



# # Competitive Security Assessment

Tonka\_Finance\_AMM

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Summary	3
Overview	4
Audit Scope	5
Code Assessment Findings	6
TFA-1:Incorrect calculation of <code>balance1Adjusted</code>	8
TFA-2:Incorrect calculation in function <code>getAmountIn()</code>	9
TFA-3:Inconsistency between <code>amount</code> and <code>reseve</code>	11
TFA-4:Recommendation use of <code>safeTransferFrom()</code>	14
TFA-5:Lack of checking if the <code>token0</code> is not an <code>estoken</code>	16
TFA-6:Missing Zero Address Check	17
TFA-7:The <code>EsSwapPair.initialize()</code> function can be called multiple times by the owner	18
TFA-8: Ownership change should use two-step process	20
TFA-9:Unused parameter	21
TFA-10:Switching between 1, 2 instead of 0, 1 is more gas efficient	22
Disclaimer	23

# Summary

This report is prepared for the project to identify vulnerabilities and issues in the smart contract source code. A group of NDA covered experienced security experts have participated in the Secure3's Audit Contest to find vulnerabilities and optimizations. Secure3 team has participated in the contest process as well to provide extra auditing coverage and scrutiny of the finding submissions.

The comprehensive examination and auditing scope includes:

- Cross checking contract implementation against functionalities described in the documents and white paper disclosed by the project owner.
- Contract Privilege Role Review to provide more clarity on smart contract roles and privilege.
- Using static analysis tools to analyze smart contracts against common known vulnerabilities patterns.
- Verify the code base is compliant with the most up-to-date industry standards and security best practices.
- Comprehensive line-by-line manual code review of the entire codebase by industry experts.

The security assessment resulted in findings that are categorized in four severity levels: Critical, Medium, Low, Informational. For each of the findings, the report has included recommendations of fix or mitigation for security and best practices.

# Overview

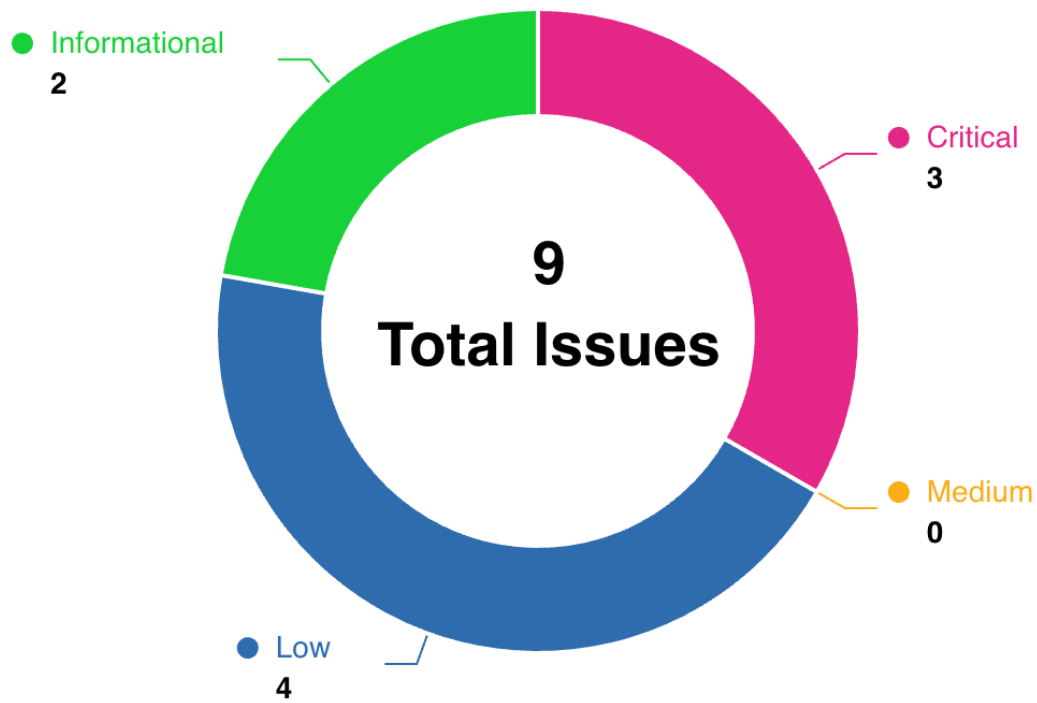
## Project Detail

<b>Project Name</b>	Tonka_Finance_AMM
<b>Platform &amp; Language</b>	Solidity
<b>Codebase</b>	<ul style="list-style-type: none"><li>• <a href="https://github.com/Tonka-Finance/Tonka-Contracts">https://github.com/Tonka-Finance/Tonka-Contracts</a></li><li>• audit commit - bcd5b93e7005005dbabda1f95511f441a48cf8dc</li><li>• final commit - 09d30d1f070af62af33e6b086c87c3b7aa88f523</li></ul>
<b>Audit Methodology</b>	<ul style="list-style-type: none"><li>• Audit Contest</li><li>• Business Logic and Code Review</li><li>• Privileged Roles Review</li><li>• Static Analysis</li></ul>

## Audit Scope

File	SHA256 Hash
<code>./contracts/Swap/EsSwapPair.sol</code>	<code>dc11bc5c076859d19594ffb1a3aa6d8d3aa62a5533a342423a394135588caf72</code>
<code>./contracts/Swap/EsSwapERC20.sol</code>	<code>974322c8866a8119c5289a6be365f83d492b361721a1e3499789d951cad8992a</code>

## Code Assessment Findings



ID	Name	Category	Severity	Client Response	Contributor
TFA-1	Incorrect calculation of <code>balance1Adj</code> used	Logical	Critical	Fixed	ginlee, Yaodao
TFA-2	Incorrect calculation in function <code>getAmountIn()</code>	Logical	Critical	Fixed	ginlee, Yaodao
TFA-3	Inconsistency between <code>amount</code> and <code>reseve</code>	Logical	Critical	Fixed	Yaodao
TFA-4	Recommendation use of <code>safeTransferFrom()</code>	Logical	Low	Fixed	ravikiran_web3, Yaodao

TFA-5	Lack of checking if the <code>token0</code> is not an <code>estoken</code>	Logical	Low	Fixed	danielt
TFA-6	Missing Zero Address Check	Logical	Low	Fixed	danielt
TFA-7	The <code>EsSwapPair.initialize()</code> function can be called multiple times by the owner	Logical	Low	Fixed	0xac, n16h7m4r3
TFA-8	Ownership change should use two-step process	Logical	Low	Declined	Yaodao, n16h7m4r3
TFA-9	Unused parameter	Code Style	Informational	Fixed	Yaodao
TFA-10	Switching between 1, 2 instead of 0, 1 is more gas efficient	Gas Optimization	Informational	Fixed	n16h7m4r3

## TFA-1: Incorrect calculation of balance1Adjusted

Category	Severity	Client Response	Contributor
Logical	Critical	Fixed	ginlee, Yaodao

### Code Reference

- code/contracts/Swap/EsSwapPair.sol#L229

```
229:uint balance1Adjusted = balance1 * 1000 - amount1In - 3;
```

### Description

ginlee :

```
uint balance1Adjusted = balance1 * 1000 - amount1In - 3;
```

The line of code `uint balance1Adjusted = balance1 * 1000 - amount1In - 3;` appears to be intended to adjust `balance1` by multiplying it by a factor (1000, which is a common scaling factor in financial calculations to avoid floating points) and then adjusting it based on the input amounts `amount0In` and `amount1In`.

The adjusted balance for `balance0` is correctly calculated by `uint balance0Adjusted = balance0 * 1000 - amount0In * 3;` where `amount0In` is multiplied by 3. However, a similar operation for `balance1Adjusted` incorrectly subtracts 3 from `amount1In`, which seems to be a typographical error.

**Yaodao :** The calculation of `balance1Adjusted` should be `balance1 * 1000 - amount1In * 3` instead of `balance1 * 1000 - amount1In - 3`.

```
uint balance0Adjusted = balance0 * 1000 - amount0In * 3;  
uint balance1Adjusted = balance1 * 1000 - amount1In - 3;
```

### Recommendation

**ginlee :** The correct calculation should multiply `amount1In` by 3 to maintain consistency with `balance0Adjusted` and the apparent intent of the function. The corrected line of code should be:

```
uint balance1Adjusted = balance1 * 1000 - amount1In * 3;
```

**Yaodao :** Recommend updating the calculation of `balance1Adjusted`.

### Client Response

Fixed: - to \* commit: <https://github.com/Tonka-Finance/Tonka-Contracts/commit/33f9ee429811aca51c04cef7e7c69b5f05ac65d0>



## TFA-2:Incorrect calculation in function `getAmountIn()`

Category	Severity	Client Response	Contributor
Logical	Critical	Fixed	ginlee, Yaodao

### Code Reference

- code/contracts/Swap/EsSwapPair.sol#L316-L322
- code/contracts/Swap/EsSwapPair.sol#L320

```
316: function getAmountIn(uint amountOut, uint reserveIn, uint reserveOut) public pure returns (uint
amountIn) {
317:     require(amountOut > 0, "EsSwapLibrary: INSUFFICIENT_OUTPUT_AMOUNT");
318:     require(reserveIn > 0 && reserveOut > 0, "EsSwapLibrary: INSUFFICIENT_LIQUIDITY");
319:     uint numerator = reserveIn * amountOut * 1000;
320:     uint denominator = reserveOut - amountOut * 997;
321:     amountIn = (numerator / denominator) + 1;
322: }

320: uint denominator = reserveOut - amountOut * 997;
```

### Description

ginlee :

```
uint denominator = reserveOut - amountOut * 997;
```

For the same implementation in Uniswap V2, denominator is calculated as `reserveOut.sub(amountOut).mul(997)`, instead of `"reserveOut - amountOut * 997"`, it is supposed to be calculated as `(reserveOut - amountOut) * 997`, by changing the sequence of calculation, a wrong denominator will lead to wrong `amountIn`, which will result in loss of fund in the protocol

**Yaodao** : The contract uses the 0.8.0+ solidity version and updates the math calculation.

According to the codes in UNISWAP, the `denominator` in the `getAmountIn()` should be `(reserveOut - amountOut) * 997`. However, in the contract `EsSwapPair` updated to be `reserveOut - amountOut * 997`.

```
function getAmountIn(uint amountOut, uint reserveIn, uint reserveOut) public pure returns (uint
amountIn) {
    require(amountOut > 0, "EsSwapLibrary: INSUFFICIENT_OUTPUT_AMOUNT");
    require(reserveIn > 0 && reserveOut > 0, "EsSwapLibrary: INSUFFICIENT_LIQUIDITY");
    uint numerator = reserveIn * amountOut * 1000;
    uint denominator = reserveOut - amountOut * 997;
    amountIn = (numerator / denominator) + 1;
}
```

Reference: <https://github.com/Uniswap/v2-periphery/blob/master/contracts/libraries/UniswapV2Library.sol#L53C14-L59>

## Recommendation

**ginlee** : Modify the calculation of denominator in the getAmountIn function to use (reserveOut - amountOut) \* 997 instead

```
uint denominator = (reserveOut - amountOut) * 997;
```

**Yaodao** : Recommend fixing the incorrect calculation.

## Client Response

Fixed: add() commit: <https://github.com/Tonka-Finance/Tonka-Contracts/commit/70eb2238e51b7cf1c6247a639b461b61ca7093ba>

## TFA-3: Inconsistency between amount and reseve

Category	Severity	Client Response	Contributor
Logical	Critical	Fixed	Yaodao

### Code Reference

- `code/contracts/Swap/EsSwapPair.sol#L270-L283`
- `code/contracts/Swap/EsSwapPair.sol#L285-L298`

```
270: function swapExactTokensForEsTokens(  
271:     uint amountIn,  
272:     uint amountOutMin,  
273:     address[] calldata path,  
274:     address to,  
275:     uint deadline  
276: ) external ensure(deadline) returns (uint amountOut) {  
277:     (uint reseveIn, uint reserveOut, ) = getReserves();  
278:     amountOut = getAmountOut(amountIn, reseveIn, reserveOut);  
279:     require(amountOut >= amountOutMin, "EsSwapRouter: INSUFFICIENT_OUTPUT_AMOUNT");  
280:     IERC20(token1).transferFrom(msg.sender, to, amountIn);  
281:  
282:     _swap(amountOut, 0, to);  
283: }  
  
285: function swapTokensForExactEsTokens(  
286:     uint amountOut,  
287:     uint amountInMax,  
288:     address[] calldata path,  
289:     address to,  
290:     uint deadline  
291: ) external ensure(deadline) returns (uint amountIn) {  
292:     (uint reseveIn, uint reserveOut, ) = getReserves();  
293:     amountIn = getAmountIn(amountOut, reseveIn, reserveOut);  
294:     require(amountIn <= amountInMax, "EsSwapRouter: EXCESSIVE_INPUT_AMOUNT");  
295:     IERC20(token1).transferFrom(msg.sender, to, amountIn);  
296:  
297:     _swap(amountOut, 0, to);  
298: }
```

## Description

**Yaodao** : The functions `swapExactTokensForEsTokens()` and `swapTokensForExactEsTokens()` are used to swap `token1` to `EsToken`.

However, the amount and reseve used to calculate are inconsistent.

For example, for `swapExactTokensForEsTokens()`

```
function swapExactTokensForEsTokens(  
    uint amountIn,  
    uint amountOutMin,  
    address[] calldata path,  
    address to,  
    uint deadline  
) external ensure(deadline) returns (uint amountOut) {  
    (uint reseveIn, uint reserveOut, ) = getReserves();  
    amountOut = getAmountOut(amountIn, reseveIn, reserveOut);  
    require(amountOut >= amountOutMin, "EsSwapRouter: INSUFFICIENT_OUTPUT_AMOUNT");  
    IERC20(token1).transferFrom(msg.sender, to, amountIn);  
  
    _swap(amountOut, 0, to);  
}
```

The `reseveIn` get by `getReserves()` is for `EsToken`, and the `amountIn` is for `token1`. In the call of `getAmountOut()`, the `amountIn` and `reseveIn` are both used for `token1`.

As a result, the calculation of `amountOut` is incorrect.

## Recommendation

**Yaodao** : Recommend using correct parameters to call `getAmountOut()`.

For example:

```
amountOut = getAmountOut(amountIn, reserveOut, reserveIn);
```

## Client Response

Fixed: to (uint reserveOut, uint reserveIn,) = getReserves() commit: <https://github.com/Tonka-Finance/Tonka-Contracts/commit/3f5179eefe80eb354a9b4d87386f8b72c8b7ffba>

## TFA-4:Recommendation use of `safeTransferFrom()`

Category	Severity	Client Response	Contributor
Logical	Low	Fixed	ravikiran_web3, Yaodao

### Code Reference

- code/contracts/Swap/EsSwapPair.sol#L108-L121
- code/contracts/Swap/EsSwapPair.sol#L280
- code/contracts/Swap/EsSwapPair.sol#L295

```
108: function removeLiquidity(  
109:     uint liquidity,  
110:     uint amountAMin,  
111:     uint amountBMin,  
112:     address to,  
113:     uint deadline  
114: ) public ensure(deadline) returns (uint amountA, uint amountB) {  
115:     (address tokenA, address tokenB) = (token0, token1);  
116:     transferFrom(msg.sender, address(this), liquidity); // send liquidity to pair  
117:     (amountA, amountB) = burn(to);  
118:  
119:     require(amountA >= amountAMin, "EsSwapRouter: INSUFFICIENT_A_AMOUNT");  
120:     require(amountB >= amountBMin, "EsSwapRouter: INSUFFICIENT_B_AMOUNT");  
121: }  
  
280: IERC20(token1).transferFrom(msg.sender, to, amountIn);  
  
295: IERC20(token1).transferFrom(msg.sender, to, amountIn);
```

### Description

**ravikiran\_web3** : In the `removeLiquidity()`, the liquidity is transferred from caller's account to the contract address.

To perform the above transfer, the contract calls `transferFrom()` of ERC20 base class. It is important that the return value of `transferFrom` is checked to confirm that the transfer went successfully. This is a norm and best practices when moving ERC20 tokens.

In the `removeLiquidity()`, the return value for `transferFrom()` was ignored, meaning failures of the underlying transactions are ignored and other processing in the `removeLiquidity()` function continues to execute. This will result in inaccurate accounting of tokens.

```
function removeLiquidity(
    uint liquidity,
    uint amountAMin,
    uint amountBMin,
    address to,
    uint deadline
) public ensure(deadline) returns (uint amountA, uint amountB) {
    (address tokenA, address tokenB) = (token0, token1);
    ==> transferFrom(msg.sender, address(this), liquidity); // send liquidity to pair
    (amountA, amountB) = burn(to);

    require(amountA >= amountAMin, "EsSwapRouter: INSUFFICIENT_A_AMOUNT");
    require(amountB >= amountBMin, "EsSwapRouter: INSUFFICIENT_B_AMOUNT");
}
```

**Yaodao** : In the functions `swapExactTokensForEsTokens()` and `swapTokensForExactEsTokens()`, the function `transferFrom()` is used to transfer `token1`.

It is recommended to use `safeTransferFrom()` to transfer `token1`.

## Recommendation

**ravikiran\_web3** : It is recommended to check the return value for `transferFrom()`.

As an alternative, using `safeTransfer` functions from `openzeppelin` could be used.

```
bool sent = transferFrom(msg.sender, address(this), liquidity);
require(sent, "Token transfer failed");
```

**Yaodao** : Recommend using `safeTransferFrom()`.

## Client Response

Fixed: use `SafeTransferFrom` commit: <https://github.com/Tonka-Finance/Tonka-Contracts/commit/d5680426dfe9b661625435500a3ad3400953d541>

## TFA-5:Lack of checking if the `token0` is not an `estoken`

Category	Severity	Client Response	Contributor
Logical	Low	Fixed	danielt

### Code Reference

- code/contracts/Swap/EsSwapPair.sol#L56-L59
- code/contracts/Swap/EsSwapPair.sol#L337-L342

```
56: function initialize(address _token0, address _token1) external onlyOwner {
57:     token0 = _token0;
58:     token1 = _token1;
59: }

337: function _transferFromEsToken(address _from, address _to, uint256 _amount) internal {
338:     address _token0 = token0;
339:     // when failing to burn or mint, token0 should revert
340:     IEsTokaToken(_token0).burn(_from, _amount);
341:     IEsTokaToken(_token0).mint(_to, _amount);
342: }
```

### Description

**danielt** : The `EsSwapPair` contract manages pairs composed of the `estoken`, which can be minted and burnt by the `EsSwapPair` contract. If the `token0` is not an `estoken`, the `_transferFromEsToken` function will revert. The point is that the check, to validate if the `token0` is an `estoken`, is better to be completed in the `initialize` function, in order to prevent the following error. Example validation:

- burns 0 `estoken` and mint 0 `estoken` in the `initialize` function.

### Recommendation

**danielt** : Recommend checking if the `token0` is an `estoken` in the `initialize` function to prevent the future error.

### Client Response

Fixed: add check for EsToken commit: <https://github.com/Tonka-Finance/Tonka-Contracts/commit/09d30d1f070af62af33e6b086c87c3b7aa88f523>



## TFA-6:Missing Zero Address Check

Category	Severity	Client Response	Contributor
Logical	Low	Fixed	danielt

### Code Reference

- code/contracts/Swap/EsSwapPair.sol#L56-L59

```
56: function initialize(address _token0, address _token1) external onlyOwner {  
57:     token0 = _token0;  
58:     token1 = _token1;  
59: }
```

### Description

**danielt**: The `initialize` function should be executed and only executed once, which can be done by using the `initializer` modifier of Openzeppelin's `Initializable` contract or adding checks that ensure `token0` and `token1` are zero addresses before initializing. Example:

- what if the private key of the owner is leakage due to the owner being attacked by the social engineering attacks, then the hacker could call the `initialize` function again lead to the DoS for the `EsSwapPair`, and permanently lock the pair's assets.

### Recommendation

**danielt**: Recommend applying the `initializer` modifier of Openzeppelin's `Initializable` contract to the `initialize` function or adding checks that ensure `token0` and `token1` are zero addresses before initializing.

### Client Response

Fixed: initialize token0 and token1 by constructor commit: <https://github.com/Tonka-Finance/Tonka-Contracts/commit/52859091c3d1b32755e3b1d5477f7fb49d9af8d1>

## TFA-7: The `EsSwapPair.initialize()` function can be called multiple times by the owner

Category	Severity	Client Response	Contributor
Logical	Low	Fixed	0xac, n16h7m4r3

### Code Reference

- code/contracts/Swap/EsSwapPair.sol#L55-L59
- code/contracts/Swap/EsSwapPair.sol#L56-L59

```
55:// called once by the factory at time of deployment
56:    function initialize(address _token0, address _token1) external onlyOwner {
57:        token0 = _token0;
58:        token1 = _token1;
59:    }

56:function initialize(address _token0, address _token1) external onlyOwner {
57:    token0 = _token0;
58:    token1 = _token1;
59: }
```

### Description

**0xac** : The initialize function can be called multiple times by the owner instead of just once. The owner can replace token0 and token1 in the pair, putting the funds in the pair in an unsafe situation. For example, replace the logic of the token0 and token1 contracts and transfer the funds in the pair.

**n16h7m4r3** : The token pair's contract addresses can be re-initialized by the factory. If the token pair is reinitialized, any existing data associated with the previous token pair would not be taken into consideration. This could affect the accuracy and integrity of the smart contract's functionality.

### Recommendation

**0xac** : It is recommended to use an initializer to ensure that this function is only called once.

<https://github.com/OpenZeppelin/openzeppelin-contracts/blob/master/contracts/proxy/utils/Initializable.sol>

**n16h7m4r3** : Consider adding checks to ensure that the function `initialize()` can only be executed once.

### Client Response

Fixed: initialize token0 and token1 by constructor commit: <https://github.com/Tonka-Finance/Tonka-Contracts/commit/52859091c3d1b32755e3b1d5477f7fb49d9af8d1>

## TFA-8: Ownership change should use two-step process

Category	Severity	Client Response	Contributor
Logical	Low	Declined	Yaodao, n16h7m4r3

### Code Reference

- code/contracts/Swap/EsSwapPair.sol#L14-L16
- code/contracts/Swap/EsSwapPair.sol#L16

```
14:import { Ownable } from "@openzeppelin/contracts/access/Ownable.sol";
15:
16:contract EsSwapPair is IEsSwapPair, Ownable, EsSwapERC20 {
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## TFA-9:Unused parameter

Category	Severity	Client Response	Contributor
Code Style	Informational	Fixed	Yaodao

### Code Reference

- code/contracts/Swap/EsSwapPair.sol#L273
- code/contracts/Swap/EsSwapPair.sol#L288

```
273:address[] calldata path,
```

```
288:address[] calldata path,
```

### Description

**Yaodao** : The parameter `path` is declared in the functions `swapExactTokensForEsTokens()` and `swapTokensForExactEsTokens()` but never be used.

### Recommendation

**Yaodao** : Recommend removing the useless parameter.

### Client Response

Fixed: remove unused paras commit: <https://github.com/Tonka-Finance/Tonka-Contracts/commit/a22f35b4c0fb348c611335ebfbb822b45fcd8912>

# TFA-10:Switching between 1, 2 instead of 0, 1 is more gas efficient

Category	Severity	Client Response	Contributor
Gas Optimization	Informational	Fixed	n16h7m4r3

## Code Reference

- code/contracts/Swap/EsSwapPair.sol#L35-L40

```
35:modifier lock() {  
36:    require(unlocked == 1, "EsSwap: LOCKED");  
37:    unlocked = 0;  
38:    _;  
39:    unlocked = 1;  
40: }
```

## Description

**n16h7m4r3** : `SSTORE` from 0 to 1 (or any non-zero value), the cost is 20000; `SSTORE` from 1 to 2 (or any other non-zero value), the cost is 5000.

By storing the original value once again, a refund is triggered (<https://eips.ethereum.org/EIPS/eip-2200>).

Since refunds are capped to a percentage of the total transaction's gas, it is best to keep them low, to increase the likelihood of the full refund coming into effect.

## Recommendation

**n16h7m4r3** : Replace 0,1 with 1, 2 to optimize the gas usage.

## Client Response

Fixed: switch between 1, 2 for gas efficiency commit: <https://github.com/Tonka-Finance/Tonka-Contracts/commit/afe77b47d7157939b36638a064cb8fd7578e41c5>

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