NASAfacts

PROPOSED ACTION AND NO ACTION ALTERNATIVE

Mars has been an object of fascination for humanity for thousands of years. A now barren planet, we know based on recent science that Mars once had a thicker atmosphere and was abundant with water. We now ask ourselves, "What happened to Mars? Was there once life there? Can humans live on Mars?"

The most Earth-like planet in the solar system, Mars may be able to tell us about the early evolution of water-rich terrestrial planets, and its relationship to the evolution of habitable environments. Mars has not been subjected to significant geological degradation, resulting in the possibility that the early geologic record of Mars has been preserved. Because of these conditions, signs of past life on Mars may have been preserved in a way that can be observed and studied. Mars, therefore, provides the opportunity to address fundamental questions about the origin and evolution of life on Earth (and elsewhere in the solar system), such as "Did life arise elsewhere in the solar system, and if so, how and when? How did Mars evolve into the planet it is today and what can that tell us about Earth's evolution? and How are the biological and geological histories of a planet related?"

The Mars Sample Return Campaign is a top priority in the planetary science community and has long been a goal of international planetary exploration programs. By acquiring and delivering to Earth a rigorously documented set of Mars samples for investigation in terrestrial laboratories, scientists would have access to the full breadth and depth of analytical science instruments available across the world.

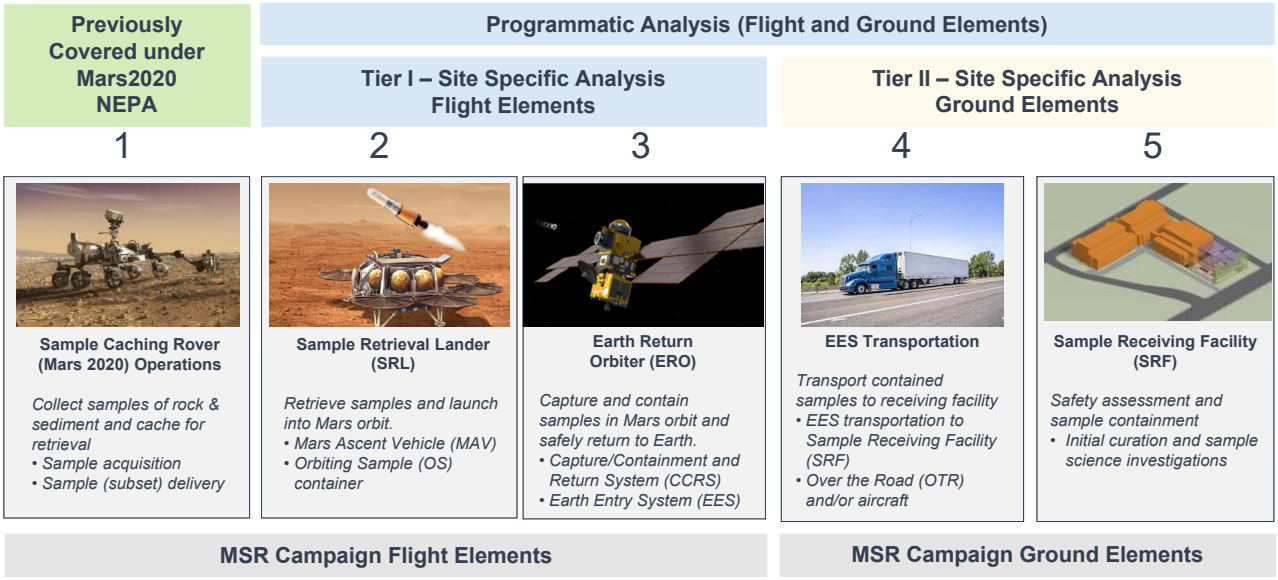
Proposed Action

Under the Proposed Action, NASA in coordination with the European Space Agency (ESA) would conduct the Mars Sample Return Campaign to retrieve a scientifically selected set of Mars samples (i.e., Martian rocks, regolith[1], and atmosphere). These samples would be transported to Earth for scientific analysis and research as part of the Proposed Action. The resulting investigations of these returned samples would enable scientific advances in:

- the search for life on Mars
- understanding the origin and evolution of Mars as a geological system
- understanding the processes and history of climate on Mars
- closing knowledge gaps required to prepare for future human exploration.

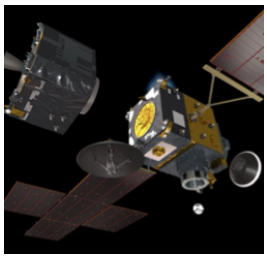
The Proposed Action, as the Mars Sample Return Campaign, includes three flight elements and two ground elements. The flight elements consist of the Perseverance rover, a Sample Retrieval Lander, and the Earth Return Orbiter, including its payload and recovery. The proposed landing location is the Utah Test and Training Range (see "Why Utah Test and Training Range" Factsheet). The ground elements are Earth Entry System transportation and a sample receiving facility.

[1]Regolith is loose unconsolidated rock and dust that sits atop a layer of bedrock.



Flight Elements

- Perseverance Rover (Sample Caching Rover): Provided by NASA and launched in July 2020, the mission currently underway is responsible for sample selection, acquisition, and caching. The total sample amount would be approximately 525 grams (about 1 pound). This flight element was previously analyzed under National Environmental Policy Act (NEPA) in NASA's Final EIS for the Mars 2020 Mission and the Final Supplemental EIS for the Mars 2020 Mission.
- Sample Retrieval Lander: Anticipated for launch in 2028 from Cape Canaveral Space Force Station or Kennedy Space Center in Brevard County, Florida, the Sample Retrieval Lander would include a lander platform delivered from launch through entry, descent, and landing on Mars. The Sample Retrieval Lander – launched by NASA – would deliver to the planet's surface the Mars Ascent Vehicle with the Orbiting Sample container, a Sample Transfer Arm provided by the ESA, and up to two Sample Recovery Helicopters. The Perseverance rover would be the primary means of transporting samples that it has retained on board directly to the Sample Retrieval Lander, where the Sample Transfer Arm would load the sample tubes into the Orbiting Sample container. The Sample Recovery Helicopters, based on the design of the Ingenuity helicopter that landed on Mars with Perseverance and has operated well beyond its original planned lifetime, would provide a secondary capability to retrieve samples cached on the surface of Mars. The Mars Ascent Vehicle would launch the Orbiting Sample container loaded with sample tubes into Mars orbit.
- Earth Return Orbiter: Provided by the ESA and launched from French Guiana in 2027 (prior to the Space Retrieval Lander launch, the Earth Return Orbiter would rendezvous with the Orbiting Sample container in space, and return it for a safe entry and landing on Earth. The Earth Return Orbiter would be capable of (1) providing communications relay for all Mars Sample Return flight elements on the surface of Mars (Sample Retrieval Lander, Perseverance rover, and Mars Ascent Vehicle), (2) locating the Orbiting Sample container in Mars orbit, and (3) supplying power, propulsion and navigation needed for the NASA-provided Capture/Containment and Return System payload to function. More information regarding ESA's role in the Mars Sample Return Campaign can be found at the ESA website: https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Exploration/Mars_sample_return. The Capture/Containment and Return System payload would provide the ability to capture and contain the Orbiting Sample container, transfer the Orbiting Sample container into the Earth Entry Vehicle (creating the Earth Entry System [EES]), and protect it during the return flight to Earth (see https://mars.nasa.gov/msr/ for additional information for additional information). To avoid Earth, the Earth Return Orbiter implements a dual-pronged strategy, including mission design and diversion operations. After all critical spacecraft systems can be verified to be healthy and reliable, the Earth Return Orbiter would be maneuvered onto a path that would allow the EES to land precisely in the target area. After EES release, the Earth Return Orbiter would navigate to a trajectory that would avoid Earth for over 100 years, ensuring that residual Mars material, if any, associated with the Earth Return Orbiter is not returned to Earth.



Ground Elements – While specific transportation protocols and sample receiving facility (SRF) design and operational requirements are still in development, this fact sheet describes the reasonably foreseeable transportation, safety, security, and storage/curation for the Mars Sample Return Campaign.

- Earth Entry System and Mars Sample Transportation: After containment of the EES (which contains the samples) at the landing site and transfer to the vault (see Recovery Operations Factsheet), the EES would be transported to an SRF. Transport methods have yet to be determined; however, the vault would be delivered to the SRF using either over-the-road transport or a combination of over-the-road transport and aircraft. Exact transportation methods and routes would depend on the type of vault utilized and the location of an SRF. Thus, potential impacts associated with possible transportation methods are analyzed from a programmatic perspective (see Programmatic Approach Factsheet) based on either over-the-road transport and/or aircraft use. There is no site-specific analysis of EES transportation from the landing site to an SRF in the Programmatic Environmental Impact Statement; future NEPA analysis will address the specific impacts once the requirements have been further defined.
- Sample Receiving Facility: Currently, NASA does not have a facility that can support the biosafety level required for a mission such as the Mars Sample Return Campaign; consequently, an SRF would need to be established or added to an existing facility. An SRF within the context of this Programmatic Environmental Impact Statement includes temporary or permanent facilities used to isolate unsterilized Mars material from the Earth's environment. Activities anticipated at this type of facility are removal of the Mars samples from the EES, sample safety assessment (curation, including the preservation, conservation, management, preliminary examination, cataloging, allocation, and distribution), and physical security of sterilized Mars materials, as well as analysis, which may include scientific or planetary protection activities.

No Action Alternative

Under the No Action Alternative, the Mars Sample Return Campaign would not be undertaken. As a result, investigation of Mars as a planetary system would be limited due to the cost and complexity of sending instruments into space or to Mars for in situ analyses. By not undertaking the Mars Sample Return Campaign, scientists would not have access to the full breadth and depth of analytical science instruments available in Earth laboratories.

Planned MSR Campaign Architecture