Louisiana Oil Spill Research and Development Program
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Field Investigation and Digital Mapping of the Pipeline Crossings of the Ouachita/Black River System in Louisiana

Louisiana Geological Survey
Louisiana State University
Baton Rouge
2004

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by
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Robert Paulsell, and
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Field Investigation and Digital Mapping of the Pipeline Crossings of the Ouachita/Black River System in Louisiana

Abstract

The limitations of currently available pipeline data prevent their dependable usage for oil spill planning and response at river crossings. The Louisiana Geological Survey conducted a research and mapping project in 2003-2004 to document the pipeline crossings of the Ouachita/Black River System in Louisiana. This work complimented similar studies this team conducted on the Atchafalaya and Red Rivers, and on Bayou Lafourche. Global positioning system (GPS), remote sensing, and geographic information system (GIS) technologies were used to create a geo-spatial database of this information. The data gathered is vital for proper contingency planning and emergency response to river disasters involving natural gas, crude oil, and hazardous chemical pipeline crossings.

Initial research was conducted on the existing pipeline documentation whether in paper map, text data, digital database, or GIS form. Field investigations were then undertaken using GPS-equipped vehicles and watercraft. Accurate site locations and digital photography was collected of all crossings and witness posts. A geographic information system was then compiled from the field and research data. Using remote sensing technology and spatial analysis of the field data, a series of verified and spatially accurate pipeline crossings was established. These were prepared in a GIS format with linked data tables, orthorectified vertical imagery, and digital field photography with HTML menus.

The investigation resulted in the development of a modern and spatially accurate pipeline crossings database for the Ouachita/Black River System in Louisiana A fully functional GIS including metadata was prepared as was a comprehensive report and a set of color maps. Information dissemination is addressed with respect to public information in light of new domestic security concerns.

1.0 Introduction

1.1 The need for pipeline river crossing data

1.1.1 Rationale

With one of the largest pipeline networks in the nation as well as a widespread system of navigable streams and canals, Louisiana has many hazardous pipeline stream crossings. As the third largest navigable river system in the state, the Ouachita/Black River System is a logical candidate to join the Mississippi River and the Red/Atchafalaya in having a detailed and documented pipeline crossings GIS. Although anchoring is prohibited near pipeline crossings the occasional dragging anchor, misplaced dredge, or shipwreck pose a threat to nearby human and environmental resources since they may rupture pipelines. Such occurrences are all too frequent in Louisiana rivers.

The potential for floodwaters to rupture and destroy pipeline crossings has been demonstrated in the recent floods of the Red River in Minnesota and the Trinity River in east Texas. Several pipelines were destroyed in each of these instances causing fires, pollution, and creating other health hazards for emergency personnel and displaced citizens already burdened with flood problems. All of Louisiana's river systems experience flood events. Several streams are large enough to endanger pipeline crossings during major flood events.

Accurate and up-to-date digital pipeline river crossing data in Louisiana are of fundamental importance to the oil spill contingency community. A high-resolution pipeline crossing GIS of these streams offers previously unavailable information and will enable increased response efficiency by allowing responders to quickly assess the size, product carried, and operator of specific pipelines in the field.

Such a pipeline database will directly augment the capabilities of oil spill planners and emergency responders as well as being a basic tool for oil spill researchers studying risk management and environmental impact. High-quality pipeline crossing information also supports economic development concerns in a riverine, oil-and-gas state like Louisiana. Clearly a GIS coverage of pipeline river crossing data can enable a more thorough understanding of oil spill potential, lower planning costs, and enhance response to oil spill emergencies.

1.1.2 Field investigation addresses inadequate pipeline maps

Reliance on the currently available pipeline maps and digital data results in an out-of-date picture of who the actual operators are due to the age of the source documents. The source maps and their digital counterparts are also possessive of several kinds of cartographic and spatial error, which lead to incorrectly located crossing points, and to "phantom" crossings that do not even exist. A field investigation is required to establish accurate spatial positions, determine current pipeline operator, characterize the nature of the crossing, and to solve and eliminate erroneous artifacts of earlier mapping.

1.1.3 Terminology

A *Crossing* is herein used to denote a mapped and/or posted point on the river where bridged or buried pipelines cross the channel. There is often more than one individual pipeline in each crossing. Crossings are designated by river mile (for instance: Crossing 65.5)

A *Pipeline* is an individual pipe system carrying hazardous gasses or liquids. Pipelines are designated by: operator, diameter, and product (for instance: Marathon Ashland 16" crude oil).

1.2 Study Area

The study area is the 221 miles of the Ouachita/Black River System in Louisiana. The Ouachita River originates in Arkansas and enters Louisiana at the 33rd parallel as the boundary between Union and Morehouse Parishes. The Ouachita is joined by the Tensas River near Jonesville in Catahoula Parish and becomes the Black River south to its confluence with the Red River near Acme in Concordia Parish.

This river system is a major navigable Louisiana waterway and is maintained by the US Army Corps of Engineers. There are four new lock and dams on the Ouachita, three in the Louisiana study area. These replace six older structures completed in the early 20th century.

River miles for the Ouachita/Black River navigation channel are established by the Corps of Engineers beginning at the confluence of the Black River with the Red River.

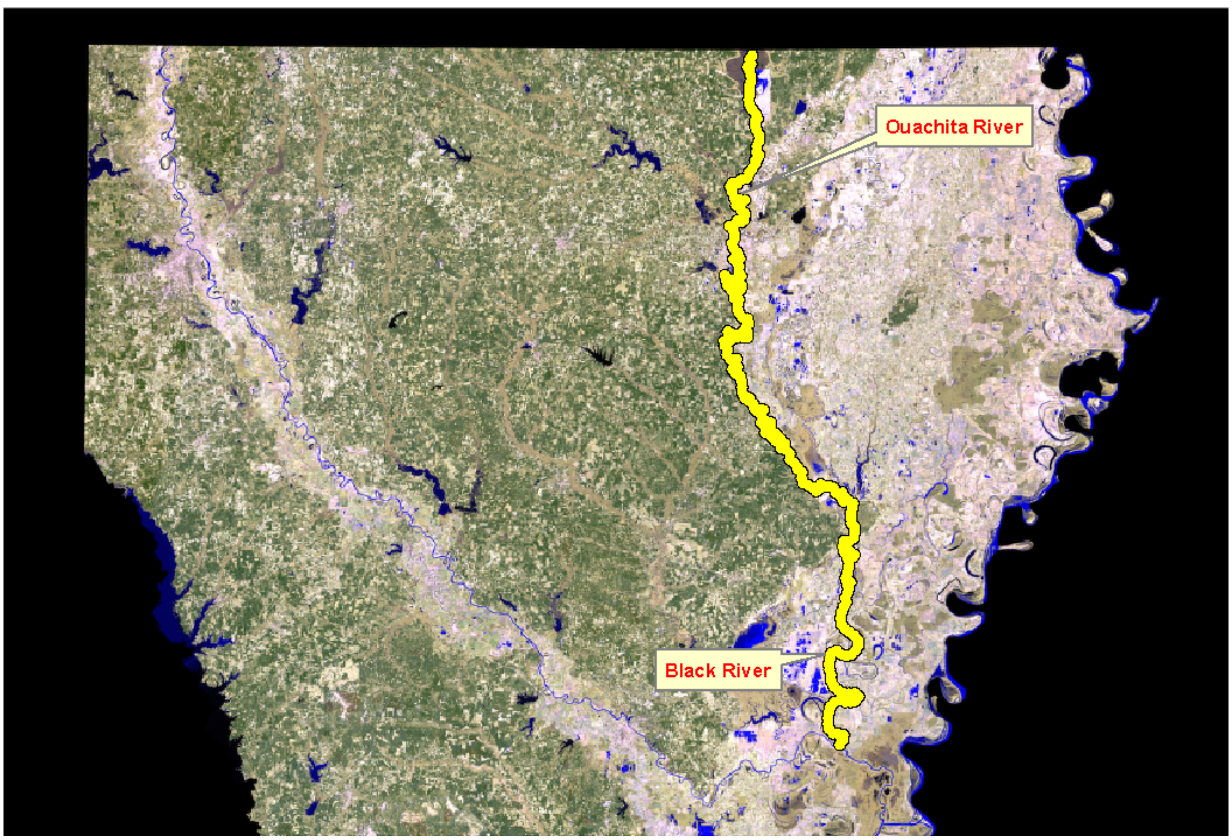

Figure 1 – The Ouachita/Black River System study area.

Figure 2 – 21st century pipeline river crossing investigations in Louisiana.

1.2.1 Geologic and environmental setting

The Ouachita River originates in the Ouachita Mountains of Arkansas where it drains ancient rocks of Pennsylvanian to Ordovician age. The river meanders southeast through Arkansas between broad Pleistocene terraces of its own construction, and draining older Tertiary sediments of the Mississippi Embayment. At mile 194, near Sterlington in Ouachita Parish, the river joins and follows an abandoned Pleistocene course of the Arkansas River south between the Tertiary uplands to the west and the great Mississippi River glacial outwash sediments forming Macon Ridge to the east.

Near mile 66 The Ouachita follows the abandoned Arkansas river channel through a gap in the Tertiary uplands, isolating Sicily Island, a Tertiary remnant to the east. At Mile 41.5, near Jonesville in Catahoula Parish, the Ouachita River is joined by the Tensas River and becomes the Black River.

In its lower 41 miles, the Black River crosses the vast alluvial valley of the Mississippi River where it now occupies giant, oversized abandoned former courses of that stream and is bounded on both sides by artificial levees. Above that point (near Jonesville), the Ouachita River sometimes impinges upon bluffs of Pleistocene and Tertiary deposits. Against these valley walls, the river requires no artificial levee to contain it.

For most of the study area the Ouachita/Black River System is in a rural setting, being bordered by backswamp forests and agricultural fields and pastures in the lower basin. Upland pine forests dominate the blufflands and terraces of the northern part of the Ouachita basin. There is one urban waterfront area in Monroe (mile 168).

There is a great deal of oil and gas development along the river system, most are natural gas gathering system and transmission pipelines associated with 100 years of operation in the vast Monroe Gas Field, north of Monroe. Natural gas dominates production and the associated pipeline crossings from Columbia, north to the Arkansas border. South of Harrisonburg, crude oil production gathering systems underlay the river. Between Columbia and Harrisonburg, several giant interstate pipelines that carry oil and gas products from the Louisiana and Texas Coastal areas to the Northeast U.S cross the Ouachita River.

Fish and wildlife abound in the river corridor and were observed many times by the field team. Waterfowl and birds of prey were especially evident, as were reptiles.

1.2.2 Transportation infrastructure

There is commercial barge traffic operating on the entire length of the river system in Louisiana. Petroleum products are among the cargos carried in the Ouachita/Black and constitute a spill threat of their own. Commercial traffic can also impact the pipeline infrastructure due to the anchoring and dredging associated with the commercial waterway.

Recreational use of the river is high due with large numbers of semi-permanently moored houseboats, especially in the Ouachita Parish reach.

Many homes and camps appear in the rural areas along the river. Major highways and railroads cross the waterway. Access to the river by vehicle, railroad, and watercraft is good due to the road and rail network and the sturdy boat ramps maintained by the Corps. State highways below Monroe closely parallel the river. However, the river north all the way to Arkansas has intermittent road access.

In the study area the Ouachita River is bridged for highways at 5 locations and for railroads at 2 locations. Abandoned railroad bridges still span the river at Sterlington and Jonesville. An automobile ferry runs at Duty in Catahoula Parish. A highway at one location at Jonesville crosses the Black river. There are no rail or highway tunnels under the Ouachita or Black Rivers. Commercial and military airports capable of handling the largest transport aircraft are located near the river at Monroe, Pineville, and Alexandria.

Figure 3 – Barges carry agricultural goods and petrochemical commercial products on the waterway. Many private houseboats and camps line the river, especially in the Monroe area.

Figure 4 – Bridges in the Monroe waterfront area.

Figure 5 – Railroad bridges are another potential spill site on the Ouachita River. Not only are tank cars filled with petroleum products carried, but each locomotive carries 1,000 gallons of diesel fuel.

1.3 Previous efforts

1.3.1 LGS pipeline mapping

Oil and gas pipelines have been placed in Louisiana since the early part of the twentieth century. When the Louisiana Geological Survey published the first Oil and Gas Map of Louisiana in 1940, the Ouachita River already had ten (10) river crossings, all natural gas pipelines associated with the giant Monroe Gas Field. The LGS continued making large-scale oil and gas maps of Louisiana through the 1970's. While useful as planning documents, the 1:500,000 scale maps lacked the detail and positional accuracy for large-scale engineering, emergency response, and other site-specific uses.

1.3.2 Published sources

The most complete published map of Louisiana pipelines is the two-map set Oil & Gas Map of Louisiana and Offshore Louisiana Oil & Gas Map at 1:380,160 published in 1981 by the Louisiana Geological Survey. Although comprehensive, the source data used for this map contains many errors, and is over twenty years out-of-date. Pennwell, Inc. published a Pipeline Map of Louisiana at 1:500,000 in the mid-1980's, but it is essentially a smaller-scale copy of the 1981 state map, complete with cartographic errors.

The most comprehensive large-scale pipeline maps of Louisiana are the 64-parish pipeline maps comprising the 1992 Atlas of Louisiana Pipelines published by the DTC Graphics Corporation. However these maps suffer from inconsistent detail level, excessive cartographic displacement, and reflect the use of much of the same poor-quality source material that is seen in the Oil and Gas map of Louisiana. Also the DTC atlas is a zealously guarded proprietary document that sells for $ 2,500 and photocopying and digitizing from it are copyright violations.

Some river pilots' navigation charts and atlases have been prepared through the years and have some pipeline crossings marked. They are by no means authoritative, show only position, and often lack any indication of company, size, or products.

The US Army Corps of Engineers has prepared a navigation atlas of the Ouachita/Black navigation channels. This large-scale document depicts pipeline crossings and characterizes them with company and product information where available. However it too shows evidence of erroneous source map utilization and is many years out of date.

1.3.3 Unpublished sources

Several of the major pipeline operators print a system map of their own pipelines. Some of the maps show the pipelines of other operators as well. While these maps are of too small a scale (1:500,00 or smaller) for digitizing into a GIS for engineering uses, they are a valuable historical reference since some of these products have editions stretching back into the 1940's. The best of these industry maps are the Transco Pipeline Map of Louisiana prepared by the Transcontinental Gas Pipeline Corporation and the Texas Gas Pipeline Map of Texas and Louisiana prepared by the Texas Gas Pipeline Company.

None of these source maps offer the detail level and positional accuracy needed to identify pipeline river crossings for navigation or emergency response purposes. There currently exist no published or digital pipeline maps of Louisiana that are large-scale, accurate, and comprehensive, use first-generation sources, and are in the public domain.

Permit information at the Louisiana Department of Natural Resources proved inadequate for this project. Most DNR data is located in the coastal zone. Permit data doesn't exist before the 1970's and is often accompanied by uncontrolled source maps and schematic diagrams intended for planning use rather than engineering uses. However this data sometimes offers help in solving differences between conflicting source maps regarding thematic data.

1.3.4 Digital data

In the 1990's the LGS began to use GIS technology to re-acquire the Louisiana pipeline data digitally using only original engineering plats and alignment sheets from the pipeline operator's themselves. This effort is still underway and involves the digitizing and database construction of thousands of large-scale source maps. Most, but not all, of the pipeline companies possess unpublished maps, engineering plats, and alignment sheets of their own systems. These documents can vary widely in scale, cartographic quality, positional accuracy, and detail level, but in general offer the best large-scale, first-generation source material needed for a detailed GIS digitization effort. The LGS has digitized over 1,200 such maps that were submitted by the pipeline operators themselves. Still, approximately 45% of the remaining Louisiana pipeline operators have made no large-scale source documents available to LGS.

LGS was designated the Louisiana Repository of the National Pipeline Mapping System (NPMS) in 1999. This effort by the federal Office of Pipeline Safety was a three-year project to complete a seamless national pipeline GIS. However at the end of the three years, only 55% of the interstate pipeline operators had provided submissions of detailed data. Plus, the intrastate pipeline operators, unregulated by OPS, did not participate at all. In addition, the NPMS effort only requires an accuracy of ±500 feet, which is inadequate for many needs of the state agencies

There exist several CD-ROM pipeline compilations from Pennwell, Inc. and the Department of Energy that cover the entire US and are available commercially. These were digitized from very small-scale source maps, are greatly generalized, out of date, and are entirely inadequate for the large-scale uses envisioned by the Louisiana GIS community. The best accuracy they can offer is ±16 miles!

1.4 Limitations of the source data

1.4.1 Recognizing error

The data validity of any map is limited by the quality of its source material. A major problem in pipeline mapping over the years has been the great variety in the quality of data available from the source documents. Some pipeline systems were depicted at a greater detail level than others, or at a different scale and projection. There are always a number of conflicts in the data forcing choices to be made by the cartographer. Cartographic error can accumulate over the years in a map series dependent on hundreds of widely varying source maps.

1.4.2 Age

Pipeline information is quickly outdated. Usually the positions of the lines remain the same, but operators change very frequently. There are many mergers and acquisitions going on in the pipeline industry causing frequent name changes. Entire pipeline systems as well as small to medium segments are sold and bought as market conditions dictate. Even the pipeline regulators at OPS and DNR find it difficult to keep up with the changes. Any pipeline source map more than a few years old is suspect. Investigations for this project revealed that there were several changes in the one-year duration of the project.

1.4.3 Cartographic error

Inevitably in the map production process, errors will occur. These errors often accumulate when a source map error is replicated in a derivative map. Common cartographic errors are: overgeneralization, positional error, thematic error, and excessive cartographic displacement.

Cartographic displacement error occurs frequently in pipeline mapping and is sometimes difficult to detect. Displacement occurs when a cartographer moves a line slightly from its true position so that it does not overlay or occlude an adjacent line. This is done for clarity and is a perfectly acceptable practice in cartographic design where it is most important to make the map readable at the publication scale. However such lines are sometime displaced excessively producing a schematic diagram of the pipeline rather than a proper map. Even minor displacements become a problem when digitized into a GIS. In a digital environment one can "zoom" in to very large scales where the displacement becomes very problematic. Gross over-displacements are usually obvious, but more subtle displacements must be detected using aerial photography to try to find the pipeline trace or by field survey with a GPS.

Cartographic omission can occur when a source document is outdated or incomplete. Occasionally intentional omission does occur on source maps in areas of dense line work where a cartographer has had to make choices in order to depict his most important elements. In rare instances a cartographer will simply forget to add a line.

Thematic error occurs when a map element had been mislabeled or incorrectly symbolized. These are usually singular instances and sometimes hard to spot. Occasionally a source map will have an error in the Map Key, which can cause hundreds of individual map elements to be incorrectly interpreted.

Phantom crossings can occur as a result of cartographic or positional errors in the source map. They can also result from use of overly generalized source maps. Often a small-scale source is unwisely transferred onto a large-scale map with a positional displacement of several miles. Sometimes this positional error can be corrected with better reference maps or from GPS data. Sometimes a badly placed, small-scale source crossing exists alongside a large-scale source crossing showing the same pipeline in its true position. The cartographer is faced with determining which source document is more accurate. Too often he encounters a source map where a previous cartographer has foolishly placed both positions on his map creating the illusion that two pipelines exist. One of these lines is a phantom line presenting a challenge to the cartographer to recognize and correct the problem when original sources are unavailable.

Source conflicts are a fairly common occurrence. Position conflicts happen from time to time, but data conflicts happen quite frequently. Name changes and mergers happen very frequently and even the most recent maps show out-of-date operator names.

1.4.4 Positional (spatial) error

Inevitably in the map compilation process, positional errors will occur. Lack of adequate geodetic control in the source map is the usual culprit, although erroneous projection translation and imprecise scaling compete for a close second place.

1.5 Inherent pipeline mapping problems

1.5.1 Operator changes

Operators of pipeline systems change names frequently through mergers, acquisitions, reorganizations, and reasons that are sometimes unclear. Often only a portion of a pipeline will be sold and renamed. Some operators systems were acquired entirely by acquisition and maintain that very few original engineers plans still exist. Keeping up with changes is difficult and any document will be obsolete soon after publication.

1.5.2 Operator contacts

Contact names, phone numbers, area codes, and their responsibilities change as frequently as pipeline operators. While every effort has been made to gather the best available data for this GIS and map product, it is recommended that users update the operator and contact information periodically rather than rely entirely on data that will be increasingly out of date even though the positional data remains accurate.

1.5.3 Operator policies

Some pipeline operators are very forthcoming in providing the needed data while others are less so. Several operators simply refused to comply with requests for data. Their reasons are a matter of company policy and take several forms:

- Refusal to submit unless required to by law or legislation. Some operators maintain that the cost of providing accurate maps and especially digital GIS files is prohibitive, If they voluntarily provide data they have to absorb those costs, while if they wait until they are required to submit by a regulatory authority they can pass the costs along to their customers.
- Refusal to submit because of proprietary issues. Some operators maintain that the maps requested contain proprietary information that they cannot risk getting into the hands of competitors.
- Unable to comply due to lack of suitable maps. Some operators maintain that they acquired a system through purchase and no longer have the original engineering plans or any subsequent map meeting our mapping standards. We find this hard to believe.
- Unable to comply due to financial limitations. Small operators sometimes argue that they have no funding to create, reproduce, nor distribute engineering maps to anybody.
- Did not follow through with promises to submit. A few operators cheerfully agreed to provide data, but never actually did so. Follow-ups sometimes ascertain that an executive that made the decision never passed on the instructions to the engineering or drafting department that actually possess the maps. In other circumstances we are told that the company has higher priorities than meeting our schedule and we will just have to wait until human resources are available.
- Simply failed to respond. A few companies never responded to letters or phone requests for map data unless to a regulatory authority which this research department was not.

1.6 Principal references

For this project four primary source documents were used.

- The DTC Atlas of Louisiana Pipelines and Industry (1992)
- The US Army Corps of Engineers (USACE) Navigation Maps of the Ouachita/Black River System (1986)
- Louisiana Geological Survey (LGS) in-house collection of pipeline maps and data
- National Pipeline Mapping System (NPMS) pipelines (incomplete)

The DTC Atlas of Louisiana Pipelines and Industry lacks the scale and detail level desired to accurately locate pipeline crossings, but it is the only comprehensive product published in the 1990’s and offers help in identifying pipeline operators, products, and diameters. It also helps resolve source conflicts, of which there are many. However it was not used for positional data due to excess cartographic displacement and inadequate detail level for crossing information.

The USACE Flood Control and Navigation Maps offer company data and pipeline positions and at a large scale appropriate for this project. However, it has used some questionable source material as have most available references so individual crossings were verified wherever possible from other references and from field observation.

The LGS in-house pipeline maps and data consists of over 1000 pipeline company system maps, plans, and alignment sheets, most of which have been digitized At present the LGS has collected data from approximately 65% of the companies operating in Louisiana. However, these data are mixed in quality and detail level, most being of insufficient positional accuracy for general GIS use.

The National Pipeline Mapping System is an ongoing effort by the federal DOT, Office of Pipeline Safety (OPS). It is a voluntary initiative between the federal government and pipeline operators to obtain modern, high quality pipeline data for the entire country. LGS participated as the Louisiana NPMS repository for the three-year initial collection period. Unfortunately only about half of the industry operators participated in the voluntary NPMS effort so the project remains incomplete. It doesn't include the many intrastate operators over whom OCS has no jurisdiction.

2.0 Technical Approach

A three-phase methodology was used to complete the project; research into the existing documentation, field investigation, and GIS compilation. A flowchart of GPS/GIS integration is provided in Figure 2.

2.1 Research

2.1.1 Source documents

Maps, CAD/GIS digital files, and other source documents described above were assembled and analyzed. Maps were assessed for reliability, detail level, positional error, and age of data. The four primary references were selected. Many other pipeline company map sheets in the map collection of LGS were consulted for historical reference, but were not principal sources for this report.

2.1.2 Analysis

From this body of documents, potential pipeline crossing positions were indicated upon the draft field maps. Conflicting data between sources were sorted out as described in section 1.0 and problems for detailed field investigation were identified. Operators were contacted for further information in some cases.

2.1.3 Digital Data

Color plots at various scales were made of the LGS pipeline digital data for field use. These were superimposed upon satellite imagery. Landsat Thematic Mapper (TM) imagery was used for medium and small scales, while high-resolution Digital Ortho Quarter Quads (DOQQ) were used for large-scale maps. Field copies of the other principal sources were procured. Draft atlas sheets were designed.

2.1.4 Database

A draft database was designed (see Appendix A.) Field forms and note sheets were prepared. A specific form was designed for collecting field pipeline attribute information. River crossings are designated by river mile. This allows future crossings to be added to the database without a renumbering of existing crossings. The US Army Corps of Engineers, Vicksburg District was the source for river mile information.

2.1.5 Planning

A plan was prepared to develop the pipeline crossing GIS. Vehicle and boat field trips were organized using reference maps and scheduled against other LGS activities. The appropriate field equipment was acquired and calibrated.

2.2 Field investigation

2.2.1 Crew and equipment

A two-person crew was utilized for road fieldwork. A GPS operator in the rear seat with the GPS receiver took readings, kept field notes, and annotated draft maps. A driver/observer in the front seat followed source maps and topographic maps, observed for crossings, and left the vehicle at stops to investigate and take photographs.

A 1999 Dodge Dakota 4-wheel-drive sport/utility truck was used for the field vehicle. It is equipped with a bumper-mounted winch, removable flashing caution light, and GPS antenna mast. A Trimble GPS unit roof-mount antenna was used to collect spatial data. A Sony and Minolta digital cameras were used to collect digital photography at stops. Binoculars proved valuable in reading signs and witness posts at a distance.

A two-person crew was also used for boat fieldwork. The boat driver also operated the GPS receiver while the observer watched for crossings with binoculars, kept field notes, and took digital photographs.

A 20-foot Boston Whaler workboat was used for the river investigations. It was well equipped with a large outboard motor and a console with marine radio, depth finder, and compass. It also had floodlights and several bins for safety equipment. It was trailered behind the Dodge SUV for trips to the study area.

Figure 6 – Four-wheel drive vehicles and watercraft were used to access the pipeline crossing sites

Windows and Macintosh laptop computers were carried in the field to collect and assemble digital photos and GPS data, often in the vehicle but mostly at day's end in the hotel or office. Laptops were not carried in the boat.

Personal desktop assistants (PDA), know as palmtop computers, were used in the field for note taking. Cellular telephones were used for communication between field and office and between field personnel.

***Figure** 7* – Modern technology enabled accurate and efficient collection of mapping data in the field. Pictured are the laptop computers, person digital assistants (PDA or "Palm" units), GPS receivers and data recorders, cellular phones, and digital cameras used in the project.

2.2.2 Assess source data

The draft maps and color reproductions of the reference maps were assessed in the field for spatial accuracy, attribute accuracy, and to locate "phantom" crossings and omissions.

2.2.3 Physical crossings investigated

All evidence of physical pipeline crossings was sought. Such evidence includes: cleared right-of-ways, levee humps, witness posts, warning signs, metering stations, pumping stations, bridges, and valves.

Figure 8 – Traditional field methods involving paper maps and compass, binoculars, field notebooks, and clipboards were also utilized.

2.2.4 GPS spatial data

GPS point locations were taken of all pipeline crossings that were vehicle or boat accessible. A Trimble Geo-Explorer 3 GPS receiver was used for the field survey, configured for collecting position data in UTM, Zone 15, NAD83. These data were used to adjust positions of inaccurately mapped crossings and to locate previously unmapped crossings. Wherever possible, both east and west bank road positions were gathered as well as a midstream river position. These data were later uploaded to the GIS in the office and post-processed for differential corrections.

2.2.5 Field notes

Field notes were kept on specially prepared forms. Data gathered from each stop was entered where appropriate. This data was later transferred to spreadsheets in the office. Late in the project, hand-held PDA computers were also used to take field notes in Excel digitally in the field.

2.2.6 Photographs

Digital photographs were made of the crossing itself as well as witness posts and warning signs where accessible. In some cases pipeline exposure were observed and photographed. However many witness posts are obscured by vegetation, illegible, or damaged. For this reason, a few locations were not photographed. This data was uploaded to the computer in the office and used to confirm operator and contact information. The best of these photos were linked to their crossing information in the GIS.

Figure 9 – Some crossing sites are well marked and the rights-of-way are kept cleared.

Figure 10 – Other active crossings have been allowed to deteriorate. There is a recent sign concealed behind this foliage in a poorly cared for right of way. There is not warning visible to prevent a towboat from anchoring here.

2.3 GIS compilation

2.3.1 Upload field data

Spatial data from the GPS unit was uploaded into the ArcView GIS on Windows XP workstations and transformed into ArcView 8.3 GIS shape file format to overlay onto Digital Ortho Quarter Quad satellite imagery. Pipeline GIS data were utilized for reference where appropriate. The pipeline crossings were then digitized on screen.

Thematic data from the field notes were entered into an Excel spreadsheet and translated into ArcView. Digital photos were uploaded into Photoshop on a Macintosh G5 workstation then enhanced and exported as JPEG images for use in ArcView.

2.3.2 Enter reference map data

Spatial and thematic data from the principal reference maps were entered via Excel spreadsheet and heads-up digitizing at the workstation. Some of this data was adjusted, revised, or deleted where appropriate as determined from field investigations.

2.3.3 Populate database

The draft database structure was finalized and populated. The appropriate links were made between the related data files, digital photographs, and HTML files.

2.3.4 Design a GIS

Appropriate ArcView GIS shape files for the river crossing information were created and symbology designed. Spatial elements were checked for proper linkage to their GIS database components.

2.3.5 Plot atlas sheets

Color plots of the Ouachita/Black River corridor showing pipeline-crossing information were prepared. A satellite image was used as the base map along with a GPS grid and the topographic quadrangle index. The atlas sheets were scaled to 1:24,000.

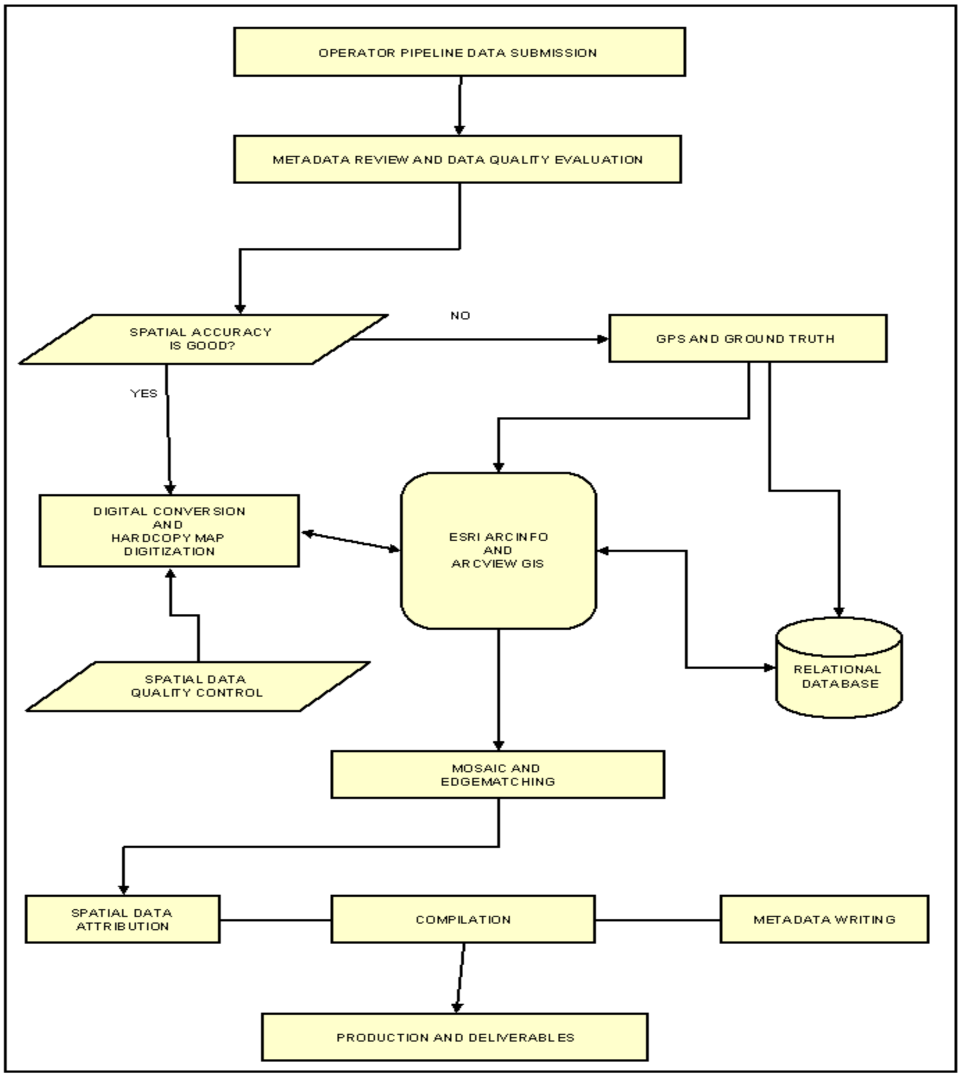

Figure 11 – Flowchart of the integration of GPS in the Ouachita/Black River System pipeline crossing GIS.

3.0 Results

3.1 Research

Of the principal sources used in this project, the DTC Atlas of Louisiana Pipelines proved the least useful for spatial data although often helpful for determining thematic data, especially pipeline diameter. The USACE Navigation Maps of the Ouachita River was useful but some locations were poorly located. Most poor locations depicted on the maps could be adjusted to their GPS-collected, accurate positions. Some source data were within map accuracy requirements for this project. The NPMS and LGS pipeline GIS data often gave excellent accuracy but are still incomplete and thus of little help on many crossings.

U.S. Geological Survey topographic quadrangles at 1:24,000 were consulted in the office and in the field. Some major pipelines are indicated on these excellent base maps and are accurately located. However they are by no means comprehensive, offer no thematic data, and date from the 1970s and 1980s primarily.

The most reliable thematic information on source maps was diameter and product data. Operator data changes frequently and was not always what was indicated on the source map. Depth of trench information is entirely lacking from all of the sources. Product and operator data could often be confirmed from witness posts, but rarely could diameter. Contact information on source documents was found to be of unreliable age with omissions, conflicts, changed area codes, and incorrect phone numbers,

Assessment of source data presented a wide range of conflicts and errors that had to be addressed. The most common conflict was outdated operator names. Few of the source maps and digital data designated modern pipeline operators correctly. Mergers, acquisitions, and name changes are common in the pipeline industry. Documents sometimes use a company name but in other places refer to the same pipeline by a subsidiary company name. It complicates the issue of locating the true current operators, which sometimes change again during the project, which happened more than once.

The second most frequent error on the source maps was erroneous positioning, usually due to inadequate scale (therefore detail level), poor geodetic control, and imprecise original drafting or digitizing. Satellite remote sensing technology using high-resolution digital ortho-photography enabled the accurate positioning of many crossings. Others would also require confirmation by GPS in the field.

Pipeline companies were contacted when specific questions could be formulated. Many were cooperative but their responses were often not timely to the project schedule as company priorities were higher on their agenda.

Permit records proved to be of little help to this project. Often this was due to their filing by original operator names that are seldom still the current operators. Information needed to track operators' changes does not appear to be available from the regulators in the Office of Conservation. Also the maps accompanying the permits were usually small-scale photocopies, with no geodetic control, and offered poor detail.

A good deal of cumulative and derivative cartographic error is embedded in the source documents as described in section 1.4. The examination of source maps in temporal sequence often reveals such problems.

3.2 Field investigation

The field investigation was the component of this project that offered high-quality positional and thematic information on the spot; spatial data being established with the GPS receiver. The principal problem with the field investigation involved lack of vehicle access to many potential crossing sites. However, boat access was valuable in reaching these areas, although complicated by the locks and dams of the Ouachita River waterway. Nevertheless seventy-seven (**77**) river crossings encompassing eighty-two (**82**) individual pipelines were investigated. All were buried in a trench under the channel, no bridge crossings were observed. Fifty-eight **(58)** crossings containing sixty-one **(61)** pipelines were verified and positions established in the field. Another twelve **(12)** crossings with fourteen (**14**) documented pipelines were investigated but no evidence of their presence could be found in the field and they are listed as unverified. Seven (**7**) documented crossings were confirmed as abandoned pipelines. Others could be source map cartographic error, undocumented abandoned pipelines, or "phantom" crossings.

3.2.1 Accessibility

Unlike the Mississippi River, the Ouachita River in Louisiana is not completely bounded by man-made levees. Where they exist, the rough road atop the levee allows access to crossing points with ease. In the uplands, the river impinges against bluffs and no levees are required. Only the occasional country lanes offered river access in this area

There is a distinct hump on the levee where pipelines cross and there is usually a witness post atop the levee or, more usually along one or both of its bases. The levees are mostly posted, often private property, and vehicles are not permitted even in most public areas. However the LGS was granted permission by the levee boards to use the levee road when needed. However, in many cases state and parish roads offered parallel routes adjacent to the levees and the investigators simply walked over the levee to the crossings.

There are many places where the levee does not offer access close enough to the river to obtain data via vehicle. Such places are often on low river points that the levee cuts across rather than following the river. Some of these areas were dry and had rough tracks allowing vehicle access to the river while others were impassable wetlands or were gated and posted.

There is extensive access to the river via watercraft and many well-maintained Corps of Engineers concrete boat-launching ramps.

Figure 12 – Typical pipeline crossing viewed from the riverbank.

3.2.2 Global Positioning System

A Trimble Geo-Explorer GPS was used to collect accurate positions in the field. An external antenna allowed collection from within the vehicle. Data was uploaded daily to a laptop computer.

Figure 13 – GPS receiver used for recording positions on the river.

3.2.3 Witness posts

All road and levee crossings are supposed to be marked by witness posts, small signs indicating that a pipeline lies buried and usually give the product carried, operating company and a phone number. Only a few crossings failed to have a witness post, but many have suffered damage from mowing machines, the elements, and floodwater. The field team endeavored to photograph at least one witness post at each crossing visited. Sometimes ditches, vegetation, quagmires, and other obstacles prevented a close photograph being taken. Binoculars proved useful to the investigators. Often conflicts between witness posts were observed. When a pipeline changes hands, it appears that some witness posts were not updated with the new operator information. Many conflicting phone numbers can be observed.

Figure 14 – A witness post along a highway fence line at the foot of a levee.

3.2.4 Warning signs

Active crossings have a large sign facing the river to alert river traffic to the presence of a "DO NOT ANCHOR OR DREDGE " Zone. Most of these signs were at the waters edge facing the river. Photographs have been obtained of most, although many were obscured by vegetation, even in the winter (Figure 5).

Along the base of the levee in many places is a paved "river road" which may also have witness posts affiliated with a pipeline crossing.

Figure ***15*** **– (A)** Warning signs placed facing the river. **(B)** Signs at facilities along the pipeline right-of-way

3.2.5 Other evidence

All pipeline crossings show a distinct hump in the levee itself where the pipelines cross. Occasionally the pipelines themselves will be exposed running atop concrete pads upon the levee sides but usually they lie buried beneath their mounds. Cleared right-of-ways approaching the levee from the backswamp and through the trees of the batture indicate pipelines. These can be observed in the field and upon high resolution aerial and satellite photography.

Some pipeline facilities are well marked and help to determine attribute data and right-of-way operators (Figure 15).

It is important to distinguish between pipeline river crossings and other levee crossings of pipelines. Many obvious pipeline levee humps with associated witness posts cover pipes that go no farther than a ship or barge terminal at the river's edge. Other humps are atop water intakes or discharge pipes for municipalities or plants. There are a few fresh water pipelines that cross the river but were beyond the scope of this study since they contained no hazardous material.

Sometimes this evidence indicates an abandoned pipeline. The distinct levee hump remains, but signs and facilities have been removed or allowed to deteriorate.

Figure 16 – Evidence of abandoned pipelines is rare in the field as most operators remove signs and above-ground facilities. The undergrowth quickly obscures any remaining evidence.

Figure 17 – Pipeline warning signs take a beating from weather and the river. Evidence of the spring high-water can be seen on a new sign. Weatherbeaten signs hinder the process, although sometimes with unexpected results. Weathering on one sign reveals three overpaintings and documents the succession of pipeline operators.

Figure 18 – Occasionally pipelines exposed by the river are evident. Usually it will prove to be an abandoned crossing, but dangerous exposures of active pipelines are also seen. A simple grounding of a barge could produce a spill.

Figure 19 – Signs that have been vandalized are sometimes seen, often having been shot up by hunters or "target" shooters. However it is rare to see a pipeline warning sign actually being used as a support for a deer stand.

3.3 GIS compilation

3.3.1 Data input

Digital spatial data from the GPS was uploaded to the GIS as a point file database and used to establish riverine and road collection points. Crossings were digitized using “heads-up” on screen technology from GPS data, GIS pipeline data sources, and points established using remote sensing of DOOQ imagery.

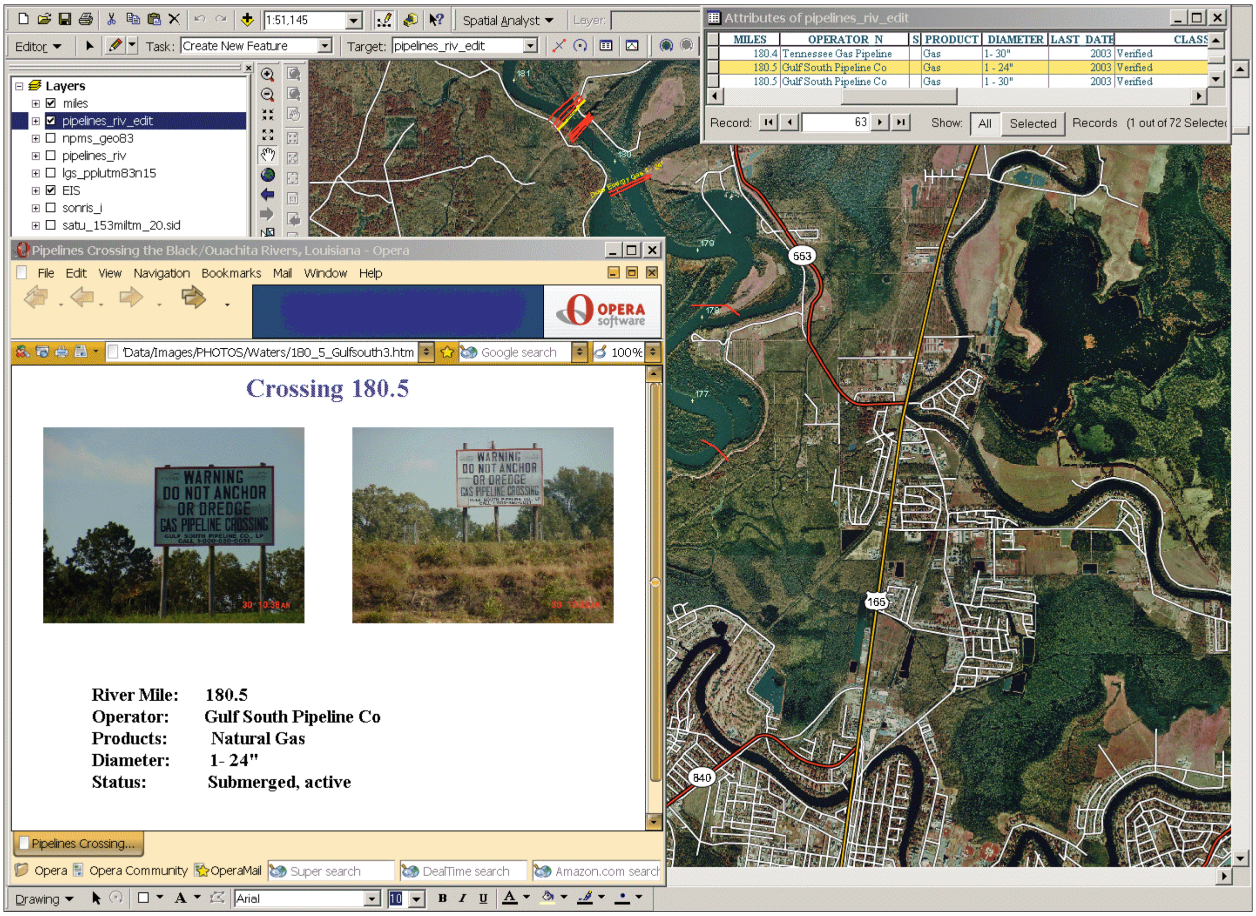

Figure 20 – Pipeline crossings in the GIS have hot links to data tables and HTML files with site photography. Base map data and both LANDSDAT and DOQQ imagery is included.

3.3.2 Analysis

Each crossing was examined and cross-checked with other data in an attempt to discover whether it could be a duplicate, phantom, omission or other cartographic error. Several instances of each error were corrected. Poorly located crossings with smaller scale source maps were adjusted to the more accurate GPS positions where data was available. Known name changes and mergers were added to the database. Extremely detailed and accurate DOQQ imagery enabled very precise positioning of crossings from visible traces and structures.

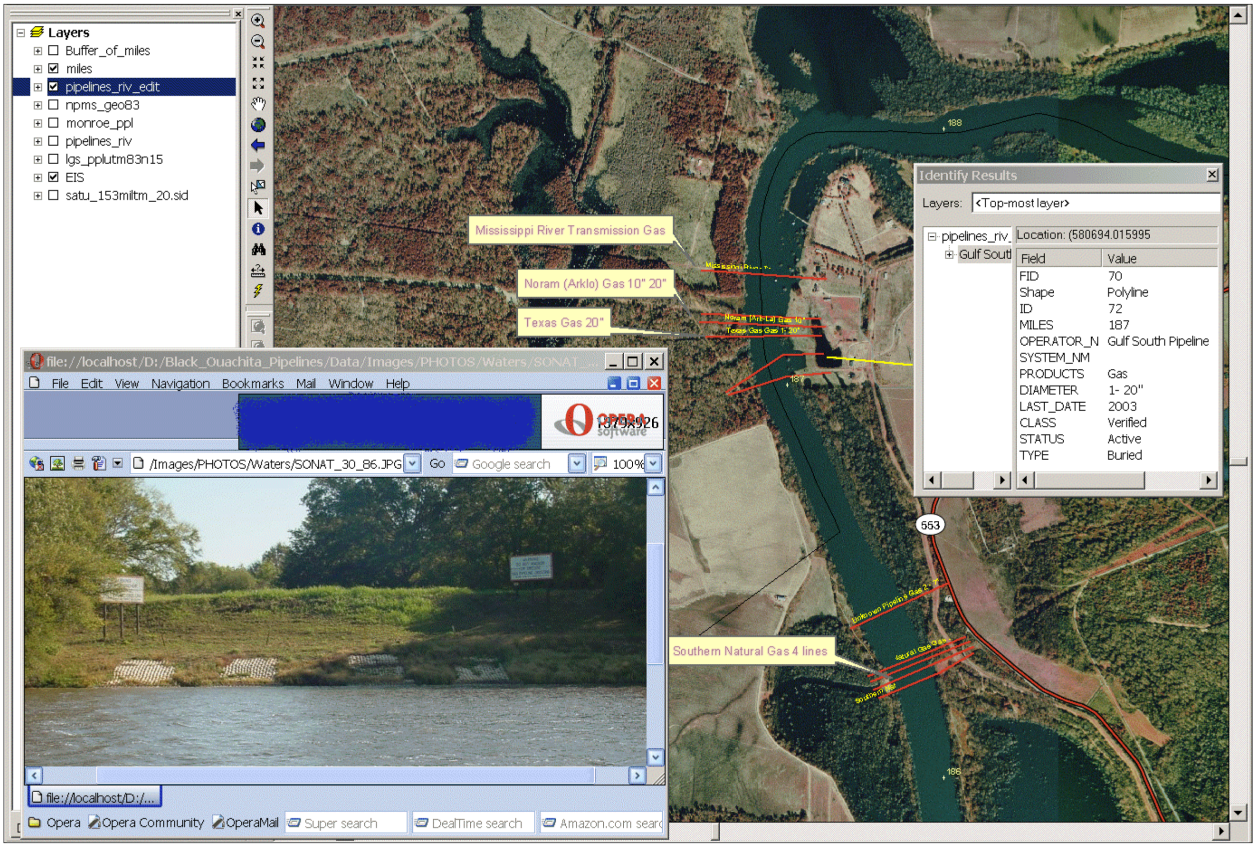

Figure 21 – Individual photos and GIS data information can also be accessed

3.3.3 Crossing categories

Each crossing and their intrinsic pipelines fell into one of three categories indicated on the maps and in the GIS:

Verified – Crossings that are documented on one of the reference maps and verified and/or updated by field investigation with GPS. Both spatial accuracy and thematic information are considered high on these crossings. Verified crossings =58 (61 pipelines)

Unverified – Crossings that are documented on the reference maps but were not verified in the field. Occasionally no evidence of a documented pipeline could be found in the field. Some of these would eventually prove to be abandoned pipelines. Others are likely unconfirmed abandoned lines, cartographic errors, or "phantom" lines. Most of these crossings have good thematic data but their spatial accuracy is unproven. Unverified crossings = 12 (14 pipelines)

Abandoned – Crossings that were not found by the field investigation but for which published documentation could be found that the crossings had been abandoned. Abandoned Crossings = 7 (7 pipelines)

3.3.4 Linked files

Each crossing in the GIS has a Hyper Text Markup Language (HTML) file associated with it by hyperlink. This document (shown in a pop-up window) lists information about the crossing and included one to five individual digital photographs taken at the site. The individual photos are also hyperlinked and can be accessed by a double-click.

3.3.5 Metadata

A metadata file compliant with FGDC standards for metadata was created. This file describes the sources, quality, and limitations of the data used in the project.

3.4 Project statistics

The GIS database was queried for data categories shown below:

3.4.1 Pipeline crossings

The total number of pipeline crossings of the main channel of the Ouachita/Black River System that were investigated is 77, comprising 82 individual pipelines.

(see Appendix B, C, and D for crossings list)

3.4.2 Pipeline operators

The number of operators of pipelines crossing the Ouachita/Black River System is 43.

(see Appendix E for operators list)

3.4.3 Products

Raw and refined products carried in Ouachita/Black River System pipeline crossings.

product	*pipelines*
unidentified, abandoned	7
crude oil/petroleum	11
natural gas	61
ammonia	2
carbon dioxide	1
Total	82

4.0 Conclusions and Recommendations

4.1 Conclusions

This project work plan proved to be effective in accurately locating pipeline crossings using multiple criteria. Errors in source maps were discovered, previously unmapped crossings were added, and much thematic information was updated.

The global positioning system receiver enabled heretofore unachievable spatial accuracy for such a project. It not only gave precise positions that would otherwise have involved expensive land surveyors, but it enabled a rapid schedule that made the project small enough to be timely and affordable. GPS also improved the efficiency of the field team by solving problems in determining between conflicting positions on source maps by providing instant spatial data and eliminating many hours of map analysis and eliminating dead reckoning.

It was disappointing when access to a potential crossing site was not available. Many crossings could not have been verified by GPS without boat investigation. While there will always be areas among wharves, shipyards, and casinos where intense development prevents access, other areas could not be investigated since the field schedule allowed little time for landowners to be sought for permission to cross posted property. The GIS pipeline crossing data is being bundled with a TM (satellite) and DOQQ (aerial) image base in ArcView 8.3 and appropriate vector base map elements for use on an ArcView GIS system.

4.2 Recommendations

It is suggested that the methodology for future projects be modified as a result of experience gained, if time and resources permit,. It is also recommended that this type of investigation be applied to the other major Louisiana waterways that are navigable or subject to flooding.

A few pipelines could not be properly investigated in the field due to lack of access. This project was intended to be a timely assessment for immediate use by oil spill planners and responders and was not handicapped because of poor access to some sites. However if future resources allow for more time and money, these access considerations could be addressed. The following suggestions are made:

- Modify the project budget and schedule to allow time for landowners of posted properties to be located and permission sought to cross private property. There was more private property than anticipated that needed to be crossed, mostly with no indication of who the owner was. Searching courthouse records and visiting residences to ask questions or obtain permits can add significant time to the field effort.
- In some areas it may be more efficient to use a helicopter. The time needed to obtain permits to cross private property is eliminated with overflight access. Also the increased speed of travel over boats could prove less expensive in the long run.

The pipeline operator information, products carried, pipe diameter and especially the contact phone numbers were mostly out of date on the reference maps and often conflicted with the witness post information. In a more comprehensive project, with adequate time and resources, acquisition of these data could be improved. The following suggestions are made:

- Broaden the scope of the research phase by an alliance with the state and/or federal pipeline regulatory agencies. Since neither LGS nor LOSCO/OSRADP is a regulatory agency and these operators are by no means required to cooperate with us or respond in a timely manner to requests, LGS sometimes made little headway in direct contacts with operators. The authority of the Louisiana Commissioner of Conservation, The State Police, or perhaps even the Governor could require the operators to promptly provide the latest information on their pipeline crossings to future projects.
- The operators, if cooperative, could even assist the team in visiting their remote crossings since it is assumed that they have the needed gate keys and permissions to perform their required inspections and maintenance.
- Recent miniaturization and improvements in magnetic detection devices and new technologies such as ground penetrating radar may offer field capability to identify misplaced or abandoned pipelines. Cost/benefit assessment needs to be conducted with the new technologies.
- OSRADP and LOSCO should classify pipeline data into public and restricted categories and establish a policy to restrict access to sensitive data to those with an established need-to-know. Much pipeline information is already public and should not be restricted, however other data (including precise river crossings data) may have real security implications if it were to be openly shared.

4.3 Suggestions for future research

Other major Louisiana rivers and waterways are navigable and subject to pipeline ruptures from dragging anchors and channel dredging. Most large Louisiana rivers are also subject to damaging floods that endanger pipeline crossings from bank and levee failures and from channel scouring and migration. The following Louisiana waterways are recommended for future mapping projects:

Calcasieu River and estuary – Navigable to ocean vessels in its lower reaches, the Calcasieu River is undammed and subject to flooding.

Amite River – Navigable to barge traffic in its lower reaches, the Amite suffers some of the most damaging flooding problems in Louisiana.

Mississippi River Gulf Outlet – This major shipping channel suffers risk from shipwrecks, anchors, coastal land loss and dredging.

Major lakes_– Lake Pontchartrain, Lake Maurepas, and portions of Sabine Lake, Calcasieu Lake, and Grand Lake are navigable and subject to hazards. Caddo, D'arbonne, and Catahoula lakes are not navigable, but are major fresh-water lakes subject to contamination by pipelines that cross them.

Navigation channels – Other navigable waterways subject to shipwreck, anchor, and dredging damage to pipelines include the Houma Navigation Channel, Six Mile Canal, and the Bayou Barataria Waterway.

4.4 Information dissemination and new security concerns

When this project was proposed it was intended to give the data as wide a distribution as possible since there are many public agencies that need pipeline data for economic planning, environmental remediation, risk management, tax assessment, and research as well as for oil spill response. Wide distribution was to have included making copies of the CD-ROM deliverable available, adding the data to the next edition of the Louisiana GIS CD, and posting the data on the Louisiana Geographic Information Center (LAGIC) Internet web site.

However since the events of 9/11/2001, the Federal government has acted to limit the availability of its digital pipeline data. It has been removed from the Office of Pipeline Safety's (OPS) National Pipeline Mapping System (NPMS) website and all users must request access in writing from the OPS. As the Louisiana repository of the NPMS data, the Louisiana Geological Survey has complied and no longer distributes NPMS pipeline data to the general public.

Natural gas and hazardous liquid pipelines are part of the critical national infrastructure. It is true that much pipeline information is already publicly available, nevertheless the increasing accuracy and accessibility of GIS data could be used by terrorists to target specific areas, determine sensitive locations, and estimate human and ecological damage from a contemplated terrorist act. We feel that pipeline river crossings constitute sensitive locations.

While the state of Louisiana has not yet established a general policy for the distribution of data regarding sensitive security-related infrastructures, we think it is prudent to do so anyway. Consequently, we are recommending that LOSCO and OSRADP limit distribution of this data to agencies with a legitimate need to know. In addition we will not be uploading any of this data to the Internet, or distributing copies of the deliverables to entities other than OSRADP.

We further recommend that LOSCO establish a policy for classification and distribution of sensitive infrastructure data so that the public's right-to-know is balanced against important security concerns.

5.0 Deliverables

The deliverable products associated with this project are as follows:

5.1 Geographic information system

The primary deliverable of the project is a geographic information system (GIS) of the oil and gas pipeline crossings of the Ouachita/Black River System in Louisiana. It is delivered on CD-ROM. The pipeline crossing data is bundled here with the 25 meter LANDSAT Thematic Mapper (TM) satellite imagery of Louisiana, the 10-meter DOQQ imagery of the river corridor, and appropriate vector base map elements from the Louisiana GIS CD. The crossing data are completely georeferenced and designed to overlay digital raster graphs (DRG) or digital line graph (DLG) version of the USGS topographic maps or whatever alternate digital bases that are used by LOSCO on their in-house geographic information system. The digital GIS files will be in ArcView 8.3 format. An FGDC-compliant metadata file is also included on the CD-ROM as well as an Adobe Acrobat (.PDF) files of the final report.

5.2 Hardcopy map set

A set of hardcopy color maps of the pipeline crossings of the Ouachita/Black River System in Louisiana is delivered. The maps are at a scale of 1:24,000 and include the DOQQ imagery as a base. These maps will also be available as Acrobat (.PDF) digital files on the CD-ROM.

5.3 Report

A comprehensive report on the pipeline crossings of the Ouachita/Black River System in Louisiana is delivered. It includes project results and suggestions for future research and is provided in both hardcopy and as an Acrobat (.PDF) digital file.

6.0 References

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Appendix A
Database Definitions

Black/Ouachita Rivers Crossing Database Structure

Entity	Type	Length (bits)	Description
ID	text	8	unique number for identifying pipeline crossing
River Mile	number	8	river channel miles above the old river junction
Class	text	16	pipeline crossings are classified as: verified, unverified, and abandoned.
Status	text	9	indicating the status of crossings, active or Abandoned.

Pipeline Database Structure

Entity	Type	Length (bits)	Description
River_mile	number	8	river channel miles above the old river junction
Product	text	24	names of product(s) carried
Diameter	text	24	nominal diameter of pipe
Ops_num	number	5	unique identification number for an operator
Operator	text	40	name of pipeline operator
Cross_type	text	24	type of pipeline crossings: aerial or submerged
Last_date	text	8	Date of last modification.

Pipeline Operator Database Structure

Entity	Type	Length (bits)	Description
Lgs_num	number	10	unique identification number for an operator
Oper_nm	text	39	name of pipeline operator
Opsabr	text	5	abbreviation of operator name
Emergency	text	14	emergency call number of pipeline operator
Street_address	text	38	street name and street number of mailing address
City	text	14	city name of mailing address
State	text	6	state name of mailing address
Zip	text	10	zip code
Cont_ph	text	15	contact phone number
Parent_com	text	27	company of pipeline ownership
Updated	text	9	last date of modification

Appendix B
Verified Pipeline Crossings

ID	MILES	CLASS	STATUS	TYPE	PRODUCT S	DIAMETER	OPERATOR	LAST_DATE
1	13.0	Verified	Active	Buried	Crude	1 - 4"	Ashland Crude Line	2003
3	40.6	Verified	Active	Buried	Crude	1 - 4"	Ashland Crude Line	2003
4	42.8	Verified	Active	Buried	Crude	1 - 4"	Scurlock Permian	2003
8	76.1	Verified	Active	Buried	Gas	1 - 30"	Tennessee Gas Pipeline	2003
9	79.8	Verified	Active	Buried	Gas	1- 30"	Columbia Gulf Trans.	2003
10	79.8	Verified	Active	Buried	Gas	1- 36"	Columbia Gulf Trans.	2003
11	79.9	Verified	Active	Buried	Gas	1- 30"	Columbia Gulf Trans.	2003
12	84.3	Verified	Active	Buried	Gas	1- 30"	ANR Pipeline	2003
13	84.4	Verified	Active	Buried	Gas	1- 30"	ANR Pipeline	2003
15	112.3	Verified	Active	Buried	Gas	1- 30"	Trunkline Gas	2003
14	112.4	Verified	Active	Buried	Crude	1- 26"	Marathon Petroleum	2003
16	112.4	Verified	Active	Buried	Gas	1- 36"	Trunkline Gas	2003
17	114.1	Verified	Active	Buried	Gas	1 - 26"	Texas Gas	2003
18	114.1	Verified	Active	Buried	Gas	1 - 30"	Texas Gas	2003
20	128.2	Verified	Active	Buried	Gas	1 - 8"	Mid-Louisiana Gas Co	2003
23	159.7	Verified	Active	Buried	Gas	1 - 10"	Lousiana Intrastate Gas	2003
24	171.6	Verified	Active	Buried	Gas	2 - 6"	Koch Gateway (U.G.)	2003
25	171.7	Verified	Active	Buried	Gas	1 - 7"	Koch Gateway (U.G.)	2003
26	171.8	Verified	Active	Buried	Gas	1 - 7"	Koch Gateway (U.G.)	2003
27	171.9	Verified	Active	Buried	Gas	1 - 6"	Mid-La Gathering Co	2003
28	176.0	Verified	Active	Buried	Gas	1 - 6"	Gulf South Pipeline Co	2003
31	179.8	Verified	Active	Buried	Gas	1 - 20"	Duke Energy	2003
32	179.8	Verified	Active	Buried	Gas	1 - 24"	Duke Energy	2003
33	180.3	Verified	Active	Buried	Gas	1 - 24"	Tennessee Gas Pipeline	2003
34	180.4	Verified	Active	Buried	Gas	1- 30"	Tennessee Gas Pipeline	2003
35	180.4	Verified	Active	Buried	Gas	1- 30"	Tennessee Gas Pipeline	2003
36	180.4	Verified	Active	Buried	Gas	1- 30"	Tennessee Gas Pipeline	2003
37	180.5	Verified	Active	Buried	Gas	1 - 24"	Gulf South Pipeline Co	2003
38	180.5	Verified	Active	Buried	Gas	1 - 30"	Gulf South Pipeline Co	2003
39	180.5	Verified	Active	Buried	Gas	1 - 30"	Gulf South Pipeline Co	2003
40	180.6	Verified	Active	Buried	Gas	1 - 24"	Noram (Ark-La)	2003
41	183.9	Verified	Active	Buried	Gas	1 - 6"	Primos Production Co	2003
43	186.3	Verified	Active	Buried	Gas	1- 14"	Southern Natural Gas	2003
44	186.3	Verified	Active	Buried	Gas	1- 14"	Southern Natural Gas	2003
45	186.3	Verified	Active	Buried	Gas	1- 20"	Southern Natural Gas	2003
71	186.3	Verified	Active	Buried	Gas	1- 20"	Southern Natural Gas	2003
69	186.5	Verified	Active	Buried	Gas	10", 18"	EnerVest Operating	2003
46	187.0	Verified	Active	Buried	Gas	1- 18"	Gulf South Pipeline	2003
72	187.0	Verified	Active	Buried	Gas	1- 20"	Gulf South Pipeline	2003

47	187.1	Verified	Active	Buried	Gas	1- 20"	Texas Gas	2003
49	187.2	Verified	Active	Buried	Gas	10"	Noram (Ark-La)	2003
48	187.2	Verified	Active	Buried	Gas	20"	Noram (Ark-La)	2003
50	187.3	Verified	Active	Buried	Gas	1- 18"	Mississippi River Trans.	2003
51	190.5	Verified	Active	Buried	Gas	1- 16"	Noram (Ark-La)	2003
52	190.8	Verified	Active	Buried	Gas	1- 12"	United American Gas Systems Inc	2003
53	191.1	Verified	Active	Buried	Ammonia	6"	Kaneb Ammonia	2003
54	191.1	Verified	Active	Buried	Ammonia	4"	Kaneb Ammonia	2003
55	191.3	Verified	Active	Buried	CO2	1- 16"	Phillips Petroleum	2003
56	191.3	Verified	Active	Buried	Gas	1- 12"	EnerVest Operating	2003
57	192.7	Verified	Active	Buried	Gas	1- 12"	Duke Energy	2003
58	192.7	Verified	Active	Buried	Gas	1- 16"	Duke Energy	2003
59	193.1	Verified	Active	Buried	Gas	1- 16"	Mid-Louisiana Pipeline	2003
60	194.5	Verified	Active	Buried	Gas	10", 12"	Coho Production Co	2003
61	194.5	Verified	Active	Buried	Gas	1- 16"	Coho Production Co	2003
63	202.4	Verified	Active	Buried	Gas	1- 12"	Gulf South Pipeline Co	2003
65	205.7	Verified	Active	Buried	Gas	1- 16"	Gulf South Pipeline Co	2003
67	208.8	Verified	Active	Buried	Gas	1 - 26"	Texas Gas	2003
68	213.5	Verified	Active	Buried	Crude	1 - 20"	Mid-Valley Petroleum	2003

Appendix C
Unverified Pipeline Crossings

ID	MILES	CLASS	STATUS	TYPE	PRODUCTS	DIAMETER	OPERATOR	LAST_DATE
2	33.0	Unverified		Buried	Crude	1 - 2"	Ashland Crude Line	1992
5	50.6	Unverified		Buried	Crude	1 - 2"	Ashland Crude Line	1992
6	53.3	Unverified		Buried	Crude	1 - 2"	Ashland Crude Line	1992
7	59.5	Unverified		Buried	Crude	1 - 4"	Ashland Crude Line	1992
19	116.0	Unverified		Buried	Gas	2 -12"	Louisiana Intrastate Gas	1992
21	130.2	Unverified		Buried	Gas	1 - 8"	Pine Gas Pipeline	1992
22	154.6	Unverified		Buried	Gas	1 - 4"	Pine Gas Pipeline	1992
29	176.6	Unverified		Buried	Gas	1 - 6"	Mid-La Gathering Co	1992
30	178.1	Unverified		Buried	Gas	1 - 6"	Mid-La Gathering Co	1992
62	200.1	Unverified		Buried	Gas	1 - 6"	Noram (Ark-La)	2003
64	205.7	Unverified		Buried	Gas	4"	Mid-La Gathering Co	2003
66	205.7	Unverified		Buried	Gas	4", 6"	Mid-La Gathering Co	2003

Appendix D
Abandoned Pipeline Crossings

ID	MILES	CLASS	STATUS	TYPE	PRODUCTS	DIAMETER	OPERATOR	LAST_DATE
76	180.6	Abandoned	Abandoned	Buried			Mid-La Gathering Co	2003
73	180.6	Abandoned	Abandoned	Buried			Mid-La Gathering Co	2003
42	185.5	Abandoned	Abandoned	Buried		1 - 6"	Mid-La Gathering Co	2003
77	189.6	Abandoned	Abandoned	Buried			Mid-La Gathering Co	2003
74	190.1	Abandoned	Abandoned	Buried			Mid-La Gathering Co	2003
70	190.8	Abandoned	Abandoned	Buried		1- 18"	Mid-La Gathering Co	2003
75	190.9	Abandoned	Abandoned	Buried			Mid-La Gathering Co	2003

Appendix E
Operators of Pipeline Crossings

OPER_CD	OPER_NM	EMERGENCY CALL	ADDRESS	CITY	STATE	ZIP	PHONE	Note
ANR	ANR Pipeline Company	(800) 231-2800	Nine Greensway Plaza	Houston	TX	77046	713-336-5000	El Paso Corp
ASH	Ashland Inc	(318) 757-4138	1000 Ashland Drive	Russell	KY	41169	(606) 329-3333	Scurlock Permian Corporation
CEGT	CenterPoint Energy Gas Trans. Co	(713) 207-5184	1111 Louisiana, 11th Floor	Houston	TX	77002	(713) 207-5184	Former: Arkla Gas
COHO	Coho Louisiana Production Co	(318) 665-4506	178 Lee Morgan Road	Sterlington	LA	71280	(318) 665-2054	Coho Energy, Inc. bankruptcy, 2002
CGT	Colombia Gulf Transmission Co	(713) 621-0101	2603 Augusta Suite 125	Houston	TX	77057	713 621-0101	
DUKE	Duke Energy Corp.	(888) 204-1481	5400 Westheimer Court	Houston	TX	77056	(318) 255-9494	Duke Energy
ENER	EnerVest Operating LLC	(318) 665-4506		Fairbanks	LA			
EPC	El Paso Corp.	(800)-231-2800	1001 Louisiana Street	Houston	TX	77002	(713) 420-2600	
GSG	Gulf South Gas LP	(318) 665-4408	P.O. Box 1478	Houston	TX	77251	713-544-4796	
KAN	Kaneb Pipe Line LP	(800) 666-0180	7340 W 21 St. N, Suite 200	Wichita	KS	67205	(316) 773-9000	
KOCH	Koch Gateway Pipeline Co		PO Box 2256	Wichita	KS	67201	316-832-5500	Gulf South Gas Co.
LIG	Louisiana Intrastate Gas Corp.	(318) 445-4568	1100 Louisiana, Suite 3300	Houston	TX	77002	(318) 445-8225	Enbridge Energy L.P.
MAP	Marathon-Ashland Pipe Line LLC	(800) 537-6644	PO Box 3128	Houston	TX	77253	(713) 629-6600	
MID-LO	Mid Louisiana Gas Co	(318) 665-4426	1200 SMITH ST STE 1850	Houston	TX	77002	(713) 646-9500	Enbridge Energy L.P.
MID-LOG	Mid-Louisiana Gathering Co		P.O. Box 5008	Fairbanks	LA	71240		Last Updated 3/2/1993
MRT	Mississippi River Transmission Inc	(713) 207-5184	1111 Louisiana, 11th Floor	Houston	TX	77002	(713) 207-5184	CenterPoint Energy
MVP	Mid-Valley Pipeline Co	(800) 753-5531	P.O. Box 2039	Tulsa	OK	74120	800-753-5531	Warex Terminals Corporation
NORAM	Noram Pipeline Service	(800) 422-7552	1111 Louisiana, 11th Floor	Houston	TX	77002	(713) 207-5184	CenterPoint Energy-Arkla Energy
PHIL	Philips Petroleum Inc	(501) 725-3666	600 North Dairy Ashford	Houston	TX	77079	(281) 293-1000	ConocoPhillips

PINE	Pine Pipeline Inc		525 Milam St.	Shreveport	LA	71101		
PRIMO	Primos Production Inc	(318) 643-0932	619 North 5th Street	Monroe	LA	71201	(318) 643-0932	
SCUR	Scurlock Permian Corporation	(318) 757-4138	333 Clay Ste 2900	Houston	TX	77002	(713) 739-4100	
SONAT	Southern Natural Gas Co	(800) 252-5960	1900 Fifth Avenue North	Birmingham	AL	35203	205-325-7401	El Paso Corp
TGP	Tennessee Gas Pipeline Co	(800) 231-2800	Nine Greensway Plaza	Houston	TX	77046	713-420-4600	El Paso Corp
TET	Texas Eastern Transmission Co	(800) 231-7794	5400 Westheimer Court	Houston	TX	77056	(318) 255-9494	Duke Energy Gas Transmission
TGT	Texas Gas Transmission Co	(800) 626-1948	3800 Frederica Street	Owensboro	KY	42304	(502) 926-8686	Williams Companies
TKLG	Trunkline Gas Co	(800) 223-3913	P.O. Box 4967; 5444 Westheimer	Houston	TX	77056	713-989-7000	CMS Panhandle Companies
UAGS	United American Gas Systems Inc	(318) 323-4007		Monroe	LA	71201	318-323-4007	new pipeline operator

Appendix F – Pipeline Crossing Data Sheets

Crossing 13.0

River Mile: 13.0
Operator: Ashland Petroleum Co
Products: Petroleum
Diameter: 1- 4"
Status: Buried, active

Crossing 40.6

River Mile: 40.6
Operator: Ashland(?)Petroleum Co
Products: Petroleum
Diameter: 1- 4"
Status: Buried, active

Crossing 42.8

River Mile: 42.8
Operator: Scurlock Permian Petroleum Co
Products: Petroleum
Diameter: 1- 4"
Status: Buried, active

Crossing 76.1

River Mile: 76.1
Operator: Tennessee Gas Pipeline Co
Products: Natural Gas
Diameter: 1- 30"
Status: Buried, active

Crossing 79.8

River Mile: 79.8
Operator: Columbia Gulf Transmission Co
Products: Natural Gas
Diameter: 1- 36"
Status: Buried, active

Crossing 79.8

River Mile: 79.8
Operator: Columbia Gulf Transmission Co
Products: Natural Gas
Diameter: 1- 30"
Status: Buried, active

Crossing 79.9

River Mile: 79.9
Operator: Columbia Gulf Transmission Co
Products: Natural Gas
Diameter: 1- 30"
Status: Buried, active

Crossing 84.3

River Mile: 84.3
Operator: ANR Pipeline Co
Products: Petroleum
Diameter: 1- 30"
Status: Buried, active

Crossing 84.4

River Mile: 84.4
Operator: ANR Pipeline Co
Products: Natural Gas
Diameter: 1- 30"
Status: Buried, active

Crossing 112.3

River Mile: 112.3
Operator: Trunkline Gas Co
Products: Natural Gas
Diameter: 1- 30"
Status: Buried, active

Crossing 112.4

River Mile: **112.4**
Operator: **Marathon Ashland Pipeline LLC**
Products: **Petroleum**
Diameter: **1- 26"**
Status: **Buried, active**

Crossing 112.4

River Mile: 112.4
Operator: Trunkline Gas Co
Products: Natural Gas
Diameter: 1- 36"
Status: Buried, active

Crossing 114.1

River Mile: 114.1
Operator: Texas Gas Transmission Co
Products: Natural Gas
Diameter: 1- 30"
Status: Buried, active

Crossing 114.1

River Mile: 114.1
Operator: Texas Gas Transmission Co
Products: Natural Gas
Diameter: 1- 26"
Status: Buried, active

Crossing 128.2

River Mile: 128.2
Operator: Mid-Louisiana Gas Co
Products: Natural Gas
Diameter: 1- 8"
Status: Buried, active

Crossing 159.7

River Mile: 159.7
Operator: Louisiana Intrastate Gas Corp
Products: Natural Gas
Diameter: 1- 10"
Status: Buried, active

Crossing 171.6

River Mile: 171.6
Operator: Gulf South Pipeline Co
Products: Natural Gas
Diameter: 2- 6"
Status: Buried, active

Crossing 171.7

River Mile: 171.7
Operator: Gulf South Pipeline Co
Products: Natural Gas
Diameter: 1- 7"
Status: Buried, active

Crossing 176

River Mile: 176
Operator: Gulf South Pipeline Co
Products: Natural Gas
Diameter: 1- 6"
Status: Buried, active

Crossing 179.8

River Mile: 179.8
Operator: Duke Energy Corp (Texas Eastern Transmission)
Products: Natural Gas
Diameter: 1- 20"
Status: Buried, active

Crossing 179.8

River Mile: 179.8
Operator: Duke Energy Corp (Texas Eastern Transmission)
Products: Natural Gas
Diameter: 1- 24"
Status: Buried, active

Crossing 180.4

River Mile: 180.4
Operator: Tennessee Gas Pipeline Co
Products: Natural Gas
Diameter: 1- 30"
Status: Buried, active

Crossing 180.4

River Mile: 180.4
Operator: Tennessee Gas Pipeline Co
Products: Natural Gas
Diameter: 1- 30"
Status: Buried, active

Crossing 180.4

River Mile: 180.4
Operator: Tennessee Gas Pipeline Co
Products: Natural Gas
Diameter: 1- 30"
Status: Buried, active

Crossing 180.4

River Mile: **180.4**
Operator: **Tennessee Gas Pipeline Co**
Products: **Natural Gas**
Diameter: **1- 24"**
Status: **Buried, active**

Crossing 180.5

River Mile: 180.5
Operator: Gulf South Pipeline Co
Products: Natural Gas
Diameter: 1- 30"
Status: Buried, active

Crossing 180.5

River Mile: 180.5
Operator: Gulf South Pipeline Co
Products: Natural Gas
Diameter: 1- 30"
Status: Buried, active

Crossing 180.5

River Mile: 180.5
Operator: Gulf South Pipeline Co
Products: Natural Gas
Diameter: 1- 24"
Status: Buried, active

Crossing 180.6

River Mile: 180.6
Operator: CenterPoint Energy (Arkla Gas)
Products: Natural Gas
Diameter: 1- 24"
Status: Buried, active

Crossing 180.6

River Mile: 180.6
Operator: Mid-La Gathering Co
Products:
Diameter:
Status: Buried, Abandoned

Crossing 183.9

River Mile: 183.9
Operator: Primos Production Company
Products: Natural Gas
Diameter: 1- 6"
Status: Buried, active

Crossing 186.3



River Mile: 186.3
Operator: Southern Natural Gas Company
Products: Natural Gas
Diameter: 1- 14"
Status: Buried, active

Crossing 186.3



River Mile: 186.3
Operator: Southern Natural Gas Company
Products: Natural Gas
Diameter: 1- 14"
Status: Buried, active

Crossing 186.3

River Mile: 186.3
Operator: Southern Natural Gas Company
Products: Natural Gas
Diameter: 1- 20"
Status: Buried, active

Crossing 186.5

River Mile: 186.5
Operator: EnerVest Operating LLC
Products: Natural Gas
Diameter: 2 x 12" lines
Status: Buried, active

Crossing 187.1

River Mile: 187.1
Operator: Texas Gas Transmission Co
Products: Natural Gas
Diameter: 20"
Status: Buried, active

Crossing 187.2

River Mile: 187.2
Operator: CenterPoint Energy Corp (Ark-La Gas)
Products: Natural Gas
Diameter: 20"
Status: Buried, active

Crossing 187.3

River Mile: 187.3
Operator: Mississippi River Transmission Pipeline Co
Products: Natural Gas
Diameter: 18"
Status: Buried, active

Crossing 187

River Mile: 187
Operator: Gulf South Pipeline Co
Products: Natural Gas
Diameter: 18"
Status: Buried, active

Crossing 187

River Mile: 187
Operator: Gulf South Pipeline Co
Products: Natural Gas
Diameter: 20"
Status: Buried, active

Crossing 189.6

River Mile: 189.6
Operator: Mid-La Gathering Co
Products:
Diameter:
Status: Buried, Abandoned

Crossing 190.1

River Mile: 190.1
Operator: Mid-La Gathering Co
Products:
Diameter:
Status: Buried, Abandoned

Crossing 190.5

River Mile: 190.5
Operator: CenterPoint Energy Corp (Ark-La Gas)
Products: Natural Gas
Diameter: 16"
Status: Buried, active

Crossing 190.8

River Mile: 190.8
Operator: Mid-La Gathering Co
Products:
Diameter:
Status: Buried, Abandoned

Crossing 190.8

River Mile: 190.8
Operator: United American Gas Systems, Inc. (formerly United Gas)
Products: Natural Gas
Diameter: 12"
Status: Buried, active

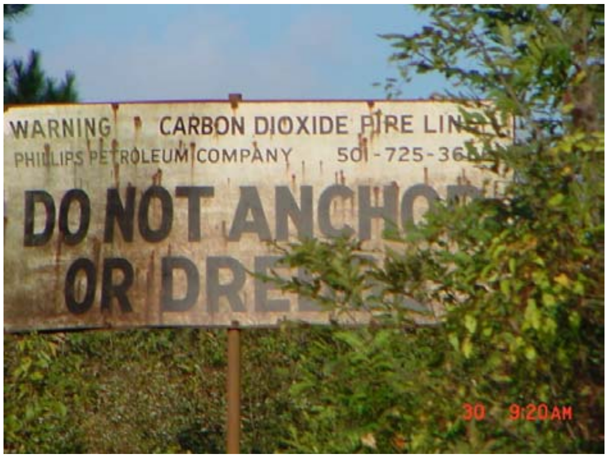
Crossing 191.1

River Mile: 191.1
Operator: Kaneb Pipe Line Partnership L.P.(Registrant)
Products: Anhydrous Ammonia
Diameter: 6"
Status: Buried, active

Crossing 191.1

River Mile: 191.1
Operator: Kaneb Pipe Line Partnership L.P.(Registrant)
Products: Anhydrous Ammonia
Diameter: 4"
Status: Buried, active

Crossing 191.3



River Mile: 191.3
Operator: Phillips Petroleum Co
Products: Carbon Dioxide
Diameter: 16"
Status: Buried, active

Crossing 191.3

River Mile: 191.3
Operator: EnerVest Operating LLC
Products: Natural Gas
Diameter: 12"
Status: Buried, active

Crossing 190.9

River Mile: 190.9
Operator: Mid-La Gathering Co
Products:
Diameter:
Status: Buried, Abandoned

Crossing 192.7

River Mile: 192.7
Operator: Duke Energy Corp
Products: Natural Gas
Diameter: 16"
Status: Buried, active

Crossing 192.7

River Mile: **192.7**
Operator: **Duke Energy Corp**
Products: **Natural Gas**
Diameter: **12"**
Status: **Buried, active**

Crossing 193.1

River Mile: 193.1
Operator: Mid-Louisiana Gas Co
Products: Natural Gas
Diameter: 16"
Status: Buried, active

Crossing 194.5

River Mile: 194.5
Operator: Coho Louisiana Production Co
Products: Natural Gas
Diameter: 12" & 16"
Status: Buried, active

Crossing 194.5

River Mile: 194.5
Operator: Coho Louisiana Production Co
Products: Natural Gas
Diameter: 12" & 10"
Status: Buried, active

Crossing 202.4

River Mile: 202.4
Operator: Gulf South Gas Pipeline (formerly United Gas)
Products: Natural Gas
Diameter: 12"
Status: Buried, active?

Crossing 205.7

River Mile: 205.7
Operator: Gulf South Gas Pipeline Company
Products: Natural Gas
Diameter: 1 - 4", 1-6" ?
Status: Buried, active

Crossing 208.8

River Mile: 208.8
Operator: Texas Gas Transmission Corp.
Products: Natural Gas
Diameter: 1 - 26"
Status: Buried, active

Crossing 213.6

River Mile: 213.6
Operator: Mid-Valley Pipeline Company
Products: Crude Oil
Diameter: 1 - 20"
Status: Buried, active

Appendix G – Metadata

Pipeline Crossings of the Ouachita/Black River System in Louisiana

Metadata:

- Identification_Information
- Spatial_Data_Organization_Information
- Spatial_Reference_Information
- Entity_and_Attribute_Information
- Distribution_Information
- Metadata_Reference_Information

Identification_Information:
Citation:
Citation_Information:
Originator: Louisiana Geological Survey, Louisiana State University
Publication_Date: June, 2004
Title: pipeline_cross
Edition: 1.0
Geospatial_Data_Presentation_Form: vector digital data
Publication_Information:
Publication_Place: Baton Rouge
Publisher:
Louisiana Applied and Educational Oil Spill Research and Development Program
Online_Linkage: ..\Data\Shapefiles\Pipelines\pipeline_cross.shp
Larger_Work_Citation:
Citation_Information:
Originator: John Snead, Robert Paulsell, and Weiwen Feng
Publication_Date: June, 2004
Title:
Field Investigation and Digital Mapping of Pipeline Crossings of the Ouachita/Black River System in Louisiana
Edition: 1.0
Geospatial_Data_Presentation_Form: vector digital data
Publication_Information:
Publication_Place: Baton Rouge
Publisher: Louisiana Geological Survey

Description:
Abstract:
This dataset was developed based on the compilation of previously documented natural gas and liquid pipeline data from LGS in-house operator supplied source maps, National Pipeline Mapping System GIS data, 1992 Louisiana Parish Pipeline and Industrial Atlas by Design Technics Corporation, as well as the field investigation and verification of pipeline crossings of the Ouachita / Black River system. The attribute data for each crossing include river mile (indicating approximate location on river navigation maps), product (e.g. natural gas, crude oil, NGL, and refined products), class (verified or unverified), status (active or abandoned), diameter, operator name, types of crossing (aerial or buried), and last date (last modified year). The verified and abandoned crossing pipelines were identified by field investigation and determined with differentially corrected GPS positions. All of the available spatial crossing pipeline data were overlaped on raster USGS digital raster graphs topographic maps (1:24,000 scale) and Louisiana one-meter resolution DOQQ aerial photo imagery (1: 12,000 scale), and then the spatial accuracy of the docummented data were evaluated and assessed against the field collected crossing differential GPS positions (about 1-3 meter spatial precision). Spatial errors were then eliminated and spatial positions of the verified crossing pipeline data were adjusted to the nearest GPS-determined positions. The accuracy of the crossing pipeline data is compliant with the NPMS standard.
Purpose:
The purpose of this research is to provide up-to-date and accurate geospatial information about crossings of natural gas and liquid pipelines along the Ouachita / Black River system. The results of this study should benefit emergency response, river navigation safety, and the pipeline service industry.
Supplemental_Information:
The dataset of the pipeline crossings of the Ouachita / Black River system was compiled based on the availability of previously documented operator-supplied pipeline source maps, third-party provided documented pipeline information and GPS-equipped field investigation on river levee system and boat observation along the river channel. The LGS (data collector and investigator) and OSRADP (research sponsor and publisher) provide the dataset for reference only, and disclaim any warranty or responsibility of loss or damage due to use of the dataset for any specific purpose.
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: May, 2003
Ending_Date: May, 2004
Currentness_Reference: ground condition
Status:
Progress: Complete
Maintenance_and_Update_Frequency: None planned
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -92.174449
East_Bounding_Coordinate: -91.756243

North_Bounding_Coordinate: 32.926300
South_Bounding_Coordinate: 31.371857
Keywords:
Theme:
Theme_Keyword_Thesaurus: Oil, Gas, Chemicals, GIS
Theme_Keyword: Pipelines, Maps
Place:
Place_Keyword_Thesaurus: Ouachita, Black Rivers
Place_Keyword: Rivers, Louisiana
Access_Constraints: Restricted to authorised personnel only
Use_Constraints: consistent with data permission contract
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: John I. Snead
Contact_Organization: Louisiana Geological Survey, Louisiana State University
Contact_Position: Cartographic Manager
Contact_Voice_Telephone: 225 578-3454
Contact_Facsimile_Telephone: 225 578-3662
Contact_Electronic_Mail_Address: snead@lsu.edu
Hours_of_Service: 8:30 AM - 4:30 PM Mon - Fri
Contact_Instructions: Preference Contact by email.
Native_Data_Set_Environment:
Microsoft Windows 2000 Version 5.0 (Build 2195) Service Pack 4; ESRI ArcCatalog 8.3.0.800
Cross_Reference:
Citation_Information:
Originator: John Snead, Robert Paulsell, Weiwen Feng
Publication_Date: June, 2004
Title:
Field Investigation and Digital Mapping of Pipeline Crossings of the Ouachita/Black River System in Louisiana
Edition: 1.0
Geospatial_Data_Presentation_Form: Baton Rouge, Louisiana

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: String
Point_and_Vector_Object_Count: 77

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 15
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -93.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.000256
Ordinate_Resolution: 0.000256
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: pipeline_cross
Attribute:
Attribute_Label: FID
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain:
Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: Shape
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.
Attribute:
Attribute_Label: ID
Attribute:
Attribute_Label: MILES
Attribute:
Attribute_Label: CLASS
Attribute:
Attribute_Label: STATUS

Attribute:
Attribute_Label: TYPE
Attribute:
Attribute_Label: PRODUCTS
Attribute:
Attribute_Label: DIAMETER
Attribute:
Attribute_Label: OPERATOR
Attribute:
Attribute_Label: LAST_DATE
Attribute:
Attribute_Label: HOTLINK

Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Don Davis
Contact_Organization:
Louisiana Applied & Educational Oil Spill Research & Development Program
Contact_Position: Administrator
Contact_Address:
Address_Type: mailing address
Address: Louisiana State University, 258 A&B Military Science Building
City: Baton Rouge
State_or_Province: LA
Postal_Code: 70803
Country: USA
Contact_Voice_Telephone: (225) 578-3481
Contact_Facsimile_Telephone: (225) 578-0403
Contact_Electronic_Mail_Address: osradp@attglobal.net
Resource_Description: Downloadable Data
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Specification: ArcGIS Shapefile 8.x
File_Decompression_Technique: no compression applied
Transfer_Size: 0.040
Fees: none
Available_Time_Period:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: July, 2004

Metadata_Reference_Information:
Metadata_Date: 20040623

Metadata_Review_Date: 20040629
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Weiwen Feng
Contact_Organization: Louisiana Geological Survey, Louisiana State University
Contact_Position: GIS Specialist
Contact_Address:
Address_Type: mailing address
Address: Energy Coast & Environment Building, #3079
City: Baton Rouge
State_or_Province: LA
Postal_Code: 70803
Country: U.S.A.
Contact_Voice_Telephone: 225 578-5879
Contact_Facsimile_Telephone: 225 578-3662
Contact_Electronic_Mail_Address: wfeng@lsu.edu
Hours_of_Service: 8:30 AM - 4:30 PM weekdays
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Time_Convention: local time
Metadata_Security_Information:
Metadata_Security_Classification: Restricted
Metadata_Security_Handling_Description:
Send a request letter to the publisher or call Don Davis of OSRADP office at (225) 578-3481
Metadata_Extensions:
Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
Profile_Name: ESRI Metadata Profile

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