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SECURITY ASSESSMENT

Magpie Protocol

December 13th 2022

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LEGAL

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D3ploy represents an extensive auditing process intending to help our customers increase the quality of their code while reducing the high level of risk presented by cryptographic tokens and blockchain technology. Blockchain technology and cryptographic assets present a high level of ongoing risk. D3ploy’s position is that each company and individual are responsible for their own due diligence and continuous security. The security audit is not meant to replace functional testing done before a software release. As one audit-based assessment cannot be considered comprehensive, we always recommend proceeding with several independent manual audits and a public bug bounty program to ensure the security of the smart contracts.

D3PLOY

Introduction

D3ploy is a leading blockchain security company that serves to verify the security and correctness of smart contracts and blockchain-based protocols. Through the utilization of our world-class technical expertise, alongside our proprietary, innovative tech, we're able to support the success of our clients with best-in-class security, all whilst realizing our overarching vision; provable trust for all throughout all facets of blockchain.

Secure your project with d3ploy

We offer field-proven audits with in-depth reporting and a range of suggestions to improve and avoid contract vulnerabilities. Industry-leading comprehensive and transparent smart contract auditing on all public and private blockchains.

Vunerability checking

A crucial manual inspection carried out to eliminate any code flaws and security loopholes. This is vital to avoid vulnerabilities and exposures incurring costly errors at a later stage.

Contract verification

A thorough and comprehensive review in order to verify the safety of a smart contract and ensure it is ready for launch and built to protect the end-user

Risk assessment

Analyse the architecture of the blockchain system to evaluate, assess and eliminate probable security breaches. This includes a full assessment of risk and a list of expert suggestions.

In-depth reporting

A truly custom exhaustive report that is transparent and depicts details of any identified threats and vulnerabilities and classifies those by severity.

Fast turnaround

We know that your time is valuable and therefore provide you with the fastest turnaround times in the industry to ensure that both your project and community are at ease.

Best-of-class blockchain engineers

Our engineers combine both experience and knowledge stemming from a large pool of developers at our disposal. We work with some of the brightest minds that have audited countless smart contracts over the last 4 years.

PROJECT

Introduction

Magpie protocol is a cross-chain liquidity aggregator that enables seamless cross-chain swaps with near-instant finality and cost efficiency on many of the top blockchains, all without the need to bridge any assets, making for an extremely fast, secure, easy, and gas efficient solution.

Magpie protocol incorporates a unique technical implementation that allows execution of cross-chain swaps without the need for the user to bridge assets from any of the top bridges. This saves time and cost by reducing the complexity and risks involved in using any of the bridging solutions to move assets across chains.

Project Name Magpie Protocol

Contract Name FLY Token

Contract Address -

Contract Chain Not Yet Deployed on Mainnet

Contract Type Smart Contract

Platform EVM

Language Solidity

Network Ethereum (ERC20)

Codebase Private GitHub Repository

Total Token Supply -

INFO

Social

https://www.magpiefi.xyz/

https://twitter.com/magpieprotocol

https://t.me/magpieprotocol

https://discord.gg/CwJuFeHp6f

https://medium.com/@Magpieprotocol

https://github.com/magpieprotocol/

contact@magpiefi.xyz

AUDIT

Score

Issues	8
Critical	0
Major	0
Medium	0
Minor	2
Informational	6
Discussion	0

All issues are described in further detail on the following pages.

AUDIT Scope

CODEBASE FILES	LOCATION
magpieprotocol/magpie-contracts MagpieBridge.sol MagpieCore.sol MagpieCurveRouter.sol MagpieGasStation.sol MagpieRouter.sol	✦ Private Repository
magpieprotocol/magpie-contracts/ interfaces/	✦ Private Repository
magpieprotocol/magpie-contracts/ lib/	✦ Private Repository
magpieprotocol/magpie-contracts/ security/	✦ Private Repository

REVIEW Methodology

TECHNIQUES

This report has been prepared for Magpie Protocol to discover issues and vulnerabilities in the source code of the Magpie Protocol project as well as any contract dependencies that were not part of an officially recognized library. A comprehensive examination has been performed, utilizing Dynamic, Static Analysis and Manual Review techniques.

The auditing process pays special attention to the following considerations:

- Testing the smart contracts against both common and uncommon attack vectors.
- Assessing the codebase to ensure compliance with current best practices and industry standards.
- Ensuring contract logic meets the specifications and intentions of the client.
- Cross referencing contract structure and implementation against similar smart contracts produced by industry leaders.
- Thorough line-by-line manual review of the entire codebase by industry experts.

The security assessment resulted in findings that ranged from major to informational. We recommend addressing these findings to ensure a high level of security standards and industry practices. We suggest recommendations that could better serve the project from the security perspective in the comments below.

TIMESTAMP

Version	*v1.0*
Date	*2022/12/12*
Descrption	*Layout project*
	Architecture / Manual review / Static & dynamic security testing
	Summary

Version	*v1.1*
Date	*2022/12/13*
Descrption	*Review Addressed Issues*
	Summary

KEY Finding

TITLE	SEVERITY	STATUS
Floating Pragma	✦ Minor	Acknowledged
Dead Code	✦ Informational	Acknowledged
Cheaper Inequalities in if()	✦ Gas	Acknowledged
Cheaper Inequalities In Require()	✦ Gas	Acknowledged
Gas Optimization in Require Statements	✦ Gas	Acknowledged
Unindexed Event Parameters	✦ Informational	Acknowledged
Missing Zero Address Validations	✦ Minor	Acknowledged
Functions should be declared External	✦ Gas	Acknowledged

Vulnerabilities

DESCRIPTION

Locking the pragma helps ensure that the contracts do not accidentally get deployed using an older version of the Solidity compiler affected by vulnerabilities. The contracts found in the repository were allowing floating or unlocked pragma to be used, i.e., >=0.8.0<0.9.0, >=0.6.2, and >=0.5.0.
This allows the contracts to be compiled with all the solidity compiler versions above the limit specified. The following contracts were found to be affected:

AFFECTED CODE

- >=0.8.0<0.9.0 - contracts/MagpieBridge.sol L02
- >=0.8.0<0.9.0 - contracts/MagpieCore.sol L02
- >=0.8.0<0.9.0 - contracts/MagpieCurveRouter.sol L02
- >=0.8.0<0.9.0 - contracts/MagpieGasStation.sol L02
- >=0.8.0<0.9.0 - contracts/MagpieRouter.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/IMagpieBridge.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/IMagpieCore.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/IMagpieCurveRouter.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/IMagpieRouter.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/IStargateFactory.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/IStargateFeeLibrary.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/IStargatePool.sol L02

Issue : Floating Pragma

Type : Floating Pragma (SWC-103)

Level : Minor

Remediation : Keep the compiler versions consistent in all the smart contract files. Do not allow floating pragmas anywhere.
Reference: https://swcregistry.io/docs/SWC-103

Alleviation / Retest :

Vulnerabilities

- >=0.8.0<0.9.0 - contracts/interfaces/IStargateReceiver.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/IStargateRouter.sol L02
- >=0.5.0 - contracts/interfaces/IWETH.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/IWormhole.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/IWormholeCore.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/balancer-v2/IAsset.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/balancer-v2/IBasePool.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/balancer-v2/IVault.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/curve/IAddressProvider.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/curve/ICryptoFactory.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/curve/ICryptoPool.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/curve/ICryptoRegistry.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/curve/ICurvePool.sol L02
- >=0.8.0<0.9.0 - contracts/interfaces/curve/IRegistry.sol L02
- >=0.6.2 - contracts/interfaces/uniswap-v2/IUniswapV2Router01.sol L02
- >=0.6.2 - contracts/interfaces/uniswap-v2/IUniswapV2Router02.sol L02
- >=0.6.2 - contracts/interfaces/uniswap-v3/IUniswapV3Router.sol L02
- >=0.8.0<0.9.0 - contracts/lib/LibAddressArray.sol L02
- >=0.8.0<0.9.0 - contracts/lib/LibAsset.sol L02
- >=0.8.0<0.9.0 - contracts/lib/LibAssetUpgradeable.sol L02
- >=0.8.0<0.9.0 - contracts/lib/LibBytes.sol L02
- >=0.8.0<0.9.0 - contracts/lib/LibSwap.sol L02
- >=0.8.0<0.9.0 - contracts/lib/LibUint256Array.sol L02
- >=0.8.0<0.9.0 - contracts/security/Pausable.sol L02

IMPACTS

If the smart contract gets compiled and deployed with an older or too recent version of the solidity compiler, there's a chance that it may get compromised due to the bugs present in the older versions or unidentified exploits in the new versions. Incompatibility issues may also arise if the contract code does not support features in other compiler versions, therefore, breaking the logic. The likelihood of exploitation is really low therefore this is only informational.

IN - DEPTH Vulnerabilities

DESCRIPTION

It is recommended to keep the production repository clean to prevent confusion and the introduction of vulnerabilities. The functions and parameters, contracts, and interfaces that are never used or called externally or from inside the contracts should be removed when the contract is deployed on the mainnet.

LOCATION

- contracts/lib/LibAddressArray.sol L05-13 - includes()
- contracts/lib/LibAsset.sol L39-46 - decreaseAllowance()
- contracts/lib/LibAssetUpgradeable.sol L58-65 - approve()
- contracts/lib/LibAssetUpgradeable.sol L39-46 - decreaseAllowance()
- contracts/lib/LibAssetUpgradeable.sol L67-73 - getAllowance()
- contracts/lib/LibAssetUpgradeable.sol L17-19 - getBalance()
- contracts/lib/LibAssetUpgradeable.sol L30-37 - increaseAllowance()
- contracts/lib/LibBytes.sol L12-14 - toBool()
- contracts/lib/LibBytes.sol L27-36 - toUint16()

IMPACTS

This does not impact the security aspect of the Smart contract but prevents confusion when the code is sent to other developers or auditors to understand and implement. This reduces the overall size of the contracts and also helps in saving gas.

Issue : Dead Code

Type : Code With No Effects - SWC-135
https://swcregistry.io/docs/SWC-135

Level : Informational

Remediation : If the variables and constants are not supposed to be used anywhere, consider removing them from the contract.

Alleviation / Retest :

Vulnerabilities

DESCRIPTION

The contract was found to be doing comparisons using inequalities inside the “if” statement. When inside the if statements, non-strict inequalities (>=, <=) are usually cheaper than the strict equalities (>, <).

LOCATION

- contracts/MagpieCurveRoter.sol L66
- contracts/MagpieCurveRoter.sol L69
- contracts/MagpieCurveRoter.sol L129
- contracts/MagpieCore.sol L151
- contracts/MagpieCore.sol L156
- contracts/MagpieCore.sol L206
- contracts/MagpieCore.sol L209
- contracts/MagpieCore.sol L297
- contracts/MagpieBridge.sol L50
- contracts/MagpieBridge.sol L216

IMPACTS

Using strict inequalities inside if statements costs more gas.

Issue : Cheaper Inequalities in if()

Type : Gas & Missing Best Practices

Level : Gas

Remediation : It is recommended to go through the code logic, and, if possible, modify the strict inequalities with the non-strict ones to save gas as long as the logic of the code is not affected.

Alleviation / Retest :

Vulnerabilities

DESCRIPTION

The contract was found to be performing comparisons using inequalities inside the “require” statement. When inside the require statements, non-strict inequalities (>=, <=) are usually costlier than strict equalities (>, <).

LOCATION

- contracts/MagpieRoter.sol L91
- contracts/MagpieCore.sol L75
- contracts/MagpieCore.sol L284
- contracts/MagpieCore.sol L286

IMPACTS

Using non-strict inequalities inside require statements cost more gas.

Issue : Cheaper Inequalities In Require()

Type : Gas & Missing Best Practices

Level : Gas

Remediation : It is recommended to go through the code logic, and, if possible, modify the non-strict inequalities with the strict ones to save some gas as long as the logic of the code is not affected.

Alleviation / Retest :

Vulnerabilities

DESCRIPTION

The require() statement takes an input string to show errors if the validation fails. The strings inside these functions that are longer than 32 bytes require at least one additional MSTORE, along with additional overhead for computing memory offset, and other parameters. For this purpose, having strings lesser than 32 bytes saves a significant amount of gas. Once such example is given below:

VULNERABLE CODE

- contracts/MagpieRoter.sol L53

IMPACTS

Having longer require strings than 32 bytes cost a significant amount of gas.

Issue : Gas Optimization in Require Statements

Type : Gas Optimization

Level : Gas

Remediation : It is recommended to shorten the strings passed inside require() statements to fit under 32 bytes. This will decrease the gas usage at the time of deployment and at runtime when the validation condition is met.

Alleviation / Retest :

Vulnerabilities

DESCRIPTION

Events in solidity contain two kinds of parameters - indexed and non-indexed. These indexes are also known as topics and are the searchable parameters used in events. In the Ethereum system, events must be easily searched for, so that applications can filter and display historical events without the undue overhead.
It was noticed that the following event parameters were not indexed making the search for past events cumbersome.

LOCATION

- contracts/interfaces/IMagpieCore.sol L64
- contracts/interfaces/IMagpieCore.sol L66
- contracts/interfaces/IMagpieCore.sol L68
- contracts/interfaces/IMagpieCore.sol L79
- contracts/interfaces/IMagpieRouter.sol L38
- contracts/MagpieCore.sol L26

IMPACTS

This does not impact the security aspect of the Smart contract but affects the ease of use when searching for past events.

Issue : Unindexed Event Parameters

Type : Missing Best Practices

Level : Informational

Remediation : It should be noted that indexed event parameters take up more gas than non-indexed ones. Keeping that in mind, the contract should add indexed keywords to the searchable parameters to make searching efficient using an event filter.

Alleviation / Retest :

Vulnerabilities

DESCRIPTION

The contracts were found to be setting or using new addresses without proper validations for zero addresses.
Address type parameters should include a zero-address check otherwise contract functionality may become inaccessible or tokens burnt forever.
Depending on the logic of the contract, this could prove fatal and the users or the contracts could lose their funds, or the ownership of the contract could be lost.

LOCATION

- contracts/MagpieRouter.sol L29 - address _magpieCoreAddress
- contracts/MagpieCore.sol L50 - address weth
- contracts/MagpieCurveRouter.sol L76 - exchangeArgs.receiver

IMPACTS

If address type parameters do not include a zero-address check, contract functionality may become unavailable or tokens may be burned permanently.

Issue : Missing Zero Address Validations

Type : Missing Input Validation

Level : Minor

Remediation : Add a zero address validation to all the functions where addresses are being set.

Alleviation / Retest :

Vulnerabilities

DESCRIPTION

Public functions that are never called by a contract should be declared external in order to conserve gas.
The following functions were declared as public but were not called anywhere in the contract, making public visibility useless.

AFFECTED CODE

The following functions were affected

- security/Pausable.sol L50 - changePauser()
- security/Pausable.sol L69 - pause()
- security/Pausable.sol L73 - unpause()

IMPACTS

Smart Contracts are required to have effective Gas usage as they cost real money, and each function should be monitored for the amount of gas it costs to make it gas efficient.
public functions cost more Gas than external functions.

Issue : Functions should be declared External

Type : Gas Optimization

Level : Gas

Remediation : Use the external state visibility for functions that are never called from inside the contract.

Alleviation / Retest :

SOURCE Code

Private GitHub Repository

REPORT Appendix

FINDING CATEGORIES

The assessment process will utilize a mixture of static analysis, dynamic analysis, in-depth manual review and/or other security techniques.

This report has been prepared for Magpie Protocol project using the above techniques to examine and discover vulnerabilities and safe coding practices in Magpie Protocol's smart contract including the libraries used by the contract that are not officially recognized.

A comprehensive static and dynamic analysis has been performed on the solidity code in order to find vulnerabilities ranging from minor gas optimizations to major vulnerabilities leading to the loss of funds.

Various common and uncommon attack vectors will be investigated to ensure that the smart contracts are secure from malicious actors. The testing methods find and flag issues related to gas optimizations that help in reducing the overall gas cost It scans and evaluates the codebase against industry best practices and standards to ensure compliance It makes sure that the officially recognized libraries used in the code are secure and up to date.

AUDIT SCORES

D3ploy Audit Score is not a live dynamic score. It is a fixed value determined at the time of the report issuance date.

D3ploy Audit Score is not, nor should be considered, an "endorsement" or "disapproval" of any particular project or team. These reports and scores are not, nor should be considered, an indication of the economics or value of any "product" or "asset" created by any team or project that contracts d3ploy to perform a security review.

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