

## **Hydrogeological Concerns in Huerfano Park**

### **Prepared by Citizens for Huerfano County**

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*Governor Hickenlooper has proclaimed 2012 the “Year of Water.” Here in Huerfano County, we fear that this is the year our already scarce water be will put further at risk by oil and gas drilling, including hydro-fracking. The eight Shell Oil drilling permits and four accompanying location assessments, filed May 18, 2012 with the Colorado Oil and Gas Conservation Commission (COGCC), threaten our lives and livelihoods here in many ways, but especially they threaten our water resources ...*

**Executive Summary:** The most basic concern in the northern Raton Basin, specifically in the Huerfano Park region of the Huerfano River drainage -- where Shell has proposed its Fortune, State, Seibert and Freeman oil wells -- is that oil and gas development could damage or destroy the quality and quantity of water available for humans, livestock and agriculture. This concern is driven and documented by three undeniable facts:

- (1) That it is not known if there are enough, and dependable enough, water resources to allow oil and gas drilling in the Huerfano drainage while continuing to barely meet human, livestock and agricultural needs.**
- (2) That the complex and unexplored hydrogeology of the Huerfano Park is not known well enough to avoid the risk of accidents caused by drilling and fracking into unmapped underground dikes, sills, fractures and fissures.**
- (3) That there have been negative impacts on water quality and quantity caused by gas development in the three Raton Basin drainages immediately to the south of the Huerfano (Cucharas, Purgatoire, Apishapa), and thus caution is required in the undeveloped Huerfano drainage.**

This paper explains why oil and gas permits should not be granted in Huerfano Park until its water resources and its complex hydrogeology are better understood. Acquiring and applying this knowledge, ahead of any permit processes, will protect human lives, help operators avoid some of the water-related damages already experienced in the Raton Basin, and fulfill the COGCC’s statutory mandate to “Foster the responsible, balanced development, production, and utilization of the natural resources of oil and gas in the state of Colorado in a manner consistent with protection of public health, safety, and welfare, including protection of the environment and wildlife resources.” (see CRS 34-60-102(1)(a)(I)). Approving oil and gas permits in Huerfano Park without the missing water resource and hydrogeological knowledge puts at risk the area’s human, animal and agricultural life.

Here are factual data and authoritative citations substantiating each of our three concerns:

**(1) Insufficient water resources to meet existing needs:** According to the EPA, the Huerfano River below the Muddy Creek confluence is classified as impaired and in need of the Total Maximum Daily Load (TMDL) calculations that determine the maximum amount of various pollutants it can receive and still safely meet water quality standards. Above the Muddy, the Huerfano and its tributaries have not been assessed. All four of Shell's recently proposed oil wells are in the near vicinity of either the Huerfano River or one of its tributaries. The area's sandy, gravelly and well-drained soils make it likely that contaminating plumes from any well pad or drilling accidents or spills will reach these drainages and the aquifers or source formations of many private water wells.

The Gardner townsite has two decreed community wells which are shallow, alluvial, close to the Huerfano River, poorly documented and barely maintained. In dry years, which are more common than not (and this is one), Gardner water quality suffers. Tributaries, the Huerfano and many local residents' shallow water wells dry up. Locals haul water from a few springs when their wells dry up. Drilling for deeper water is not necessarily a solution, as many deeper aquifers are highly mineralized and thus unsuitable for human, livestock and agricultural consumption.

***Conclusions (responsible government agency): Before oil and gas permits are granted in Huerfano Park, the Huerfano River and its tributaries needs a groundwater study (CWCB) and TMDL planning (WQCD), one of the two decreed Gardner community water wells needs to be registered (DWR), and both Gardner community wells need to be evaluated and upgraded (DWR/CWCB/CDPHE). Oil and gas drilling permits should not be approved until these critical water-protective steps are taken (COGCC). Any permits subsequently approved above the town of Gardner (e.g., the Fortune) need to be evaluated under COGCC Rule 317B.***

*Water Resource Citations:*

*EPA's 2006 classifications of the Huerfano and Cucharas Rivers:*

[http://iaspub.epa.gov/tmdl\\_waters10/attains\\_watershed.control?p\\_huc=11020006&p\\_state=CO&p\\_cycle=2006&p\\_report\\_type=](http://iaspub.epa.gov/tmdl_waters10/attains_watershed.control?p_huc=11020006&p_state=CO&p_cycle=2006&p_report_type=)

*USDA NRCS report on Huerfano County soils (1983):*

<http://soildatamart.nrcs.usda.gov/manuscripts/CO627/0/huerfano.pdf>

*The one registered Gardner community water well is documented here:*

<http://www.dwr.state.co.us/WellPermitSearch/View.aspx?receipt=9087011>

*Recent Gardner water quality report:*

[http://www.huerfano.us/uploads/gpid\\_ccr.pdf](http://www.huerfano.us/uploads/gpid_ccr.pdf)

*Deep water characteristics in Huerfano Park, McLaughlin (1966)*

<http://pubs.usgs.gov/wsp/1805/report.pdf>

Groundwater study resources:

<http://cwcb.state.co.us/water-management/basin-roundtables/Pages/ArkansasWaterSupplyReserveAccountGrants.aspx>

Ancillary data: COGCC responsible as implementing agency of WQCD (2011 report):

<http://www.cdph.state.co.us/op/wqcc/Reports/SB181/SB181arCOGCC2011.pdf>

Ancillary data: December 2011 presentation on groundwater classification --

[http://www.cdph.state.co.us/wq/drinkingwater/pdf/GWUDI\\_Stakeholder\\_Presentation.pdf](http://www.cdph.state.co.us/wq/drinkingwater/pdf/GWUDI_Stakeholder_Presentation.pdf)

## **(2) Lack of knowledge of the complex and relatively unexplored hydrogeology of the area:**

The Huerfano Park drainage and the proposed Shell oil wells roughly track a portion of the La Veta syncline, which lies at the bottom of the trough between the Sangre de Cristo mountains on the west and the Wet mountains to the northeast. From a hydrogeological standpoint, Huerfano County in general, and Huerfano Park in particular, are virtual blank spots on the map – unexplored, unmapped and undeveloped. The unique proximity of ancient volcanic stocks, with their radiating dikes and sills, to the more recent and still actively folding, faulting upthrusts of the Sangres makes for a very complex substructure.

Johnson (1959) and McLaughlin (1966) are primary resources for understanding the geology of Huerfano Park, while Abbott, Geldon, *et.al.* (1983) is the primary hydrology resource. Currently, the EPA is retrospectively reviewing the disastrous impacts on water wells and ranch irrigation of coalbed methane development in River Ridge Ranch and the Corsentino Ranch, with results to be published in 2014. The EPA has already published findings (2004) on the Raton Basin speculating that hydraulic fracturing could be opening links between oil/gas target formations and water-bearing formations.

To date, however, no one has actually documented the subsurface locations of the many dikes, sills, faults, fractures and fissures in the Huerfano Park. Nor are there any maps or authoritative study data documenting the transmissivity of these dikes, sills, faults, fractures and fissures. In other words, there have been no hydrogeological or groundwater studies in Huerfano Park – a critical lack of knowledge with pending drilling applications under review and Shell in possession of 130,000 + acres of mineral leases.

The need is widely acknowledge for more specific studies of this unique area to determine the actual subsurface geology and to more carefully assess the potential hydrological consequences of drilling. For example, Abbott, Geldon, *et.al.* (1983) state in the introduction to their Area 61 Hydrology Report:

“This information should be useful to mine owners, mine operators, and consulting engineers in the preparation of permit applications and to regulatory authorities in appraising the adequacy of the permits. ... It is expected that this hydrologic information will be supplemented by data from the lease applicant's specific site and from other sources to provide a more detailed appraisal of the hydrology in the vicinity of the mine and of the anticipated hydrologic consequences of the mining operation.”

More recently, in Watts (2004), we read

“More detailed geologic and hydrologic information is needed in these areas to quantify the potential effects of coalbed-methane production on water levels and the availability and sustainability of ground-water resources.”

The conventional wisdom among operators and some others holds that “layers of impermeable rock” separate oil- and gas-drilling target zones from water-well target formations (aquifers), and that adequate casings protect aquifers between the surface and the target oil and gas formation – but our research and experience in the Raton Basin have shown that (1) these layers are at least variably permeable, while (2) the unmapped dikes, sills, faults and fissures provide ample conduits for moving gases and fluids, especially when (3) these fissures and faults are disturbed or modified by drilling and fracking. For example, Bredehoeft (1983) notes that

“No stratum is entirely impervious. It is scarcely too strong to assert that no rock is absolutely impenetrable to water. Minute pores are well-nigh all pervading. To these are added microscopic seams, and to these again larger cracks and crevices. Consolidated strata are almost universally fissured. Even clay beds are not entirely free from partings.”

And Bredehoeft concludes that “Comparison of the hydraulic conductivity values derived from regional model analyses with the in situ and laboratory determinations suggests that much of the flow through the Cretaceous shale confining layers probably occurs as flow through fractures.”

***Conclusions (responsible government agency): Before oil and gas permits are granted in Huerfano Park, a comprehensive hydrogeological study of the area, including thorough field work (not just a literature review) should be accomplished (USGS/COGCC). Oil and gas drilling permits should not be approved until this research concludes that drilling and fracking will not adversely impact water resources (USGS/COGCC).***

*Hydrogeological Citations:*

Johnson (1959)

[http://ngmdb.usgs.gov/Prodesc/proddesc\\_20710.htm](http://ngmdb.usgs.gov/Prodesc/proddesc_20710.htm)

Abbott, Geldon, et al Hydrology of Area 61 (1983):

<http://pubs.usgs.gov/of/1983/0132/report.pdf>

McLaughlin (1966)

<http://pubs.usgs.gov/wsp/1805/report.pdf>

EPA pending groundwater study, including Raton Basin

[www.epa.gov/hfstudy/raton-qapp.pdf](http://www.epa.gov/hfstudy/raton-qapp.pdf)

EPA hypothesizes about relationship between hydraulic fracturing and water drawdowns from connected aquifers (2004)

[http://www.epa.gov/ogwdw/uic/pdfs/cbmstudy\\_attach\\_uic\\_attach09\\_raton.pdf](http://www.epa.gov/ogwdw/uic/pdfs/cbmstudy_attach_uic_attach09_raton.pdf)

*More study is needed, Watts (2004)*

<http://pubs.usgs.gov/sir/2006/5109/>

*Coal Bed Methane vs. Deep Oil/Gas Drilling: Is Deeper Safer? (2011)*

<http://huerfanofrack.blogspot.com/2011/10/coal-bed-methane-vs-deep-shale-oil-is.html>

*All stratigraphic layers are permeable, Bredehoeft et.al. (1983)*

<http://pubs.er.usgs.gov/publication/wsp2237>

*Bredehoeft cites Darton (1896)*

<http://pubs.usgs.gov/bul/0127/report.pdf>

**(3) documented negative impacts on water quality and quantity from coalbed methane development in Raton Basin river drainages immediately to the south (the Cucharas, Purgatoire and Apishapa):** The Colorado portion of the Raton Basin includes not only Huerfano Park and the Huerfano River drainage in the north, but also the more developed Cucharas, Purgatoire and Apishapa River drainages to the south. Water quality and quantity in all three of these drainages have already been damaged by oil and gas drilling, giving residents along the Huerfano great cause for caution and concern.

To summarize briefly, in the Cucharas River drainage, just 20 miles south of Shell's proposed Fortune, State, Seibert and Freeman oil well sites, the COGCC documented findings in 2007 that dikes, sills, fractures and faults are transmissive and that drilling and fracking operations did lead to transmission of methane from the target coalbed methane formation into water well aquifers that were thought to be separated from the CBM target by "hundreds of feet of impermeable rock." The CBM wells in River Ridge Ranch were capped and abandoned and monetary settlements were made by Petroglyph with impacted water well owners. The Corsentino dairy farm downstream was also impacted by Petroglyph's permitted discharge of produced water with high sodium absorption ratios (SAR) into the Cucharas drainage; this matter is in litigation.

Another 20 miles south of the Cucharas, in the Purgatoire and Apishapa River drainages, produced water discharge permits issued to CBM operators, coupled with out-of-date water quality standards (both the responsibility of WQCD), have caused complicated water use issues. Many landowners' water wells have been damaged irreparably by CBM development, but the produced water also has been a boon to some ranchers downstream, who use it for watering livestock. Operators have paid off some impacted landowners; other landowners have had varying success pleading their cases in court or before the COGCC. Meanwhile, expensive water monitoring projects are ongoing in both the Purgatoire and Apishapa drainages because of these irresponsible and questionable practices. Such costly damages and projects can be avoided in the Huerfano, if the proper studies are done before oil and gas permits are granted.

***Conclusions (responsible government agency): If groundwater and hydrogeological studies in Huerfano Park conclude that oil and gas drilling will not threaten the water resources necessary to sustain human life, livestock or agriculture, then the COGCC should attach as conditions of approval (COA) to all permits to drill in Huerfano Park, at least the following conditions:***

***(1) that only closed-loop, pitless drilling with non-toxic drilling and fracking chemicals and green completions will be allowed.***

***(2) that no raw produced water from drilling, fracking, completion or production will be stored in pits or ponds or spread on roads or grounds. Instead, that all raw produced water will be treated onsite to agricultural irrigation standards and then gradually returned to the ground downgrade from the well pad as far as possible on the leased surface.***

***(3) that the operator will immediately and completely remediate any and all damage to public or private water wells, including damage by the operator, its contractors or their sub-contractors.***

***(4) that the operator, prior to the beginning of activity at the well site, will post a bond, escrow account or liability insurance policy of sufficient monetary value to fully compensate local citizens for any damages to their air, water, health, safety, environment or property value that occurs subsequent to the operator's activities.***

***(5) that the operator, prior to the filing of permits to drill or location assessments, will perform a 3-d azimuthal seismic survey of the proposed site and environs in a five mile radius, in order to specifically identify dikes, sills, faults, fractures and fissures to be avoided.***

*Raton Basin Impacts Citations:*

*COGCC documents methane migration (2011) -- go to [www.cogcc.state.co.us](http://www.cogcc.state.co.us), click on 'Library,' then click on Raton Basin, then croll down under Huerfano County and select "Petroglyph and Norwest Questa Engineering MIMMP Presentation" (12/7/2007) and the "Petroglyph and Norwest Questa Hydrology MIMMP Presentation" (12/7/2007)*

*COGCC orders to Petroglyph regarding River Ridge Ranch (2011):*  
[http://cogcc.state.co.us/Hearings/Applications/2011/2011\\_June/1106-GA-07\\_Petroglyph.appl.pdf](http://cogcc.state.co.us/Hearings/Applications/2011/2011_June/1106-GA-07_Petroglyph.appl.pdf)

*EPA speculates about hydraulic fracturing and water drawdowns from connected aquifers (2004)*  
[http://www.epa.gov/ogwdw/uic/pdfs/cbmstudy\\_attach\\_uic\\_attach09\\_raton.pdf](http://www.epa.gov/ogwdw/uic/pdfs/cbmstudy_attach_uic_attach09_raton.pdf)

*Denver Post article summarizing Purgatoire and Apishapa water conflicts (2007):*  
[http://www.denverpost.com/search/ci\\_6616176](http://www.denverpost.com/search/ci_6616176)

*COGCC order denying compensation on Corsentino Ranch (2010):*  
<http://cogcc.state.co.us/orders/orders/1/148.html>

*Purgatoire River monitoring project:*  
<http://purgatoirewatershed.org/>

*Apishipa River monitoring project:*  
<http://www.apishapawatershed.org/>

*This report was prepared by Ciizens forHuerfano County, a non-profit citizens group whose mission is to protect the health, safety, welfare and environment of Huerfano County from the effects of oil and gas development. The reader is invited to learn more at [www.huerfaNOfrack.blogspot.com](http://www.huerfaNOfrack.blogspot.com)*