# GoodDollar

### CompoundStakingV2

# Smart Contract Audit Report


**May 30, 2022**

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# Introduction

## 1. About GoodDollar

GoodDollar is a 100% non-profit foundation looking to secure financial freedom for everyone in the world by launching a digital coin built on the blockchain and based on the principles of universal basic income (UBI). GoodDollar: Changing the Balance, For Good.

**About Contract:**
GoodDollar project is launching publicly. Its mechanism allows people & organizations to lock funds into an interest-bearing decentralized protocol, currently compound.finance, and donate its created interest towards the Global Basic Income cause. Anyone who proves they are not a bot can claim Global Basic Income.

Visit https://www.gooddollar.org/ to know more about it.

## 2. About ImmuneBytes

ImmuneBytes is a security start-up that provides professional services in the blockchain space. The team has hands-on experience in conducting smart contract audits, penetration testing, and security consulting. ImmuneBytes's security auditors have worked on various A-league projects and understand DeFi projects like AAVE, Compound, 0x Protocol, Uniswap, and dydx.

The team has been able to secure 175+ blockchain projects by providing security services on different frameworks. ImmuneBytes team helps start-ups with a detailed analysis of the system, ensuring security and managing the overall project.

Visit http://immunebytes.com/ to know more about the services.

# Documentation Details

The GoodDollar team has provided the following doc for the purpose of audit:

1. GoodDollar High Level Overview.pdf

## Audit Process & Methodology

ImmuneBytes team has performed thorough testing of the project, starting with analyzing the code design patterns in which we reviewed the smart contract architecture to ensure it is structured and safe use of third-party smart contracts and libraries.

Our team then performed a formal line-by-line inspection of the Smart Contract to find potential issues like Signature Replay Attacks, Unchecked External Calls, External Contract Referencing, Variable Shadowing, Race conditions, Transaction-ordering dependence, timestamp dependence, DoS attacks, and others.

In the Unit testing phase, we run unit tests written by the developer in order to verify the functions work as intended. In Automated Testing, we tested the Smart Contract with our in-house developed tools to identify vulnerabilities and security flaws.

The code was audited by a team of independent auditors, including -

1. Structural analysis of the smart contract is checked and verified.
2. An extensive automated testing of all the contracts under scope is conducted.
3. Line-by-line Manual Code review is conducted to evaluate, analyze and identify the potential security risks in the contract.
4. Evaluation of the contract's intended behavior and the documentation shared is an imperative step to verify the contract behaves as expected.
5. For complex and heavy contracts, adequate integration testing is conducted to ensure that contracts perform in an acceptable manner while interacting with each other.
6. Storage layout verifications in the upgradeable contract are a must.
7. An important step in the audit procedure is highlighting and recommending better gas optimization techniques in the contract.

## Audit Details

- Project Name: GoodDollar
- Contracts Name: CompoundStakingV2.sol, SimpleStakingV2
- Languages: Solidity(Smart contract), Typescript (Unit Testing)
- Github commits for the audit: 7ee04d23fb8ad3468a041e3f907d9310fb5ffa1d
- Platforms and Tools: Remix IDE, Truffle, Truffle Team, Ganache, Solhint, VScode, Contract Library, Slither, SmartCheck

## Audit Goals

The focus of the audit was to verify that the smart contract system is secure, resilient, and working according to its specifications. The audit activities can be grouped into the following three categories:

1. Security: Identifying security-related issues within each contract and within the system of contracts.
2. Sound Architecture: Evaluation of the architecture of this system through the lens of established smart contract best practices and general software best practices.
3. Code Correctness and Quality: A full review of the contract source code. The primary areas of focus include
    a. Correctness
    b. Readability
    c. Sections of code with high complexity
    d. Quantity and quality of test coverage

## Security Level Reference

Every issue in this report were assigned a severity level from the following:

**High severity issues** will bring problems and should be fixed.

**Medium severity issues** could potentially bring problems and should eventually be fixed.

**Low severity issues** are minor details and warnings that can remain unfixed but would be better fixed at some point in the future.

| Issues | High | Medium | Low |
|---|---|---|---|
| Open | - | - | 5 |
| Closed | - | 1 | - |

# CompoundStakingV2.sol

## High Severity Issues

No issues were found.

## Medium Severity Issues

1. **Multiplication is being performed on the result of Division**

   **Explanation:**
   During the automated testing of the **GoodCompoundStakingV2** contract, it was found that 2 functions in the contract are performing multiplication on the result of a Division.

```
269     function iTokenWorthInToken(uint256 _amount⬆)
270         internal
271         view
272         override
273         returns (uint256)
274     {
275         uint256 er = cERC20(address(iToken)).exchangeRateStored();
276         (uint256 decimalDifference, bool caseType) = tokenDecimalPrecision();
277         uint256 mantissa = 18 + tokenDecimal() - iTokenDecimal();
278         uint256 tokenWorth = caseType == true
279             ? (_amount⬆ * (10**decimalDifference) * er) / 10**mantissa
280             : ((_amount⬆ / (10**decimalDifference)) * er) / 10**mantissa; // calculation
```

   Integer Divisions in Solidity might truncate. Moreover, this performing division before multiplication might lead to a loss of precision.

   The following functions involve division before multiplication in the mentioned lines:

   - **iTokenWorthInToken** at 278-280
   - **tokenWorthIniToken** at 297-299

   **Recommendation:**
   Solidity doesn't encourage arithmetic operations that involve division before multiplication. Therefore, the above-mentioned function should be checked once and redesigned if they do not lead to the expected results.

**Note by the auditor:**
The abovementioned multiplication and division issue was primarily found during the automated contract testing via Slither. The reason behind documenting this issue was specific to point out the fact that *multiplication being performed on the result of a division is not a recommended* approach in Solidity since there is a possibility that integer division might truncate or leads to some precision loss.

However, in the case of the ***GoodCompoundStakingV2*** contract, it was found that the chances of precision loss have been eradicated since it includes the use of *mantissa,* an unsigned integer, to perform calculations at an adequate level of precision.

Moreover, regarding the division at Line *280, 298,* the division shall only fail if the *decimal difference* between token and iToken is unusually large, which is not the case here. Therefore, it can be safely stated that no locked funds shall be affected due to any precision loss while withdrawing the funds back in the original token.

## Low Severity Issues

1. **Absence of input validation in the setcollectInterestGasCostParams() function**
   **Line no -307-314**

   **Description:**
   The setcollectInterestGasCostParams() function doesn't include any input validation on the uint32 arguments being passed to the function.

   Although the function is only accessible by the owner(avatar), collectInterestGasCost and compCollectGasCost are imperative state variables as these are being used for gas costs during interest transfers).

   **Recommendation:**
   Input validations must be included before updating important state variables

2. **No Events emitted after imperative State Variable modification**
   **Line no -307-314**

   **Description:**
   Functions that update an imperative arithmetic state variable contract should emit an event after the state modification.

The setcollectInterestGasCostParams() function modifies some crucial arithmetic parameters like collectInterestGasCost, compCollectGasCost in the GoodCompoundStakingV2 contract but doesn't emit any event after the updation.

Since no event is emitted on updating these variables, it might be difficult to track it off-chain.

**Recommendation:**
An event should be fired after changing crucial arithmetic state variables.

3. **Zero Address validations not found in initializer function**

**Description:**
The init() function of GoodCompoundStakingV2 doesn't include adequate zero address validations for the addresses passed to the function.

**Recommendation:**
A require statement should be included in such functions to ensure no zero address is passed in the arguments.

## Recommendation / Informational

1. **Redundant comparisons to boolean Constants**
   **Line no: 278, 297**

   **Description:**
   Boolean constants can directly be used in conditional statements or require statements.


   Therefore, it's not considered a better practice to explicitly use TRUE or FALSE in the require statements.

   **Recommendation:**
   The equality to boolean constants could be removed from the above-mentioned line.

2. **Unlocked Pragma statements found in the contracts**
   **Line no: 2**

   **Explanation:**
   During the code review, it was found that the contracts included unlocked pragma solidity version statements.

   It’s not considered a better practice in Smart contract development to do so as it might lead to accidental deployment to a version with unfixed bugs.

   **Recommendation:**
   It’s always recommended to lock pragma statements to a specific version while writing contracts.

3. **Coding Style Issues in the Contract**

**Explanation:**
Code readability of a Smart Contract is largely influenced by the Coding Style issues and in some specific scenarios, may lead to bugs in the future.

During the automated testing, it was found that the GoodCompoundStakingV2 contract had quite a few code style issues.

**Recommendation:**
Therefore, it is recommended to fix the issues like naming convention, indentation, and code layout issues in a smart contract.

# CompoundStakingV2.sol

## High Severity Issues

No issues were found.

## Medium Severity Issues

No issues were found.

## Low Severity Issues

1. **recover() function doesn't adequately ensure the withdrawable amount of tokens**
   **Line no: 435 - 444**

   **Description:**
   The recover() function allows the owner of the contract to pass any erc20 token address to recover the withdrawable token for the given address.

```
435     function recover(ERC20 _token⬆) public {
436         _onlyAvatar();
437         uint256 toWithdraw = _token⬆.balanceOf(address(this));
438
439         // recover left iToken(stakers token) only when all stakes have been withdrawn
440         if (address(_token⬆) == address(iToken)) {
441             require(totalProductivity == 0 && isPaused, "recover");
442         }
```

   However, the function doesn't include any adequate check to ensure that the total withdrawable amount that is stored in the local variable toWithdraw, is actually more than zero.

   This leads to a scenario where there could be no token balance for a given address, but the function would still execute since it lacks adequate validations and lead to loss of gas.

   **Recommendation:**
   The function should include adequate checks to ensure that the withdrawable token amount is actually more than zero.

2. **No Events are emitted after updating the maxLiquidityPercentageSwap variable**

**Line no -307-314**

**Description:**
The setMaxLiquidityPercentageSwap() function updates the maxLiquidityPercentageSwap state variable but doesn't emit any event after the modification.

Since no event is emitted on updating these variables, it might be difficult to track it off-chain.

**Recommendation:**
An event should be fired after changing crucial arithmetic state variables.

## Recommendation / Informational

1. **Redundant comparisons to boolean constants can be avoided**
   **Line no: 190**

   **Description:**
   Boolean constants can directly be used in conditional statements or require statements.

   Therefore, it's not considered a better practice to explicitly use TRUE or FALSE in the require statements. The require statement at Line 190 involves an unnecessary comparison to the boolean constant, which can be avoided.

   **Recommendation:**
   The equality to boolean constants could be removed from the above-mentioned line.

2. **Unlocked Pragma statements found in the contracts**
   **Line no: 2**

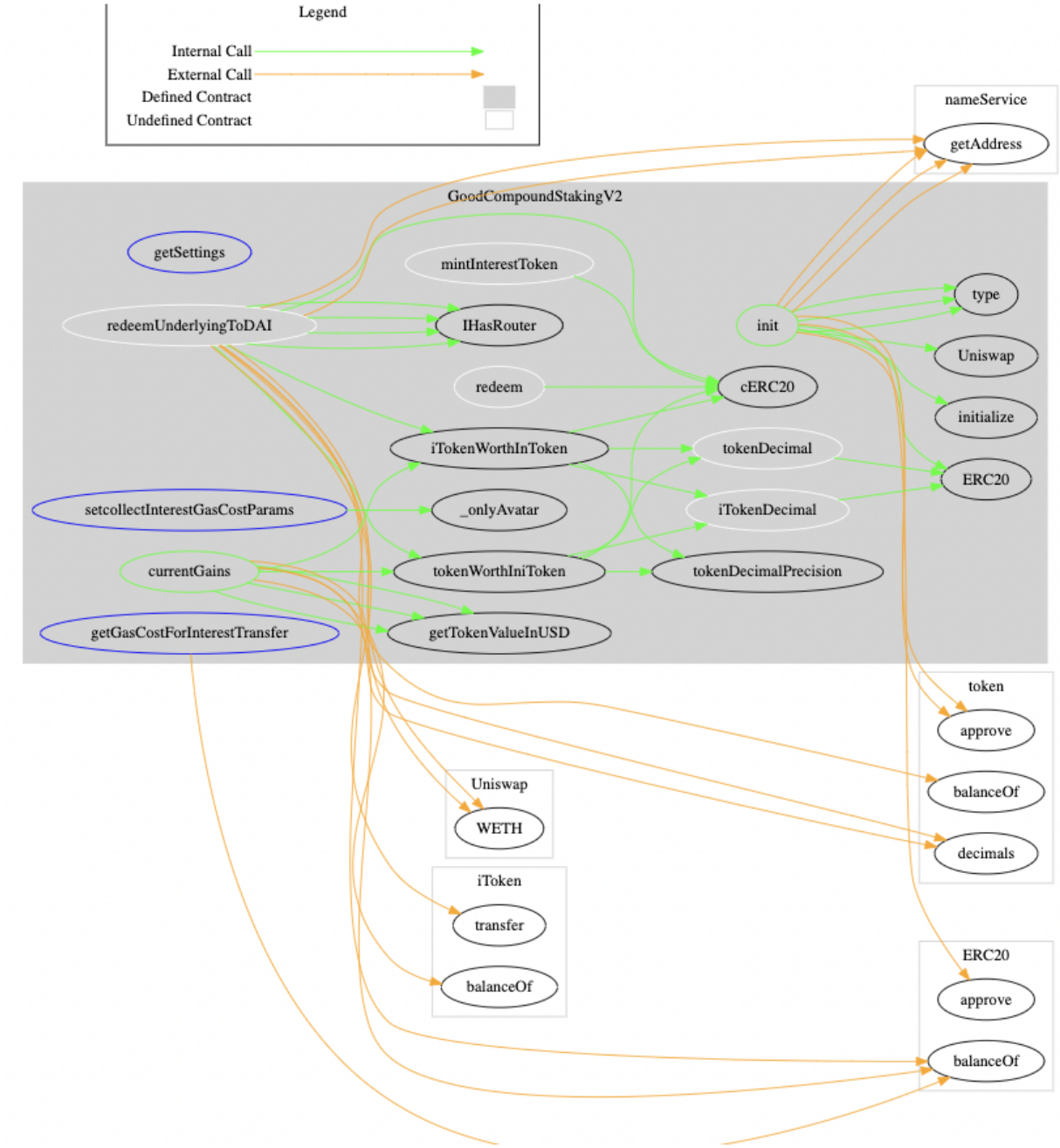
   **Explanation:**
   During the code review, it was found that the contracts included unlocked pragma solidity version statements.

   It’s not considered a better practice in Smart contract development to do so as it might lead to accidental deployment to a version with unfixed bugs.

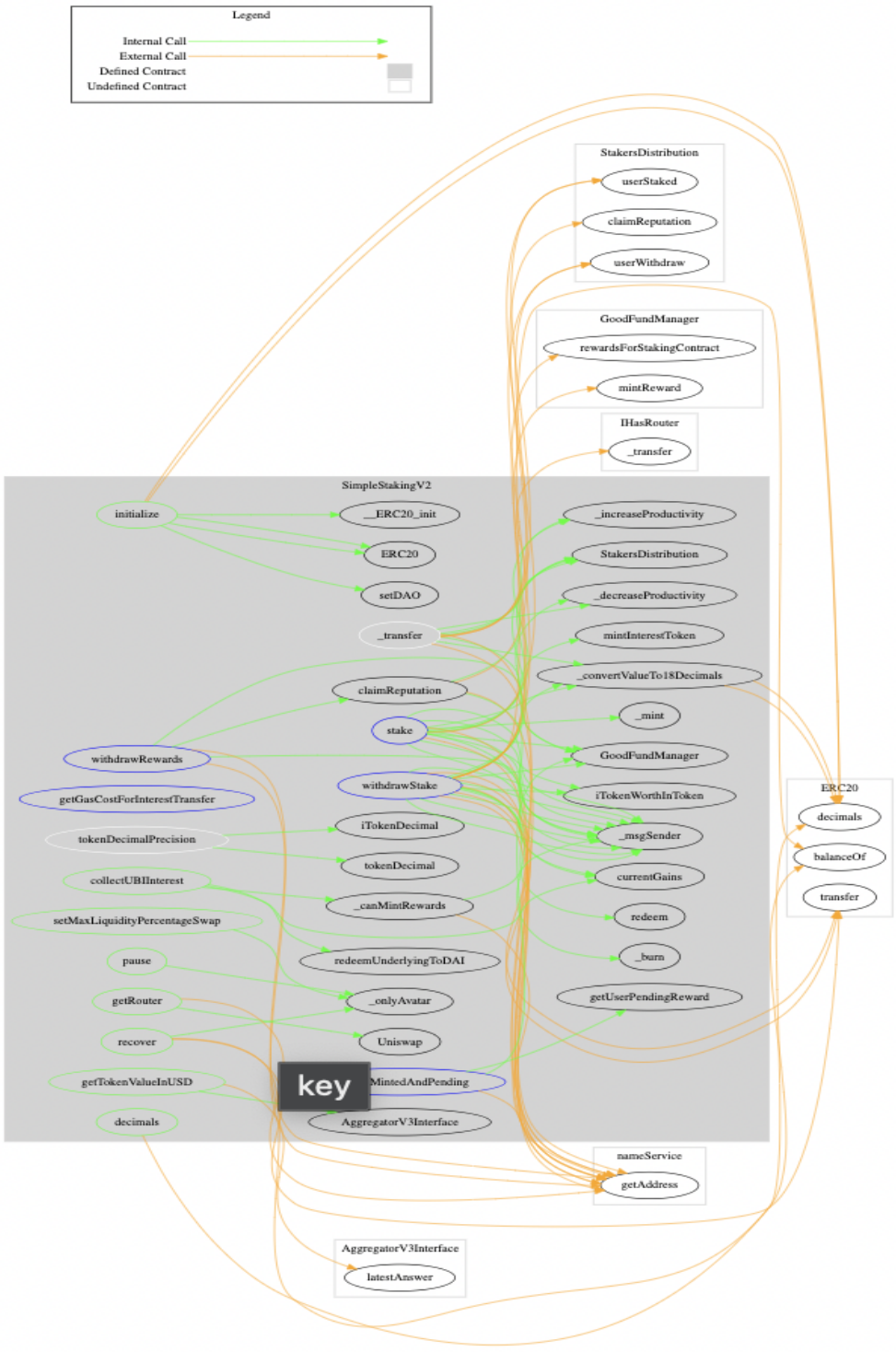
   **Recommendation:**
   It’s always recommended to lock pragma statements to a specific version while writing contracts.

# Call Graph

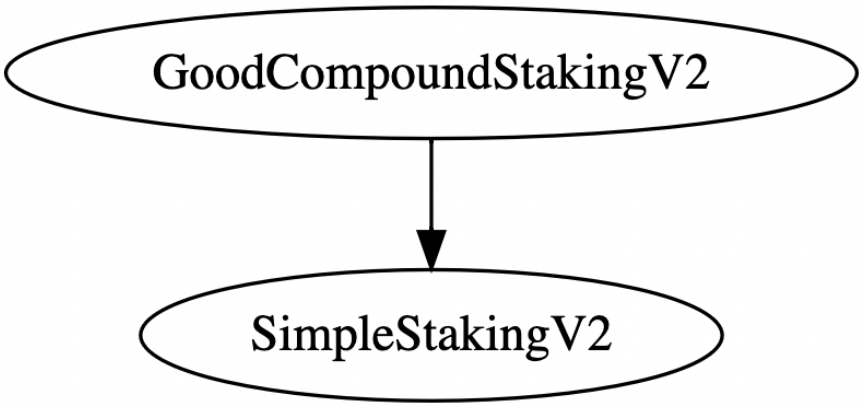
- GoodCompoundStakingV2 Contract



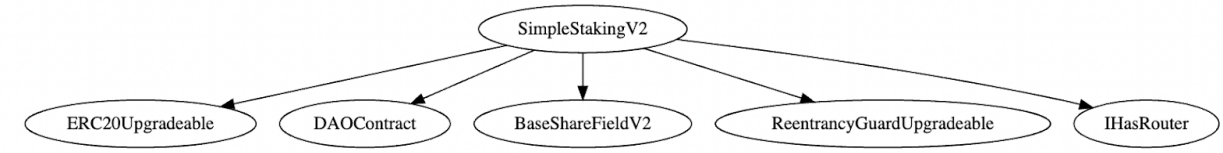
- SimplStakingV2



- Inheritance graph for GoodCompoundStakingV2 Contract




- Inheritance graph for SimpleStaking

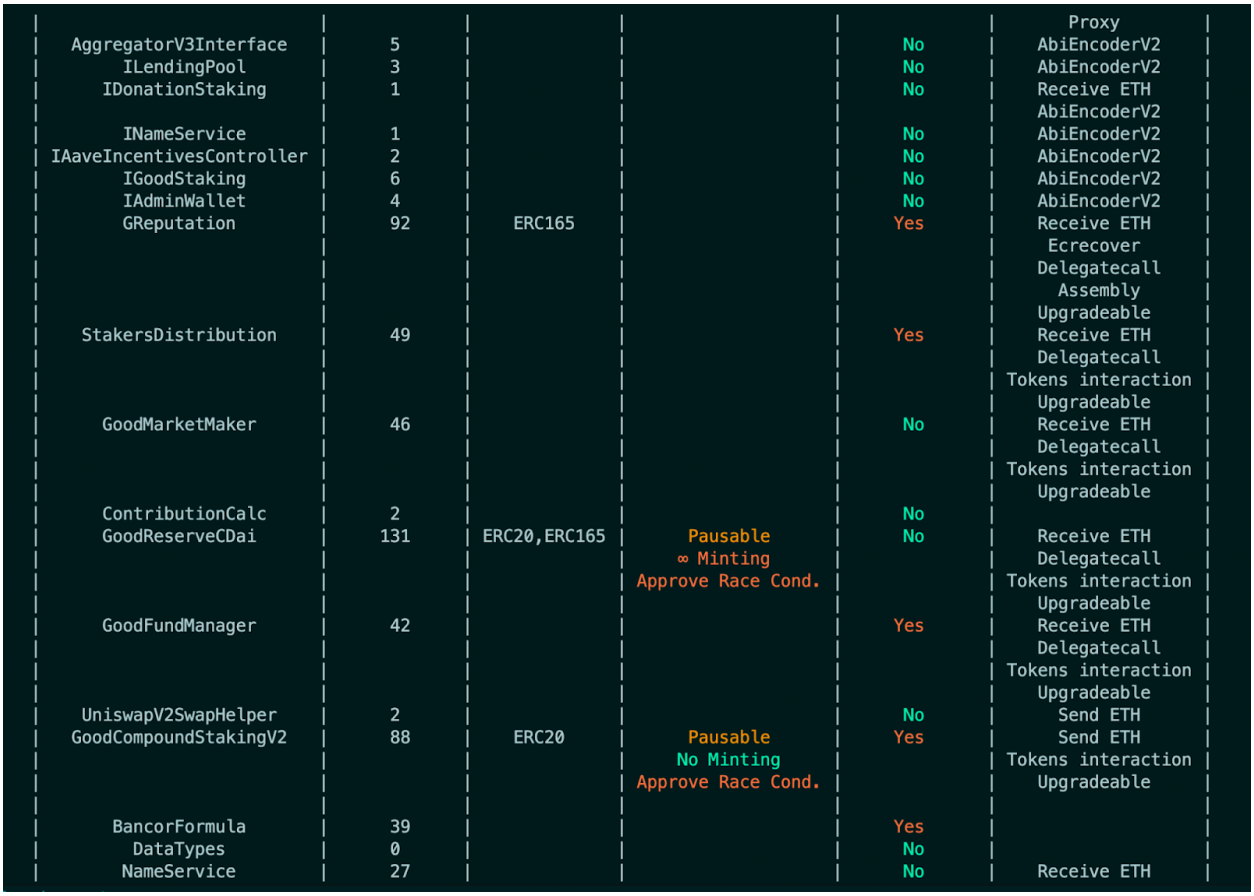


# Automated Audit Result

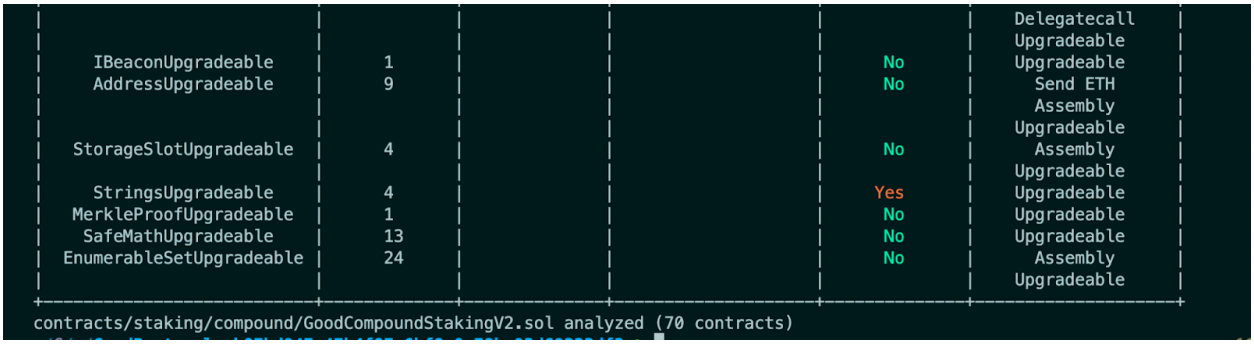
```
Compiled with solc
Number of lines: 9018 (+ 0 in dependencies, + 0 in tests)
Number of assembly lines: 0
Number of contracts: 70 (+ 0 in dependencies, + 0 tests)

Number of optimization issues: 90
Number of informational issues: 624
Number of low issues: 47
Number of medium issues: 230
Number of high issues: 18
ERCs: ERC165, ERC20
```

| Name | # functions | ERCS | ERC20 info | Complex code | Features |
|---|---|---|---|---|---|
| Avatar | 3 | | | No | |
| Controller | 11 | | | No | |
| ReputationInterface | 7 | | | No | |
| SchemeRegistrar | 1 | | | No | |
| IntVoteInterface | 8 | | | No | |
| cERC20 | 16 | ERC20 | ∞ Minting<br>Approve Race Cond. | No | AbiEncoderV2 |
| IGoodDollar | 18 | ERC20 | ∞ Minting<br>Approve Race Cond. | No | AbiEncoderV2 |
| IERC2917 | 18 | ERC20 | ∞ Minting<br>Approve Race Cond. | No | AbiEncoderV2 |
| Staking | 3 | | | No | AbiEncoderV2 |
| Uniswap | 9 | | | No | Receive ETH<br>AbiEncoderV2 |
| UniswapFactory | 1 | | | No | AbiEncoderV2 |
| UniswapPair | 6 | | | No | AbiEncoderV2 |
| Reserve | 1 | | | No | AbiEncoderV2 |
| IIdentity | 7 | | | No | AbiEncoderV2 |
| IUBIScheme | 3 | | | No | AbiEncoderV2 |
| IFirstClaimPool | 2 | | | No | AbiEncoderV2 |
| ProxyAdmin | 5 | | | No | AbiEncoderV2 |



| | | | | | |
|---|---|---|---|---|---|
| | | | | | Proxy |
| AggregatorV3Interface | 5 | | | No | AbiEncoderV2 |
| ILendingPool | 3 | | | No | AbiEncoderV2 |
| IDonationStaking | 1 | | | No | Receive ETH |
| | | | | | AbiEncoderV2 |
| INameService | 1 | | | No | AbiEncoderV2 |
| IAaveIncentivesController | 2 | | | No | AbiEncoderV2 |
| IGoodStaking | 6 | | | No | AbiEncoderV2 |
| IAdminWallet | 4 | | | No | AbiEncoderV2 |
| GReputation | 92 | ERC165 | | Yes | Receive ETH |
| | | | | | Ecrecover |
| | | | | | Delegatecall |
| | | | | | Assembly |
| | | | | | Upgradeable |
| StakersDistribution | 49 | | | Yes | Receive ETH |
| | | | | | Delegatecall |
| | | | | | Tokens interaction |
| | | | | | Upgradeable |
| GoodMarketMaker | 46 | | | No | Receive ETH |
| | | | | | Delegatecall |
| | | | | | Tokens interaction |
| | | | | | Upgradeable |
| ContributionCalc | 2 | | | No | |
| GoodReserveCDai | 131 | ERC20,ERC165 | Pausable | No | Receive ETH |
| | | | ∞ Minting | | Delegatecall |
| | | | Approve Race Cond. | | Tokens interaction |
| | | | | | Upgradeable |
| GoodFundManager | 42 | | | Yes | Receive ETH |
| | | | | | Delegatecall |
| | | | | | Tokens interaction |
| | | | | | Upgradeable |
| UniswapV2SwapHelper | 2 | | | No | Send ETH |
| GoodCompoundStakingV2 | 88 | ERC20 | Pausable | Yes | Send ETH |
| | | | No Minting | | Tokens interaction |
| | | | Approve Race Cond. | | Upgradeable |
| BancorFormula | 39 | | | Yes | |
| DataTypes | 0 | | | No | |
| NameService | 27 | | | No | Receive ETH |



| | | | | | |
|---|---|---|---|---|---|
| | | | | | Delegatecall |
| | | | | | Upgradeable |
| IBeaconUpgradeable | 1 | | | No | Upgradeable |
| AddressUpgradeable | 9 | | | No | Send ETH |
| | | | | | Assembly |
| | | | | | Upgradeable |
| StorageSlotUpgradeable | 4 | | | No | Assembly |
| | | | | | Upgradeable |
| StringsUpgradeable | 4 | | | Yes | Upgradeable |
| MerkleProofUpgradeable | 1 | | | No | Upgradeable |
| SafeMathUpgradeable | 13 | | | No | Upgradeable |
| EnumerableSetUpgradeable | 24 | | | No | Assembly |
| | | | | | Upgradeable |

contracts/staking/compound/GoodCompoundStakingV2.sol analyzed (70 contracts)

## Concluding Remarks

While conducting the audits of the GoodDollar smart contracts, it was observed that the contracts contain Medium and Low severity issues.

Our auditors suggest that Medium and Low severity issues should be resolved by the developers. The recommendations given will improve the operations of the smart contract.

## Disclaimer

ImmuneBytes's audit does not provide a security or correctness guarantee of the audited smart contract. Securing smart contracts is a multistep process, therefore running a bug bounty program as a complement to this audit is strongly recommended.

Our team does not endorse the GoodDollar platform or its product nor this audit is investment advice.
Notes:

- Please make sure contracts deployed on the mainnet are the ones audited.
- Check for the code refactor by the team on critical issues.

***ImmuneBytes***