Swell Network

Aura Vault

SMART CONTRACT AUDIT

02.10.2022

Made in Germany by Chainsulting.de

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1. Disclaimer

The audit makes no statements or warrantees about utility of the code, safety of the code, suitability of the business model, investment advice, endorsement of the platform or its products, regulatory regime for the business model, or any other statements about fitness of the contracts to purpose, or their bug free status. The audit documentation is for discussion purposes only.

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Major Versions / Date	Description
0.1 (27.09.2022)	Layout
0.4 (29.09.2022)	Automated Security Testing Manual Security Testing
0.5 (01.10.2022)	Verify Claims and Test Deployment
0.6 (02.10.2022)	Testing SWC Checks
0.9 (02.10.2022)	Summary and Recommendation
1.0 (02.10.2022)	Final document
1.1 (TBA)	Added deployed contract

2. About the Project and Company

Company address:

DL Labs Pte. Ltd.
Reg.: 202204142H
20 Tanjong Pagar Road
Singapore 088443

Website: https://www.swellnetwork.io

Twitter: https://twitter.com/swellnetworkio

Discord: https://discord.gg/SeMQbGbeqC

Medium: https://medium.com/swell-network

Forum: https://forum.swellnetwork.io

Reddit: https://www.reddit.com/r/SwellNetwork

2.1 Project Overview

Swell delivers fast, simple and liquid staking. Swell Network is a decentralized, open, liquid, non-custodial, Ethereum staking DeFi protocol. Swell Network is organised as a Decentralised Autonomous Organisation (DAO). In return for staking ether, you receive a liquid derivative token (swETH which is pegged 1:1 to ether.) that can be used across DeFi to compound yield. Swell eliminates the complexity of setting up a validator and managing your own infrastructure or needing to have 32 ETH requirements.

Swell network supports 3 key pillars
(a) Liquid Staking
(b) DPools (decentralised mini pools)
(c) Decentralised marketplace.

The connectivity between swETH and the staked ether is maintained by the sWETH protocol which factors in the total amount of staked ether, level of staking rewards, and any adjustments including any slashing penalties.

3. Vulnerability & Risk Level

Risk represents the probability that a certain source-threat will exploit vulnerability, and the impact of that event on the organization or system. Risk Level is computed based on CVSS version 3.0.

Level	Value	Vulnerability	Risk (Required Action)
Critical	9 – 10	A vulnerability that can disrupt the contract functioning in a number of scenarios, or creates a risk that the contract may be broken.	Immediate action to reduce risk level.
High	7 – 8.9	A vulnerability that affects the desired outcome when using a contract, or provides the opportunity to use a contract in an unintended way.	Implementation of corrective actions as soon as possible.
Medium	4 – 6.9	A vulnerability that could affect the desired outcome of executing the contract in a specific scenario.	Implementation of corrective actions in a certain period.
Low	2 – 3.9	A vulnerability that does not have a significant impact on possible scenarios for the use of the contract and is probably subjective.	Implementation of certain corrective actions or accepting the risk.
Informational	0 – 1.9	A vulnerability that have informational character but is not effecting any of the code.	An observation that does not determine a level of risk

4. Auditing Strategy and Techniques Applied

Throughout the review process, care was taken to evaluate the repository for security-related issues, code quality, and adherence to specification and best practices. To do so, reviewed line-by-line by our team of expert pentesters and smart contract developers, documenting any issues as there were discovered.

4.1 Methodology

The auditing process follows a routine series of steps:

1. Code review that includes the following:
   i. Review of the specifications, sources, and instructions provided to Chainsulting to make sure we understand the size, scope, and functionality of the smart contract.
   ii. Manual review of code, which is the process of reading source code line-by-line in an attempt to identify potential vulnerabilities.
   iii. Comparison to specification, which is the process of checking whether the code does what the specifications, sources, and instructions provided to Chainsulting describe.
2. Testing and automated analysis that includes the following:
   i. Test coverage analysis, which is the process of determining whether the test cases are actually covering the code and how much code is exercised when we run those test cases.
   ii. Symbolic execution, which is analysing a program to determine what inputs causes each part of a program to execute.
3. Best practices review, which is a review of the smart contracts to improve efficiency, effectiveness, clarify, maintainability, security, and control based on the established industry and academic practices, recommendations, and research.
4. Specific, itemized, actionable recommendations to help you take steps to secure your smart contracts.

5. Metrics

The metrics section should give the reader an overview on the size, quality, flows and capabilities of the codebase, without the knowledge to understand the actual code.

5.1 Tested Contract Files

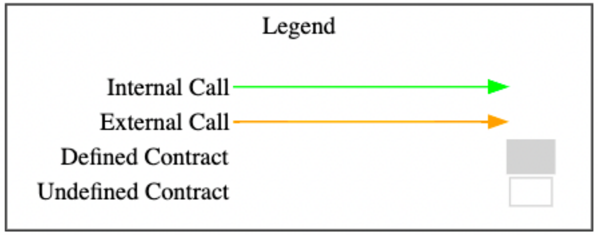
The following are the MD5 hashes of the reviewed files. A file with a different MD5 hash has been modified, intentionally or otherwise, after the security review. You are cautioned that a different MD5 hash could be (but is not necessarily) an indication of a changed condition or potential vulnerability that was not within the scope of the review

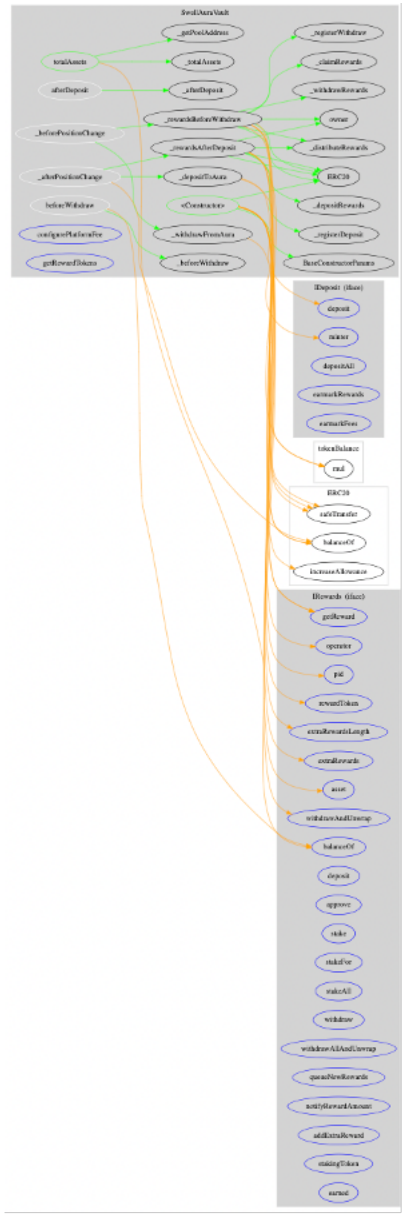
File	Fingerprint (MD5)
./contracts/implementations/SwellAuraVault.sol	f950de2804a8fddeaf589e1af2d6153c
./contracts/vendor/aura/IRewards.sol	17706e7432e1cc1a863a1c763cd49025
./contracts/vendor/aura/IDeposit.sol	279378e0b2b539d68cc89ed8aae6a6e3

5.2 Used Code from other Frameworks/Smart Contracts (direct imports)

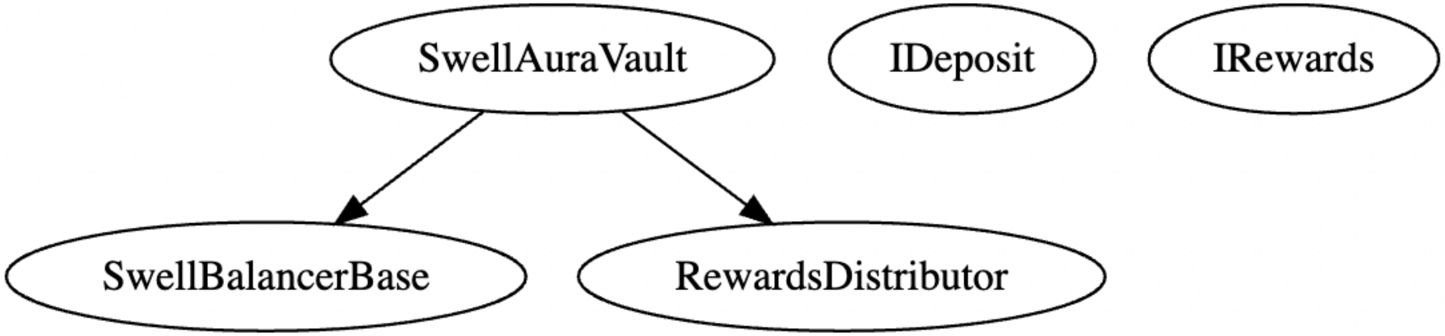
Dependency / Import Path	Source
@openzeppelin/contracts/access/Ownable.sol	https://github.com/OpenZeppelin/openzeppelin-contracts/tree/v4.5.0/contracts/access/Ownable.sol
@prb/math/contracts/PRBMathUD60x18.sol	https://github.com/paulrberg/prb-math/blob/v2.5.0/contracts/PRBMathUD60x18.sol
./vendor/rari-capital/SafeTransferLib.sol	https://github.com/transmissions11/solmate/blob/main/src/utils/SafeTransferLib.sol
./vendor/rari-capital/FixedPointMathLib.sol	https://github.com/transmissions11/solmate/blob/main/src/utils/FixedPointMathLib.sol

5.3 CallGraph

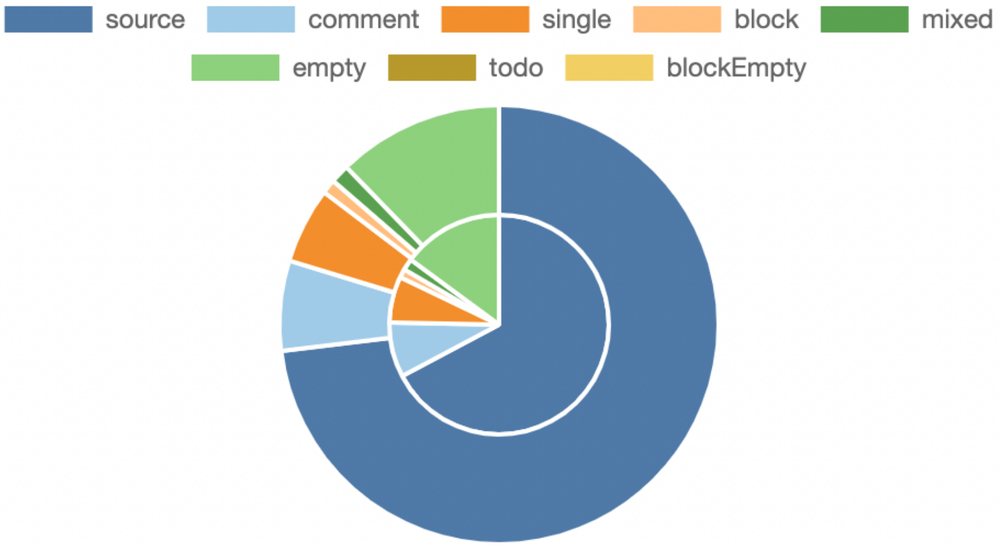


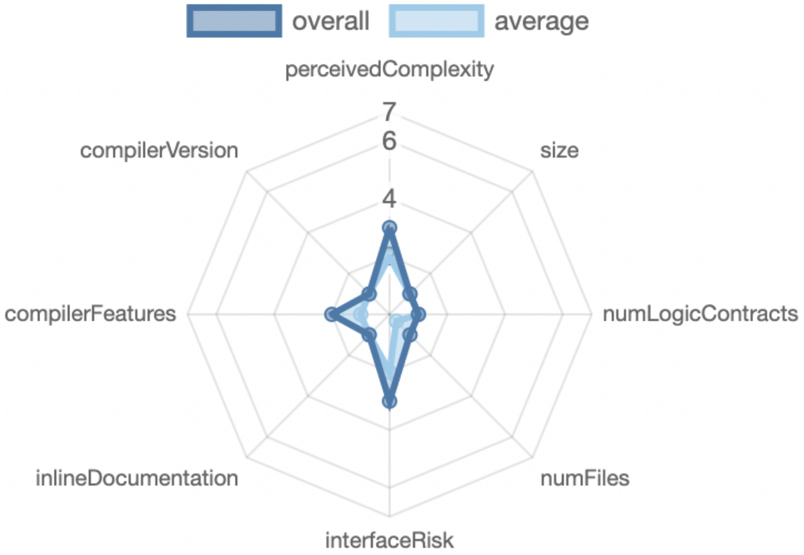


5.4 Inheritance Graph



5.5 Source Lines & Risk





5.6 Capabilities

Solidity Versions observed	🧪 Experimental Features	💰 Can Receive Funds	🖥 Uses Assembly	💣 Has Destroyable Contracts
`0.8.13`				

📤 Transfers ETH	⚡ Low-Level Calls	👥 DelegateCall	🧮 Uses Hash Functions	🔖 ECRecover	🌀 New/Create/Create2

Exposed Functions
This section lists functions that are explicitly declared public or payable. Please note that getter methods for public stateVars are not included.

🌐Public	💰Payable
30	0

External	Internal	Private	Pure	View
29	36	0	0	11

StateVariables

Total	🌐Public
6	4

5.7 Source Unites in Scope

Source: https://github.com/SwellNetwork/vault/blob/dev/contracts/implementations/SwellAuraVault.sol
Last commit: 24709163392836d7868bd11f998e0875e51a3ef9
Branch: dev

Type	File	Logic Contracts	Interfaces	Lines	nLines	nSLOC	Comment Lines	Complex. Score	Capabilities
📝	contracts/implementations/SwellAuraVault.sol	1		218	194	152	13	142	
🔍	contracts/vendor/aura/IDeposit.sol		1	12	7	3	3	11	
🔍	contracts/vendor/aura/IRewards.sol		1	29	7	3	3	45	
📝 🔍	**Totals**	**1**	**2**	**259**	**208**	**158**	**19**	**198**	

Legend:

- **Lines**: total lines of the source unit
- **nLines**: normalized lines of the source unit (e.g. normalizes functions spanning multiple lines)
- **nSLOC**: normalized source lines of code (only source-code lines; no comments, no blank lines)
- **Comment Lines**: lines containing single or block comments
- **Complexity Score**: a custom complexity score derived from code statements that are known to introduce code complexity (branches, loops, calls, external interfaces, ...)

6. Scope of Work

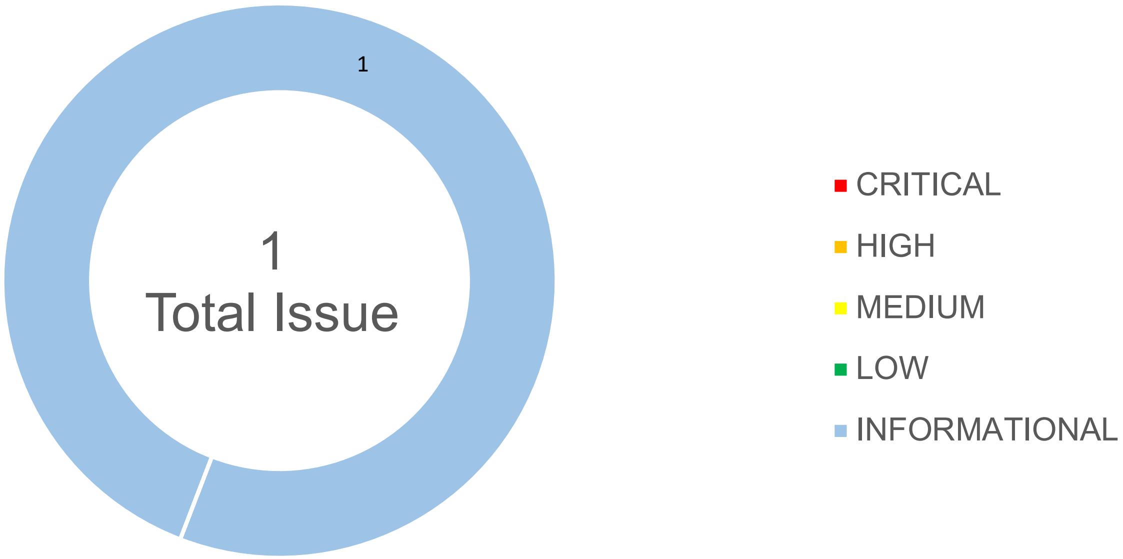
The Swell Network team provided us with the files that needs to be tested. The scope of the audit is the aura vault contract.

The team put forward the following assumptions regarding the security, usage of the contracts:

- Implementations of the vendor Aura and Rari-Capital are safe to use and correctly implemented
- Deposits are working as expected
- Rewards are working as expected
- Withdrawals are working as expected
- The smart contract is coded according to the newest standards and in a secure way.

The main goal of this audit was to verify these claims. The auditors can provide additional feedback on the code upon the client's request.

6.1 Findings Overview



No	Title	Severity	Status
6.2.1	Missing Natspec Documentation	INFORMATIONAL	ACKNOWLEDGED

6.2 Manual and Automated Vulnerability Test

CRITICAL ISSUES

During the audit, Chainsulting‘s experts found **0 Critical issues** in the code of the smart contract.

HIGH ISSUES

During the audit, Chainsulting’s experts found **0 High issues** in the code of the smart contract.

MEDIUM ISSUES

During the audit, Chainsulting’s experts found **0 Medium issue** in the code of the smart contract.

LOW ISSUES

During the audit, Chainsulting’s experts found **0 Low issues** in the code of the smart contract.

INFORMATIONAL ISSUES

During the audit, Chainsulting’s experts found **1 Informational issue** in the code of the smart contract.

6.2.1 Missing Natspec Documentation

Severity: INFORMATIONAL
Status: ACKNOWLEDGED
Code: NA
File(s) affected: SwellAuraVault.sol

Attack / Description	Solidity contracts can use a special form of comments to provide rich documentation for function, return variables, and more. This special form is named Ethereum Natural Language Specification Format(NatSpec).
Code	//
Result/Recommendation	It is recommended to include natspec documentation and follow the doxygen style including @author, @title, @notice, @dev, @param, @return and make it easier to review and understand your smart contract.

6.3 SWC Attacks

ID	Title	Relationships	Test Result
SWC-131	Presence of unused variables	CWE-1164: Irrelevant Code	✓
SWC-130	Right-To-Left-Override control character (U+202E)	CWE-451: User Interface (UI) Misrepresentation of Critical Information	✓
SWC-129	Typographical Error	CWE-480: Use of Incorrect Operator	✓
SWC-128	DoS With Block Gas Limit	CWE-400: Uncontrolled Resource Consumption	✓

ID	Title	Relationships	Test Result
SWC-127	Arbitrary Jump with Function Type Variable	CWE-695: Use of Low-Level Functionality	✅
SWC-125	Incorrect Inheritance Order	CWE-696: Incorrect Behavior Order	✅
SWC-124	Write to Arbitrary Storage Location	CWE-123: Write-what-where Condition	✅
SWC-123	Requirement Violation	CWE-573: Improper Following of Specification by Caller	✅
SWC-122	Lack of Proper Signature Verification	CWE-345: Insufficient Verification of Data Authenticity	✅
SWC-121	Missing Protection against Signature Replay Attacks	CWE-347: Improper Verification of Cryptographic Signature	✅
SWC-120	Weak Sources of Randomness from Chain Attributes	CWE-330: Use of Insufficiently Random Values	✅
SWC-119	Shadowing State Variables	CWE-710: Improper Adherence to Coding Standards	✅
SWC-118	Incorrect Constructor Name	CWE-665: Improper Initialization	✅

ID	Title	Relationships	Test Result
SWC-117	Signature Malleability	CWE-347: Improper Verification of Cryptographic Signature	✅
SWC-116	Timestamp Dependence	CWE-829: Inclusion of Functionality from Untrusted Control Sphere	✅
SWC-115	Authorization through tx.origin	CWE-477: Use of Obsolete Function	✅
SWC-114	Transaction Order Dependence	CWE-362: Concurrent Execution using Shared Resource with Improper Synchronization ('Race Condition')	✅
SWC-113	DoS with Failed Call	CWE-703: Improper Check or Handling of Exceptional Conditions	✅
SWC-112	Delegatecall to Untrusted Callee	CWE-829: Inclusion of Functionality from Untrusted Control Sphere	✅
SWC-111	Use of Deprecated Solidity Functions	CWE-477: Use of Obsolete Function	✅
SWC-110	Assert Violation	CWE-670: Always-Incorrect Control Flow Implementation	✅
SWC-109	Uninitialized Storage Pointer	CWE-824: Access of Uninitialized Pointer	✅
SWC-108	State Variable Default Visibility	CWE-710: Improper Adherence to Coding Standards	✅

ID	Title	Relationships	Test Result
SWC-107	Reentrancy	CWE-841: Improper Enforcement of Behavioral Workflow	✅
SWC-106	Unprotected SELFDESTRUCT Instruction	CWE-284: Improper Access Control	✅
SWC-105	Unprotected Ether Withdrawal	CWE-284: Improper Access Control	✅
SWC-104	Unchecked Call Return Value	CWE-252: Unchecked Return Value	✅
SWC-103	Floating Pragma	CWE-664: Improper Control of a Resource Through its Lifetime	✅
SWC-102	Outdated Compiler Version	CWE-937: Using Components with Known Vulnerabilities	✅
SWC-101	Integer Overflow and Underflow	CWE-682: Incorrect Calculation	✅
SWC-100	Function Default Visibility	CWE-710: Improper Adherence to Coding Standards	✅

6.4. Verify Claims

6.4.1 Implementations of the vendor Aura and Rari-Capital are safe to use and correctly implemented
Status: tested and verified ✅

6.4.2 Deposits are working as expected
Status: tested and verified ✅

6.4.3 Rewards are working as expected
Status: tested and verified ✅

6.4.4 Withdrawals are working as expected
Status: tested and verified ✅

6.4.5 The smart contract is coded according to the newest standards and in a secure way.
Status: tested and verified ✅

7. Executive Summary

Two (2) independent Chainsulting experts performed an unbiased and isolated audit of the smart contract codebase.

The main goal of the audit was to verify the claims regarding the security and functions of the smart contract. During the audit, no critical, no medium, no low and one informational issue have been found, after the manual and automated security testing. We advise the Swell Network team to implement the recommendation to further enhance the code's readability and documentation.

8. Deployed Smart Contract

PENDING

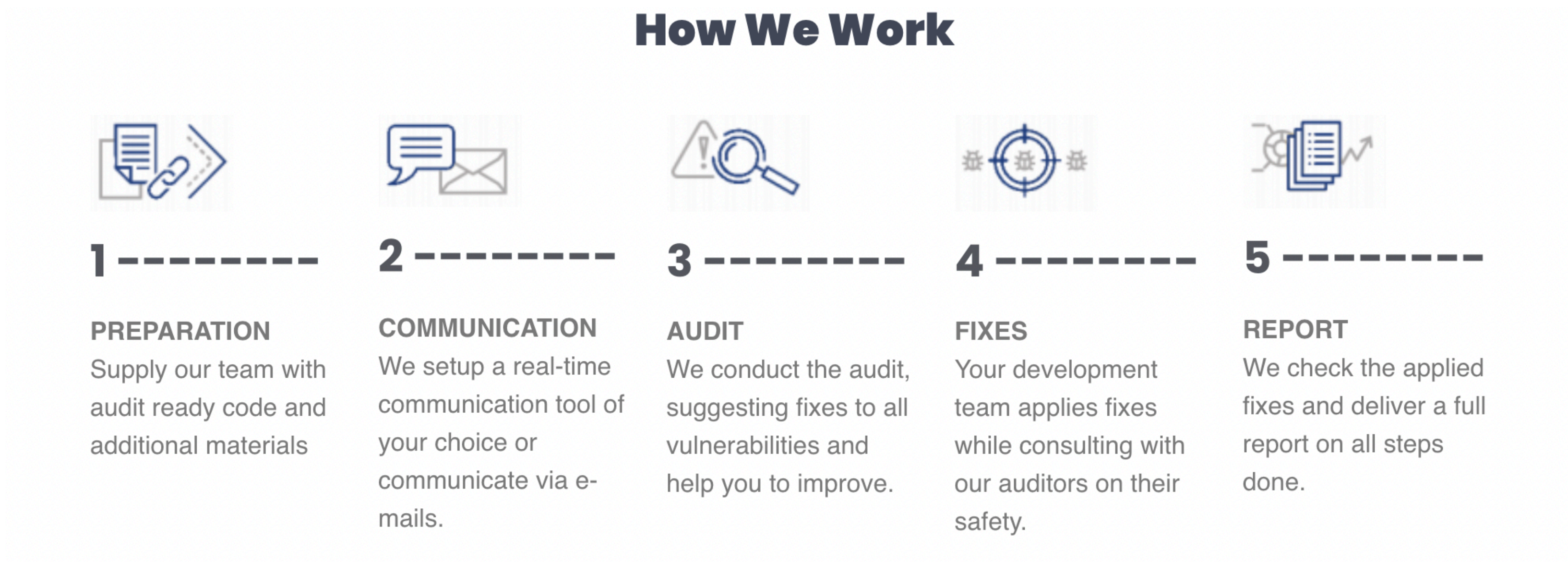
9. About the Auditor

Chainsulting is a professional software development firm, founded in 2017 and based in Germany. They show ways, opportunities, risks and offer comprehensive web3 solutions. Their services include web3 development, security and consulting.

Chainsulting conducts code audits on market-leading blockchains such as Solana, Tezos, Ethereum, Binance Smart Chain, and Polygon to mitigate risk and instil trust and transparency into the vibrant crypto community. They have also reviewed and secure the smart contracts of 1Inch, POA Network, Unicrypt, LUKSO among numerous other top DeFi projects.

Chainsulting currently secures $100 billion in user funds locked in multiple DeFi protocols. The team behind the leading audit firm relies on their robust technical know-how in the web3 sector to deliver top-notch smart contract audit solutions, tailored to the clients' evolving business needs.

Check our website for further information: https://chainsulting.de



How We Work

1 PREPARATION
Supply our team with audit ready code and additional materials

2 COMMUNICATION
We setup a real-time communication tool of your choice or communicate via e-mails.

3 AUDIT
We conduct the audit, suggesting fixes to all vulnerabilities and help you to improve.

4 FIXES
Your development team applies fixes while consulting with our auditors on their safety.

5 REPORT
We check the applied fixes and deliver a full report on all steps done.