



CERTIK

Xend Finance: Yearn Savings

Smart Contracts

Security Assessment

January 27th, 2021

By:

Sheraz Arshad @ Certik

sheraz.arshad@certik.org

Camden Smallwood @ Certik

camden.smallwood@certik.org





Disclaimer

CertiK reports are not, nor should be considered, an “endorsement” or “disapproval” of any particular project or team. These reports 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 CertiK to perform a security review.

CertiK Reports do not provide any warranty or guarantee regarding the absolute bug-free nature of the technology analyzed, nor do they provide any indication of the technologies proprietors, business, business model or legal compliance.

CertiK Reports should not be used in any way to make decisions around investment or involvement with any particular project. These reports in no way provide investment advice, nor should be leveraged as investment advice of any sort.

CertiK Reports represent 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. CertiK’s position is that each company and individual are responsible for their own due diligence and continuous security. CertiK’s goal is to help reduce the attack vectors and the high level of variance associated with utilizing new and consistently changing technologies, and in no way claims any guarantee of security or functionality of the technology we agree to analyze.

What is a CertiK report?

- A document describing in detail an in depth analysis of a particular piece(s) of source code provided to CertiK by a Client.
- An organized collection of testing results, analysis and inferences made about the structure, implementation and overall best practices of a particular piece of source code.
- Representation that a Client of CertiK has indeed completed a round of auditing with the intention to increase the quality of the company/product's IT infrastructure and or source code.



Project Summary

Project Name	Xend Finance: Yearn Savings
Description	The codebase comprise of contracts which allow staking of DAI tokens individually and as group and allows yield farming on Yearn Dai contract.
Platform	Ethereum; Solidity, Yul
Codebase	GitHub Repository
Commits	<ol style="list-style-type: none">0b93bc9c84e53dffca0e0c292fb1d214104fa241249b1989dbd98107e972fbcead25f5a4c4754f54c95a05704ee7ce10bdd2ce30cbfdc2358b586070

Audit Summary

Delivery Date	January 27th, 2021
Method of Audit	Static Analysis, Manual Review
Consultants Engaged	2
Timeline	November 6th, 2020 - January 27th, 2021

Vulnerability Summary

Total Issues	74
● Total Critical	5
● Total Major	5
● Total Medium	3
● Total Minor	12
● Total Informational	49



Executive Summary

This report represents the results of CertiK's engagement with Xend on their implementation of the Yearn-savings smart contracts.

Our findings mainly refer to optimizations and a couple of major issues. All of the findings except a few informational were remediated. The overall security of the contracts can be deemed as high after the remediations were applied.

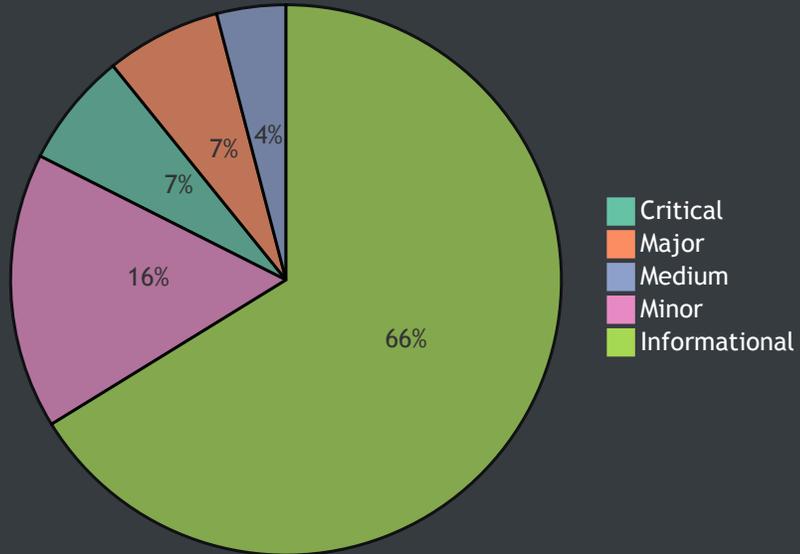


Files In Scope

ID	Contract	Location
CYC	Cycle.sol	Cycle.sol
CRD	ClientRecord.sol	ClientRecord.sol
GRO	Groups.sol	Groups.sol
ICE	ICycle.sol	ICycle.sol
IGS	IGroups.sol	IGroups.sol
IGR	IGroupSchema.sol	IGroupSchema.sol
ICR	IClientRecord.sol	IClientRecord.sol
ISC	ISavingsConfig.sol	ISavingsConfig.sol
ICS	IClientRecordShema.sol	IClientRecordShema.sol
ISS	ISavingsConfigSchema.sol	ISavingsConfigSchema.sol
SCG	SavingsConfig.sol	SavingsConfig.sol
SOS	StorageOwners.sol	StorageOwners.sol
TRE	Treasury.sol	Treasury.sol
XFG	XendFinanceGroup_Yearn_V1.sol	XendFinanceGroup_Yearn_V1.sol
XFI	XendFinanceIndividual_Yearn_V1.sol	XendFinanceIndividual_Yearn_V1.sol



Finding Summary



ID	Title	Type	Severity	Resolved
<u>IGR-01</u>	Unlocked Compiler Version	Language Specific	● Informational	✓
<u>IGR-02</u>	Inefficient struct layout	Gas Optimization	● Informational	✓
<u>IGR-03</u>	Inefficient struct layout	Gas Optimization	● Informational	✓
<u>IGR-04</u>	Inefficient struct layout	Gas Optimization	● Informational	✓
<u>SOS-01</u>	Unlocked Compiler Version	Language Specific	● Informational	✓

<u>SOS-02</u>	Inefficient functions	Gas Optimization	 Informational	✓
<u>SOS-03</u>	if statement can substituted with a require statement	Volatile Code	 Minor	🔄
<u>GRO-01</u>	Unlocked Compiler Version	Language Specific	 Informational	✓
<u>GRO-02</u>	Unsafe addition	Mathematical Operations	 Minor	✓
<u>GRO-03</u>	Unsafe subtraction	Mathematical Operations	 Minor	✓
<u>GRO-04</u>	Unsafe addition	Mathematical Operations	 Minor	✓
<u>GRO-05</u>	Unsafe subtraction	Mathematical Operations	 Minor	✓
<u>GRO-06</u>	Inefficient function implementation	Gas Optimization	 Informational	✓
<u>GRO-07</u>	Comparison with a literal boolean value	Gas Optimization	 Informational	✓
<u>GRO-08</u>	Explicitly returning a local variable	Gas Optimization	 Informational	✓
<u>CYC-01</u>	Unlocked Compiler Version	Language Specific	 Informational	✓
<u>CYC-02</u>	Explicitly returning a local variable	Gas Optimization	 Informational	✓
<u>CYC-03</u>	Comparison with a literal boolean value	Gas Optimization	 Informational	✓
<u>CYC-04</u>	Inefficient function implementation	Gas Optimization	 Informational	✓
<u>CYC-05</u>	updateCycleMember is not restricted by onlyStorageOracle	Volatile Code	 Critical	✓
<u>CYC-06</u>	Incorrect code	Control Flow	 Major	🔄

<u>CYC-07</u>	Incorrect implementation of functions	Volatile Code	● Major	✓
<u>CRD-01</u>	Unlocked Compiler Version	Language Specific	● Informational	✓
<u>CRD-02</u>	Inefficient local variable	Gas Optimization	● Informational	✓
<u>CRD-03</u>	Comparison with a literal boolean value	Gas Optimization	● Informational	✓
<u>CRD-04</u>	Redundant Variable Initialization	Coding Style	● Informational	⌚
<u>CRD-05</u>	Inefficient storage update	Gas Optimization	● Informational	⌚
<u>ICS-01</u>	Unlocked Compiler Version	Language Specific	● Informational	✓
<u>ISS-01</u>	Unlocked Compiler Version	Language Specific	● Informational	✓
<u>ISS-02</u>	Inefficient struct layout	Gas Optimization	● Informational	✓
<u>SCG-01</u>	Unlocked Compiler Version	Language Specific	● Informational	✓
<u>SCG-02</u>	Empty constructor declaration	Volatile Code	● Informational	✓
<u>SCG-03</u>	Comparison with a literal boolean value	Gas Optimization	● Informational	✓
<u>SCG-04</u>	Explicitly returning a local variable	Gas Optimization	● Informational	✓
<u>SCG-05</u>	Redundant Statements	Dead Code	● Informational	✓
<u>SCG-06</u>	<code>_validateRuleCreation</code> always reverts the transaction	Volatile Code	● Major	✓
<u>SCG-07</u>	<code>modifyRule</code> does not save the Rule	Volatile Code	● Major	✓

<u>TRE-01</u>	Unlocked Compiler Version	Language Specific	● Informational	✓
<u>TRE-02</u>	Redundant <code>require</code> statement	Gas Optimization	● Informational	✓
<u>TRE-03</u>	Redundant <code>require</code> statement	Gas Optimization	● Informational	✓
<u>TRE-04</u>	Comparison with a literal boolean value	Gas Optimization	● Informational	✓
<u>TRE-05</u>	<code>enum</code> type is declared but never used	Dead Code	● Informational	✓
<u>XFI-01</u>	Unlocked Compiler Version	Language Specific	● Informational	✓
<u>XFI-02</u>	Redundant Variable Initialization	Coding Style	● Informational	✓
<u>XFI-03</u>	Redundant storage variables	Gas Optimization	● Informational	✓
<u>XFI-04</u>	Comparison with a literal boolean value	Gas Optimization	● Informational	✓
<u>XFI-05</u>	Requisite Value of ERC-20 <code>transferFrom()</code> / <code>transfer()</code> Call	Logical Issue	● Minor	✓
<u>XFI-06</u>	Inefficient local variable	Gas Optimization	● Informational	✓
<u>XFI-07</u>	Function does not return a value	Logical Issue	● Minor	✓
<u>XFI-08</u>	Unused local variables	Dead Code	● Informational	🕒
<u>XFI-09</u>	Incorrect code	Logical Issue	● Critical	✓
<u>XFI-10</u>	Incorrect value provided for struct property	Logical Issue	● Critical	✓
<u>XFI-11</u>	Incorrect code	Logical Issue	● Critical	✓

<u>XFI-12</u>	Incorrect code	Logical Issue	● Critical	✓
<u>XFI-13</u>	Possibility of re-entrancy attack	Control Flow	● Medium	✓
<u>XFG-01</u>	Unlocked Compiler Version	Language Specific	● Informational	✓
<u>XFG-02</u>	Redundant Variable Initialization	Coding Style	● Informational	✓
<u>XFG-03</u>	Comparison with a literal boolean value	Gas Optimization	● Informational	✓
<u>XFG-04</u>	Unnecessary local variables	Gas Optimization	● Informational	✓
<u>XFG-05</u>	Explicitly returning a local variable	Gas Optimization	● Informational	⚠
<u>XFG-06</u>	Unnecessary local variables	Gas Optimization	● Informational	✓
<u>XFG-07</u>	Function does return a value	Dead Code	● Minor	✓
<u>XFG-08</u>	Requisite Value of ERC-20 <code>transferFrom()</code> / <code>transfer()</code> Call	Logical Issue	● Minor	✓
<u>XFG-09</u>	Inefficient code	Gas Optimization	● Informational	✓
<u>XFG-10</u>	Unsafe subtraction	Mathematical Operations	● Minor	✓
<u>XFG-11</u>	Unnecessary parenthesis around expressions	Language Specific	● Informational	✓
<u>XFG-12</u>	Confusing modifier name	Inconsistency	● Informational	✓
<u>XFG-13</u>	Unused local variables	Gas Optimization	● Informational	⚠
<u>XFG-14</u>	Unsafe subtraction	Mathematical Operations	● Minor	✓
<u>XFG-</u>	Requisite Value of ERC-20 <code>transferFrom()</code> /	Logical Issue	● Minor	✓

<u>15</u>	transfer() Call			
<u>XFG-16</u>	Ineffectual code	Gas Optimization	● Informational	✓
<u>XFG-17</u>	Anyone can make a particular depositor join cycle	Volatile Code	● Major	✓
<u>XFG-18</u>	Possibility of reentrancy attack	Control Flow	● Medium	✓
<u>XFG-19</u>	Possibility of reentrancy attack	Control Flow	● Medium	✓



IGR-01: Unlocked Compiler Version

Type	Severity	Location
Language Specific	● Informational	IGroupSchema.sol L1

Description:

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation:

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.6.2` the contract should contain the following line:

```
pragma solidity 0.6.2;
```

Alleviation:

Alleviations were applied as advised.



IGR-02: Inefficient struct layout

Type	Severity	Location
Gas Optimization	● Informational	!GroupSchema.sol L5, L9

Description:

The struct properties of `bool` and `address` on the aforementioned lines can be placed together to tight pack the storage layout of the struct.

Recommendation:

We recommend to place the struct properties of `bool` and `address` types on the aforementioned lines together so they utilize only one slot instead of two slots.

Alleviation:

Alleviations were applied as advised.



IGR-03: Inefficient struct layout

Type	Severity	Location
Gas Optimization	● Informational	IGroupSchema.sol L13 , L20 , L26

Description:

The struct properties of `bool` and `enum` on the aforementioned lines can be placed together to to tight pack the struct.

Recommendation:

We advise to place the struct properties of `bool` and `enum` on the aforementioned lines next to each other so they are stored in a single storage slot instead of three slots.

Alleviation:

Alleviations were applied as advised.



IGR-04: Inefficient struct layout

Type	Severity	Location
Gas Optimization	● Informational	IGroupSchema.sol L49 , L52 , L56

Description:

The struct properties of `bool` and `address` types on the aforementioned lines can be placed together to tightly pack the struct.

Recommendation:

We advise to place the struct properties of `bool` and `address` on the aforementioned lines next to each other so they are stored in a single storage slot instead of three slots.

Alleviation:

Alleviations were applied as advised.



SOS-01: Unlocked Compiler Version

Type	Severity	Location
Language Specific	● Informational	StorageOwners.sol L1

Description:

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation:

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.6.2` the contract should contain the following line:

```
pragma solidity 0.6.2;
```

Alleviation:

Alleviations were applied as advised.



SOS-02: Inefficient functions

Type	Severity	Location
Gas Optimization	● Informational	StorageOwners.sol L11, L15

Description:

The functions on the aforementioned lines can be replaced with a single function accepting the activate or deactivate state of the oracle as a `bool` parameter in the function signature. This will reduce the bytecode footprint of the contract resulting in reduced gas cost for the deployment of the contract.

Recommendation:

We recommend to replace functions on the aforementioned with a single function that accepts status of the oracle to change as `bool` parameter in the function signature.

```
function changeStorageOracleStatus(address oracle, bool status) external onlyOwner {
    storageOracles[oracle] = status;
}
```

Alleviation:

Alleviations were applied as advised.



SOS-03: `if` statement can substituted with a `require` statement

Type	Severity	Location
Volatile Code	● Minor	<u>StorageOwners.sol L28-L30</u>

Description:

The `if` statement on the aforementioned does not revert the transaction when the `newOwner` is set to `address(0)`.

Recommendation:

We advise to use a `require` statement in place of `if` statement that reverts when `newOwner` is set to `address(0)`.

Alleviation:

No alleviations..



GRO-01: Unlocked Compiler Version

Type	Severity	Location
Language Specific	● Informational	Groups.sol L1

Description:

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation:

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.6.2` the contract should contain the following line:

```
pragma solidity 0.6.2;
```

Alleviation:

Alleviations were applied as advised.



GRO-02: Unsafe addition

Type	Severity	Location
Mathematical Operations	● Minor	Groups.sol L55

Description:

The aforementioned line performs unsafe addition which can result in overflow of integer value.

Recommendation:

We advise to use the `add` function from `SafeMath` library to perform safe addition which reverts the transaction if overflow happens.

```
totalTokensDeposited[tokenAddress] = totalTokensDeposited[tokenAddress].add(amount);
```

Alleviation:

Alleviations were applied as advised.



GRO-03: Unsafe subtraction

Type	Severity	Location
Mathematical Operations	● Minor	Groups.sol L69

Description:

The aforementioned line performs unsafe subtraction which can be result in underflow of integer value.

Recommendation:

We advise to use `sub` function from `SafeMath` library to perform subtraction so that the transaction is reverted if underflow happens.

```
totalTokensDeposited[tokenAddress] = totalTokensDeposited[tokenAddress].sub(amount);
```

Alleviation:

Alleviations were applied as advised.



GRO-04: Unsafe addition

Type	Severity	Location
Mathematical Operations	● Minor	Groups.sol L86

Description:

The aforementioned line performs unsafe addition which can result in overflow of integer value.

Recommendation:

We advise to use `add` function of `SafeMath` library to perform addition so that the transaction is reverted if overflow happens.

```
totalEthersDeposited = totalEthersDeposited.add(amount);
```

Alleviation:

Alleviations were applied as advised.



GRO-05: Unsafe subtraction

Type	Severity	Location
Mathematical Operations	● Minor	Groups.sol L99

Description:

The aforementioned line performs unsafe subtraction which can result in underflow of integer value.

Recommendation:

We recommend to use `sub` function of `SafeMath` library to perform subtraction so that the transaction is reverted if underflow happens.

```
totalEthersDeposited = totalEthersDeposited.sub(amount);
```

Alleviation:

Alleviations were applied as advised.



GRO-06: Inefficient function implementation

Type	Severity	Location
Gas Optimization	● Informational	Groups.sol L208

Description:

The implementation of the function on the aforementioned line is inefficient as it redundantly checks `bool` value with an `if` statement and then returns it as is.

Recommendation:

We advise to remove the `if-else` block and directly return the expression `MemberIndexer[depositor].exists` from the function to have efficient implementation.

Alleviation:

Alleviations were applied as advised.



GRO-07: Comparison with a literal boolean value

Type	Severity	Location
Gas Optimization	● Informational	Groups.sol L1

Description:

The contract has several occurrences of comparison with a literal boolean values of `true` or `false` that can be replaced replacing with compared expression itself to increase the legibility of the code.

Recommendation:

We advise to use the compared expression itself in place of expression's comparison with a boolean literal. The expression can be replaced as is when the expression is expected to evaluate to `true` and negation of expression can be used when the expression is expected to have `false` value.

Alleviation:

Alleviations were applied as advised.



GRO-08: Explicitly returning a local variable

Type	Severity	Location
Gas Optimization	● Informational	Groups.sol L123 , L130 , L194 , L397 , L180 , L295

Description:

The functions on the aforementioned line explicitly return a local variable which increases overall cost of gas.

Recommendation:

Since named return variables can be declared in the signature of a function, consider refactoring to remove the local variable declaration and explicit return statement in order to reduce the overall cost of gas.

Alleviation:

Alleviations were applied as advised.



CYC-01: Unlocked Compiler Version

Type	Severity	Location
Language Specific	● Informational	Cycle.sol L1

Description:

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation:

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.6.2` the contract should contain the following line:

```
pragma solidity 0.6.2;
```

Alleviation:

Alleviations were applied as advised.



CYC-02: Explicitly returning a local variable

Type	Severity	Location
Gas Optimization	● Informational	Cycle.sol L370 , L459 , L453 , L446 , L428 , L491 , L465 , L356 , L361

Description:

The functions on the aforementioned line explicitly return a local variable which increases overall cost of gas.

Recommendation:

Since named return variables can be declared in the signature of a function, consider refactoring to remove the local variable declaration and explicit return statement in order to reduce the overall cost of gas.

Alleviation:

Alleviations were applied as advised.



CYC-03: Comparison with a literal boolean value

Type	Severity	Location
Gas Optimization	● Informational	Cycle.sol L1

Description:

The contract has several occurrences of comparison with a literal boolean values of `true` or `false` that can be replaced replacing with compared expression itself to increase the legibility of the code.

Recommendation:

We advise to use the compared expression itself in place of expression's comparison with a boolean literal. The expression can be replaced as is when the expression is expected to evaluate to `true` and negation of expression can be used when the expression is expected to have `false` value.

Alleviation:

Alleviations were applied as advised.



CYC-04: Inefficient function implementation

Type	Severity	Location
Gas Optimization	● Informational	Cycle.sol L517

Description:

The implementation of the function on the aforementioned line is inefficient as it redundantly checks `bool` value with an `if` statement and then returns it as is.

Recommendation:

We advise to remove the `if-else` block and directly return the expression `CycleMembersDeepIndexer[cycleId][depositor].exists;` from the function to have efficient implementation.

Alleviation:

Alleviations were applied as advised.



CYC-05: `updateCycleMember` is not restricted by `onlyStorageOracle`

Type	Severity	Location
Volatile Code	● Critical	Cycle.sol L220

Description:

The function `updateCycleMember` on the aforementioned line updates a member within cycle and can be called by anyone while it should have been restricted to `onlyStorageOracle`.

Recommendation:

We advise to add `onlyStorageOracle` modifier in the function declaration so that only an allowed address could call this function keeping the integrity of the data.

```
function updateCycleMember(
    uint256 cycleId,
    address payable depositor,
    uint256 totalLiquidityAsPenalty,
    uint256 numberOfCycleStakes,
    uint256 stakesClaimed,
    bool hasWithdrawn
) external onlyStorageOracle {...}
```

Alleviation:

Alleviations were applied as advised.



CYC-06: Incorrect code

Type	Severity	Location
Control Flow	● Major	Cycle.sol L487

Description:

The aforementioned line calls the function `_getCycleIndex` to get the index of `CycleFinancial` but the call returns the index of `Cycle` corresponding to the `cycleId`.

Recommendation:

We advise to call the function `_getCycleFinancialIndex` to correctly get the index of `CycleFinancial`.

```
uint256 index = _getCycleFinancialIndex(cycleFinancial.cycleId);
```

Alleviation:

No alleviations were applied suggesting that the finding was incorrectly identified.



CYC-07: Incorrect implementation of functions

Type	Severity	Location
Volatile Code	● Major	Cycle.sol L378-L396

Description:

The functions `getRecordIndexForCycleMembersIndexerByDepositor` and `getRecordIndexForCycleMembersIndexer` on the aforementioned lines have incorrect implementation where `getRecordIndexForCycleMembersIndexerByDepositor` returns record index for cycle member while `getRecordIndexForCycleMembersIndexer` returns record index for cycle member by depositor.

Recommendation:

We advise to swap the implementations of both function so they returns record index from their corresponding mappings.

```
function getRecordIndexForCycleMembersIndexerByDepositor(
    uint256 cycleId,
    uint256 recordIndexLocation
) external view returns (bool, uint256) {
    RecordIndex memory recordIndex
        = CycleMembersIndexerByDepositor[depositorAddress][recordIndexLocation];
    return (recordIndex.exists, recordIndex.index);
}
```

```
function getRecordIndexForCycleMembersIndexer(
    address depositorAddress,
    uint256 recordIndexLocation
) external view returns (bool, uint256) {
    RecordIndex memory recordIndex
        = CycleMembersIndexer[cycleId][recordIndexLocation];
    return (recordIndex.exists, recordIndex.index);
}
```

Alleviation:

Alleviations were applied as advised.



CRD-01: Unlocked Compiler Version

Type	Severity	Location
Language Specific	● Informational	<u>ClientRecord.sol L1</u>

Description:

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation:

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.6.2` the contract should contain the following line:

```
pragma solidity 0.6.2;
```

Alleviation:

Alleviations were applied as advised.



CRD-02: Inefficient local variable

Type	Severity	Location
Gas Optimization	● Informational	ClientRecord.sol L18-L19

Description:

The local variable on the aforementioned line is inefficient as it copies the struct value into a memory variable and then it returns one property of the struct from the function.

Recommendation:

We recommend to directly return the value from the function instead of copying the struct into `memory` and then returning the property of it.

```
function doesClientRecordExist(address depositor)
    external
    view
    returns (bool)
{
    return ClientRecordIndexer[depositor].exists;
}
```

Alleviation:

Alleviations were applied as advised.



CRD-03: Comparison with a literal boolean value

Type	Severity	Location
Gas Optimization	● Informational	ClientRecord.sol L1

Description:

The contract has several occurrences of comparison with a literal boolean values of `true` or `false` that can be replaced replacing with compared expression itself to increase the legibility of the code.

Recommendation:

We advise to use the compared expression itself in place of expression's comparison with a boolean literal. The expression can be replaced as is when the expression is expected to evaluate to `true` and negation of expression can be used when the expression is expected to have `false` value.

Alleviation:

Alleviations were applied as advised.



CRD-04: Redundant Variable Initialization

Type	Severity	Location
Coding Style	● Informational	ClientRecord.sol L66-L74

Description:

All variable types within Solidity are initialized to their default "empty" value, which is usually their zeroed out representation. Particularly:

- `uint / int` : All `uint` and `int` variable types are initialized at `0`
- `address` : All `address` types are initialized to `address(0)`
- `byte` : All `byte` types are initialized to their `byte(0)` representation
- `bool` : All `bool` types are initialized to `false`
- `ContractType` : All contract types (i.e. for a given `contract ERC20 {}` its contract type is `ERC20`) are initialized to their zeroed out address (i.e. for a given `contract ERC20 {}` its default value is `ERC20(address(0))`)
- `struct` : All `struct` types are initialized with all their members zeroed out according to this table

Recommendation:

We advise that the linked initialization statements are removed from the codebase to increase legibility.

Alleviation:

No alleviations.



CRD-05: Inefficient storage update

Type	Severity	Location
Gas Optimization	● Informational	ClientRecord.sol L78-L84

Description:

The aforementioned lines update a struct inside array and upon each update it computes the location of struct inside array which is an inefficient approach.

Recommendation:

We advise to store a reference to struct inside a variable of type `ClientRecord` pointing to storage and then update the properties of struct using this storage variable which is gas efficient compared to the current implementation.

```
ClientRecord storage clientRecord = ClientRecords[index];
clientRecord.underlyingTotalDeposits = underlyingTotalDeposits;
clientRecord.underlyingTotalWithdrawn = underlyingTotalWithdrawn;
clientRecord.derivativeBalance = derivativeBalance;
clientRecord.derivativeTotalDeposits = derivativeTotalDeposits;
clientRecord.derivativeTotalWithdrawn = derivativeTotalWithdrawn;
```

Alleviation:

No alleviations.



ICS-01: Unlocked Compiler Version

Type	Severity	Location
Language Specific	● Informational	<u>IClientRecordShema.sol L1</u>

Description:

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation:

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.6.2` the contract should contain the following line:

```
pragma solidity 0.6.2;
```

Alleviation:

Alleviations were applied as advised.



ISS-01: Unlocked Compiler Version

Type	Severity	Location
Language Specific	● Informational	ISavingsConfigSchema.sol L1

Description:

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation:

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.6.2` the contract should contain the following line:

```
pragma solidity 0.6.2;
```

Alleviation:

Alleviations were applied as advised.



ISS-02: Inefficient struct layout

Type	Severity	Location
Gas Optimization	● Informational	ISavingsConfigSchema.sol L5, L9, L10

Description:

The properties `bool` and `enum` of struct on the aforementioned lines can be placed together to tight pack the struct.

Recommendation:

We recommend to place the properties of `bool` and `enum` on the aforementioned lines next to each other so that they can be packed within a single storage slot.

```
struct RuleSet {
    uint256 minimum;
    uint256 maximum;
    uint256 exact;
    bool applies;
    RuleDefinition ruleDefinition;
    bool exists;
}
```

Alleviation:

Alleviations were applied as advised.



SCG-01: Unlocked Compiler Version

Type	Severity	Location
Language Specific	● Informational	SavingsConfig.sol L1

Description:

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation:

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.6.2` the contract should contain the following line:

```
pragma solidity 0.6.2;
```

Alleviation:

Alleviations were applied as advised.



SCG-02: Empty constructor declaration

Type	Severity	Location
Volatile Code	● Informational	SavingsConfig.sol L12

Description:

An empty constructor is declared on the aforementioned line which is unnecessary.

Recommendation:

We advise to remove the empty constructor declaration on the aforementioned line to increase the quality of the code.

Alleviation:

Alleviations were applied as advised.



SCG-03: Comparison with a literal boolean value

Type	Severity	Location
Gas Optimization	● Informational	SavingsConfig.sol L1

Description:

The contract has several occurrences of comparison with a literal boolean values of `true` or `false` that can be replaced replacing with compared expression itself to increase the legibility of the code.

Recommendation:

We advise to use the compared expression itself in place of expression's comparison with a boolean literal. The expression can be replaced as is when the expression is expected to evaluate to `true` and negation of expression can be used when the expression is expected to have `false` value.

Alleviation:

Alleviations were applied as advised.



SCG-04: Explicitly returning a local variable

Type	Severity	Location
Gas Optimization	● Informational	SavingsConfig.sol L40, L119

Description:

The functions on the aforementioned line explicitly return a local variable which increases overall cost of gas.

Recommendation:

Since named return variables can be declared in the signature of a function, consider refactoring to remove the local variable declaration and explicit return statement in order to reduce the overall cost of gas.

Alleviation:

Alleviations were applied as advised.



SCG-05: Redundant Statements

Type	Severity	Location
Dead Code	● Informational	SavingsConfig.sol L150

Description:

The linked statements do not affect the functionality of the codebase and appear to be either leftovers from test code or older functionality.

Recommendation:

We advise that they are removed to better prepare the code for production environments.

Alleviation:

Alleviations were applied as advised.



SCG-06: `_validateRuleCreation` always reverts the transaction

Type	Severity	Location
Volatile Code	● Major	SavingsConfig.sol L96, L134

Description:

The call to function `_validateRuleCreation` on the aforementioned line always reverts the transaction because the `exists` property of an existing Rule is set to `true` and the `_validateRuleCreation` asserts that the `exists` property should be `false`.

Recommendation:

We advise to set the property of `exists` to `false` so that `_validateRuleCreation` call does not revert the transaction and it successfully modify the Rule.

```
ruleSet.exists = false;
```

Alleviation:

Alleviations were applied as advised.



SCG-07: `modifyRule` does not save the Rule

Type	Severity	Location
Volatile Code	● Major	SavingsConfig.sol L96

Description:

The function `modifyRule` does not save the new state of Rule in the storage making the transaction ineffecutal.

Recommendation:

We advise to add the call to `_saveRule` so that the update RuleSet is saved to storage of the contract.

```
_saveRule(ruleKey, ruleSet);
```

Alleviation:

Alleviations were applied as advised.



TRE-01: Unlocked Compiler Version

Type	Severity	Location
Language Specific	● Informational	Treasury.sol L1

Description:

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation:

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.6.2` the contract should contain the following line:

```
pragma solidity 0.6.2;
```

Alleviation:

Alleviations were applied as advised.



TRE-02: Redundant `require` statement

Type	Severity	Location
Gas Optimization	● Informational	Treasury.sol L26-L29

Description:

The `require` statement on the aforementioned line is redundant as the same check is performed by the `require` statement on L24 .

Recommendation:

We advise to remove the redundant `require` statement on the aforementioned line from the function.

Alleviation:

Alleviations were applied as advised.



TRE-03: Redundant require statement

Type	Severity	Location
Gas Optimization	● Informational	Treasury.sol L58-L61

Description:

The `require` statement on the aforementioned line is redundant as the same check is performed by the `require` statement on L56 .

Recommendation:

We advise to remove the redundant `require` statement on the aforementioned line from the function.

Alleviation:

Alleviations were applied as advised.



TRE-04: Comparison with a literal boolean value

Type	Severity	Location
Gas Optimization	● Informational	Treasury.sol L1

Description:

The contract has several occurrences of comparison with a literal boolean values of `true` or `false` that can be replaced replacing with compared expression itself to increase the legibility of the code.

Recommendation:

We advise to use the compared expression itself in place of expression's comparison with a boolean literal. The expression can be replaced as is when the expression is expected to evaluate to `true` and negation of expression can be used when the expression is expected to have `false` value.

Alleviation:

Alleviations were applied as advised.



TRE-05: `enum` type is declared but never used

Type	Severity	Location
Dead Code	● Informational	Treasury.sol L16

Description:

The `enum` type `DepositType` is never used in the code and can be removed from the contract.

Recommendation:

We advise to remove the `enum` type declared on the aforementioned line to increase the quality of the code.

Alleviation:

Alleviations were applied as advised.



XFI-01: Unlocked Compiler Version

Type	Severity	Location
Language Specific	● Informational	<u>XendFinanceIndividual_Yearn_V1.sol L1</u>

Description:

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation:

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.6.2` the contract should contain the following line:

```
pragma solidity 0.6.2;
```

Alleviation:

Alleviations were applied as advised.



XFI-02: Redundant Variable Initialization

Type	Severity	Location
Coding Style	● Informational	XendFinanceIndividual_Yearn_V1.sol L47

Description:

All variable types within Solidity are initialized to their default "empty" value, which is usually their zeroed out representation. Particularly:

- `uint / int` : All `uint` and `int` variable types are initialized at `0`
- `address` : All `address` types are initialized to `address(0)`
- `byte` : All `byte` types are initialized to their `byte(0)` representation
- `bool` : All `bool` types are initialized to `false`
- `ContractType` : All contract types (i.e. for a given `contract ERC20 {}` its contract type is `ERC20`) are initialized to their zeroed out address (i.e. for a given `contract ERC20 {}` its default value is `ERC20(address(0))`)
- `struct` : All `struct` types are initialized with all their members zeroed out according to this table

Recommendation:

We advise that the linked initialization statements are removed from the codebase to increase legibility.

Alleviation:

Alleviations were applied as advised.



XFI-03: Redundant storage variables

Type	Severity	Location
Gas Optimization	● Informational	<u>XendFinanceIndividual_Yearn_V1.sol L50-L51</u>

Description:

The storage variables of `TreasuryAddress` and `TokenAddress` are redundant as its values are also stored in storage variables of `treasury` and `daiToken`.

Recommendation:

We advise to remove the redundant storage variables from the aforementioned lines and storage variables of `treasury` and `daiToken` be used in place of them.

Alleviation:

Alleviations were applied as advised.



XFI-04: Comparison with a literal boolean value

Type	Severity	Location
Gas Optimization	● Informational	<u>XendFinanceIndividual_Yearn_V1.sol L1</u>

Description:

The contract has several occurrences of comparison with a literal boolean values of `true` or `false` that can be replaced replacing with compared expression itself to increase the legibility of the code.

Recommendation:

We advise to use the compared expression itself in place of expression's comparison with a boolean literal. The expression can be replaced as is when the expression is expected to evaluate to `true` and negation of expression can be used when the expression is expected to have `false` value.

Alleviation:

Alleviations were applied as advised.



XFI-05: Requisite Value of ERC-20 `transferFrom()` / `transfer()` Call

Type	Severity	Location
Logical Issue	● Minor	<u>XendFinanceIndividual_Yearn_V1.sol L86</u>

Description:

While the ERC-20 implementation does necessitate that the `transferFrom()` / `transfer()` function returns a `bool` variable yielding `true`, many token implementations do not return anything i.e. Tether (USDT) leading to unexpected halts in code execution.

Recommendation:

We advise that the `SafeERC20.sol` library is utilized by OpenZeppelin to ensure that the `transferFrom()` / `transfer()` function is safely invoked in all circumstances through the use of `safeTransferFrom()` / `safeTransfer()` functions of SafeERC20 library.

Alleviation:

Alleviations were partly applied as advised.



XFI-06: Inefficient local variable

Type	Severity	Location
Gas Optimization	● Informational	XendFinanceIndividual_Yearn_V1.sol L357

Description:

The aforementioned line declares a local variable which is used only once in the function and hence it is inefficient to declare and use it.

Recommendation:

We advise to use the initialization part of local variable declaration directly at the place where it is used.

```
_deposit(msg.sender);
```

Alleviation:

Alleviations were applied as advised.



XFI-07: Function does not return a value

Type	Severity	Location
Logical Issue	● Minor	<u>XendFinanceIndividual_Year_V1.sol L285</u>

Description:

The function on the aforementioned lines specifies a `uint256` as a return type in its signature yet no value is returned from the body of the function.

Recommendation:

We advise to remove return type of `uint256` from the signature of the function as the function does not need to return a value.

Alleviation:

Alleviations were applied as advised.



XFI-08: Unused local variables

Type	Severity	Location
Dead Code	● Informational	<u>XendFinanceIndividual_Year_V1.sol</u> L316, L317, L337, L338

Description:

The local variables on the aforementioned lines are declared to store the values from the returned tuple yet these local variables are never used within the code.

Recommendation:

We advise to remove the declaration of the local variables on the aforementioned lines as they are never used in the code.

Alleviation:

No alleviations.



XFI-09: Incorrect code

Type	Severity	Location
Logical Issue	● Critical	<u>XendFinanceIndividual_Year_V1.sol</u> L446-L455

Description:

The aforementioned lines add the deposit amounts to `record` the second time as the amounts are already added when the struct is initialized on `L36`.

Recommendation:

We advise to remove the aforementioned lines so that the amounts are not added twice to the `record` variable of struct type.

Alleviation:

Alleviations were applied as advised.



XFI-10: Incorrect value provided for struct property

Type	Severity	Location
Logical Issue	● Critical	<u>XendFinanceIndividual_Yearn_V1.sol L440</u>

Description:

The value of `underlyingAmountDeposited` is used for the initialization of struct property `underlyingTotalWithdrawn` which is incorrect as the property `underlyingTotalWithdrawn` should be initialized with `0` when the record is new.

Recommendation:

We advise to pass the literal `0` on the aforementioned line to correctly initialize the struct property of `underlyingTotalWithdrawn`.

```
ClientRecord memory record = ClientRecord(  
    true,  
    client,  
    underlyingAmountDeposited,  
    0,  
    derivativeAmountDeposited,  
    derivativeAmountDeposited,  
    0  
);
```

Alleviation:

Alleviations were applied as advised.



XFI-11: Incorrect code

Type	Severity	Location
Logical Issue	● Critical	<u>XendFinanceIndividual_Yearn_V1.sol</u> L486

Description:

The aforementioned line adds `derivativeAmountWithdrawn` to `record.derivativeTotalDeposits` which is incorrect as the function is called after withdrawal and not after deposit.

Recommendation:

We recommend to use the struct property of `derivativeTotalWithdrawn` to correctly update the record with the amount of derivative that is withdrawn.

```
record.derivativeTotalWithdrawn = record.derivativeTotalWithdrawn.add(  
    derivativeAmountWithdrawn  
);
```

Alleviation:

Alleviations were applied as advised.



XFI-12: Incorrect code

Type	Severity	Location
Logical Issue	● Critical	XendFinanceIndividual_Yearn_V1.sol L489

Description:

The aforementioned line adds `derivativeAmountWithdrawn` to `record.derivativeBalance` which is incorrect as the function is called after withdrawal and not after deposit.

Recommendation:

We recommend to subtract `derivativeAmountWithdrawn` from `record.derivativeBalance` as the derivative balance is decreased after withdrawal.

```
record.derivativeBalance = record.derivativeBalance.sub(  
    derivativeAmountWithdrawn  
);
```

Alleviation:

Alleviations were applied as advised.



XFI-13: Possibility of re-entrancy attack

Type	Severity	Location
Control Flow	● Medium	XendFinanceIndividual_Yearn_V1.sol L258

Description:

The `transfer` function call on the aforementioned has possibility of re-entrancy if the `transfer` function of the called contract is compromised. The re-entrancy will allow the draining of funds from the contract as the record are updated only after the `transfer` call.

Recommendation:

We advise to either move the `transfer` call at the end of function or make the function non-reentrant by inheriting from Openzeppelin's `ReentrancyGuard` contract and using the modifier `nonReentrant`.

```
https://github.com/OpenZeppelin/openzeppelin-contracts/blob/master/contracts/utils/ReentrancyGuard.sol
```

Alleviation:

Alleviations were applied as advised.



XFG-01: Unlocked Compiler Version

Type	Severity	Location
Language Specific	● Informational	<u>XendFinanceGroup_Year_V1.sol L3</u>

Description:

The contract has unlocked compiler version. An unlocked compiler version in the source code of the contract permits the user to compile it at or above a particular version. This, in turn, leads to differences in the generated bytecode between compilations due to differing compiler version numbers. This can lead to an ambiguity when debugging as compiler specific bugs may occur in the codebase that would be hard to identify over a span of multiple compiler versions rather than a specific one.

Recommendation:

We advise that the compiler version is instead locked at the lowest version possible that the contract can be compiled at. For example, for version `v0.6.2` the contract should contain the following line:

```
pragma solidity 0.6.2;
```

Alleviation:

Alleviations were applied as advised.



XFG-02: Redundant Variable Initialization

Type	Severity	Location
Coding Style	● Informational	XendFinanceGroup_Year_V1.sol L96

Description:

All variable types within Solidity are initialized to their default "empty" value, which is usually their zeroed out representation. Particularly:

- `uint / int` : All `uint` and `int` variable types are initialized at `0`
- `address` : All `address` types are initialized to `address(0)`
- `byte` : All `byte` types are initialized to their `byte(0)` representation
- `bool` : All `bool` types are initialized to `false`
- `ContractType` : All contract types (i.e. for a given `contract ERC20 {}` its contract type is `ERC20`) are initialized to their zeroed out address (i.e. for a given `contract ERC20 {}` its default value is `ERC20(address(0))`)
- `struct` : All `struct` types are initialized with all their members zeroed out according to this table

Recommendation:

We advise that the linked initialization statements are removed from the codebase to increase legibility.

Alleviation:

Alleviations were applied as advised.



XFG-03: Comparison with a literal boolean value

Type	Severity	Location
Gas Optimization	● Informational	<u>XendFinanceGroup_Yearn_V1.sol L1</u>

Description:

The contract has several occurrences of comparison with a literal boolean values of `true` or `false` that can be replaced replacing with compared expression itself to increase the legibility of the code.

Recommendation:

We advise to use the compared expression itself in place of expression's comparison with a boolean literal. The expression can be replaced as is when the expression is expected to evaluate to `true` and negation of expression can be used when the expression is expected to have `false` value.

Alleviation:

Alleviations were applied as advised.



XFG-04: Unnecessary local variables

Type	Severity	Location
Gas Optimization	● Informational	<u>XendFinanceGroup_Yearn_V1.sol L108-L113</u>

Description:

The local variables declarations on the aforementioned lines are unnecessary as the function call on L115 can directly utilize the properties of struct variable `group` for arguments.

Recommendation:

We advise to remove the redundant local variable declarations on the aforementioned lines.

Alleviation:

Alleviations were applied as advised.



XFG-05: Explicitly returning a local variable

Type	Severity	Location
Gas Optimization	 Informational	<u>XendFinanceGroup_Year_V1.sol</u> <u>L118</u> , <u>L134</u> , <u>L154</u> , <u>L294</u> , <u>L304</u> , <u>L343</u> , <u>L382</u> , <u>L409</u> , <u>L448</u> , <u>L716</u> , <u>L643</u>

Description:

The functions on the aforementioned line explicitly return a local variable which increases overall cost of gas.

Recommendation:

The functions on the aforementioned line explicitly return a local variable which increases overall cost of gas.

Alleviation:

No alleviations.



XFG-06: Unnecessary local variables

Type	Severity	Location
Gas Optimization	● Informational	<u>XendFinanceGroup_Year_V1.sol L255-L269</u>

Description:

The local variables on the aforementioned lines are unnecessary as the function call on L170 can directly utilize the properties of struct variable `cycleMember` as arguments.

Recommendation:

We advise to remove the local variables declarations on the aforementioned lines as they are redundant.

Alleviation:

Alleviations were applied as advised.



XFG-07: Function does not return a value

Type	Severity	Location
Dead Code	● Minor	<u>XendFinanceGroup_Year_V1.sol L465</u>

Description:

The function on the aforementioned line specifies `CycleMember` as a return type yet the body of the function does not return any value.

Recommendation:

We recommend to remove the `CycleMember` as return type from the signature of the function as the function does not need to return it.

Alleviation:

Alleviations were applied as advised.



XFG-08: Requisite Value of ERC-20 `transferFrom()` / `transfer()` Call

Type	Severity	Location
Logical Issue	● Minor	XendFinanceGroup_Year_V1.sol L1189

Description:

While the ERC-20 implementation does necessitate that the `transferFrom()` / `transfer()` function returns a `bool` variable yielding `true`, many token implementations do not return anything i.e. Tether (USDT) leading to unexpected halts in code execution.

Recommendation:

We advise that the `SafeERC20.sol` library is utilized by OpenZeppelin to ensure that the `transferFrom()` / `transfer()` function is safely invoked in all circumstances through the use of `safeTransferFrom()` / `safeTransfer()` functions of SafeERC20 library.

Alleviation:

Alleviations were partly applied as advised.



XFG-09: Inefficient code

Type	Severity	Location
Gas Optimization	● Informational	XendFinanceGroup_Year_V1.sol L795-L796

Description:

The `if-else` block on the aforementioned lines is inefficient as it explicitly return boolean literal depending the evaluation of the predicate.

Recommendation:

We advise to directly return the predicate expression for the efficient implementation of the code.

```
return currentTimeStamp >= cycleEndTimeStamp;
```

Alleviation:

Alleviations were applied as advised.



XFG-10: Unsafe subtraction

Type	Severity	Location
Mathematical Operations	● Minor	XendFinanceGroup_Yearn_V1.sol L763

Description:

The aforementioned line performs unsafe subtraction which can be result in underflow of integer value.

Recommendation:

We advise to use `sub` function from `SafeMath` library to perform subtraction so that the transaction is reverted if underflow happens.

```
uint256 derivativeBalanceToWithdraw = cycleFinancial.derivativeBalance.sub(  
    cycleFinancial.derivativeBalanceClaimedBeforeMaturity  
);
```

Alleviation:

Alleviations were applied as advised.



XFG-11: Unnecessary parenthesis around expressions

Type	Severity	Location
Language Specific	● Informational	<u>XendFinanceGroup_Year_V1.sol L819, L825</u>

Description:

The expressions on the aforementioned lines have unnecessary parenthesis around them.

Recommendation:

We advise to remove the parenthesis around expressions on the aforementioned lines to increase the legibility of the codebase.

Alleviation:

Alleviations were applied as advised.



XFG-12: Confusing modifier name

Type	Severity	Location
Inconsistency	● Informational	XendFinanceGroup_Year_V1.sol L816

Description:

The modifier `onlyCycleCreator` 's name suggests that it only allows the creator of cycle to execute function guarded by this modifier yet the implementation of the modifier suggests that it also allows the cycle member to execute function guarded by the modifier.

Recommendation:

We advise to change the name of modifier to `onlyCycleCreatorOrMember` to suggest that it also allows cycle member in addition to cycle creator to execute function guarded by the modifier.

Alleviation:

Alleviations were applied as advised.



XFG-13: Unused local variables

Type	Severity	Location
Gas Optimization	 Informational	<u>XendFinanceGroup_Year_V1.sol L1276, L1277, L1255, L1256, L1301, L1302</u>

Description:

The local variables on the aforementioned lines are declared to store the values from the returned tuple yet these local variables are never used within the code.

Recommendation:

We advise to remove the declaration of the local variables on the aforementioned lines as they are never used in the code.

Alleviation:

No alleviations.



XFG-14: Unsafe subtraction

Type	Severity	Location
Mathematical Operations	● Minor	XendFinanceGroup_Yearn_V1.sol L951

Description:

The aforementioned line performs unsafe subtraction which can be result in underflow of integer value.

Recommendation:

We advise to use `sub` function from `SafeMath` library to perform subtraction so that the transaction is reverted if underflow happens.

```
underlyingAmountThatMemberDepositIsWorth =  
underlyingAmountThatMemberDepositIsWorth.sub(totalDeductible);
```

Alleviation:

Alleviations were applied as advised.



XFG-15: Requisite Value of ERC-20 `transferFrom()` / `transfer()` Call

Type	Severity	Location
Logical Issue	● Minor	XendFinanceGroup_Yearn_V1.sol L977

Description:

While the ERC-20 implementation does necessitate that the `transferFrom()` / `transfer()` function returns a `bool` variable yielding `true`, many token implementations do not return anything i.e. Tether (USDT) leading to unexpected halts in code execution.

Recommendation:

We advise that the `SafeERC20.sol` library is utilized by OpenZeppelin to ensure that the `transferFrom()` / `transfer()` function is safely invoked in all circumstances through the use of `safeTransferFrom()` / `safeTransfer()` functions of SafeERC20 library.

Alleviation:

Alleviations were applied as advised.



XFG-16: Ineffectual code

Type	Severity	Location
Gas Optimization	● Informational	<u>XendFinanceGroup_Yearn_V1.sol L976</u>

Description:

The `if` statement on the aforementioned line will never evaluate to `false` as the same condition is checked in a `require` statement on L973 and the control flow reaches to `if` statement only after the condition in `require` statement evaluates to `true`.

Recommendation:

We advise to remove the `if` condition on the aforementioned line as it is redundant.

Alleviation:

Alleviations were applied as advised.



XFG-17: Anyone can make a particular depositor join cycle

Type	Severity	Location
Volatile Code	● Major	XendFinanceGroup_Yearn_V1.sol L1713

Description:

The function `joinCycleDelegate` on the aforementioned line allows anyone to call it and make `depositorAddress` join the cycle if it has approved sufficient tokens amount to the contract.

Recommendation:

We advise to remove this function as only the depositing address should be allowed to call the function.

Alleviation:

Alleviations were applied as advised.



XFG-18: Possibility of reentrancy attack

Type	Severity	Location
Control Flow	● Medium	<u>XendFinanceGroup_Yearn_V1.sol L977</u>

Description:

The `transfer` function call on the aforementioned line will allow reentrancy into the contract if the `transfer` function of the called contract is compromised leading draining of funds as the `cycle`, `cycleMember` and `cycleFinancials` are updated after the `transfer` call.

Recommendation:

We advise to move the `transfer` call at the end of function execution so reentrancy would not allow draining of funds or alternatively the function can be non-reentrant by inheriting the contract from Openzeppelin's `ReentrancyGuard` contract and using the `nonReentrant` modifier on the function.

```
https://github.com/OpenZeppelin/openzeppelin-contracts/blob/master/contracts/utils/ReentrancyGuard.sol
```

Alleviation:

Alleviations were applied as advised.



XFG-19: Possibility of reentrancy attack

Type	Severity	Location
Control Flow	● Medium	XendFinanceGroup_Yearn_V1.sol L1150

Description:

The `transfer` call on the aforementioned line will allow reentrancy into the contract if the `transfer` function of the called contract is compromised. This will lead draining of funds as the cycle related storage variables are updated after the call to `transfer`.

Recommendation:

We advise either to move `transfer` call at the end of function or make the function non-Reentrant by inheriting the contract from Openzeppelin's `ReentrancyGuard` contract and use modifier `nonReentrant` with the function.

```
https://github.com/OpenZeppelin/openzeppelin-contracts/blob/master/contracts/utils/ReentrancyGuard.sol
```

Alleviation:

Alleviations were applied as advised.

Appendix

Finding Categories

Gas Optimization

Gas Optimization findings refer to exhibits that do not affect the functionality of the code but generate different, more optimal EVM opcodes resulting in a reduction on the total gas cost of a transaction.

Mathematical Operations

Mathematical Operation exhibits entail findings that relate to mishandling of math formulas, such as overflows, incorrect operations etc.

Logical Issue

Logical Issue findings are exhibits that detail a fault in the logic of the linked code, such as an incorrect notion on how `block.timestamp` works.

Control Flow

Control Flow findings concern the access control imposed on functions, such as owner-only functions being invoke-able by anyone under certain circumstances.

Volatile Code

Volatile Code findings refer to segments of code that behave unexpectedly on certain edge cases that may result in a vulnerability.

Data Flow

Data Flow findings describe faults in the way data is handled at rest and in memory, such as the result of a `struct` assignment operation affecting an in-memory `struct` rather than an in-storage one.

Language Specific

Language Specific findings are issues that would only arise within Solidity, i.e. incorrect usage of `private` or `delete`.

Coding Style

Coding Style findings usually do not affect the generated byte-code and comment on how to make the codebase more legible and as a result easily maintainable.

Inconsistency

Inconsistency findings refer to functions that should seemingly behave similarly yet contain different code, such as a `constructor` assignment imposing different `require` statements on the input variables than a setter function.

Magic Numbers

Magic Number findings refer to numeric literals that are expressed in the codebase in their raw format and should otherwise be specified as `constant` contract variables aiding in their legibility and maintainability.

Compiler Error

Compiler Error findings refer to an error in the structure of the code that renders it impossible to compile using the specified version of the project.

Dead Code

Code that otherwise does not affect the functionality of the codebase and can be safely omitted.