Central Arizona Project

CAWCD Guidelines for Blasting

June 2022

Table of Contents

ACRONYMS AND ABBREVIATIONS

ANFO	Ammonium Nitrate/Fuel Oil
AOE	Authorized Operating Entity
AWWA	American Water Works Association
CAP	Central Arizona Project
CAWCD	Central Arizona Water Conservation District
CFR	Code of Federal Regulations
CPS	Cathodic Protection System
CSV	Comma Separated Values
DOT	Department of Transportation
FFT	Fast Fourier Transformation
HDD	Horizontal Directional Drilling
ISEE	International Society of Explosives Engineers
kV	Kilovolt(s)
MERL	Materials Engineering and Research Laboratory
O&M	Operations and Maintenance
BOR	Bureau of Reclamation, also known as, Reclamation
ROW	Right-of-Way
WB-67	67-foot Wheelbase

1 INTRODUCTION

BACKGROUND

The Central Arizona Project (CAP), owned and constructed by the United States Bureau of Reclamation, is a 336-mile-long system of aqueducts, tunnels, pumping plants, and pipelines that carry water across Arizona. Designed to bring 1.5 million acre-feet of Colorado River water per year to Pima, Pinal, and Maricopa Counties. The CAP is the largest single renewable water resource in the state.

In 1971, the Central Arizona Water Conservation District (CAWCD) was created to not only provide a means for Arizona to repay the federal government for the reimbursable costs of construction, but to also assume the responsibility for the operation, and maintenance of the system.

CAWCD's Engineering Services Department is responsible for providing and enforcing the blasting requirements necessary to protect all CAP infrastructure. Colorado River water diversion and delivery is CAWCD's primary mission; therefore all proposed blasting near CAP infrastructure (canal, dikes, siphons, buildings, etc.) are evaluated to determine acceptable blasting limits and the overall effect on the CAP.

PURPOSE

To establish acceptable blasting practices near CAP infrastructure and ensure that water delivery is not interrupted, the CAWCD has developed this set of guidelines to assist in the planning and monitoring process of blasting operations near CAP assets. Please utilize this guide when communicating blasting plans with CAWCD.

2 WHEN TO CONTACT CAWCD

CAWCD requires notice of blasting when the blast operations are located within 2640 feet (1/2 mile) of CAP Right-of-Way (R/W). If there is blasting within 1320 feet (1/4 mile) of the R/W, CAWCD requires a Blasting Near CAP Permit Application from the blasting company. This application can be found at the following location: <Insert Link for Application>.

BLASTING BETWEEN 1320-2640 FEET OF CANAL

Within the 1/2 mile, please send email notification within 48 hours of the blast operation, a location map, and a tentative timeline for the blasting operations so CAWCD is aware of how long the construction process will be. If at any point during blasting it is discovered that blasting will be required within the 1/4 mile limit, please submit the application with the updated map and all additional information as described below.

BLASTING WITHIN 1320 FEET (1/4 MILE)

Within the 1320 feet (1/4 Mile) Limit, the CAWCD requires the company performing the blasting to file the application and submit the following items:

1. A general blasting plan showing:
    a. Company
        i. Name
        ii. Address
        iii. Contact Information
    b. Blaster-in-charge
        i. Name and Contact info
    c. Type of Blast (Confined or Face)
    d. Max Charge-weight/delay
    e. Delay Interval
    f. Hole Diameter
    g. Charge Weight per hole
    h. Number of holes per blast
    i. Spacing & Burden
    j. Type of Explosive
    k. Number of holes
2. Geotechnical Report
3. Location Document
    a. This may be a .KMZ file or .PDF file.
    b. The CAP will use the closest distance to the top of the Canal concrete lining as the basis for predictive Peak Particle Velocity (PPV)
4. Permit on file with local authority (Municipal Fire Department)
5. Blasting Safety Plan
6. Preliminary Schedule
7. Calibration Certificates for Seismographs used in the field

Blasting Plan

The following table is an example showing what is expected during a submittal for a general blast plan:

DETAILS OF PLANNED BLAST

Blast hole diameter (in)	3.5	Charge weight per hole (lb)	26
Average hole depth (ft)	15	Number of holes per delay	2
Burden distance (ft)	8	Charge weight per delay (lb)	52 Max
Spacing distance (ft)	7	Total number of production holes (range)	20-70
Subdrill (ft)	0	Total explosives quantity per blast (lb)	1000 - 2500
Minimum stem (ft)	7	Total quantity of shot material per hole (yd^3)	18,000
Blast hole inclination	Vertical	Powder factor (lb/yd^3)	1.13
Total # of holes per blast	400	Total explosives in sho	
Explosives type	ANFO		
Primer	1 ¼ x 8 Detagel (Dyno)		
Initiation system	Non Electric		

***Please note that the above table is just an example and includes more information than described on page 5.**

As noted above, the blast plan may also include additional information if it also meets the minimum requirements.

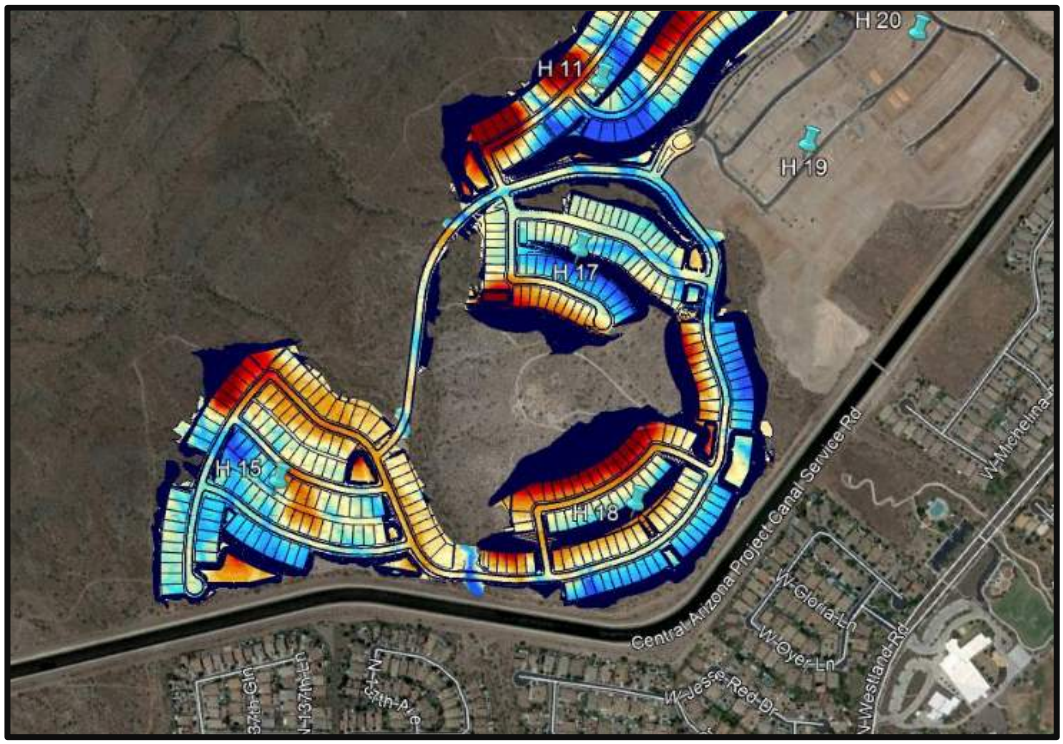
Geotechnical Report

The geotechnical report done as part of the site investigation for the project that determined blasting was necessary shall be submitted to the CAWCD. The report shall be stamped and signed by the PE in charge of the investigation.

Location Document

The Location Document shall include an image such as the following that is to scale and measurable. Acceptable formats include scalable PDF files and KMZ files that show the area in question.

The information provided will be measured by scale to the CAP Right-of-Way, and CAWCD will use the provided information from the Blasting Plan and Location Document to predict the proposed blasting effect at the Canal.



Permit and Blasting Safety Plan

CAWCD will require the submitter to provide a copy of the approved permit from the local municipality, and a blasting safety plan. The safety plan shall include a provision that any vehicle or temporary structure storing explosives material shall be located a minimum of a ¼ mile away from the canal and any procedures visitors must follow as CAP representatives may attend some of the blasting operations.

In addition, CAWCD also requests the permit on file with the local municipality to confirm that the public is aware of the activities as well and that other local codes are being followed.

Schedule

A preliminary schedule will be submitted to CAP. In the event there are any changes or deviations from this submittal, the CAP shall be notified by the blaster in charge or another representative the Blasting Company.

The Company shall also give weekly updates of planned blasting the CAP is aware of when explosions shall occur.

BLASTING WITHIN 300 FEET

CAWCD recommends all other methods for excavation be exhausted prior to blasting within 300 feet of CAWCD Right-of-Way. The CAWCD does not typically allow blasting within 300 feet of the Right-of-Way. If this is required for the project, CAWCD requires everything that is submitted for 'Within 1320 Feet' but also includes:

1. A site-specific blast plan for each individual blast to occur showing:
    a. Ignition point
    b. Profile of hole
    c. Specific layout of each hole in space on a scaled drawing or KMZ file.
    d. Calculations PPV generated by the blast at any points of interest.
2. Geotechnical data with showing the type of rock between the Canal and the blast point.
3. A schedule that will be determined by the CAWCD. The blast will need to be conducted during an outage.
4. An ROV inspection of the canal will need to be completed before and after the blast to ensure no damage occurs.
5. Reporting completed as described in Section 3 of this document.

With all of this submitted, it is not guaranteed that blasting will be allowed.

3 CAP BLASTING REQUIREMENTS

CAWCD's blasting requirements are based on documents published from experts in the blasting industry. These publishers include the US Bureau of Mines, the International Society of Explosives Engineer, and other institutes who focus on the use of controlled explosions.

PEAK PARTICLE VELOCITY LIMIT

The blasting requirements limited by the CAP are restricted to the proximity to CAP Right-of-Way and the blast frequency and Peak Particle Velocity (PPV). From the submitted information, the CAP will verify that the data will meet our standard criteria for ultimate PPV per frequency. The CAP limit at the Right-of-Way shall be consistent the Bureau of Mining's Peak Particle Velocity Limits:

Table 10.1.1 Peak Particle Velocity Limits

Distance from Blasting Site		Maximum Allowable Peak Particle Velocity*	
m	ft	mm/s	in./s
0–91.4	0–300	31.75	1.25
91.5–1524	301–5000	25.4	1.00
1525 and over	5001 and over	19	0.75

*Peak particle velocity shall be measured in three mutually perpendicular directions, and the maximum allowable limits shall apply to each of these measurements.

In the event the submitted info does not meat the CAP criteria, CAP will ask for the blast plan to be revised or for calculations and supporting evidence to be provided for the blast in question.

From the submitted materials, the calculation for PPV and frequency at the point of interest (CAP Right-of-Way) shall be based on the Construction Vibration Amplitude Equation as shown in USBM RI 8507.

$$PPV = 5 * (SD_2)^{-1.09}$$

Where:

PPV = Peak Particle Velocity (in/s)
SD_2 = Square root scaled distance (feet/$lb^{1/2}$)

This equation shall be used along with the following to predict the blast:

$$SD_2 = \frac{R}{W^{1/2}}$$

Where:

SD_2 = Square root scaled distance (feet/$lb^{1/2}$)
R = Distance between Point of Interest and Blast (ft)
W = Max charge-weight detonated within any 8-millisecond period (lbs)

The limit for blasting near the CAP shall not exceed 1.25 in/s. In the event that the blaster's calculations are exceeding this amount, the blaster will be asked to either change their maximum charge amount to an acceptable level or to provide rock data and calculations that will be reviewed by the CAP.

4 MONITORING REQUIREMENTS

The CAP requires monitoring all blasts within the 1320-foot limit established by this document.

MONITORS

Monitors placed for the purpose of recording blasting vibrations shall be seismographs equipped with geophones buried 9-inches deep and compacted with native soil or well graded sand. The compaction shall be completed per ISEE Field Practice Guidelines for Blasting Seismographs. The geophones shall be able to obtain the following information:

1. Radial Peak Component Velocity & Frequency
2. Vertical Peak Component Velocity & Frequency
3. Transverse Peak Component Velocity & Frequency
4. Over-blast decibel level

Calibration

The monitors shall be calibrated annually against a frequency range of 2 to 250 hz. The calibration. The calibration standards shall meet those set forth in the ISEE Performance Specifications for Blasting Seismographs. Records of the calibration shall be provided to CAWCD during the application process, and for any additional monitor that may be used during the project.

Placement

Where the monitor is placed can affect the accuracy of the readings. For any blasting done within 1320 feet, the monitor shall be placed between the blast site and the canal as shown below:

When the blasting is taking place within 500 feet of the canal, monitor(s) must be placed at the perimeter fence for the canal, or at the top of the concrete lining of the canal at the request of CAWCD. If the Canal is in a concave bend and there are two possible close points, there shall be two monitors placed at each of the locations as shown below:

When setting up the monitors at the monitoring location(s), a representative of the CAP will meet with the recorder on-site to approve of the monitoring set-up location.

Blasting Report

The blasting report produced by the blast shall contain the following information:

- Monitoring Unit Number
- Distance to Blast (ft)
- Scale Distance ($ft/lb^{1/2}$)
- Peak Particle Velocity (in/s)
- PPV Frequency (Hz)

- FFT Frequency (Hz)
- Cube-root scaled distance ($ft/lb^{1/3}$)
- Peak Air Blast (dBL)
- Compliance Plot showing PPV and Peak Frequency
- Compliance Plot showing Airblast and Cube Root Scaled Distance
- Raw data from each monitoring station used to monitor blast.

Each individual blast will require a report be completed. Following each blasting activity, the report should be sent within 48 hours.

5 THE CANAL AND OTHER INFRASTRUCTURE

While the major infrastructure for the CAWCD is the Canal, there are also pump stations, groundwater recharge sites, dams, dykes, and other facilities that may be affected by blasting operations. In the unlikely event that there is blasting within ¼ mile of these structures, the CAP may have a representative on site to observe the operation.

When filling out the application, please indicate any buildings, pipe crossings, or bridges that cross CAP Right-of-Way and are visible from the blasting site. CAP may request that these structures be treated as Points-of-Interest and the monitors be placed between the blasting operation and the structure or crossing.

In the event that one of these structures or crossings is deemed critical, the CAP may issue other safety protocols or require that the blast be completed in a time that is coordinated with CAP operations.

6 INSPECTIONS

The CAP may require that an inspector be present for any blast within 500 feet or any blast that appears to approach the CAP blasting limits. The inspector will be assigned during the application process and contact info of the inspector will be given to the applicant upon permit approval.

Prior to any blasting, the applicant will need to show the inspector where the explosives are stored, as well as go over the safety plan with them. After this, the inspector will need to be given weekly schedule updates.