

Department of the Interior  
U.S. Geological Survey

**LANDSAT  
MULTISPECTRAL SCANNER (MSS)  
COLLECTION 2 LEVEL 1 (L1)  
DATA FORMAT CONTROL BOOK (DFCB)**

**Version 1.0**

**August 2019**



**LANDSAT  
MULTISPECTRAL SCANNER (MSS)  
COLLECTION 2 LEVEL 1 (L1)  
DATA FORMAT CONTROL BOOK (DFCB)**

**August 2019**

Approved By:

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Sioux Falls, South Dakota

## **Executive Summary**

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This Data Format Control Book (DFCB) presents detailed data formats of the Multispectral Scanner (MSS) output files that the Landsat Product Generation System (LPGS) generates. These L1 processing systems produce L1 output files using Level 0 Reformatted (L0R) images as input. The standard output format used to generate images from the LPGS is the Geographic Tagged Image File Format (GeoTIFF) format.

The Landsat Data Processing and Archive System (DPAS) Configuration Control Board (CCB) maintains and controls this DFCB. Staff may update or revise this document only upon Landsat DPAS CCB approval. Please direct comments and questions regarding this DFCB to the following:

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## Document History

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# Section 1 Introduction

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## 1.1 Purpose

This Data Format Control Book (DFCB) provides a high-level description of the Landsat Multispectral Scanner (MSS) Level 1 (L1) distribution product, output product packaging, and viewing tools. This document outlines Landsat 1-5 MSS data products. The different MSS data types include Multispectral Scanner–Processed Format (MSS-P), Multispectral Scanner–X Format (MSS-X), and Multispectral Scanner–A Format (MSS-A).

## 1.2 Scope

This DFCB describes the format and data contents of the MSS L1 output files. The output format generated by the Landsat Product Generation System (LPGS) for distribution is the Geographic Tagged Image File Format (GeoTIFF).

The file formats contained in this DFCB are applicable to the LPGS-generated product, operated at the U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center.

## 1.3 Intended Users

This document is intended as a guide for L1 product recipients. It provides detailed information on L1 product packaging.

## 1.4 Definitions

**Level 0 Reformatted Archive (L0Ra) product** - Raw Computer Compatible (RCC) data that have been reformatted to support data production and includes individual band, browse data, a Mirror Scan Correction Data (MSCD) file, a Payload Correction Data (PCD) file, and Scene Metadata

**Level 0 Reformatted Product (L0Rp) digital image** - Spatially reformatted, demultiplexed, and unrectified scene data

**L0Rp product** - L0Rp digital image plus radiometric, calibration, spacecraft attitude, and ephemeris data, consisting of the following files in Hierarchical Data Format (HDF):

- L0Rp digital image (one file per band)
- Internal Calibrator (IC) data - Calibration data file containing all calibration data received on a major frame basis subset to the product size ordered
- MSCD - Scan direction and error information subset to the product size ordered
- PCD - Information on spacecraft attitude and ephemeris, including quality indicators for the entire subinterval from which the product is derived
- Metadata - Descriptive information about the L0Rp image and names of appended files associated with the image
- Calibration Parameter File (CPF) - A formatted file containing radiometric and geometric correction parameters

- Scan Line Offsets (SLO) - Information on actual starting and ending pixel positions for valid image data on a line-by-line basis
- Geolocation table - File containing scene corner coordinates and product-specific scene line numbers for bands
- HDF directory - File containing all pointers, file size information, and data objects required to process the LORp product
- Annotation file - Contains the tic marks required for mapping scene-based u,v coordinates to projection space

**Level 1 Radiometric Corrected (L1R) digital image** - Radiometrically corrected but not geometrically resampled

**Level 1 Systematic Corrected (L1GS) digital image** - Radiometrically corrected and resampled for geometric correction and registration to a geographic map projection

**L1GS product** - L1 product distributed to the customer that includes, for all bands, a GeoTIFF format L1GS image and associated data accommodated by the format

**Level 1 Terrain Corrected (L1TP) product** - Includes radiometric, geometric, and precision correction, and uses a Digital Elevation Model (DEM) to correct parallax error due to local topographic relief. The accuracy of the terrain-corrected product depends on the availability of Ground Control Points (GCPs) and the resolution of the best available DEM.

**Worldwide Reference System (WRS) scene** - A global-notation system for Landsat data. The WRS indexes orbits (paths) and scene centers (rows) into a global grid system. The path / row notation was originally employed to provide a standard designator for every nominal scene center and to allow straightforward referencing without using longitude and latitude coordinates.

The WRS system design is tied to orbital parameters such as inclination and mean motion; thus, swathing patterns and repeat cycles are different if these orbital parameters are different. Because Landsats 1-3 orbit on an 18-day repeat cycle, and Landsats 4, 5, 7, and 8 orbit on a 16-day repeat cycle, each set completes a different number of orbits before covering the same area on Earth. This difference in repeat cycles is the impetus for the difference in the number of paths between the WRS-1 and WRS-2.

WRS-1, used for Landsats 1-3, divides the Earth into 251 paths and 248 rows, for a total of 62,248 scenes. Each WRS-1 scene represents approximately 25 seconds of flight. WRS-2, used for Landsats 4, 5, 7, and 8, divides the Earth into 233 paths by 248 rows. The WRS-2 structure defines 57,784 scene centers, each translating to approximately 24 seconds of flight.



## **1.5 Level 0 (L0) Pre-Archive Processing**

A basic knowledge of pre-archive ground processing enables the user to better understand the L1 product.

The L0 data format contains wideband data processed from the Landsats 1-5 spacecraft. The L0 format is the standard output format of the Landsat Archive Conversion System (LACS) and Multispectral Scanner – X Format Archive Conversion System (MACS). The LACS and MACS output conforms to the L0 format that the USGS uses. This format supports multiple data types for the MSS sensor, including MSS-P, MSS-X, and MSS-A.

The archived MSS data are processed through an "MSS formatter" to make the format similar to that of Landsat 7 Enhanced Thematic Mapper Plus (ETM+) and Landsat 4 / Landsat 5 Thematic Mapper (TM). This makes the data format consistent among the different MSS data types (P, X, and A), compatible with the L1 processing systems, and easier to work with for those already familiar with the ETM+ and TM L0Rp formats. Although archived MSS data have often been geometrically and/or radiometrically corrected to some degree, this reformatted product is referred to as "MSS L0Rp" because of its similarities to other L0Rp data sets (with respect to format and role as input to L1 processing).

The MSS L0Rp format consists of a Hierarchical Data Format Version 4 (HDF4) data set composed of several files (an HDF catalog file, four image band files, and a variable number of metadata files, based on the MSS data type). It also includes a CPF.

## Section 2 Overview of the L1 Output Files

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This section provides an overview of the L1 output files.

### 2.1 L1GS / L1TP Output Files Overview

The L1GS digital image is radiometrically and geometrically corrected and is available in GeoTIFF format. The L1TP product includes radiometric, geometric, and precision correction, and uses a DEM to correct parallax error due to local topographic relief. The processing level to which an image is generated is determined by the best available level for that particular scene, based on available DEM and GCPs for precision modeling.

The on-demand L1 products available for download at no charge are generated using a standard set of parameters. These products are output using the best available processing level for that particular scene (L1GS or L1TP). The processing parameters and output product details used for all standard products are as follows:

- Pixel Size                                   60 meter (m)
- Output Format                                GeoTIFF
- Resampling Method                        Cubic Convolution (CC)
- Map Projection                              Universal Transverse Mercator (UTM)  
Polar Stereographic (PS) for Antarctica scenes
- Datum   World Geodetic System 1984 (WGS84)
- Image Orientation                         Map (North Up (NUP))
- Distribution                                 Hypertext Transfer Protocol Secure (HTTPS)  
download

Table 2-1 details the MSS L1 product components included with each format. The number of bands and optional data files that the user orders determines the number of components included with a specific product.

Component	L1GS	L1TP
L1 image file (for each band)	X	X
L1 MTL files (text [.txt] and XML [.xml])	X	X
GCP file (text [.txt] file)		X
Three Band Verification Browse Image (JPEG [.jpg] file)		X
Geometric Verification Statistics file (text [.txt] file)		X
Quality Assessment (QA) Band files	X	X

**Table 2-1 GeoTIFF Product Components**

### 2.2 Naming Convention

The file-naming convention for the GeoTIFF product is as follows:

LXSS\_LLLL\_PPPRRR\_YYYYMMDD\_yyyymmdd\_CC\_TX\_FT.ext

Identifier	Description
L	Landsat
X	Sensor: M = MSS
SS	Landsat satellite (01 for Landsat 1, 02 for Landsat 2, 03 for Landsat 3, 04 for Landsat 4, and 05 for Landsat 5)
LLLL	Processing level (L1TP, L1GS)
PPP	Three-digit Worldwide Reference System-2 (WRS-2) path
RRR	Three-digit WRS-2 row
YYYY	Acquisition year of the image
MM	Acquisition month of the image
DD	Acquisition day of the image
yyyy	Processing year of the image
mm	Processing month of the image
dd	Processing day of the image
CC	Collection number (e.g., 02)
TX	Tier of the image: "T1" for Tier 1 (highest quality) and "T2" for Tier 2
FT	File type, where FT equals one of the following: image band file number (B1–B7), MTL (metadata file), QA_PIXEL (QA Band file), QA_RADSAT (Radiometric saturation and dropped pixel QA Band), MD5 (checksum file), GCP (Ground Control Point), VER (Verification file)
.ext	File extension, where .TIF equals GeoTIFF file extension, .jpg equals verification browse extension, .xml equals XML extension (metadata), and .txt equals text extension (ODL, VER and GCP)

**Table 2-1. Product Naming Convention**

## Section 3 Data Format Definition

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This section describes the storage format for the data.

### 3.1 GeoTIFF File Formats

GeoTIFF defines a set of public domain Tagged Image File Format (TIFF) tags that describe all cartographic and geodetic information associated with GeoTIFF imagery. GeoTIFF is a means for tying a raster image to a known model space or map projection and for describing those projections. A metadata format provides geographic information to associate with the image data, but the TIFF file structure allows both the metadata and the image data to encode into the same file.

#### 3.1.1 L1 Image File

The description of an image in GeoTIFF requires tags and keys as described in the GeoTIFF Specification document (see References). The L1 image files include these tags and keys, which TIFF readers automatically detect and read. The following sections describe the tags and keys.

Each Earth image band in the requested product is contained in a separate file, as is the optionally available DEM data file. The data are laid out in a scan line sequential format in descending detector order (e.g., detector 6 followed by detector 5 and so forth for the 60 m bands). The L1GS image is radiometrically corrected and resampled for geometric correction and registration to geographic map projections. The L1TP image is radiometrically, geometrically, and precision corrected, and uses a DEM to correct parallax error due to local topographic relief.

##### 3.1.1.1 GeoTIFF Tags

TIFF tags convey metadata information about the image. The tags describe the image with information that the TIFF reader needs to control the appearance of the image on the user's screen. The TIFF tags are in the same file as the TIFF image.

A complete description of the raster data requires georeferencing of the data, which uses tags. Landsat L1 production systems use the transformation raster, model space tie points, and scaling parameters. ModelTiepointTag and ModelPixelScaleTag are used for this purpose.

##### ModelTiepointTag

Tag = 33922

Type = DOUBLE

N = 6\*K, K = Number of tiepoints

Alias: GeoreferenceTag

Owner: Intergraph

The ModelTiepointTag stores the raster-to-model tiepoint pairs in order.

ModelTiepointTag = (... , I, J, K, X, Y, Z...),

where (I, J, K) is the point at location (I, J) in raster space with pixel-value K, and (X, Y, Z) is a vector in model space.

The raster image is georeferenced by specifying its location, size, and orientation in the model coordinate space. Because the relationship between the raster space and the model space often is an exact, affine transformation, the relationship can be defined using one set of tiepoints and the ModelPixelScaleTag, which gives the vertical and horizontal raster grid cell size.

### **ModelPixelScaleTag**

Tag = 33550

Type = DOUBLE

N = 3

Owner: SoftDesk

The ModelPixelScaleTag specifies the size of raster pixel spacing in the model space units when the raster space can be embedded in the model space coordinate system without rotation. The ModelPixelScaleTag consists of the following three values:

ModelPixelScaleTag = (ScaleX, ScaleY, ScaleZ)

where ScaleX and ScaleY give the horizontal and vertical spacing of raster pixels, and ScaleZ maps the pixel value of a DEM into the correct Z-scale. ScaleZ is not used for L1GS data because it is only systematically corrected and not corrected for elevation.

A single tiepoint in the ModelTiepointTag, together with the ModelPixelScaleTag, completely determines the relationship between raster and model space.

#### **3.1.1.2 GeoTIFF Keys**

In addition to tags, the description of a projection in GeoTIFF requires using keys. Table 3-1 lists the keys necessary to define the projections supported by the L1 production systems and the possible values of the keys.

Valid Keys	Possible Values	Meaning
<b>UTM</b>		
GTModelTypeGeoKey	1	ModelTypeProjected (Projection Coordinate System)
GTRasterTypeGeoKey	1	RasterPixellsArea
	2	RasterPixellsPoint
GTCitationGeoKey	(ASCII, 17)	American Standard Code for Information Interchange (ASCII) reference to public documentation
GeogLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
GeogAngularUnitsGeoKey	9102	Angular_Degree
ProjectedCSTypeGeoKey	20000 - 32760	European Petroleum Survey Group (EPSG) Projection System Codes
	32767	User-defined
<b>PS</b>		
ProjCoordTransGeoKey	15	CT_PolarStereographic
GTModelTypeGeoKey	1	ModelTypeProjected (Projection Coordinate System)
GTRasterTypeGeoKey	1	RasterPixellsArea
	2	RasterPixellsPoint
GTCitationGeoKey	(ASCII, 17)	ASCII reference to public documentation
GeographicTypeGeoKey	4326	GCS_WGS_84
GeogLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
GeogAngularUnitsGeoKey	9102	Angular_Degree
ProjectedCSTypeGeoKey	20000 - 32760	EPSG Projection System Codes
	32767	User-defined
ProjectionGeoKey	10000 - 19999	EPSG / Petrotechnical Open Software Corporation (POSC) Projection Codes
	32767	User-defined
ProjLinearUnitsGeoKey	9001	Linear_Meter
	9002	Linear_Foot
ProjStraightVertPoleLongGeoKey		Value in units of GeogAngularUnits
ProjNatOriginLatGeoKey		Value in units of GeogAngularUnits
ProjFalseNorthingGeoKey		Value entered in units of ProjLinearUnits
ProjFalseEastingGeoKey		Value entered in units of ProjLinearUnits

**Table 3-1. GeoTIFF Keys**

### 3.1.2 QA Band File

The QA band contains quality statistics gathered from the image data and cloud mask information for the scene. The QA band file is an unsigned 16-bit image with the same dimensions as the L1 scene. Bit 0 is the least significant. Bits are allocated for data artifacts and several land surface classification types. A range of confidence levels are provided for each classification type.

The bit confidence levels are as follows:

- 00 No confidence level set (used for fill or for a class not reported)
- 01 Low confidence
- 10 Mid confidence
- 11 High confidence

Bit	Flag Description	Values
0	Fill	0 for image data 1 for fill data
1	Unused	Unused
2	Unused	Unused
3	Cloud	0 Not likely to exist 1 Likely to exist
4	Unused	Unused
5	Unused	Unused
6	Unused	Unused
7	Unused	Unused
8-9	Cloud Confidence	00 for no confidence level set 01 Low confidence 10 Mid confidence 11 High confidence
10-11	Unused	Unused
12-15	Unused	Unused

**Table 3-2. QA Band Bit Description**

### 3.1.3 Radiometric Saturation and Dropped Pixel QA Band File

The radiometric saturation quality assessment band indicates which sensor band(s) are saturated. Table 3-3 shows which bits are for band data saturation and which bit is for dropped pixel. Radiometric saturation has two sources:

1. Radiometric saturation can occur when the processed Level 1 Terrain (Corrected) (L1T) / L1GT product's saturated pixels have the maximum unsigned 8-bit value of 255.
2. Radiometric saturation can occur when a sensor is saturated during data capture. This happens when the N bit MSS sensor reaches a value of  $(2^N - 1)$  DN. N = 6 bits for MSS.

Bit	Flag Description	Values
0	Band 1 Data Saturation	0 no saturation 1 saturated data
1	Band 2 Data Saturation	0 no saturation 1 saturated data
2	Band 3 Data Saturation	0 no saturation 1 saturated data
3	Band 4 Data Saturation	0 no saturation 1 saturated data
4	Band 5 Data Saturation	0 no saturation 1 saturated data
5	Band 6 Data Saturation	0 no saturation 1 saturated data
6	Band 7 Data Saturation	0 no saturation 1 saturated data
7	Unused	0
8	Unused	0
9	Dropped Pixel	0 Pixel present 1 detector doesn't have a value, no data

Bit	Flag Description	Values
10	Unused	0
11	Unused	0
12	Unused	0
13	Unused	0
14	Unused	0
15	Unused	0

*\*0 is Least Significant Bit, 15 is Most Significant Bit*

**Table 3-3. Radiometric Saturation QA Band Bit Description**

### 3.2 L1 Metadata (MTL) Files

The L1 MTL files are created during product generation and contain information specific to the product ordered. One of the metadata files is text in the Object Description Language (ODL) format. All of the parameters contained in the MTL file using ODL format are also in a separate MTL file using Extensible Markup Language (XML) format.

lists the full contents of the ODL L1 Metadata. Table 3-5 lists the full contents of the XML L1 metadata file. Table 3-5's purpose is to show the structure of the XML L1 metadata file. Table 3-5 does not show every possible value associated with each parameter name like does.

The PRODUCT\_CONTENTS group contains information about files in the product. E.g., it includes file names and the data type for the GEOTIFF files. Most of the parameters and parameter values in PRODUCT\_CONTENTS are duplicates of the same parameter and parameter values in LEVEL1\_PROCESSING\_RECORD.



Parameter Name	Value, Format, and Range	Parameter Description / Remarks
GROUP	= LANDSAT_METADATA_FILE	The beginning of the first-level ODL group. It indicates the start of the Landsat metadata file group.
GROUP	= PRODUCT_CONTENTS	The beginning of the product contents group.
ORIGIN	= "Image courtesy of the U.S. Geological Survey"	Origin of the product.
DIGITAL_OBJECT_IDENTIFIER	= "https://doi.org/10.5066/P9AF14YV"	Digital Object Identifier(DOI) for MSS. For more information on DOI visit <a href="https://www.doi.org">https://www.doi.org</a> .
LANDSAT_PRODUCT_ID	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX"	Unique Landsat product identifier. (Earth-imaging), orbital path/row Where: L = Landsat X = Sensor SS = Satellite LLLL = Processing level PPP = WRS path RRR = WRS row YYYYMMDD = Acquisition year / month / day yyyymmdd = Processing year / month / day CC = Collection number QQ = Collection category
PROCESSING_LEVEL	= "L1TP" = "L1GS"	The identifier to inform the user of the processing level of the product.
COLLECTION_NUMBER	= NN	The product collection number.
COLLECTION_CATEGORY	= "T1" = "T2"	The scene collection category, "T1" for Tier 1 quality and "T2" for Tier 2 quality collection.
OUTPUT_FORMAT	= "GEOTIFF"	Output file format for image files.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
FILE_NAME_BAND_1	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_B1.TIF"	The file name for L1 Band 1. This parameter is only present if the band is included in the product.
FILE_NAME_BAND_2	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_B2.TIF"	The file name for L1 Band 2. This parameter is only present if the band is included in the product.
FILE_NAME_BAND_3	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_B3.TIF"	The file name for L1 Band 3. This parameter is only present if the band is included in the product.
FILE_NAME_BAND_4	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_B4.TIF"	The file name for L1 Band 4. This parameter is only present if the band is included in the product.
FILE_NAME_BAND_5	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_B5.TIF"	The file name for L1 Band 5. This parameter is only present if the band is included in the product.
FILE_NAME_BAND_6	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_B6.TIF"	The file name for L1 Band 6. This parameter is only present if the band is included in the product.
FILE_NAME_BAND_7	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_B7.TIF"	The file name for L1 Band 7. This parameter is only present if the band is included in the product.
FILE_NAME_QUALITY_L1_PIXEL	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_QA_PIXEL.TIF"	The file name for the L1 Quality Assessment (QA) Band.
FILE_NAME_QUALITY_L1_RADIO METRIC_SATURATION	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_QA_RADSAT.TI F"	The file name for the Radiometric Saturation Quality Assessment (QA) Band.
FILE_NAME_GROUND_CONTRO L_POINT	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_GCP.txt"	L1-generated external element file name for the GCP, if part of the product.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
FILE_NAME_METADATA_ODL	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_MTL.txt"	The file name for L1 ODL metadata.
FILE_NAME_METADATA_XML	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_MTL.xml"	The file name for L1 XML metadata.
FILE_NAME_VERIFY_REPORT	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_VER.txt"	L1-generated external element file name where information from the scoring of geometric verification is located.
FILE_NAME_VERIFY_BROWSE	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_VER.jpg"	L1-generated external element file name for the Three Band Browse file (JPEG file), if part of the product.
DATA_TYPE_BAND_1	= "UINT8"	The GeoTIFF file for band 1 uses unsigned 8-bit integers.
DATA_TYPE_BAND_2	= "UINT8"	The GeoTIFF file for band 2 uses unsigned 8-bit integers.
DATA_TYPE_BAND_3	= "UINT8"	The GeoTIFF file for band 3 uses unsigned 8-bit integers.
DATA_TYPE_BAND_4	= "UINT8"	The GeoTIFF file for band 4 uses unsigned 8-bit integers.
DATA_TYPE_BAND_5	= "UINT8"	The GeoTIFF file for band 5 uses unsigned 8-bit integers.
DATA_TYPE_BAND_6	= "UINT8"	The GeoTIFF file for band 6 uses unsigned 8-bit integers.
DATA_TYPE_BAND_7	= "UINT8"	The GeoTIFF file for band 7 uses unsigned 8-bit integers.
DATA_TYPE_QUALITY_L1_PIXEL	= "UINT16"	The L1 QA Band uses unsigned 16-bit integers.
DATA_TYPE_QUALITY_L1_RADIOMETRIC_SATURATION	= "UINT16"	The L1 radiometric saturation QA Band uses unsigned 16-bit integers.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
PRESENT_BAND_1	= "Y" = "N" = "M" = "U"	Presence of Band 1. Values: Y = Band 1 is present. N = Band 1 is not present and is not expected. M = Band 1 is missing (expected but not there). U = Band 1 presence is unknown (expected but insufficient information).
PRESENT_BAND_2	= "Y" = "N" = "M" = "U"	Presence of Band 2. Values: Y = Band 2 is present. N = Band 2 is not present and is not expected. M = Band 2 is missing (expected but not there). U = Band 2 presence is unknown (expected but insufficient information).
PRESENT_BAND_3	= "Y" = "N" = "M" = "U"	Presence of Band 3. Values: Y = Band 3 is present. N = Band 3 is not present and is not expected. M = Band 3 is missing (expected but not there). U = Band 3 presence is unknown (expected but insufficient information).
PRESENT_BAND_4	= "Y" = "N" = "M" = "U"	Presence of Band 4. Values: Y = Band 4 is present. N = Band 4 is not present and is not expected. M = Band 4 is missing (expected but not there). U = Band 4 presence is unknown (expected but insufficient information).

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
PRESENT_BAND_5	= "Y" = "N" = "M" = "U"	Presence of Band 5. Values: Y = Band 5 is present. N = Band 5 is not present and is not expected. M = Band 5 is missing (expected but not there). U = Band 5 presence is unknown (expected but insufficient information).
PRESENT_BAND_6	= "Y" = "N" = "M" = "U"	Presence of Band 6. Values: Y = Band 6 is present. N = Band 6 is not present and is not expected. M = Band 6 is missing (expected but not there). U = Band 6 presence is unknown (expected but insufficient information).
PRESENT_BAND_7	= "Y" = "N" = "M" = "U"	Presence of Band 7. Values: Y = Band 7 is present. N = Band 7 is not present and is not expected. M = Band 7 is missing (expected but not there). U = Band 7 presence is unknown (expected but insufficient information).
END_GROUP	= PRODUCT_CONTENTS	
GROUP	= IMAGE_ATTRIBUTES	
SPACECRAFT_ID	= "LANDSAT_1" = "LANDSAT_2" = "LANDSAT_3" = "LANDSAT_4" = "LANDSAT_5"	Spacecraft from which the data were captured.
SENSOR_ID	= "MSS"	Sensor(s) used to capture this scene.
WRS_TYPE	= 1 or 2	World Reference System (WRS) type used for the collection of this scene.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
WRS_PATH	= 1-251	WRS-defined nominal Landsat satellite track (path) (orbital). Valid ranges: WRS-1 (1-251) and WRS-2 (1-233).
WRS_ROW	= 1-248	WRS-defined nominal Landsat satellite row, based on the latitudinal center frame of a Landsat image (orbital). The value is the row of the first full or partial scene in the product. It's the same for WRS-1 and WRS-2.
DATE_ACQUIRED	= YYYY-MM-DD	The date the image was acquired.
SCENE_CENTER_TIME	= "HH:MI:SS.SSSSSSZ"	Scene center time and date for when the image was acquired. HH = Hour (00-23), MI = Minute, SS.SSSSSSZ = Fractional seconds, Z = constant (indicates "Zulu" time (same as GMT)).
STATION_ID	= "XXX"	The Ground Station that received the data. See LSDS-547 Landsat Ground Station (GS) Identifiers for all possible station IDs (e.g., "LGN" = Landsat Ground Network).
CLOUD_COVER	= 0.00–100.00, -1	The overall cloud coverage (percent) of the WRS scene. -1 indicates that the score was not calculated.
CLOUD_COVER_LAND	= 0.00–100.00, -1	The overall cloud coverage over land (percent) in the WRS scene. -1 indicates that the score was not calculated.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
IMAGE_QUALITY	= 0-9, -1	Composite image quality for the bands. Values: 9 = Best. 0 = Worst. -1 = Image quality not calculated or assessed.
SATURATION_BAND_1	= "Y" = "N" = "U"	Indicates Band 1 includes saturated pixels identified by the Radiometric Saturation Quality Assessment (QA) Band. This parameter is only present if the band is included in the product.
SATURATION_BAND_2	= "Y" = "N" = "U"	Indicates Band 2 includes saturated pixels identified by the Radiometric Saturation QA Band. This parameter is only present if the band is included in the product.
SATURATION_BAND_3	= "Y" = "N" = "U"	Indicates Band 3 includes saturated pixels identified by the Radiometric Saturation QA Band. This parameter is only present if the band is included in the product.
SATURATION_BAND_4	= "Y" = "N" = "U"	Indicates Band 4 includes saturated pixels identified by the Radiometric Saturation QA Band. This parameter is only present if the band is included in the product.
SATURATION_BAND_5	= "Y" = "N" = "U"	Indicates Band 5 includes saturated pixels identified by the Radiometric Saturation QA Band. This parameter is only present if the band is included in the product.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
SATURATION_BAND_6	= "Y" = "N" = "U"	Indicates Band 6 includes saturated pixels identified by the Radiometric Saturation QA Band. This parameter is only present if the band is included in the product.
SATURATION_BAND_7	= "Y" = "N" = "U"	Indicates Band 7 includes saturated pixels identified by the Radiometric Saturation QA Band. This parameter is only present if the band is included in the product.
SUN_AZIMUTH	= -180.00000000 through 180.00000000	The Sun azimuth angle in degrees for the image center location at the image center acquisition time. A positive value indicates angles to the east or clockwise from the north. A negative value (-) indicates angles to the west or counterclockwise from the north.
SUN_ELEVATION	= -90.00000000 through 90.00000000	The Sun elevation angle in degrees for the image center location at the image center acquisition time. A positive value indicates a daytime scene. A negative value (-) indicates a nighttime scene. Note: For reflectance calculation, the sun zenith angle is needed, which is 90 - sun elevation angle.
EARTH_SUN_DISTANCE	= N.NNNNNNN	Measurement of the earth to sun distance at the particular day and time of imagery acquisition. Astronomical Unit (AU) of measurement.
END_GROUP	= IMAGE_ATTRIBUTES	
GROUP	= PROJECTION_ATTRIBUTES	



Parameter Name	Value, Format, and Range	Parameter Description / Remarks
MAP_PROJECTION	= "UTM" = "PS"	The map projection used in creating the image. Universal Transverse Mercator (UTM) or Polar Stereographic (PS).
DATUM	= "WGS84"	The datum used in creating the image.
ELLIPSOID	= "WGS84"	The ellipsoid used in creating the image.
UTM_ZONE	= 1 through 60	The value used to indicate the zone number. This parameter is only included for the UTM projection.
VERTICAL_LON_FROM_POLE	= -180.00000 through +180.00000	Vertical longitude (decimal degrees) from the pole. Only present when MAP_PROJECTION is PS.
TRUE_SCALE_LAT	= -90.00000 through +90.00000	Latitude of true scale in a map projection. Only present when MAP_PROJECTION is PS.
FALSE_EASTING	= -200000000 through +200000000	Value added to all "x" values in the rectangular coordinates for a map projection. Frequently assigned to eliminate negative numbers. Expressed in the unit of measure identified in the ProjLinearUnitsGeoKey. Only present when MAP_PROJECTION is PS.
FALSE_NORTHING	= -200000000 through +200000000	Value added to all "y" values in the rectangular coordinates for a map projection. Frequently assigned to eliminate negative numbers. Expressed in the unit of measure identified in the ProjLinearUnitsGeoKey. Only present when MAP_PROJECTION is PS.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
GRID_CELL_SIZE_REFLECTIVE	= 0.00 – 120.00	The grid cell size in meters used in creating the image for Visible and Near Infrared (VNIR) / Short-Wave Infrared (SWIR) bands, if part of the product. This parameter is only included if the reflective bands are included in the product.
REFLECTIVE_LINES	= 0–99999	Product lines for the reflective bands.
REFLECTIVE_SAMPLES	= 0–99999	Product samples for the reflective bands.
ORIENTATION	= "NORTH_UP"	The orientation used in creating the image.
CORNER_UL_LAT_PRODUCT	= -90.00000 through +90.00000	The latitude value for the upper-left corner of the product, measured at the center of the pixel. A positive (+) value indicates north latitude; a negative (-) value indicates south latitude. Units are in degrees.
CORNER_UL_LON_PRODUCT	= -180.00000 through +180.00000	The longitude value for the upper-left corner of the product, measured at the center of the pixel. Positive (+) value indicates east longitude; negative (-) value indicates west longitude. Units are in degrees.
CORNER_UR_LAT_PRODUCT	= -90.00000 through +90.00000	The latitude value for the upper-right corner of the product, measured at the center of the pixel. Units are in degrees.
CORNER_UR_LON_PRODUCT	= -180.00000 through +180.00000	The longitude value for the upper-right corner of the product, measured at the center of the pixel. Units are in degrees.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
CORNER_LL_LAT_PRODUCT	= -90.00000 through +90.00000	The latitude value for the lower-left corner of the product, measured at the center of the pixel. Units are in degrees.
CORNER_LL_LON_PRODUCT	= -180.00000 through +180.00000	The longitude value for the lower-left corner of the product, measured at the center of the pixel. Units are in degrees.
CORNER_LR_LAT_PRODUCT	= -90.00000 through +90.00000	The latitude value for the lower-right corner of the product, measured at the center of the pixel. Units are in degrees.
CORNER_LR_LON_PRODUCT	= -180.00000 through +180.00000	The longitude value for the lower-right corner of the product, measured at the center of the pixel. Units are in degrees.
CORNER_UL_PROJECTION_X_PRODUCT	= -132000000.000 through 132000000.000	The upper-left corner map projection X coordinate, measured at the center of the pixel. Units are in meters.
CORNER_UL_PROJECTION_Y_PRODUCT	= -132000000.000 through 132000000.000	The upper-left corner map projection Y coordinate, measured at the center of the pixel. Units are in meters.
CORNER_UR_PROJECTION_X_PRODUCT	= -132000000.000 through 132000000.000	The upper-right corner map projection X coordinate, measured at the center of the pixel. Units are in meters.
CORNER_UR_PROJECTION_Y_PRODUCT	= -132000000.000 through 132000000.000	The upper-right corner map projection Y coordinate, measured at the center of the pixel. Units are in meters.
CORNER_LL_PROJECTION_X_PRODUCT	= -132000000.000 through 132000000.000	The lower-left corner map projection X coordinate, measured at the center of the pixel. Units are in meters.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
CORNER_LL_PROJECTION_Y_PRODUCT	= -132000000.000 through 132000000.000	The lower-left corner map projection Y coordinate, measured at the center of the pixel. Units are in meters.
CORNER_LR_PROJECTION_X_PRODUCT	= -132000000.000 through 132000000.000	The lower-right corner map projection X coordinate, measured at the center of the pixel. Units are in meters.
CORNER_LR_PROJECTION_Y_PRODUCT	= -132000000.000 through 132000000.000	The lower-right corner map projection Y coordinate, measured at the center of the pixel. Units are in meters.
END_GROUP	= PROJECTION_ATTRIBUTES	
GROUP	= LEVEL1_PROCESSING_RECORD	
ORIGIN	= "Image courtesy of the U.S. Geological Survey"	Origin of the product.
DIGITAL_OBJECT_IDENTIFIER	= "https://doi.org/10.5066/P9AF14YV"	Digital Object Identifier(DOI) for MSS. For more information on DOI visit <a href="https://www.doi.org">https://www.doi.org</a> .
REQUEST_ID	= "NNNNNNNNNNNNN_UUUUU"	USGS products use the "NNNYMMDDSSSS_UUUUU" format, where: NNNYMMDDSSSS = 13-digit Tracking, Recording, and Metrics (TRAM) order number NNN = Node indicator YY = Year MM = Month DD = Day SSSS = Sequence number for the day UUUUU = Five-digit TRAM unit number
LANDSAT_SCENE_ID	= "LsSpprrrYYYYDDDGGGVV"	The unique Landsat scene identifier.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
LANDSAT_PRODUCT_ID	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX"	Unique Landsat product identifier. (Earth-imaging), orbital path/row Where: L = Landsat X = Sensor SS = Satellite LLLL = Processing level PPP = WRS path RRR = WRS row YYYYMMDD = Acquisition year / month / day yyyymmdd = Processing year / month / day CC = Collection number QQ = Collection category
PROCESSING_LEVEL	= "L1TP" = "L1GS"	The identifier to inform the user of the processing level of the product.
COLLECTION_CATEGORY	= "T1" = "T2"	The scene collection category, "T1" for Tier 1 quality and "T2" for Tier 2 quality collection.
OUTPUT_FORMAT	= "GEOTIFF"	Output file format for image files.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
DATE_PRODUCT_GENERATED	= YYYY-MM-DDTHH:MI:SSZ	The date when the metadata file for the product was created: YYYY-MM-DDTHH:MI:SSZ Where: YYYY = Four-digit Julian year MM = Month of the Julian year (01-12) DD = Day of the Julian month (01-31) T = Start of time information in ODL American Standard Code for Information Interchange (ASCII) time code format HH = Hours (00-23) MI = Minutes (00-59) SS = Seconds (00-59) Z = Zulu time (same as Greenwich Mean Time (GMT))
PROCESSING_SOFTWARE_VERSION	= "IAS_X.Y.Z" = "LPGS_X.Y.Z"	The processing software version that created the product. The version consists of a system name followed by an underscore and then the software version, where X is the major release number, Y is the minor release number, and Z is the patch (or engineering) release number. X, Y, and Z are all numeric values.
FILE_NAME_BAND_1	= "LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX_B1.TIF"	The file name for L1 Band 1. This parameter is only present if the band is included in the product.
FILE_NAME_BAND_2	= "LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX_B2.TIF"	The file name for L1 Band 2. This parameter is only present if the band is included in the product.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
FILE_NAME_BAND_3	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_B3.TIF"	The file name for L1 Band 3. This parameter is only present if the band is included in the product.
FILE_NAME_BAND_4	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_B4.TIF"	The file name for L1 Band 4. This parameter is only present if the band is included in the product.
FILE_NAME_BAND_5	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_B5.TIF"	The file name for L1 Band 5. This parameter is only present if the band is included in the product.
FILE_NAME_BAND_6	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_B6.TIF"	The file name for L1 Band 6. This parameter is only present if the band is included in the product.
FILE_NAME_BAND_7	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_B7.TIF"	The file name for L1 Band 7. This parameter is only present if the band is included in the product.
FILE_NAME_QUALITY_L1_PIXEL	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_QA_PIXEL.TIF"	The file name for the L1 Quality Assessment (QA) Band.
FILE_NAME_QUALITY_L1_RADIO METRIC_SATURATION	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_QA_RADSAT.TI F"	The file name for the Radiometric Saturation Quality Assessment (QA) Band.
FILE_NAME_GROUND_CONTRO L_POINT	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_GCP.txt"	L1-generated external element file name for the GCP, if part of the product.
FILE_NAME_METADATA_ODL	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_MTL.txt"	The file name for L1 ODL metadata.
FILE_NAME_METADATA_XML	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyyymmdd_CC_TX_MTL.xml"	The file name for L1 XML metadata.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
FILE_NAME_CPF	= "LXSSCPF_YYYYMMDD_yyyymmdd _CC.NN"	The file name for the CPF used to generate the product.
FILE_NAME_VERIFY_REPORT	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyymmdd_CC_TX_VER.txt"	L1-generated external element file name where information from the scoring of geometric verification is located.
FILE_NAME_VERIFY_BROWSE	= "LXSS_LLLL_PPPRRR_YYYYMMDD _yyymmdd_CC_TX_VER.jpg"	L1-generated external element file name for the Three Band Browse file (JPEG file), if part of the product.
DATA_SOURCE_ELEVATION	= "GLS2000" = "RAMP"	Identifies the digital elevation data set used to terrain correct the product.
GROUND_CONTROL_POINTS_VERSION	= 0-999	GCP dataset version used in the precision correction process. This parameter is only present if the DATA_TYPE is L1TP.
GROUND_CONTROL_POINTS_MODEL	= 0-9999	Number of GCPs used in the precision correction process. This parameter is only present if the DATA_TYPE is L1TP.
GEOMETRIC_RMSE_MODEL	= 0.000 – 9999.999	Combined Root Mean Square Error (RMSE) of the geometric residuals (meters) in both across-track and along-track directions measured on the GCPs used in geometric precision correction. This parameter is only present if the DATA_TYPE is L1TP.



Parameter Name	Value, Format, and Range	Parameter Description / Remarks
GEOMETRIC_RMSE_MODEL_Y	= 0.000 – 9999.999	The post-fit RMSE for the along-track direction. Units are in meters equal to or greater than zero, with no upper limit, and three decimal places. This parameter is only present if the DATA_TYPE is L1TP.
GEOMETRIC_RMSE_MODEL_X	= 0.000 – 9999.999	The post-fit RMSE for the along-track direction. Units are in meters equal to or greater than zero, with no upper limit, and three decimal places. This parameter is only present if the DATA_TYPE is L1TP.
GROUND_CONTROL_POINTS_VERIFY	= 1-9999	Number of GCPs used in the verification of the terrain corrected product. This parameter is only present for L1T images with enough successfully correlating validation GCPs to calculate geometric accuracy.
GEOMETRIC_RMSE_VERIFY	= 0.000-9999.999	RMSE of the geometric residuals (meters) measured on the terrain-corrected product independently using GLS2000. This parameter is only present for L1T images with enough successfully correlating validation GCPs to calculate geometric accuracy.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
GEOMETRIC_RMSE_VERIFY_QU AD_UL	= 0.000 – 9999.999	RMSE of the geometric residuals (pixels) for the upper-left quadrant in both line and sample directions measured on the terrain-corrected product independently using GLS2000.
GEOMETRIC_RMSE_VERIFY_QU AD_UR	= 0.000 – 9999.999	RMSE of the geometric residuals (pixels) for the upper-right quadrant in both line and sample directions measured on the terrain-corrected product independently using GLS2000.
GEOMETRIC_RMSE_VERIFY_QU AD_LL	= 0.000 – 9999.999	RMSE of the geometric residuals (pixels) for the lower-left quadrant in both line and sample directions measured on the terrain-corrected product independently using GLS2000.
GEOMETRIC_RMSE_VERIFY_QU AD_LR	= 0.000 – 9999.999	RMSE of the geometric residuals (pixels) for the lower-right quadrant in both line and sample directions measured on the terrain-corrected product independently using GLS2000.
EPHEMERIS_TYPE	= “DEFINITIVE” = “PREDICTIVE”	Identifier to inform the user of the orbital ephemeris type used. If the field is not present, the user should assume PREDICTIVE in all cases.
END_GROUP	= LEVEL1_PROCESSING_RECORD	
GROUP	= LEVEL1_MIN_MAX_RADIANCE	

<b>Parameter Name</b>	<b>Value, Format, and Range</b>	<b>Parameter Description / Remarks</b>
RADIANCE_MAXIMUM_BAND_1	= -999.999 through 999.999, "NULL"	Maximum achievable spectral radiance value for Band 1. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 1 is missing or unknown.
RADIANCE_MINIMUM_BAND_1	= 0.000 – 999.999, "NULL"	Minimum achievable spectral radiance value for Band 1. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 1 is missing or unknown.
RADIANCE_MAXIMUM_BAND_2	= -999.999 through 999.999, "NULL"	Maximum achievable spectral radiance value for Band 2. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 2 is missing or unknown.
RADIANCE_MINIMUM_BAND_2	= 0.000 – 999.999, "NULL"	Minimum achievable spectral radiance value for Band 2. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 2 is missing or unknown.
RADIANCE_MAXIMUM_BAND_3	= -999.999 through 999.999, "NULL"	Maximum achievable spectral radiance value for Band 3. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 3 is missing or unknown.

<b>Parameter Name</b>	<b>Value, Format, and Range</b>	<b>Parameter Description / Remarks</b>
RADIANCE_MINIMUM_BAND_3	= 0.000 – 999.999, “NULL”	Minimum achievable spectral radiance value for Band 3. This parameter is only present if this band is included in the product. A “NULL” value indicates that Band 3 is missing or unknown.
RADIANCE_MAXIMUM_BAND_4	= -999.999 through 999.999, “NULL”	Maximum achievable spectral radiance value for Band 4. This parameter is only present if this band is included in the product. A “NULL” value indicates that Band 4 is missing or unknown.
RADIANCE_MINIMUM_BAND_4	= 0.000 – 999.999, “NULL”	Minimum achievable spectral radiance value for Band 4. This parameter is only present if this band is included in the product. A “NULL” value indicates that Band 4 is missing or unknown.
RADIANCE_MAXIMUM_BAND_5	= -999.999 through 999.999, “NULL”	Maximum achievable spectral radiance value for Band 5. This parameter is only present if this band is included in the product. A “NULL” value indicates that Band 5 is missing or unknown.
RADIANCE_MINIMUM_BAND_5	= 0.000 – 999.999, “NULL”	Minimum achievable spectral radiance value for Band 5. This parameter is only present if this band is included in the product. A “NULL” value indicates that Band 5 is missing or unknown.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
RADIANCE_MAXIMUM_BAND_6	= -999.999 through 999.999, "NULL"	Maximum achievable spectral radiance value for Band 6. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 6 is missing or unknown.
RADIANCE_MINIMUM_BAND_6	= 0.000 – 999.999, "NULL"	Minimum achievable spectral radiance value for Band 6. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 6 is missing or unknown.
RADIANCE_MAXIMUM_BAND_7	= -999.999 through 999.999, "NULL"	Maximum achievable spectral radiance value for Band 7. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 7 is missing or unknown.
RADIANCE_MINIMUM_BAND_7	= 0.000 – 999.999, "NULL"	Minimum achievable spectral radiance value for Band 7. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 7 is missing or unknown.
END_GROUP	= LEVEL1_MIN_MAX_RADIANCE	
GROUP	= LEVEL1_MIN_MAX_REFLECTANCE	
REFLECTANCE_MAXIMUM_BAND_1	= 0.000000 through 2.000000, "NULL"	Maximum achievable reflectance value for Band 1. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 1 is missing or unknown.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
REFLECTANCE_MINIMUM_BAND_1	= -1.000000 through 2.000000, "NULL"	Minimum achievable reflectance value for Band 1. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 1 is missing or unknown.
REFLECTANCE_MAXIMUM_BAND_2	= 0.000000 through 2.000000, "NULL"	Maximum achievable reflectance value for Band 2. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 2 is missing or unknown.
REFLECTANCE_MINIMUM_BAND_2	= -1.000000 through 2.000000, "NULL"	Minimum achievable reflectance value for Band 2. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 2 is missing or unknown.
REFLECTANCE_MAXIMUM_BAND_3	= 0.000000 through 2.000000, "NULL"	Maximum achievable reflectance value for Band 3. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 3 is missing or unknown.
REFLECTANCE_MINIMUM_BAND_3	= -1.000000 through 2.000000, "NULL"	Minimum achievable reflectance value for Band 3. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 3 is missing or unknown.
REFLECTANCE_MAXIMUM_BAND_4	= 0.000000 through 2.000000, "NULL"	Maximum achievable reflectance value for Band 4. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 4 is missing or unknown.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
REFLECTANCE_MINIMUM_BAND_4	= -1.000000 through 2.000000, "NULL"	Minimum achievable reflectance value for Band 4. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 4 is missing or unknown.
REFLECTANCE_MAXIMUM_BAND_5	= 0.000000 through 2.000000, "NULL"	Maximum achievable reflectance value for Band 5. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 5 is missing or unknown.
REFLECTANCE_MINIMUM_BAND_5	= -1.000000 through 2.000000, "NULL"	Minimum achievable reflectance value for Band 5. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 5 is missing or unknown.
REFLECTANCE_MAXIMUM_BAND_6	= 0.000000 through 2.000000, "NULL"	Maximum achievable reflectance value for Band 6. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 6 is missing or unknown.
REFLECTANCE_MINIMUM_BAND_6	= -1.000000 through 2.000000, "NULL"	Minimum achievable reflectance value for Band 6. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 6 is missing or unknown.
REFLECTANCE_MAXIMUM_BAND_7	= 0.000000 through 2.000000, "NULL"	Maximum achievable reflectance value for Band 7. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 7 is missing or unknown.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
REFLECTANCE_MINIMUM_BAND_7	= -1.000000 through 2.000000, "NULL"	Minimum achievable reflectance value for Band 7. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 7 is missing or unknown.
END_GROUP	= LEVEL1_MIN_MAX_REFLECTANCE	
GROUP	= LEVEL1_MIN_MAX_PIXEL_VALUE	
QUANTIZE_CAL_MAX_BAND_1	= 0 - 255, "NULL"	Maximum possible pixel value for Band 1. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 1 is missing or unknown.
QUANTIZE_CAL_MIN_BAND_1	= 0 - 255, "NULL"	Minimum possible pixel value for Band 1. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 1 is missing or unknown.
QUANTIZE_CAL_MAX_BAND_2	= 0 - 255, "NULL"	Maximum possible pixel value for Band 2. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 2 is missing or unknown.
QUANTIZE_CAL_MIN_BAND_2	= 0 - 255, "NULL"	Minimum possible pixel value for Band 2. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 2 is missing or unknown.



Parameter Name	Value, Format, and Range	Parameter Description / Remarks
QUANTIZE_CAL_MAX_BAND_3	= 0 - 255, "NULL"	Maximum possible pixel value for Band 3. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 3 is missing or unknown.
QUANTIZE_CAL_MIN_BAND_3	= 0 - 255, "NULL"	Minimum possible pixel value for Band 3. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 3 is missing or unknown.
QUANTIZE_CAL_MAX_BAND_4	= 0 - 255, "NULL"	Maximum possible pixel value for Band 4. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 4 is missing or unknown.
QUANTIZE_CAL_MIN_BAND_4	= 0 - 255, "NULL"	Minimum possible pixel value for Band 4. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 4 is missing or unknown.
QUANTIZE_CAL_MAX_BAND_5	= 0 - 255, "NULL"	Maximum possible pixel value for Band 5. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 5 is missing or unknown.
QUANTIZE_CAL_MIN_BAND_5	= 0 - 255, "NULL"	Minimum possible pixel value for Band 5. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 5 is missing or unknown.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
QUANTIZE_CAL_MAX_BAND_6	= 0 - 255, "NULL"	Maximum possible pixel value for Band 6. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 6 is missing or unknown.
QUANTIZE_CAL_MIN_BAND_6	= 0 - 255, "NULL"	Minimum possible pixel value for Band 6. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 6 is missing or unknown.
QUANTIZE_CAL_MAX_BAND_7	= 0 - 255, "NULL"	Maximum possible pixel value for Band 7. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 7 is missing or unknown.
QUANTIZE_CAL_MIN_BAND_7	= 0 - 255, "NULL"	Minimum possible pixel value for Band 7. This parameter is only present if this band is included in the product. A "NULL" value indicates that Band 7 is missing or unknown.
END_GROUP	= LEVEL1_MIN_MAX_PIXEL_VALUE	
GROUP	= LEVEL1_RADIOMETRIC_RESCALING	
RADIANCE_MULT_BAND_1	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Radiance units for Band 1 ( $W/(m^2 \text{ sr } \mu m)/DN$ ). A "NULL" value indicates that Band 1 is missing or unknown.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
RADIANCE_MULT_BAND_2	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Radiance units for Band 2 ( $W/(m^2 \text{ sr um})/DN$ ). A "NULL" value indicates that Band 2 is missing or unknown.
RADIANCE_MULT_BAND_3	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Radiance units for Band 3 ( $W/(m^2 \text{ sr um})/DN$ ). A "NULL" value indicates that Band 3 is missing or unknown.
RADIANCE_MULT_BAND_4	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Radiance units for Band 4 ( $W/(m^2 \text{ sr um})/DN$ ). A "NULL" value indicates that Band 4 is missing or unknown.
RADIANCE_MULT_BAND_5	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Radiance units for Band 5 ( $W/(m^2 \text{ sr um})/DN$ ). A "NULL" value indicates that Band 5 is missing or unknown.
RADIANCE_MULT_BAND_6	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Radiance units for Band 6 ( $W/(m^2 \text{ sr um})/DN$ ). A "NULL" value indicates that Band 6 is missing or unknown.
RADIANCE_MULT_BAND_7	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Radiance units for Band 7 ( $W/(m^2 \text{ sr um})/DN$ ). A "NULL" value indicates that Band 7 is missing or unknown.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
RADIANCE_ADD_BAND_1	= -9999.99999 through +9999.99999, "NULL"	The additive rescaling factor used to convert calibrated DN to Radiance units for Band 1 ( $W/(m^2 \text{ sr } \mu m)$ ). A "NULL" value indicates that Band 1 is missing or unknown.
RADIANCE_ADD_BAND_2	= -9999.99999 through +9999.99999, "NULL"	The additive rescaling factor used to convert calibrated DN to Radiance units for Band 2 ( $W/(m^2 \text{ sr } \mu m)$ ). A "NULL" value indicates that Band 2 is missing or unknown.
RADIANCE_ADD_BAND_3	= -9999.99999 through +9999.99999, "NULL"	The additive rescaling factor used to convert calibrated DN to Radiance units for Band 3 ( $W/(m^2 \text{ sr } \mu m)$ ). A "NULL" value indicates that Band 3 is missing or unknown.
RADIANCE_ADD_BAND_4	= -9999.99999 through +9999.99999, "NULL"	The additive rescaling factor used to convert calibrated DN to Radiance units for Band 4 ( $W/(m^2 \text{ sr } \mu m)$ ). A "NULL" value indicates that Band 4 is missing or unknown.
RADIANCE_ADD_BAND_5	= -9999.99999 through +9999.99999, "NULL"	The additive rescaling factor used to convert calibrated DN to Radiance units for Band 5 ( $W/(m^2 \text{ sr } \mu m)$ ). A "NULL" value indicates that Band 5 is missing or unknown.
RADIANCE_ADD_BAND_6	= -9999.99999 through +9999.99999, "NULL"	The additive rescaling factor used to convert calibrated DN to Radiance units for Band 6 ( $W/(m^2 \text{ sr } \mu m)$ ). A "NULL" value indicates that Band 6 is missing or unknown.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
RADIANCE_ADD_BAND_7	= -9999.99999 through +9999.99999, "NULL"	The additive rescaling factor used to convert calibrated DN to Radiance units for Band 7 ( $W/(m^2 \text{ sr } \mu m)$ ). A "NULL" value indicates that Band 7 is missing or unknown.
REFLECTANCE_MULT_BAND_1	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Reflectance for Band 1 ( $DN^{-1}$ ).
REFLECTANCE_MULT_BAND_2	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Reflectance for Band 2 ( $DN^{-1}$ ).
REFLECTANCE_MULT_BAND_3	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Reflectance for Band 3 ( $DN^{-1}$ ).
REFLECTANCE_MULT_BAND_4	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Reflectance for Band 4 ( $DN^{-1}$ ).
REFLECTANCE_MULT_BAND_5	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Reflectance for Band 5 ( $DN^{-1}$ ).
REFLECTANCE_MULT_BAND_6	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Reflectance for Band 6 ( $DN^{-1}$ ).
REFLECTANCE_MULT_BAND_7	= N.NNNNE-NN	The multiplicative rescaling factor used to convert calibrated DN to Reflectance for Band 7 ( $DN^{-1}$ ).
REFLECTANCE_ADD_BAND_1	= N.NNNNNN	The additive rescaling factor used to convert calibrated DN to Reflectance for Band 1.
REFLECTANCE_ADD_BAND_2	= N.NNNNNN	The additive rescaling factor used to convert calibrated DN to Reflectance for Band 2.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
REFLECTANCE_ADD_BAND_3	= N.NNNNNN	The additive rescaling factor used to convert calibrated DN to Reflectance for Band 3.
REFLECTANCE_ADD_BAND_4	= N.NNNNNN	The additive rescaling factor used to convert calibrated DN to Reflectance for Band 4.
REFLECTANCE_ADD_BAND_5	= N.NNNNNN	The additive rescaling factor used to convert calibrated DN to Reflectance for Band 5.
REFLECTANCE_ADD_BAND_6	= N.NNNNNN	The additive rescaling factor used to convert calibrated DN to Reflectance for Band 6.
REFLECTANCE_ADD_BAND_7	= N.NNNNNN	The additive rescaling factor used to convert calibrated DN to Reflectance for Band 7.
END_GROUP	= LEVEL1_RADIOMETRIC_RESCALIN G	
GROUP	= LEVEL1_PROJECTION_PARAMETE RS	
MAP_PROJECTION	= "UTM" = "PS"	The map projection used in creating the image. Universal Transverse Mercator (UTM) or Polar Stereographic (PS).
DATUM	= "WGS84"	The datum used in creating the image.
ELLIPSOID	= "WGS84"	The ellipsoid used in creating the image.
UTM_ZONE	= 1 through 60	The value used to indicate the zone number. This parameter is only included for the UTM projection.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
VERTICAL_LON_FROM_POLE	= -180.00000 through +180.00000	Vertical longitude (decimal degrees) from the pole. Only present when MAP_PROJECTION is PS.
TRUE_SCALE_LAT	= -90.00000 through +90.00000	Latitude of true scale in a map projection. Only present when MAP_PROJECTION is PS.
FALSE_EASTING	= -200000000 through +200000000	Value added to all "x" values in the rectangular coordinates for a map projection. Frequently assigned to eliminate negative numbers. Expressed in the unit of measure identified in the ProjLinearUnitsGeoKey. Only present when MAP_PROJECTION is PS.
FALSE_NORTHING	= -200000000 through +200000000	Value added to all "y" values in the rectangular coordinates for a map projection. Frequently assigned to eliminate negative numbers. Expressed in the unit of measure identified in the ProjLinearUnitsGeoKey. Only present when MAP_PROJECTION is PS.
GRID_CELL_SIZE_REFLECTIVE	= 0.00 – 120.00	The grid cell size in meters used in creating the image for Visible and Near Infrared (VNIR) / Short-Wave Infrared (SWIR) bands. This parameter is only included if the reflective bands are included in the product.
ORIENTATION	= "NORTH_UP"	The orientation used in creating the image.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
RESAMPLING_OPTION	= "CUBIC_CONVOLUTION"	The resampling option used in creating the image. Cubic Convolution (CC).
MAP_PROJECTION_L0RA	= "PS" = "UTM" = "HOM" = "SOM" = "NA"	L0Ra map projection selectively applied to High Density Tapes (HDTs) based on geographic location. Used for processed archive data. Polar Stereographic (PS), Universal Transverse Mercator (UTM), Hotine Oblique Mercator (HOM), Space Oblique Mercator (SOM) and Not Applicable (NA).
END_GROUP	= LEVEL1_PROJECTION_PARAMETERS	
GROUP	= PRODUCT_PARAMETERS	Beginning of the product parameters group (both 1R and 1G products).
DATA_TYPE_L0RP	= "MSSA_L0RP" = "MSSX_L0RP" = "MSSP_L0RP" = "MSSR_L0RP"	Data type identifier string used to create the L0Rp product.
CORRECTION_GAIN_BAND_1	= "CPF" = "INTERNAL_CALIBRATION" = "NA"	Correction method used by L1 in creating the image for Band 1, if part of the product.
CORRECTION_GAIN_BAND_2	= "CPF" = "INTERNAL_CALIBRATION" = "NA"	Correction method used by L1 in creating the image for Band 2, if part of the product.
CORRECTION_GAIN_BAND_3	= "CPF" = "INTERNAL_CALIBRATION" = "NA"	Correction method used by L1 in creating the image for Band 3, if part of the product.



Parameter Name	Value, Format, and Range	Parameter Description / Remarks
CORRECTION_GAIN_BAND_4	= "CPF" = "INTERNAL_CALIBRATION" = "NA"	Correction method used by L1 in creating the image for Band 4, if part of the product.
CORRECTION_GAIN_BAND_5	= "CPF" = "INTERNAL_CALIBRATION" = "NA"	Correction method used by L1 in creating the image for Band 5, if part of the product.
CORRECTION_GAIN_BAND_6	= "CPF" = "INTERNAL_CALIBRATION" = "NA"	Correction method used by L1 in creating the image for Band 6, if part of the product.
CORRECTION_GAIN_BAND_7	= "CPF" = "INTERNAL_CALIBRATION" = "NA"	Correction method used by L1 in creating the image for Band 7, if part of the product.
GAIN_BAND_1	= "H" = "L" = "U"	Gain state for Band 1's first data line, if part of the product.
GAIN_BAND_2	= "H" = "L" = "U"	Gain state for Band 2's first data line, if part of the product.
GAIN_BAND_3	= "H" = "L" = "U"	Gain state for Band 3's first data line, if part of the product.
GAIN_BAND_4	= "H" = "L" = "U"	Gain state for Band 4's first data line, if part of the product.
GAIN_BAND_5	= "H" = "L" = "U"	Gain state for Band 5's first data line, if part of the product.
GAIN_BAND_6	= "H" = "L" = "U"	Gain state for Band 6's first data line, if part of the product.

Parameter Name	Value, Format, and Range	Parameter Description / Remarks
GAIN_BAND_7	= "H" = "L" = "U"	Gain state for Band 7's first data line, if part of the product.
END_GROUP	= PRODUCT_PARAMETERS	End of the projection parameters group.
END_GROUP	= LANDSAT_METADATA_FILE	
END		

**Table 3-4. Metadata ODL File**

The XML metadata file and ODL metadata file have comparable fields. The LANDSAT\_METADATA\_FILE group for ODL is synonymous to the root element LANDSAT\_METADATA\_FILE for XML. The LANDSAT\_METADATA\_FILE group for ODL contains nested groups, synonymously the LANDSAT\_METADATA\_FILE root element for XML has children elements. In the XML metadata file the ODL parameter name is used in the start-tag and end-tag for elements. All parameters listed in the metadata file using ODL format are also in a separate MTL file using XML format.

The XML metadata file and ODL metadata file have some contrasts. The ODL file distinguishes between strings and numerical values through the presence or absence of quotes around a value. The XML file does not make that distinction. The ODL file has an END statement signifying the end of the file. The XML file does not have a comparable entity.

XML Elements
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<PRODUCT_CONTENTS>
<ORIGIN>Image courtesy of the U.S. Geological Survey</ORIGIN>
<DIGITAL_OBJECT_IDENTIFIER>https://doi.org/10.5066/P9AF14YV</DIGITAL_OBJECT_IDENTIFIER>
<LANDSAT_PRODUCT_ID>LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX</LANDSAT_PRODUCT_ID>
<PROCESSING_LEVEL>L1TP</PROCESSING_LEVEL>
<COLLECTION_NUMBER>NN</COLLECTION_NUMBER>
<COLLECTION_CATEGORY>T1</COLLECTION_CATEGORY>
<OUTPUT_FORMAT>GEOTIFF</OUTPUT_FORMAT>
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<FILE_NAME_BAND_2>LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX_B2.TIF</FILE_NAME_BAND_2>
<FILE_NAME_BAND_3>LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX_B3.TIF</FILE_NAME_BAND_3>
<FILE_NAME_BAND_4>LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX_B4.TIF</FILE_NAME_BAND_4>
<FILE_NAME_BAND_5>LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX_B5.TIF</FILE_NAME_BAND_5>
<FILE_NAME_BAND_6>LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX_B6.TIF</FILE_NAME_BAND_6>
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<FILE_NAME_VERIFY_BROWSE>LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX_VER.jpg</FILE_NAME_VERIFY_BROWSE>
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XML Elements
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<DATA_TYPE_BAND_5>UINT8</DATA_TYPE_BAND_5>
<DATA_TYPE_BAND_6>UINT8</DATA_TYPE_BAND_6>
<DATA_TYPE_BAND_7>UINT8</DATA_TYPE_BAND_7>
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<DATA_TYPE_QUALITY_L1_RADIOMETRIC_SATURATION>UINT16</DATA_TYPE_QUALITY_L1_RADIOMETRIC_SATURATION>
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<WRS_PATH>1-251</WRS_PATH>
<WRS_ROW>1-248</WRS_ROW>
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<CLOUD_COVER_LAND>0.00–100.00, -1</CLOUD_COVER_LAND>
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XML Elements
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XML Elements
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XML Elements
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<GEOMETRIC_RMSE_MODEL_X>0.000 – 9999.999</GEOMETRIC_RMSE_MODEL_X>
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XML Elements
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<RADIANCE_MULT_BAND_6>N.NNNNE-NN</RADIANCE_MULT_BAND_6>
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XML Elements
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<GAIN_BAND_2>H</GAIN_BAND_2>
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<GAIN_BAND_6>H</GAIN_BAND_6>
<GAIN_BAND_7>H</GAIN_BAND_7>
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</LANDSAT_METADATA_FILE>

**Table 3-5. L1 Metadata XML File**

### 3.3 Ground Control Point (GCP) File

The GCP file included with an L1TP product is written in ASCII format and contains a header followed by records, one on each line. Each record corresponds to a single GCP. Each record has eight column headings and looks similar to Table 3-6.

```

Sat. Jan. 25, 2014          LANDSAT 5          Time: 03:23
                          Image Assessment System
                          GCP Residual Report
-----
WOID: L9858339           Path/Row: 027 / 036

LOR Reference Image: L51XXX1113003000101_HDF.140250918
Acquisition Date: Jan 03, 2013

Band Number: 2

GLS date for each WRS-2 path/row used:
Path Row Date
026 035 2000-08-28
026 036 2000-09-29
026 037 2000-09-29
027 035 1999-08-17
027 036 1999-08-17
027 037 2001-04-16
028 035 2000-07-09
028 036 2000-05-22

Point_ID      Latitude Longitude Height Across Along Residual Residual
              (deg)      (deg)      (meters) Residual Scan Scan In y in x
              (deg)      (deg)      (meters) (meters) (meters) (meters) (meters)
026C350036_C1 35.320015 -95.433774 155.267 0.000 0.000 -35.624 -3.935
026C350054_C1 35.318373 -95.461440 157.033 0.000 0.000 -18.643 0.889
026C350059_C1 35.372089 -95.824250 158.797 0.000 0.000 -6.377 -24.224
026C350074_C1 35.379182 -95.727430 164.982 0.000 0.000 4.320 -10.401
026C350083_C1 35.374461 -95.861309 158.508 0.000 0.000 -2.719 -21.763
026C360006_C1 35.319745 -95.433765 152.015 0.000 0.000 -5.291 2.318
026C360019_C1 35.306833 -95.535646 150.915 0.000 0.000 -2.748 55.628
026C360021_C1 33.599348 -95.931886 150.774 0.000 0.000 18.208 26.530

```

**Table 3-6. Example GCP Output File**

### 3.4 Verify File

The Geometric Verification Statistics file included with an L1TP product is written in ASCII format and contains a header followed by records, one on each line. Each record has seven column headings and looks similar to Table 3-7. Each record corresponds to a single GCP marked with a colored dot in the Three Band Verification Browse Image. The contents of the verify file look similar to Table 3-7.

```

Example Verify Output File
=====
Thu. Nov. 1 2012          LANDSAT 5          Time: 16:58
                          Image Assessment System
                          GEOMETRIC VERIFY Report
-----
Order ID: 0101210315929_00002          Path / Row - 15 / 41
Reference Image: L51AAA1188075150100_HDF.L

Color mapping per rank

```

```

-----
Rank 1 is Green: total residual <= 0.5
Rank 2 is Cyan: 0.5 < total residual <= 1
Rank 3 is Blue: 1 < total residual <= 2
Rank 4 is Yellow: 2 < total residual <= 3
Rank 5 is Red: 3 < total residual

```

Percentage of residuals by rank

```

-----
Rank 1 -- 51.6%
Rank 2 -- 48.4%
Rank 3 -- 0.0%
Rank 4 -- 0.0%
Rank 5 -- 0.0%

```

GCP ID	Latitude (Degree)	Longitude (Degree)	Sample Residual (Pixel)	Line Residual (Pixel)	Total Residual (Pixel)	Rank
0150410091	28.32760	-80.69813	0.47	0.47	0.66	2
0150410092	28.32753	-80.66692	0.63	0.33	0.71	2
0150410093	28.32745	-80.63570	0.41	0.01	0.41	1
0150410167	28.30315	-80.66699	0.62	0.29	0.68	2
0150410168	28.30307	-80.63578	0.19	0.08	0.21	1
0150410169	28.30299	-80.60458	0.15	-0.36	0.39	1
0150410242	28.27878	-80.66707	0.27	0.29	0.40	1
0150410244	28.27861	-80.60467	0.77	-0.43	0.88	2
0150410319	28.25424	-80.60476	0.16	-0.14	0.21	1
0150410392	28.23004	-80.66722	0.27	0.29	0.40	1
0150410394	28.22987	-80.60484	0.31	-0.11	0.32	1
0150410467	28.20566	-80.66730	0.24	0.00	0.24	1
0150410468	28.20558	-80.63612	0.16	0.02	0.16	1
0150410469	28.20550	-80.60493	0.23	-0.11	0.26	1
0150410617	28.15692	-80.66745	0.20	0.18	0.27	1
0150410619	28.15675	-80.60511	0.34	-0.13	0.37	1
0150410693	28.13247	-80.63636	-0.06	0.12	0.13	1
0150410694	28.13238	-80.60520	0.01	0.18	0.18	1
0150410766	28.10825	-80.69875	0.06	0.12	0.14	1
0150410843	28.08372	-80.63653	-0.36	0.01	0.36	1

**Table 3-7. Example Verify File**

## **Section 4 Product Packaging**

---

L1 products are available for distribution via HTTPS download. The following provides information on each distribution method for the available L1 product formats.

### **4.1 Electronic Transfer**

Products available via electronic transfer also include the L1 volume descriptor (readme file) with the same file names as listed. When data are packaged and ready for distribution, they are stored in directories on the production online cache for retrieval.

The LPGS GZips (compression) all standard products for distribution. Each individual file within the scene is GZipped.

## Section 5 Software Tools

---

### 5.1 ODL Parser

The University of Colorado's Laboratory for Atmospheric and Space Physics (LASP) originally implemented the ODL parser (Version 1.0) incorporated into the Science Data Processing (SDP) Toolkit. The Jet Propulsion Laboratory (JPL) enhanced the ODL parser in building their Planetary Data System. IAS modified this enhanced version, available at <https://pds.nasa.gov/tools/>. LPGS uses this IAS-modified version.

The IAS-modified version should be particularly useful to those operating in a non-HDF-Earth Observing System (EOS) environment. The software stands alone and reads the L0Rp or L1 metadata external elements and the CPF.

## Appendix A Projection Parameters

---

This appendix contains the map projection parameters used in the L1 output products and the USGS projection parameters.

Project Name	Mnemonic
Polar Stereographic	PS
Universal Transverse Mercator	UTM

**Table A-1. L1 Output Product Projection Parameters**

Projection Name Mnemonic	Array Element							
	1	2	3	4	5	6	7	8
PS	SMajor	SMinor			LongPol	TrueScale	FE	FN
UTM	Lon/Z	Lat/Z						

**Table A-2. USGS Projection Parameters – Projection Transformation Package  
Projection Parameters (Elements 1-8)**

Projection Name Mnemonic	Array Element						
	9	10	11	12	13	14	15
PS							
UTM							

**Table A-3. USGS Projection Parameters - Projection Transformation Package  
Projection Parameters (Elements 9-15)**



Where	Lon/Z	=	Longitude of any point in the UTM zone or zero
	Lat/Z	=	Latitude of any point in the UTM zone or zero
	SMajor	=	Semi-major axis of the ellipsoid. If zero, Clarke 1866 in meters is assumed.
	SMinor	=	Eccentricity squared of the ellipsoid if less than zero. If zero, a spherical form is assumed. If greater than zero, the semi-major axis of the ellipsoid.
	Sphere	=	Radius of the reference sphere. If zero, 6370997 meters is used.
	Stdpar	=	Latitude of the standard parallel
	Stdpr1	=	Latitude of the first standard parallel
	Stdpr2	=	Latitude of the second standard parallel
	CentMer	=	Longitude of the central meridian
	OriginLat	=	Latitude of the projection origin
	FE	=	False easting in the same units as the semi-major axis
	FN	=	False northing in the same units as the semi-major axis
	LongPol	=	Longitude below the pole of the map
	TrueScale	=	Latitude of the true scale
	Factor	=	Scale factor at the central meridian (TM) or center of projection (Oblique Mercator Type A (OMA) / Oblique Mercator Type B (OMB))
	CentLon	=	Longitude of the center of projection
	CenterLat	=	Latitude of the center of projection
	Height	=	Height of the perspective point
	Long1	=	Longitude of the first point on the center line
	Long2	=	Longitude of the second point on the center line
	Lat1	=	Latitude of the first point on the center line
	Lat2	=	Latitude of the second point on the center line
	AziAng	=	Azimuth angle east of north of the center line
	AzmthPt	=	Longitude of point on the central meridian where azimuth occurs
	Satnum	=	Landsat satellite number
	Path	=	Landsat path number (use WRS-1 for Landsat 1, 2, and 3, and WRS-2 for Landsat 4, 5, and 7)
	Shapem	=	Oval shape parameter m
	Shapen	=	Oval shape parameter n
	Angle	=	Oval rotation angle

**Table A-4. USGS Projection Parameters Key**

Note: All array elements with blank fields are set to zero. All angles (latitudes, longitudes, azimuths, etc.) are entered in a degrees / minutes / seconds (DDMMSS.SS) format.

## References

---

Please see <https://www.usgs.gov/land-resources/nli/landsat/glossary-and-acronyms> for a list of acronyms.

USGS/EROS. LSDS-52. Landsat 1-5 Multispectral Scanner (MSS) Calibration Parameter File (CPF) Definition Document.

USGS/EROS. LSDS-285. Landsat Multispectral Scanner (MSS) Level 0 Reformatted Product (LORp) Data Format Control Book (DFCB).

USGS/EROS. LSDS-293. Landsat Data Management Policy.

USGS/EROS. LSDS-524. Landsat Metadata Description Document (LMDD).

505-10-36. Earth Science Data and Information System (ESDIS) Project Mission Specific Requirements for the Landsat 7 Mission L1 Processing. November 1998.

GeoTIFF Specification. Revision 1.0. <http://geotiff.maptools.org/spec/geotiffhome.html>

JPL D-7669, Part 2, Planetary Data System Standards Reference, Object Description Language Specification and Usage. Version 3.7. March 2006.