THREATENED IMPACT OF 20 11 AG5: A POTENTIAL DEFLECTION CAMPAIGN SHOULD BE ANALYZED NOW. Clark R. Chapman[1], [1]Southwest Research Inst. (Suite 300, 1050 Walnut St., Boulder CO 80302 USA, cchapman@boulder.swri.edu).

Introduction: The near-Earth asteroid 2011 AG5 (hereafter AG5) is now the most problematical case of a possible catastrophic impact with Earth. The essential question is: "If it turns out that AG5 is actually on an impact trajectory, by what date must we begin a deflection campaign to prevent the ~100 MT disaster?"

The AG5 example also can teach us about required end-to-end planning to deal responsibly with NEO impact threats generally. AG5 has an unusually high probability of striking Earth with potentially severe consequences on 5 Feb. 2040. Although its Torino Scale is just 1, and its Palermo Scale -1.12, its particular circumstances warrant more attention in the next months than the "no cause for public attention or public concern" wording associated with TS=1.

The Issues: While AG5's chances of impact are low by common standards, severe consequences would be likely were it to strike in the already known narrow risk corridor (stretching from northern Mexico, through south Texas and central Florida, across the Atlantic to the western Sahara [due to ambiguity in published data, this corridor may be ~2,700 km south across northern South America]). Consequences depend on whether it would strike land, the ocean, or the Gulf of Mexico, and also on its size (actually mass). AG5 is currently surmised to be much smaller than Apophis though large enough to cause an enormous tsunami; because its albedo is not known, it could be as large as Apophis. Its uncertain size also critically affects whether we could practically deflect AG5 and avert the catastrophe (see below). Impact in 2040 happens if AG5 passes through a large keyhole (~100 km width) on 3 Feb. 2023. There seems to be no opportunity to observe AG5 again and update its orbit until an apparition beginning about Sept. 2013. Thus its TS=1 threat will remain unchanged for at least 18 months.

Preliminary analyses (e.g. presentations in February to the U.N. COUPOS Action Team 14 meeting in Vienna by the Association of Space Explorers, which included engineering analyses by the European NEO-Shield consortium) show that it may be challenging or even impossible to mount an adequate campaign to deflect AG5 from the keyhole, if we wait until after the late-2013 update to initiate preparations. Furthermore, it may be challenging or impossible to begin to prepare to mount missions to directly deflect AG5 from Earth impact after it actually passes through the keyhole -- if it were to do that -- with current or possibly even prospective launch vehicles. NASA's present policy is to wait until after the 2013 (or even 2015) observations to decide if further consideration of this threat is warranted. That, however, is not a responsible way to handle a low-probability high-consequence threat.

A common, uneducated attitude is "the probability is so low, let's wait until we know the probability is zero, which has a 600-to-1 chance of happening a few years from now." But that is a false approach to risk management. Instead, we must assume that the unlikely impact will actually happen, then ask "what are the prudent actions we will need to have taken in advance to ensure that the negative consequences were minimized (e.g. by evacuations) or to ensure that an adequate, reliable deflection could be achieved to avert the impact." The U.S. Weather Bureau and New Orleans officials faced an analogous situation a week before Katrina struck, when the chances of striking the city were still low and the storm's strength was unpredicatable. We now know that timely advance actions were not taken to protect the levees, plan for evacuation, or otherwise be ready for the potential disaster.

Conclusions: In the case of AG5, we need to understand now whether a verifiable deflection from the keyhole can be accomplished if started after 2013 or 2015. For the generic case with nominal parameters, deflection could be possible. It has been argued that Deep Impact took only six years to develop and successfully strike Comet Tempel 1. But terminal guidance and control would be much more difficult for AG5: it is ~2000 times smaller in area, has a higher closing velocity, involves a ~20 times greater impactor mass, and the observing conditions from the impacting spacecraft are worse (analyses of Deep Impact targeting have raised serious issues). When are there feasible launch windows? Because deflection by kinetic impact with AG5 assumes uncertain physical attributes of AG5 and uncertain effectiveness of an impact of given energy and momentum, a deflection campaign must verify the success (by transponder) and have a back-up gravity tractor capability, which would be provided by an observer spacecraft. What are the launch windows and timing requirements for such a spacecraft to rendezvous with AG5? None of these issues have yet been analyzed. Analyses are also necessary to determine if we can wait until after a keyhole passage to mount a campaign to directly deflect AG5 from Earth impact, given existing or prospective launch capabilities. If it turns out that we cannot afford to wait, we need to know that now. Full end-to-end mission analyses need to be done within the next few months.