FINAL FOUR LANDING SITES FOR THE MARS SCIENCE LABORATORY. M. Golombek[1], J. Grant[2], A. R. Vasavada[1], J. Grotzinger[3], M. Watkins[1], D. Kipp[1], E. Noe Dobrea[1], J. Griffes[3], and T. Parker[1], [1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, [2]Smithsonian Institution, Center for Earth and Planetary Sciences, Washington, D.C. 20560, [3]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA 91125.

Introduction: Four sites remain under consideration for landing the Mars Science Laboratory (MSL) after 4 open community workshops and the consideration of over 50 candidates during the past 4 years [1, 2]. The four landing sites (Holden crater, Gale crater, Mawrth Vallis and Eberswalde crater [Table 1, Figure 1]) represent compelling locations where MSL can significantly advance our knowledge of the conditions and potential habitability of Mars.

Since the last report in this venue, a call was issued for new MSL landing sites, 5 sites were proposed and two were recommended for imaging by orbiters. These two sites were evaluated and neither was selected. The final four sites were the subject of extensive science and characterization discussions at the Fourth Landing Site Workshop. This abstract describes these activities and future plans to select the final site in the summer of 2011.

Potential New Sites: Because of the delay in launching MSL and extensive new remote sensing data, a call was issued for potential new sites in Aug. 2009 [3]. Addition of any new site required both mineralogic and morphologic evidence demonstrating a compelling argument that it is at least as promising as the four sites under evaluation. Moreover, any proposed sites must appear as safe as the four sites under consideration. Five sites were proposed in Oct. 2009 that were evaluated: 1) Nili Carbonate (21.7N, 78.8E), 2) NE Syrtis, a diverse assemblage of minerals straddling the Noachian-Hesperian boundary (16.7N, 76.9E), 3) a delta deposit in a crater in Xanthe Terra (2.3N, 309E), 4) chloride and phyllosilicate deposits in east Margaritifer Terra (5.6S, 353.5E), and 5) Ladon basin (18.8S, 332.5E). These sites were considered at a MSL Project and MSL Landing Site Steering Committee meeting in Dec. 2009 that emphasized discussion of the science merit of the sites as well as landing site safety based on initial evaluation of thermal inertia, slopes, and other first order safety parameters. There was a clear consensus that the NE Syrtis [4] and E Margaritifer chloride [5] were the top ranked sites based on science and both were recommended to go forward for additional imaging by Mars Reconnossaince Orbiter (MRO) and Mars Odyssey.

These two sites were discussed in depth by the MSL Landing Site Steering Committee in early May 2010, after the return of substantial new orbital image data. The meeting included discussion of the science potential and initial safety evaluations of the sites. Most Steering Committee members felt that the NE Syrtis site was as or more compelling than the existing four sites, whose abundant and varied aqueous mineralogy likely spans the Noachian-Hesperian boundary. The well exposed rock sequence within and nearby the landing ellipse likely represents diverse geologic settings and may represent a pervasive and continuously habitable zone on Mars. Preliminary evaluation of the safety of the sites revealed several concerns related mostly to eolian ripples at E Margaritifer and 1 km slopes and other steep rocky scarps at NE Syrtis. These concerns resulted in neither site being added to the existing four sites.

4th Landing Site Workshop: The Fourth MSL Landing Site Workshop was open to the science community and was held Sept. 27-29, 2010 in Monrovia, CA. Workshop presentations were grouped into an introductory session followed by individual sessions for each of the four sites. A final session on the morning of the last day related to ongoing characterization of the candidate sites. Ample time was provided for discussion at the end of each session and on the final day of the workshop and was focused on the science opportunities afforded at each site. All discussion sessions were lively and involved. Supporting materials related to all aspects of the workshop, including all presentation materials, were posted in real time at [3], providing an additional means for participants to review each site.

All four remaining sites clearly possess high science merit and were deemed to be generally safe for landing by the MSL project. Eberswalde crater contains a delta with phyllosilicates, a potentially habitable environment that is particularly favorable to the preservation of organic materials. Holden crater contains finely layered phyllosilicates suggesting deposition in quiet fluvial or lacustrine setting with a well

Table 1: MSL Landing Site Ellipse Coordinates.

Landing Site	Latitude (°)	Longitude (°)	Elevation (m)
Eberswalde	23.8953ºS	326.7426ºE	-1435
Gale	4.4868ºS	137.4239ºE	-4444
Holden	26.4007ºS	325.1615ºE	-2177
Mawrth	23.9883ºN	341.0399ºE	-2245

Ellipses are 25 km by 20 km oriented east-west for the 2011 launch opportunity. Longitude, positive E, planetocentric. Elevation with respect to the MOLA geoid.

understood context. Mawrth Vallis exposes an ancient preserved layered stratigraphic section providing an opportunity to characterize early wetter conditions in the Noachian. Gale crater offers access to diverse stratigraphy, including interbedded sulfates and phyllosilicates in a 5 km high mound that reflects deposition during changing environmental conditions. There was unanimous agreement from workshop participants that all four of the sites remain under consideration.

Summary statements representing strong community consensus on the science merits of the sites were generated at the workshop (available in the "Workshop Summary Letter" at [3]. A common theme that emerged for each site was the need to develop specific sets of targets for exploration by the rover within and outside of the proposed landing ellipse. Such efforts should include a statement on why each target is important and what instruments on MSL would be used in the target interrogation. Such a set of targets and proposed measurements can help to define the mission resources required to complete the science investigation at each site. These targets will help inform integrated traversability and science evaluation studies conducted by the MSL Project and community over the coming months.

Future Plans: Between now and the next MSL Landing Site Workshop, to be held in the spring of 2011, the MSL Project would like to collect suggestions from the community of specific targets for study at each of the four landing sites. Directions for suggesting targets for study at the landing sites, including a brief description of their attributes and motivation for study can be found at [6]. At some future date, the MSL Project will host a series of telecons where these targets can be presented and discussed with members of the community.

A Fifth Landing Site Workshop to be held in Spring 2011 will enable each of the final four sites to be fully discussed and evaluated before the MSL Project recommends a landing site. Following a series of reviews of the site selected and the process used, NASA Headquarters will select the MSL landing site in summer 2011, before launch in Nov. 2011.

References: [1] Golombek M. et al. (2007) *LPS XXXVIII*, Abs. #1392; (2008) *LPS XXXIX*, Abs. #2181; (2009) *40th LPS*, Abs. #1409; (2010) *41st LPS*, Abs. # 2407. [2] Grant et al. (2010) Planet. Space Sci., doi:10.1016/j.pss.2010.06.016. [3] All documents are posted at http://marsoweb.nas.nasa.gov/landingsites/ and http://webgis.wr.usgs.gov/msl. [4] Mustard J. & Ehlmann B. at [3]. [5] Christensen P. et al. at [3]. [6] Griffes J. at http://msl.gps.caltech.edu

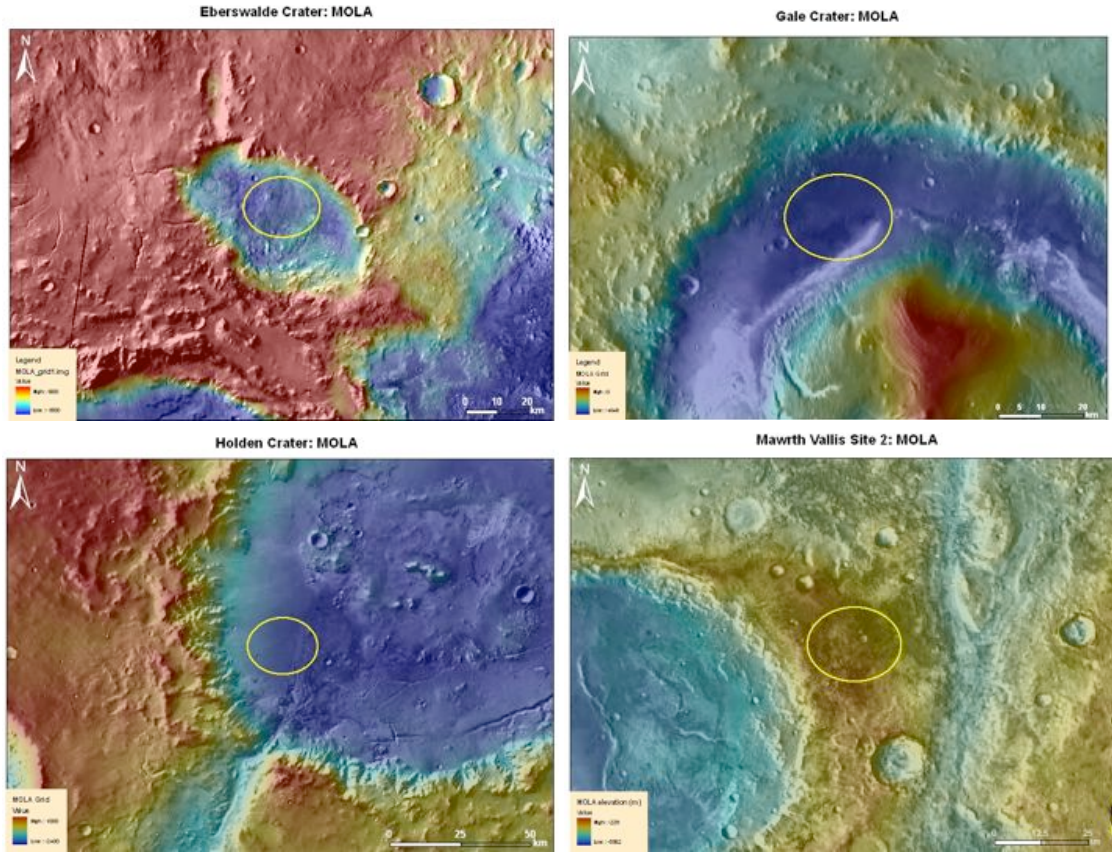

Figure 1: MSL landing ellipses on MOLA shaded relief base maps. Center coordinates in Table 1.