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# **Pit Survey and Field Investigation Elbert County, Colorado**



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Boulder, Colorado

**June 2008**

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*Prepared for:*

**State of Colorado Department of Natural Resources,  
Colorado Oil and Gas Conservation Commission**

*Prepared by:*



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## **1.0 INTRODUCTION**

The Colorado Oil & Gas Conservation Commission (COGCC) Pit Survey and Field Investigation Project consists primarily of evaluating the accuracy and completeness of pit data listed in the COGCC web-based information system (COGIS) for Elbert County and updating the status of COGCC pit information. Status updates are based on the review of online documentation for each pit and through performance of site inspections for select pits requiring additional review. Under contract to the COGCC, S. S. Papadopoulos & Associates, Inc. (SSPA) conducted field evaluations in June, 2008. Findings from these inventories are summarized in brief Pit Status Evaluation Forms and are discussed with respect to a possible statewide pit evaluation.

### **1.1 Objectives**

The objectives of the Pit Survey and Field Investigation are as follows:

- 1) Evaluate the status of 176 pits in Elbert County, Colorado using information gathered from the COGCC online documents database and through aerial photo verification. Pit status classifications were evaluated to be one of the following:
  - Active: a pit was classified as active if an earthen pit or skim culvert pit was documented near sites with ongoing oil and gas exploration and production operations.
  - Closed: a pit was classified as closed if evidence of approved pit closure was discovered and/or an earthen pit had been backfilled and the pit site was found to be reclaimed.
  - No Pit On-Site: a pit was classified as part of a common use water disposal facility if documentation shows produced water was transported off site to another well or battery tank site. This classification effectively indicates the pit Facility ID is closed.
  - Duplicate: a pit Facility ID that is a replica of another Facility ID entry was classified as a duplicate.
  - Other: all remaining pits were classified as other, including pits found to have incorrect or unknown location information (i.e., not in Elbert County).
- 2) Conduct field inventories of locations where pit status is initially indeterminate through document investigations and update the pit status and pit location information during visual site inspections and from field GPS surveys.
- 3) Develop a database of updated pit information, including revised pit location data, updated operator information and updated status.

- 4) Evaluate the completeness and accuracy of the COGIS pit data and assess the feasibility of performing a statewide pit inventory using this process.

## **1.2 Methods**

This project was performed in a two-phase process. Section 2 describes the evaluation process for updating pit status based on pit and well documents available from the COGCC online database. Evaluations were implemented for the pits shown in Figure 1. These documents were used to classify each pit as active, closed, abandoned, or unknown. Additional classifications that were found and noted included pit locations that were replicates and pit locations that did not exist on-site (ie. produced water was stored off site at a common lease storage area).

The second phase of this project included selecting pit sites where the status was indeterminate and performing visual site inspections. Pits were selected for field surveys if they were classified as abandoned or unknown or where pit investigations indicated that site conditions were unsatisfactory. Section 3 discusses the investigation procedures for the Elbert County field inventories.

## **1.3 Field Locations**

Pits to be evaluated were queried and selected with a COGCC Facility database search for “pit” facilities for the American Petroleum Institute (API) county number “039” (Elbert). Pit locations identified by the COGIS database are shown in Figure 1. Each database pit location is assigned a unique Facility ID number. For the purposes of this study, an associated well API number was required to thoroughly evaluate site status using the COGCC online documents library. For these well locations only the 4<sup>th</sup> part (or 5 digits) of the full 4-part (14-digit) API number were necessary to uniquely identify these wells; the first two digits indicate state number (05), the next three digits are the county number (039), and the 4th part five digits are the sequence number (or permit number).

## **2.0 PIT STATUS EVALUATIONS**

### **2.1 Pre-Evaluation Procedures**

COGCC pits and wells for Elbert County were imported to a Geographic Information System (GIS) geodatabase framework, overlain on aerial photographs and select attributes were posted onto brief Pit Status Evaluation Forms. Forms for each site were produced and utilized in the evaluation of each pit's status. All sites were evaluated in Phase I of this project. Pit Status Evaluation Forms for sites initially classified from documentation and aerial imagery verification are included in Appendix A; Pit Status Evaluation Forms for field-verified sites are included in Appendix B.

#### **2.1.1 Aerial Imagery**

The Elbert County aerial image utilized in evaluations and published in the Pit Status Evaluation forms was obtained from the U. S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Geospatial Data Gateway (<http://datagateway.nrcs.usda.gov/>). The photograph was collected as part of the Aerial Photography Field Office (APFO) National Agricultural Inventory Project (NAIP) for 2006. Metadata for this image is in Appendix C. These photos were used as a reference for the most recent and available imagery capture of existing pits and well equipment in Elbert County.

The 2005 COGIS aeriels were used to verify the conditions at a pit and to reference pit or water disposal locations. The resolution of these photos exceeds the NAIP 2006 images.

#### **2.1.2 Pit Status Evaluation Forms**

The Pit Status Evaluation Forms were structured to show the location information from GIS at the top of the page, the COGCC source information in the middle section of the page and the evaluation of the pit status at the bottom of the page (refer to Appendix B and Appendix C). Maps are shown at a 1:6,000 scale centered on the pit location as provided by the COGCC or updated from field inventories performed in this study. Each map shows the well API sequence number for associated locations obtained via the COGCC downloadable GIS file for the state of Colorado.

The COGCC pit database does not currently relate pit information to associated well information or well site inspection reports. To associate pits with well information, coordinate locations were “snapped to” the closest wellhead point location in GIS. In some cases the pit location was not associated with the correct well, but was verified matching facility and well names in the COGCC online database.

The pit operator name was updated using the associated well information in the geodatabase. Pit attribute data was queried and displayed in the middle section of each form using a macro routine. This information included;

- Pit facility ID and pit name;
- COGCC pit status;
- COGCC owner/operator name; and
- Location information including the Public Land Survey System (Township, Range, Section, Quarter –Quarter and Meridian) and Latitude and Longitude.

Pit status codes in this section reflect source data input. Status codes used in these fields are described in Table 1. 158 of the 176 source data pit status fields were empty (null) and are reported on the Pit Status Evaluation forms as Not Reported (NR).

### **2.1.3 COGCC Pit Documentation**

Pertinent scanned documents from the COGCC online database were saved and categorized by pit Facility ID. Relevant documents were noted on the forms by the COGCC document number and the document date. Codes for the type of forms referenced in the Pit Status Evaluation Forms are listed in Table 1.

Application for Permit to Use Earthen Pits (Form 15) and lease inspection forms (LIF) are linked to the COGCC online scanned document web-page by pit facility ID. Form 15 pit permit dates are documented on the Pit Status Evaluation Forms and note whether the pit was new or existing at the time of permitting. During initial database evaluations, it was discovered that not all approved pit permits were obtainable via the website. Approximately 57% of the pits in Elbert County did not have a Form 15 on the COGCC documents database and were noted by indicating not available (NA) on the forms. Other forms such as lease inspection forms

documented whether a pit had ever been built, the size and condition of pits and if the pit served a multiple wells.

Some site inspection documents were only available by querying the COGCC database by well API number. Field inventory reports (FIR) and well site inspection forms (WSIF) reported well equipment, pits and conditions at the time of inspection. Plat maps and site sketches assisted in locating pits on aerials. Well site inspection forms were utilized during the plugging and abandonment (P&A) of wells; final P&A surveys indicate whether the pit had been backfilled and the site cleaned. Sundry Notices (Form 4) occasionally were filed for pit closure. A small number of remediation work plans (Form 27) were discovered during the online investigations for Elbert County.

## **2.2 Pit Status Evaluation**

A flowchart of the pit status evaluation process is shown in Figure 2. Initially, duplicate records were identified by querying for identical latitude and longitude coordinates. Twenty-three of the 176 pits were identified and labeled (DUP). An additional three duplicates were identified through visual site inspection of maps. The priority pit Facility ID that will be used for reporting pit status is documented under the checked box for “Duplicate Facility ID#”.

Pits that serve a plugged and abandoned (PA) or dry and abandoned (DA) well were investigated to verify if the pit had been backfilled and the site cleaned. Pit closure was verified by one of the following documents;

- Remediation work plans (Form 27);
- Well site inspection forms (WSIF);
- Sundry notices (Form 4) ; or
- Field inventory reports (FIR).

COGCC document numbers and document dates were noted on the Pit Status Evaluation Forms. Both aerial photo images from 2005 and 2006 were inspected to inventory the site for possible un-remediated environmental impacts or hazardous conditions. Pit sites determined to be clean were classified as closed (CL).



Documents that indicated a common use disposal for multiple wells were noted. Aerial photos were inventoried to determine the battery tank site or area where the pit exists or had existed. Pits locations that did not exist on site and were part of a common use lease were classified as No Pit On Site (NPOS). The associated pit facility IDs are listed under the unchecked box for “Duplicate Facility ID#” and documented in the notes section of the Pit Status Evaluation Forms. Effectively, these pit facility IDs are closed.

Pits that were examined and found to be un-reclaimed were classified as abandoned (AB) during evaluations using documents and aerial imagery analysis. Pits that showed stained soils and/or stressed vegetation were selected for pit field investigations. If a pit was discovered during field inspections it was classified as active. Un-reclaimed pits with unsatisfactory conditions were classified as active with unsatisfactory site conditions; pit sites with adverse environmental conditions or violating the COGCC waste management and reclamation rules are summarized in Table 2.

Pits that are located in Section Quarter – Quarters near a well that is currently reported as producing (PR) or shut-in (SI) were examined for active status (AC). Field inspection reports were reviewed to determine if a pit exists near the well site. If a culvert or pit was listed in the well site investigation report, the pit status was classified as active. Culverts were classified as active pits because of water seepage and possible impacts to surrounding vegetation. Concrete vaults, fiberglass tanks and covered steel tanks are used for produced water storage but do not impose similar environmental concerns and are therefore classified as closed.

In cases where no pit documentation was available and well closure inspection forms did not indicate the current water storage facilities at a well or battery tank site, the pit was classified as unknown (UN) and selected for field site surveys.

### **3.0 PIT FIELD EVALUATIONS**

#### **3.1 Field Inventory Site Selection**

Field inspections were conducted for pit locations classified as unknown or abandoned or for select sites that were investigated to confirm the pit status evaluation process. Figure 3 shows the locations of the thirty-two sites visited during the field surveys. Access to and determination of the location of produced water storage sites was greatly facilitated by performing field inventories with the COGCC regional Field Inspector, Jim Precup. Field inspection surveys are summarized in the Pits Status Evaluation Forms in Appendix B.

#### **3.2 Field Survey Procedures**

Each pit site was investigated by locating the area where an existing pit or remediated pit location was found and describing the nearby area. Observed site conditions were documented in the field surveying notebook and on Pit Status Evaluation Forms. Field observation summaries and updated Pit Status Evaluation Forms for the surveyed sites are included in Table 2. Field observation summaries describe:

- Pit Facility ID and Pit Name;
- Closest well API number;
- Survey date;
- Description of the site conditions including any of observed impacts;
- Updated coordinate information in Latitude/Longitude (NAD83 Datum); and
- Recommended action for COGCC review.

Pit locations were recorded using a sub-meter accuracy global positioning system (GPS) instrument. Recording of GPS coordinates is explained in further detail in Section 3.3. Field GPS mapping was collected for the following features:

- Top of berm extents for earthen pits;
- Center of culvert;
- Well equipment including tank fenced areas, wellheads and separators; and
- Any observed impacts such as disturbed vegetation or any oil saturated soil conditions.

Photographs were taken at each site to document site conditions and to provide information for relocating the pit in the future. Each photograph was noted in the sampler's field notebook; site photographs are included in Appendix C with the Phase II Pit Status Evaluation Forms.

### **3.3     GPS Data Collection**

In accordance with COGCC Rule 215, the location of all pits, well equipment and areas of disturbance were mapped using a GPS with the following minimum standards:

- Differential GPS capabilities with a precision of less than one meter
- Position dilution of precision (PDOP) values higher than six (6) were not recorded
- Elevation mask (lowest acceptable height above horizon) of less than 15 degrees (15o) were blocked
- Latitude and longitude coordinates were provided in decimal degrees to an accuracy of at least five (5) decimal places using the North American Datum (NAD) of 1983 and are reported with six (6) decimal places in the site inventory forms

A Trimble GeoExplorer XT was used to map the abandoned well locations during this survey. Specifications for this instrument are in Appendix D and indicate compliance with COGCC Rule 215. Field personnel collected coordinate location data; differential corrections were made at the end of sampling activities by Field Environmental Instruments using the post-processing software, Trimble Pathfinder.

## **4.0 SUMMARY OF PIT STATUS EVALUATIONS**

### **4.1 Pit Status Evaluation Completeness and Accuracy Results**

Source data from the COGCC pit data table indicated eight of the 176 pits were active and ten were closed. The remaining 158 sites were not classified. Of the eight sites originally classified as active (AC), three are duplicate records (DUP), five are closed (CL) and one is part of a closed common use storage site (NPOS). Of the ten sites originally classified as closed, one is active, one is a duplicate, seven are closed and one is part of a closed common use site. These results indicate that the current reported status for pits does not reflect the current physical status.

The field reconnaissance portion of the investigation was performed both to update the status of pits and to analyze the status classification process described in this report. Of select sites evaluated, the following trends were documented in Elbert County;

- 100% of the abandoned status pits were closed,
- 100% of the closed status pits were closed,
- One of the sites proposed as part of common use pit was verified to be an off-site water storage facility,
- 67% of the unknown status pits were closed and the remaining were part of a common use facility,
- 25% of the active status pits were active, 71% were closed and one of the sites was part of an off-site water storage facility.

During field GPS data collection, Whitehead 1 and Whitehead 8-15 “areas of disturbance” GPS line features exceeded the maximum PDOP value of 6 due to cloud cover and lack of satellite geometry at the time of surveying. These areas are shown on the Pit Status Evaluation Forms in Appendix B.

Pit status updates for all Elbert County facilities are listed in Table 3. Final classification shows that 114 pits are closed (CL), 25 pit sites are part of an off-site water storage facility (NPOS), six are active (AC), four are classified as other indicating incorrect coordinate locations (WLOC) or unknown associated wells, and 26 records are duplicates (DUP).

## **4.2     Statewide Pit Inventory Recommendations**

1)     Following field sampling, GPS data and visual site observations were compiled into the GIS database and in a field investigation summary. Sites with possible areas of disturbance were selected based on visual inspection and indicate possible non-compliance with COGCC 900 and 1000 series Rules. Locations and observed conditions of these pits are described in Table 2. The following pits should be reviewed;

- Facility ID# 111797, Duffy 10-3
- Facility ID# 115044, Morris 13-4 & 14-8
- Facility ID# 115084, Miller 6-11
- Facility ID# 115091, Hay 4-5
- Facility ID# 115160, Whitehead 4-13

2)     SSPA recommends the COGCC update pit facility ID information to include associated well information. By associating pit facility IDs to well API numbers the COGCC pit Facility ID database can be linked to related well inspection documentation. The association procedure is performed in GIS by “snapping” pit locations to well locations. The association will produce a table that links pit Facility IDs with well API numbers and can be imported into the COGCC SQL database.

Verification of this procedure is required; validation can be performed by matching well and pit names from the database and by reviewing the distances between pit point locations and well point locations. In cases where well spacing is irregular (variable distance between points), this procedure requires a thorough review of well and pit facility names. After well association is complete, pit operator information should be updated from current well operator information found in the COGCC database.

3)     Initial pit status definitions from the Scope of Work were found to be unrepresentative of classifications in terms of available pit documentation and pit status. SSPA recommends the COGCC consider classifying pits as the following:

- Closed/Form 27: Pits that have been closed and proper remediation/closure documents have been submitted and approved.

- Closed/No Documentation: Pits that have been closed but have not been properly approved for pit closure.
- Active/Satisfactory: Active or existing pits identified from documents and/or imagery that have proper pit permit documentation (Form 15) and the pit site conditions meet the Waste Management and Reclamation Regulations in the COGCC 900 series and the 1000 series Rules.
- Active/Needs Review: Active or existing pits that do not have proper pit permit documentation (Form 15) and/or the pit site conditions were found to be unsatisfactory according to the COGCC Waste Management and Reclamation Regulations.
- Duplicate: Pit Facility IDs should be classified as duplicates if they are repeated pit locations. These Facility IDs should be linked to the Facility ID that contains the pit information and status for that pit.
- Other: Pits not meeting the above classification definitions classified as other.

4) As part of the future work for a statewide pit status investigation, SSPA recommends pit surveys include summaries of sites that indicate possible adverse conditions or violating environmental regulations mandated by the current COGCC rules.