VALLEY NETWORK ANALYSIS AND DRAINAGE CHARACTERISTICS OF PROPOSED MARS SCIENCE LABORATORY LANDING SITES. A. Vidal, [1]University of Colorado, 2200 Colorado Ave, UCB 399, Boulder, CO, 80309-0399, arwen.vidal@colorado.edu.

Introduction: Many authors have pointed to valley networks on the surface of Mars, visually similar to river channels on Earth, as indicative of an active fluvial past. Several authors have used a variety of methods to map these valley networks and drainage basins[1-4]. In this study, valley networks were digitally mapped at seven proposed Mars Science Laboratory (MSL) landing sites. Drainage basins were identified and drainage densities calculated for each of these areas in order to constrain the past hydrologic character of each.

The seven landing sites analyzed were Nili Fossae Trough (NFT), Holden Crater (HC), Terby Crater (TC), Marwth Vallis (MV), Eberswalde Crater (EC), Gale Crater (GC), and West Candor (WC). Table 1 lists the geographic location of these proposed sites. Each was assessed for valley network stream order and drainage density.

Name	Latitude	Longitude
Nili Fossae Trough	20.93° N	74.35° E
Holden Crater	26.32° S	325.30° E
Terby Crater	27.74° S	74.11° E
Marwth Vallis	24.65° N	340.10° E
Eberswalde Crater	23.19° S	326.75° E
Gale Crater	4.50° S	137.35° E
West Candor	5.80° S	284.17° E

Table 1. Geographic coordinates of proposed landing sites for MSL used in this study.

Valley Network Mapping: Valley networks were mapped using Mars Orbiter Laser Altimeter (MOLA) digital elevation models (DEMs) and existing algorithms in the software package ArcGIS. Areas of approximately 5 degrees latitude and 7.6 degrees longitude centered around the locations in Table 1 were selected from the existing dataset for this study. Neighboring pixels were sampled to find the maximum slope (flow direction). The flow accumulation across each pixel was calculated. Local sinks (pits) were filled in order to preserve the continuity of networks.

Stepinski and Collier [4] cautioned that the channeling threshold, A_{th}, (the flow accumulation level which marks a true channel) is difficult to constrain. After testing several thresholds, the most appropriate, A_{th} = 350 pixels, was chosen to conduct analyses of all landing site candidate areas. Valley networks were mapped using the Hydrologic Toolbox in ArcGIS. Total stream length was determined for all stream segments with flow accumulation greater than 350 pixels. Streams were then ordered using the Strahler stream ordering method (Ω) [5].

Drainage Basins: Drainage basins were mapped using the flow direction previously calculated. Drainage areas were determined from this mapping. Only drainage basins whose area exceeded 10,000 square pixels were included in this study to reduce edge effects and data skew. Drainage density was calculated as:

$$D = L_t / A_b \qquad (1)$$

Where L_t is the total length of streams (A_{th} = 350), A_b is the basin areas sampled by these streams (basins > 10,000 square pixels) and D is the drainage density.

Results: Valley networks were mapped and ordered for each landing site. Several were marked by linear segments through crater floors, an artificact of the sink-fill procedure. Previous work, however, has shown that this has minimal effect on calculated drainage density [6]. Drainage basins were mapped and evaluated for drainage density. Table 2 summarizes the results for each landing site.

	Ω	L_t (km)	N_b	A_b (km)	D (km^{-1})
EC	5	9,501	11	109,513	**0.0868**
TC	5	9,962	11	117,959	**0.0845**
NFT	5	8,791	6	111,046	**0.0792**
MV	5	9,234	7	116,555	**0.0792**
HC	5	9,328	5	119,162	**0.0783**
WC	4	9,203	13	118,043	**0.0780**
GC	5	9,176	12	118,067	**0.0777**

Table 2. Results from network mapping and drainage analyses. N_b is the number of basins mapped in the area.

Conclusions: Valley network mapping reveals typical branching morphologies at all proposed landing sites. Most sites, with the exception of West Candor, had a stream order of 5, indicating mature development of valley networks in these areas. It is possible that at West Candor and other landing site areas, the stream networks have a lower channeling threshold or were not resolved in the data used.

All landing sites had similar drainage densities, and were within the range of values found for other locations on Mars [3,4]. The average drainage density for all sites was 0.0805 ± 0.0036 km^{-1}. The highest drainage density was at Eberswalde Crater, with a value of 0.0868 km^{-1}. From this brief study, it appears that both Eberswalde and Terby Craters have significant potential for evidence of past fluvial modification (Figures 1 and 2).

References:

[1] Carr, M. C., and F. C. Chuang (1997), *JGR*., 102(E4), 9145–9152. [2] Banerdt, W.B. and A. Vidal (2001), *LPSC XXXII*, Abstract #1488. [3] Hynek, B. M., and R. J. Phillips (2003), *Geology*, 31(9), 757–760. [4] Stepinski, T.F. and M.L. Collier (2004), JGR, *109*, 10.1029/2004JE002269. [5] Strahler, A. N. (1952), *GSA Bulletin*, *63*, 923 – 938. [6] Vidal, A. (2006), *Eos Trans. AGU*, 87(52), Abstract #P31B-0134.

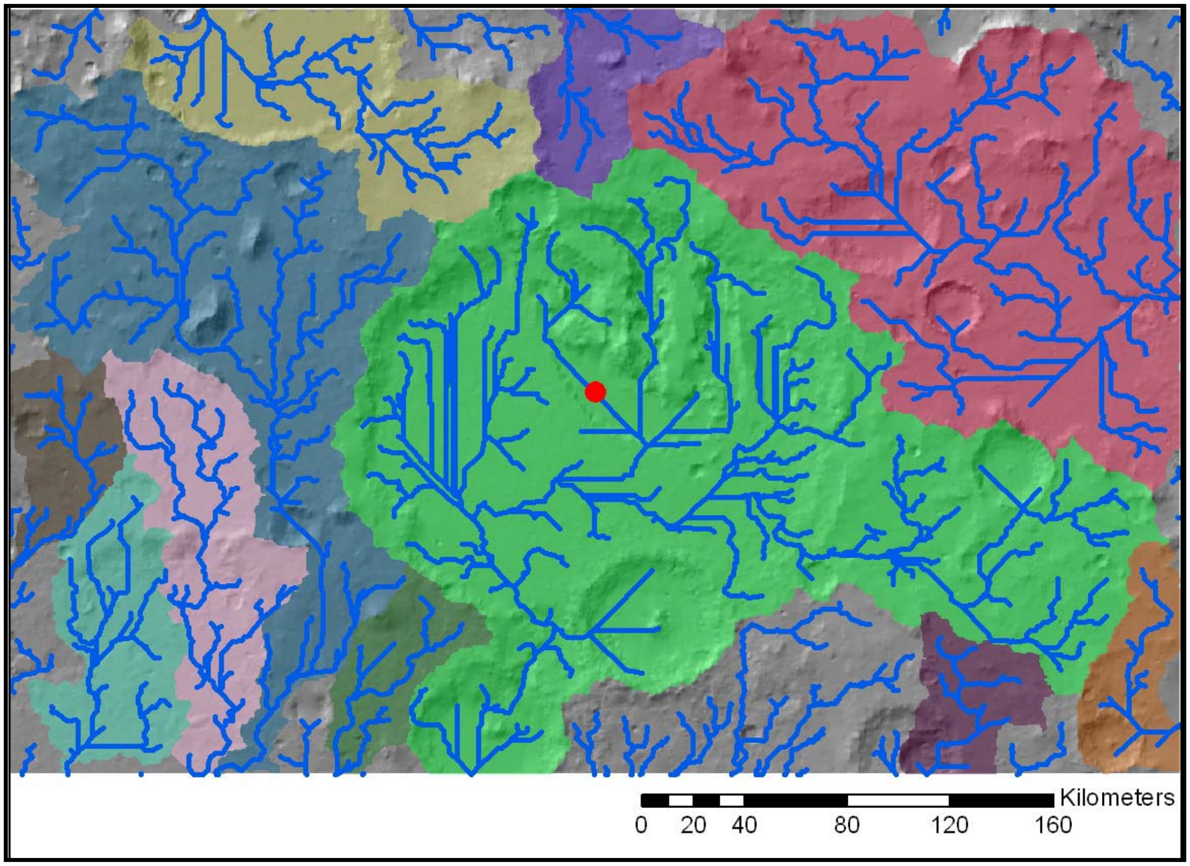

Figure 1. Valley networks and drainage basins mapped at Terby Crater. Red dot marks the approximate location of the proposed landing site.

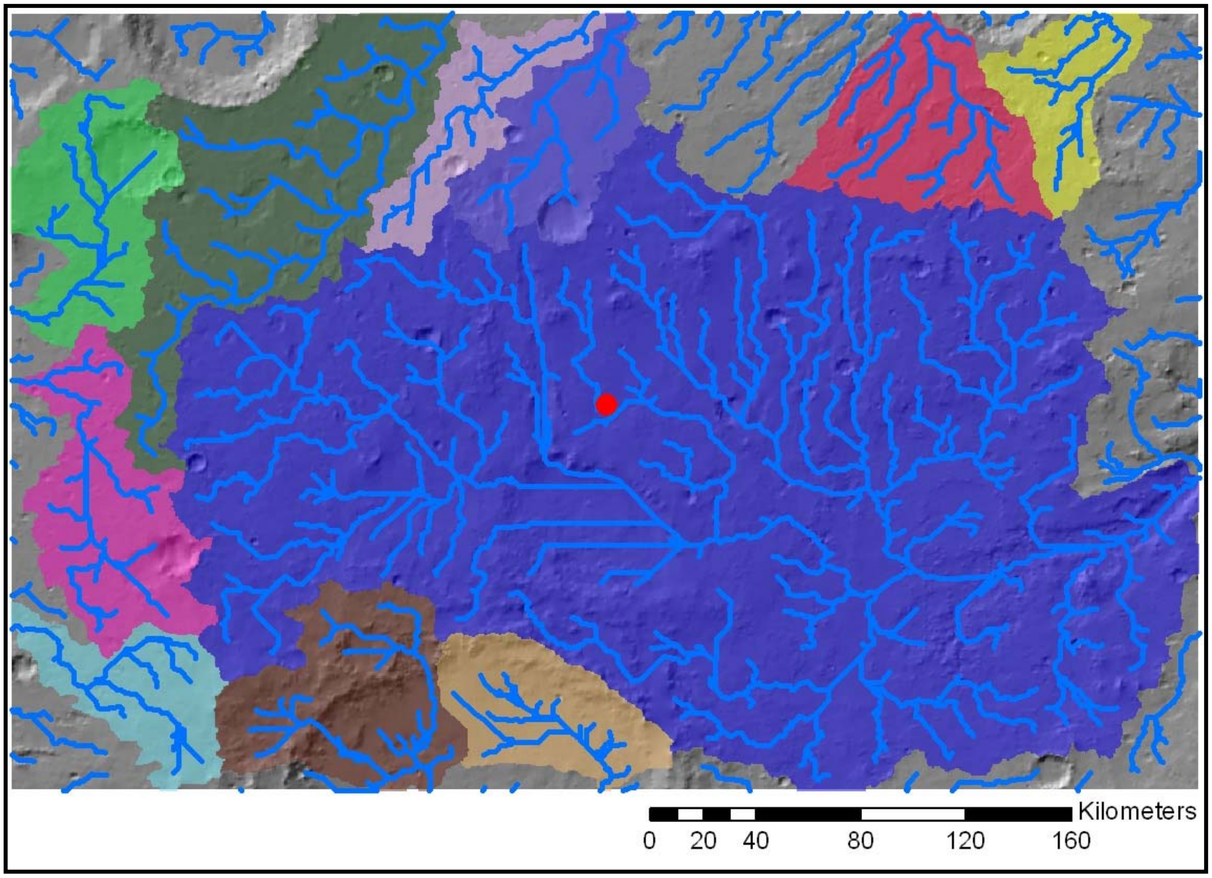

Figure 2. Valley networks and drainage basins mapped at Eberswalde Crater. Red dot marks the approximate location of the proposed landing site.