# Abstract

This White Paper outlines the data structure that HighStone applies in holding Asset Maintenance data records. These definitions include the class of Defect or Damage that can be recorded against Asset Records, Classification of a recorded Defect in terms of criticality and risk, application of required Correction or Fix Times against a Defect Classification.

Routine Maintenance checks or inspections / surveys are a common regime in industry and the recording of Asset Condition may also be recorded and managed through the same data recording mechanisms. This enables HighStone to record 'OK' or 'Satisfactory' status against Asset Records as a positive record of assessment, and not rely on a default status of satisfactory unless a defect has been recorded.

HighStone is designed to build up and hold a complete history of the maintenance and checking of all assets held within the contract database. Additional maintenance records can be created to monitor specific aspects of an asset type and provide a complete history log from within the same data framework.

This document is intended as a technical briefing on HighStone database definitions and usage - it is not written as a User Manual for the day to day operation of HighStone.

## Document Summary

| Title of Document | HighStone Asset Management Definitions (Defects) |
| --- | --- |
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## Maintenance Asset Defect Definitions

Asset Defect definitions are held in the central data table definition [tblMasterDefects].  The basic definition holds the following values for each Defect type definition.

| | |
|---|---|
| Internal Identifier | Integer identifier for the record.  This value is used by HighStone in all data table cross-references.  The value is cast automatically when new definitions are added. |
| Code | A short, unique Code or Tag identification for the record. |
| Description | A full text description for the record. |
| Specialist | A Boolean setting that can be used to identifying repairs requiring specialist attention. |
| Inspection | A Boolean setting that identifies those Defects that may be recorded as part of routine maintenance surveys and inspections. |
| Associated Assets | Identifies those Assets that may be recorded with the Defect Record.  Many Defect records can be applied to a number of different Asset Definitions. |
| Internal GUID | HighStone also holds a GUID identifier for each Defect Class record.  These values are used in Mobile Applications and when reporting spans across more than one Contract Database - where common GUID values can identify similar definitions across multiple databases. |

The above definition identifies a handful of broad Defect Types that are relevant to each Asset Type.

Each Defect Record is broken down in to potential sub-classifications through the child data table [tblMasterDefectItems].   This definition allows any number of specific defect types to be created within each Master Defect class.  The table holds the following definitions.

| | |
|---|---|
| Internal Identifier | Integer identifier for the record.  This value is used by HighStone in all data table cross-references.  The value is cast automatically when new definitions are added. |
| Parent Defect Identifier | Link to the parent record in [tblMasterDefects]. |
| Code | A short, unique Code or Tag identification for the record. |
| Description | A full text description for the record. |
| Sort | A numeric count that defines the order in which entries should be displayed (this overrides an alphabetic sort based on the record Code value). |
| Attribute 1 | Optional attribute value. |
| Attribute 2 | Optional attribute value. |

| Internal GUID | HighStone also holds a GUID identifier for each Defect Sub-class record.  These values are used in Mobile Applications and when reporting spans across more than one Contract Database - where common GUID values can identify similar definitions across multiple databases. |
|---|---|

The two Attribute entries are optional definitions that allow the holding of characteristic values for the defect recorded.  This may be used to hold a scope or size of recorded defect - such as a length dimension, a count or area affected.

## Defect Severity or Priority

When Defects are logged it is usual to record an assessment on the severity or urgency of the required repair.  These definitions are held in data table [tblDefectPrority].  The classifications used to prioritise asset defects varies between different industries and organisations and the HighStone definitions are flexible and can be cast as required.

The definitions for [tblDefectPriority] are:

| Internal Identifier | Integer identifier for the record.  This value is used by HighStone in all data table cross-references.  The value must be defined when new definitions are added. |
|---|---|
| Code | A short, unique Code or Tag identification for the record. |
| Description | A full text description for the record. |
| Sort | A numeric count that defines the order in which entries should be displayed (this overrides an alphabetic sort based on the record Code value). |
| Is Condition | This Boolean value is used to identify those Defect Priority classifications that are 'Condition' assessments rather than Defect Priority (this is discussed in more detail below). |
| Internal GUID | HighStone also holds a GUID identifier for each Defect record.  These values are used in Mobile Applications and when reporting spans across more than one Contract Database - where common GUID values can identify similar definitions across multiple databases. |

Whilst HighStone definitions are flexible and can be set as required, the following is a suggested classification that will suit many applications.  Captions may be adjusted to suit, or new definitions made in the definition table.

| Code | Description | Application |
|---|---|---|
| IMM | Immediate Repair Effected | A Defect has been noted and a repair was actioned at the time of recording. |
| Cat 1 | Category 1 | Urgent or dangerous defect that requires immediate attention. |
| Cat 2.1 | Category 2 - Priority | The defect should be addressed as part of current work schedules. |
| Cat 2.2 | Category 2 - Routine | The defect should be noted and included in the next round of maintenance works |

| | | packages. |
|---|---|---|
| Cat 2.3 | Category 2 - Notification | The defect should be noted and included in medium term scheduling of maintenance works packages. |
| None | No Action Required | A comment or defect is noted, but no action is appropriate. |

## Required Defect Correction Times

On many contracts the damage and defects recorded against assets need to be addressed and fixed within defined time periods.  The HighStone definitions include entries for setting these target times so that they may be used in scheduling maintenance works activities and reporting.

HighStone supports three classifications of fix and repair on assets - not all three classifications may be required in all implementations and they can be applied as required.

| Repair Class | Usage |
|---|---|
| Make Safe | Applicable where a situation is dangerous and requires protective measures to be put in place as a priority.  For example: disconnect live power supplies, cover an open void or hole. |
| Temporary Repair | Applicable where a full repair cannot be effected immediately and an interim repair is required.  For example: back-filling of voids, temporary patching of damaged surfaces, provision of emergency lighting. |
| Permanent Repair | A full and permanent repair of a defect.  This may involve repair, or even replacement of the asset. |

HighStone allows a target fix time to be applied to each of these three stages of an asset repair.

HighStone may be used to apply required defect fix times in one of two ways:

1. The target fix times are applied based on the Defect Priority assessment *only*.  In this instance all classes of Defect are run under the same fix time definition.  This is the easiest means of applying target times, however it is in-flexible as it cannot address variations in target times relating to the *type* of defect being considered.

2. The target fix times are applied based on both the Defect Priority assessment *and* the Class of Defect being recorded.   This is the more usual configuration as it allows for variations in repair times based on asset type - such as electrical equipment, geotechnical structures, safety barriers.

### Fix Times Based on Defect Priority Only

| | |
|---|---|
| Make Safe | If a Make Safe activity is appropriate for the recorded Defect Priority this is flagged as such on the definition record in [tblDefectPrioprity].

The required Make Safe time is held internally in HighStone coding - typically set to 24 hours. |
| Temporary Repair | If a Temporary Repair activity is appropriate for the recorded Defect Priority this is flagged as such on the definition record in [tblDefectPrioprity].

The required Temporary Repair time is held internally in HighStone coding - typically set to 7 days. |
| Permanent Repair | The Permanent Repair fix time for the recorded Defect Priority this is defined as an entry on the definition record in [tblDefectPrioprity].

The entry may be set as a number of minutes, days, months or years - being applied from the date the defect record was recorded. |

## Fix Times Based on Defect Priority and Defect Class

This is the more common scenario for managing Defect Repair target times and the required definitions are held as entries against each Master Defect record declared in table [tblMasterDefects].  Note that the definitions are held at this level, and not the more detailed sub-classifications held under [tblMasterDefectItems].

Each record may hold target definitions for each of the standard classifications of Defect Priority listed above.

| | |
|---|---|
| Make Safe | Defined if category is valid |
| Temporary Repair | Defined if category is valid |
| Cat 1 Repair | Defined for urgent / dangerous Defects. |
| Cat 2.1 Repair | Defined for Priority maintenance repairs. |
| Cat 2.2 Repair | Defined for Priority routine repairs. |
| Cat 2.3 Repair | Defined for Notification maintenance repairs. |

## Definition of Target Fix Times

The method of setting target fix times in the database definitions tables is the same across all definitions.  Target times may be given in minutes, days, months or years, with the number of units set followed by a classification letter of N, D, M or Y.  As follows:

| Interval | Examples | Application |
|---|---|---|
| Minutes | 1440N | Period is measured in minutes.  This entry will be applied to both the Date *and* the Time of the recorded defect - and therefore can be used to apply target times based on a strict 24 hour period.<br><br>An entry of 1440N is equivalent to 24 hours. |
| Days | 7D | Period is measured in days.  When an interval in Days is used the time of day is ignored and the target date is determined through a sequential day count.<br><br>An entry of 7D is equivalent to one calendar week. |
| Months | 6M | Period is measured in months.  The time of day for the original recording of the defect is ignored. |
| Years | 1Y | Period is measured in years.  The time of day for the original recording of the defect is ignored. |

## Defect Corrective Treatment

The required treatment to correct a defect found on an asset can be specified and recorded as part of the inspection entry. The most common corrective treatments can be listed in table [tblDefectTreats] and HighStone will prompt with the relevant list of items.

Amongst the available treatment codes an entry for 'Other Treatment' should be included to ensure a valid entry can be made by the user.

[tblDefectTreats] includes the following definitions.

| | |
|---|---|
| Internal Identifier | Integer identifier for the record. This value is used by HighStone in all data table cross-references.<br><br>The value must be cast manually when new records are added. An entry of zero indicates a generic 'Other Treatment' record. |
| Code | A short, unique Code or Tag identification for the record. |
| Description | A full text description for the record. |
| Sort | A numeric count that defines the order in which entries should be displayed (this overrides an alphabetic sort based on the record Code value). |
| Parent Defects | A list of parent Master Defect codes for which the current Defect Treatment record applies. HighStone uses this definition to link the current record to parent entries. |
| Internal GUID | HighStone also holds a GUID identifier for each Defect Sub-class record. These values are used in Mobile Applications and when reporting spans across more than one Contract Database - where common GUID values can identify similar definitions across multiple databases. |

# Asset Condition Surveys

## Condition Survey Definitions

Asset Condition Surveys provide a different mechanism for undertaking Asset Surveys and recording the condition of managed assets.  Under this regime the survey is not looking for specific damage, deterioration or defects, but is making an assessment of the asset condition at the time of the survey or inspection.  Two factors characterise this style of inspection:

- Conditions of 'Satisfactory' [that is, No Defect noted] are explicitly recorded as part of the inspection regime.

- Conditions associated with deterioration of the asset are classified on the basis of anticipated residual life - time left before asset repair / replacement is required.

Where a survey or inspection is also looking out for immediate or dangerous conditions, then it may be appropriate to record an Asset Defect record in line with the main regime outlined above.  The precise management of Asset Inspection and Assessment will be defined by the client's own process and quality requirements documentation.

Condition surveys typically assess the Asset in the following terms, and each of these terms needs to be declared as a definition record in the Defect Priority table [tblDefectPriority].  These records are flagged as 'Condition' class entries to differentiate them from the classification used above.

| Code | Description | Usage |
|---|---|---|
| As New | As New | Applied for new construction, recently replaced and assets where the condition is of immaculate standard. |
| Satis | Satisfactory | Condition is appropriate to current use and no significant deterioration is anticipated before the next inspection round. |
| Near EOL | Near End of Live | Condition is showing signs of routine wear and tear, and repair or replacement should be considered in forthcoming maintenance regimes. |
| Fail | Failed / Not fit for purpose | Asset condition is severely compromised and immediate attention for repair / replacement is required.<br><br>It may be appropriate to raise a more detailed Defect Record in this instance. |

### Other Definition Requirements for Condition Inspections

In order to support the recording of Condition Inspections in HighStone, in addition to the classifications listed above for [tblDefectPrority] the following definitions must also be created.

| Data Table | Required Record Entries |
|---|---|
| [tblMasterDefects] | A record entry for 'Condition' (often termed 'Long Stop' - or 'LS') must be declared in this table. This entry is used by HighStone as the main defect class in defect record entry.<br><br>Generally this condition assessment is applied to all asset types, hence an entry of '*' against affected asset types is appropriate to define this 'select all' option.<br><br>HighStone reporting may fail a reference to this record is not set against all entered Defect record entries. |
| [tblMasterDefectItems] | A child entry of 'Condition Status' *must* be defined in this data table and linked to the parent record above. This is often cast with the definition code of 'LGST'.<br><br>HighStone reporting may fail if this record is not defined and set against all entered Defect record entries. |

## Asset Inspection and Survey Intervals

Details to be provided.

# Cyclic Routine Maintenance

Routine Maintenance activities can also be recorded through the Asset Defects records system in HighStone.  Whilst HighStone uses the same data tables for recording this maintenance information as that used for traditional asset defects, the records are not representative of 'defects' in the same sense.

There are numerous examples on the type of routine maintenance that can be recorded:

- Grass cutting and other horticulture activities

- Drainage (gully) cleaning

- Sign cleaning

- Safety barrier tensioning

- Electrical lamp bulb changing

In all cases the required configuration is similar and can be applied as follows:

| | Data Table | Required Configuration |
|---|---|---|
| 1 | [tblMasterDefects] | Identify a Master Defect Record entry that can be used to carry the Routine Maintenance activity and is relevant to the target Asset Type(s). |
| | | If necessary, add a new master defect record, and associate it the required Asset Type(s). |
| 2 | [tblMasterDefectItems] | Add an individual definition record for the Cyclic Maintenance Activity to this table, and link it to the parent record identified above. |
| | | It is recommended that a consistent naming convention is applied so as to identify these cyclic maintenance records readily. |
| | | If necessary, an attribute value may be associated with the entry to record a value from the field (e.g. number of bags of litter collected, level of debris found in drains). |

HighStone Survey / Inspection facilities can then record details of Cyclic Maintenance within the contract database - listing records for Asset Defects, Asset Condition Assessments and Cyclic Maintenance Activities from the same data definition source.

## Asset Defects Records

All assets defects records are held in the single database table [tblDefects] - this includes records raised to record Damage / Defects, Condition Assessments and Cyclic Maintenance activities.

HighStone anticipates that all Defect records are linked to a specific Asset Record held on the system. However this link is not mandatory as it is possible to record Defects records without direct reference to a specific asset record. Therefore each defined Defect record can include location details and it is general policy to ensure that these values are completed and held in the data table - even where the details can be established through the link to an asset record.

There are other legacy issues in the way the data is held in this table and specific details are noted below. The data table is quite large as each record holds 60 data values. Not all values are used in all scenarios - but it is expected that as full a data set will be completed and held at all times.

| Data Values | Usage and Comment |
|---|---|
| Identifier | Record identifier that is used internally and is shown to the user as the record identifier. |
| | The identifier value is set automatically. |
| Master Defect Identifier | This defines the defect class held in [tblMasterDefects]. |
| | This field value *must* be set in all instances. Some reporting may fail if this value is not set. |
| Master Defect Item Identifier | This defines the defect sub-class item held in [tblMasterDefectItems]. |
| | This field value should be set when known. |
| Chart Section Identifier | Link to the parent Chart Section under which the defect record falls. Most highways implementations of HighStone require this field to be set. |
| Chainage (Offset Location) | Defines the position within the parent Chart Section where the defect is located. Most highways implementations of HighStone require this field to be set. |
| | Older implementations expect a single point value to be set in the target field (all defects are considered 'single point' entities). Asset Condition inspections introduced the concept of Start and Finish location points (conditions along linear assets) and these values are set. |
| | It is expected that *both* the Start and Finish values are set - *and* the single point value is set {usually as an average of the two other values}. Some reporting may fail if this requirement is not followed. |
| Location Detail | A text notation of the location of the Defect |
| Cross Reference on Carriageway | This entry defines to position across a highway carriageway where the defect is located. |
| | Record definition carries both an identifier link to the cross section lookup - and the code entry for the target location entry. It is recommended both values are cast - the numeric identifier is the prime reference and *must* be cast. |

| | |
|---|---|
| Parent Asset Record | This entry defines the parent asset type that the defect record applies to. |
| | Record definition carries both an identifier link to the parent asset type - and the code entry for the target asset type. It is recommended both values are cast - the numeric identifier is the prime reference and *must* be cast. |
| | If the specific parent asset record is known (this is expected to be defined but is not mandatory) then the parent asset identifier is set. |
| Defect Attribute Value | The parameters hold optional values defining the recorded defect, for example length, area, number. |
| Date Raised | Date / time the Defect record is first raised - which is also the date / time required fix times are deemed to start from. |
| Defect Priority | Link to the Defect Priority / Severity definition held in [tblDefectPriority]. |
| Corrective Action | Link to the suggested corrective action held in [tblDefectTreats]. |
| Make Safe, Temporary Repair, Permanent Repair | Boolean values allow the specification as to which of these three repair classifications actually apply to the entered record. |
| | Each repair classification may be cancelled independently. |
| Required Make Safe, Temporary Repair, Permanent Repair Completion Date / Time | Specified required completion date / times for each of the repair classifications. |
| Works Order for Make Safe, Temporary Repair, Permanent Repair | Works Orders raised or allocated to each of the repair classifications can be defined through references to the identifiers in the Works Orders data table. |
| Date / Time of Completion of Make Safe, Temporary Repair, Permanent Repair | Records the actual completion date / time for each of the repair classifications. |
| Survey Section Identifier | Provides the link between the Defect Record and the Survey on which it was raised. |
| | This field is mandatory and links to the Chart Section reference *within* the parent survey record [tblSectionSurvey]. This link provides a route to establish the user who raised the defect. |
| | A valid survey entry *must* be raised in HighStone to hold references to all raised Defects records. |
| Cancelled Defect | If a Defect is cancelled - then this Boolean value is set to true. |

| | |
|---|---|
| Grid Reference Location | Fields allow the holding of GPS grid reference values as Easting and Northing. |
| | Points may be held for both the start and end of the recorded defect - for single point defects it is recommended that both start and finish references are cast to the same value. |
| Satellite Location | Fields allow the holding of GPS satellite reference values as Longitude and Latitude (double precision decimal values). |
| | Points may be held for both the start and end of the recorded defect - for single point defects it is recommended that both start and finish references are cast to the same value. |
| Record Edit Date / Time | HighStone casts this date stamp whenever the record is updated (by HighStone functions only).  Changes to this value are used as a trigger to refresh Defects records in external applications - such as GIS applications. |
| | Other applications should cast this date / time stamp when changes are made to the Defects record so that external applications are updated with the new values. |
| Internal GUID | HighStone also holds a GUID identifier for each Defect record raised.  These values are used in Mobile Applications when new records are raised and new record Identifiers are not available.  All Defects records are given a new and unique GUID code. |