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SMART CONTRACT CODE REVIEW AND SECURITY ANALYSIS REPORT

Customer: Polywhale
Date: April 28th, 2021

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This document may contain confidential information about IT systems and the intellectual property of the Customer as well as information about potential vulnerabilities and methods of their exploitation.

The report containing confidential information can be used internally by the Customer, or it can be disclosed publicly after all vulnerabilities are fixed - upon a decision of the Customer.

Document

Name	Smart Contract Code Review and Security Analysis Report for Polywhale - Initial Audit
Approved by	Andrew Matiukhin | CTO Hacken OU
Type	ERC20 Token, Staking
Platform	Ethereum / Solidity
Methods	Architecture Review, Functional Testing, Computer-Aided Verification, Manual Review
Deployed Smart contracts	▪ https://explorer-mainnet.maticvigil.com/address/0x05089C9EBFFa4F0AcA269e32056b1b36B37ED71b/contracts ▪ https://explorer-mainnet.maticvigil.com/address/0x34bc3D36845d8A7cA6964261FbD28737d0d6510f/contracts
Timeline	27 APRIL 2021 - 29 APRIL 2021
Changelog	29 APRIL 2021 - INITIAL AUDIT

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Introduction

Hacken OÜ (Consultant) was contracted by Polywhale (Customer) to conduct a Smart Contract Code Review and Security Analysis. This report presents the findings of the security assessment of Customer's smart contract and its code review conducted on April 29th, 2021.

Scope

The scope of the project is the smart contracts deployed in the matic mainnet:

https://explorer-mainnet.maticvigil.com/address/0x05089C9EBFFa4F0AcA269e32056b1b36B37ED71b/contracts
https://explorer-mainnet.maticvigil.com/address/0x34bc3D36845d8A7cA6964261FbD28737d0d6510f/contracts

We have scanned these smart contracts for commonly known and more specific vulnerabilities. Here are some of the commonly known vulnerabilities that are considered:

Category	Check Item
Code review	▪ Reentrancy ▪ Ownership Takeover ▪ Timestamp Dependence ▪ Gas Limit and Loops ▪ DoS with (Unexpected) Throw ▪ DoS with Block Gas Limit ▪ Transaction-Ordering Dependence ▪ Style guide violation ▪ Costly Loop ▪ ERC20 API violation ▪ Unchecked external call ▪ Unchecked math ▪ Unsafe type inference ▪ Implicit visibility level ▪ Deployment Consistency ▪ Repository Consistency ▪ Data Consistency

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Functional review	▪ Business Logics Review ▪ Functionality Checks ▪ Access Control & Authorization ▪ Escrow manipulation ▪ Token Supply manipulation ▪ Asset’s integrity ▪ User Balances manipulation ▪ Kill-Switch Mechanism ▪ Operation Trails & Event Generation

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Executive Summary

According to the assessment, the Customer's smart contracts are well-secured.

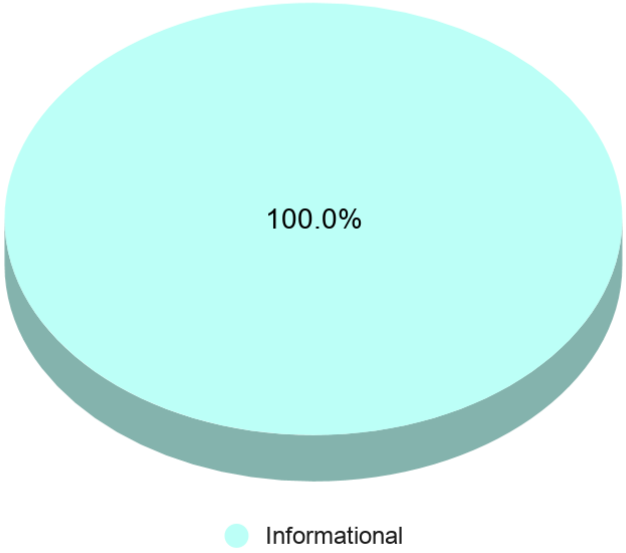
Insecure	Poor secured	Secured	Well-secured

You are here

Our team performed an analysis of code functionality, manual audit, and automated checks with Mythril and Slither. All issues found during automated analysis were manually reviewed, and important vulnerabilities are presented in the Audit overview section. A general overview is presented in AS-IS section, and all found issues can be found in the Audit overview section.

Security engineers found **3** informational issues during the first review.

Graph 1. The distribution of vulnerabilities after the first review.



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Severity Definitions

Risk Level	Description
Critical	Critical vulnerabilities are usually straightforward to exploit and can lead to assets loss or data manipulations.
High	High-level vulnerabilities are difficult to exploit; however, they also have a significant impact on smart contract execution, e.g., public access to crucial functions
Medium	Medium-level vulnerabilities are important to fix; however, they can't lead to assets loss or data manipulations.
Low	Low-level vulnerabilities are mostly related to outdated, unused, etc. code snippets that can't have a significant impact on execution
Lowest / Code Style / Best Practice	Lowest-level vulnerabilities, code style violations, and info statements can't affect smart contract execution and can be ignored.

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Audit overview

Critical

No Critical severity issues were found.

High

No High severity issues were found.

Medium

No Medium severity issues were found.

Low

No Low severity issues were found.

Lowest / Code style / Best Practice

1. **Vulnerability:** Function mutability could be pure.
Contracts: MasterChef

   This function doesn't read any state variable so it can be restricted to pure

   Lines: MasterChef.sol:1180-1182

```
function getMultiplier(uint256 _from, uint256 _to) public view returns
(uint256) {
   return _to.sub(_from).mul(BONUS_MULTIPLIER);
}
```

2. **Vulnerability:** Public function that could be declared external
Contracts: MasterChef, Krill

   public functions that are never called by the contract should be declared **external** to save gas.

   Lines: MasterChef.sol#1046

```
function mint(address _to, uint256 _amount) public onlyOwner {
```

   Lines: MasterChef.sol#1151

```
function add(uint256 _allocPoint, IERC20 _lpToken, uint16
_depositFeeBP, bool _withUpdate) public onlyOwner
nonDuplicated(_lpToken) {
```

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Lines: MasterChef.sol#1169

```
function set(uint256 _pid, uint256 _allocPoint, uint16 _depositFeeBP,
bool _withUpdate) public onlyOwner {
```

Lines: MasterChef.sol#1226

```
function deposit(uint256 _pid, uint256 _amount) public nonReentrant {
```

Lines: MasterChef.sol#1251

```
function withdraw(uint256 _pid, uint256 _amount) public nonReentrant {
```

Lines: MasterChef.sol#1269

```
function emergencyWithdraw(uint256 _pid) public nonReentrant {
```

Lines: MasterChef.sol#1292

```
function dev(address _devaddr) public {
```

Lines: MasterChef.sol#1298

```
function setFeeAddress(address _feeAddress) public {
```

Lines: MasterChef.sol#1305

```
function updateEmissionRate(uint256 _krillPerBlock) public onlyOwner {
```

Lines: MasterChef.sol#1312

```
function updateStartBlock(uint256 _startBlock) public onlyOwner {
```

3. Lines 388, 403, 404, 413, 428, 438, 462, 470, 517, 540, 544, 545, 881, 883, 919, 1151, 1169 and 1192 in the MasterChef.sol of the code are above the recommended maximum line length.

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Conclusion

Smart contracts within the scope were manually reviewed and analyzed with static analysis tools. For the contract, high-level description of functionality was presented in As-Is overview section of the report.

Audit report contains all found security vulnerabilities and other issues in the reviewed code.

Security engineers found **3** informational issues during the first review.

Category	Check Items	Comments
Code Review	Style guide violation	▪ view function could be pure ▪ public function that could be declared external ▪ maximum line length

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Disclaimers

Hacken Disclaimer

The smart contracts given for audit have been analyzed in accordance with the best industry practices at the date of this report, in relation to cybersecurity vulnerabilities and issues in smart contract source code, the details of which are disclosed in this report (Source Code); the Source Code compilation, deployment, and functionality (performing the intended functions).

The audit makes no statements or warranties on security of the code. It also cannot be considered as a sufficient assessment regarding the utility and safety of the code, bugfree status or any other statements of the contract. While we have done our best in conducting the analysis and producing this report, it is important to note that you should not rely on this report only - we recommend proceeding with several independent audits and a public bug bounty program to ensure security of smart contracts.

Technical Disclaimer

Smart contracts are deployed and executed on blockchain platform. The platform, its programming language, and other software related to the smart contract can have its vulnerabilities that can lead to hacks. Thus, the audit can't guarantee the explicit security of the audited smart contracts.