Research Report
KTC-89-16

EARTHQUAKE HAZARD MITIGATION OF TRANSPORTATION FACILITIES FOR WEBSTER COUNTY

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16. Abstract

Concern has grown in recent years over the seismic activity of the New Madrid seismic zone in Western Kentucky. Webster County, Kentucky is located in this region. To permit emergency medical, supply, and equipment traffic into this area after an earthquake has occurred, the Kentucky Transportation Cabinet is interested in the possibility of keeping selected routes passable. This report lists the routes that have been investigated and recommended as being the routes in Webster County that should be maintained in a passable condition. The recommended routes, KY 109 and US 41 have been visually surveyed and all seismically significant features cataloged. These features are logged by their location on strip maps contained in Appendix A and a detailed listing of all the potentially critical features is given in Appendix B.

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Earthquake Earthquake Mitigation Alluvium Seismic Analyses Modified Mercalli Scale	

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INTRODUCTION

An awareness of earthquakes and their possible effects upon the nation's infrastructure is critically important to the public, and in particular, to public officials. The nation's highway system is one of the most important components of the infrastructure. After the occurrence of an earthquake, the highway system is the primary mode of transporting emergency supplies and services into an affected area. Thus, it is important to catalog the important components of the highway system and attempt to anticipate the possible damage to these components from an earthquake.

Western Kentucky in general and Webster County in particular are in a high risk earthquake zone. In 1811-1812, three of the most severe earthquakes in American history shook the country. The location of these quakes was not on the infamous San Andreas fault nor anywhere along the well-known fault laden Pacific coast but was near a small town on the Mississippi River where the states of Kentucky and Missouri share a border (Figure 1). It is this river town, New Madrid, Missouri, that is the namesake of a region now regarded by seismologists and disaster response planners as the most hazardous earthquake zone east of the Rocky Mountains -- the New Madrid seismic zone.

In addition to these three great earthquakes, there are several other well documented factors demonstrating the susceptibility of the New Madrid region to the recurrence of major earthquakes. Through a decade of extensive research, an ancient crustal rift has been found to underlie the relatively shallow sediments comprising the region's surface. This type of geologic structure is prone to seismic activity. The New Madrid rift has been identified as being of sufficient size to generate major earthquakes. Further evidence of the area's seismicity is the record of over 2,000 earthquakes detected in the zone since 1974. Though most have been of a magnitude below the threshold of human perception, their existence clearly indicates the high level of seismic activity occurring in the zone.

Seismologists have calculated the probabilities of recurrence of sizeable earthquakes in the New Madrid rift zone. The probability of a magnitude 6.3 earthquake (Richter scale) within 50 years is from 86 to 97 percent. The probability (1) of that same earthquake occurring within the next 15 years is from 40 to 63 percent. For comparison, the 1971 San Fernando earthquake (magnitude 6.6) killed 58 people and caused $480 million worth of damage. The 1988 Armenian earthquake of similar magnitude killed approximately 25,000 to 30,000 people.

The probability of a magnitude 7.6 earthquake occurring within 50 years is from 19 to 29 percent. The probability for this size earthquake occurring within 15 years drops to a range of 5.4 to 8.7 percent. On February 4, 1975, the Haicheng earthquake in China had a magnitude of 7.3 and destroyed or damaged about 90 percent of the structures in a city of 90,000 people.
When comparing historical earthquakes of similar magnitude, one must take into consideration that death totals and damage estimates will vary greatly due to the geology, population density, types of building, and quality of construction.

For a given earthquake, effects at a given location are described by the Modified Mercalli Intensity (MMI) scale (2) which ranges from I (no damage and felt only by instruments) to XII (total destruction). Details of the MMI scale are given in Table 1. Values of MMI associated with the 1811-1812 earthquakes are shown in Figure 1. The potential for damage and destruction from earthquakes in the region is significant.

In 1982, the Governor's Task Force on Earthquake Hazards and Safety was created to evaluate Kentucky's earthquake risk and to make recommendations for responding to those risks. This task force recommended increased public awareness and education programs, improved emergency response planning and training, improved building codes and seismic restraint designs, evaluation of other mitigation measures, and participation in national and regional earthquake forums and funding programs.

In 1984, Governor Collins created the Governor's Earthquake Hazards and Safety Technical Advisory Panel (GEHSTAP) to analyze scientific and engineering data regarding seismic risks in Kentucky and to make specific recommendations on mitigation, public awareness, response planning, and policy development for public health and safety. The States are dependent on their highway systems for the movement of goods and services. Due to the possible adverse effects a major earthquake could have on this system, the Earthquake Stability and Transportation Subcommittee (ESTS) of GEHSTAP was formed.

ESTS has encouraged the Kentucky Transportation Cabinet to secure funding for generating and implementing an earthquake hazard mitigation plan in an attempt to safeguard the highway system against catastrophic earthquake failure. As a result, the Cabinet commissioned the Kentucky Transportation Center at the University of Kentucky to analyze and assess the possible effects of an earthquake on highway facilities. The study area includes the 26 western-most counties in Kentucky that are adjacent to the New Madrid seismic zone (Figure 1). To date, one of the results of that study has been the recommendation that over 1,000 miles of highways in the study area be utilized as emergency or "priority" routes. These would be the primary routes used for transporting emergency supplies and personnel after an earthquake. Also, it is anticipated that these would be the first routes repaired after an earthquake.

The initial task in identifying these priority routes was to decide where they should begin; that is, in the event of a major earthquake, the point at which the transport of goods and services would originate. Ideally, the city chosen should possess the following attributes:

1. Sufficient size to contain all necessary personnel, supplies, and facilities to respond quickly to a major emergency;

2. Proximity to the high hazard area to speed the relief effort but not so close as to suffer the same high risk potential;

3. Easy access from other major cities in the State; and

4. Sufficient routes to provide relatively direct access to all 26

high-risk counties.

The city best fitting these criteria is Bowling Green. Located at the eastern edge of the earthquake zone in Warren County, Bowling Green meets both the size criterion (population 40,450) and the accessibility criterion (Louisville and Nashville via I 65 and Lexington via the Bluegrass Parkway). Bowling Green provides access to the 26-county area via US 68/KY 80; this road was chosen as the main east-west artery because it crosses Lake Barkley and Kentucky Lake upstream from the dams impounding those bodies of water.

As a first step towards establishing an overall policy for earthquake hazard mitigation in the highway system, these priority routes have been visually surveyed and all natural and man-made features along these routes that are considered seismically significant were cataloged. With this information, a realistic and cost-effective plan for "hardening" these routes against earthquakes can be established. Such efforts are currently under way.

PRIORITY ROUTES IN WEBSTER COUNTY

Webster County is located approximately 100 miles northeast of the center of the New Madrid Seismic Zone. Figure 1 indicates that Webster County is in the IX band of the MMI scale. This indicates considerable damage could occur in Webster County in the event of a major earthquake.

KY 109 and US 41 have been designated as the priority routes in Webster County. The KY 109 route starts at the Hopkins County - Webster County line and continues north 14.60 miles to the Webster County - Union County line. US 41 begins at the Hopkins County - Webster County line and continues north 12.10 miles to the Webster County - Henderson County line.

A number of features along these priority routes could potentially hamper rescue and relief efforts. These features included bridges, soil fills, cut slopes, gas pipelines, power lines, power lines, water towers, geologic faults, large trees, mines, water impoundments, and swamps. These features are logged by their location on strip maps contained in Appendix A and a detailed listing of all potentially critical features is given in Appendix B.

BRIDGES

Bridges are the most significant and important features on the priority route. With few exceptions, existing highway bridges in the study area have not been designed to resist motions and forces that may be generated by earthquakes. Bridges located within the seismic zone could possibly be damaged, thus reducing their load-carrying ability. In some cases, damage could be sufficiently great to cause complete collapse. Several types of damage could occur:

1. A bridge could fail at the bearing which supports the main spans, causing the spans to fall from the bearings and possibly from the piers or abutments.

2. Failure could occur in the columns, piers, or footings which would reduce the load-carrying capacity of the bridge, if the bridge was still in place.

3. An abutment could tilt allowing the entire span to fall.

4. Soil movement or slumping could affect the bridge approach fills, damaging the abutments or piers, or making the bridge inaccessible.

There are three bridges located on KY 109 and two bridges on US 41. The bridges are located at:

KY 109

1. Owens Creek,

2. Crab Orchard Creek, and

3. Caney Fork.

US 41

1. Deer Creek, and

2. Groves Creek.

Current research is studying the effects that an earthquake could have on these bridges and their approach fills.

FILLS

Highway fills are particularly important because of their tendency to fail from seismically induced motions. Fills fail in one of two major modes. The first is a generalized circular or wedge-shaped failure resulting in one or both traffic lanes moving down and out. If both lanes failed, this would certainly render the route impassable and immediate repairs would be necessary. The second mode of failure is a general slumping or settling of the embankment. The roadway would probably remain passable if settlement or slumping were not severe but reduced speed limits would be required for safety.

Large fills on the priority routes in Webster County are located as follows:

KY 109

1. Approach fills for the Owens Creek bridge,

2. Approach fills for the Crab Orchard Creek bridge, and

3. Approach fills for the Caney Fork bridge.

US 41

1. Approach fills for the Deer Creek bridge, and

2. Approach fills for the Groves Creek bridge.

GAS PIPELINES AND WELLS

Gas pipelines under or near a priority route could fail in the event of an earthquake. If a pipeline failed, an explosion might destroy a section of the priority route. Repair could be delayed by further gas leaks, fire, and/or additional explosions.

Gas wells could be suseptable to damage durring an earthquake. As with gas pipelines, fire and/or explosion could result in closure of a priority route.

It appears that most of the pipelines in Webster County were constructed with little or no seismic considerations. Gas pipelines and wells near priority routes are located at:

KY 109

1. 0.15 mile north of the Webster County - Hopkins County line, and

2. 0.77 mile north of the Owens Creek bridge.

US 41

1. 1.20 mile south of KY 147 (south) junction,

2. 0.70 mile south of KY 495 (southwest) junction,

3. 0.40 mile south of the Deer Creek bridge, and

4. 0.99 and 0.80 mile south of KY 56 junction.

POWER LINES

High voltage power lines also were cataloged during the route surveys. The height of the lines above the roadway were estimated visually. Power company officials speculated that a number of breaks along each power line would occur during a major earthquake. In most cases, fallen lines would not be transmitting power because power would be automatically cut off within a few seconds in the event of a break.

In addition to the potential problem of live power lines, power line support towers could fall across and block a priority route. Power lines cross the priority routes at the following locations:

KY 109

1. 0.15 mile north of the Webster County - Hopkins County line,

2. 2.07 miles north of the Owens Creek bridge,

3. 0.27 mile north of the Crab Orchard Creek bridge, and

4. 0.92 and 0.22 mile south of the Caney Fork bridge.

US 41

1. 0.30, 1.00, and 1.60 mile north of KY 56 junction.

STRUCTURES

Several structures, some of which are masonry, are located along the priority route KY 109 in the city of Clay. Masonry structures in particular are suseptable to earthquake damage. The priority route could be blocked if these structures collapsed.

GEOLOGIC FAULTS

There are numerous geologic faults (breaks in the bedrock where movement has occurred in the past) in the study area. The faults are seismically significant since a large earthquake could trigger additional movement along one or more old slip planes. There are no precautionary measures that can be taken to reduce hazards from faults except that construction of bridges and other facilities over or near such faults requires special consideration. The faults are included for informational purposes only. Faults which cross under priority routes in Webster County are listed below:

US 41

1. 0.23, 0.73, 0.83, and 0.96 mile north of the Hopkins County - Webster County line, and

2. 0.02, 0.10, 0.21, 0.40, 0.59, 2.24,

and 2.30 miles north of the KY 494 (west) junction,

FUEL STORAGE TANK

Three oil storage tanks are located near US 41 approximately 0.08 mile south of the Groves Creek bridge. These tanks could develope leaks or rupture during an earthquake and close the priority route.

WATER TANK

A water tank is located near US 41 approximately 0.88 mile south of the Groves Creek bridge. Failure of the support structure or rupture of the tank could result in closure of the priority route.

MINES

There are several types of mining operations, both current and abandoned, along the priority routes in Webster County. These operations include strip mines, deep mines, and quarries.

A large earthquake could collapse portions of quarry walls, breach strip mine water impoundments, or collapse underground shafts. Any of these actions could temporarily block or destroy a section of a priority route. Further inspection should be conducted to determine if these mines constitute a probable threat to the priority routes. Mines are located at:

KY 109

1. At the Owens Creek bridge,
2. 0.92 and 0.62 mile south of KY 670 (east) junction,
3. 1.17 and 0.37 miles south of the Crab Orchard Creek bridge, and
4. 0.28 and 0.84 mile north of the Caney Fork bridge.

US 41

1. 0.72 mile north of KY 56 junction.

TREES

The behavior of trees during an earthquake depends upon many factors including their condition, type, height, and size. Local soil conditions, geometry of the ground surface, and characteristics of the earthquake can also be important. Violent ground motions accompanied by surface rupture and perhaps permanent displacement of the soil surface produce sudden surface accelerations of the ground which can snap and uproot large trees (3).

Trees are so numerous that, if many of them fell, the priority routes could effectively be blocked for several hours or days before emergency crews could clear the debris. Groups of large trees are located near the road at the following sites:

KY 109

1. 0.40 mile north of the Hopkins County - Webster County line,
2. 0.13 mile south of the Crab Orchard Creek bridge,
3. 1.20 mile north of KY 132 (southwest) junction, and
4. 1.08, 1.78, and 2.38 miles north of the Caney Fork bridge.

ALLUVIUM

Soil maps for Webster County indicate

that there are large amounts of alluvium present throughout the county. Alluvium is a loose, fine-grain soil which is deposited by flowing water such as creeks and rivers. Due to the nature of the alluvium, ground motions at the surface of the soil can be many times greater than those within the underlying bedrock and temporary liquefaction can occur (Figure 2). An alluvium map for Webster County is shown in Figure 3.

CONCLUSIONS

In 1984, ESTS developed a fivefold plan of action for formulating and implementing a seismic mitigation policy for the western Kentucky seismic zone. To date, the Kentucky Transportation Center has established priority routes for all 26 counties in the western Kentucky seismic zone and developed seismic risk maps of all natural and man-made features that are susceptible to earthquake damage that could jeopardize the priority routes.

Current work is being conducted to analyze these features and make recommendations for hardening them against earthquake damage.

Future work involves training key personnel in the Transportation Cabinet in hazard mitigation and seismic safety; which includes bridge inspectors, district engineers, construction inspectors, designers, and maintenance personnel.

Following the education of key personnel, the mitigation plan proposed by the Kentucky Transportation Center will be reviewed by the Kentucky Transportation Cabinet and a program will be established for implementation. The final step involves the use of relevant seismic codes for all new construction, repair, and maintenance.

REFERENCES

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2. Green, N. B., "Earthquake Resistant Building Design and Construction," Third Edition, Elsevier, 1987, Page No. 179-180.

3. Keller, Edward A., "Environmental Geology," Charles E. Merrill Publishing Company, A Bell and Howell Company, 1979, Page No. 157.

Additional Information

The Commonwealth of Kentucky has prepared a State Emergency Operations Procedures (State EOP) manual that is produced by the Division of Disaster and Emergency Services (DES), Department of Military Affairs, Frankfort, 40601. Annexes H. on Transportation and DD on Earthquakes give additional information on disaster preparedness and response.

A copy of the State EOP and information on local hazard mitigation activities and response preparedness are available from the AREA 2 Office of DES which is located in Hopkinsville. The phone numbers at this office are (502) 564-8602 and (502) 885-7100.

Additional information about the study discussed in this report should be directed to David L. Allen, Project Director, at the Kentucky Transportation Center, (606) 257-4513. Requests to be placed on the mailing list for updated information should be submitted on your company or agency letterhead to the Kentucky Transportation Center at the University of Kentucky, Lexington Kentucky 40506-0043.

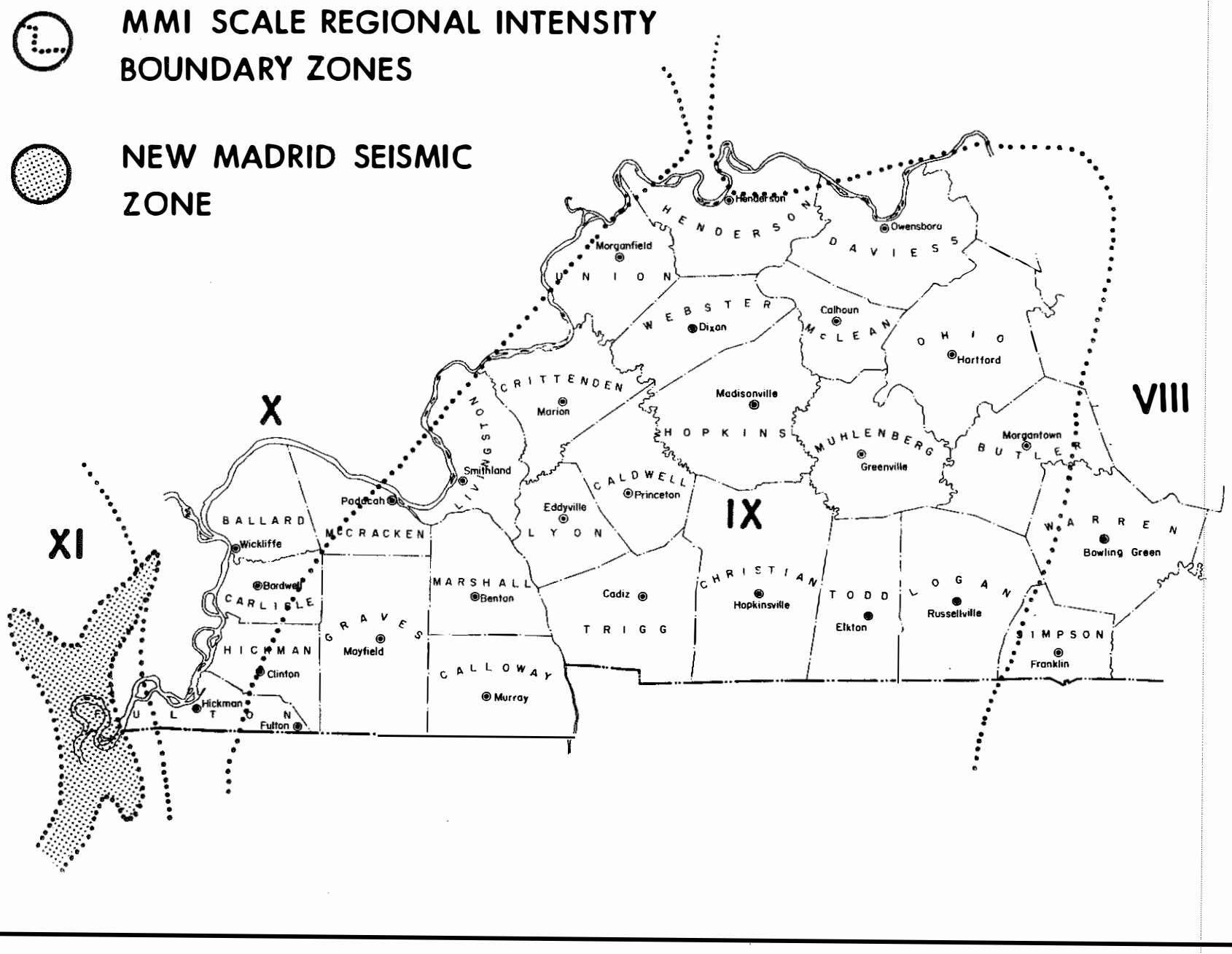


Figure 1: The twenty-six counties included in this study area.

Table 1: MODIFIED MERCALLI INTENSITY SCALE

Modified Mercalli Intensity Scale, 1956 Version

The following comments by Dr. Richter precede the published statement of the intensity scale:

...Each effect is named at the level of intensity at which it first appears frequently and characteristically. Each effect may be found less strongly, or in fewer instances, at the ne t lower grade of intensity; more strongly or more often at the next higher grade. A few effects are named at two successive levels to mdicate a more gradual increase.

Masonry A, B, C, D. To avoid ambiguity of language, the quality of masonry, brick or otherwise, is specified by the following lettering.

Masonry A. Good workmanship, mortar, and design; reinforced, especially laterally, and bound together by using steel, concrete, etc.; designed to resist lateral forces.

Masonry B. Good workmanship and mortar, reinforced by not designed in detail to resist lateral forces.

Masonry C. Ordinary workmanship and mortar; no extreme weakness like failing to tie corners, but neither reinforced nor designed against horizontal forces.

Masonry D. Weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally.

The following list represents the twelve grades of the scale.

I. Not felt. Marginal and long-period effects of large earthquakes.

II. Felt by persons at rest, on upper floors, or favorable placed.

III. Felt indoors, Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.

IV. Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV wooden walls and frame creak.

V. Felt outdoors; direction estimated. Sleepers awakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.

VI. Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken, Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken.

VII. Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices. Same cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.

VIII. Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundation if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

IX. General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. Frame structures, if not bolted, shifted off foundations. Frames cracked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluviated areas sand and mud ejected, earthquake fountains, sand crater.

X. Most masonry and frame structures destroyed with their foundations. Some will-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large land slides. Water thrown on banks of canals, river, lakes, etc. Sand and mud shifted horizontally on beaches and flat lands. Rails bent slightly.

XI. Rails bent greatly. Underground pipelines completely out of service.

XII. Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown in the air.

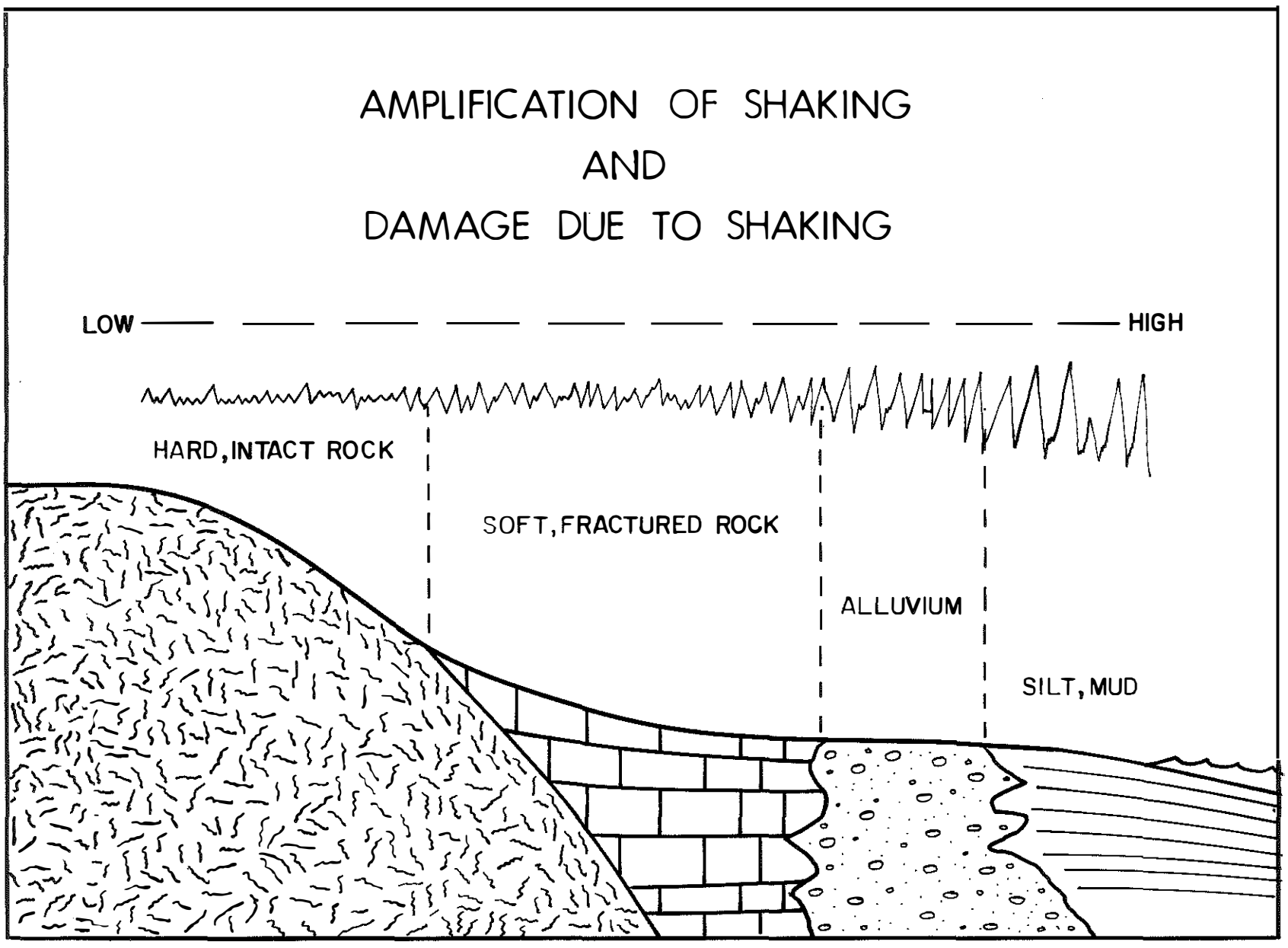
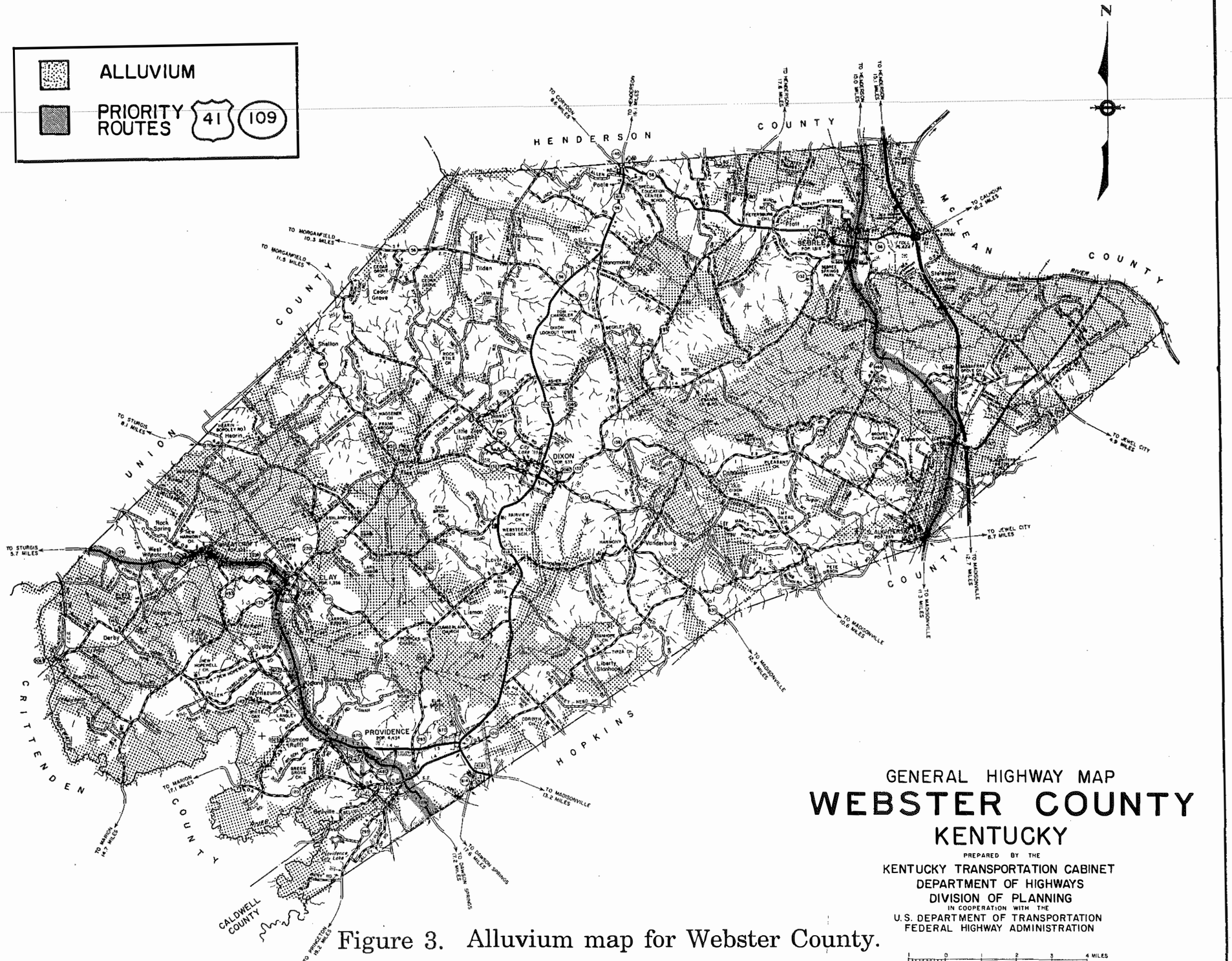


Figure 2 : Amplification of shaking in softer rock & soil during an earthquake.



GENERAL HIGHWAY MAP

WEBSTER COUNTY

KENTUCKY

PREPARED BY THE
KENTUCKY TRANSPORTATION CABINET
DEPARTMENT OF HIGHWAYS
DIVISION OF PLANNING
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

1 0 1 2 3 4 MILES
0 0.5 1.0 MILE
SCALE FOR ENLARGEMENTS

POLYCONIC PROJECTION

876

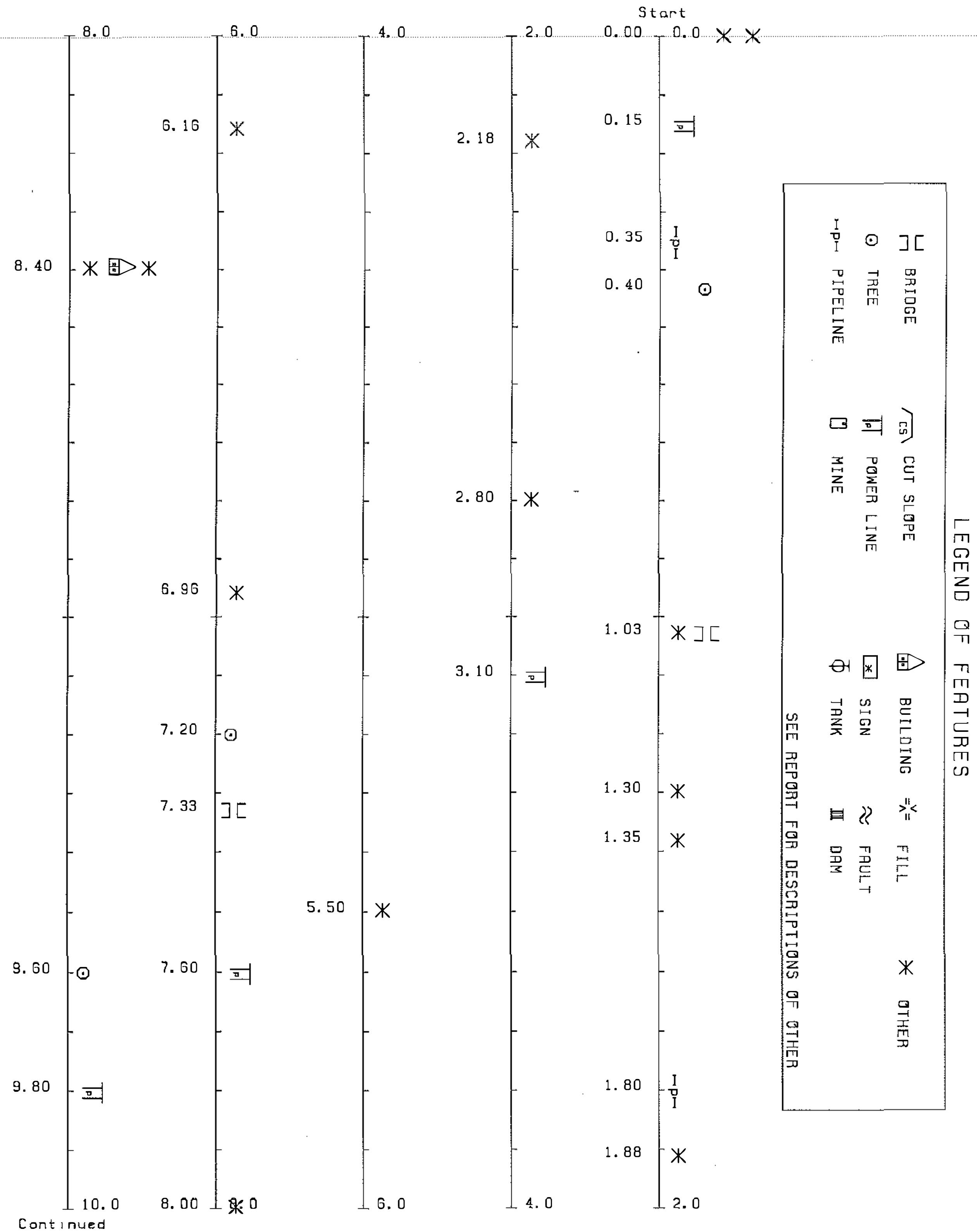
Figure 3. Alluvium map for Webster County.

APPENDIX A

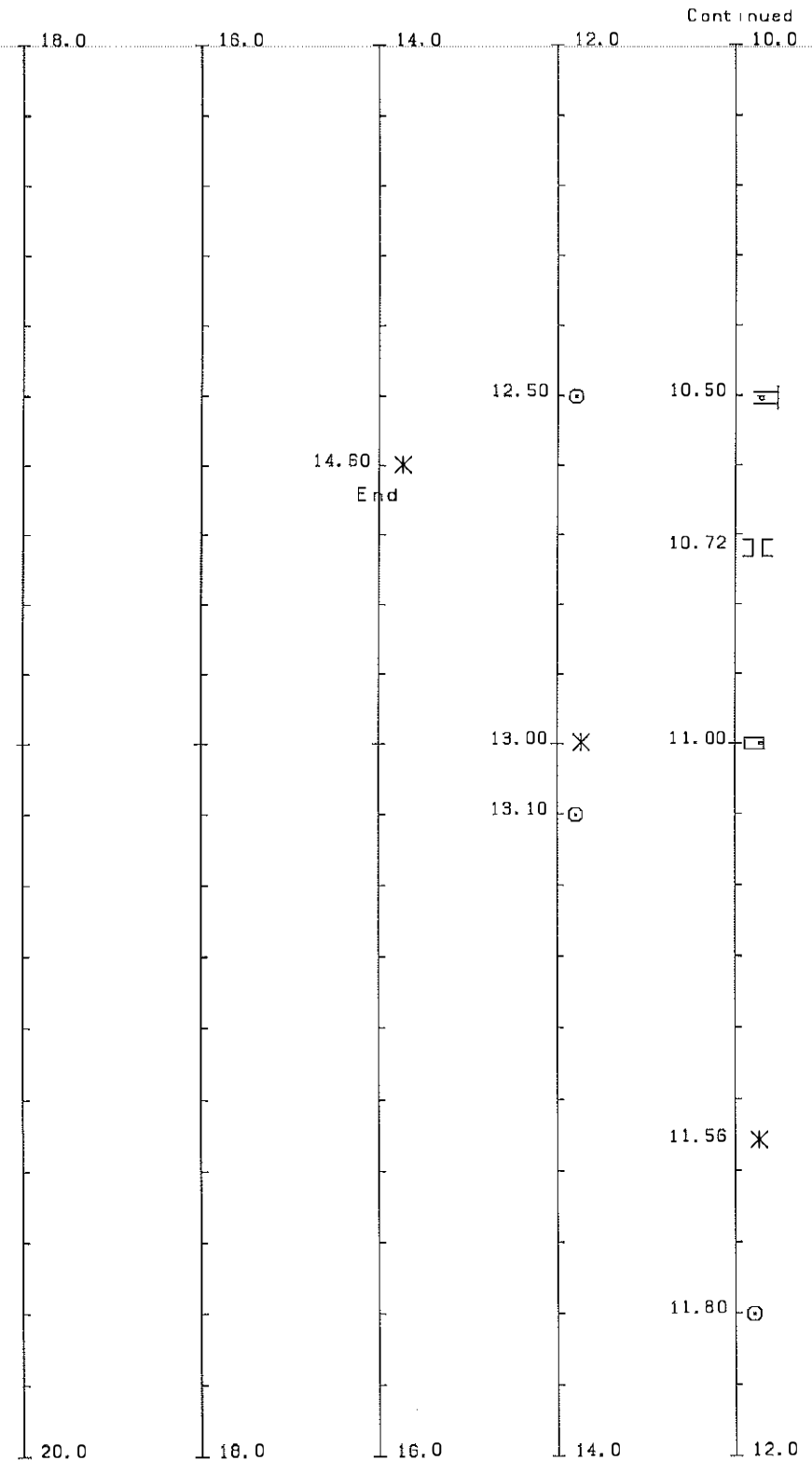
STRIP MAP FOR WEBSTER COUNTY

KY 109 and US 41

KY109 WEBSTER



KY109 WEBSTER

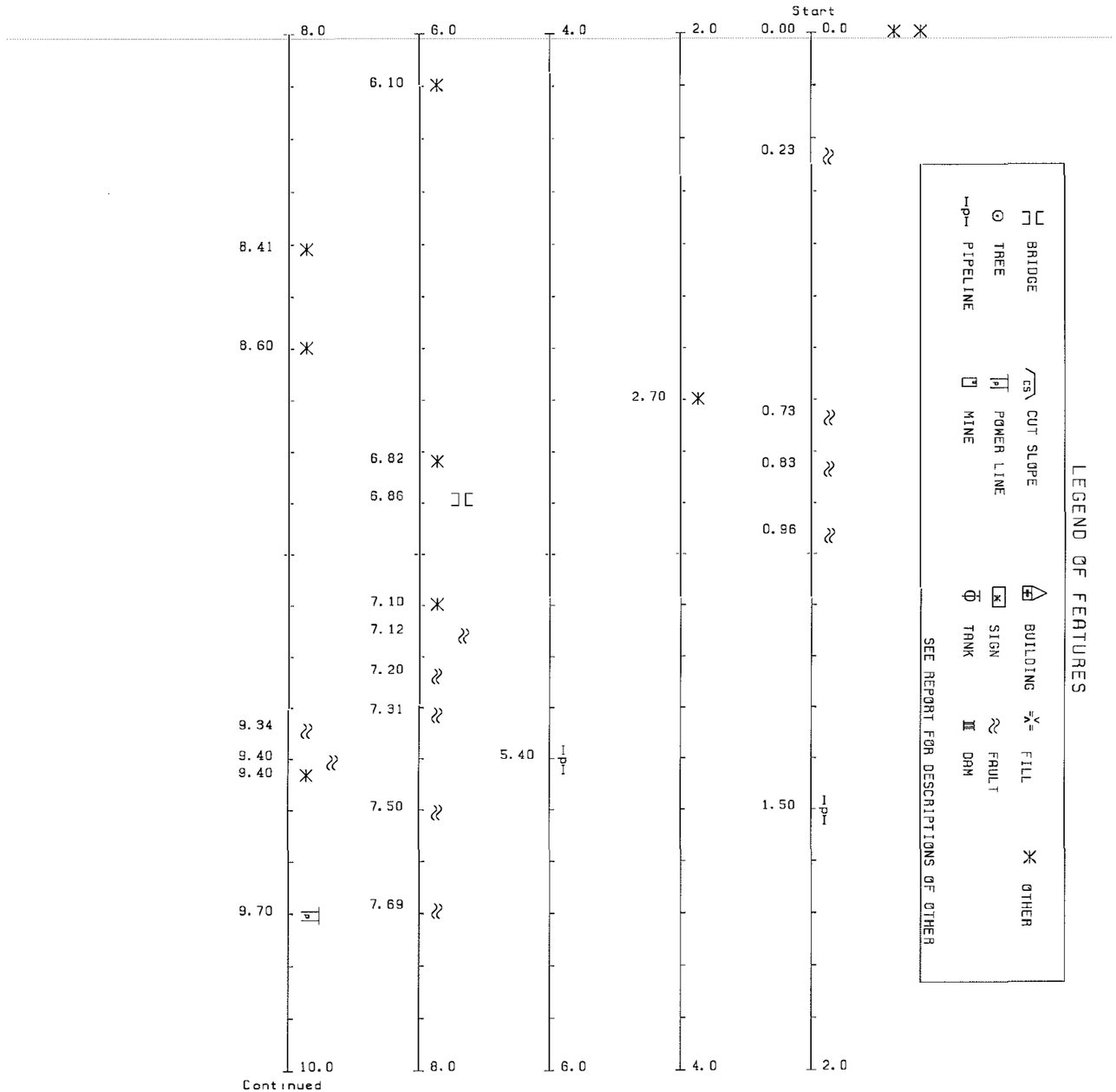


LEGEND OF FEATURES

BRIDGE
TREE
PIPELINE
CUT SLOPE
POWER LINE
MINE
BUILDING
SIGN
TANK
FILL
FAULT
DAM
OTHER

SEE REPORT FOR DESCRIPTIONS OF OTHER

US41 WEBSTER

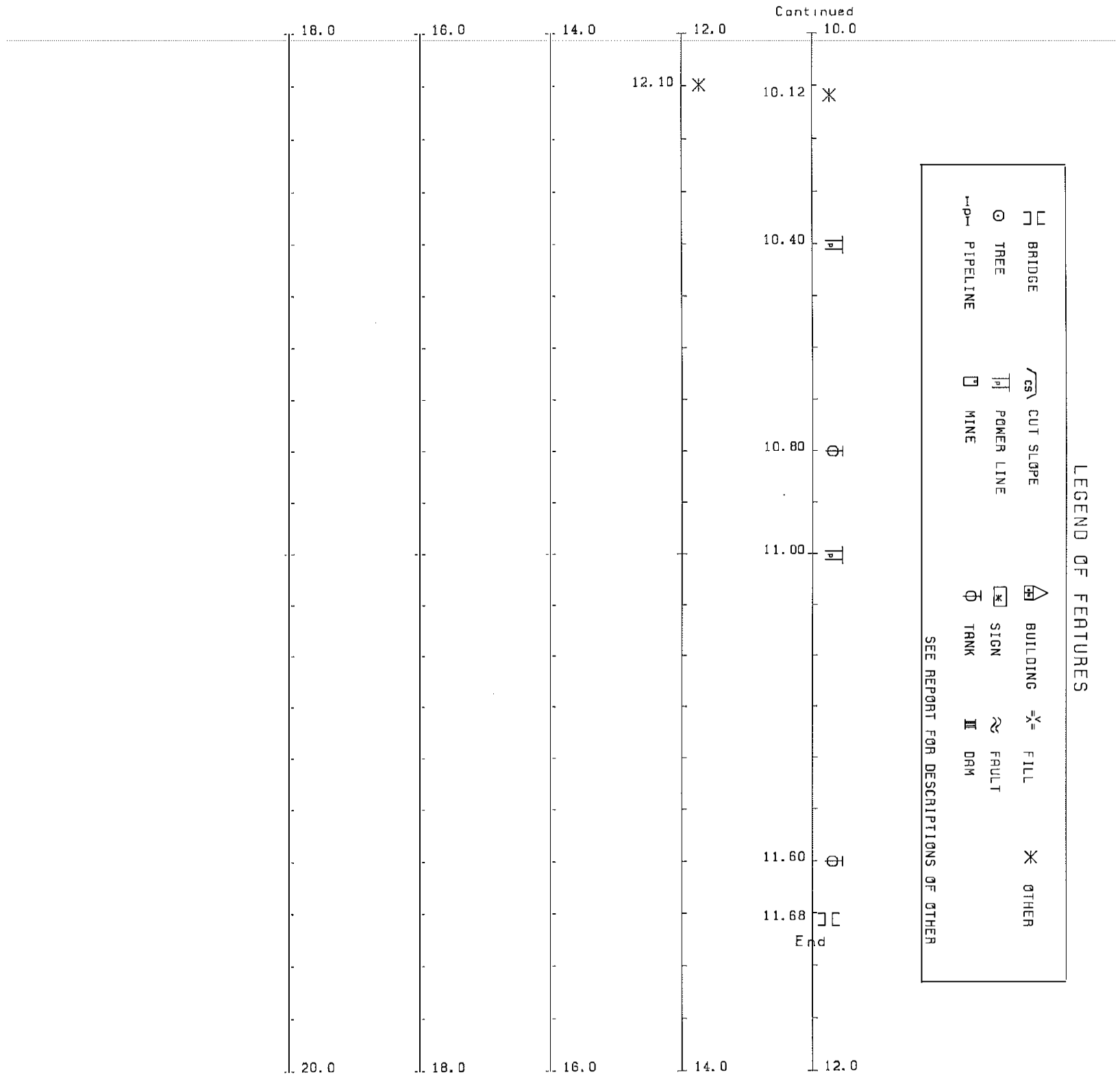


LEGEND OF FEATURES

BRIDGE	CUT SLOPE	BUILDING	
TREE	POWER LINE	SIGN	FILL
PIPELINE	MINE	TANK	DAM
			OTHER

SEE REPORT FOR DESCRIPTIONS OF OTHER

US41 WEBSTER



APPENDIX B

SEISMICALLY SIGNIFICANT FEATURES

Report by Road and Milepoint
for Webster County - Kentucky
KY 109

Milepoint	Feature	Data
0.00	Other	Webster Co - Hopkins Co Boundary Road Surface Type - Flexible
0.00	Other	City of Providence Road Surface Type - Flexible
0.15	Power Line	Electrical Power Line 4 Lines Height 35 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
0.35	Pipeline	Pipeline Type - Gas Road Surface Type - Flexible
0.40	Trees	Number of Trees 30 Height 45 feet Diameter 20 in. Ending Milepoint 0.70 Distance From Road 15 feet Road Surface Type - Flexible
1.03	Other	Mining Shaft (1,300 feet West of Road) Road Surface Type - Flexible
1.03	Bridge	Number of Spans 1 Over Stream Concrete Box Beam End 1 Fixed End 2 Fixed Deck Type - Concrete Length 32 feet Width 31 feet Pier Type - Solid SPC Rating - B Surface Type - Flexible Expansion Type - Poured Compression End 1 Substructure - Stub End 2 Substructure - Stub Foundation Type - Unknown
1.30	Other	Junction KY 293 Heading Southwest Road Surface Type - Flexible
1.35	Other	Junction KY 120 Northeast-West Road Surface Type - Flexible

Report by County and Milepoint
for Webster County - Kentucky
KY 109

Milepoint	Feature	Data
1.80	Pipeline	Pipeline Type - Gas Road Surface Type - Flexible
1.88	Other	Shafts North & South Road Surface Type - Flexible
2.18	Other	Strip Mining Road Surface Type - Flexible
2.80	Other	Junction KY 670 Heading East Road Surface Type - Flexible
3.10	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
5.50	Other	Junction KY 143 Heading West Road Surface Type - Flexible
6.16	Other	Strip Mining Road Surface Type - Flexible
6.96	Other	Mining Shaft (400 feet West of Road) Road Surface Type - Flexible
7.20	Trees	Number of Trees 50 Height 40 feet Diameter 15 in. Ending Milepoint 7.40 Distance From Road 15 feet Road Surface Type - Flexible
7.33	Bridge	Number of Spans 5 Over Stream Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed Pier 3 Fixed Pier 4 Fixed End 2 Fixed Deck Type - Concrete Length 240 feet Width 19 feet Pier Type - Solid SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Stub End 2 Substructure - Stub Foundation Type - Unknown

Report by County and Milepoint
for Webster County - Kentucky
KY 109

Milepoint	Feature	Data
7.60	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
8.00	Other	City of Clay Road Surface Type - Flexible
8.40	Other	Junction KY 132 Heading Southwest Road Surface Type - Flexible
8.40	Building	Urban Location Masonary Building Floors 5 Area/Floor 5555 sq.ft. Road Surface Type - Flexible Manufacturing Use
8.40	Other	5 Buildings at this Location Road Surface Type - Flexible
9.60	Trees	Number of Trees 300 Height 40 feet Diameter 36 in. Ending Milepoint 10.60 Distance From Road 10 feet Road Surface Type - Flexible
9.80	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
10.50	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
10.72	Bridge	Number of Spans 4 Over Stream Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed Pier 3 Fixed End 2 Fixed Deck Type - Concrete Length 191 feet Width 19 feet Pier Type - Solid SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Stub End 2 Substructure - Stub Foundation Type - Unknown

Report by County and Milepoint
for Webster County - Kentucky
KY 109

Milepoint	Feature	Data
11.00	Mine	Mineral Type- Coal Underground Mine Road Surface Type - Flexible Mine Depth Unknown
11.56	Other	Strip Mining Road Surface Type - Flexible
11.80	Trees	Number of Trees 200 Height 45 feet Diameter 30 in. Ending Milepoint 11.84 Distance From Road 10 feet Road Surface Type - Flexible
12.50	Trees	Number of Trees 100 Height 60 feet Diameter 25 in. Ending Milepoint 12.80 Distance From Road 15 feet Road Surface Type - Flexible
13.00	Other	Junction KY 143 Heading South Road Surface Type - Flexible
13.10	Trees	Number of Trees 25 Height 35 feet Diameter 28 in. Ending Milepoint 13.12 Distance From Road 10 feet Road Surface Type - Flexible
14.60	Other	Webster Co - Union Co Boundary Road Surface Type - Flexible

Report by County and Milepoint
for Webster County - Kentucky
US 41

Milepoint	Feature	Data
0.00	Other	Webster Co - Hopkins Co Boundary Road Surface Type - Flexible
0.00	Other	Junction KY 138 Heading Northeast Road Surface Type - Flexible
0.23	Fault	South Slaughters Fault Road Surface Type - Flexible
0.73	Fault	Slaughters Fault System Road Surface Type - Flexible
0.83	Fault	North Slaughters Fault Road Surface Type - Flexible
0.96	Fault	Slaughters Fault System Road Surface Type - Flexible
1.50	Pipeline	Pipeline Type - Gas Road Surface Type - Flexible
2.70	Other	Junction KY 147 Heading South Road Surface Type - Flexible
5.40	Pipeline	Pipeline Type - Petro Gas Road Surface Type - Flexible
6.10	Other	Junction KY 495 Heading Southwest Road Surface Type - Flexible
6.82	Other	Gas Well Road Surface Type - Flexible
6.86	Bridge	Number of Spans 3 Steel Girder I-Beam Bridge Type - Over Stream End 1 Rocker Pier 1 Rocker Pier 2 Rocker End 2 Rocker Deck Type - Concrete Length 245 feet Width 26 feet Pier Type - Solid SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Stub End 2 Substructure - Stub Foundation Type - Unknown

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Milepoint	Feature	Data
7.10	Other	Junction KY 494 Headed West Road Surface Type - Flexible
7.12	Fault	Fault Road Surface Type - Flexible
7.20	Fault	Fault Road Surface Type - Flexible
7.31	Fault	Fault Road Surface Type - Flexible
7.50	Fault	Fault Road Surface Type - Flexible
7.69	Fault	Fault Road Surface Type - Flexible
8.41	Other	Gas Well Road Surface Type - Flexible
8.60	Other	Gas Well Road Surface Type - Flexible
9.34	Fault	Sebree Fault System Road Surface Type - Flexible
9.40	Other	Junction KY 370 & KY 56 Headed SE & NW Road Surface Type - Flexible
9.40	Fault	Sebree Fault System Road Surface Type - Flexible
9.70	Power Line	Electrical Power Line 3 Lines Height 20 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible

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Milepoint	Feature	Data
10.12	Other	Abandoned Vertical Shaft Road Surface Type - Flexible
10.40	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
10.80	Tank	Water Tank Number of Tanks 1 Capacity Unknown Distance From Road 100 feet Road Surface Type - Flexible
11.00	Power Line	Electrical Power Line 3 Lines Height 20 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
11.60	Tank	Oil Tank Number of Tanks 3 Capacity Unknown Distance From Road 30 feet Road Surface Type - Flexible
11.68	Bridge	Number of Spans 4 Over Stream Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed Pier 3 Fixed End 2 Fixed Deck Type - Concrete Length 172 feet Width 26 feet Pier Type - Solid SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Stub End 2 Substructure - Stub Foundation Type - Unknown
12.10	Other	Webster Co - Henderson Co Boundary Road Surface Type - Flexible