



**Corporate Services for the Natural Resource  
Sector**

**Information Management Branch**

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## **NRS Physical Data Modeling Standards**

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## 1. Version Control

Document Version	Date	Author(s)	Change Reference
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2.3	20150505	Jeff Card	More DA comments, Additions from Other Gov't agencies, Document reformatted and reordered
2.4	20150820	Jeff Card	Changed document name to NRS Physical Data Modeling Standards, changed spelling of 'modelling' to 'modeling'
2.5	20161128	Jeff Card	Changes to reflect recent standards changes; Flashback, Column Order, GUID, job scheduling, Oracle Locator references; feedback from DA and DBA
2.5	20161201	Jeff Card	Further DA feedback on column order, GUID

## 2. Preface

This document is intended for NRS IMB technical staff and development teams working on behalf of the NRS to deliver database entities to the sector. The physical data model standards are designed to guide database development in the NRS Oracle Database environment and inform the physical modeling exercise within Sparx Enterprise Architect.

*The physical data modeling effort is only to proceed following the approval of the logical data model from the NRS [IMB Data Architecture](#) team.* NRS logical data modeling standards can be found [here](#).

## 3. Contacts

All inquiries should be directed to the Database Administrator (DBA) assigned to the project or contact the NRS IMB Database Administration group mailbox at [CSNRDBA@gov.bc.ca](mailto:CSNRDBA@gov.bc.ca)

## 4. Scope and Exclusions

The scope of this document covers all database physical models delivered or maintained by the sector and largely pertains to the database architecture for the Operational Spatial Temporal Database being delivered as part of the NRS ISSS Strategy. Where there are conflicts with previous or other existing documented standards, please consult with the Business Portfolio Manager assigned to your project. Developers are encouraged to provide feedback on these standards, and routinely check for updates to the NRS Physical Modeling Standards prior to commencing their project.

This document outlines several physical modeling standards to inform database and application development within the NRS. Note: the standards in this document are in reference to the Oracle database release 12C or greater.

## 5. Character Set

- All NRS Oracle Databases are created using the AL32UTF8 (Unicode) Character Set and the AL16UTF16 National Character Set

## 6. Date and Time Zone

- Database servers and databases will be configured to use the UTC time zone with no offset
  - The purpose of this configuration is to be agnostic to daylight savings time
  - Application developers must code accordingly and are discouraged from using Javascript date/time calculations
- DATE datatype should be used unless true timestamp (ie. sub-second granularity) is required.
  - In cases where sub second granularity is required **TIMESTAMP** is used
  - Columns using **DATE** are be suffixed with **\_DATE**
  - Columns using **TIMESTAMP** are suffixed with **\_TIMESTAMP**
- Effective/Expiry Date vs Valid Time Modeling
  - Depends on business requirements around data visibility
    - valid time modeling obscures historical data from the ‘current’ view but allows queries to be executed using “PERIOD FOR” clause
    - effective/expiry date applies if the user requires current visibility into historical events
    - see entity naming standards
  - In some cases both scenarios apply

## 7. Account Naming

- Application Schemas:
  - used to host business and/or application data
  - application schemas are prefixed with **APP\_<application\_acronym>**
  - application schema names do not include references to organization or business unit names
  - application schema names should reference business themes (e.g. **APP\_WATER**)
- Proxy Accounts:
  - used to connect application servers to database servers
  - account name prefixed with **PROXY\_<type>\_<application\_name>**
    - e.g. **PROXY\_GEO\_CWMS** references a proxy account for Common Web Mapping originating from Geoserver
    - <type> includes (but not limited to):

- JAVA – Java Application or Service
    - FME – FME Application or Service
    - GEO – Geoserver Application or Service
    - RPT – Jasper Reports Application or Service
    - ORB – Orbeon Application or Service
    - SCR – Scripting Call to a Proxy Account
    - LFR – Liferay Application or Service
  - proxy accounts are configured from a single known source (i.e. OFM)
  - proxy accounts are not permitted to own database objects aside from private synonyms referencing objects in other schemas
    - NOTE : this exception was made to obscure the schema name in user interfaces such as Geoserver
  - unless an exemption is issued, access to data for proxy accounts is done via RBAC (role based access control) – see Security Standards
- Named user accounts:
    - explicitly for use by a person/individual
    - must match IDIR or BCEID userid
    - are subject to password strength and expiry policies
  - Distributed database accounts:
    - for use with Oracle database links to interconnect two or more databases
    - inbound database link access accounts –  
DBLINK\_<source>\_<application\_name>
      - e.g. DBLINK\_BCGW\_TANTALIS

## 8. Datatypes

- Strings and Characters:
  - strings represented using the VARCHAR2 datatype
  - string lengths must be appropriate for the described attribute
  - when using VARCHAR2 specify CHAR semantics (default is BYTE)
    - e.g. NAME VARCHAR2 (25 CHAR)
- Numbers and Integers:
  - represented using the NUMBER(<length>,<scale>) datatype
- Dates and Timestamps:
  - represented using the DATE and TIMESTAMP datatypes

- DATE datatype should be used unless true timestamp (i.e. sub-second granularity) is required
- Boolean values (true/false):
  - represented using the VARCHAR2(1) datatype combined with a “Y/N” check constraint
  - in cases where a business rule allows NULL in a Boolean column consult with the IMB Data Architecture group to obtain an exception
- Spatial features:
  - represented using the SDO\_GEOMETRY datatype
  - contains point, line or polygon data
  - always uses Oracle SRID 3005
- Unstructured content:
  - represented using the BLOB or CLOB datatype
  - used to store non-relational data in the database such as documents and images
  - **DBA approval is required before implementing any unstructured data and will be reviewed on a case by case basis**
  - file size thresholds and data retention limits will apply to unstructured content being stored in the database
  - unstructured content stored in BLOB’s and/or CLOB’s may require a separate table with a 1:1 relationship to the business table
- GUID’s (Globally Unique Identifiers):
  - represented using the RAW(16) datatype
  - column to be named with \_GUID suffix
  - GUID’s may be used as a primary key and is the standard for surrogate keys
  - if used as a primary key, there must be another unique business constraint (unique business key)
  - records using GUID as the primary key must transfer the GUID as part of any data replication processes (if using FME, RAW support introduced in FME 2015)
  - GUID should be generated as close to the source of record generation as technically possible
  - GUID must be compliant with RFC 4122 standard UID format
- URI’s (Uniform Resource Identifiers):
  - represented using the VARCHAR2(2000) datatype
  - column to be named with \_URI suffix
  - includes URI and URL



- note: use discretion when storing URI/URL in the database such that schemas in the non-production environment can be refreshed from production

## 9. Restricted Datatypes and Objects

- Use of the following datatypes is not permitted without DBA approval. It is recommended to seek approval prior to generating physical DDL
  - BYTE
  - RAW and LONG RAW (exception: columns containing GUID are to be stored as RAW(16))
  - CHAR, NCHAR and NVARCHAR2
  - ST\_GEOMETRY
  - BINARY FLOAT and BINARY\_DOUBLE
  - NCLOB and BFILE
  - ROWID, UROWID and ROWNUM
  - PUBLIC SYNONYMS
  - DIRECTORIES

## 10. Physical Naming and Describing

- General Naming Standards:
  - names in the physical model are referenced as singular (not plural)
  - names in the physical model are as descriptive as possible (within prescribed character length limits)
  - names in the physical model are strictly alphanumeric (and do not include punctuation) and must begin with a letter
  - names in the physical model are not case sensitive
  - names in the physical model do not duplicate the name of existing database objects and do not use Oracle Reserved Words (see below)
  - underscore “\_” is used as a separator for nouns/adjectives used in object naming
  - the use of abbreviations in object names is permitted (to keep within the 25 character limit) in some cases provided they are widely recognized or documented within NRS standards (e.g. MANAGEMENT=MGT)
    - See Appendix A – Standard Abbreviations
- Object Naming:
  - The following naming standards are applicable to all database objects:

Type	Prefix	Suffix
Primary Key	<table_name>	_PK
Foreign Key	<child_alias>_<parent_alias>	_FK

Unique Constraint	<table_name>	_UK
B-Tree Index	<table_alias>_<column_alias>	_IDX
R-Tree (Domain) Index	<table_alias>_<column_alias>	_DDX
Bitmap Index	<table_alias>_<column_alias>	_BDX
Function Based Index	<table_alias>_<column_alias>_<function>	_FDX
Sequences	<table_name>	_SEQ
Synonyms	<table_name>	_SYN
Triggers	<table_name>_<b/a> <i/u/d>	_TRG
Packages	<package_name>	_PKG
Views	<view_name>	_VW
Spatial Views	<spatial_view_name>	_SVW
Materialized Views	<mview_name>	_MVW
Shadow Table*	<source_name>	_SDW
Database Link	<target_db>_<target_user>	_LNK

- <table\_name> may be abbreviated, if necessary
- <column\_name> may be abbreviated, if necessary
- <child\_alias> and <parent\_alias>
  - aliases to be tagged within Enterprise Architect Project
  - remove vowels and consonants and/or abbreviate where it makes sense to produce a legible alias
- <b/a> = before or after <i/u/d> = insert, update or delete
- shadow tables are full or partial representations of a “common” table that is replicated to a LOB schema typically using subscription to web services
- Table Naming:
  - table names are not to be prefixed with the application acronym
  - table names are restricted to a maximum of 30 characters in length
    - **NOTE** : subject to change following adoption of 12c R2
  - table names are defined in the singular (i.e. CLIENT\_ADDRESS and not CLIENT\_ADDRESSES)
  - it is mandatory to define an alias for each table within the logical model in Enterprise Architect for the purposes of using in index and/or constraint naming
    - The alias is limited to 8 characters such that two entity names can be combined to form constraint names (foreign keys)
- Column Naming:
  - column names are restricted to a maximum of 30 characters in length (including standard naming suffixes e.g. \_PK, \_GUID, \_FK)
  - In most cases, column names are defined in the singular (i.e. STREET\_NAME and not STREET\_NAMES)
  - spatial columns are named GEOMETRY

- Only one spatial column is to be modelled in each table
- Table and Column Comments:
  - table comments will be included in the DDL for all tables in the physical model
  - column comments will be included in the DDL for all non-standard columns in the physical model
  - table and column comments must be descriptive such that they can relate to the business process around the collection of the data
- Audit Columns:
  - used to record user and time information (where necessary) at the row level
  - standard audit columns:
    - CREATE\_USER, CREATE\_DATE, UPDATE\_USER, UPDATE\_DATE
    - If sub-second granularity is required, time tracking attributes may use the TIMESTAMP(6) datatype
    - If TIMESTAMP(6) is used, time tracking attributes become CREATE\_TIMESTAMP and UPDATE\_TIMESTAMP
    - CREATE\_USER and UPDATE\_USER are the BCEID or IDIR username propagated from the application tier
    - For business requirements that MUST identify an individual as unique for auditing purposes, the model can optionally include CREATE\_USER\_GUID and UPDATE\_USER\_GUID (using the RAW(16) datatype)
- Special Naming Considerations:
  - Effective and Expiry Date:
    - **NOTE** : Effective and Expiry date are one form of valid time modelling. The valid time modelling standard for NRS is currently under review. Please consult with IMB DA prior to modelling valid time.
    - used when there is a business requirement to “expire” data but still have it visible to the user interface
    - standard naming for this scenario is EFFECTIVE\_DATE and EXPIRY\_DATE
    - EFFECTIVE\_DATE and EXPIRY\_DATE use the DATE datatype unless sub-second granularity is required
    - if sub-second granularity is required, time tracking attributes may use the TIMESTAMP(6) datatype
    - if TIMESTAMP(6) is used, effective and expiry attributes become EFFECTIVE\_TIMESTAMP and EXPIRY\_TIMESTAMP

- Optimistic Locking:
  - used to facilitate “check out, check in” of data in order to manage concurrent DML operations (e.g. for example in an airline booking system when a user selects a seat within a transaction such that another user cannot select it concurrently resulting in a deadlock)
  - also known as write locking, allows unlimited read access to a given object, but allows a client to modify the object only if the object has not changed since the client last read it.
  - standard naming for this scenario is REVISION\_COUNT
  - REVISION\_COUNT uses the NUMBER(10) datatype and the DEFAULT value is 0
    - revision\_count number(10) default 0;
  - order before audit columns
  
- Globally Unique Identifiers:
  - used in the physical model to uniquely identify an individual or asset
  - standard naming for this scenario is <context>\_GUID
  - <context\_GUID> uses the RAW(16) datatype
  - **NOTE** : the GUID standard is currently evolving, please consult with the IMB DA group prior to modelling GUID in your logical data model
  
- Constraint Naming:
  - where possible, foreign key constraint names should closely match the referenced key name
  - primary keys:
    - <table\_alias>\_PK
  - surrogate keys:
    - <table\_alias>\_GUID
  - business keys:
    - <table\_alias>\_<column\_alias>\_UK
  - foreign keys:
    - <child\_alias>\_<parent\_alias>\_FK
  - check constraints:
    - <table\_alias>\_CHK
  
- Column Order:
  - Columns in the physical model are ordered in a consistent, standardized fashion through the database lifecycle (i.e. order will ALWAYS be identical in DEV=>INT=>TST=>PRD)
  - Column order on any 1.0 structural release will exactly match the logical model

- First : primary identifier, unique business keys
- Second : business attributes, foreign keys (order based on common sense groupings)
- Third : spatial column (if present)
- Fourth : logging, auditing and time tracking columns
  - CREATE\_USER, CREATE\_DATE, UPDATE\_USER, UPDATE\_DATE, VALID\_START, VALID\_END
- Changes to prescribe column order post 1.0 structural release will not cascade into the physical implementation in most cases; new attributes to database tables will be added to the end using ALTER TABLE statements
- In some cases, DA may prescribe column order to match logical data standards (e.g. adding FIRST\_NAME will likely be ordered right before LAST\_NAME in the logical model, physical model and database table).
- Oracle Reserved Words:
  - use of Oracle Reserved Words are not permitted within entity names
  - reserved words are specific to database version and release and can be found by querying v\$reserved\_words in the Oracle database
  - [https://docs.oracle.com/database/121/SQLRF/ap\\_keywd001.htm#SQLRF55621](https://docs.oracle.com/database/121/SQLRF/ap_keywd001.htm#SQLRF55621)

## 11. Keys, Constraints and Relationships

- the physical model must provide a means to uniquely identify any row in any table
- indexes are used to enforce business rules and constraints and/or uniqueness
- where a surrogate key is used as the primary key standard practice is to also define a unique business key to avoid duplicate records and where this practice cannot be met approval from DBA must be obtained.
- referential integrity constraints are not permitted cross schema or cross database
- not all foreign key columns require indexes – depends on data volume and cardinality – consult with DBA
- surrogate keys, if required, are always in the form of a GUID:
  - <table\_name>\_GUID using RAW(16) datatype
  - must be in UUID format
  - should be generated as close to the data record as possible
- logical model subtypes cannot exist in the physical model; they are resolved into one or more tables during table generation.

## 12. Spatial Data

- **NOTE:** BC NRS does NOT have an Oracle Spatial and Graph license and developers are therefore limited to the features included with Oracle Locator
- Features included with Locator are:
  - [SDO\\_JOIN](#) (but not SDO\_POINTLINEPOLYGON)
  - [SDO\\_GEOM](#)
  - [Spatial Aggregate Functions](#)
    - SDO\_AGGR\_CENTROID
    - SDO\_AGGR\_CONCAT\_LINES
    - SDO\_AGGR\_CONVEXHULL
    - SDO\_AGGR\_LRS\_CONCAT
    - SDO\_AGGR\_MBR
    - SDO\_AGGR\_SET\_UNION
    - SDO\_AGGR\_UNION
  - [Spatial Operators](#)
    - SDO\_FILTER
    - SDO\_JOIN
    - SDO\_NN
    - SDO\_NN\_DISTANCE
    - SDO\_POINTINPOLYGON
    - SDO\_RELATE
    - SDO\_WITHIN\_DISTANCE
  - [SDO\\_CS](#) (coordinate system transformation)
  - [SDO\\_GEOMETRY](#) (including function based spatial indexing)
  - SDO\_MIGRATE (for upgrading from previous editions)
  - [SDO\\_TUNE](#) (tuning subprograms)
  - [SDO\\_UTIL](#) (spatial utilities)
- all spatial data will be stored the Oracle RDBMS using Oracle's SDO\_GEOMETRY data type
- all spatial data will be represented in the BC Albers coordinate reference system (Oracle implementation of Geographics limits the precision that can be used which is too large for many of our applications)
- spatial metadata in the SDO\_GEOM\_METADATA\_TABLE will use the Oracle supplied SRID EPSG 3005 (not 1000003005)
- USER\_SDO\_GEOM\_METADATA entries are formed as follows:
  - INSERT INTO USER\_SDO\_GEOM\_METADATA  
(TABLE\_NAME,COLUMN\_NAME,DIMINFO,SRID)  
VALUES

```
( '<TABLE_NAME>', 'GEOMETRY', SDO_DIM_ARRAY(
  SDO_DIM_ELEMENT('X', 200000, 1900000, 0.0005),
  SDO_DIM_ELEMENT('Y', 300000, 1800000, 0.0005)), 3005);
```

- physical entities will only have a single spatial attribute (GEOMETRY)
- a table containing a single SDO\_GEOMETRY type will only contain one type of geometry; point OR line OR polygon
  - it is not permissible to store mixed geometries within a single GEOMETRY column
- all spatial attributes will have a spatial R-Tree index
  - INDEXTYPE IS MDSYS.SPATIAL\_INDEX
  - the USER\_SDO\_GEOM\_METADATA view must contain an entry with the dimensions and coordinate boundary information for the table column to be spatially indexed
- R-Tree index creation will consider specialized parameters where applicable; such as: SDO\_DML\_BATCH\_SIZE, LAYER\_GTYPE, WORK\_TABLESPACE
- SDO\_GEOMETRY features are limited to 524288 vertices (in 2D)
- Quad Tree indexes are not permitted

### 13. Automated Database Job Scheduling

- Job scheduling in the Oracle database will be done using the supplied DBMS\_SCHEDULER package
  - DBMS\_JOB is not supported
  - Scheduling database jobs outside of the database is discouraged and requires an exemption from the NRS DBA group
- The following is a standard template for submitting a scheduled job in the database.
  - NOTE : NRS Exadata is configured to use UTC so time zone information must be explicit in job scheduling in order to manage time zone offset and daylight savings time (DST)

```
BEGIN
  DBMS_SCHEDULER.CREATE_SCHEDULE (
    schedule_name    => '<schedule_name>',
    start_date       => SYSTIMESTAMP AT TIME ZONE 'America/Vancouver',
    repeat_interval  => 'freq=daily;byhour=05;byminute=0;bysecond=0',
    comments         => '<insert_comment_here>');
END;
/
```

## 14. Metadata

- Work is currently underway to define a standard metadata record for all feature classes and will be extended to include all data in future
- Business Metadata will target the BC Data Catalogue
  - [https://catalogue.data.gov.bc.ca/dataset?download\\_audience=Public](https://catalogue.data.gov.bc.ca/dataset?download_audience=Public)
- Technical Metadata (machine generated) work is in progress and will be included in the next release of the physical standards
- Metadata records will include the ‘dublin core’ elements with additional attributes defined by NRS ([https://en.wikipedia.org/wiki/Dublin\\_Core](https://en.wikipedia.org/wiki/Dublin_Core))
  - Addition attributes will include but not limited to:
    - Coordinate system
    - Spatial format
    - Geometry type
    - Organization
    - Data Custodian
    - Who collected the data
    - When the data was last collected and loaded
    - Source application
    - Source name and format
    - Data currency and update frequency
    - Data security classification

## 15. Logging, Auditing and Archiving

- **NOTE** : transaction and/or statement logging standards are currently under review and will be updated once the overall strategy is determined. Please consult with the database architect ([jeff.card@gov.bc.ca](mailto:jeff.card@gov.bc.ca)) at time of design
- **NOTE** : The valid time modelling standard for NRS is currently under review. Please consult with IMB DA prior to modelling valid time
- valid time will be implemented using the PERIOD FOR feature of the SQL 2011 Standard and will be physically modelled using VALID \_START and VALID \_END attributes (with VALID\_TIME system generated pseudo column)
  - These attributes have a datatype of TIMESTAMP(6)
- all lookup or reference entities include CREATE\_USER, CREATE\_DATE, UPDATE\_USER, UPDATE\_DATE logging auto populated by using [Identity Columns](#) or the persistence (JPA) layer

## 16. Database Security

- security in the database is controlled using RBAC (Role Based Access Control)
  - all explicit object grants (e.g. grant select on <table\_name> to <user>) must be approved by the NRS DBA team
  - role naming standards are as follows:



- <schema>\_VIEWER : select/read access on all tables, views, materialized views in the schema. Grants for this role are limited to a single schema.
  - <schema>\_ADMIN : select/insert/update/delete on all tables, views, materialized views in the schema. Grants for this role are limited to a single schema.
  - <application>\_USER : hybrid user role based on application requirements
  - <application>\_SUPERUSER : hybrid admin role based on application requirements
  - Note : in some cases, <schema> and <application> will be the same
- the following privileges are NOT to be included in any DDL delivered to the NRS Database Administration team (note: this list is not inclusive and all security related DDL is subject to review and refusal) :
  - select | read | insert | update | delete | drop | lock | alter | comment any... table | user | view
  - select any dictionary
  - grant any object privilege
  - grant any privilege
  - execute any procedure
  - create public synonym
  - become user
  - force any transaction
  - create any \*
  - drop any \*
  - grant any \*
  - alter any \*
  - create | alter | drop..... role | profile
  - alter system | database | tablespace
  - unlimited tablespace
- do not create public synonyms or grant any privileges to PUBLIC unless previously approved by the NRS DBA team
- do not create public database links
  - private database link are permitted but require approval from the NRS DBA team
  - FME may be encouraged as an alternative solution to the hard dependency of database links
- do not apply grants WITH ADMIN OPTION unless previously approved by the NRS DBA Team
  - NOTE : this may be required when using private synonyms to consume data via PROXY account
- database password policies will be enforced
  - Named user accounts will be setup with a password expiry interval of 60 days

- Mixed case and alpha/numeric passwords are required
- Proxy accounts will also have expiry intervals but will be managed through reporting and manual remediation
- profiles will be used against named user and application accounts to limit resource consumption (e.g. sessions\_per\_user)
- writing content to a database server filesystem is strictly prohibited

## 17. Replication

- datasets that are to be replicated from OSDB to other databases must be fully compatible with Safe Software's Feature Manipulation Engine (FME)
- datasets with a replication component must be delivered with corresponding FMW (FME Workbench File)
  - **NOTE** : if replication is a 'pull' from NRS into other sources, developers must consult the external agency to determine if they have an existing FME template or specific configuration associated with their replication processes
  - e.g. DataBC has FME information here:  
[http://apps.bcgov/standards/dbc/FME\\_Standards\\_and\\_Template](http://apps.bcgov/standards/dbc/FME_Standards_and_Template)
- fast Refresh is the preferred method for refreshing Materialized Views
  - Full refresh is only acceptable in cases where incremental refresh is not available
  - Note: Safe Software FME is the sector standard for data replication
  - Materialized views are acceptable in certain situations (DBA to approve)
- unless technically restricted, incremental replication is to be used (rather than full refreshes)
- replication granularity is scheduled daily, weekly, monthly or annually
  - Hourly or sub-daily replication requirements to be approved by DBA on a case by case basis
- replicated datasets are not to be modelled with RI (referential integrity)
  - If RI is mandatory, review and approval is required by the NRS DA and DBA teams
  - RI in replicated datasets requires restrictive firing order of replications and can cause cascading failures

## 18. Storage and Performance

- **NOTE** : tablespace creation DDL is no longer accepted from vendors and will be executed by the DBA in all corresponding databases (INT/TST/PRD) prior to the initial 1.0 DDL/DML code release
- Tablespace Naming:
  - <application\_acronym> for data (i.e. TANTALIS)

- < application\_acronym>\_IDX for indexes (i.e. TANTALIS\_IDX)
- Tablespace clause in Oracle DDL:
  - include “TABLESPACE=<user>” for tables
  - include “TABLESPACE=<user\_IDX>” for all indexes
  - e.g create table TANTALIS.<table\_name> tablespace TANTALIS...
  - e.g. create index TANTALIS.<table\_name>\_pk tablespace TANTALIS\_IDX
- Bigfile tablespaces are to be used with the autoextend option (Exadata only)
  - i.e. create bigfile tablespace...autoextend on;
- Standard tablespace creation DDL:
  - **NOTE** : this applies to databases using ASM only
  - create bigfile tablespace <tablespace\_name> datafile size 10m autoextend on maxsize unlimited;
- Oracle partitioning must be considered for high volume data sets
  - when tables are partitioned the indexes are equi-partitioned
  - partition management (ADD, SPLIT, DROP, EXCHANGE, MAX\_VALUES) must be discussed with DBA during physical design
- Compression techniques must be considered for online archiving (e.g. Hybrid Columnar Compression)
- Indexing
  - **NOTE** : indexing on Oracle Exadata differs from traditional Oracle database technology in that Exadata supports an implicit technique called storage indexing on the Exadata storage cells, meaning some traditional indexing techniques may not provide performance benefit
    - **NOTE** : domain/R-Tree indexes are always mandatory
  - all SDO\_GEOMETRY attributes are to be indexed with an R-Tree index
  - do not apply B-tree indexes to small tables (lookup tables, code tables etc) that have an estimated volume of 1,000 rows or less
  - do not, by default, index attributes used in foreign key constraints (as was the case with Oracle Designer by default)
  - apply B-tree indexes to attributes in large tables that are most commonly used in the WHERE clause of run time views and application queries

## 19. Oracle Feature Usage

- Information below is intended to inform database designers and developers what Oracle database features are available to exploit when designing and developing physical data models and line of business applications:
- NRS has licensed the following Oracle features:
  - Oracle Database 12c Enterprise Edition
  - Oracle Database 12c Multitenant Option

- Oracle Database 12c Partitioning Option
- Oracle Database 12c Real Application Clusters
- Oracle X4-2 Database Machine (includes HCC – Hybrid Columnar Compression)
- NRS has NOT licensed and is not permitted to use the following Oracle features:
  - Oracle Database 12c Advanced Compression Option
  - Oracle Database 12c Advanced Security Option
  - Oracle Database 12c Spatial and Graph (Oracle Locator is part of 12c Enterprise Edition – see Spatial Standards)
  - Oracle Database 12c Active Data Guard Option
  - Oracle Database 12c Real Application Testing
- **NOTE** : Oracle Flashback Data Archive is not to be used as a permanent solution to store and retrieve temporal data due to lack of data portability

## 20. Oracle Multitenant Considerations

- Specify CONTAINER = CURRENT to locally grant a system privilege, object privilege, or role to a user or role. The privilege or role is granted to the user or role only in the current PDB
  - E.g. alter session set container=current
- As of Oracle 12cR1, RMAN backup and recovery is not available at the PDB (pluggable) level; these operations apply to all PDB's in the CDB (changed in 12.2)

## 21. Transaction Logging and Temporal Database– **CURRENTLY UNDER REVIEW.**

- **NOTE** : **consult with the NRS Database Architect on the status of the evolving standard for the collection and storage of temporal data. A review is currently underway to define a standard method of transactional change detection and storage of transaction history.**
- **NOTE** : Data collected using Flashback Data Archive is NOT portable due to the system timestamp mapping to Oracle's System Change Number (SCN), therefore using Flashback Data Archive for the perpetual storage and retrieval of historical data is not supported in the NRS database environment

## 22. Sparx Enterprise Architect Attributes

- The following metrics must be gathered and populated with each entity such that DBA's can design the physical database accordingly:
  - VolumeInitialRecords – number of records to be initially populated in the entity
  - StorageInitialRecords – storage amount (in GB) to be initially populated in the entity

- VolumeAnnualGrowthPercent – estimated annual percentage of growth
- VolumeMaxRecords – estimated maximum record count
- VolumeAverageAnnualRecords – estimated average number of new records annually
- UserEstConcurrentAccess – estimated number of concurrent users for the application
- DataOnlineRetentionPeriod – if known, time period data must stay online in the database
- DataArchiveRetentionPeriod – if known, time period data must remain archived offline

## 23. Appendix A – Standard Abbreviations

ADDRESS	ADDR
ADMINISTRATION	ADMIN
ALTERNATE	ALT
AMOUNT	AMT
AMERICAN	USA
APPLICATION	APPL
AUTHORITY	AUTH
AVERAGE	AVG
BREASTHEIGHT	BH
BUSINESS	BUS
CANADIAN	CDN
CATEGORY	CAT
CLASSIFICATION	CLASS
CLIENT	CLI
COLLECTION	CLCTN
COLUMN	COL
COMMENT	CMT
COMMISSION	COMM
COMMITTEE	CTTE
COMPANY	CO
CONDITION	CONDTN
CONTROL	CTL
CONVERSION	CNV
COORDINATE	COORD
CORPORATION	CORP
CORRECTION	CRCTN
COUNT	CNT
CREDIT	CR
CROSS REFERENCE	XREF
DATE (Gregorian Date)	DT
DAY	DY
DESCRIPTION	DESC
DESTINATION	DEST

DEPARTMENT	DEPT
DETAIL	DTL
DEVELOPMENT	DEV
DIAMETER	DIAM
DIAMETER AT BREAST HEIGHT	DBH
DIAMETER INSIDE BARK	DIB
DIAMETER OUTSIDE BARK	DOB
DISTURBANCE	DISTRB
DOUBLE BARK THICKNESS	DBT
DISTRICT	DIST
DIVISION	DIV
DOCUMENT	DOC
EFFECTIVE	EFF
ELEMENT	ELMNT
ERROR	ERR
ESTIMATE	EST
EXECUTIVE	EXEC
EXPIRY	EXP
FACTOR	FCTR
FEDERAL	FED
FORESTS LANDS AND NATURAL RESOURCE OPERATIONS	FLNRO
GROUP	GRP
HARVEST	HARV
HECTARES	HA
HEIGHT	HGHT
HOUR	HR
IDENTIFICATION	ID
INDEX	IDX
INDICATOR	IND
INITIAL	INIT
INVENTORY	INV
JURISDICTION	JURIS
LATITUDE	LAT
LENGTH	LEN
LETTER	LTR
LICENCE	LIC
LOAD	LD
LOCATION	LOCN
LONGITUDE	LONG
MANAGEMENT	MGT

MAXIMUM	MAX
METERS CUBED	M3
METERS SQUARED	M2
METHOD	MTHD
MINIMUM	MIN
MINUTE	MN
MONTH	MO
NAME	NM
NUMBER	NO
ORGANIZATION	ORG
PAYMENT	PAY
PERCENT	PCT
PERMIT	PRMT
PIECE	PCE
POSITION	POS
PREVIOUS	PREV
PRIMARY	PRI
PRODUCT	PROD
PROJECT	PROJ
QUANTITY	QTY
RECEIVED	RECV
REFERRED	REF
REGION	REG
REGISTRATION	REGN
RESPONSE CENTRE	RC
REQUEST	RQST
REQUIRED	REQ
REQUIREMENT	RQMT
RETURN	RET
REVENUE	REV
SCHEDULE	SCHED
SCREEN	SCR
SEARCH	SRCH
SECONDARY	SEC
SECTION	SECT
SEQUENCE	SEQ
SERVICE	SRVC
SILVICULTURE	SILV
SOURCE	SRCE
SPECIES	SPP
STATEMENT	STMT

STATUS	STS
STATUTORY	STAT
STATISTICS	STATS
TENURE	TENR
TEXT	TXT
TIMBER	TMBR
TIMBER SUPPLY AREA	TSA
TIMBER SUPPLY BLOCK	TSB
TIME	TM
TIMESTAMP	TS
TITLE	TTL
TOTAL	TOT
TRANSACTION	TXN
TREATMENT	TRTMT
TYPE	TYP
USERID	UID
VALUE	VAL
VERSION	VER
VISITATION	VISIT
VOLUME	VOL
WITHDRAWAL	WD
WEIGHT	WGT
YEAR	YR
YEAR-TO-DATE	YTD