Final Report on the Effects of Developing Angel Oak Village on the Angel Oak

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Summary:

The Angel Oak Village development plan, as I have thus far seen, is highly likely to cause irreparable harm to the Angel Oak, and result in the premature death of the tree. Most trees, live oaks included, have no set life span. They essentially live forever, unless killed by environmental factors. All trees have characteristics that make them more or less susceptible to negative environmental factors. Red maples, for example, have little defense against rot, and thus tend to succumb at young ages. Many other trees, including live oaks, develop rot resistant heartwood that helps them maintain structural integrity for longer periods of time. Development of the Angel Oak Village would cause too many environmental changes, all of which would have a negative impact on the Angel Oak. If the project is completed, the cumulative result will be intolerable degradation of the environment around the tree. Death may take years, or decades, but in my opinion, is certain to be considerably accelerated by the development.

Impacts on Site Hydrology:

Summary: Although the proposed project plans to keep most stormwater on site, this is probably unrealistic, and regardless, the distribution of the water will be changed dramatically, with unpredictable effects on the hydrological regime experienced by the Angel Oak. Reducing transpiration will also alter the water table, with unpredictable results. These changes in hydrology are probably the most significant threat to the survival of the Angel Oak.

Current Hydrology: The natural drainage patterns on the site are complex (Figures 1 – 3). There is an intermittent stream that drains west into Church Creek on the northern part of the property. This drain and the associated wetlands occupy about one third of the property. This stream is degraded but still functions as a drain, as indicated by culverts under Bohicket Road and an apparent culvert under Maybank Highway. The culvert opening on the west side of that highway is visible; there appears to be a sub-surface box junction on the east side. Infrastructure maps are necessary to confirm the presence of a culvert. The stream apparently drains into 2 detention ponds on the housing development on the west side of Maybank Highway, and from those into a stream that flows west to a tributary of Church Creek. Again, much of the culverting is sub-surface, and infrastructure maps are necessary to confirm the flow pattern.

However, the soils maps and the vegetation patterns clearly indicate a stranded wetland that drains from the Haut Gap School property, under Bohicket Road, across the Angel

Oak Village site, under Maybank Highway and west into Church Creek (Figures 4 – 6). The soil series underlying the entire strand is Stono, described as very poorly drained (the wettest possible drainage class) (Figure 4). Adjacent to the strand are several additional wet soils, ranging from somewhat poorly drained to very poorly drained. In general, soils that are somewhat poorly drained or wetter are considered hydric. Wetland vegetation indicators include (not a complete list): *Nyssa biflora* (pond gum), *Iris virginica* (blue flag iris), *Woodwardia areolata* (chain fern), *Woodwardia virginica* (Virginia chain fern) (all OBL), *Magnolia virginiana* (sweet bay), *Osmunda cinnamomea* (cinnamon fern) (both FACW+), *Lyonia lucida* (smooth fetterbush) (FACW), *Liquidambar styraciflua* (sweetgum) (FAC+), *Acer rubrum* (red maple) and *Quercus nigra* (water oak) (both FAC).

The bottom of the drain is about 19' above mean sea level (MSL), with two deeper pools. The land slopes upward to the north to about 22' above MSL. To the south, the land slopes upward to a ridge that is about 23' above MSL, and then downward south to Church Creek (Figures 2 and 7). The ridge is about at the mid-line from north to south on the whole property and is partially included in the northern section of the proposed 150' buffer around the Angel Oak Park. Accordingly, the natural drainage pattern would be for the northern half of the property to drain into the intermittent stream, and the southern half by sub-surface flow south to Church Creek (Figure 2). There are several surface drains indicated by the topography, and one on the east side of the property has been slightly enhanced with shallow ditch (Figures 1, 3 and 4). These drains are too shallow to significantly carry surface water, but do indicate areas where sub-surface drainage is probably concentrated.

Although surface water in the drain will generally flow west into Church Creek, this wetland likely also serves as a significant source of ground water flowing sub-surface south to Church Creek. The elevation along Angel Oak Road is slightly lower than the edge of the interior wetlands. Transpiration of the intact forest around the Angel Oak likely drops the water table enough that subsurface flow occurs from the wetland south toward Church Creek (Figure 7).

Potential Alterations to Hydrology: The developer proposes to fill about half of the intermittent stream producing several isolated wetlands that are connected by culverts. The goal appears to be to capture all rainfall on the site, and direct it to isolated infiltration points. This will obviously impair the natural drainage pattern, and will also reduce the size of the catchment basin that is supplying sub-surface water flow to the south. In addition, filling the wetlands directly north of the Angel Oak will largely eliminate sub-surface flow to the tree.

Currently there are essentially no impervious surfaces in the project area. Rainfall is absorbed by an intact forest canopy, and throughfall infiltrates the sandy soils over the entire project area. Sub-surface flow replenishes the groundwater and moves water off site to the south or into the stream flowing west. This is the hydrological regime to which the Angel Oak is adapted. The proposed project would completely alter this regime. The forest will be essentially clear cut and replaced almost entirely with impervious surfaces.

Rainfall will become stormwater runoff, and will be channeled into isolated infiltration points, several of which (Detention Pond 1 and several of the bioswales) are quite close to the Angel Oak. Even if precipitation is retained on site, the distribution of this water will be completely different. Some areas will become much wetter, others much drier. Given the topography of the site, groundwater flow to the Angel Oak is likely to be interrupted as the proposed drainage system will direct most water off to the west or east.

In addition, the loss of the forest canopy will nearly eliminate transpiration, which will raise the water table throughout the site. Detention ponds and possibly even the bioswales are likely to fill with groundwater, leaving no room to accept stormwater runoff. This runoff will be channeled off the site, further altering the natural hydrologic regime and probably causing downstream flooding problems.

An additional clear result of so much impervious surface will be pulses of pollution that will be entering the groundwater.

References: Demolition and Tree Removal Plan and Overall Site Plan/Phasing, Angel Oak Village; produced by HLA Inc; stamped by Registered Professional Engineer Jason Donald Coffman, 11 December 2008. Topographic maps from DeLorme 3-D TopoQuads. Web Soil Survey, accessed at http://websoilsurvey.nrcs.usda.gov/app/. NRCS Hydric Soils Database accessed at http://soils.usda.gov/use/hydric/criteria.html. Site visit with Robert DeMoura and Mike Gruenloh, 19 February 2009.

Other Impacts on Site Ecology and Integrity:

The Angel Oak is adapted to the forest ecosystem that has grown up around it. Clear cutting this forest and replacing it with dense urban development will significantly diminish the ecological integrity of the site, and will significantly threaten the long-term future of the tree.

Removing the forest will isolate the Angel Oak and diminish the plant/animal interactions that currently exist at the site. There are many insects that forage on live oak, and these in turn are prey to many birds and other animals. Clear cutting the forest will remove bird nesting habitat and disrupt foraging patterns. Herbivory tends to increase on isolated trees, but the birds and other animals that control herbivorous insects will be much more likely to move to other areas where the forest community is intact. Live oaks are pretty robust, but the Angel Oak is a very old and somewhat fragile individual.

Trees growing in a forest environment are significantly less strong structurally than trees growing in an open habitat. Removing the forest around the Angel Oak will likely make it more susceptible to wind damage, especially from strong windstorms, including hurricanes.

Forests cool the surrounding habitat by providing shade and by evaporating enormous quantities of water. Removal of the forest around the Angel Oak will alter the temperature regime this tree experiences. In addition, the dense urban development will act as a heat sink, further increasing the ambient temperature around the Angel Oak.

The edge effect from dense urban development is well known. Typically, when an intact forest is clear cut, several rows of trees along the edge will eventually die from the sudden exposure and damage to their root systems. The Angel Oak is a very old tree, and its root system unquestionably extends much further away from the bole than the drip line of the canopy. Also, the Angel Oak is likely interconnected via fungal bridges to trees far from the actual location of the tree. For these reasons, I consider the 150’ buffer around the park to be insufficient to protect the root system and water/nutrient uptake system of the Angel Oak. The Angel Oak is one of the oldest trees east of the Rockies. It is likely one the oldest trees currently in the US, other than some ancient cypress forests on the Black River in North Carolina and the bristlecone pines of the White Mountains in California and Nevada. It is inappropriate to apply lessons from younger trees to this very old specimen. Only a tracer study can determine the actual extent of the soil area that supplies this tree with water and nutrients.

Having dense urban development so close to the Angel Oak will certainly increase traffic and vandalism around the tree. There is also likely to be an increase in invasive plant species resulting from soil disturbance and the influx of new residents. Increased traffic on Angel Oak Road will increase soil compaction with negative effects for that part of the tree’s root system. The tree will also certainly lose its serene setting.

Several other scientists were consulted as I developed this report. I gratefully acknowledge assistance from Tim Callahan (College of Charleston, Geology), Brian Scholtens, Seth Pritchard and Phil Dustan (College of Charleston, Biology), Lee Daniels (Virginia Tech, Crop and Soil Environmental Sciences) and Charlie Everett, (MUSC, Family Medicine, formerly with Westvaco Forest Research).

Please Note: Although I have generated this report as a part of my required academic commitment to community service, my findings and interpretations are entirely my own, and do not necessarily reflect the positions of the College of Charleston.