Assessing the Impacts of the Shell Falcon Ethane Pipeline System

Submitted as Public Comments on the
Shell Falcon Ethane Pipeline System
Permit #: E02-1773, E04-369, E63-710

April 16, 2018

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Executive Summary

This document serves a number of purposes. Firstly, it outlines some of the most prominent risks related to the proposed Falcon ethane pipeline that deserve close regulatory scrutiny by the Pennsylvania Department of Environmental. This document also outlines the importance of ensuring early and adequate public access to information on pipeline projects in order to ensure their participation in the permit review process. Finally, this document argues the case that the DEP's scrutiny of the Falcon must go beyond Ch.102 and Ch.105 permit reviews towards a more comprehensive environmental impact assessment.

1. Background

In August 2016, Shell Pipeline Company announced plans for the "Falcon Ethane Pipeline System," a 97-mile pipeline network intended to feed Shell's ethane cracker facility in Beaver County, Pennsylvania. The Falcon will carry more than 107,000 barrels of ethane per day through Pennsylvania, West Virginia, and Ohio to Shell's facility, which would then "crack," or break apart, ethane molecules to create ethylene and polyethylene. The Shell cracker would be the first step in building a regional petrochemical hub.

The industry often refers to ethane as a "natural gas liquid," and it is classified by the Pipeline and Hazardous Materials Safety Administration (PHMSA) as a "hazardous liquid" and a "highly volatile liquid." But these terms can be misleading. Ethane is only a liquid at very high pressure or extremely cold temperatures. At the normal atmospheric conditions, such as those experienced outside the pipeline, ethane is a colorless and odorless gas; slightly heavier than air and extremely flammable. Triggers such as cell phones, doorbells, or light switches are capable of providing an effective ignition source if concentrations are high enough.

The Falcon pipeline will cross through 25 municipalities in three states, in some cases through densely populated residential neighborhoods. Building the expansive pipelines will also be disruptive to the natural environment, as it must pass through many wetlands, protected forests, and sensitive habitats.

2. The Falcon Public EIA Project

FracTracker began monitoring developments on the Falcon pipeline beginning in December 2016, when we discovered a significant cache of GIS data related to the project that was left unprotected on the internet by the engineering consulting company working on the project, AECOM. FracTracker worked for nearly a year to replicate Shell's analysis for a public audience. Through many months of recreating the data, we developed a rich series of interactive maps and analyses illustrating the many components of the project for public audience, including a range of content not included in Shell's permit applications. In January 2018, FracTracker also obtained copies of Shell's permit applications from the PA DEP through file review to compare its work. tive

Sunoco's controversial Mariner East pipeline illustrates why is this data is so important. The DEP released GIS data for that project under public pressure and only very late in the review process, but it

has since proved crucial - such as in helping residents locate more than a hundred drilling mud spills that have led to permit suspensions.[1] It also supported the education of parents about the 40 schools that lie within the pipeline's blast zone, leading to multiple townships coming out against the project.[2] These risks must be weighed in public forum long before permits are approved and construction crews arrive.

However, in general, the public is given few real opportunities to influence how pipelines are constructed. Part of the problem is that the DEP maintains antiquated views on how the public wants to engage with the permitting process. For instance, citizens have the desire to review geospatial data on proposed pipelines. While operators must submit maps and analysis to the DEP, they are not required to provide the underlying data used to produce those maps. As a result, the public has only weeks to stitch together paper-based maps and scattered spreadsheets in order to understand the scope of the project before the close of narrow 30-day public comment windows. Independent proactive assessments by concerned citizens are nearly impossible.

The Falcon Public EIA Project was built on these lessons. It offered a detailed review of the pipeline far enough in advance for people to comprehend its complexities. It enables more informed engagements with the regulatory process. Ultimately, the project serves as a model for how data transparency ought to be done by the DEP. The findings presented in the remainder of this document come from the Falcon Public EIA's contents.

3. Water Resource Impacts and Geological Concerns

3.1. Stream Impacts

According to Shell's survey data, engineers identified and/or surveyed a total of 993 stream sections in planning for the Falcon's construction. According to Shell's data, the pipeline's workspace and access roads will directly intersect 319 of these streams with the following classifications: perennial (96), ephemeral (79), and intermittent (114). An additional 361 streams are located only 500ft from construction areas. A number of these streams have special designations, which is of great concern. For instance, we found ten Pennsylvania waterways listed as Trout Stocked (TS), and three listed as Cold Water Fishes (CWF).

3.1.1. Ambridge / Service Creek watershed

We noted a number of locations of exceptional risk where the Falcon will cross the commonwealth's waters, such as in the headwaters of the Ambridge / Service Creek watershed (Figure 1). the Falcon will cross tributaries to the Service Creek watershed 13 times. These feed into three High Quality Cold Water Fishes (HQ/CWF) headwater streams of the Ambridge Reservoir in Beaver County, PA, shown in the image below. They also support the endangered Southern Redbelly Dace.

[1] https://www.fractracker.org/2018/03/me2-spills-sinkholes/

[2] https://www.fractracker.org/2016/12/me2-schools-populations/

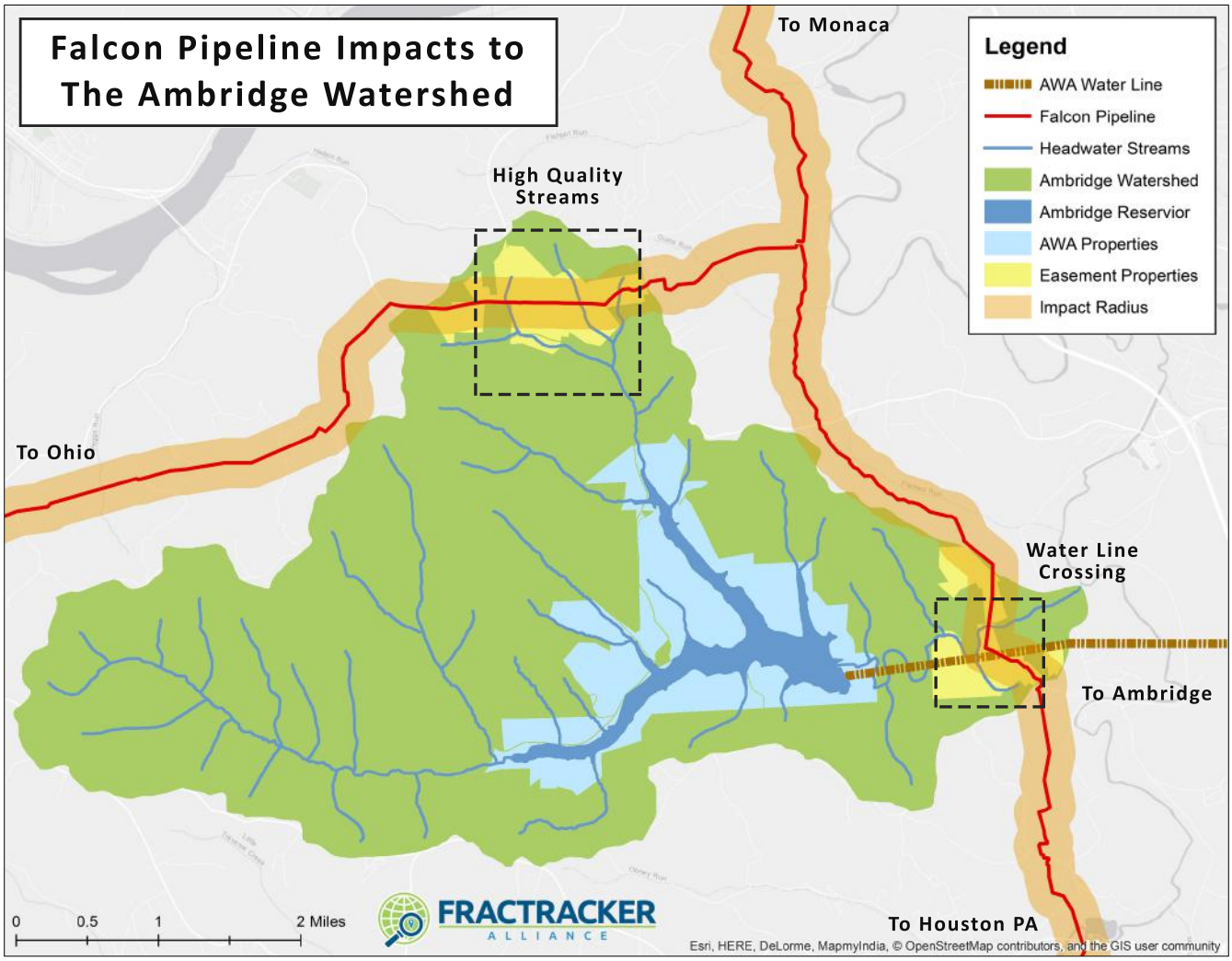

Figure 1: Proposed Falcon Pipeline route through the Ambridge / Service Creek watershed

On the eastern edge of the watershed, the Falcon will cross the raw water line leading out of the reservoir. The reservoir supplies 6.5 million gallons of water a day to five townships in Beaver County (Ambridge, Baden, Economy, Harmony, and New Sewickley) and four townships in Allegheny County (Leet, Leetsdale, Bell Acres and Edgeworth). This includes drinking water services to 30,000 people, which is a great concern to those who live in these townships. The Ambridge Water Authority has also spoken in opposition to the project, stating the additional concern that, if service were disrupted, these customers would have only 32 hours of backup water supply with no other sources available. These discoveries and statements highlight why the DEP must require Shell seek alternate routes around the watershed and in avoidance of the raw water line.

3.2. Wetland Impacts

Shell identified a total of 682 wetland features relevant to Falcon's construction, as well as 6 ponds. Of these, the pipeline's workspace and access roads will directly intersect 174 wetlands with the following classifications: PEM (141), PSS (13), PFO (7), PUB (10), POW (3). An additional 470 of these wetlands,

plus the 6 ponds, are located only 500ft from construction areas. A few wetland locations stand out as problematic in Shell's construction plans.

3.2.1 Lower Raccoon Creek

Wetlands that drain into Raccoon Creek in Beaver County will be particularly vulnerable in two locations. The first is in Potter Township, where the Falcon will run along a wooded ridge populated by half a dozen perennial and intermittent streams that lead directly to a wetland of approximately 14 acres in size. Complicating erosion control further, Shell's survey data shows that this ridge is susceptible to landslides, shown in Figure 2.

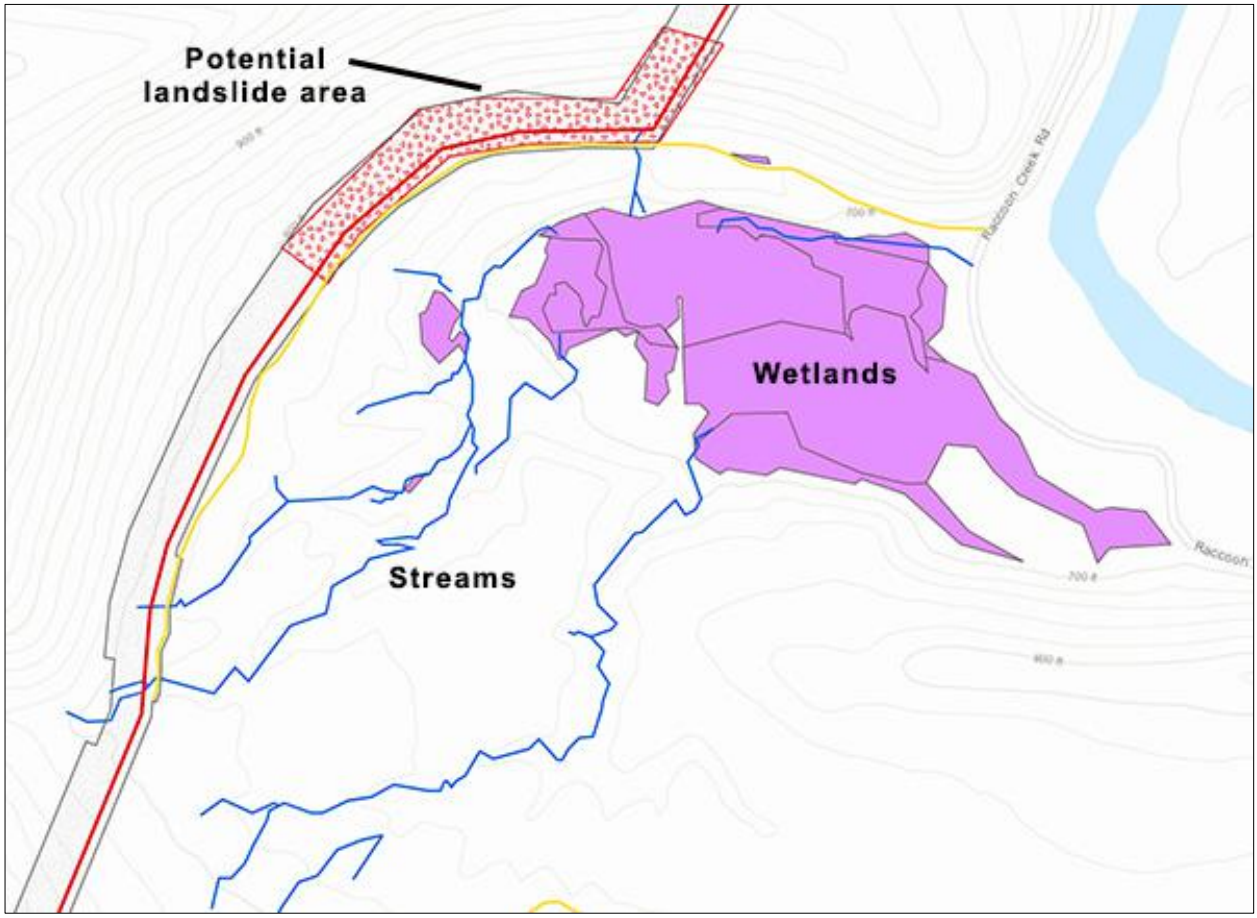

Figure 2: Landslide areas along Lower Raccoon Creek (Shell data)

This area is also characterized by the USGS as having a "high hazard" area for soil erosion, as seen in Figure 3. As such, this area deserves additional scrutiny as a site of potential construction failures and not appropriate for the proposed right-of-way execution.

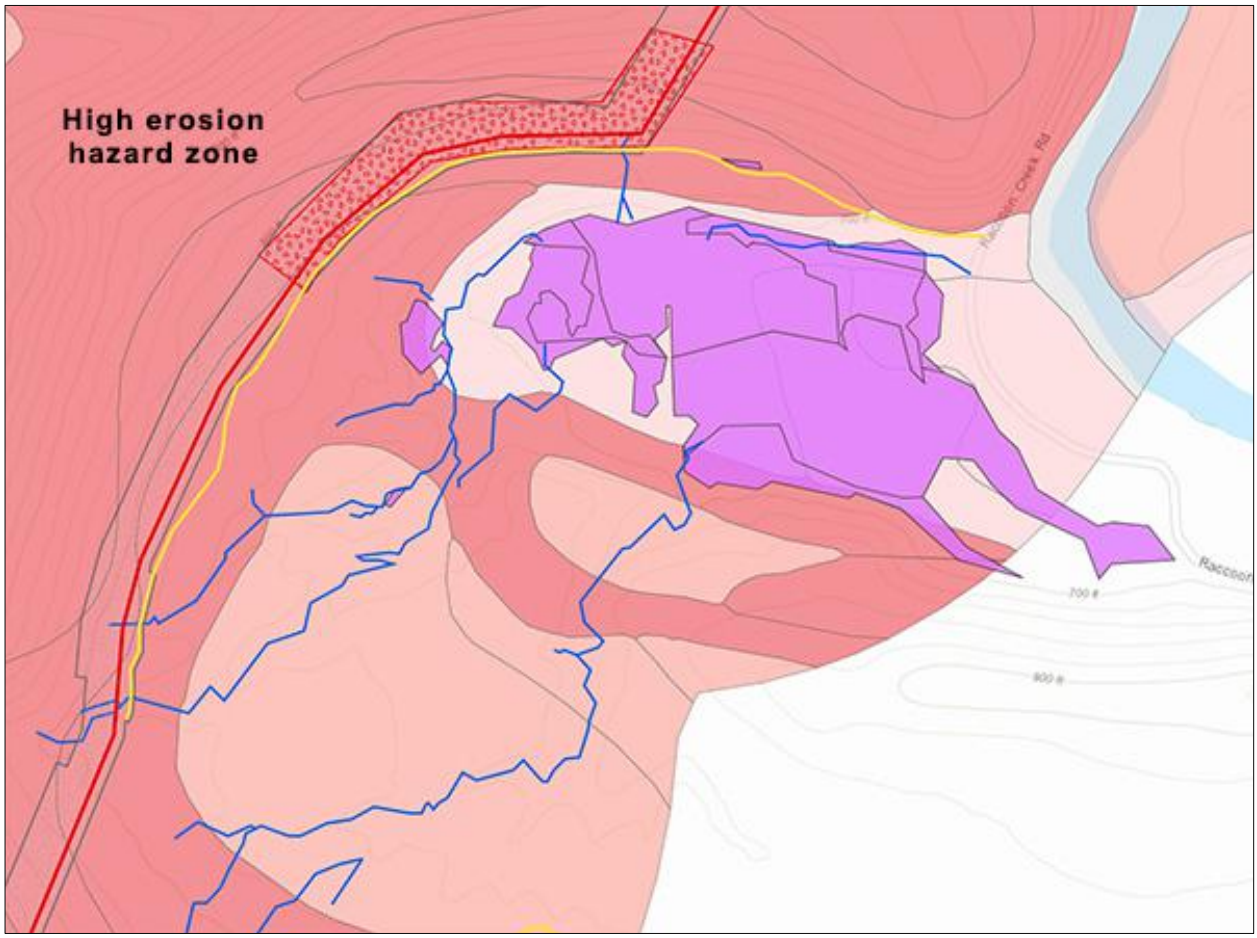

Figure 3: High erosion hazard zones along Lower Raccoon Creek (USGS data)

3.2.2 Independence Marsh

The other wetland area of concern along Raccoon Creek is found in Independence Township. Here, the Falcon will go under the Creek using an HDD (Figure 4). Nevertheless, the workspace needed to execute the HDD crossing is within the designated wetland itself, highlighted in purple.

It is concerning that the permit applications mention this crossing as the only viable option: "*Due to the location of Raccoon Creek, an UNT to Raccoon Creek (S-PA-151013-MRK-002), the entrance to the Beaver Creek Conservation District and the Conservation District buildings themselves, this was the only suitable location for a borepit. The borepit is narrowed as much as possible to minimize impact. This wetland was crossed at the narrowest location possible.*" It is highly unusual to place the staging pad for the horizontal boring directly on top of a documented wetland.

Furthermore, an additional 15 acres of wetland lie only 300ft east of the crossing but are not mentioned in Shell's permit applications. This unidentified wetland is called Independence Marsh, considered of great importance to the Independence Conservancy's watershed stewardship program. The marsh is only referred to as an unnamed tributary. Finally, this crossing is particularly troubling given the landowner allowing the easement is the Beaver County Conservation District, a steward of publicly-owned land. For these many reasons, The HDD should not be allowed at this site.

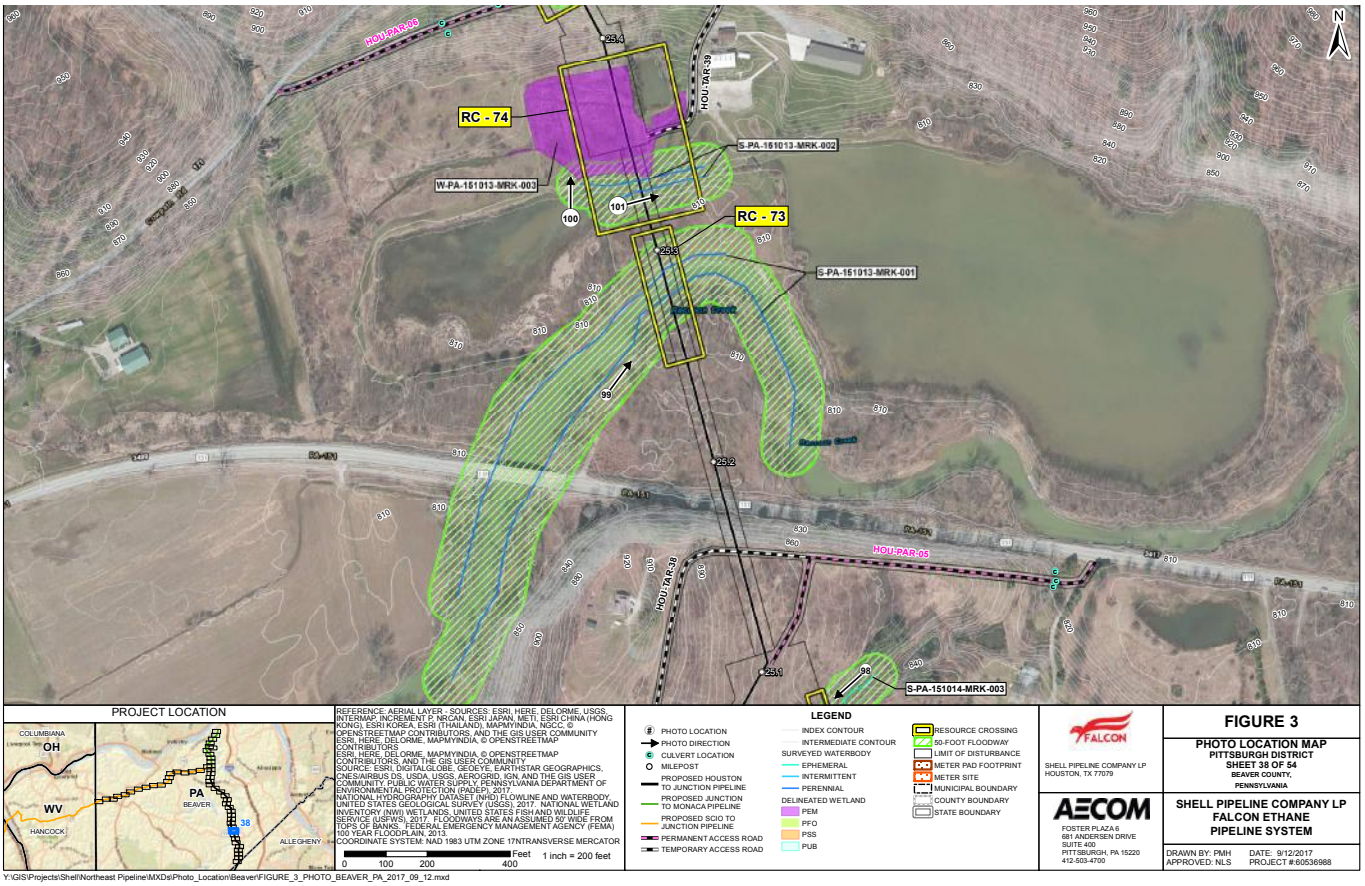

Figure 4: Falcon HDD crossing of Raccoon Creek at Independence Marsh (Beaver County JPA pg.214)

3.3. Karst Limestone and Inadvertent Returns

Karst landscapes are known for containing sinkholes, caves, springs, and surface water streams that weave in and out of underground tunnels. Limestone formations are where we are most likely to see karst landscapes along the Falcon's route. FracTracker's analysis found that more than 25 of the Falcon's 97 pipeline miles will be laid within karst landscapes, all of which are in located in Pennsylvania, including under multiple proposed HDD sites (Figure 5).

The DEP should be very familiar with the risks of HDDs in karst formations. The DEP has cited Sunoco Pipeline for 33 violations in constructing their Mariner East 2 pipeline in the last year, many of which were due to karst-related IRs and sinkholes impacting waterways and private groundwater wells. As part of DEP's recent settlement with Sunoco, 64 of their HDD sites are under additional review. Sunoco must furthermore notify 17 residents within 450ft of an HDD site, and 22 residents within 150ft of other sites prior to recommencing construction.[3]

[3] https://www.fractracker.org/2018/03/me2-spills-sinkholes/

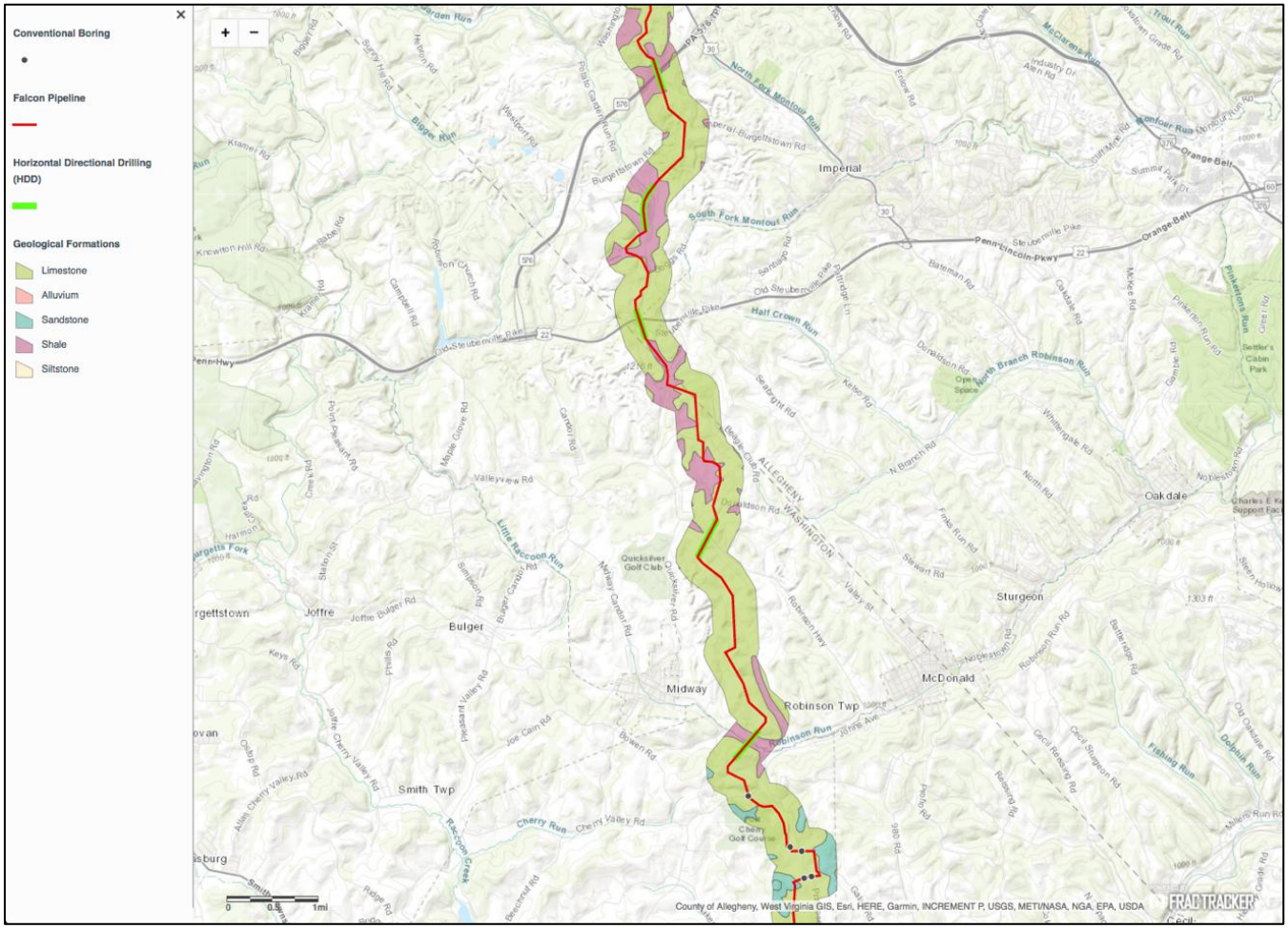

Figure 5: Multiple HDD sites in Allegheny/Washington County limestone formations (in green)

No technical engineering diagrams pertaining to HDDs were supplied by Shell in their permit applications. No detailed assessments of the Falcon's risks relative to karst are highlighted in the applications, nor were geophysical study data provided for HDDs. Despite this, Shell identified in their internal risk assessment 240 private water wells within 1/4 mile of the Falcon across the three states. In Pennsylvania, this data is maintained by the PA Department of Natural Resources as part of their Ground Water Inventory System (GWIS), known by the agency to account for less than half of likely wells in the Commonwealth.

All drinking water wells that exist in proximity to the pipeline in Pennsylvania should be assessed for their level of risk beyond Shell's relying on the deficient GWIS as their source. Furthermore, a subset of wells nearest to HDD sites deserve particular attention. Shell's internal data highlights 24 wells of the GWIS data that are within 1,000 feet of a proposed HDD site, 20 of which are located in Pennsylvania. Shell must be required by the DEP to provide pre- and post-construction water testing to well owners. Figure 6, below, shows those wells within 1,000 feet to an HDD sites in Beaver County, circled in blue.

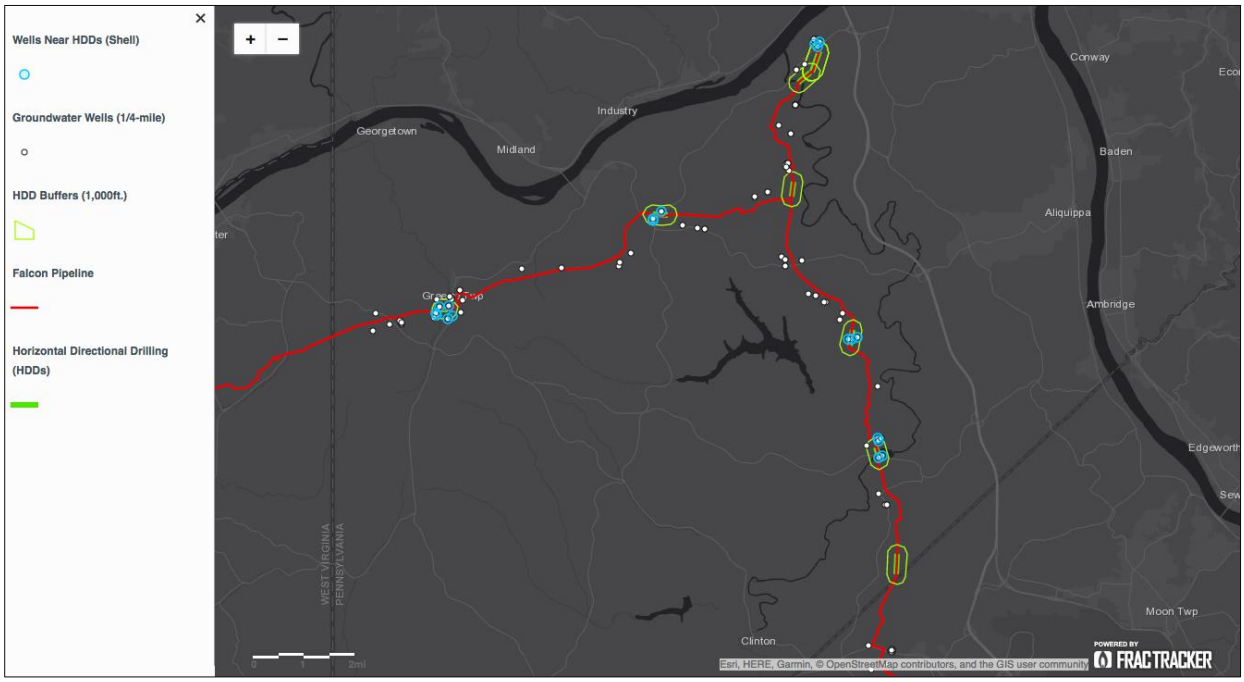

Figure 6: Beaver County groundwater wells, those within 1,000ft of HDD in blue.

3.4 Mined lands

Across three states, the Falcon pipeline intersects 20 miles of under-mined areas and 18 miles of surface-mined areas. More than half of these miles are located in the Commonwealth of Pennsylvania, such as areas of Allegheny and Washington counties, seen in the image below (Figure 7).

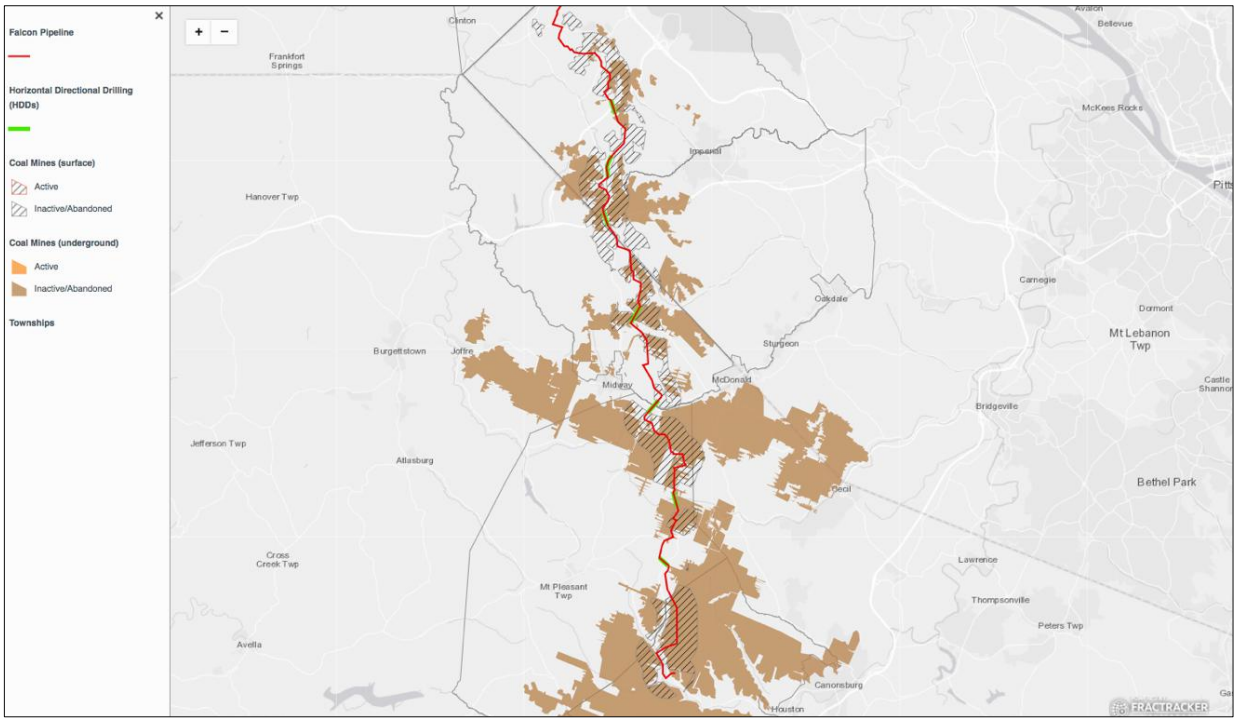

Figure 7: Falcon intersections with mined areas in Allegheny and Washington County.

3.4.1. Coal Slurry Site, Imperial PA

Shell's application notes that one proposed HDD ("HOU-06") will cross a coal waste site identified in the permits as "Imperial Land Coal Slurry" along with a large Palustrine Emergent (PEM) wetland along Potato Garden Run, seen below in Figure 8. AECOM did survey work along Potato Garden Run in Imperial PA due to concerns about undermined areas near proposed HDD sites. They concluded that "the majority of rock encountered was shale, sandstone, limestone, and claystone." In addition, a 2003 DEP report commented on this region, stating:

> All of the coal has been underground mined. Most of the coal ribs and stumps (remnants from the abandoned underground mine) have been surface mined… The extensive deep mining, which took place from the 1920's through the 1950's, has had a severe effect on groundwater and surface water in this watershed.[4]

The compounded risk in this area of known AMD sites, a coal slurry impoundment, and identified limestone formations is cause for concern. The DEP should rule this area inappropriate for the pipeline's right-of-way or any HDD execution.

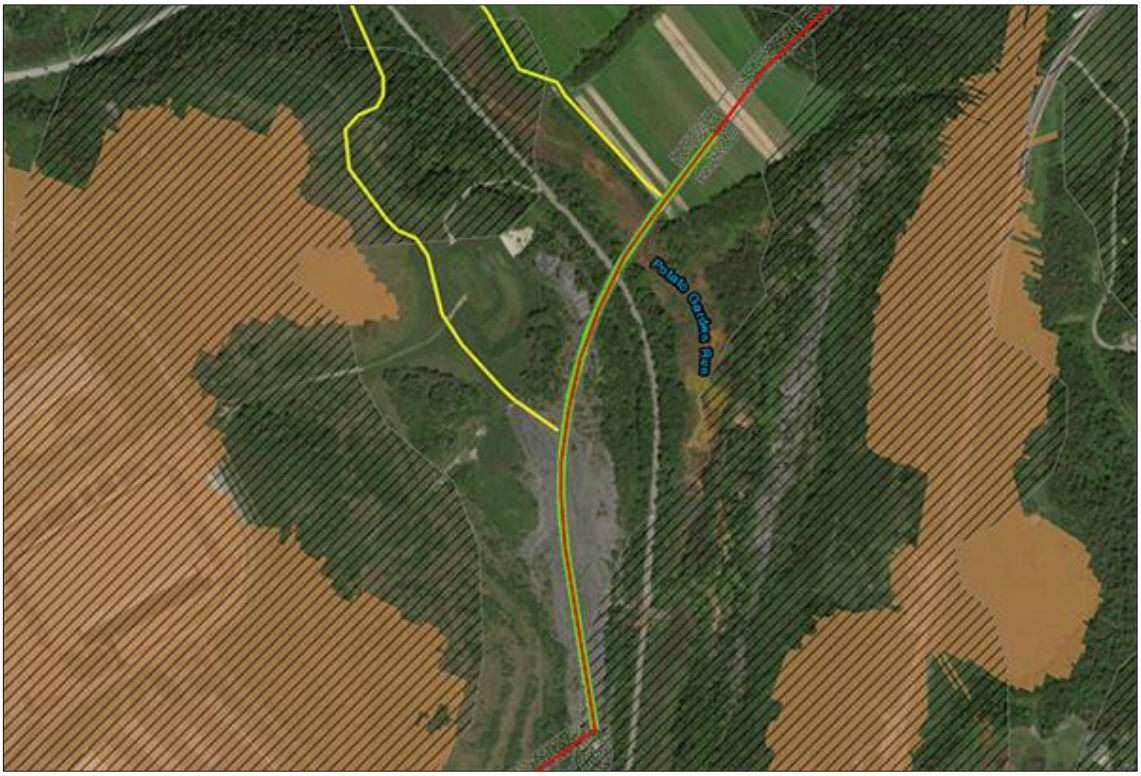

Figure 8: Proposed HDD execution (HOU-06) at Potato Garden Run / Imperial Coal Slurry Site

[4] http://www.dep.state.pa.us/dep/deputate/watermgt/wqp/wqstandards/tmdl/potatogardenrun_tmdl.pdf

3.4.2. Beaver Valley Mine

The Beaver Valley Mine in Greene Township, PA, appeared to be of particular importance in Shell's analysis. Of the three active mines intersected by the Falcon along its route, Shell maintained an active data layer in their GIS files with the mine's underground cell map for reference in selecting routes, as seen in Figure 9 below. The current route changed since the map was originally digitized, indicating that a shift was made to accommodate areas around the mine, but the current route is still a risky option considering known issues of subsidence in mined areas. The DEP should assess alternate routes around this area.

Figure 9: Shell's digitized map of Beaver Valley Mine

4. Ecological Impacts

Shell's permit applications detail extensive correspondences over a number of years — as early as August 2015 — with the U.S. Fish and Wildlife Service (USFWS), Pennsylvania Game Commission (PGC), Pennsylvania Fish and Boat Commission (PFBC), Pennsylvania Department of Conservation and Natural Resources (DCNR), among other agencies. These interactions tell a story of locating the pipeline near a number of threatened flowers, birds of prey, aquatic species, and bats.

4.1. Rare Botanicals

In their correspondences with state agencies, Shell was notified that a number of important species would likely be found in these habitats. For instance, Pennsylvania Department of Conservation and Natural Resources (DCNR) noted the following botanical species on their watch list would be present:

- Vase-vine Leather-flower (endangered): documented in floodplain and slopes of Raccoon Creek
- Harbinger-of-spring (rare): documented in forested floodplain of Raccoon Creek
- White Trout-lily (rare): documented in forested floodplain of Raccoon Creek
- Purple Rocket (endangered): documented in forested floodplain of Raccoon Creek
- Declined Trillium (threatened): documented along wooded tributaries and slopes of Raccoon Creek
- Snow Trillium (rare): documented in tributary ravines along Raccoon Creek

DCNR requested a survey of the Falcon's route through all of Beaver County and the portion of Allegheny County north of the western fork of Raredon Run. AECOM, Shell's contractor for this work, surveyed a 300-foot wide buffer along the pipeline route to allow for "minor alignment shifts" as construction plans are refined.

A final survey report was submitted to DCNR in March 2017. In it, AECOM noted having found multiple populations of Harbinger-of-spring, Purple Rocket, as well as Climbing Fern (Lygodium palmatum), also on the PA Watch List. DCNR's response to the survey stated that route changes and plans to bore under Raccoon Creek using HDDs eliminated risks to Harbinger-of-spring and Purple Rocket, however we are doubtful HDDs will eliminate these impacts given the extent of surface disturbances involved in establishing staging areas. Shell should be required to do additional studies prior to executing right-of-ways to identify and relocate sensitive botanical species.

4.2. Federally Protected Bats

The USFWS notified Shell that the Falcon is located within the range of federally protected Indiana Bats and Northern Long-eared Bats in Pennsylvania and West Virginia and requested Shell conduct a bat "mist net" study. AECOM's bat survey was conducted from April-July 2016. While bats are known to live in caves and abandoned mines in winter, the study focused only on summer habitats — mainly forests that support roost trees, with the assumption that that tree clearing would be the most likely impact.

A total of 274 bats from 6 different species were captured in the study, included 190 Big Brown Bats, 2 Silver-haired Bats, 62 Eastern Red Bats, 2 Hoary Bats, and 1 Little Brown Bat. Seventeen (17) Northern Long-eared Bats were found at 13 of the MNL sites, but no Indiana Bats were captured. Radio transmitters were then attached to the Northern Long-eared Bats in order to follow them to roost trees. A total of 9 roost trees were located, with the nearest roost tree located 318 feet from the pipeline's workspace.

In January 2018, USFWS stated that, because the Falcon's construction area is not within 150 feet of a known roost tree during breeding season or within a 1/4 mile of a known year-round hibernation site, that "incidental take that might result from tree removal is not prohibited." However, USFWS also

stated that “Due to the presence of several Northern Long-eared Bat roost trees within the vicinity of the project footprint (although outside of the 150-foot buffer), we recommend the following voluntary conservation measure: No tree removal between June 1 and July 31.”

There are a number of possible gaps in AECOM’s study that need attention. First, the Falcon study does not satisfy the USFWS’s requirement of not causing disturbances “within a 1/4 mile of a known year-round hibernation site,” as the study as it did not identify winter habitat sites. This is a technical deficiency that must be corrected by a more comprehensive year-round study. Second, PGC noted in early correspondences that Silver-haired Bats may be in the region (a PA species of special concern). This was confirmed in AECOM’s mist net study, but PGC did not require a further study for the species. Third, numerous bat roost trees were found just outside the study area. The study notes the nearest roost tree to the Falcon’s workspace is 318 feet. However, as seen in Figure 10 below, a larger cluster of five roost trees are all within 750 feet of the pipeline’s workspace in Raccoon Township. Tree clearing in this area will be extensive, considering its proximity to the Falcon’s juncture point that also must accommodate a metering pad and access roads.

These omissions are noteworthy given the already significant stressors experienced by bat populations in the region. As such, we believe the bat study is technically deficient and does not account for the full impact that will occur to protected bat species.

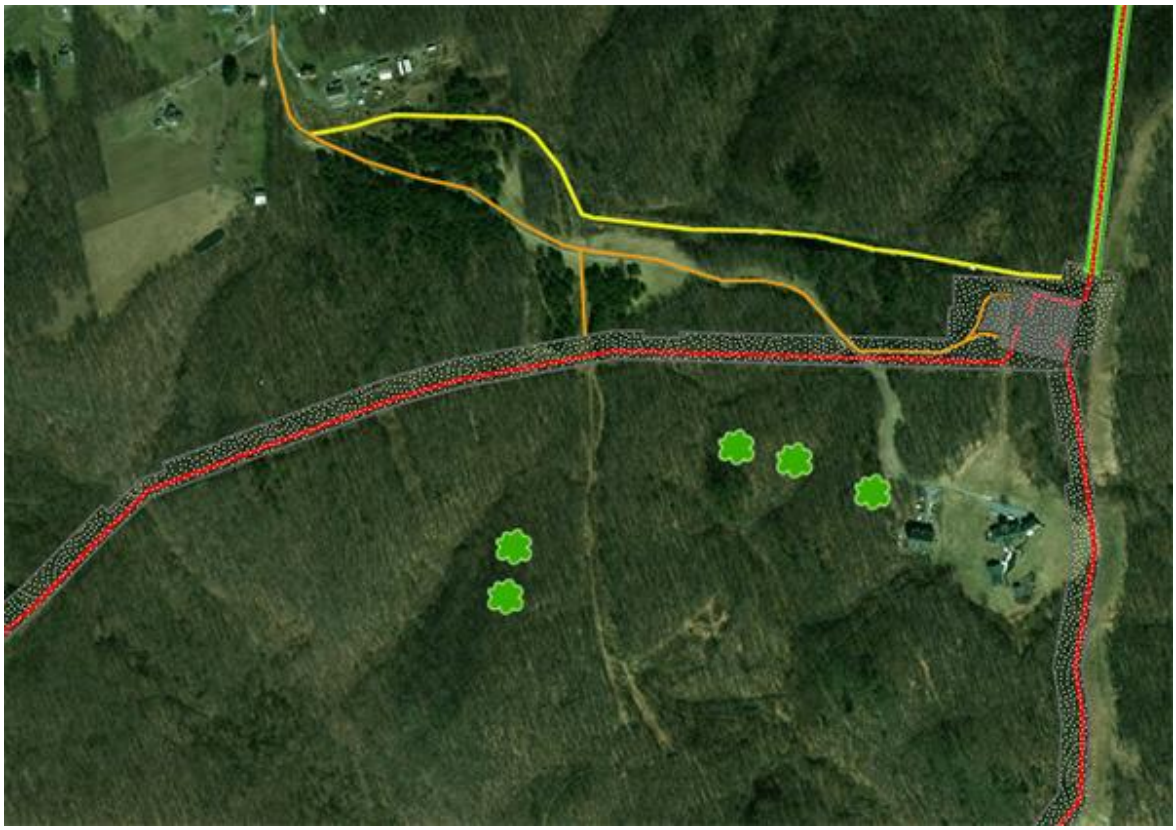

Figure 10: A dense cluster of bat roosting trees

4.3. Short-eared Owls and Northern Harriers

Shell notified the Pennsylvania Game Commission (PGC) that portions of the Falcon's workspace would be located near six areas with known occurrences of Short-eared Owls (PA endangered species) and Northern Harriers (PA threatened species). PGC requested a study of these areas to identify breeding and nesting locations, which AECOM executed from April-July 2016 within a 1,000-foot buffer of the pipeline's workspace (limited to land cover areas consisting of meadows and pasture). One Short-eared Owl observation and 67 Northern Harrier observations were recorded, but some of these harriers appeared to be nesting just outside the study area. The study area is visible in Figure 11 below.

Figure 11: Shell's Owl and Harrier study areas (in purple)

In February 2017, Shell notified PGC that a number of reroutes had occurred that would shift the Falcon pipeline away from a subset of the observed Northern Harrier habitat. Although, there is no mention in the permit applications about identifying potential nest locations in these neighboring areas where AECOM's biologists observed additional harriers. Nevertheless, PGC's final determination in August 2017 approved the project, stipulating that, "based on the unusually high number of observations at these locations" work should not be done in these areas during harrier breeding season, April 15 through August 31. We believe this is a deficiency in the study, as Shell failed to fully account for how reroutes will impact the Harrier's habitat. Additional habitat studies should be done to determine these new risks.

4.4. Freshwater Mussels

The USFWS and PGC identified very early in the Shell's construction plans that the project would likely impact four endangered mussel species: The Northern Riffelshell, Clubshell, Rayed Bean, and the Snuffbox. AECOM conducted a survey in May 2016, at the request of Pennsylvania and Ohio agencies, at 16 perennial streams along the route in those two states. In PA, mussels were found to be present at both of the Falcon's intersections with Raccoon Creek. Shell's applications argue these waters will not be impacted due to the fact that they would be crossing using HDD boring, but we are doubtful of these claims due to the risks of executing HDDs without pre-drilling geotechnical surveys. Furthermore, any HDDs executed at these sites should be preceded by relocating any endangered mussel species prior to construction in event of impacts due to inadvertent returns.

4.5. Coldwater Fish

The PA Fish and Boat Commission notified Shell that the Falcon may impact the Southern Redbelly Dace. This threatened species is especially vulnerable to physical and chemical (turbidity, temperature) changes to their environment. PAFB explicitly notes in their correspondences that "we are concerned about potential impacts to the fish, eggs and the hatching fry from any in-stream work." Of note is that these sites of concern are located in HQ/CWF streams of the Service Creek watershed.

Early correspondences with PFBC show the agency requesting that directional boring be used for these stream crossings or, if work necessitated direct impacts (such as open-cut crossings), that these activities be avoided during the spawning season. Shell responded to the request in stating that, with the exception of lower Service Creek, which will be crossed by HDD, the terrain surrounding its headwater streams was not suitable for boring and would thus require open-cuts. PFBC's final determination on these matters is that they generally agreed, with the exception of the HDD site and one headwater stream (S-PA-151104-MRK-001), that all other crossings must adhere to seasonal restrictions with no in-stream activity being conducted between May 1-July 31. However, we believe that all of Service Creek watershed including its headwaters should be avoided due to concerns for protecting the Ambridge Reservoir, as well as due to the additional concerns for protected aquatic species.

5. Risk Assessments

The National Environmental Policy Act (NEPA) requires federal agencies prepare an Environmental Impact Statement (EIS) to investigate how the pipelines they get involved in pertain to things like the Clean Water Act, the Endangered Species Act, the National Historic Preservation Act. However, for the Falcon pipeline, there is limited federal oversight due to the fact that natural gas liquid (NGL) pipelines are not jurisdictional to the Federal Energy Regulatory Commission (FERC). As such, the Falcon will not undergo a full environmental impact assessment (EIA).

While different state agencies noted above have given their blessing for the project, the extent to which permits are required to proceed are limited to DEP Chapter 102 and 105 permits for sedimentation, erosion control, and waterways crossings. It is our position that this limited review of

potential risks is a failure on the part of the Commonwealth in ensuring the public safety and environmental protections. This final section highlights Shell's risk analysis—much of which did not make it into their permit applications to the DEP—that should be accounted for in the DEP's review of the Falcon. Shell's internal risk analysis was done in two parts. The first was to determine Class Locations along the pipeline's route, the other to determine High Consequence Areas (HCAs). FracTracker duplicated these analyses and summarized our findings below.

5.1. Class Locations Analysis

Pipeline "Class locations" determine certain aspects of how a pipeline is constructed. Essentially, a pipeline's route is segmented into lengths that are each given different classifications as outlined in PHMSA guidelines. In general terms, a segment's Class is established by first calculating a buffer that extends 220 yards (660ft) on either side of the pipeline's center in 1-mile continuous lengths. This buffer area is then analyzed for how many building structures are present. Classes are then assigned to each 1-mile segment using the follow criteria:

- Class 1: a segment with 10 or fewer buildings intended for human occupancy
- Class 2: a segment with more than 10, but less than 46 buildings intended for human occupancy
- Class 3: a segment with 46 or more buildings intended for human occupancy, or where the pipeline lies within 100 yards of any building, or small well-defined outside area occupied by 20 or more people on at least 5 days a week for 10 weeks in any 12-month period (i.e. schools, businesses, recreation areas, churches)
- Class 4: a segment where buildings with four or more stories aboveground are prevalent

By replicating the 600-foot buffer from the Falcon's centerline (used as the standard distance for determining Class Locations) we found that, across the three states in which the pipeline travels, 67% of the Falcon route will qualify as Class 1, 27% as Class 2, and 3% as Class 3.

5.1.1. Residential Structures

In total, there are 557 single family residences, 20 businesses, and a church within the 660ft buffer across the three states. Shell's data also identify non-occupied structures along the route, such as sheds, garages, and other outbuildings. There are 535 such structures, but we did not have the time to replicate the locations of these sites. It is also important to note that the points on our interactive map represent only those identified by Shell, which we believe is an incomplete assessment of occupied structures based on our quick review of satellite maps. Three residential structures lie directly within the 50-foot right-of-way. One of these homes, located in a Class 2 segment in Independence Township. The Falcon will come as close as 20 feet to the edge of the structure and surround the home on three sides.

Figure 12: Class 3 (orange) near Raccoon Township structures and Municipal Park (purple)

Neighborhoods in the following three Pennsylvania communities were identified by Shell to be within Class 3 locations. These would be considered the most "at risk" areas along the route in terms of proximity to the number of occupied structures. Above is a satellite view of the Class 3 section of Raccoon Township.

- Raccoon Township, Beaver County PA
- Independence Township, Beaver County PA
- Mount Pleasant Township, Washington County PA

5.1.2. Maronda Farms Housing Developments

One discovery worth noting in our recreation of Shell's Class Location analysis is that the Falcon will run straight through a large luxury housing development being built in Clinton, Allegheny County, PA. Shell mentions this development in their permit applications, stating:

> Maronda Homes is in the planning and design stage of a very large housing development and SPLC [Shell Pipeline LC] worked closely with the developer and the Project was rerouted to avoid most of the housing sites.

Shell maintained in their internal GIS data a partial copy of the development's lot lines. FracTracker used this in combination with additional lot line diagrams obtained from the developer's website to reconstruct a full layout of how the Falcon will cut through Maronda Farms, seen in Figure 13 below.

Investigations by the Pittsburgh Post-Gazette and FracTracker found that residents in this development were not notified about Maronda Homes's agreement with Shell prior to purchasing their homes.[5] Maronda Homes negotiated easements with Shell for a total of $675,000, then subdivided two large parcels into smaller lots for sale. This is an egregious omission on the part of Maronda Homes and Shell, which must be rectified prior to approving any right-of-way through this neighborhood.

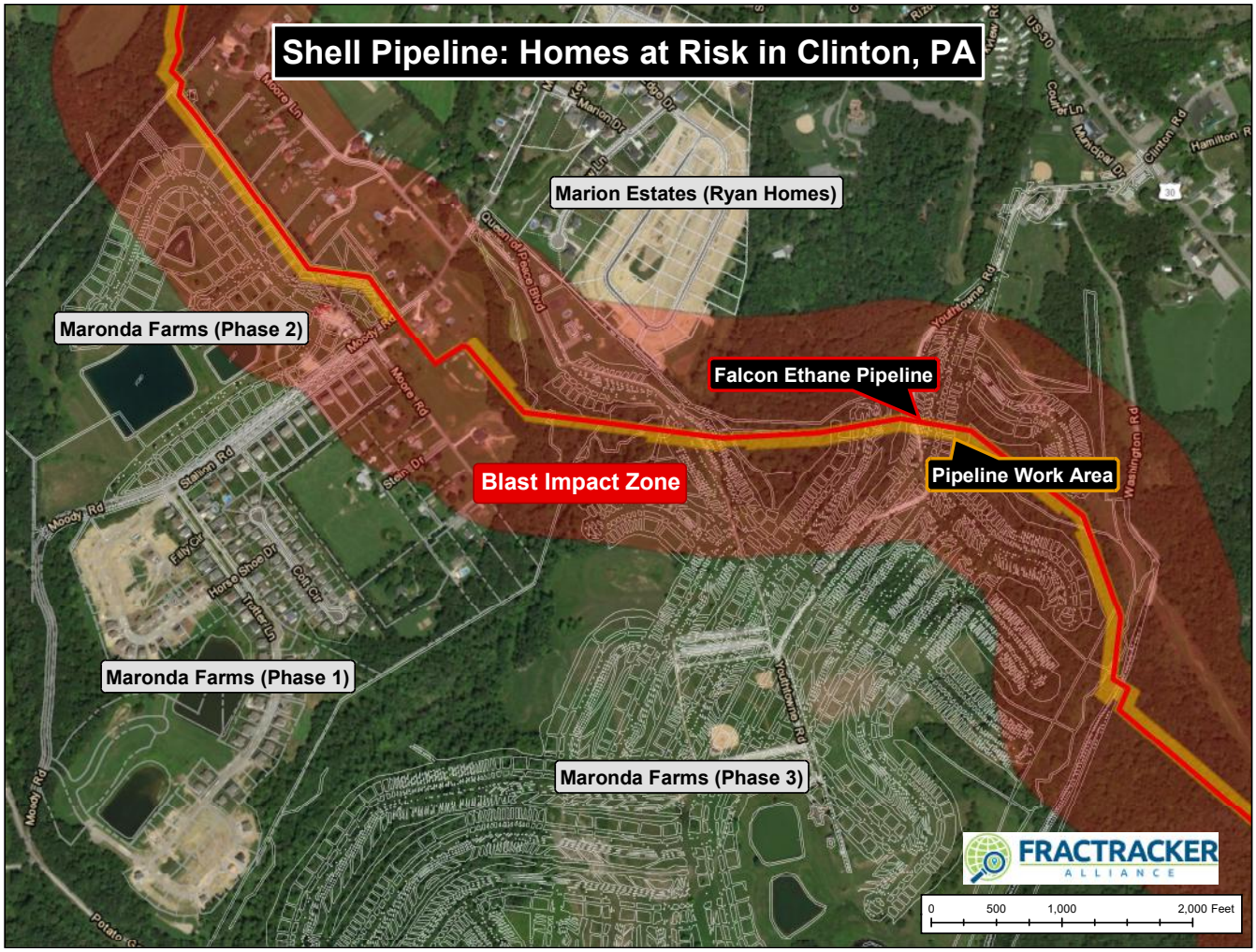

Figure 13: Maronda Farms development relative to the Falcon (and its potential blast zone)

Concerns about disclosure in this community are compounded by the fact these same parcels were found by FracTracker to have been leased by Maronda Homes for future oil and gas drilling prior to sectioning off plots for sale.[6] New homeowners are, thus, also unknowing victims of split-estate, amplifying their level of risk.

[5] http://powersource.post-gazette.com/

[6] https://www.fractracker.org/projects/lease-mapping/

There are no setback restrictions for building new homes in proximity to a pipeline. Parcels will eventually be sectioned off and sold to home buyers, begging the question of whether or not people in this community will realize a hazardous liquid pipeline runs past their driveways and backyards. This is a dilemma that residents in a similar development in Firestone, Colorado, are now grappling with following a recent pipeline explosion that killed two people, seen in Figure 14 below, due to inadequate building setbacks.

We suggest that DEP not allow Shell to route the Falcon through the Maronda Homes area because of the lack of transparency that led to agreements. We argue this position because this area, once fully developed and highly populated, will create an extreme hazard to public safety beyond acceptable risk.

Figure 14: A pipeline explodes in a Colorado home development (source: InsideEnergy, CO)

5.2. High Consequence Area Analysis

High Consequence Areas (HCAs) designate when operators must implement integrity management programs (IMP) where pipeline failures could cause major impacts to populated areas, as well as drinking water systems and ecological resources — otherwise defined as unusually sensitive areas (USAs).

Two considerations are used when determining pipeline proximity to population centers:

- High Population Areas – an urbanized area delineated by the Census Bureau as having 50,000 or more people and a population density of at least 1,000 people per square mile; and
- Other Populated Areas – a Census Bureau designated “place” that contains a concentrated population, such as an incorporated or unincorporated city, town, village, or other designated residential or commercial area – including work camps.

PHMSA’s definition of drinking water USAs include things such as:

- Community Water Systems (CWS) – serving at least 15 service connections and at least 25 year-round residents
- Non-transient Non-community Water Systems (NTNCWS) – schools, businesses, and hospitals with their own water supplies
- Source Water Protection Areas (SWPA) for a CWS or a NTNCWS
- Wellhead Protection Areas (WHPA)
- Sole-source karst aquifer recharge areas

With the exception of sole-source aquifers, drinking water sources are only considered if they lack an alternative water source. However, PHMSA is strict on what alternative source means, stating that they must be immediately usable, of minimal financial impact, with equal water quality, and capable of supporting communities for at least one month for a surface water sources of water and at least six months for a groundwater sources. One important note in these "drinking water" USA designations is that they do not include privately owned groundwater wells used by residences or businesses.

Ecological resource USAs are established based on any number of qualities with different variations. In general terms, they contain imperiled, threatened, or endangered aquatic or terrestrial species; are known to have a concentration of migratory waterbirds; or are a "multi-species assemblage" area (where three or more of the above species can be found).

5.2.1. Calculating Falcon's HCAs (aka "Vapor Zone")

HCAs are calculated based on proximity. The first step in this process is to determine the pipeline's Potential Impact Radius (PIR) — the distance beyond which a person standing outdoors in the vicinity of a pipeline rupture and fire would have a 99% chance of survival; or in which death, injury, or significant property damage could occur. PIR is calculated based on the pipeline's maximum allowable operating pressure (MAOP), diameter, and the type of gas. In these definitions, "identified sites" include such things as playgrounds, recreational facilities, stadiums, churches, office buildings, community centers, hospitals, prisons, schools, and assisted-living facilities.

However, there is a notable difference in how HCAs are calculated for natural gas pipelines vs. hazardous liquid pipelines. Pipelines that contain gasses such as ethane potentially impact a much broader area, as vapors may flow over land or within a river, stream, lake, or by other means. A truly accurate HCA analysis for an ethane pipeline leak requires extensive atmospheric modeling for likely vapor dispersions. Thus, Shell's internal risk analysis uses an HCA radius of 1.25 miles, seen in Figure 15 below. FracTracker referred to this area as the Falcon's "vapor zone" in the Falcon Public EIA Project.

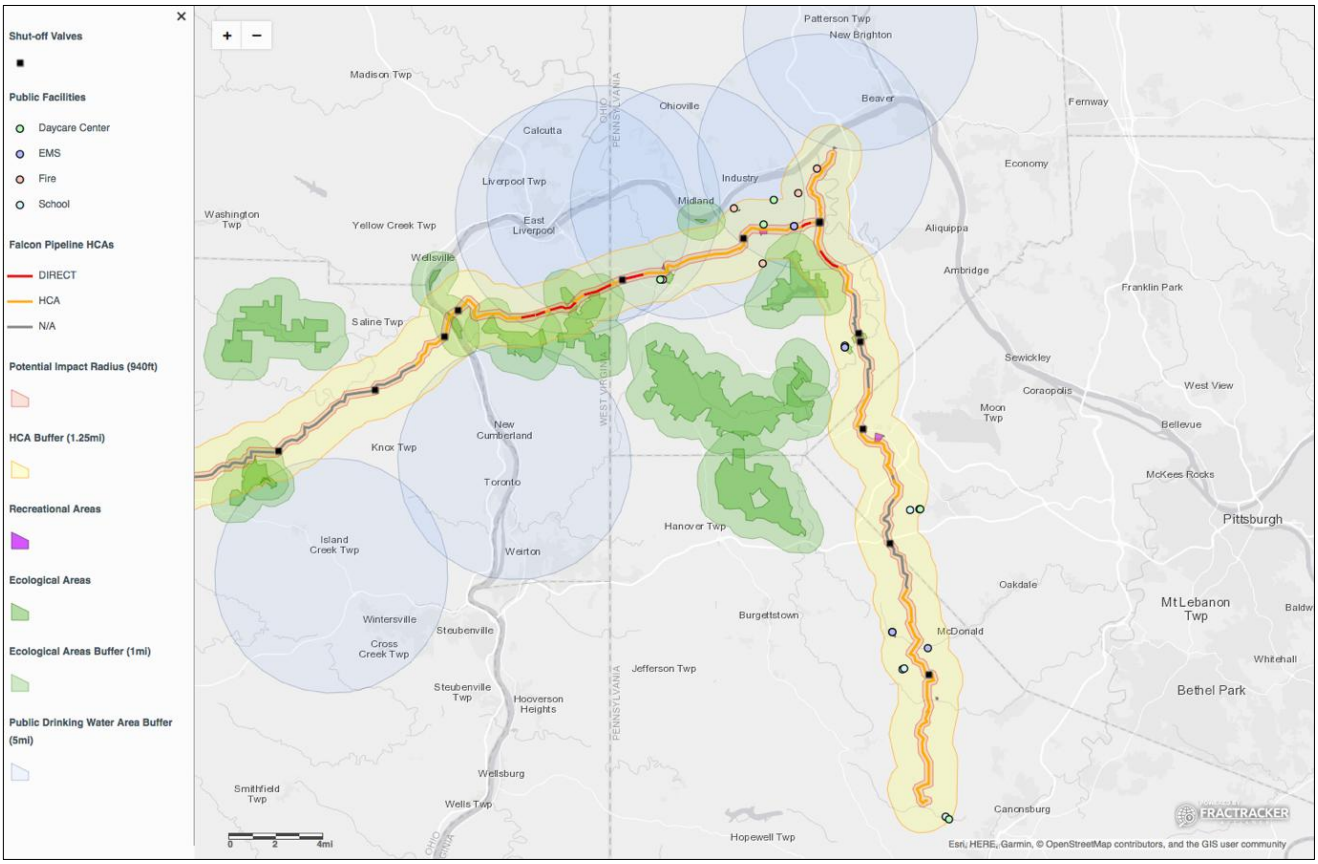

Figure 15: Drinking water and ecological areas in Shell's HCA analysis

5.3. Calculating the Potential Impact Radius (aka "Blast Zone")

Shell's permit applications state a number of different pipeline dimensions will be used throughout the project. Most of the Falcon will be built with 12-inch steel pipe, with two exceptions: 1) The segment running from the Cadiz, OH, separator facility to its junction with line running from Scio, OH, will be a 10-inch diameter pipe; and 2) 16-inch diameter pipe will be used from the junction of the Falcon's two main legs located four miles south of Monaca, PA, to its end destination at the ethane cracker. We also know from comments made by Shell in their public informational session held in Beaver County in March, 2018, that the Falcon's maximum allowable operating pressure (MOAP) will be 1,440 psi. These numbers allow us to calculate the Falcon's Potential Impact Radius (PIR).

PHMSA has a standad equation for calculating the PIR of a methane natural gas pipeline.[7] The PIR is established using the combustion energy and pipeline-specific fuel mass of methane to determine a blast radius: **PIR = 0.69*sqrt(p*d^2)**. Where: **PIR** = Potential Impact Radius (in feet), **p** = maximum allowable operating pressure (in pounds per square inch), **d** = nominal pipeline diameter (in inches), and **0.69** is a constant applicable to natural gas. Ethane, propane, butane, and methane have very similar combustion energies (about 50-55 MJ/kg). Therefore, the PIR equation can be updated for each NGL based on the mass density of the flow material as follows: **PIR = 0.69*sqrt(r*p*d^2)**. Where: **r** =

[7] https://primis.phmsa.dot.gov/gasimp/faqs.htm

the density ratio of hydrocarbons with similar combustion energy to methane natural gas. At 1,440 psi, methane remains a gas with a mass density 5 times less than liquid ethane at the same pressure.[8]

	Fluid Mass Density At 1,440psi (lb/ft^3)	Density Ration (R) vs. Methane at 1,440psi
Methane	5.10	1.00
Ethane	25.6	5.00
Propane	33.1	6.46
Butane	37.5	7.32

Table 1. Density relationships for methane, ethane, propane, and butane

Therefore, for the Falcon's 16" pipeline segments the PIR is about 940 feet. The PIR for 12" segments is about 700 feet. Note that Shell did not conduct a PIR analysis in their internal risk assessments, however FracTracker did do this analysis when publishing the Falcon Public EIA Project. We've termed these PIR risk areas as the Falcon's "blast zone" on our maps.[9]

5.4. HCA and PIR Risk Assessments

Shell's permit applications to the PA DEP state the pipeline:

> … is not located in or within 100 feet of a national, state, or local park, forest, or recreation area. It is not located in or within 100 feet of a national natural landmark, national wildlife refuge, or federal, state, local or private wildlife or plant sanctuaries, state game lands. It is also not located in or within 100 feet of a national wild or scenic river, the Commonwealth's Scenic Rivers System, or any areas designated as a Federal Wilderness Area. Additionally, there are no public water supplies located within the Project vicinity.

The statement above by Shell is a partial truth, as many such areas are located within the Falcon's HCA (vapor zone) and PIR (blast zone).

Within the HCA we find that 60 of the Falcon's 97 miles qualify as high consequence areas, with 35 miles triggered due to their proximity to drinking water sources, 25 miles trigger for proximity to populated areas, and 3 miles for proximity to ecological areas.

5.4.1. Populated Areas

Shell's HCA buffer intersects 14 US Census-designated populated areas. Falcon's right-of-way directly intersects two of these areas: Cadiz Village in Harrison County, Ohio, and Southview CDP (Census Designated Place) in Washington County, PA. Many public facilities were found inside the HCA buffer. These include 5 public schools, 6 daycare centers, 10 fire stations, and 6 EMS stations.

While it is difficult to determine the actual number of people living in the PIR and HCA vapor zone, there are ways one can estimate populations. In order to calculate the number of people who may live

[8] https://www.fractracker.org/2016/12/me2-schools-populations/

[9] https://www.fractracker.org/2018/01/falcon-hca/

within the HCA and PIR zones, we first identified U.S. Census blocks that intersect each respective buffer. Second, we calculated the percentage of that census block's area that lies within each buffer. Finally, we used the ratio of the two to determine the percentage of the block's population that lies within the buffer. Below are the population totals for the Pennsylvania segment of the Falcon's route.

PA Counties	PIR est. pop.	HCA est. pop.
Allegheny	186	969
Beaver	990	3,023
Washington	461	1,419
Total	**1,637**	**5,410**

Table 2. Populations at risk in PA by Potential Impact Radius (PIR) and High Consequence Areas (HCA)

5.4.2. Drinking Water Sources

Shell's data identified a number of drinking water features considered in their HCA analysis. Shell's metadata for this information show these sites were obtained from the Ohio Division of Drinking and Ground Waters, the West Virginia Source Water Assessment and Wellhead Protection Program, and the Pennsylvania DEP Wellhead Protection Program. The exact locations of public drinking water wells and intake points are generally protected by states for safety reasons so inaccessible to FracTracker during our analysis. However, we duplicated the 5-mile buffer zones around these features, as used on Shell's map around these points, denoting the boundaries of source water protection areas, wellhead protection areas, or intake points.

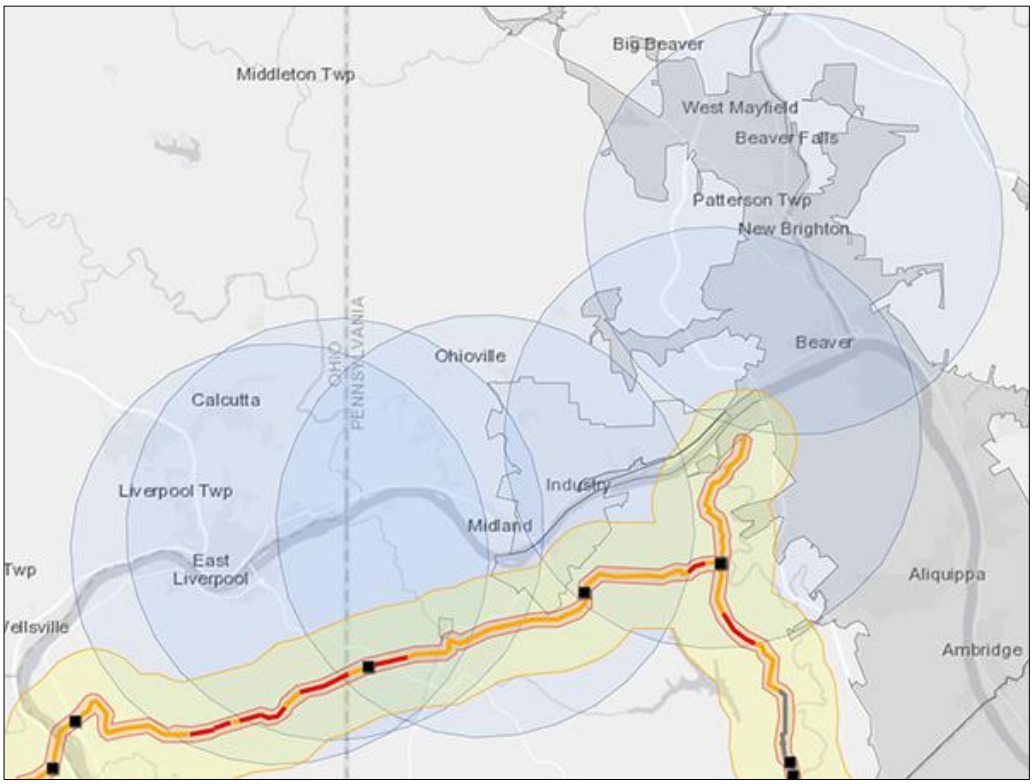

Figure 16: Beaver County drinking water USAs in Shell's HCA analysis

As shown in Figure 16 above, five of these areas serve communities in the northern portions of Beaver County. Recall that HCA drinking water analysis only requires consideration of groundwater wells and not surface waters. This is an important distinction, as the Ambridge Reservoir is within the HCA zone but was not part of Shell's drinking water portion of their HCA analysis.

5.4.3. Ecological Areas

Shell's permits state that they consulted with the U.S. Fish and Wildlife Service (USFWS), Pennsylvania Game Commission (PGC), Pennsylvania Fish and Boat Commission (PFBC), and the Pennsylvania Department of Conservation and Natural Resources (DCNR) on their intended route in order to determine potential risks to protected species and ecologically sensitive areas.

DCNR responded that the pipeline had the potential to impact six sensitive plant species: Vase-vine Leather-Flower, Harbinger-of-spring, White Trout-Lily, Purple Rocket, Declined Trillium, and Snow Trillium. PFBC responded that the project may impact the Southern Redbelly Dace, a threatened temperate freshwater fish, within the Service Creek watershed. PGC responded that the pipeline had potential impact to habitats used by the Short-Eared Owl, Northern Harrier, and Silver-Haired Bat. Finally, the USFWS noted the presence of freshwater mussels in a number of water features crossed by the Falcon. We believe that the presence of these species was not considered as part of Shell's HCA analysis and requires additional scrutiny by the DEP and relevant agencies.

5.5. Compounded Risk from Cumulative Development

The Falcon will be built in a region heavily impacted by prior oil and gas development infrastructure, compounding risk in many areas. More than 260 "foreign pipelines" carrying oil, natural gas, and natural gas liquids, were identified by AECOM engineers when selecting the Falcon's right-of-way. Owners of these pipelines run the gamut, including companies such as Williams, MarkWest, Columbia, Kinder Morgan, Energy Transfer Partners, Momentum, Peoples Gas, Chesapeake, and Range Resources. Their purposes are also varied. Some are gathering lines that move oil and gas from well pads, others are midstream lines connecting things like compressor stations to processing plants, others still are distribution lines that eventually bring gas to homes and businesses. FracTracker took note of these numbers and their significance but did not have the capacity to document all of them for our interactive map.

5.5.1 Mariner West

However, we did include one pipeline, the Mariner West, because of its importance in the Falcon's construction plans. Mariner West was built in 2011-2013 as part of an expanding network of pipelines initially owned by Sunoco Pipeline but now operated by Energy Transfer Partners. The 10-inch pipeline transports 50,000 barrels of ethane per day from the Separator plant in Houston, PA, to processing facilities in Canada. Another spur in this network is the controversial Mariner East 2.

Mariner West is pertinent to the Falcon because the two pipelines will share the same right-of-way through a 4-mile stretch of Beaver County, PA, as shown in Figure 17 below.

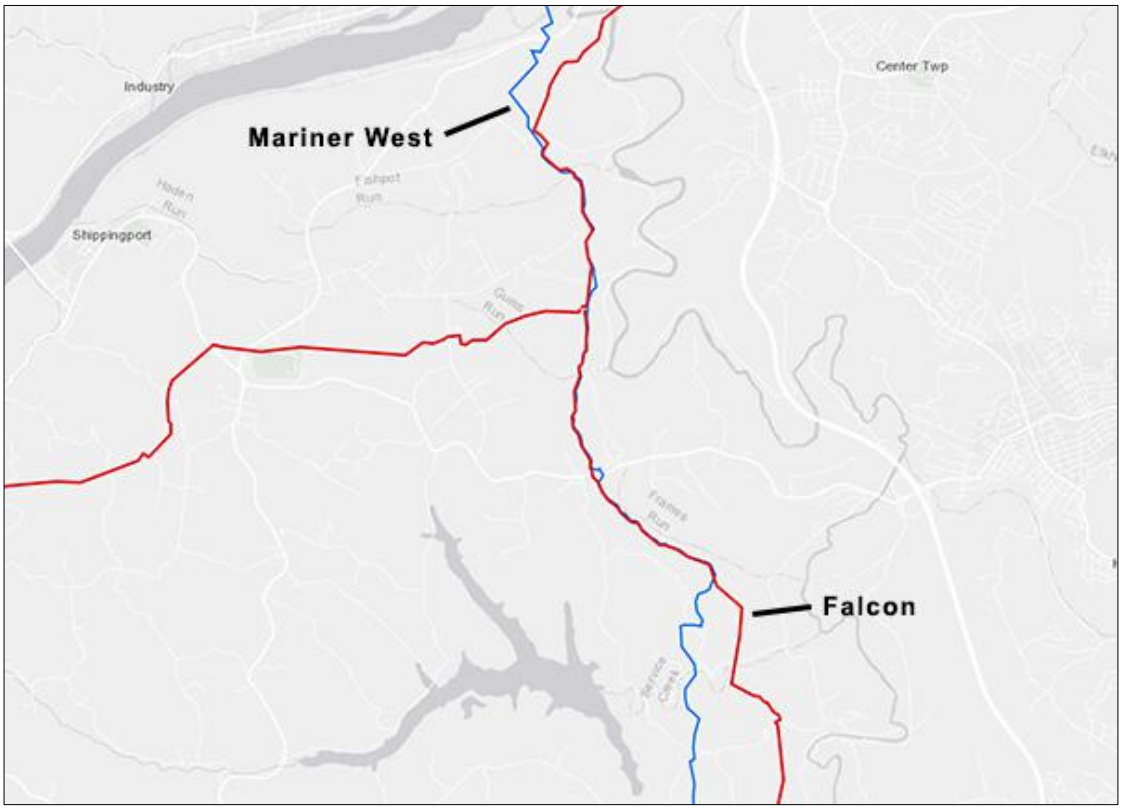

Figure 17: Falcon and Mariner West shared right-of-way in Beaver County

Reuse of existing rights-of-way is generally considered advantageous by pipeline operators and regulatory agencies. The logistics of sharing pipelines can be complicated, however. As noted in Shell's permit applications:

> Construction coordination will be essential on the project due to the numerous parties involved and the close proximity to other utilities. Accurate line location was completed; however, verification will also be key, along with obtaining proper crossing design techniques from the foreign utilities. A meeting with all of pipeline companies will be held to make sure that all of the restrictions are understood prior to starting construction, and that they are documented on the construction alignment sheets/bid documents for the contractor(s). This will save a potential delay in the project. It will also make working around the existing pipelines safe.

Shell's attention to coordinating with other utility companies is no doubt important, as is their recognition of working near existing pipelines as a safety issue. However, there are compounded risks with co-located pipelines when they come into operation. For instance, PIR and HCA analysis should account for the presence of the 10-inch Mariner West and 12-inch Falcon in the areas they travel together. As such, the DEP must scrutinize the cumulative risks in these areas.

5.5.2. Robinson Township Compressor Station

We found 11 unconventional oil and gas pads, hosting a combined 48 well heads, within the Falcon's PIR. We also found a large compressor station operated by Range Resources, located in Robinson Township, PA. This is shown in Figure 18 below, along with a nearby gas pad.

Figure 18: Robinson Township compressor station in Falcon's PIR

We noted these well pads and the compressor station because PIR and HCA risk analysis may account for proximity to occupied businesses and homes but does not always consider a pipeline's proximity to other high-risk industrial sites. Nevertheless, serious incidents have occurred at well pads and processing facilities that could implicate nearby hazardous liquid pipelines. By the same measure, an accident with the Falcon could implicate one of these facilities, given they are all within the Falcon's blast zone.

6. Shell Pipeline's Safety Record

Maintaining a reputation as a "good neighbor" is paramount to pipeline companies. Negotiating with landowners, working with regulators, and getting support from implicated communities can hinge on the perception that the pipeline will be built and operated in a responsible manner. This is evident in cases where Shell Pipeline has sold the Falcon in press releases as an example of the company's commitment to safety.

Shell reinforced their "good neighbor" narrative on several occasions at a recent Shell-sponsored information meeting held in Beaver County, stating that, "everywhere they do business, Shell was committed to the reliable delivery of their product." According to project managers speaking at the event, this is achieved through "planning and training with first responders, preventative maintenance for the right-of-way and valves, and through inspections—all in the name of maintaining pipeline integrity."

Shell, safety record is not all that is seems, however, and should raise cautions on the part of the DEP in accepting their claims that the Falcon will be constructed and operated without incident. In total, FracTracker found that Shell was responsible for 194 pipeline incidents since 2002. These incidents spilled 59,290 barrels of petrochemical products totaling some $183-million in damages. This analysis was based on PHMSA data on operators that transport hazardous volatile liquids (HVL), dating from 2002 through March 2018.[10]

6.1 Incidents Relative to Other Operators

PHMSA's hazardous liquid pipeline data account for more than 350 known pipeline operators. Some operators are fairly small, only maintaining a few miles of pipeline. Others are hard to track subsidiaries of larger companies. However, the big players stand out from the pack — some 20 operators account for more than 60% of all pipeline miles in the U.S., and Shell Pipeline is one of these 20.

Comparing Shell Pipeline to other major operators carrying HVLs, we found that Shell ranks 2nd in the nation in the most incidents-per-mile of maintained pipeline, seen in table 3 below. These numbers are based on the total incidents since 2002 divided by the number of miles maintained by each operator as of 2016 miles.

Operator	HVL Incidents	HVL Pipeline Miles (2016)	Incidents Per Mile
Kinder Morgan	387	3,370	0.115
Shell Pipeline	194	3,490	0.056
Chevron	124	2,380	0.051
Sunoco Pipeline	352	6,459	0.049
ExxonMobile	240	5,090	0.048

Table 3: Top 5 U.S. Pipeline operators by incidents-per-mile

[10] https://www.phmsa.dot.gov/data-and-statistics/pipeline/distribution-transmission-gathering-lng-and-liquid-accident-and-incident-data

6.2 Cause & Location of Failure

PHMSA data reveal that most of Shell's incidents issues should have been under the company's control. For instance, 66% (128) of incidents were due to equipment failure, corrosion, welding failure, structural issues, or incorrect operations (Table 4).

Cause	Incidents
Equipment Failure	51
Corrosion	37
Natural Forces	35
Incorrect Operation	25
Other	20
Material and/or Weld Failure	15
Excavation Damage	11

Table 4: Shell Pipeline incidents by cause of failure

However, not all of these incidents occurred at one of Shell's petrochemical facilities. As Table 5 below illustrates, at least 57 incidents occurred somewhere along the pipeline's right-of-way through public areas or migrated off Shell's property to impact public spaces. These numbers may be higher as 47 incidents have no mention of the property where incidents occurred.

Location	Incidents
Contained on Operator Property	88
Pipeline Right-of-Way	54
Unknwon	47
Originated on Operator Property, Migrated off Property	3
Contained on Operator-Controlled Right-of-Way	2

Table 5: Shell Pipeline incidents by location of failure

On several occasions, Shell has claimed that the Falcon will be safely "unseen and out of mind" beneath at least 4ft of ground cover. However, even when this standard is exceeded, PHMSA data revealed that at least a third of Shell's incidents occurred beneath 4ft or more of soil.

Many of the aboveground incidents occurred at sites like pumping stations and shut-off valves. For instance, a 2016 ethylene spill in Louisiana was caused by lightning striking a pumping station, leading to pump failure and an eventual fire. In numerous incidents, valves failed due to water seeping into systems from frozen pipes, or large rain events overflowing facility sump pumps. Table 6 below breaks these incidents down by the kind of commodity involved in each case.

Commodity	Barrels
Crude Oil	51,743
Highly Volatile Liquids	6,066
Gas/Diesel/Fuel	1,156
Petroleum Products	325
Total	**59,290**

Table 6. Shell Pipeline incidents by commodity spill volumes

6.3 Impacts & Costs

None of Shell's incidents resulted in fatalities, injuries, or major explosions. However, there is evidence of significant environmental and community impacts. Of 150 incidents that included such data, 76 resulted in soil contamination and 38 resulted in water contamination issues. Furthermore, 78 incidents occurred in high consequence areas (HCAs)—locations along the pipeline that were identified during construction as having sensitive environmental habitats, drinking water resources, or densely populated areas.

Table 7 below shows the costs of the 194 incidents. These numbers are somewhat deceiving as the "Public (other)" category includes such things as inspections, environmental cleanup, and disposal of contaminated soil. Thus, the costs incurred by private citizens and public services totaled more than $80-million.

Private Property	Emergency Response	Environmental Cleanup	Public (other)	Damage to Operator	Total Cost
$266,575	$62,134,861	$11,024,900	$7,308,000	$102,778,856	**$183,513,192**

Table 7. Costs of damage from Shell Pipeline incidents

Table 8 breaks these incidents down by year and number of miles maintained each year. We offer this additional breakdown to counter Shell's claims that the majority of their incidents can be credited to major weather events such as Gulf coast hurricanes. As this breakdown shows, these events only account for a small portion of the total.

Year	Incidents	Pipeline Miles	Total Damage	Notes
2002	15	no PHMSA data	$2,173,704	
2003	20	no PHMSA data	$3,233,530	
2004	25	5,189	$40,344,002	Hurricane Ivan
2005	22	4,830	$62,528,595	Hurricane Katrina & Rita
2006	10	4,967	$11,561,936	
2007	5	4,889	$2,217,354	
2008	12	5,076	$1,543,288	
2009	15	5,063	$11,349,052	
2010	9	4,888	$3,401,975	
2011	6	4,904	$2,754,750	
2012	12	4,503	$17,268,235	
2013	4	3,838	$10,058,625	
2014	11	3,774	$3,852,006	
2015	12	3,630	$4,061,340	
2016	6	3,490	$6,875,000	
2017	9	no PHMSA data	$242,800	
2018	1	no PHMSA data	$47,000	As of 3/1/18

Table 8: Shell incidents per year and maintained pipeline miles by year

6.4 Safety Data Implications

A number of significant Shell Pipeline incidents are worth mention that are relevant to the Falcon. For instance, in 2013, a Shell pipeline rupture led to as much as 30,000 gallons of crude oil spilling into a waterway near Houston, Texas, that connects to the Gulf of Mexico. Shell's initial position was that no rupture or spill had occurred, but this was later found not to be the case after investigations by the U.S. Coast Guard.[11]

Another incident found that a Shell crude oil pipeline ruptured twice in less than a year in the San Joaquin Valley, CA. Investigations found that the ruptures were due to "fatigue cracks" that led to 60,000 gallons of oil spilling into grasslands, resulting in more than $6 million in environmental damage and emergency response costs. Concerns raised by the State Fire Marshal's Pipeline Safety Division following the second spill in 2016 forced Shell to replace a 12-mile stretch of the problematic pipeline.[12]

These findings suggest that while Shell is obligated to stress safety to sell the Falcon pipeline, the DEP should take Shell's "good neighbor" narrative with a degree of skepticism. The numbers presented by PHMSA's pipeline incident data significantly undermine Shell's claim of having a proven track record as a safe and responsible operator. In addition, many of Shell's incidents appear to be the result of inadequate maintenance and improper operations, and less so due to factors beyond their control. As Shell's footprint in the Appalachian region expands, their safety history suggests we could see the same proliferation of pipeline incidents in this area over time, as well.

7. Conclusions

FracTracker's core intentions are to help people engage with data. The Falcon Public EIA Project brought the story of Shell's pipeline to the public for greater scrutiny. In the course of our work, we discovered a number of issues outlined in this document that we believe are technically deficient with Shell's permits. We, furthermore, found numerous cases where Shell's plan for the Falcon poses a high risk to the environment and the public. Finally, the review of PHMSA raises alarms about Shell's claims of being a safe and responsible pipeline operator. Our findings have generated similar responses from concerned residents and public interest groups who have utilized the Falcon Public EIA Project's resources, and we stand by their assertions that the DEP carefully consider the implications of the project prior to approving Shell's permits in their current state.

Finally, we ask that the DEP incorporate new rules requiring all pipeline permit applications from this date forward include geospatial data from operators. This data must be posted to the agency's website, along with application documents, prior to the start of public comments. Finally, this data should be integrated into the agency's public mapping tools to expand accessibility. Nonprofits should not have to bear the weight of providing these resources to the public as FracTracker has in the past year of developing the Falcon Public EIA Project. The DEP must honor its responsibility to participatory governance, recognize the public's expertise, and bring the permitting process into the 21st century.

[11] https://www.rt.com/usa/shell-pipeline-oil-texas-409/

[12] https://www.kqed.org/news/11495013/after-two-spills-shell-oil-to-replace-miles-of-problem-pipeline

insights empowering action

The FracTracker Alliance is a non-profit organization dedicated to enhancing the public's understanding of the impacts of the global oil and gas industry by collecting, interpreting, and sharing data and visualizations through our website, FracTracker.org. We partner with citizens, organizations and institutions allied in a quest for objective, helpful information to perpetuate awareness and support actions that protect public health, the environment, and socioeconomic well-being. We believe that data, science, and public participation can, and should, influence public policy and decision-making.

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FracTracker Alliance studies, maps, and communicates the risks of oil and gas development to protect our planet and support the renewable energy transformation.

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