GREEN INTERNATIONAL AFFILIATES, INC.
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PLANNING BOARD
GRAFTON, MA

September 22, 2016

Mr. Brian Marchetti
McCarty Companies
42 Jungle Road
Leominster, MA 01453

Subject: Estate at Bull Meadow, Appaloosa Drive
Graves Engineering Vertical Curve Comment

Dear Mr. Marchetti:

We have reviewed the Definitive Plan Review of the Estates at Bull Meadow, Appaloosa Drive, with respect to the Town of Grafton Subdivision Rules and Regulations, as well as AASHTO's A Policy on Geometric Design of Highway from 2011. We have looked at comment 6 of the letter from Grave's Engineering regarding the proposed vertical curves on Paddock Ridge Avenue. We have the following observations and recommendations.

The sag curve at 12+24 has a k values of 27.5 which exceeds AASHTO design standards for a 25 MPH design. The crest curve at 13+81 has a k value of 6.5 which exceeds AASHTO's calculated k value for 20 MPH, but is below AASHTO's recommended design k value of 7. The minimum horizontal curve radius on Paddock Ridge Avenue is 125 feet which exceeds AASHTO design standards for a 20 MPH design.

Grafton's standard for sag curves is a k value of 35, which falls between a 25 MPH and 30 MPH design speed based on AASHTO standards. The town's standard for crest curves is a k value of 28, which falls between a 30 MPH and 35 MPH design speed based on AASHTO standards. The town standards for minimum radius on a horizontal curve is 100 feet, which falls between a 15 MPH and 20 MPH design speed based on AASHTO standards.

Based on the town's minimum radius standard of 100 feet and the 125 foot minimum radius proposed and the residential character of the proposed roadway, a 20 MPH design speed is reasonable and appropriate for this roadway. We recommend no changes to the current sag curve as it exceeds a 25 MPH design speed. We recommend lengthening the crest curve to meet a k value of 7 at a minimum, as this is the AASHTO design k value for 20 MPH. With the recommended changes, the roadway design would then meet or exceed all AASHTO design requirements for a 20 mph design speed, and allow for safe vehicular operations. We also note that it appears that the crest curve in question could be lengthened to meet the town's minimum k value of 28 without any additional wetland impacts, as flattening the crest curve would lower the grades and potentially reduce wetland impacts.

Sincerely,

Green International Affiliates, Inc.

Drew Talcoff

Drew Talcoff, P.E.

Cc: Jason Sobel
William Scully