PRESENTATION BY [redacted] CLARIFYING THE

FEBRUARY 15, 2001 REPORT BY EXPONENT, INC.

PRESENTED AT THE APRIL 27, 2001 MEETING WITH FEMA

IN COLUMBIA, SOUTH CAROLINA

EXECUTIVE SUMMARY

This is a clarification of the computations prepared by Exponent, Inc. and submitted to FEMA on February 15, 2001. On the basis of more current software, more complete data, and a more comprehensive analysis, the most correct determination is that the area behind the Manning levee in Richland County is not a floodway.

CLARIFICATION

My name is [redacted]. I am a civil engineer with Exponent, Inc. based in Menlo Park, California. Exponent is one of the nation's leading scientific and engineering consulting firms offering services in 70 different disciplines to clients such as General Electric, Farmer's Insurance and the US Army. In addition to investigating major disasters, like the Exxon Valdez, we analyze the risks involved with natural events such as floods.

After I moved to Atlanta last fall from California, I was asked by [redacted] on behalf of Columbia Venture to review the Congaree River floodway determination analysis presented by FEMA last September.

Currently, the most advanced way of analyzing flood patterns is with a two-dimensional flow model. This is the way FEMA did it, employing what is known in the industry as the RMA-2 computer program. Using these types of models to understand how floods occur is my area of expertise. My graduate school professor at University of California Davis, [redacted], is one of the creators of the RMA-2 software. This is the computer program that forms the basis for the studies you will hear about today. Since that time, I have conducted numerous flood studies with this and other two-dimensional models and have published several technical articles on the subject.

I am here today to report to you the results of my study which analyzed the existing conditions of the Congaree River floodplain using more modern software, the SMS program that [redacted] has already described, and more current data that I will describe later on. This report was submitted to FEMA on February 15, 2001 in response to their request for comments. Our study confirms that, during the 100-year flood event, the area behind the Manning levee on the Richland County

side of the floodplain is not a floodway. Let me repeat that. Our computations show that the area is not a floodway.

Let's stop here for a second so I can explain what a floodway is. The floodway is the area close to the river where water may flow at a higher velocity. The flow patterns in a floodway are well-organized and the direction is generally parallel to the river. The National Flood Insurance Program Regulations define a floodway as the part of a river that must be reserved in order to pass the baseflood without increasing the water level by more than 1 foot. FEMA's guidelines define a floodway as a waterway that is free from obstructions. The most important aspect of a floodway is that it has a starting point and eventually returns the water to the river. A floodway returns the water to the river.

A two-dimensional model is extremely valuable in identifying a floodway because it shows you the natural flow patterns in the floodplain during a flood. So we need to thank FEMA for going to the extra effort and introducing this technology for this case.

SLIDE 1

WHAT A FLOODWAY LOOKS LIKE IN A TWO-DIMENSIONAL MODEL

This is what a floodway looks like in a two-dimensional model. This is the river. This is the floodplain. Along this part of the floodplain the flow is unobstructed and the pattern, indicated by arrows, is parallel to the main river. In a floodway, the velocities are high. These white areas indicate low velocity and are not floodway. The most important characteristic of a floodway is that it eventually returns the water to the river.

In our review of FEMA's two-dimensional flow model used in the September 26, 2000 appeal resolution report, we determined that they used the original two-dimensional analysis developed by the USGS in 1981 for analyzing the effects of Interstate 77. The purpose of the USGS study was to design the Interstate 77 bridges recognizing that the entire design flood would someday be confined to either the Richland side or the Lexington side but not spread out over both floodplains.

The analytical tools used by the USGS in 1981 and adopted by FEMA in 2000 are now considered archaic and need to be revised. And, floodway determination was not an objective of the USGS modeling effort. We decided that an entirely new model using the most up-to-date software and data was necessary.

SLIDE 2

OUR STUDY DATA COMPARED TO FEMA'S

This slide compares our data to FEMA's. First, boundary conditions. Boundary conditions are important because if they are too close to the questioned area, they affect the answer. The reason is that you are taking an approximation and forcing it to be the answer. This is the case with FEMA's model which has a boundary condition less than one mile downstream of Gills Creek. This might be OK for bridge design but it is too close for floodway determination. Our data uses a boundary condition more than 4 miles downstream of Gills Creek.

Physical features. These are important because they allow the model to accurately depict existing condition flooding patterns. FEMA uses the USGS mesh which was prepared by hand in 1981 and lacks the resolution obtainable today by using more modern software. We used the SMS software with the most accurate digital mapping available.

Geographic area. FEMA's model covers 9,500 acres. Our model extends much further downstream and covers 21,400 acres. This gives us a more realistic view of flooding patterns. The limited size of FEMA's geographic area impair the ability to interpret the overall flow pattern.

Elements and Node Points. We used roughly 4 times as many elements and nodes. These numbers represent a level of detail that allows for a more precise analysis of flow characteristics in important parts of the floodplain. In 1981, personal computers were not capable of handling large problems. The practice at that time was to scale back on the number of elements in order to fit the constraints of the computer. This barrier no longer exists, however.

SLIDE 3

OUR ASSUMPTIONS COMPARED TO FEMA'S

This slide shows our assumptions compared to FEMA's. Although we advanced the level of data used, we tried to match FEMA's assumptions as closely as possible in order to have an apples-to-apples comparison. Once we did this, it became clear that there is no floodway in Richland County. First FEMA assumed both the Gills Creek levee and the Hunting club levee located just south of Interstate 77 were both gone. We think these are unrealistic and improbable assumptions for a floodway determination but we included the same assumptions in our model.

Next the breach configuration in the levee. FEMA assumes two worst-case scenarios. One is a double breach scenario with

120-foot wide breaches located both behind the school and at the north end of the Manning levee. The second is a single, 1,000-foot wide breach located behind the school. We combined these two scenarios in order to create an ultimate worst case and used both a 1,000-foot breach behind the school AND a 120 foot breach at the north end.

SLIDE 4

OUR CONCLUSIONS COMPARED TO FEMA'S

This slide shows FEMA's conclusion that the area behind the Manning levee is a floodway. Even after adopting FEMA's assumptions that the downstream levees are not present, our computations confirm that no floodway exists in Richland County. And why don't we get a floodway? Because we used more modern software and more complete data that give us a more accurate result.

SLIDE 5

100-YEAR FLOOD FLOW PATTERNS

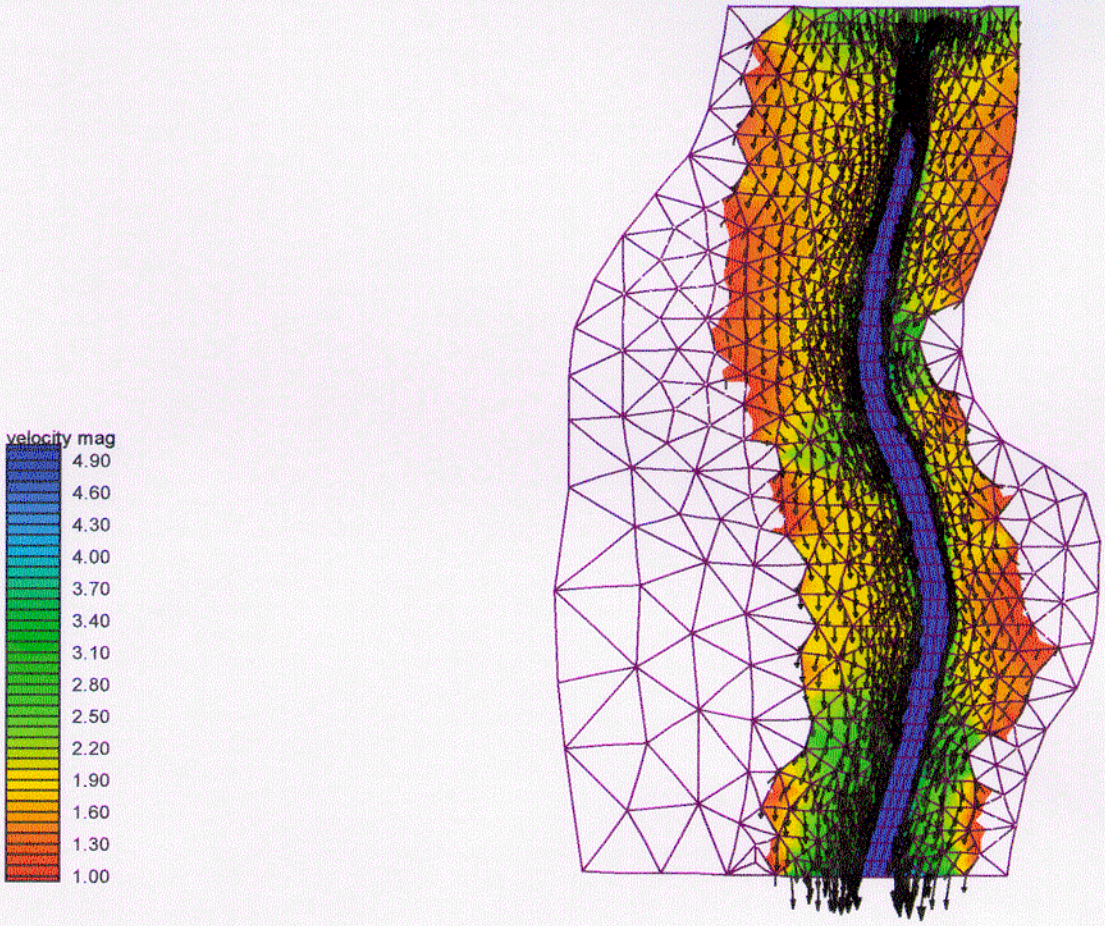
Let's look at the big picture. This diagram shows the areas with flow velocities greater than 1 foot per second. When water enters the Richland County floodplain it travels away from the Congaree River and backs up in the Gills Creek area

due to natural ponding. Remember that a floodway returns the water to the river. This is a good example of ineffective flow because it looks like it is conveying flow for awhile but, upon further inspection, you can see that it does not actually go anywhere.

By looking at a bigger, more accurate picture, and utilizing a two-dimensional flow model, we can see the flow characteristics during a 100-year flood. None of these characteristics are consistent with a floodway. For all of the reasons stated in this clarification, our computations show that there is no floodway on the Richland County side of the levee.

SLIDE 1

WHAT A FLOODWAY LOOKS LIKE IN A TWO-DIMENSIONAL MODEL



SLIDE 2

OUR STUDY DATA COMPARED TO FEMA'S

DATA	FEMA	OUR STUDY
Boundary Conditions	Less Than 1 mile downstream of Gills Creek	More than 4 miles downstream of Gills Creek
Physical Features	1981 Mesh from USGS	SMS With Digital Mapping
Geographic Area	9,500 Acres	21,400 Acres
Elements	1,541	6,090
Node Points	3,392	13,611

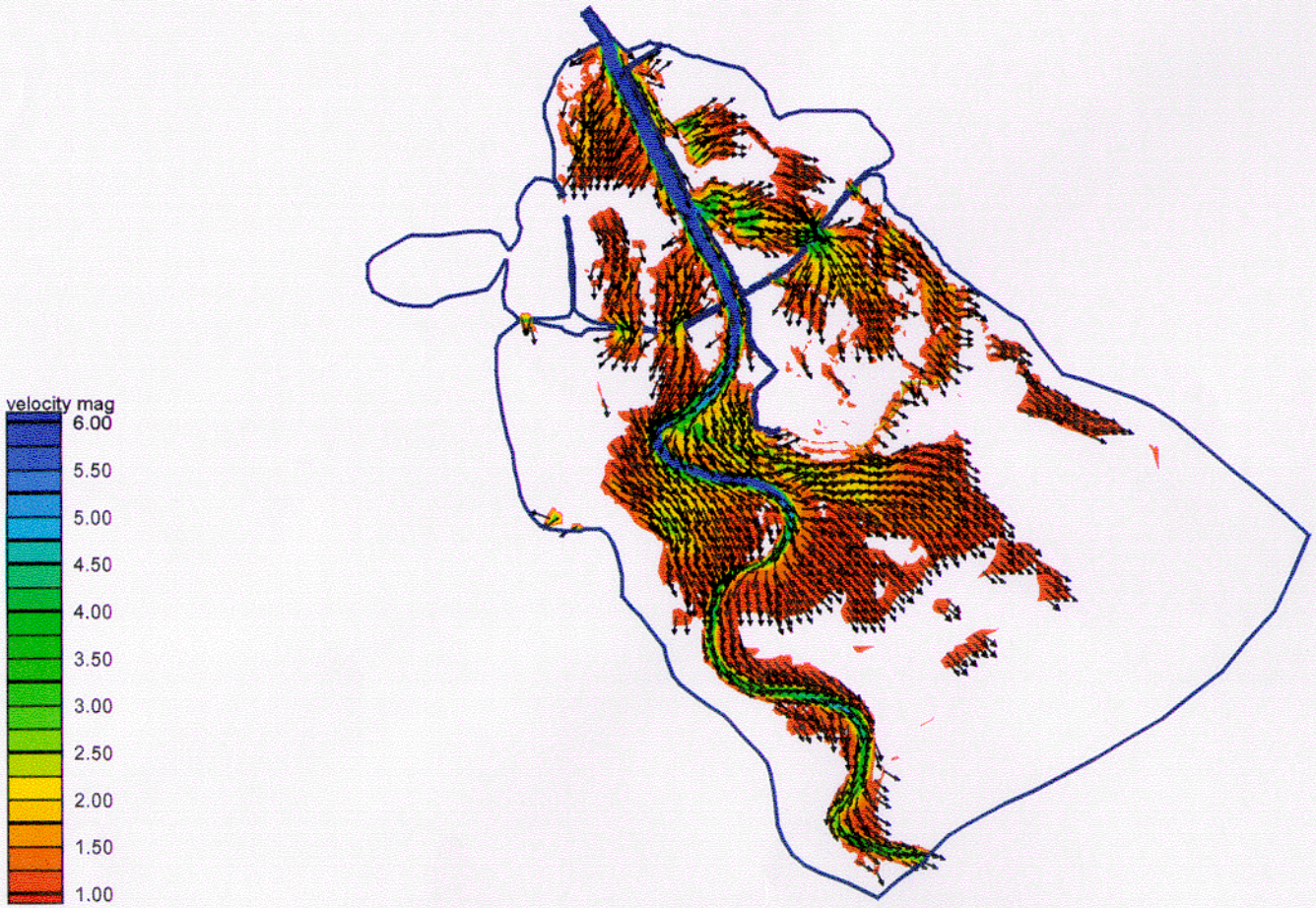
SLIDE 3

OUR ASSUMPTIONS COMPARED TO FEMA'S

ASSUMPTIONS	FEMA	OUR STUDY
Gills Creek Levee	Gone	Gone
Hunting Levee	Gone	Gone
Breach Configuration	120 foot Breach at North End OR 1,000 Foot Breach Near School	120 foot Breach at North End AND 1,000 Foot Breach Near School

SLIDE 4

OUR CONCLUSIONS COMPARED TO FEMA'S

CONCLUSIONS	FEMA	OUR STUDY
Result	Floodway East of Levee	NO Floodway East of Levee

SLIDE 5
100-YEAR FLOOD FLOW PATTERNS