connected E+ to S+ = + 13,511 LBS

Calibration traceable to NIST.

STRAINSERT CALIBRATION DATA

Intertechnology Inc. Ontario, Canada For: RWDI Cust. P.O. No. 1727/4606	Q-14490 Strainsert Job No. Date: MAY 0 3 1999 Sign:

Transducer:	Shackle Tension Link, Model STL-8.5 (SS) 17,000-lbs. Capacity, 2-mv/V, 350 Ohms		
		Type:	C (Bendix PT02H-10-6P)
Service Temp.:	150 Deg. F Max.	Ins. Res.:	Over 10,000 megohms

CAL TEMP: 72

S/N: Q14490-1

TEST LOAD LBS	STRAIGHT LINE SIGNAL mv/V	DEVIATIONS-uv/V RUN-1	RUN-2	RUN-3	REP uv/V
0	0.000	0.0	0.0	0.0	0.0
3,400	0.400	-3.0	-3.0	-3.0	0.0
6,800	0.800	-3.0	-3.0	-2.5	0.5
10,200	1.200	-1.0	-0.5	-0.5	0.5
13,600	1.600	1.5	1.5	2.0	0.5
17,000	2.000	3.0	3.0	3.0	0.0
13,600	1.600	2.0	1.5	2.0	0.5
10,200	1.200	0.5	0.5	0.5	0.0
6,800	0.800	-1.5	-1.5	-1.5	0.0
3,400	0.400	-2.0	-2.0	-2.0	0.0
0	0.000	0.0	0.0	0.0	0.0
	HYSTERESIS :	1.5	1.5	1.0	

CALIBRATION ANALYSIS :

NON-LINEARITY	:	3.0	PARTS IN	2,000	= 0.15%
REPETITION					
LOADING	:	0.5	PARTS IN	2,000	= 0.03%
UNLOADING	:	0.5	PARTS IN	2,000	= 0.03%
ZERO LOAD	:	0.0	PARTS IN	2,000	= 0.00%
MAX. LOAD	:	0.0	PARTS IN	2,000	= 0.00%
END POINT	:	3.0	PARTS IN	2,000	= 0.15%
HYSTERESIS	:	1.5	PARTS IN	2,000	= 0.08%

SHUNT CAL: 55,000 Ohms connected E+ to S+ = + 13,468 LBS

Calibration traceable to NIST.

STRAINSERT CALIBRATION DATA

Intertechnology Inc. Ontario, Canada For: RWDI Cust. P.O. No. 1727/4606	Q-14490 Strainsert Job No. Date: MAY 03 1999 Sign:

Transducer:	Shackle Tension Link, Model STL-8.5 (SS) 17,000-lbs. Capacity, 2-mv/V, 350 Ohms		
		Type:	C (Bendix PT02H-10-6P)
Service Temp.:	150 Deg. F Max.	Ins. Res.:	Over 10,000 megohms

CAL TEMP: 72

S/N: Q14490-5

TEST LOAD LBS	STRAIGHT LINE SIGNAL mv/V	DEVIATIONS-uv/V RUN-1	RUN-2	RUN-3	REP uv/V
0	0.000	0.0	0.0	0.0	0.0
3,400	0.400	-2.5	-3.0	-2.5	0.5
6,800	0.800	-2.5	-2.5	-3.0	0.5
10,200	1.200	-1.5	-2.0	-2.0	0.5
13,600	1.600	0.5	0.5	0.0	0.5
17,000	2.000	3.0	3.0	2.5	0.5
13,600	1.600	1.5	1.5	1.5	0.0
10,200	1.200	0.5	1.0	0.5	0.5
6,800	0.800	-0.5	-0.5	-0.5	0.0
3,400	0.400	0.5	0.0	0.5	0.5
0	0.000	0.0	0.0	0.0	0.0
	HYSTERESIS :	3.0	3.0	3.0	

CALIBRATION ANALYSIS :

NON-LINEARITY	:	3.0	PARTS IN	2,000	= 0.15%
REPETITION					
LOADING	:	0.5	PARTS IN	2,000	= 0.03%
UNLOADING	:	0.5	PARTS IN	2,000	= 0.03%
ZERO LOAD	:	0.0	PARTS IN	2,000	= 0.00%
MAX. LOAD	:	0.5	PARTS IN	2,000	= 0.03%
END POINT	:	3.0	PARTS IN	2,000	= 0.15%
HYSTERESIS	:	3.0	PARTS IN	2,000	= 0.15%

SHUNT CAL: 55,000 Ohms connected E+ to S+ = + 13,464 LBS

Calibration traceable to NIST.

APPENDIX G

Calibration Data for Wind Sensor used during the Full Scale Mock-up Tests

Record of Calibration

Instrument Type:	R.M. Young Wind Sensor	**Serial Number:**	1546
Readout:	Campbell Scientific CR23X	**Serial Number:**	1966

		Temperature:	25 °C
Date Tested:	4-June-99	**Barometric Pressure:**	29.16 "Hg
		Relative Humidity:	62 %
Reference:	Dantec Flowmaster **M/N:** 54N60	**S/N:** 699	

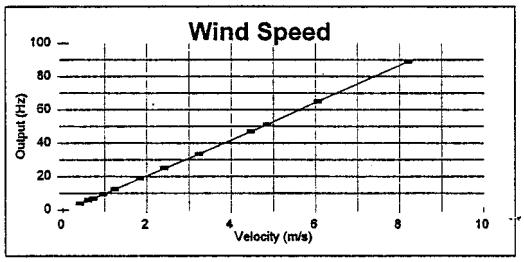
Wind Speed

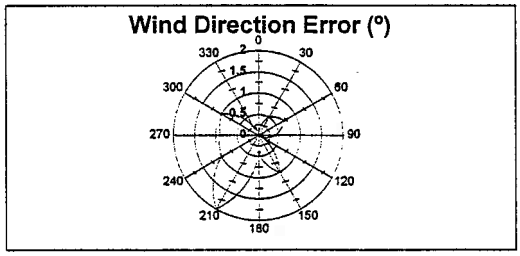
Ref. (m/sec.)	Out(Hz)
0.406	4
0.607	6
0.729	7
0.961	9.5
1.240	12.5
1.840	19
2.410	25
3.240	33.5
4.460	47
4.840	51
6.05	65
8.21	89

Instruction: P3
Pulse Chan: 1
Multiplier 1.0
Offset: 0.0

Calibration Multiplier

Units	Multiplier
m/sec	0.092
ft/sec	0.302
fpm	18.110
Kph	0.331
Mph	0.206
Knots	0.179





Direction

AZ °Actual	AZ °Read	ERROR (deg)
0	0.0	0
30	29.5	-0.5
60	60.7	0.7
90	89.6	-0.4
120	120.0	0
150	149.0	-1
180	179.6	-0.4
210	208.0	-2
240	239.0	-1
270	269.1	-0.9
300	299.0	-1
330	329.8	-0.2

Instruction: P4
Range: 5000mv, Fast
SE Chan: 21
Ex. Chan: 3
Excit Volts: 2.5
Multiplier 0.142
Offset: 0

Calibration By: _____

Reviewed By: _____

Rowan Williams Davies and Irwin Inc. Consulting Engineers
650 Woodlawn Road West, Guelph, Ontario, Canada N1K 1B8
Tel: 519-823-1311 Fax: 519-823-1316

Record of Calibration

This is to certify that the below referenced thermocouple was calibrated in reference to Ertco certified thermometer s/n 1186

Instrument Type: Thermocouple - Campbell CR23X

Model Number: T-Type

Console S/N: 1966

Serial Number: T-type

Range: 0-100°C

Temperature: 24 °F

Barometric Pressure: 28.82 "Hg

Relative Humidity: 66 %

Date Tested: June 9, 1999

Calibrated By: _____
Dean MacLanders

Reviewed By: _____
Adam Quipp

Calibration Data

Location	Room °C	Ice Bath °C	Boiling Water °C	Hot Oil °F
Ref.	24	0	100	-
T/C	24	0	99	-

Reference: Ertco Certified Mercury Thermometer **M/N**: 1003-3 **S/N**: 1186

Comments: Read from Campbell Scientific CR23X s/n 1966 output location #9. T-type thermocouple on SE input channel #22. Multiplier of 1.0. Insulated shield in place over analog input terminals.

Rowan Williams Davies and Irwin Inc. Consulting Engineers
650 Woodlawn Rd. West, Guelph, Ontario, Canada N1K 1B8
Tel: 519-823-1311 Fax: 519-823-1316

APPENDIX H

Detailed Comparison of Wind Loads from Full Scale Mock-up Tests to Aeroelastic Model Tests

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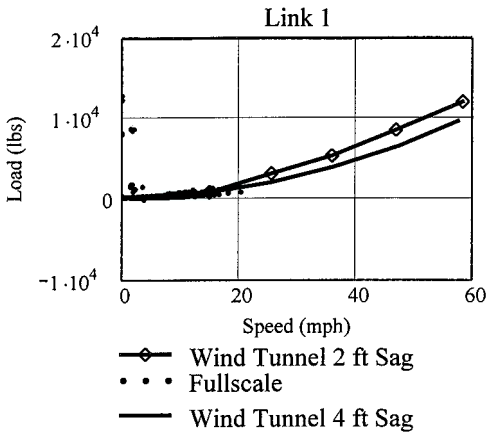
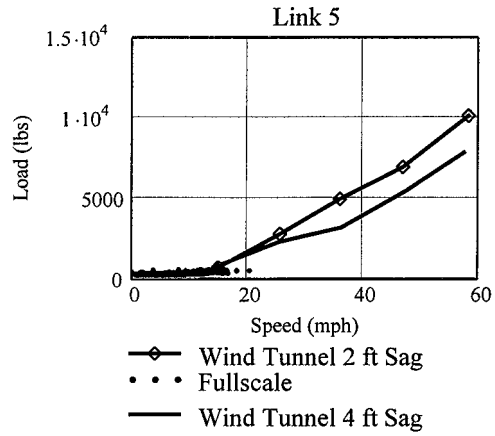
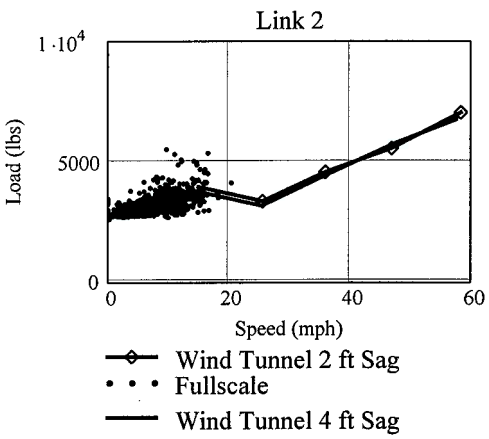
Figure H1: Wind Direction at 0°
Figure H2: Wind Direction at +/- 22.5°
Figure H3: Wind Direction at +/- 45°
Figure H4: Wind Direction at +/-67.5°
Figure H5: Wind Direction at +/- 90°
Figure H6: Wind Direction at +/- 112.5°
Figure H7: Wind Direction at +/- 135°
Figure H8: Wind Direction at +/-157.5°
Figure H9: Wind Direction at 180°

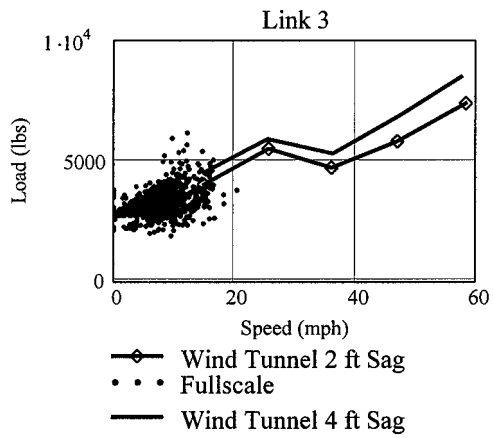
Diagonal Cables





Cross River Cables





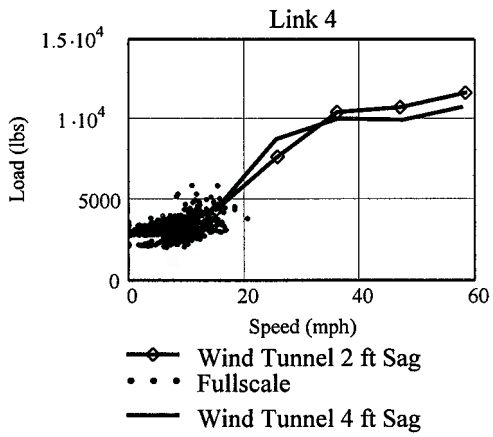
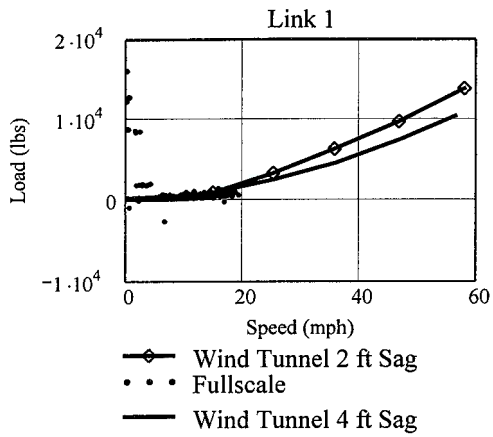
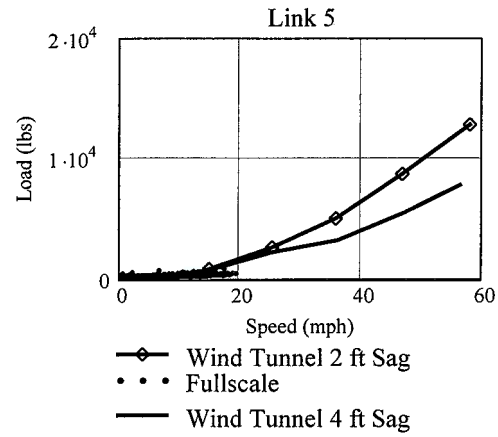


Figure H1: Wind Direction at 0°

Diagonal Cables





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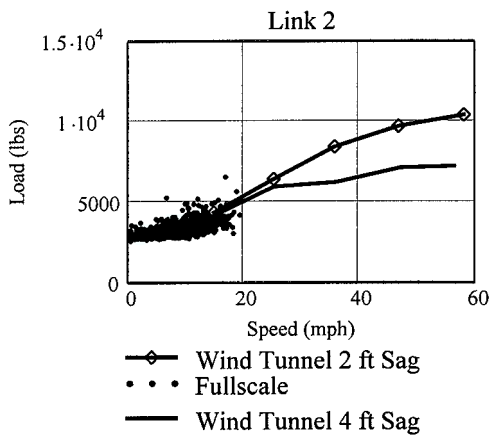
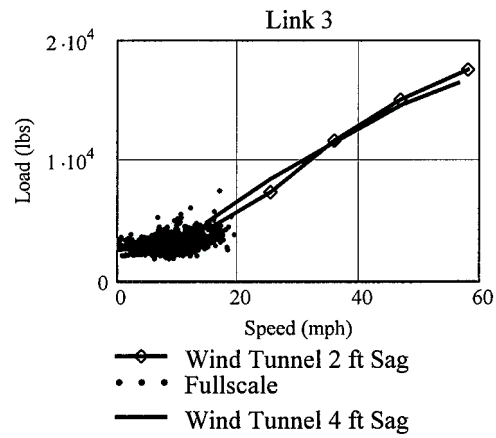




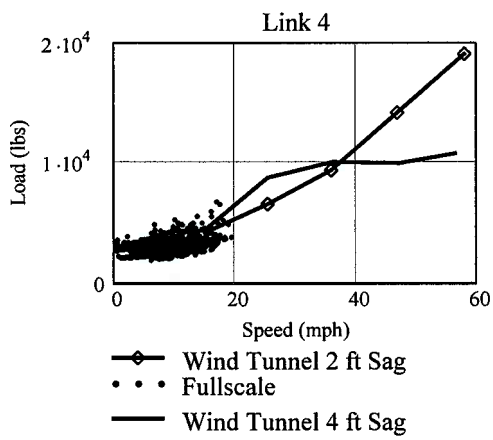
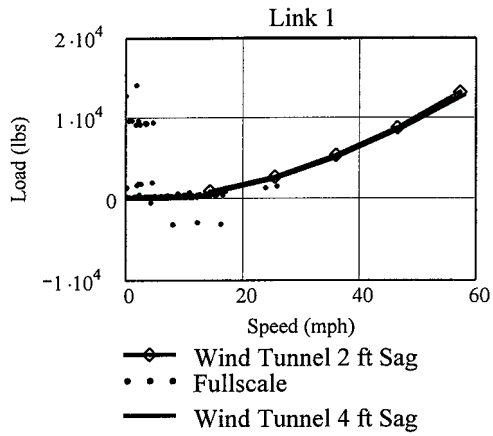
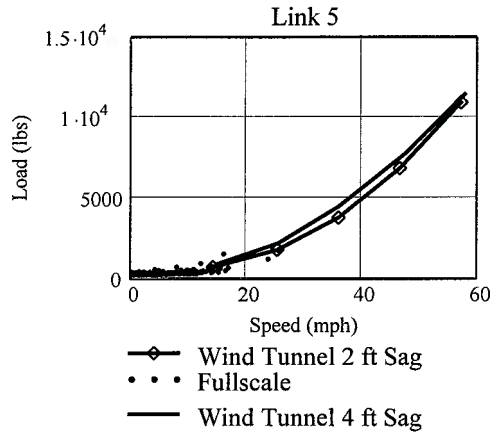


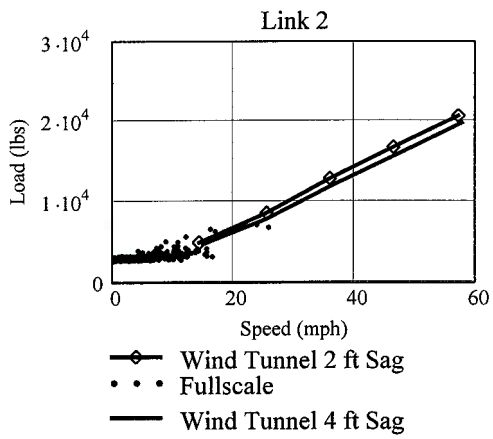
Figure H2: Wind Direction at +/- 22.5°

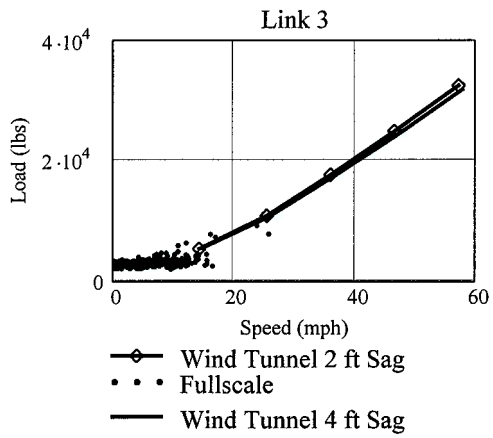
Diagonal Cables





Cross River Cables





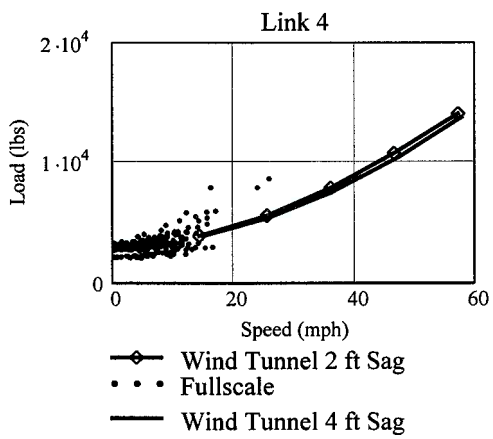
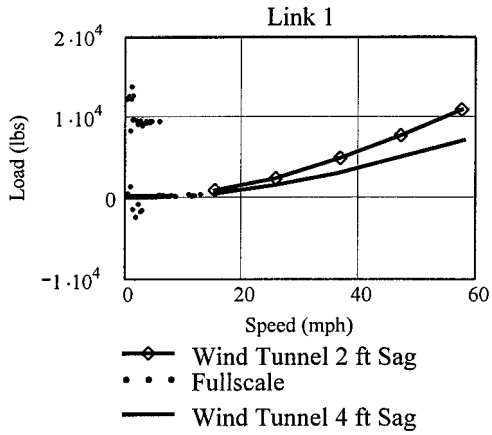
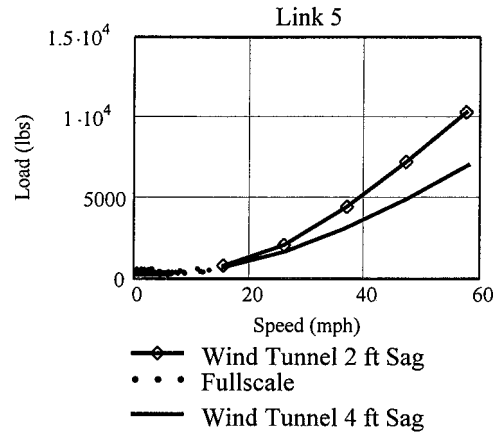


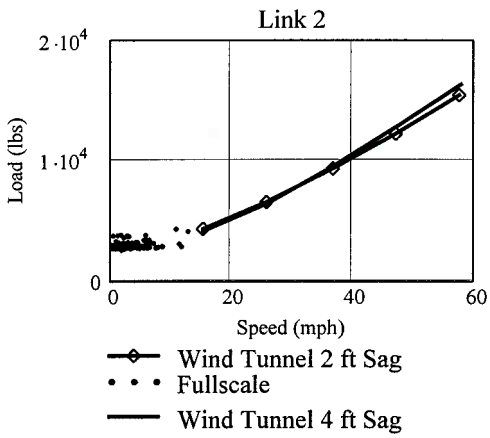
Figure H3: Wind Direction at +/- 45°

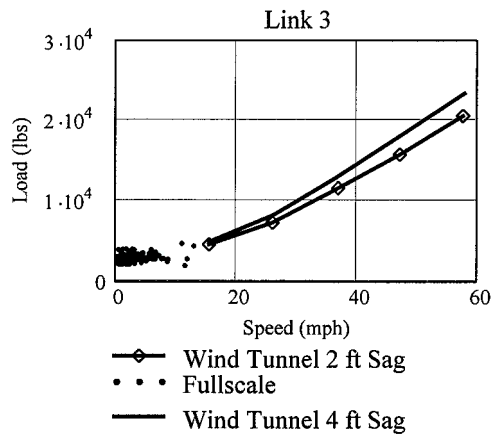
Diagonal Cables





Cross River Cables





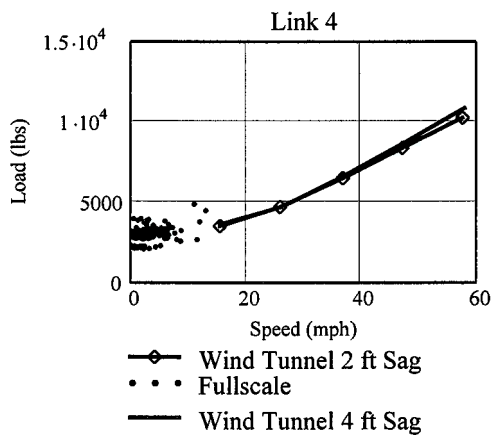
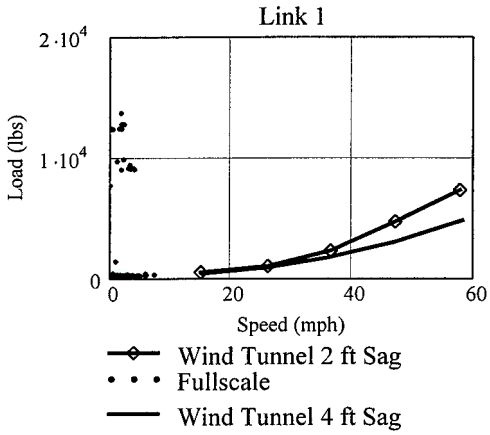
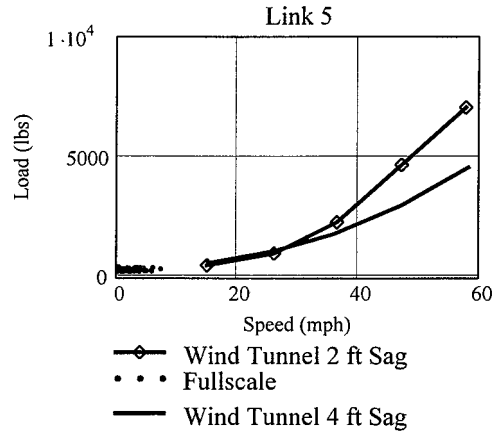


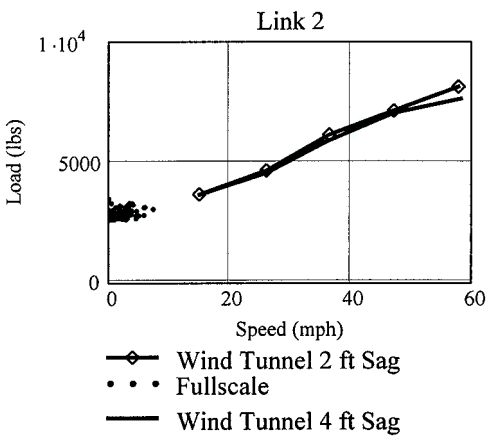
Figure H4: Wind Direction at +/-67.5°

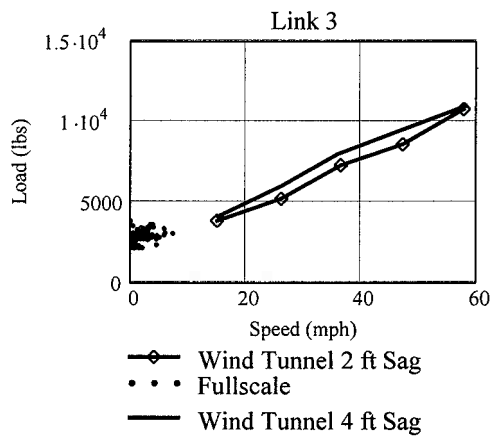
Diagonal Cables





Cross River Cables





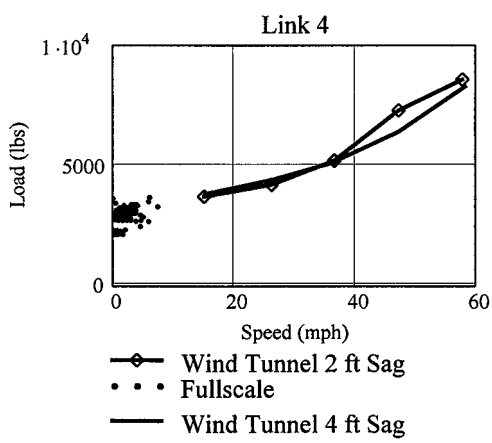
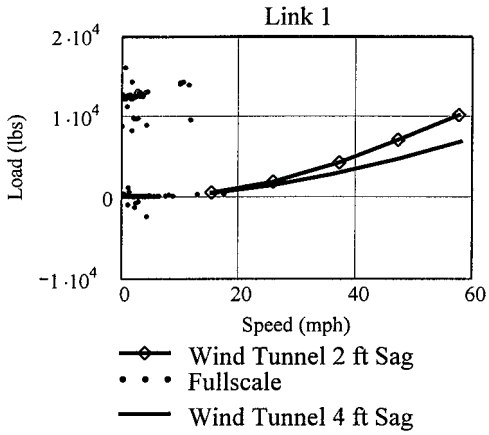
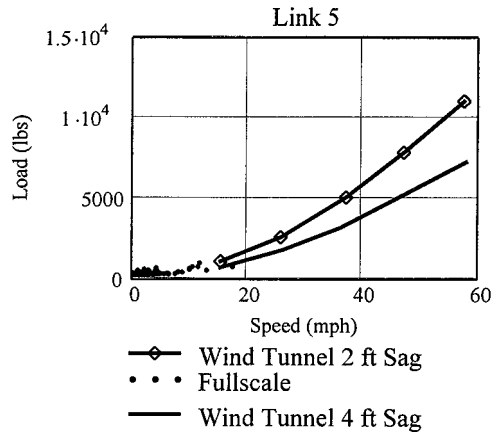


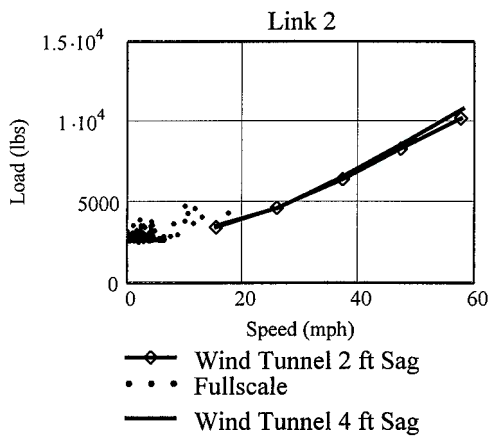
Figure H5: Wind Direction at +/- 90°

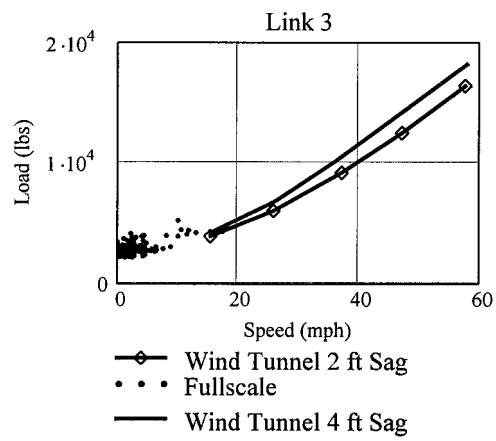
Diagonal Cables





Cross River Cables





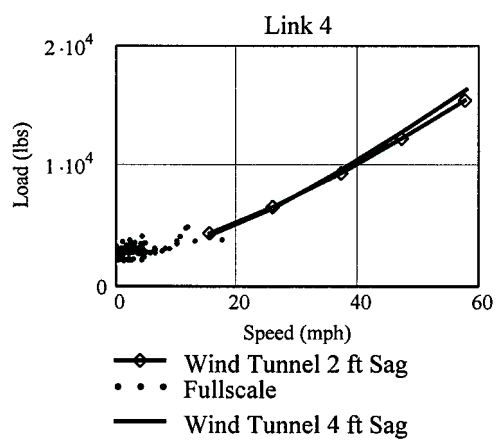
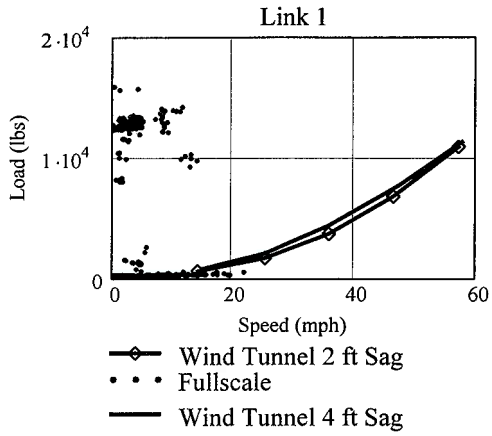
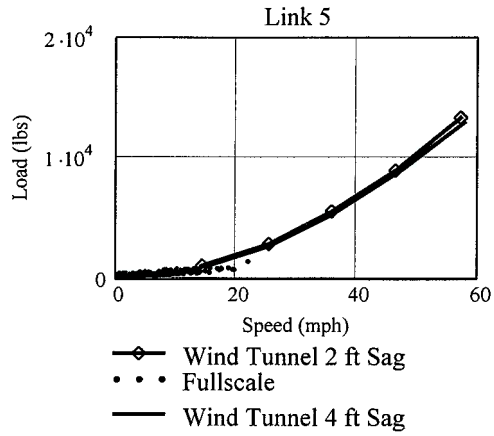


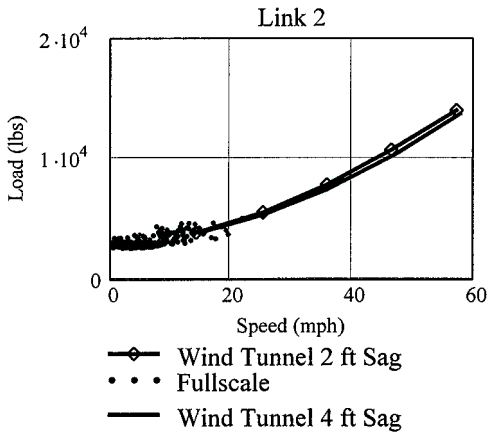
Figure H6: Wind Direction at +/- 112.5°

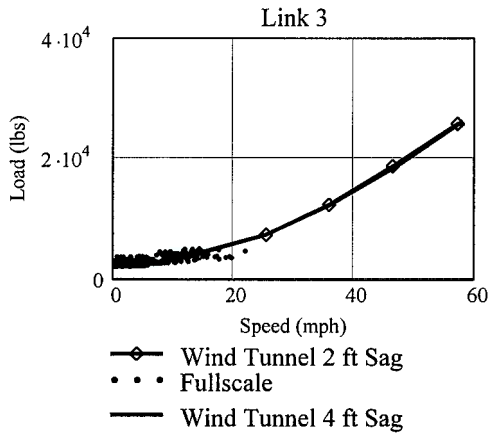
Diagonal Cables





Cross River Cables





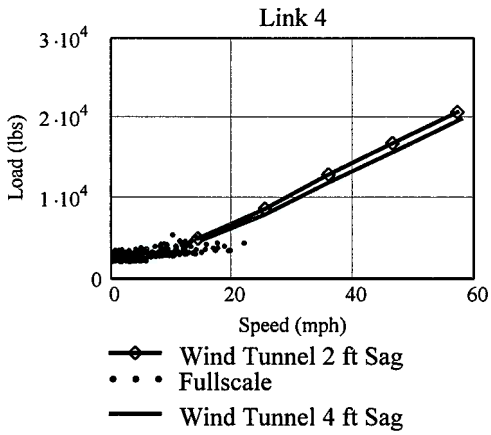
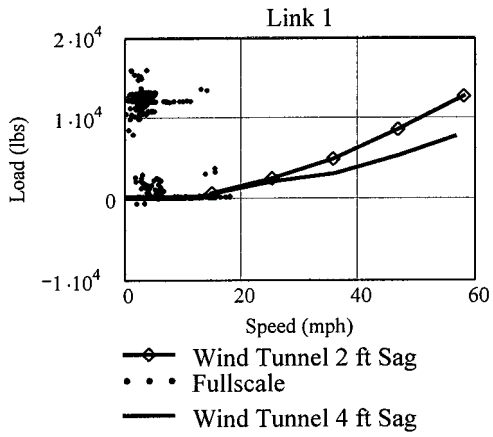
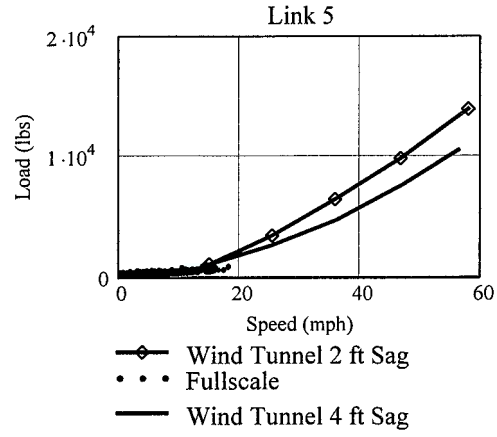


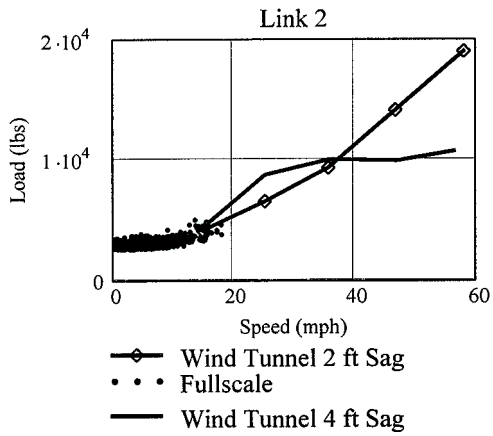
Figure H7: Wind Direction at +/- 135°

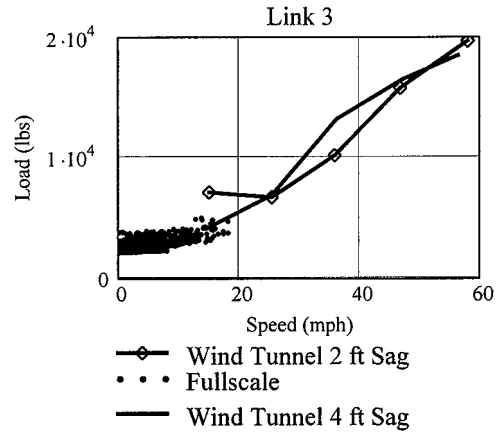
Diagonal Cables





Cross River Cables





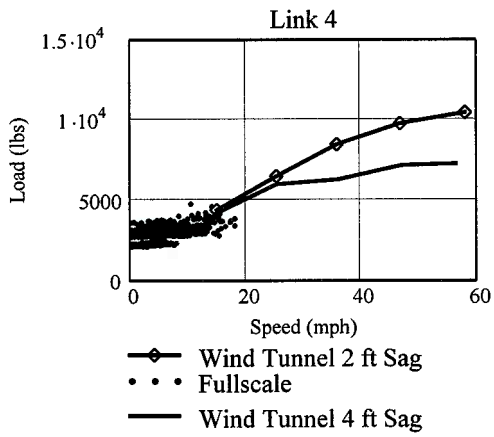
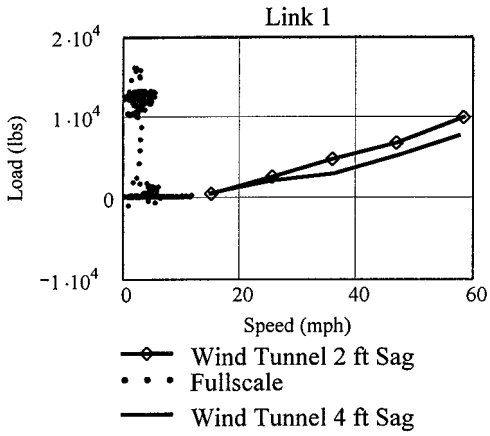
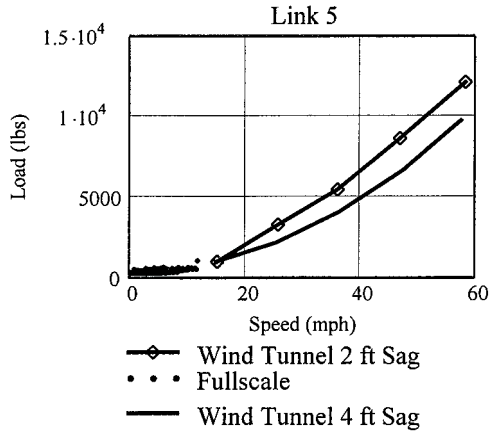


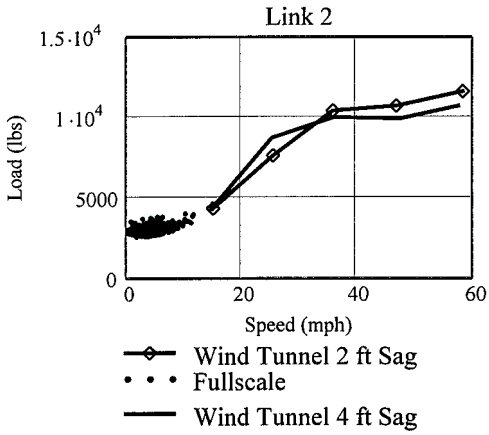
Figure H8: Wind Direction at +/-157.5°

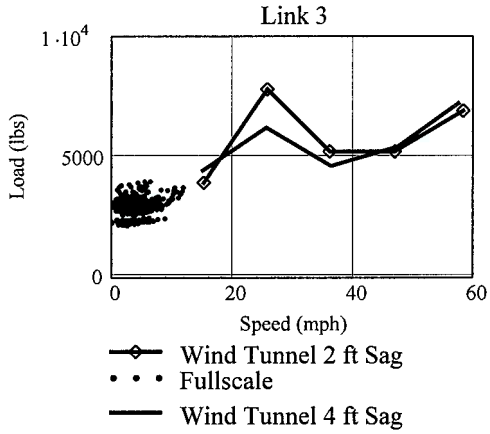
Diagonal Cables





Cross River Cables





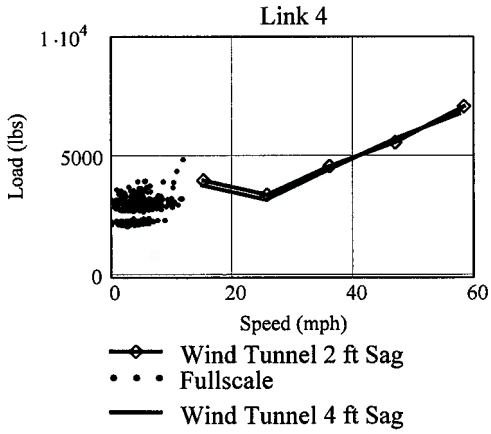


Figure H9: Wind Direction at 180°

J1.1.4 Fabric Rainfall Test

J1.1.4 Fabric Rainfall Test

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Phone 303.797.1200 • Fax 303.797.1187
www.jfsato.com

Sheet 1
Project OTR | Reference | JFSA Job No. 0558
Subject FABRIC | Designed SL | Date 10.12.06
Item F. RAIN PASSAGE | Checked | Date

2" hose to apply water:

Assume vel = 10'/sec

$$Q = A \cdot V$$
$$= \frac{\pi \left(\frac{2}{12}\right)^2}{4} \times 10 \text{ ft/sec}$$
$$Q = 0.22 \text{ ft}^3/\text{sec} \sim 100 \text{ gpm}$$ OK for small pump.

AREA WETTED:

From photo, about $2' \times 2' = 4 \text{ ft}^2$

No retention on fabric, per witnesses

$$V = \frac{Q}{A} = \frac{100 \text{ gpm}}{4 \text{ ft}^2} = 25 \frac{\text{gpm}}{\text{ft}^2}$$

Compare to 50 gpm/ft² for Mirafi 1160N non woven
or 18 gpm/ft² " " FW700 woven
– Reasonable value.

Compare to 100-year rainfall
~ 9"/hr

on one 1 sq. ft:

$$\frac{9'}{12} \times \frac{1 \text{ hr}}{60 \text{ min}} \times 1 \text{ ft}^2 \times \frac{7.5 \text{ gal}}{\text{ft}^3} \doteq 0.1 \frac{\text{gpm}}{\text{ft}^2} \ll 25 \text{ gpm}$$

→ ∴ Can easily pass 100-year

Assumes no clogging by dirt, debris, ice, hail, snow, etc.

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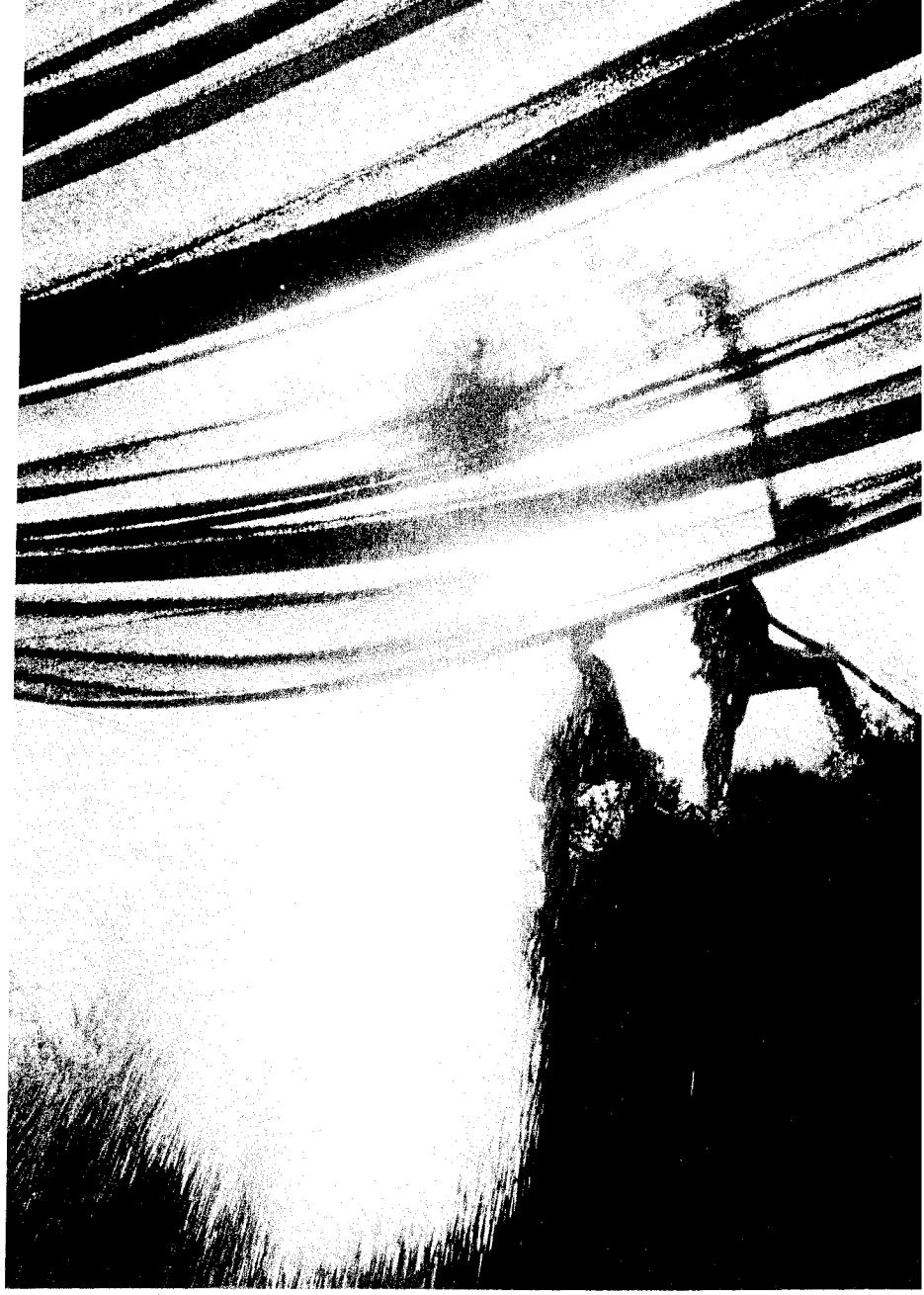
The fabric manufacturer Stephan Schilgen had said that water will go through the panels in case of heavy summer rains but because seeing is believing, the team hires a water truck and pours 37,854 liters (10,000 gallons) of water on the fabric. The water goes straight through.

The working team plus a few visiting friends pose for a family portrait. From the left, front row: Jonathan Henery, Dimiter Zagoroff, Harrison Rivera-Terreaux, Jok Church, and Christo. Second row: Sylvia Volz, Polly Drinkwater, Vince and Jonita Davenport, Stephan Schilgen, Masa Yanagi, Jack Gaby, Jeanne-Claude and Tom Golden. Last row: Simon Chaput, Vladimir Yavachev, John Thomson, Frank Seltenheim, Dick Miller, Keer Shananda, Jeff Bollig and Dan Telleen.



J1.2 Installation, Removal, and Restoration Operations Plan

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J1.2 Installation, Removal, and Restoration Operations Plan

Appendix J1.2. Installation, Removal, and Restoration Operations Plan

J1.2.1 Transportation, Traffic, and Emergency Response Management

J1.2.1.1 Installation Traffic Operations Analysis

J1.2.1.1.1 Installation Traffic Control

Management of the traffic control process is one important installation activity. CDOT's Special Use Permit is a requirement for any work involving lane closures or other use of US 50. Keeping the installation process on schedule will require identifying the officials responsible for issuing those permits, as well as preparing all the necessary Methods for Handling Traffic (MHTs). Close coordination with CDOT region staff is necessary for successful implementation of traffic control on US 50. If work is needed along county roads, permits may also be required from the county. Finally, public information on the progress of the work and any road/lane closures to keep road users and travelers informed is a key ingredient in traffic management of the installation, removal, and restoration phases.

Installation traffic control measures will follow Manual on Uniform Traffic Control Devices (MUTCD), 2003 standards and guidance. If required, traffic control relates only to single-lane closure, then appropriate measures are limited to barrels or cones or glow-posts to direct the traffic, sufficient signage to describe the closure (such as "Road Work Ahead" and "Be Prepared to Stop"), flaggers who should be in radio contact, and possibly traffic control vehicles (also in radio contact).

For single-lane operation with pilot cars, conventional static signs and variable message signs (VMS) would first warn motorists of the potential delays and to prepare to stop. A flagger would stop cars while the other direction passes. As the other direction clears the work site, the front pilot vehicle would turn off its "Follow Me" sign and become the back or "sweep" vehicle, and the other pilot vehicle would assume the front role. By switching roles, the pilot vehicles would equalize the distance that each travels and reduce confusion to the drivers being led.

After a radio check, the front pilot vehicle would begin to lead queued vehicles around the work zone while the flagger for the other direction would stop arriving motorists. The process would continue as before, with pilot vehicles trading roles for each direction. Figure J1.2-1 shows pilot vehicle operation with a pilot vehicle leading westbound US 50 traffic around a work zone.

Operation with flaggers and no pilot vehicles would be similar, except the flaggers would radio a description of the last vehicle in each platoon, so the other flagger would know when to check that all is clear for a platoon in the other direction. Flaggers could also ask the last vehicle of each platoon to pass a physical "baton" to the other flagger to indicate that all traffic has passed.

CDOT will be consulted regarding development of traffic control plans for the installation period.

J1.2.1.1.2 Evaluation of Installation Delays

The duration of installation delays can be estimated with a number of traffic analysis and simulation packages, including VISSIM, Synchro, and SimTraffic. Flaggers may need to be represented as traffic lights, which perform the same function of indicating when traffic may proceed or must stop. Outputs would include average delay per vehicle, total delay, and maximum queue length. Any of these measures exceeding target values would indicate a need to reformulate the operating plan and check the revised plan with another simulation.

Once installation begins, field observations can be collected and compared against established performance measures. If performance measures are not being met, the collected traffic data can be used

to re-run and better calibrate the traffic software. Recommendations can be developed from the output, and field procedures modified as appropriate.

J1.2.1.1.3 Temporary Signing and Pavement Marking

The MUTCD presents several illustrations of temporary signing and striping for work zones. The treatment of anchor installation would be similar to that for work being performed on a single traffic lane. The difference here is that materials would be delivered in the traffic lane, while the actual work would occur off the highway. Engineering judgment will indicate the situations in which additional roadside barriers might be advised to protect workers from any vehicles that might run off the roadway.

Figure J1.2-1 shows a typical configuration for a single-lane closure during installation. In the figure, westbound vehicles are proceeding in the eastbound lane guided by pilot vehicles. A flagger stops eastbound motorists west of the work zone. The truck within the closed lane holds materials for assembly of ATFs, which are shown as square blocks beside the river. The material delivery truck is separated from the traffic flow by glow-posts, cones, barrels, or plastic barriers that may be filled with sand or water. Selection of separating device depends on the expected duration of the work and the need to isolate traffic from the work site to protect both motorists and employees.

J1.2.1.1.4 Lane Closures, Flagging, and Traffic Control Vehicles

OTR installation, removal, and restoration activities (described in Appendix J1.1) will require periodic lane closures, flagging, and traffic control vehicles (or “pilot cars”) when deemed necessary. The OTR traffic team will follow guidance from CDOT in developing appropriate protocols.

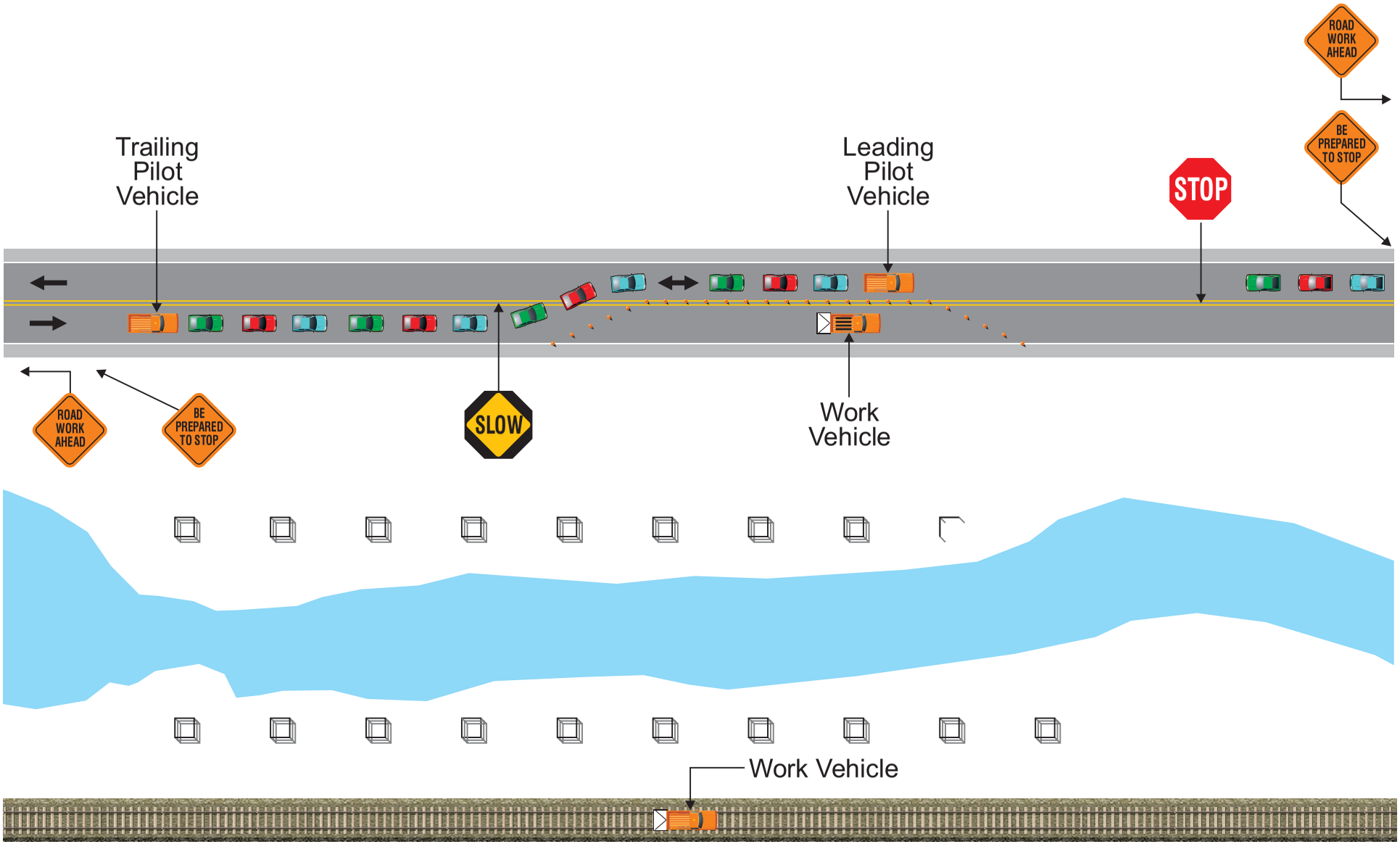
OTR anticipates that activities will temporarily close no more than 400 feet in any 10-mile span of highway at any point in time. Single-lane delays during installation activities are expected to last between 5 and 10 minutes. The OTR estimated needs are preliminary and are shown in the following text only to give an idea of the anticipated needs. These estimates will adjust as engineering plans are finalized and traffic planning is guided by CDOT and BLM to minimize impacts and ensure public safety.

- During anchor and anchor transition frame (ATF) installation and removal, it is estimated that there would be approximately 295 days where portions of lanes on US 50 need to be temporarily closed to traffic, in two different areas at the same time.
- During cable installation and removal, it is estimated that there would be approximately 60 days where portions of lanes on US 50 need to be temporarily closed to traffic, in two different areas at the same time. Exact procedures for cable installation will be defined by the cable contractor; which has not been determined as of April 2007.
- For fabric panel installation and removal, it is estimated that there will be approximately 24 days where portions of lanes on US 50 need to be temporarily closed to traffic, in two different areas at the same time.
- For restoration, it is estimated that there would be approximately 20 days where portions of lanes on US 50 need to be temporarily closed to traffic, in two different areas at the same time.

For the anchor survey, no highway closures would be necessary because this work would not take place within the US 50 right-of-way (ROW). Warning signs, and/or other protocols as advised by CDOT, would be provided to caution drivers of proximity to survey crew.

These highway needs will be spread out over the entire period of installation removal, and restoration activities, estimated to occur over a 2.5-year period.

Figure J1.2-1. Typical Configuration for a Single-Lane Closure During Installation



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J1.2.1.1.5 Staging Areas and Construction Vehicle Parking

A staging area will be located at Texas Creek. Construction activities would be based at this staging area, where materials and equipment would be stored until deployment. The staging area would also serve as a natural base of operations and lunch break area for construction employees.

Portosans will also be plentiful at the staging area. Provision will be made so that vehicles servicing the Portosans can have access without impeding normal construction activities.

Parking at the staging area is likely to be limited, which also produces a natural incentive for construction employees to use shared-ride modes to the greatest extent possible. Vegetation disturbed by parking or operations at the staging area will be reseeded as part of the restoration efforts.

J1.2.1.1.6 Monitor Shuttles

To minimize congestion from single-occupant vehicles, shuttle buses or vans may be provided to transport monitors.

J1.2.1.1.7 Assessing Installation Mitigation

Assessing installation mitigation techniques would follow a similar method as that of assessing installation impacts because the benefit of the mitigation would be the difference from the unmitigated situation. That is, the assessment of installation mitigation would yield the same kinds of performance measures as the impacts assessment. Cost-effectiveness ratios could be constructed to identify which mitigation measures are most effective at mitigating the impacts of installation delays.

J1.2.1.2 Removal and Restoration Traffic Operations Analysis

Transportation management during the removal and restoration period will be similar to that of the installation period. For example, where lane closures were required during installation to set up the ATFs, they will likely be required for their removal. The lane closures needed for removal and restoration are stated above in Section J1.2.1.1.4, Lane Closures, Flagging, and Traffic Control Vehicles. The duration of removal lane closures may be shorter than installation lane closures if only minimal operations are performed at the anchor site and ATFs are removed to the Texas Creek staging area for further disassembly and sorting for recycling. Because restoration could begin immediately after ATF removal, there will likely not be a need for separate closures for removal and later for restoration. From the point of view of US 50 traffic, the lane closure for removal and restoration would not be distinguishable from lane closure for installation or for routine maintenance of the highway itself. Only minor modifications, if any, would need to be made to the installation signing and striping plans to produce the corresponding removal and restoration signing and striping plans.

J1.2.2 Transportation, Traffic, and Emergency Response Tool Box Applications by Target Group

During the installation and removal of the temporary work of art, various applications can be used to enhance traffic control, traveler information, travel demand management, and incident management. For each of these areas, there are different users or target groups with distinct needs and expectations for highway operations. The following tables provide a list of potential tools for each combination of target groups and management area: Table J1.2-1 addresses residents and commuters; Table J1.2-2, emergency responders; and Table J1.2-3, recreation users.

Potential tools are defined in Appendix J2.2, Section J2.2.5.7 of the Event Management Plan. In developing the installation and removal traffic management plans, input from local stakeholders (community representatives and emergency responders) would be sought to identify the appropriate tools. A collaborative dialog would be necessary to identify these stakeholder needs and desires and to provide a balanced approach to the varying concerns of all of the canyon residents and users.

Table J1.2-1. Potential Transportation, Traffic, and Emergency Response Tools for Residents and Commuters

Traffic Control	Traveler Information	Travel Demand Management	Emergency Response Management
• Actuated or static trailblazers • Preplanned alternate routes • Emergency pullouts • Public education program • Video surveillance • Dedicated service patrols • Portable/temporary traffic signals and signs	• Variable message signs • Internet • Cable television • Broadcast radio • Traffic reporting services • Public education program • Video surveillance • Special event phone number • HAR	• Public education program • Special event phone number • Alternative mode opportunities	• Variable message signs • Mass fax and email • Internet • Broadcast radio • Traffic reporting services • Actuated or static trailblazers • Public education program • Call boxes • Video surveillance • Closely spaced milepost markers • Dedicated service patrols

Table J1.2-2. Potential Transportation, Traffic, and Emergency Response Tools for Response Agencies

Traffic Control	Traveler Information	Travel Demand Management	Emergency Response Management
• Accident investigation sites • Push bumpers • Rapid vehicle removal guidelines • Preplanned alternate routes • Emergency pullouts • Public education program • Video surveillance • Dedicated service patrols • 24-hour patrol • Motorcycle patrol • Aircraft patrol • Volunteer spotters • Agency and transit "probes" • Automated vehicle identifiers • Mobile Incident Command Unit	• Media interface guidelines • Public education program • Video surveillance • Special event phone number • Public information officer	• Public education program • Special event phone number	• Variable message signs • Mass fax and email • Internet • Broadcast radio • Traffic reporting services • Actuated or static trailblazers • Incremental lane opening guidelines • Accident investigation sites • Push bumpers • Predetermined landing zones • Rapid vehicle removal guidelines • Closure and alternate route guidelines • Travel on shoulder guidelines • Incident management review team • Incident response teams • Mobile command post • Identification vests • Flashing lights guidelines • Predetermined staging areas • Defined traffic control techniques • Alternative emergency response access routes • Incident Response Manual • Communication plan • Interagency training program • Equipment storage sites • Preplanned alternate routes • Emergency pullouts • Personnel resource list • Equipment/materials resource list • Public education program • Call boxes • Video surveillance • Closely spaced milepost markers • Dedicated service patrols • 24-hour patrol • Motorcycle patrol • Aircraft patrol • Volunteer spotters • Agency and transit "probes" • Automated vehicle identifiers

Table J1.2-3. Potential Transportation, Traffic, and Emergency Response Tools for Recreation Users

Traffic Control	Traveler Information	Travel Demand Management	Emergency Response Management
• Actuated or static trailblazers • Preplanned alternate routes • Emergency pullouts • Public education program • Video surveillance • Dedicated service patrols	• Variable message signs • Internet • Cable television • Broadcast radio • Traffic reporting services • Public education program • Video surveillance • Special event phone number	• Public education program • Special event phone number • Permitting • Vendor coordination • Alternative modes	• Variable message signs • Mass fax and email • Internet • Broadcast radio • Traffic reporting service • Actuated or static trailblazers • Preplanned alternate routes • Emergency pullouts • Public education program • Call boxes • Video surveillance • Closely spaced milepost markers • Dedicated service patrols

J1.2.3 Sanitation and Services

Development of sanitation and services plans for construction, removal, and restoration phases of OTR will be based on the same information collected on existing infrastructure for the Event Management Plan (see Section J2.2.8, Sanitation and Services, of the Event Management Plan for details on existing infrastructure. Sanitation and service needs for installation and removal periods are described below.

J1.2.3.1 Portosans

Calculating portosans needs requires:

- Identification of use locations
- Calculation of need types
- Calculation of numbers of users at each location
- Calculations on frequency of service (time of service and number of times)
- Identification of services (preferably local from Salida or Cañon City) to provide facilities

J1.2.3.2 Trash/Recycling Service

Calculating trash/recycling service needs requires:

- Identification of use locations
- Calculation of need types (overnight users, day visitors)
- Calculations of frequency of pickup
- Identification of proximity to overnight facilities, day users
- Identification of services (preferably local from Salida or Canon City)
- Signage and information associated with recycling

J1.2.3.3 Housing Needs for Project Personnel

The artists hire local labor whenever possible. If the need for certain specialized skills exceeds the capacity of the local labor market, workers would need to be brought in from farther away, and housing may be provided for these workers. For example, members of the OTR team will relocate to the OTR site and will require temporary housing.

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