

Lunar Surface Commitment Irreversibility Map

How a lunar site moves from signal to lock-in

Lunar irreversibility does not begin at full base construction. It begins when signal, access, support, disturbance, and resource assumptions start reinforcing one another.



A lunar pathway becomes structurally irreversible when one site, corridor, resource interpretation, or support architecture becomes harder to abandon than to continue.

■ Blue	Knowledge acquisition / reversible
■ Teal	Bounded verification
■ Amber	Commitment-proximate
■ Iron Oxide	Lock-in / inadmissible unless evidence burden is met

Infrastructure should not harden faster than understanding.

Trigger Register and Threshold Rule

When reversible exploration becomes commitment-bearing action

A trigger does not need to be permanent to matter. It matters when it reduces the practical ability to refuse, defer, re-site, or re-sequence later.

1. Commitment Trigger Register

ID	Trigger	What activates it	Primary irreversibility	Why it matters
T-LUN-1	Site Fixation	<i>A site becomes the working reference location</i>	Precedent / narrative	Alternatives lose practical credibility
T-LUN-2	Landing / Access Commitment	<i>Landing zones, approaches, or routes are preferred or repeated</i>	Access / corridor	Access geometry begins to govern future operations
T-LUN-3	Power / Support Anchoring	<i>Power, comms, nav, survival, or logistics support privileges one geometry</i>	Power / support	Support architecture narrows site optionality
T-LUN-4	Disturbance-Based Verification	<i>Drilling, trenching, excavation, sampling, plume effects, or thermal forcing alter the site</i>	Physical disturbance / scientific foreclosure	Verification changes the evidence baseline
T-LUN-5	Corridor Formation	<i>Movement or support logic turns a route into logistics structure</i>	Path dependence	Reachable zones and future operations inherit the corridor
T-LUN-6	ISRU Dependency Formation	<i>Resource assumptions shape processing, power, logistics, or mission sequencing</i>	Resource dependency	The system depends on a resource before it has earned that role
T-LUN-7	Infrastructure Hardening	<i>Pads, berms, blast protection, fixed logistics, power, or comms become durable</i>	Physical / operational lock-in	Site identity becomes reinforced by assets
T-LUN-8	Programmatic / Governance Designation	<i>A site, corridor, or resource zone is treated as primary in public, partner, or mission materials</i>	Governance / precedent	Exit becomes politically or institutionally costly

2. Optionality Half-Life

Use a compact ladder.

LONG HALF-LIFE	MEDIUM HALF-LIFE	SHORT HALF-LIFE	IMMEDIATE HALF-LIFE
<p><i>Reversal remains credible</i></p> <ul style="list-style-type: none"> • Desktop analysis • Broad site comparison • Non-hardening orbital prospect ranking • Private scenario modeling • Early architecture concepts preserving alternatives <p>Governance status: Generally reversible.</p>	<p><i>Reversal remains possible but increasingly contested</i></p> <ul style="list-style-type: none"> • Bounded rover traverse • Local sensing • Preliminary access concept • Private partner coordination • Temporary local support <p>Governance status: Admissible only if bounded by a clear evidence question.</p>	<p><i>Refusal credibility decays quickly</i></p> <ul style="list-style-type: none"> • Landing site finalization • Public site designation • Fixed power / support emplacement • Repeated corridor use • ISRU demonstration framed as feasibility proof <p>Governance status: Presumptively DEFER unless evidence is decision-adequate.</p>	<p><i>Reversal requires redesign, loss, or precedent damage</i></p> <ul style="list-style-type: none"> • Landing pad preparation • Berm / blast protection • Permanent infrastructure placement • Operational ISRU dependency • Shared infrastructure commitment • Exclusion or safety zones <p>Governance status: Inadmissible unless the commitment burden has already been met.</p>

3. Dominant Coupling and Decision Rule

Dominant Lunar Coupling

Volatile interpretation × access geometry × power support × disturbance × ISRU dependency

A volatile signal may identify an attractive target. Access and illumination may make one site operationally convenient. Power and communications may reinforce that site. Disturbance may produce knowledge while altering the evidence base. ISRU assumptions can then convert the site from a prospect into an infrastructure anchor.

This is the pathway from signal to lock-in.

ADMISSIBILITY RULE

A commitment-bearing action is inadmissible when: multiple materially plausible subsurface states remain consistent with current evidence; those states imply incompatible site, access, support, excavation, or ISRU architectures; the proposed action would make refusal, re-siting, or re-sequencing non-credible.

DEFER RULE

DEFER is a non-commitment state. During Defer, only bounded evidence acquisition is admissible. No site hardening, corridor normalization, power anchoring, or ISRU dependency formation should occur unless explicitly authorized by a new admissibility determination.

REFUSE RULE

REFUSE is required when learning would require crossing a threshold that makes reversal infeasible before decision-dominant uncertainty can be reduced.

Lunar irreversibility does not begin at full base construction. It begins when signal, access, support, disturbance, and resource narrative start reinforcing one another.

A site becomes committed when continuing becomes easier than refusing.