Audit of The ValueGovernanceVault 2
Contract

a report of findings by

Van Cam Pham, PhD

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</tr>
<tr>
<td>Reviewed By</td>
<td>Joel Farris</td>
</tr>
<tr>
<td>Approved By</td>
<td>Rasikh Morani</td>
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Contact

For more information on this report, contact The Arcadia Media Group Inc.

<table>
<thead>
<tr>
<th>Rasikh Morani</th>
</tr>
</thead>
<tbody>
<tr>
<td>(972) 543-3886</td>
</tr>
<tr>
<td><a href="mailto:rasikh@arcadiamgroup.com">rasikh@arcadiamgroup.com</a></td>
</tr>
<tr>
<td><a href="https://t.me/thearcadiagroup">https://t.me/thearcadiagroup</a></td>
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Executive Summary

A Representative Party of the Value DeFi ("ValueDeFi") engaged The Arcadia Group ("Arcadia"), a software development, research and security company, to conduct a review of the following Value Governance Vault smart contract on the Value DeFi repo at Commit #a6697d7baf7c604076d9b6eb13b2f6069b475b80.

ValueGovernanceVault.sol

Arcadia completed the review using various methods primarily consisting of dynamic and static analysis. This process included a line by line analysis of the in-scope contracts, optimization analysis, analysis of key functionalities and limiters, and reference against intended functionality.

Conclusion

While most of the findings do not require any immediate action, some may require additional disclosure and communication to the end users for clarity, additionally code review and audits should be completed prior to launch in order to be maximally effective and to lower end-user risk.
Findings

1. Constructor input parameters

- VAULT-1
- Severity: Low
- Likelihood: Low
- Impact: Low

In the ValueGovernanceVault contract, the constructor takes \_startBlock as its input. This input parameter should be checked for its value greater than the current block number in order to avoid the situation that the contract rewarding block would be before the block at which the contract is deployed.

```solidity
constructor (ITokenInterface _yfvToken,
            ITokenInterface _valueToken,
            ITokenInterface _vUSD,
            ITokenInterface _vETH,
            uint _valuePerBlock,
            uint _vusdPerBlock,
            uint _startBlock) public ERC20("GovVault:ValueLiquidity", "gvVALUE") {
    yfvToken = _yfvToken;
    valueToken = _valueToken;
    vUSD = _vUSD;
    vETH = _vETH;
    valuePerBlock = _valuePerBlock;
    vusdPerBlock = _vusdPerBlock;
    lastRewardBlock = _startBlock;
    governance = msg.sender;
}
```

Action Recommended: Add a require statement to verify that \_startBlock must be after the current block.

2. Code Readability
Repeated require statement checking code should have a modifier in the contract. Specifically, `require(msg.sender == governance, "!governance");` is repeated in 15 functions.

```
function setFundCap(uint _fundCap) external {
    require(msg.sender == governance, "!governance");
    fundCap = _fundCap;
}

function setTotalDepositCap(uint _totalDepositCap) external {
    require(msg.sender == governance, "!governance");
    totalDepositCap = _totalDepositCap;
}

function setGovernance(address _governance) public {
    require(msg.sender == governance, "!governance");
    governance = _governance;
}...
```

Action Recommended: The code should have a modifier isGovernance to check whether function callers in the functions are the governance contract. This improves readability.

### 3. Hardcoding Token Addresses

In the ValueGovernanceVault contract, as the token contracts for Value, vUSD, vETH are already deployed, ValueGovernanceVault the contract should hardcode these addresses of the
token contracts.

Using constructor parameters to pass the token contract addresses is good for testing but downgrading code readability and explicitness.

```solidity
constructor (ITokenInterface _yfvToken,
            ITokenInterface _valueToken,
            ITokenInterface _vUSD,
            ITokenInterface _vETH,
            uint _valuePerBlock,
            uint _vusdPerBlock,
            uint _startBlock) public ERC20("GovVault:ValueLiquidity", "gvVALUE") {
    yfvToken = _yfvToken;  
    valueToken = _valueToken;  
    vUSD = _vUSD;  
    vETH = _vETH;  
    valuePerBlock = _valuePerBlock;  
    vusdPerBlock = _vusdPerBlock;  
    lastRewardBlock = _startBlock;  
    governance = msg.sender;
}
```

Action Recommended: Hardcoding the token contract addresses in the contract while still allowing to change the token contract addresses in the constructor, by using a simple check for input token addresses.

```solidity
constructor (ITokenInterface _yfvToken,
            ITokenInterface _valueToken,
            ITokenInterface _vUSD,
            ITokenInterface _vETH,
            uint _valuePerBlock,
            uint _vusdPerBlock,
            uint _startBlock) public ERC20("GovVault:ValueLiquidity", "gvVALUE") {
    yfvToken = _yfvToken != address(0x0)?_yfvToken:0x..;
    valueToken = _valueToken != address(0x0)?_valueToken:0x..;
    vUSD = _vUSD != address(0x0)?_vUSD:0x..;
    vETH = _vETH != address(0x0)?_vETH:0x..;
    valuePerBlock = _valuePerBlock;
}
```
vusdPerBlock = _vusdPerBlock;
lastRewardBlock = _startBlock;
governance = msg.sender;

4. Users would not receive bonus Value reward

- **VAULT-4**
- **Severity:** Medium
- **Likelihood:** Medium
- **Impact:** Medium
- **Target:** ValueGovernanceVault.sol
- **Category:** Medium
- **Finding Type:** Dynamic
- **Lines:** 393-402

In the ValueLiquidityToken contract, any user can deposit Value or YFV to receive a corresponding amount of gvValue token (called shares). The user can stake the shares to receive rewards paid in Value, vUSD, and vETH (newly minted). The user can decide to lock the shares for a certain amount of time (from 7 days to 150 days) in order to receive bonus rewards paid in Value for the locked shares. The user should receive bonus rewards regardless of the time the user makes the transaction to withdraw the rewards. The function `_getReward`, however, does not take bonus rewards into account if the user withdraws rewards after the expected unlock time. Specifically, line 395, the lockedAmount share of the user is reset to 0 without calculating the bonus rewards the user should receive. This is not the behavior that the user expects as the bonus rewards should be sent to the user regardless of when the user makes transactions to withdraw rewards.

```solidity
function _getReward() internal {
    UserInfo storage user = userInfo[msg.sender];
    uint _pendingValue = user.amount.mul(accValuePerShare).div(1e12).sub(user.valueRewardDebt);
    if (_pendingValue > 0) {
        if (user.lockedAmount > 0) {
            if (user.unlockedTime < block.timestamp) {
                user.lockedAmount = 0;
            } else {
                uint _bonus =
                    _pendingValue.mul(user.lockedAmount.mul(user.boostedExtra).div(1e12)).div(user.amount);
                uint _ceilingBonus = _pendingValue.mul(33).div(100); // 33%
                if (_bonus > _ceilingBonus) _bonus = _ceilingBonus; // Additional check to avoid insanely high bonus!
                _pendingValue = _pendingValue.add(_bonus);
            }
        }
        user.accumulatedStakingPower = user.accumulatedStakingPower.add(_pendingValue);
    }
    uint actualPaid = _pendingValue.mul(99).div(100); // 99%
    uint commission = _pendingValue - actualPaid; // 1%
}
```
safeValueMint(msg.sender, actualPaid);
address _referrer = address(0);
if (rewardReferral != address(0)) {
    _referrer = IYFVReferral(rewardReferral).getReferrer(msg.sender);
}
if (_referrer != address(0)) {
    // send commission to referrer
    safeValueMint(_referrer, commission);
    CommissionPaid(_referrer, commission);
} else {
    // send commission to valueInsuranceFund
    safeValueMint(valueInsuranceFund, commission);
    CommissionPaid(valueInsuranceFund, commission);
}

uint _pendingVusd = user.amount.mul(accVusdPerShare).div(1e12).sub(user.vusdRewardDebt);
if (_pendingVusd > 0) {
    safeVusdMint(msg.sender, _pendingVusd);
}

Action Recommended: Function _getReward should take bonus rewards into account even if users withdraw after unlock time. Here’s a possible solution:

if (user.unlockedTime < block.timestamp) {
    uint lockedAmount = user.lockedAmount;
    user.lockedAmount = 0;
    if (user.previousRewardTimestamp < user.unlockedTime) {
        uint timeFromLastRewardTimeTilNow = block.timestamp.sub(user.previousRewardTimestamp);
        uint previousRewardTimestamp = user.unlockedTime.sub(user.lockedDays * 86400);
        uint timeFromLastRewardTimeToUnlockTime = user.unlockedTime.sub(previousRewardTimestamp);
        uint pendingValueFromLastRewardTimeTilUnlockTime = pendingValue.mul(timeFromLastRewardTimeTilUnlockTime).div(timeFromLastRewardTimeToUnlockTime);
        uint bonus = pendingValueFromLastRewardTimeTilUnlockTime.mul(lockedAmount.mul(user.boostedExtra).div(1e12)).div(user.amount);
        uint _ceilingBonus = pendingValueFromLastRewardTimeTilUnlockTime.mul(33).div(100); // 33%
        if (_bonus > _ceilingBonus) _bonus = _ceilingBonus;
        _pendingValue = _pendingValue.add(_bonus);
    }
}

uint _bonus =
As a summary of the solution, the code computes the pending rewards the user can receive since the last time _getReward function is called by the user till the expected unlocked time of the locked share. Based on the computed pending value, bonus will be calculated accordingly. previousRewardTimestamp is a newly introduced field in User struct in order to record the last time _getReward is called. previousRewardTimestamp should be updated every time _getReward is called.

5. Function pendingValue returns false results if called after unlockedTime

   - VAULT-5
   - Severity: Medium
   - Likelihood: Medium
   - Impact: Medium
   - Target: ValueGovernanceVault.sol
   - Category: Bonus rewards
   - Finding Type: Dynamic
   - Lines: 405-430

In the ValueLiquidityToken contract, any user can deposit Value or YFV to receive a corresponding amount of gvValue token (called shares). The user can stake the shares to receive rewards paid in Value, vUSD, and vETH (newly minted). The user can decide to lock the shares for a certain amount of time (from 7 days to 150 days) in order to receive bonus rewards paid in Value for the locked shares. The user should be able to read pending rewards plus bonus rewards regardless of the time the user makes the call to compute the pending Value rewards. The function pendingValue, however, does not take bonus rewards into account if the function is called after the expected unlock time. Specifically, line 422, the function does not calculate the bonus rewards the user should receive.

```
function pendingValue(address _account) public view returns (uint256 _pending)
{
    UserInfo storage user = userInfo[_account];
    _pendingValue = _pendingValue.mul(user.lockedAmount.mul(user.boostedExtra).div(1e12)).div(user.amount);

    uint _ceilingBonus = _pendingValue.mul(33).div(100); // 33%
    if (_bonus > _ceilingBonus) _bonus = _ceilingBonus; // Additional check to avoid insanely high bonus!
    _pendingValue = _pendingValue.add(_bonus);
}
```
Action Recommended: `pendingValue` should take bonus rewards into account even if users call the function after unlock time. See Issue VAULT-4 for a possible solution.

6. Function `withdrawAll` will not send bonus rewards if called after unlocked time.

- VAULT-6
- Severity: Medium
- Likelihood: Medium
- Impact: Medium
- Target: ValueGovernanceVault.sol
- Category: Bonus rewards
- Finding Type: Dynamic
- Lines: 405-430

In the ValueLiquidityToken contract, the user should be able to withdraw pending rewards plus bonus rewards regardless of the time the user makes transactions to execute function `withdrawAll`. The function `withdrawAll`, however, resets `lockedAmount` to 0 if the function is called after the expected unlock time.
if (user.unlockedTime < block.timestamp) {
    user.lockedAmount = 0;
} else {
    _amount = user.amount.sub(user.lockedAmount);
}
unstake(_amount, 0x0);
withdraw(balanceOf(msg.sender), 0x0);

Action Recommended: See Issue VAULT-4 for a possible solution. Once Vault-4’s solution is implemented, `withdrawAll` should let `unstake` reset `lockedAmount` as the function `unstake` already implements the code to reset `lockedAmount`.

```solidity
function withdrawAll(uint8 _flag) public discountCHI(_flag) {
    // User info storage
    UserInfo storage user = userInfo[msg.sender];
    uint _amount = user.amount;
    if (user.lockedAmount > 0) {
        if (user.unlockedTime >= block.timestamp) {
            _amount = user.amount.sub(user.lockedAmount);
        }
    }
    unstake(_amount, 0x0);
    withdraw(balanceOf(msg.sender), 0x0);
}
```

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